WA-49-L Gemtree Exploration Drilling Environment Plan

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1 INTRODUCTION

1.1 Overview

Woodside Energy Julimar Pty Ltd (Woodside), as Titleholder under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (referred to as the Environment Regulations), proposes to drill a single exploration well (named Gemtree-A) within Permit Area WA-49-L. This activity will hereafter be referred to as the Petroleum Activities Program and form the scope of this Environment Plan (EP).

This EP has been prepared as part of the requirements under the Environment Regulations, as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

1.2 Defining the Petroleum Activity

The Petroleum Activities Program to be undertaken in Permit Area WA-49-L comprises exploration drilling, which is classified as a petroleum activity as defined in Regulation 4 of the Environment Regulations. As such an EP is required.

1.3 Purpose of the Environment Plan

In accordance with the objectives of the Environment Regulations, the purpose of this EP is to demonstrate that:

- The potential environmental impacts (planned (routine and non-routine) and unplanned) and risks (unplanned events) that may result from the Petroleum Activities Program are identified.
- Appropriate management controls are implemented to reduce impacts and risks to a level that is 'as low as reasonably practicable' (ALARP) and acceptable.
- The Petroleum Activities Program is performed in a manner consistent with the principles of ecologically sustainable development (as defined in Section 3A of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

This EP describes the process and resulting outputs of the risk assessment, whereby impacts and risks are managed accordingly.

The EP defines activity-specific environmental performance outcomes (EPOs), environmental performance standards (PSs) and measurement criteria (MCs). These form the basis for monitoring, auditing and management of the Petroleum Activities Program to be undertaken by Woodside and its contractors. The implementation strategy (derived from the decision support framework tools) specified within this EP provides Woodside and NOPSEMA with the required level of assurance that impacts and risks associated with the activity are reduced to ALARP and are acceptable.

1.4 Scope of the Environment Plan

The scope of this EP covers the activities that define the Petroleum Activities Program, as described in Section 3. The Operational Area defines the spatial boundary of the Petroleum Activities Program, and includes a 4 km radius around the proposed exploration well, within the Permit Area WA-49-L.

This EP addresses potential environmental impacts from planned petroleum activities within the Operational Area and any potential unplanned events that originate from within the Operational Area.

Transit to and from the Operational Area by the Mobile Offshore Drilling Unit (MODU) and support vessels are not within the scope of this EP. Vessels supporting the Petroleum Activities Program operating outside the Operational Area (e.g. transiting to and from port) are subject to all applicable maritime regulations and other requirements and are not managed by this EP.

1.5 Environment Plan Summary

An EP summary has been prepared from material provided in this EP. This summarises the items listed in Table 1-1, as required by Regulation 11(4).

Table 1-1: EP summary table

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	Section 3.3, pages 39–41
A description of the receiving environment	Section 4, pages 52–153
A description of the activity	Section 3, pages 39–51
Details of the environmental impacts and risks	Section 6, pages 168–319
The control measures for the activity	Section 6, pages 168–319
The arrangements for ongoing monitoring of the titleholder's environmental performance	Section 7.5, pages 323–328
Response arrangements in the oil pollution emergency plan	Section 7.9, pages 333–343, Appendix D
Consultation already undertaken and plans for ongoing consultation	Section 5, pages 154–168
Details of the titleholder's nominated liaison person for the activity	Section 1.8, pages 18–19

1.6 Structure of the Environment Plan

The EP has been structured to reflect the process and requirements of the Environment Regulations as outlined in Table 1-2.

Table 1-2: EP requirements under the Environment Regulations and applicable elements and sections of the EP

Criteria for acceptance	Content Requirements/Relevant Regulations	Applicable Elements of the EP	Section of EP
Regulation 10A(a): *is appropriate for the nature and scale of the activity*	Regulation 13: *Environmental assessment* Regulation 14: *Implementation strategy for the environment plan* Regulation 16: *Other information in the environment plan*	The principle of 'nature and scale' is applicable throughout the EP	Section 2 Section 3 Section 4 Section 5 Section 6 Section 7
Regulation 10A(b): *demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable*	Regulation 13(1) to 13(7): *13(1) Description of the activity* *13(2)(3) Description of the environment* *13(4) Requirements*	Set the context (activity and existing environment) Define 'acceptable' (the requirements, the corporate policy, relevant persons)	Section 1 Section 2 Section 3 Section 4 Section 5

Criteria for acceptance	Content Requirements/Relevant Regulations	Applicable Elements of the EP	Section of EP
Regulation 10A(c): *demonstrates that the environmental impacts and risks of the activity will be of an acceptable level*	*13(5)(6) Evaluation of environmental impacts and risks* *13(7) Environmental performance outcomes and standards* Regulation 16(a) to 16(c): *A statement of the titleholder's corporate environmental policy* *A report on all consultations between the titleholder and any relevant person*	Detail the impacts and risks Evaluate the nature and scale Detail the control measures – ALARP and acceptable	Section 6 Section 7
Regulation 10A(d): *provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria*	Regulation 13(7): *Environmental performance outcomes and standards*	Environmental performance outcomes Environmental performance standards Measurement criteria	Section 6
Regulation 10A(e): *includes an appropriate implementation strategy and monitoring, recording and reporting arrangements*	Regulation 14: *Implementation strategy for the environment plan*	Implementation strategy, including: Environmental Management System (EMS) Performance monitoring Oil Pollution Emergency Plan and scientific monitoring Ongoing consultation	Section 7 Appendix D
Regulation 10A(f): *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*	Regulation 13(1) to 13(3): *13(1) Description of the activity* *13(2) Description of the environment* *13(3) Without limiting [Regulation 13(2)(b)], particular relevant values and sensitivities may include any of the following:* *(a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act;* *(b) the national heritage values of a National Heritage place within the meaning of that Act;* *(c) the ecological character of a declared Ramsar wetland within the meaning of that Act;* *(d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act;* *(e) the presence of a listed migratory species within the meaning of that Act;* *(f) any values and sensitivities that exist in, or in relation to, part or all of:* *(i) a Commonwealth marine area within the meaning of that Act; or* *(ii) Commonwealth land within the meaning of that Act.*	No activity, or part of the activity, undertaken in any part of a declared World Heritage property	Section 3 Section 4

Criteria for acceptance	Content Requirements/Relevant Regulations	Applicable Elements of the EP	Section of EP
Regulation 10A(g): *(i) the titleholder has carried out the consultations required by Division 2.2A* *(ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate*	Regulation 11A: *Consultation with relevant authorities, persons and organisations, etc.* Regulation 16(b): *A report on all consultations between the titleholder and any relevant person*	Consultation undertaken in the preparation of the EP	Section 5
Regulation 10A(h): *complies with the Act and the regulations*	Regulation 13(4)a: *Describe the requirements, including legislative requirements, that apply to activity and are relevant to the environmental management of the activity* Regulation 15: *Details of the titleholder and liaison person* Regulation 16(a): *A statement of the titleholder's corporate environmental policy* Regulation 16(c): *details of all reportable incidents in relation to the proposed activity.*	All contents of the EP must comply with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the Environment Regulations	Section 1 Section 6 Section 7 Appendix A Appendix B

1.7 Description of the Titleholder

The nominated Titleholder for this activity is Woodside Energy Julimar Pty Ltd, on behalf of a Joint Venture comprising Woodside Energy Julimar Pty Ltd and KUFPEC Australia (Julimar) Pty Ltd.

Woodside's mission is to deliver superior shareholder returns through realising its vision of becoming a global leader in upstream oil and gas. Wherever Woodside works, we are committed to living its values of integrity, respect, working sustainably, discipline, excellence and working together.

Woodside's operations are characterised by strong safety and environmental performance in remote and challenging locations.

Through collaboration, Woodside leverages its capabilities to progress its growth strategy. Since 1984, the company has been operating the landmark Australian project, the North West Shelf, and it remains one of the world's premier LNG facilities. In 2012, Woodside added the Pluto LNG Plant to its onshore operating facilities.

Woodside has an excellent track record of efficient and safe production. Woodside strives for excellence in safety and environmental performance and continues to strengthen relationships with customers, partners co-venturers, governments and communities to ensure they are a partner of choice. Further information about Woodside can be found at http://www.woodside.com.au.

1.8 Details of Titleholder, Liaison Person and Public Affairs Contact

In accordance with Regulation 15 of the Environment Regulation, details of the Titleholder, liaison person and arrangements for the notification of changes are described below.

1.8.1 Titleholder

Woodside Energy Julimar Pty Ltd
Mia Yellagonga, 11 Mount Street, Perth WA 6000
Telephone: 08 9348 4000
Fax: 08 9214 2777
ABN: 56 130 391 365

1.8.2 Activity Contact

Matthew Strika
Exploration Manager, Pluto Growth NWS
Mia Yellagonga, 11 Mount Street, Perth WA 6000
Phone: 08 9348 4000
Fax Number: 08 9214 2777
feedback@woodside.com.au

1.8.3 Nominated Liaison Person

Andrew Decet
Corporate Affairs Manager (Exploration)
Mia Yellagonga, 11 Mount Street, Perth WA 6000
Phone: 08 9348 4000
Fax Number: 08 9214 2777
feedback@woodside.com.au

1.8.4 Arrangements for Notifying of Change

Should the Titleholder, nominated liaison person or the contact details for either change, then NOPSEMA is to be notified of the change in writing within two weeks or as soon as practicable.

1.9 Woodside Management System

The Woodside Management System (WMS) provides a structured framework of documentation to set common expectations governing how all employees and contractors at Woodside will work. Many of the standards presented in Section 6 are drawn from the WMS documentation, which comprises of four elements: Compass & Policies; Expectations; Processes & Procedures; and Guidelines outlined below (and illustrated in Figure 1-1):

- **Compass & Policies:** Set the enterprise-wide direction for Woodside by governing our behaviours, actions and business decisions and ensuring we meet our legal and other external obligations.
- **Expectations:** Set essential activities or deliverables required to achieve the objectives of the Key Business Activities and provide the basis for developing processes and procedures.
- **Processes & Procedures:** Processes identify the set of interrelated or interacting activities which transforms inputs into outputs, to systematically achieve a purpose or specific objective. Procedures specify what steps, by whom and when required to perform an activity or a process.
- **Guidelines:** Provide recommended practice and advice on how to perform the steps defined in Procedures, together with supporting information and associated tools. Guidelines provide advice on: how activities or tasks may be performed; information that may be considered; or how to use tools and systems.

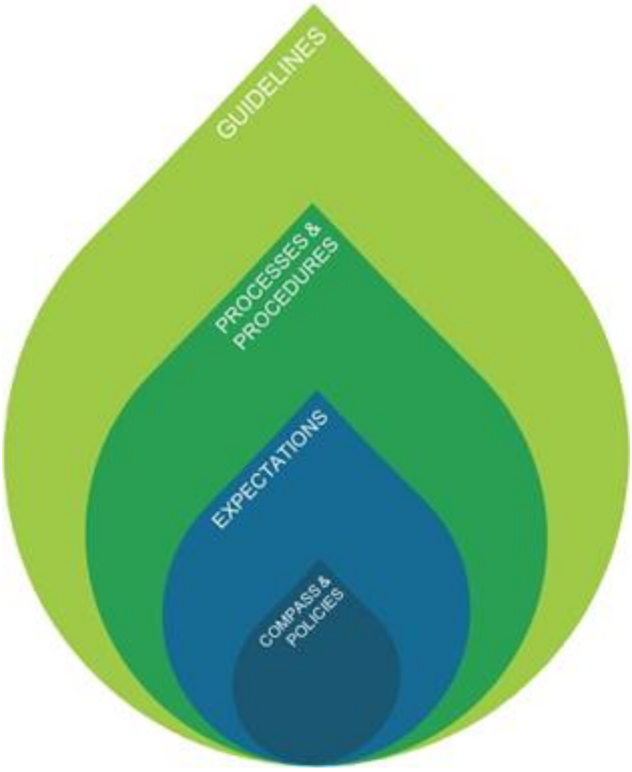


Figure 1-1: The four major elements of the WMS System

The WMS is organised within a Business Process Hierarchy based upon Key Business Activities to ensure the system remains independent of organisation structure, is globally applicable and scalable wherever required. These Business Activities are grouped into Management, Support and Value Stream activities as shown in Figure 1-2. The Value Stream activities capture, generate and deliver value through the exploration and production lifecycle. The Management activities influence all areas of the business, while Support activities may influence one or more Value Stream activities.

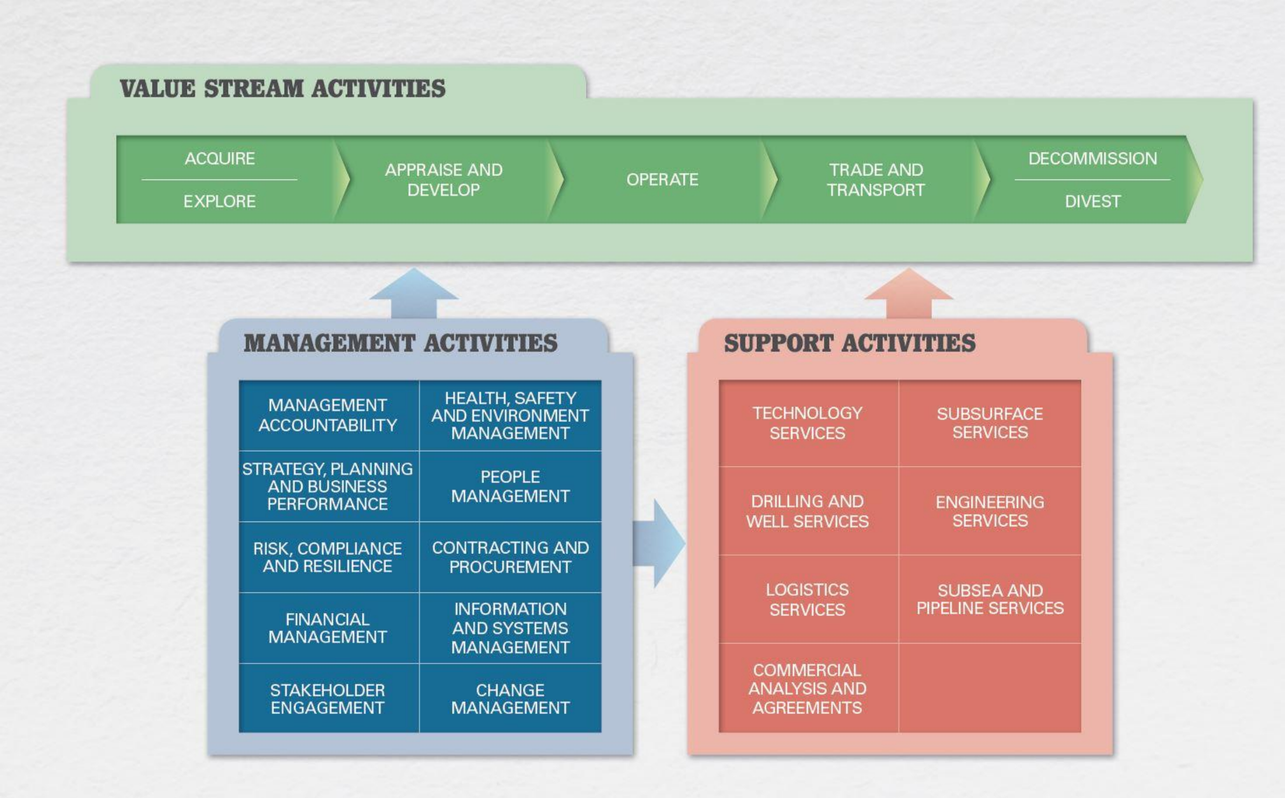


Figure 1-2: The WMS business process hierarchy

1.9.1 Health, Safety, Environment and Quality Policy

In accordance with Regulation 16(a) of the Environment Regulations, Woodside's corporate Health Safety, Environment and Quality Policy is provided in Appendix A of this EP.

1.10 Description of Relevant Requirements

In accordance with Regulation 13(4) of the Environment Regulations, a description of requirements, including legislative requirements, that apply to the activity and are relevant to managing risks and impacts of the Petroleum Activities Program is provided in Appendix B.

1.10.1 Applicable Environmental Legislation

The Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) controls exploration and production activities beyond three nautical miles to the outer extent of the Australian Exclusive Economic Zone at 200 nautical miles, also known as Commonwealth waters.

The Environment Regulations apply to petroleum activities in Commonwealth waters. The Environment Regulations are administered by NOPSEMA.

The objectives of the Environment Regulations include provisions to ensure petroleum activities are performed in a manner:

- consistent with the principles of ecologically sustainable development
- by which the environmental impacts and risks of the activity will be reduced to ALARP
- by which the environmental impacts and risks of the activity will be of an acceptable level.

1.10.1.1 Australian Marine Parks

Under the EPBC Act, Australian Marine Parks (AMPs), formerly known as Commonwealth Marine Reserves, are recognised for conserving marine habitats and the species that live and rely on these habitats. The Director of Marine Parks (DNP) is responsible for managing AMP’s (supported by Parks Australia), and is required to publish management plans for them. Other parts of the Australian Government must not perform functions or exercise powers in relation to these parks that are inconsistent with management plans (s.362 of the EPBC Act). Relevant AMPs are described in Section 4.7, The North-west Marine Parks Network Management Plan describes the requirements for management.

Specific zones within the AMPs have been allocated conservation objectives as stated below (International Union for Conservation of Nature (IUCN) Protected Area Category) based on the Australian IUCN reserve management principles outlined in Schedule 8 of the EPBC Regulations 2000.

Special Purpose Zone (IUCN category VI)—managed to allow specific activities though special purpose management arrangements while conserving ecosystems, habitats and native species. The zone allows or prohibits specific activities.

- Sanctuary Zone (IUCN category Ia)—managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring.
- National Park Zone (IUCN category II)—managed to protect and conserve ecosystems, habitats and native species in as natural a state as possible. The zone only allows non-extractive activities unless authorised for research and monitoring.
- Recreational Use Zone (IUCN category IV)—managed to allow recreational use, while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreational fishing, but not commercial fishing.
- Habitat Protection Zone (IUCN category IV)—managed to allow activities that do not harm or cause destruction to seafloor habitats, while conserving ecosystems, habitats and native species in as natural a state as possible.
- Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park values.

There is no overlap between the Operational Area for the Petroleum Activities Program and any AMP in the North-west Marine Parks Network. The nearest AMP is the Montebello AMP (VI – Multiple Use Zone), located 11 km from the Operational Area, in the EMBA. Other AMPs within the EMBA include Gascoyne, Argo-Rowley Terrace and Ningaloo AMPs.

The principles for each zone determine what activities are acceptable within a protected area under the EPBC Act. The Australian IUCN Reserve Management Principles for Multiple Use Zone (IUCN category VI) are considered relevant to the scope of this EP and are provided in Table 1-3. Assessment of the impacts of an unplanned activity (hydrocarbon spill) on marine park values in the EMBA is provided in Section 6.7.

Table 1-3: The Australian IUCN Reserve Management Principles for Multiple Use Zone (IUCN category VI)

Condition Number	Principle
7.01	The reserve or zone should be managed mainly for the sustainable use of natural ecosystems based on the principles.
7.02	The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.
7.03	Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.
7.04	Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with the principles.

2. ENVIRONMENT PLAN PROCESS

2.1 Overview

This section outlines the process that Woodside follows to prepare the EP once an activity has been defined as a petroleum activity (refer Section 1.2). The process (Section 2.3) describes the environmental risk management methodology that is used to identify, analyse and evaluate risks to meet ALARP and acceptability requirements and develop environmental performance outcomes and standards. This section also describes Woodside's risk management methodologies applicable to implementation strategies applied during the activity.

Regulation 13(5) of the Environment Regulations requires environmental impacts and risks to be detailed, and evaluated appropriate to the nature and scale of each impact and risk associated with the Petroleum Activities Program. The objective of the risk assessment process described in this section is to identify risks and associated impacts of an activity, so they can be assessed and appropriate control measures applied to eliminate, control or mitigate the impact/risk to ALARP and to determine if the impact or risk level is acceptable.

Environmental impacts and risks include those directly and indirectly associated with the Petroleum Activities Program, and includes potential emergency and accidental events:

- Planned activities have the potential for inherent environmental impacts.
- An environmental risk is an unplanned event with the potential for impact (termed risk 'consequence').

Herein, potential impact from planned activities are termed 'impacts', and 'risks' are associated with unplanned events with the potential for impact (should the risk be realised), with such impact termed potential 'consequence'.

2.2 Environmental Risk Management Methodology

2.2.1 Woodside Risk Management Processes

Woodside recognises that risk is inherent to its business and effectively managing those risks is vital to delivering on company objectives, success and continued growth. Woodside is committed to managing all risks proactively and effectively. The objective of Woodside's risk management system is to provide a consistent process for recognising and managing risks across Woodside's business. Achieving this objective includes ensuring risks consider impacts across the following key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural. A copy of Woodside's Risk Management Policy is provided in Appendix A.

The environmental risk management methodology used in this EP is based on Woodside's Risk Management Procedure. This procedure aligns to industry standards such as international standard ISO 31000. The WMS risk management procedures, guidelines and tools provide guidance on specific techniques for managing risk, these tailor the Risk Management Procedure for particular areas of risk within certain business processes. Three such procedures applied for managing environmental risk include Woodside's:

- Health Safety and Environment Management Procedure
- Impact Assessment Procedure
- Process Safety Management Procedure.

The risk management methodology provides a framework to demonstrate that the identified risks and impacts are continually identified, reduced to ALARP and assessed to be at an acceptable level, as required by the Environment Regulations. The key steps of Woodside's Risk Management

Process are shown in Figure 2-1. A description of each step and how it is applied to the scopes of this activity is provided in Sections 2.1 to Section 2.10.

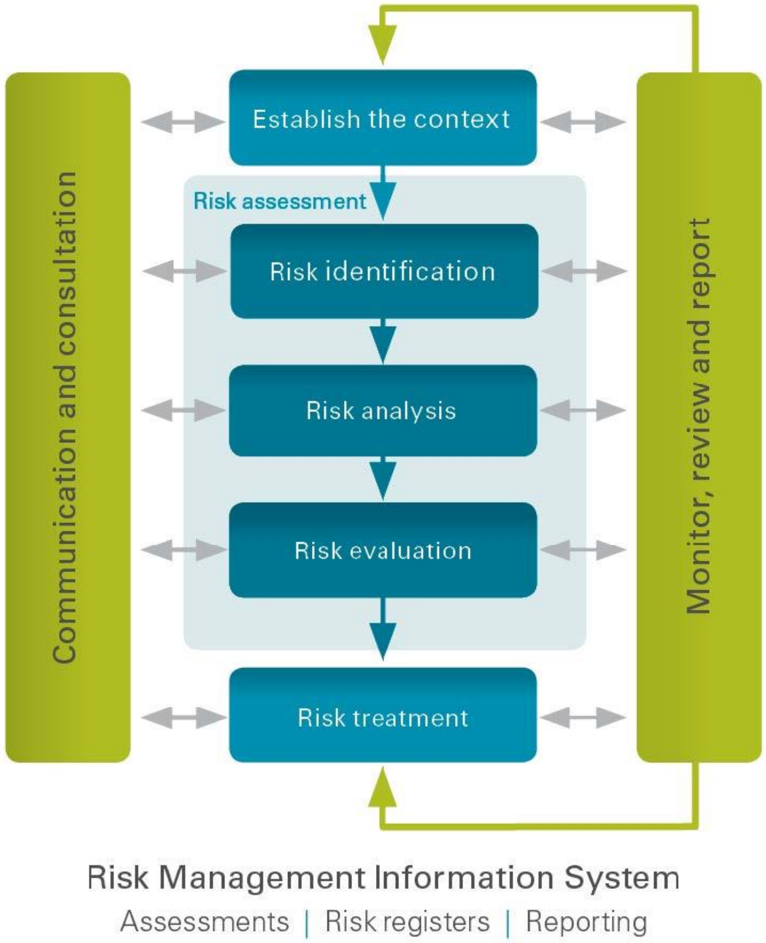


Figure 2-1: Woodside's risk management process

2.2.2 Health, Safety and Environment Management Procedure

Woodside's Health, Safety and Environment Management Procedure provides a structure for managing health, safety and environment (HSE) risks and impacts across Woodside and defines the decision authorities for company-wide HSE management activities and deliverables, and to support continuous improvement in HSE management.

2.2.3 Impact Assessment Procedure

To support effective environmental risk assessment, Woodside's Impact Assessment Procedure (Figure 2-2) provides the steps needed to meet required environment, health and social standards through ensuring impact assessments are undertaken appropriate to the nature and scale of the activity, the regulatory context, the receiving environment, interests, concerns and rights of stakeholders, and the applicable framework of standards and practices.

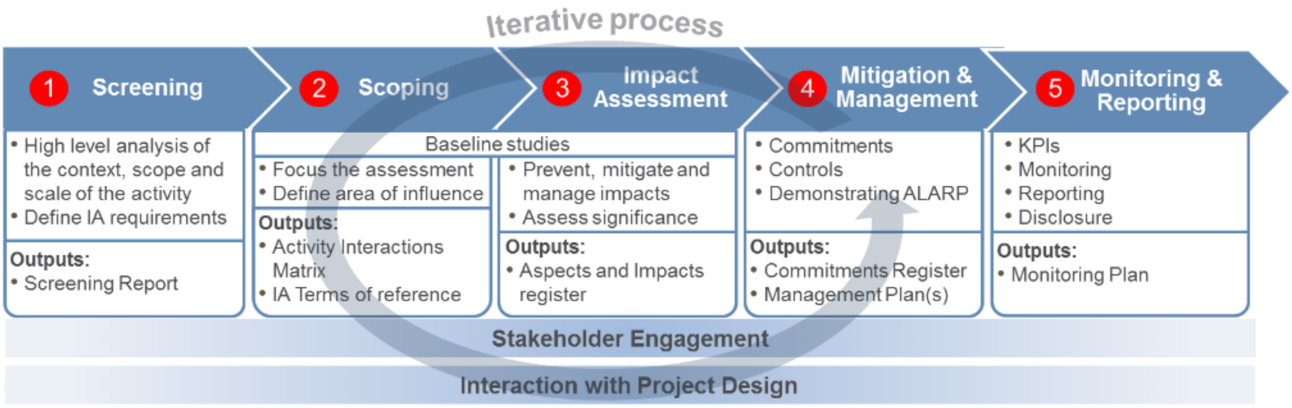


Figure 2-2: Woodside's impact assessment process

2.3 Environment Plan Process

Figure 2-3 illustrates the Environment Plan development process. Each element of this process is discussed in Sections 2.4 to Section 2.10.

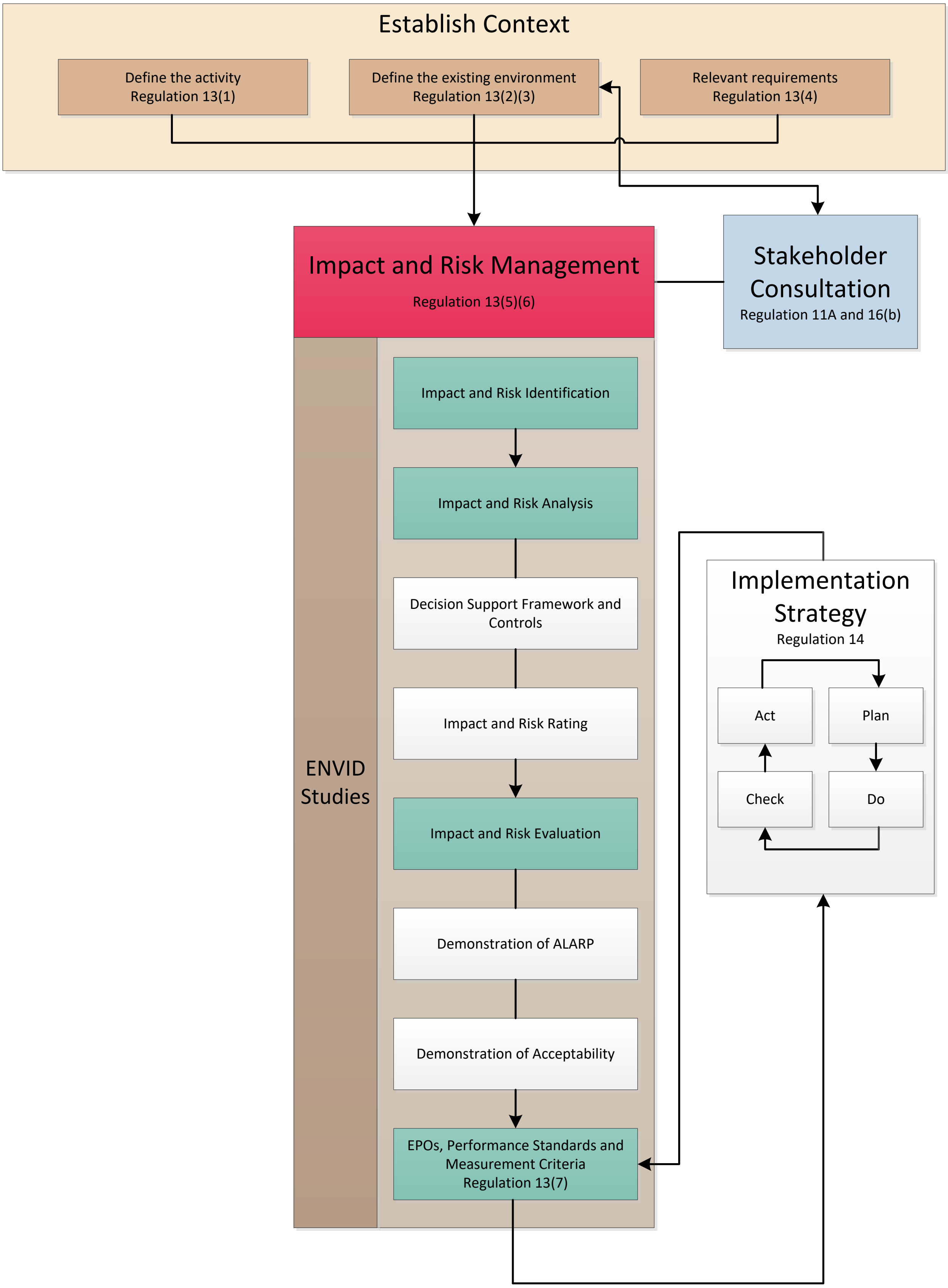


Figure 2-3: Environment plan development process

2.4 Establish the Context

2.4.1 Define the Activity

This first stage involves evaluating whether the activity meets the definition of a 'petroleum activity' as defined in the Environment Regulations.

The activity is then described in relation to:

- the location
- what is to be undertaken
- how it is planned to be undertaken, including outlining operational details of the activity and proposed timeframes.

The 'what' and 'how' are described in the context of 'environmental aspects'[1] to inform the risk and impact assessment for planned (routine and non-routine) and unplanned (accidents/incidents/emergency conditions) activities.

The activity is described in Section 3 and referred to as the Petroleum Activities Program.

2.4.2 Define the Existing Environment

The existing environment that may be impacted by the Petroleum Activities Program (as described in Section 4) is defined by considering the nature and scale of the activities (i.e. size, type, timing, duration, complexity and intensity). The existing environment may potentially be impacted directly or indirectly by planned and unplanned[2] events. The existing environment (Section 4) is structured into sub-sections defining the physical, biological, socio-economic and cultural attributes of the area of interest in accordance with the definition of 'environment' in Regulation 4(a) of the Environment Regulations. These sub-sections make particular reference to the following:

- The environmental values potentially impacted by the Petroleum Activities Program, which include key physical and biological attributes of the existing environment (as defined by Woodside in Table 2-1 and Section 2.4.2).
- EPBC Act matters of national environmental significance (MNES) including listed threatened species and ecological communities, and listed migratory species. Defining the spatial extent of the existing environment is guided by the nature and scale of the Petroleum Activities Program within the Operational Area (planned activities) and the environment that may be affected (EMBA) by unplanned events. Potential impacts to MNES as defined within the EPBC Act are addressed through Woodside's impact and risk assessment process (Section 2.6).
- Relevant values and sensitivities, which may include world or national heritage listed areas, Ramsar wetlands, listed threatened species or ecological communities, listed migratory species, sensitive values that exist in, or in relation to commonwealth marine area or land.

[1] An environmental aspect is an element of the activity that can interact with the environment.

[2] The worst-case unplanned event is considered to be an unplanned hydrocarbon release, further defined for each activity through the risk assessment process. Interpretation of stochastic oil spill modelling determines the EMBA for the release, which defines the spatial scale of the environment that may be potentially impacted by the Petroleum Activities Program, which provides context to the 'nature and scale' of the existing environment.

- In categorising the environmental values potentially impacted by the Petroleum Activities Program (as presented in Table 2-1), information is standardised relevant to the understanding of the receiving environment. Potential impacts to these environmental values are evaluated in the risk analysis (refer Section 2.6), and risk-rated for all planned and unplanned activities. This provides a robust approach to the overall environmental risk evaluation and its documentation in the EP.

Table 2-1: Example of the environment values potentially impacted which are assessed within the EP

Environmental Value Potentially Impacted *Regulations 13(2)(3)*						
Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl odour)	Ecosystems/Habitats	Species	Socio-Economic

The existing environment is described in Section 4.

2.4.3 Relevant Requirements

The relevant requirements in the context of legislation, other environmental approval requirements, conditions and standards that apply to the Petroleum Activities Program are identified and reviewed.

Relevant requirements are presented in Appendix B.

Woodside's corporate Heath Safety, Environment and Quality Policy is presented in Appendix A.

2.5 Impact and Risk Identification

Relevant environmental aspects and hazards have been identified to support the process to define environmental impacts and risks associated with an activity.

The environmental impact and risk assessment presented in this EP has been informed by recent and historic hazard identification studies (e.g. HAZID/ENVID), process safety risk assessment processes, reviews and associated desktop studies associated with the Petroleum Activities Program. Risks are identified based on planned and potential interaction with the activity (based on the description in Section 3), the existing environment (Section 4) and the outcomes of Woodside's stakeholder engagement process (Section 5). The environmental outputs of applicable risk and impact workshops and associated studies are referred to as ENVID thereafter in this EP.

The ENVID has been undertaken by multidisciplinary teams consisting of relevant engineering and environmental personnel with sufficient breadth of knowledge, training and experience to reasonably assure that risks were identified and their potential environmental impacts assessed. Impacts and risks were identified during the ENVID for both planned (routine and non-routine) activities and unplanned (accidents/incidents/emergency conditions) events. During this process, risks that are identified as not applicable (not credible) are removed from the assessment. This is performed by defining the activity and identifying that an aspect is not applicable.

The impact and risk information is classified, evaluated and tabulated for each planned activity and unplanned event. Environmental impacts and risk are recorded in an environmental impacts and risk register. The output of the ENVID is used to present the risk assessment and forms the basis to develop performance outcomes, standards and measurement criteria. This information is presented in Section 6), using the format presented in Table 2-2.

Table 2-2: Example of layout of identification of risks and impacts in relation to risk sources

Impacts and Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***					
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socio-Economic	Decision Type	Consequence/Impact	Likelihood	Risk Rating	ALARP Tools	Acceptability
Summary of source of impact/risk													

2.6 Impact and Risk Analysis

Risk analysis further develops the understanding of a risk by defining the impacts and assessing appropriate controls. Risk analysis considered previous risk assessments for similar activities, reviews of relevant studies, reviews of past performance, external stakeholder consultation feedback and review of the existing environment.

The key steps undertaken for each risk identified during the risk analysis were:

- Identify the decision type in accordance with the decision support framework.
- Identify appropriate control measures (preventative and mitigative) aligned with the decision type.
- Assess the risk rating.

2.6.1 Decision Support Framework

To support the risk assessment process, and Woodside's determination of acceptability (Section 2.7.2), Woodside's HSE risk management procedures include using a decision support framework based on principles set out in the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014). This concept has been applied during the ENVID, or equivalent preceding processes during historical design decisions, to determine the level of supporting evidence that may be required to draw sound conclusions about risk level and whether the risk is acceptable and ALARP (Table 2-4). This is to confirm:

- Activities do not pose an unacceptable environmental risk.
- Appropriate focus is placed on activities where the risk is anticipated to be acceptable and demonstrated to be ALARP.
- Appropriate effort is applied to managing risks based on the uncertainty of the risk, the complexity and risk rating (i.e. potential higher order environmental impacts are subject to further assessment).

The framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the risk (referred to as Decision Type A, B or C). The decision type is selected based on an informed discussion around the uncertainty of the risk, and documented in ENVID output.

This framework enables Woodside to appropriately understand a risk, determine if the risk is acceptable and can be demonstrated to be ALARP.

2.6.1.1 Decision Type A

Risks classified as a Decision Type A are well understood and established practice. They generally consider recognised good industry practice, which is often embodied in legislation, codes and standards and use professional judgement.

2.6.1.2 Decision Type B

Risks classified as Decision Type B typically involve greater uncertainty and complexity (and can include potential higher order impacts/risks). These risks may deviate from established practice or have some lifecycle implications, and therefore require further engineering risk assessment to support the decision and ensure the risk is ALARP. Engineering risk assessment tools may include:

- risk-based tools such as cost based analysis or modelling
- consequence modelling
- reliability analysis
- company values.

2.6.1.3 Decision Type C

Risks classified as Decision Type C typically have significant risks related to environmental performance. Such risks typically involve greater complexity and uncertainty, therefore requiring a precautionary approach. The risks may result in significant environmental impact, significant project risk/exposure or may elicit negative stakeholder concerns. For these risks, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and external stakeholder consultation as part of the risk assessment process.

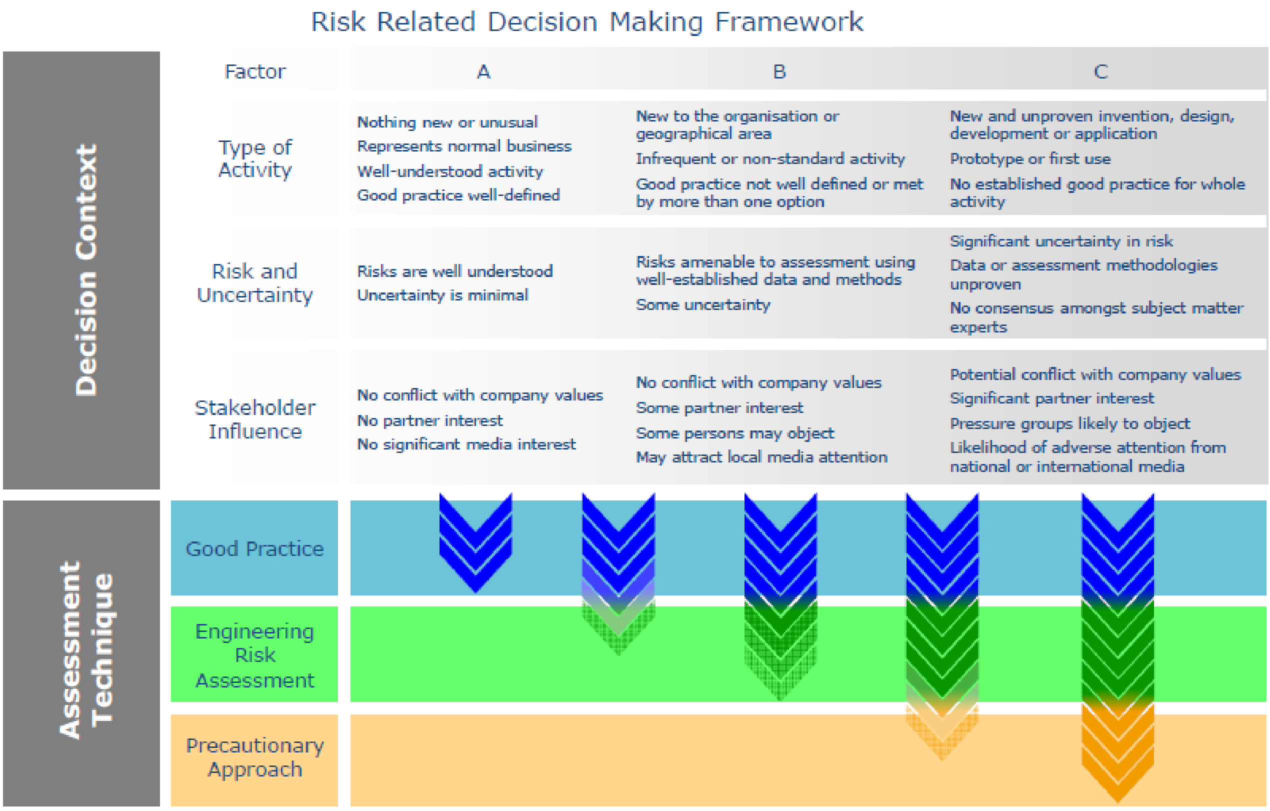


Figure 2-4: Risk related decision making framework (Oil & Gas UK, 2014)

2.6.1.4 Decision Support Framework Tools

The following framework tools are applied, as appropriate, to assist with identifying control measures based on the decision type described above:

- **Legislation, Codes and Standards (LCS)** identifies the requirements of legislation, codes and standards which are to be complied with for the activity.
- **Good Industry Practice (GP)** identifies further engineering control standards and guidelines which may be applied by Woodside above those required to meet the legislation, codes and standards.
- **Professional Judgement (PJ)** uses relevant personnel with the knowledge and experience to identify alternative controls. Woodside applies the hierarchy of control as part of the risk assessment to identify any alternative measures to control the risk.
- **Risk Based Analysis (RBA)** assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost-benefit analysis to support the selection of control measures identified during the risk assessment process.
- **Company Values (CV)** identifies values detailed in Woodside's code of conduct, policies and the Woodside compass. Views, concerns and perceptions are to be considered from internal Woodside stakeholders directly affected by the planned impact or potential risk.
- **Societal Values (SV)** identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder views, concerns and perceptions.

2.6.1.5 Decision Calibration

To determine that the selected alternatives and control measures applied are suitable, the following tools may be used for calibration (i.e. checking) where required:

- **Legislation, Codes and Standards/Verification of Predictions –** Verification of compliance with applicable legislation, codes and standards and/or good industry practice.
- **Peer Review –** Independent peer review of professional judgements, supported by risk based analysis, where appropriate.
- **Benchmarking** – Where appropriate, benchmarking against a similar facility or activity type or situation which has been accepted to represent acceptable risk.
- **Internal Stakeholder Consultation** – Consultation undertaken within Woodside to inform the decision and verify company values are met.
- **External Stakeholder Consultation –** Consultation undertaken to inform the decision and verify societal values are considered.

Where appropriate, additional calibration tools may be selected specific to the decision type and the activity.

2.6.2 Control Measures (Hierarchy of Controls)

Risk reduction measures should be prioritised and categorised in accordance with the hierarchy of controls, where risk reduction measures at the top of the hierarchy take precedence over risk reduction measures further down:

- **Elimination** of the risk by removing the hazard.
- **Substitution** of a hazard with a less hazardous one.

- **Engineering Controls** which include design measures to prevent or reduce the frequency of the risk event, detect or control the risk event (limiting the magnitude, intensity and duration) such as:
  - prevention: design measures that reduce the likelihood of a hazardous event occurring
  - detection: design measures that facilitate early detection of a hazardous event
  - control: design measures that limit the extent/escalation potential of a hazardous event
  - mitigation: design measures that protect the environment should a hazardous event occur
  - response equipment: design measures or safeguards that enable clean-up/response after a hazardous event occurs.
- **Procedures and Administration** which include management systems and work instructions used to prevent or mitigate environmental exposure to hazards.
- **Emergency Response and Contingency Planning** which includes methods to enable recovery from the impact of an event (e.g. protection barriers deployed near the sensitive receptor).

2.6.3 Impact and Risk Classification

Environmental impacts and risks are assessed to determine the potential impact significance/consequence. The impact significance/consequence considers the magnitude of the impact or risk and the sensitivity of the potentially impacted receptor (represented by Figure 2-5).

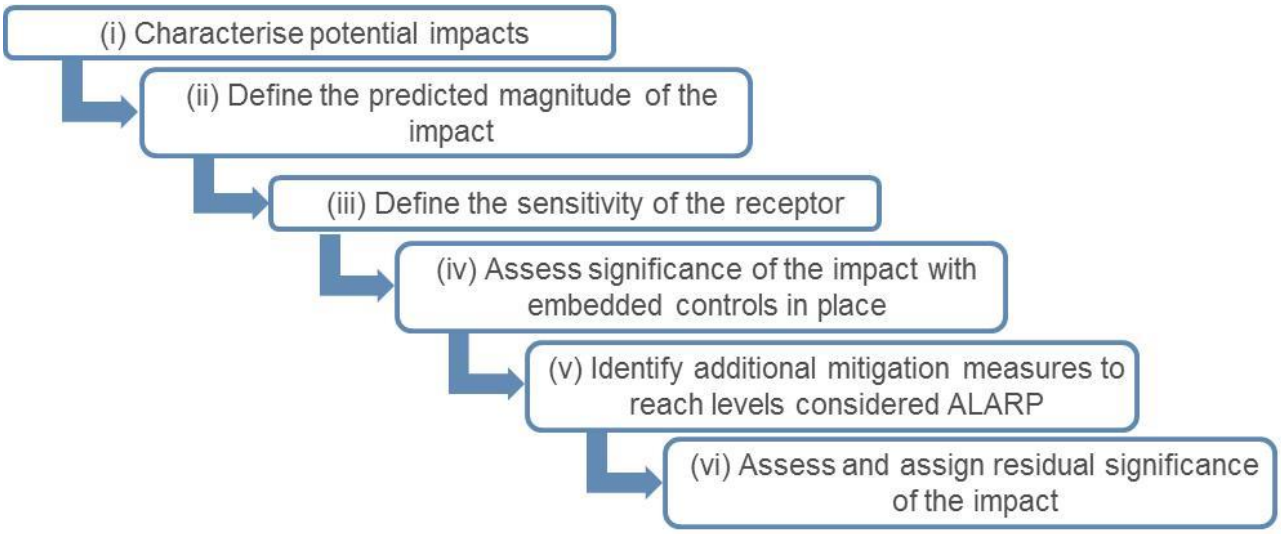


Figure 2-5: Environmental impact analysis

Impacts are classified in accordance with the consequence (Section 2.6.3) outlined in Woodside Risk Management Procedure and Risk Matrix.

Risks are assessed qualitatively and/or quantitatively in terms of both likelihood and consequence in accordance with the Woodside Risk Management Procedure and Risk Matrix.

The impact and risk information is summarised, including classification, and evaluation information as shown in the example (Table 2-2) for each planned activity and unplanned event evaluated.

Table 2-3: Woodside risk matrix (environment and social and cultural) consequence descriptions

Environment	Social & Cultural	Consequence Level
Catastrophic, long-term impact (>50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	Catastrophic, long-term impact (>20 years) to a community, social infrastructure or highly valued areas/items of international cultural significance	*A*
Major, long term impact (10–50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	Major, long-term impact (5–20 years) to a community, social infrastructure or highly valued areas/items of national cultural significance	*B*
Moderate, medium-term impact (2–10 years) on ecosystems, species, habitat or physical or biological attributes	Moderate, medium term Impact (2–5 years) to a community, social infrastructure or highly valued areas/items of national cultural significance	*C*
Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes	Minor, short-term impact (1–2 years) to a community or highly valued areas/items of cultural significance	*D*
Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	Slight, short-term impact (<1 year) to a community or areas/items of cultural significance	*E*
No lasting effect (<1 month). Localised impact not significant to environmental receptors	No lasting effect (<1 month). Localised impact not significant to areas/items of cultural significance	*F*

2.6.3.1 Risk Rating Process

The risk rating process is undertaken to assign a level of risk to each risk event, measured in terms of consequence and likelihood. The assigned risk level is therefore determined after identifying the decision type and appropriate control measures.

The risk rating process considers the potential environmental consequences and where applicable, the social and cultural consequences of the risk. The risk ratings are assigned using the Woodside Risk Matrix (refer to Figure 2-6).

The risk rating process is performed using the following steps.

Select the Consequence Level

Determine the worst case credible consequence associated with the selected event, assuming all controls (preventative and mitigative) are absent or have failed (Table 2-3). Where more than one potential consequence applies, the highest severity consequence level is selected.

Select the Likelihood Level

Determine the description that best fits the chance of the selected consequence occurring, assuming reasonable effectiveness of the prevention and mitigation controls (Table 2-4).

Table 2-4: Woodside risk matrix likelihood levels

Likelihood Description						
Frequency	1 in 100,000–1,000,000 years	1 in 10,000–100,000 years	1 in 1000–10,000 years	1 in 100–1000 years	1 in 10–100 years	>1 in 10 years
Experience	**Remote**: Unheard of in the industry	**Highly Unlikely**: Has occurred once or twice in the industry	**Unlikely**: Has occurred many times in the industry but not at Woodside	**Possible**: Has occurred once or twice in Woodside or may possibly occur	**Likely**: Has occurred frequently at Woodside or is likely to occur	**Highly Likely**: Has occurred frequently at the location or is expected to occur
Likelihood Level	0	1	2	3	4	5

Calculate the Risk Rating

The risk level is derived from the consequence and likelihood levels determined above in accordance with the risk matrix shown in Figure 2-6. A likelihood and risk rating is only applied to environmental risks using the Woodside Risk Matrix.

This risk level is used as an input into the risk evaluation process and ultimately for prioritising further risk reduction measures. Once each risk is treated to ALARP, the risk rating articulates the ALARP baseline risk as an output of the ENVID studies.

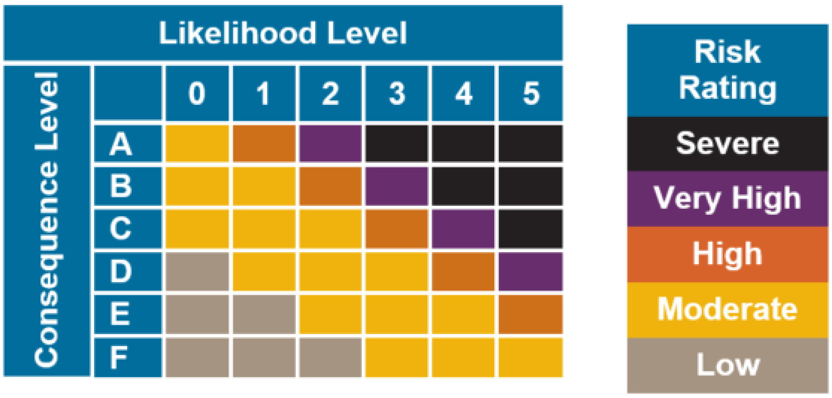


Figure 2-6: Woodside risk matrix: risk level

In support of ongoing risk management (as a key component of Woodside's Process Safety Management Framework – refer to Implementation Strategy (Section 7)), Woodside uses the concept of 'current risk' and applies a current risk rating to indicate the current or 'live' level of risk, considering controls that are currently in place and regularly effective. Current Risk Classification is effective in articulating potential divergence from baseline risk, such as if certain controls fail or could potentially be compromised. Current risk ratings aid in communication and visibility of the risk events, and ensures risk is continually managed to ALARP by identifying risk reduction measures and assessing acceptability.

2.7 Impact and Risk Evaluation

Environmental impacts and risks cover a wider range of issues, affected by differing species, persistence, reversibility, resilience, cumulative effects and variability in severity. Determining the degree of environmental risk and the corresponding threshold for whether a risk/impact has been reduced to ALARP and is acceptable, is evaluated to a level appropriate to the nature and scale of each impact or risk. The evaluation considers:

- the Decision Type
- the Principles of Ecologically Sustainable Development as defined under the EPBC Act
- the internal context – the proposed controls and risk level are consistent with Woodside policies, procedures and standards (Section 6 and Appendix A)
- the external context – the environment consequence (Section 6) and stakeholder acceptability (Section 5) are considered
- other requirements – the proposed controls and risk level are consistent with national and international standards, laws and policies.

In accordance with OPGGS (Environment) Regulation 10A(a), 10A(b) and 10A(c), and 13(5)(b) t, Woodside applies the following process to demonstrate ALARP and acceptability for environmental impacts and risks appropriate to the nature and scale of each impact or risk.

2.7.1 Demonstration of ALARP

Descriptions have been provided in Table 2-5 to articulate how Woodside demonstrates that different risks, impacts and Decision Types identified within the EP are ALARP.

Table 2-5: Summary of Woodside's criteria for demonstrating ALARP

Risk	Impact	Decision Type
Low and Moderate	***Negligible, Slight, or Minor (D, E or F)***	***A***
Woodside demonstrates these Risks, Impacts and Decision Types are reduced to ALARP if: • controls identified meet legislative requirements, industry codes and standards, applicable company requirements and industry guidelines • further effort towards impact/risk reduction (beyond employing opportunistic measures) is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.		
High, Very High or Severe	***Moderate and above (A, B or C)***	***B and C***
Woodside demonstrates these higher order Risks, Impacts and Decision Types are reduced to ALARP (where it can be demonstrated using good industry practice and risk based analysis) if: • legislative requirements, applicable company requirements and industry codes and standards are met • societal concerns are accounted for • the alternative control measures are grossly disproportionate to the benefit gained.		

2.7.2 Demonstration of Acceptability

Descriptions have been provided in Table 2-6 to articulate how Woodside demonstrates that different risks, impacts and Decision Types identified within the EP are Acceptable. (Please also refer to Figure 2-7 for a visual representation against Woodside's risk matrix).

Table 2-6: Summary of Woodside's criteria for Acceptability

Risk	Impact	Decision Type
Low and Moderate	***Negligible, Slight, or Minor (D, E or F)***	***A***
Woodside demonstrates these Risks, Impacts and Decision Types are 'Broadly Acceptable' if they meet legislative requirements, industry codes and standards, applicable company requirements and industry guidelines. Further effort towards reducing risk (beyond employing opportunistic measures) is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.		
High, Very High or Severe	***Moderate and above (A, B or C)***	***B and C***
Woodside demonstrates these higher order Risks, Impacts and Decision Types are 'Acceptable if ALARP' if it can be demonstrated using good industry practice and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. In undertaking this process for Moderate and High current risks, Woodside evaluates: • the Principles of Ecological Sustainable Development as defined under the EPBC Act • the internal context – the proposed controls and consequence/risk level are consistent with Woodside policies, procedures and standards the external context – the environment consequence (Section 6) and stakeholder acceptability (Section 5) are considered • other requirements – the proposed controls and consequence/risk level are consistent with national and international industry standards, laws and policies. Additionally, Very High and Severe risks require 'Escalated Investigation' and mitigation. If after further investigation the risk remains in the Very High or Severe category, the risk requires appropriate business engagement with increasing involvement of senior management in accordance with Woodside's Risk Management Procedure to accept the risk. This includes due consideration of regulatory requirements.		

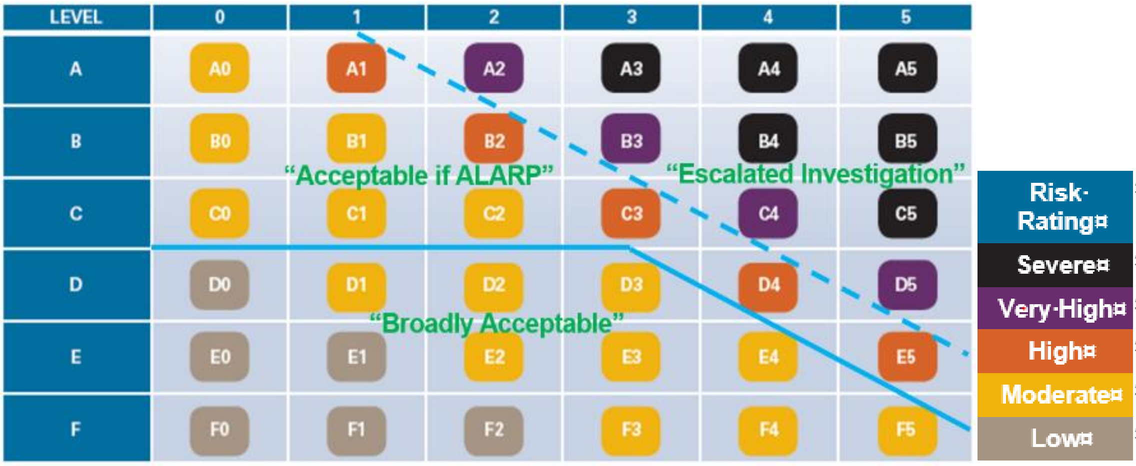


Figure 2-7: Environmental risk evaluation

2.8 Environmental Performance Objectives/Outcomes, Standards and Measurement Criteria

Environmental performance objectives/outcomes, standards, and measurement criteria are defined to address the potential environmental impacts and risks and are explored in Section 6.

2.9 Implementation, Monitoring, Review and Reporting

An implementation strategy for the Petroleum Activities Program describes the specific measures and arrangements to be implemented for the duration of the Petroleum Activities Program. The implementation strategy is based on the principles of AS/NZS ISO 14001 Environmental Management Systems, and demonstrates:

- control measures are effective in reducing the environmental impacts and risks of the Petroleum Activities Program to ALARP and acceptable levels
- environmental performance outcomes and standards set out in the EP are met through monitoring, recording, audit, management of non-conformance and review
- all environmental impacts and risks of the Petroleum Activities Program are periodically reviewed in accordance with Woodside's risk management procedures
- roles and responsibilities are clearly defined, and personnel are competent and appropriately trained to implement the requirements set out in this EP, including in actual or potential emergencies
- arrangements are in place for oil pollution emergencies to respond to and monitor impacts
- environmental reporting requirements, including 'reportable incidents'
- appropriate stakeholder consultation is undertaken throughout the activity.

The implementation strategy is presented in Section 7.

2.10 Stakeholder Consultation

A stakeholder assessment is performed to identify relevant persons (as defined under Regulation 11A of the Environment Regulations) to whom an activity update is issued electronically to provide a reasonable consultation period. Further details and information is provided to any stakeholder if requested.

A summary and assessment of each stakeholder response is performed and a response, where appropriate, is provided by Woodside.

The stakeholder consultation, along with the process for ongoing engagement and consultation throughout the activity, is presented in Section 5.

3. DESCRIPTION OF THE ACTIVITY

3.1 Overview

This section has been prepared in accordance with Regulation 13(1) of the Environment Regulations, and describes the activities to be performed as part of the Petroleum Activities Program under this EP.

3.2 Project Overview

The Petroleum Activities Program will involve the drilling of one exploration well within Permit Area WA-49-L.

The well will be drilled using a moored semi-submersible MODU. Typically, two or three vessels will support the MODU during drilling activities, with at least one vessel in the vicinity to complete standby duties, if required. Supply vessels from NWS ports will frequent the MODU at regular intervals, throughout operations.

A 500 m petroleum safety zone, from which unauthorised vessels will be excluded, will be in place around the Petroleum Activities Program location for the duration of the activities.

An overview of the Petroleum Activities Program is provided in Table 3-1.

Table 3-1: Petroleum Activities Program overview

Item	Description
Permit Area	WA-49-L
Location	Barrow Sub-basin
Number of wells	One exploration well
Water depth Gemtree-A exploration well	201 m
Water depth Operational Area	166 – 511 m
MODU	Semi-submersible moored MODU
Vessels	Activity support vessels, including general supply/support vessels and anchor handling vessel(s) (AHV)
Key activities	• pre-lay of anchors by AHV and contingent suction piling if necessary • mooring activity on arrival of MODU • top hole section drilling • installation of blow-out preventer (BOP) and marine riser • bottom hole section drilling • temporary suspension and/or permanent abandonment of well

3.3 Location

The proposed Gemtree-A Well is located within Permit Area WA-49-L, in Commonwealth waters in the Barrow Sub-basin, about 142 km off the Pilbara coast of Western Australia (Figure 3-1). The closest landfall to the Permit Area is the Montebello Islands, which are about 52 km southeast.

Approximate location details for the Petroleum Activities Program are provided in Table 3-2.

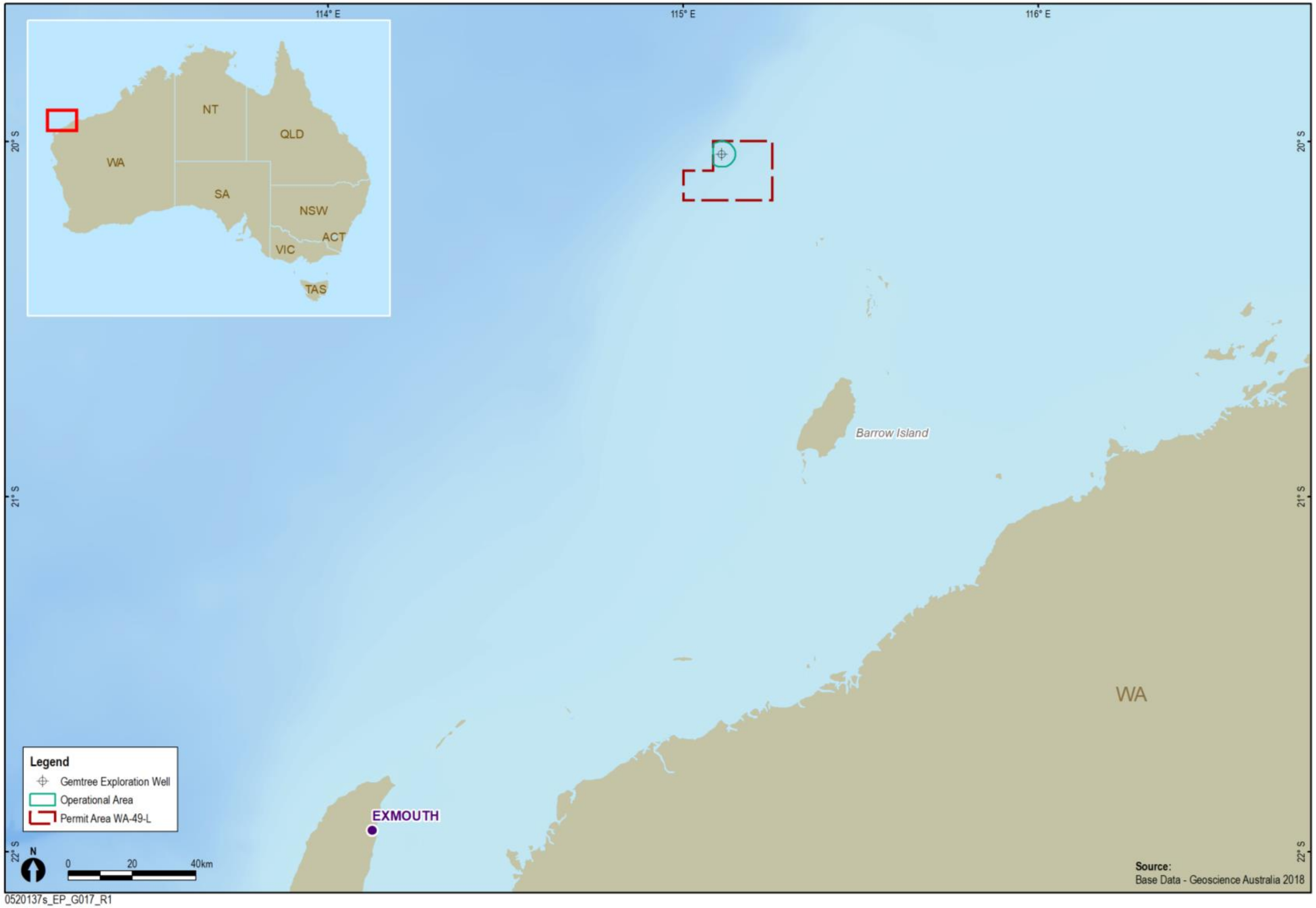


Figure 3-1: Location map

Table 3-2: Approximate location details for the Petroleum Activities Program

Activity	Water Depth (Approx. m LAT)	Latitude	Longitude	Production Licence
Gemtree-A	201 m	20^0 02’ 06.754 S	115^0 06’ 32.749 E	WA-49-L

3.3.1 Operational Area

The Operational Area defines the spatial boundary of the Petroleum Activities Program, as described, risk-assessed and managed by this EP, including vessel-related petroleum activities within the Operational Area[3]. The Operational Area encompasses a radius of 4000 m from the well centre, within the Permit Area WA-49-L. This area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel-related petroleum activities. The Operational Area for drilling activities includes a 500 m petroleum safety zone around the MODU to manage vessel movements. The 500 m petroleum safety zone is under the control of the MODU Person in Charge (PIC) and excludes other vessels from this area.

3.4 Timing

The proposed drilling of the exploration well is being targeted to commence in 2021 and take about 50 days to complete.

When ongoing, activities will be 24 hours per day, seven days per week. Timing of commencement and duration of these activities is subject to change due to project schedule requirements, MODU/vessel availability, unforeseen circumstances and weather. Therefore flexibility has been included, if the well is postponed from the original date, and the well may be drilled in 2022 to 2024.

This EP has risk assessed drilling activities throughout the year (all seasons) to provide operational flexibility for requirements and schedule changes, as well as vessel/MODU availability. The timeframes are therefore subject to change within the calendar year and, as no particular windows have been nominated for avoidance based on environmental and/or stakeholder sensitivities, changes to the above will not be interpreted as ‘new stages’ against Regulation 17(5).

3.5 Project Vessels

Several vessel types will be required to complete the activities associated with the Petroleum Activities Program. These are discussed in further detail in the next section and will include:

- semi-submersible moored MODU
- support vessels, required for activities such as to run and set anchors and operate on standby to support the MODU during operations.

All project vessels, are subject to the Marine Offshore Assurance process and review of the Offshore Vessel Inspection Database (OVID). All required audits and inspections will assess compliance with the laws of the international shipping industry, which includes safety and environmental management requirements, and maritime legislation including International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL) and other International Maritime Organization (IMO) standards.

A description and assessment of support vessel environmental impacts and risks, credible spill scenarios and environmental sensitivities for the activities within the scope of this EP are included

[3] Vessels supporting the Petroleum Activities Program operating outside of the Operational Area (e.g. transiting to and from port) are subject to all applicable maritime regulations and other requirements, which are not managed under this EP.

in Section 6. Some support vessels may be required on ad hoc to support periods of high activity and will be subject to the above processes.

For power generation, vessels may use diesel-powered generators and/or LNG. All vessels will display navigational lighting and external lighting, as required for safe operations. Lighting levels will be determined primarily by operational safety and navigational requirements under relevant legislation, specifically the *Navigation Act 2012*. The MODU and support vessels will be lit to maintain operational safety on a 24-hour basis.

3.5.1 MODU

The Petroleum Activities Program is proposed to be drilled by the *Ocean Apex* MODU or similar. Due to variabilities such as contractual and operational matters, the MODU used may be subject to change. If this occurs, a MODU meeting Woodside's required technical specifications and with similar specifications as listed in Table 3-3 will be utilised.

Table 3-3: Typical moored MODU specifications ranges for Ocean Apex

Component	Specification Range
Rig type/design/class	Semi-submersible MODU
Accommodation	120 to 200 personnel (maximum persons on board)
Station keeping	Minimum eight-point mooring system
Bulk mud and cement storage capacity	283 to 770 m^3
Liquid mud storage capacity	576 to 2500 m^3
Fuel oil storage capacity	966 to 1400 m^3
Drill water storage capacity	3500 m^3

3.5.1.1 Holding Station: Mooring Installation

Mooring uses a system of chains/ropes and anchors, which may be pre-laid before the MODU arrives at the location, to maintain position when drilling. A mooring analysis will be performed to determine the appropriate mooring system for the Petroleum Activities Program. The mooring analysis will identify whether the mooring system will be pre-laid or set by the rig, proof tension values, or if using synthetic fibre mooring ropes is required.

Installation and proof tensioning of anchors involves some disturbance to the seabed. Anchor handling vessels are used to deploy and recover the mooring system. Suction piling may be required as a contingent activity, and will be reviewed with the MODU contractor.

Anchor hold testing is not covered in the scope of this EP and is described in the WA-49-L Gemtree Anchor Hold Testing Environment Plan, accepted 15 January 2020.

3.5.2 Support Vessels

During the Petroleum Activities Program, the MODU will be supported by other vessels, such as general support vessel(s), anchor handling vessel(s).

Support vessels are used to transport equipment and materials between the MODU and port. Support vessels may transit between the Operational Area and NWS Ports including Dampier, Onslow and Exmouth. If required, one of the vessels will be at the MODU to perform standby duties as stipulated in Woodside's OneMarine Charterers Instructions. Others will make regular trips between the Operational Area and port for routine, non-routine and emergency operations.

Support vessels do not anchor within the Operational Area during the activities due to water depth; therefore, vessels will utilise Dynamic Positioning (DP).

The support vessels may also be available to assist in implementing the Oil Pollution First Strike Plan, should an environmental incident occur (e.g. spills).

3.5.3 Vessel Mobilisation

Vessels may mobilise from the nearest Australian port or directly from international waters to the Operational Area, in accordance with biosecurity and marine assurance requirements.

3.6 Other Support

3.6.1 Remotely Operated Vehicles

The MODU and support vessels may be equipped with a ROV system that is maintained and operated by a specialised contractor aboard the vessel. ROVs may be used for activities such as:

- pre-drill seabed and hazard survey
- observation of blow-out preventer land-out and recovery
- BOP well control contingency
- visual observations at seabed during riserless drilling operation
- post-well seabed survey.

An ROV can be fitted with various tools and camera systems that can be used to capture permanent records (both still images and video) of the operations and immediate surrounding environment.

An ROV may also be used in an incident to deploy the Subsea First Response Toolkit. This is discussed further in Appendix D.

3.6.2 Helicopters

During the Petroleum Activities Program, crew changes will be performed using helicopters as required. Helicopter operations within the Operational Area are limited to helicopter take-off and landing on the helideck. Helicopters may be refuelled on the helideck. This activity will take place within the Operational Area and has been included in the risk assessment for this EP.

3.7 MODU and Support Vessel Activities

A variety of materials are routinely bulk transferred from support vessels to the MODU, including, but not limited to, drilling fluids (e.g. muds), base fluids, cements and drill water. A range of dedicated bulk transfer stations and equipment is in place to accommodate the bulk transfer of each type of material. There is also a capacity to bulk transfer waste oil from the MODU to the support vessel, for back-loading and disposal on shore.

The loading and back-loading of equipment, materials and wastes is one of the most common supporting activities conducted during drilling programs. Loading and back-loading is performed using cranes on the MODU to lift materials in appropriate offshore rated containers (e.g. ISO tanks, skip bins, containers) between the MODU and support vessel.

Seawater is pumped on board and used as a heat exchange medium for the cooling of machinery engines on the MODU. It is subsequently discharged from the MODU to the sea surface at potentially a higher temperature. Alternatively, MODUs may utilise closed loop cooling systems.

Potable water, primarily for accommodation and associated domestic areas, may be generated on vessels. This process will produce brine, which is diluted and discharged at the sea surface.

The MODU and support vessels will also discharge deck drainage from open drainage areas, bilge water from closed drainage areas, putrescible waste and treated sewage and grey water. Solid hazardous and non-hazardous wastes generated during the Petroleum Activities Program are disposed onshore by support vessels.

3.7.1 Refuelling

The MODU will be refuelled via support vessels about once a month, or as required. This activity will take place within the Operational Area of the well being drilled at the time and has been included in the risk assessment for this EP. Other fuel transfers that may occur on board the MODU include refuelling of cranes, helicopters or other equipment as required.

3.8 Drilling Activities

Well construction activities are conducted in a number of stages. The detailed well design will be submitted to the Well Integrity department of NOPSEMA as part of the Approval to Drill and the accepted Well Operation Management Plan (WOMP), as required under the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011.

3.8.1 Underwater Acoustic Positioning

An array of long base line (LBL) transponders and/or ultra short baseline (USBL) transponders may be installed on the seabed as required to support drilling activities. USBL subsea transponders mounted on ROV and structures transmit an acoustic pulse back to the vessel receiver, hence providing an accurate positioning of the ROV and structure locations. An LBL array provides accurate positioning by measuring ranges to three or more transponders deployed at known locations on the seabed and structures. If used, an array of transponders is proposed within a radius of 300 m from the proposed location of infrastructure. The array may be in place for a period of about three months and will be recovered at the end of the drilling program. Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds. Transponders will not emit any sound when on standby and are planned to only be actively emitted sound for about 6 hours. When required for general positioning they will emit one chirp every five seconds (estimated to be required for four hours at a time). When required for precise positioning they will emit one chirp every second (estimated to be required for two hours at a time).

If required, the LBL transponders may be moored to the seabed either by a clump weight or mounted on a seabed frame. The standard clump weights, made of bio-degradable cement, used will likely weigh about 80 kg. A typical seabed frame is 1.5 m x 1.5 m x 1.5 m in dimension and weighs about 40 kg. On completion of the positioning operation, all LBL and USBL transponders will be recovered from the seabed using ROV. Alternatively, if moored by clump weight, transponders will be recovered by means of a hydrostatic release, which leaves the clump weight on the seabed.

3.8.2 Cement Unit Test

Upon arrival on location at the Operational Area, the MODU may be required to perform a cement unit test, or ‘dummy cement job’ to test the functionality of the cement unit and the MODU’s bulk cement delivery system prior to performing an actual cement job. Proper functioning of the cement system is important for ensuring well integrity. This operation is usually performed after a MODU has been out of operation for an amount of time (warm-stack), if maintenance on the cement unit has been performed, or if it is the first time a MODU is being used in-country and commissioning of the cement unit system is required.

A ‘dummy cement job’ involves mixing a cement slurry at surface, and once functionality of the cement unit and delivery system has been confirmed, the slurry is discharged through the usual cement unit discharge line (which may be up to 10 m above the sea level) or through drill pipe below sea level, and occur as a cement slurry. The slurry is usually a mix of cement and water, however, may contain stabilisers or chemical additives in low concentrations.

3.8.3 Top Hole Section Drilling

Petroleum Activities Program drilling commences with the top hole section as follows:

- The MODU arrives and establishes position over the well site.
- Top hole sections are drilled riserless using seawater with pre-hydrated bentonite sweeps/XC polymer sweeps or water based drilling fluids to circulate drilled cuttings from the wellbore (refer Section 3.9.2).
- Once each top hole section is drilled, steel tubulars (called conductor or casing) are inserted into the wellbore to form the surface casing, and secured in place by pumping cement into the annular space to above the casing shoe, which may involve a discharge of excess cement at the seabed.

3.8.4 Blowout Preventer and Marine Riser Installation

After setting the required casing, a BOP is installed on the wellhead, and the marine riser above it, to provide a physical connection between the well and MODU. This enables a closed circulation system to be maintained, where weighted drilling fluids and cuttings can be circulated from the wellbore back to the MODU, via the riser.

In addition, the BOP provides means for sealing, controlling and monitoring the well during drilling operations. The operation of the BOP components uses open hydraulic systems, using water based BOP control fluids. Each time the BOP is operated (including pressure testing approximately every 21 days and a function test approximately every seven days, excluding the week a pressure test is conducted), the maximum volume of BOP control fluid that will be released to the marine environment is up to about 90 L per test.

BOP control fluid used for operating the BOP rams is subject to the chemical assessment process outlined in Section 3.9.1.

3.8.5 Bottom Hole Section Drilling

A closed system (riser in place) is used for drilling bottom hole sections to the planned wellbore Total Depth (TD). The preference is for bottom hole sections to be drilled using water based mud (WBM) drilling fluids.

Protective steel tubulars (casings and liners) are inserted as required. The size, length and inclination of the casing/liner sections within the wellbore is determined by factors such as the geology/subterranean pressures likely to be encountered in the area and any specific information or resource development requirements.

After a string of casing/liners has been installed into the wellbore, it is cemented into place. The casing/liner is then pressure tested. Once the pressure testing is passed, drilling of the next section can resume with the riser in place to circulate drill cuttings and drilling fluids back to the MODU.

Cementing operations are also undertaken to:

- provide annular isolation between hole sections and structural support of the casing as required
- set a plug in an existing well to sidetrack
- plug a well so it can be suspended/abandoned.

Cements are transported as dry bulk to the MODU by the support vessels, mixed as required by the cementing unit on the MODU, and are pumped by high pressure pumps to the surface cementing head then directed down the well.

Excess dry bulk (e.g. cement, bentonite, barite) after well operations are completed will be held onboard and used for subsequent wells, provided to the next operator at the end of the program, or discharged to the marine environment. Excess dry bulk that does not meet technical integrity requirements or excess to requirements may also be bulk discharged to the environment. Dry bulk discharges may occur as a slurry through a discharge line, or blown as dry bulk and discharged.

3.8.6 Formation Evaluation

Formation evaluation is the interpretation of a combination of measurements taken inside a wellbore to detect and quantify rock quality and hydrocarbon presence adjacent to the well. Two sub-types of formation evaluation are to be used: Formation Evaluation While Drilling (FEWD) and Wireline logging. FEWD involves the use of logging tools as part of the drill string to gain a near-real-time understanding of the type of rock and fluid fill present without ceasing drilling according to its response to radioactive and electrical input. Typical tools may include Deep Directional Resistivity (DDR), gamma ray, resistivity, density, neutron, sonic and tools which can measure formation pressures. Wireline logging may occur in addition to FEWD and occurs after the drill string has been removed from the well. Wireline logging may include extracting side-wall cores, vertical seismic profiling, fluid sampling, gamma ray (GR) and Casing Collar Locator (CCL) for depth correlation and an Ultrasonic Imaging Tool and Cement Bond Log to measure cement integrity, in addition to similar tools run for FEWD as required. Wireline contingency work will be carried out with appropriate isolation barriers in place, i.e. an overbalanced fluid column. If wireline work is required to take place in a live well, or where there is a risk of barrier failure, then the operation will be carried out with full pressure control equipment at the surface. Some FEWD and wireline tools contain radioactive sources; however, no radioactive material will be released to the environment and radiation fields are not generally detectable outside the tool when the tool is not energised. Therefore, they do not present an environmental risk.

Vertical seismic profiling (VSP) is a contingent activity that may be performed during the Petroleum Activities Program and is described in Section 3.10.1.

3.8.7 Well Abandonment

The Petroleum Activities Program covers the drilling of one exploration well, which will be abandoned. For technical reasons, it may also be required to abandon the lower section of a well, prior to side-tracking, or in the event that a respud is required.

Well abandonment activities are conducted in accordance with Woodside’s internal standards. Base oil may be used for inflow testing prior to abandonment, to verify barrier integrity. Base oil would be pumped down the drill string and reverse circulated back to the rig, with fluids collected for disposal onshore. If stored in a mud pit, the base oil and other fluids associated with the test may result in pit wash water contaminated with hydrocarbons. If this is the case, mud pit wash water would be discharged in accordance with requirements in this EP; with a hydrocarbon content <1% by volume.

If required, wells will be abandoned with abandonment cement plugs, including verification of the uppermost cement plug by tagging and/or pressure testing through a prescribed program. A lower section of a well may also be abandoned prior to side-tracking.

Following abandonment activity, the marine riser and BOP will be removed and every reasonable attempt for retrieval made to retrieve the wellhead. Conventional wellheads are removed by deploying a cutting device on drill pipe which then cuts through the conductor, allowing the wellhead to be retrieved to the surface. Backup cutting equipment is available offshore as a contingency should the primary set of equipment fail. The conductor cutting equipment is very reliable with a high success rate of cutting wellheads.

3.9 Project Fluids

3.9.1 Assessment of Project Fluids

All chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program are evaluated using a defined framework and set of tools to ensure the potential impacts are acceptable, ALARP and meet Woodside’s expectation for environmental performance.

All approved drilling chemicals are included on the Drilling and Completions – Master Chemical List which is reviewed during a six month chemical review to drive continuous environmental improvement.

The chemical assessment process follows the principles outlined in the Offshore Chemical Notification Scheme (OCNS) which manages chemical use and discharge in the United Kingdom (UK) and the Netherlands. It applies the requirements of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). The OSPAR Convention is widely accepted as best practice for chemical management.

All chemical substances listed on the OCNS ranked list of registered products have an assigned ranking based on toxicity and other relevant parameters, such as biodegradation and bioaccumulation, in accordance with one of two schemes (as shown in Figure 3-2):

- Hazard Quotient (HQ) Colour Band: Gold, Silver, White, Blue, Orange and Purple (listed in order of increasing environmental hazard), or
- OCNS Grouping: E, D, C, B or A (listed in order of increasing environmental hazard) and applied to inorganic substances, hydraulic fluids and pipeline chemicals, only.

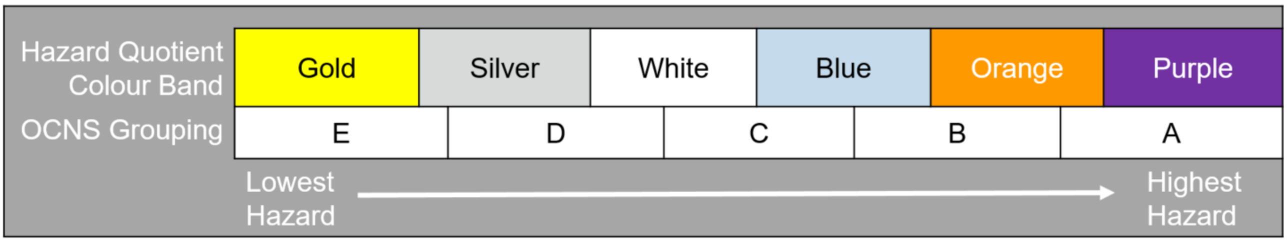


Figure 3-2: OCNS ranking scheme

Chemicals fall into the following assessment types:

- No further assessment: Chemicals with an HQ band of Gold or Silver or an OCNS ranking of E or D with no substitution or product warnings do not require further assessment. Such chemicals do not represent a significant impact on the environment under standard use scenarios and are, therefore, considered ALARP and acceptable.
- Further assessment/ALARP justification required: The following types of chemicals require further assessment to understand the environmental impacts of discharge into the marine environment:
  - chemicals with no OCNS ranking
  - chemicals with an HQ band of White, Blue, Orange, Purple or an OCNS ranking of A, B or C
  - chemicals with an OCNS product or substitution warning.

3.9.1.1 Further Assessment/ALARP Justification

This includes assessing the ecotoxicity, biodegradation and bioaccumulation of the chemicals in the marine environment in accordance with the Centre for Environment, Fisheries and Aquaculture

Science (CEFAS) Hazard assessment and the Department of Mine and Petroleum (DMP) Chemical Assessment Guide: *Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.*

Ecotoxicity

Chemical ecotoxicity is assessed using the criteria used by CEFAS to group chemicals based on ecotoxicity results for a range of marine biota primarily based on ppm concentration for LC_{50} (Table 3-6). If a chemical has an aquatic or sediment toxicity within the criteria for the OCNS grouping of D or E this is considered acceptable in terms of ecotoxicity.

Table 3-4: CEFAS OCNS grouping based on ecotoxicity results

Initial grouping	A	B	C	D	E
Results for aquatic-toxicity data (ppm)	<1	>1-10	>10-100	>100-1000	>1000
Result for sediment toxicity data (ppm)	<10	>10-100	>100-1000	>1000-10,000	>10,000

Note: Aquatic toxicity refers to the Skeletonema constatum EC50, Acartia tonsa lethal concentration 50% (LC_{50}) and Scophthalmus maximus (juvenile turbot) LC_{50} toxicity tests; sediment toxicity refers to Corophium volutator LC_{50} test

Biodegradation

The biodegradation of chemicals is assessed using the CEFAS biodegradation criteria, which align with the categorisation outlined in the DMP Chemical Assessment Guide: *Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline*.

CEFAS categorises biodegradation into the following groups:

- Readily biodegradable: results of >60% biodegradation in 28 days to an OSPAR harmonised offshore chemical notification format (HOCNF) accepted ready biodegradation protocol.
- Inherently biodegradable: results >20% and <60% to an OSPAR HOCNF accepted ready biodegradation protocol or result of >20% by OSPAR accepted inherent biodegradation study.
- Not biodegradable: results from OSPAR HOCNF accepted biodegradation protocol or inherent biodegradation protocol are <20%, or half life values derived from aquatic simulation test indicate persistence.
- Chemicals with >60% biodegradation in 28 days to and OSPAR HOCNF accepted ready biodegradation protocol are considered acceptable in terms of biodegradation.

Bioaccumulation

The bioaccumulation of chemicals is assessed using the CEFAS bioaccumulation criteria, which align with the categorisation outlined in the DMP Chemical Assessment Guide*: Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.*

The following guidance is used by CEFAS:

- Non-bioaccumulative: LogPow <3, or BCF ≤100 and molecular weight is ≥700.
- Bioaccumulative: LogPow ≥3 or BC >100 and molecular weight is <700.

Chemicals that meet the non-bioaccumulative criteria are considered acceptable.

If a product has no specific ecotoxicity, biodegradation or bioaccumulation data available, the following options are considered:

- Environmental data for analogous products can be referred to where chemical ingredients and composition are largely identical; or,

- Environmental data may be referenced for each separate chemical ingredient (if known) within the product.

Alternatives

If no environmental data are available for a chemical or if the environmental data does not meet the acceptability criteria outlined above, potential alternatives for the chemical will be investigated, with preference for options with an HQ band of Gold or Silver, or OCNS Group E or D with no substitution or product warnings.

If no more environmentally suitable alternatives are available, further risk reduction measures (e.g. controls related to use and discharge) will be considered for the specific context and implemented where relevant to ensure the risk is ALARP and acceptable.

Decision

Once the further assessment/ALARP justification has been completed, the relevant environment adviser must concur that the environmental risk as a result of chemical use is ALARP and acceptable.

3.9.2 Drilling Fluid System

3.9.2.1 Water based Mud System

The Petroleum Activities Program will use a water based drilling fluid system.

In addition to the aqueous base fluid, drilling muds contain a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements (e.g. mud weight required to manage pressure, or for borehole stability). All chemicals selected for use have been assessed under Woodside’s internal guidelines to ensure potential impacts are acceptable, ALARP and meet Woodside’s expectation for environmental performance.

The WBM drilling fluid will either be mixed on the MODU or received pre-mixed, then stored and maintained in a series of pits aboard the MODU. The top hole sections will be drilled riserless with seawater containing pre-hydrated bentonite sweeps, and cuttings and drilling fluids are deposited directly on the surrounding seabed. The bottom hole sections may be drilled using WBM in a closed circulation system which enables re-use of the WBM drilling fluids.

WBM drilling fluids that cannot be reused (e.g. due to bacterial deterioration or do not meet required drilling fluid properties) or are mixed in excess of required volumes, may be operationally discharged to the ocean under the MODU’s Permit to Work (PTW) system. Opportunities to reuse the WBM drilling fluids at the end of the Petroleum Activities Program are reviewed across current Woodside drilling activities.

WBM may not be able to be reused between drilling sections due to the drilling sequence, technical requirements of the mud (i.e. no tolerance for deterioration of mud during storage) and maintenance of productivity/injectivity.

A number of factors unique to each drilling program will determine the quantities of WBM drilling fluids required and subsequent bulk discharge volumes if no suitable reuse option is available.

3.9.2.2 Mud Pits

There are typically a number of mud pits (tanks) on the MODU that provide a capacity to mix, maintain and store drilling fluids required for drilling activities. The mud pits form part of the drilling fluid circulation system. The mud pits and associated equipment/infrastructure are cleaned out at the completion of drilling. Mud pit wash residue is operationally discharged.

3.9.3 Drill Cuttings

Drill cuttings generated from the well are expected to range from very fine to very coarse (<1 cm) particle/sediment sizes. Cuttings generated during drilling of the top hole sections are discharged from the wellbore at the seabed. Estimated volumes of drill cuttings that may be discharged during the Petroleum Activities Program are presented in Table 6-4.

The bottom hole sections will be drilled with a marine riser in place that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the solids control equipment (SCE). The SCE comprises but is not limited to shale shakers, cuttings dryers and centrifuges. The SCE uses shale shakers to remove coarse cuttings from the drilling mud. After being processed by the shale shakers, the recovered muds from the cuttings may be directed to centrifuges, which are used to remove fine solids (particle size distribution range: 4.5 to 6 µm). The cuttings are usually discharged below the water line and the recovered muds recirculated into the drilling fluid system.

3.10 Contingent Activities

The next sections present contingencies that may be required, if operational or technical issues occur during the Petroleum Activities Program. These contingencies have been considered within the relevant impact assessment sections and do not represent significant additional risks or impacts, but may generate additional volumes of drilling fluids and cuttings being operationally discharged. and/or and a slight increase in emissions (e.g. atmospheric, light, noise, vessel discharges).

3.10.1 Vertical Seismic Profiling

Vertical seismic profiling (VSP) is a contingent activity that may be performed during the Petroleum Activities Program. VSP is used to generate a high-resolution seismic image of the geology in the well’s immediate vicinity. It uses a small airgun array, typically comprising either a system of three 250 cubic inch airguns with a total volume of 750 cubic inches of compressed air or nitrogen at about 1800 psi (12,410 kPa) or two 250 cubic inch airguns with a total volume of 500 cubic inches. During VSP operations, four to five receivers are positioned in a section of the wellbore (station) and the airgun array is discharged approximately five times at 20-second intervals. The generated sound pulses are reflected through the seabed and are recorded by the receivers to generate a profile along a 60–75 m section of the wellbore. This process is repeated as required for different stations in the wellbore and it may take up to 24 hours to complete, depending on the wellbore’s depth and number of stations being profiled.

3.10.2 Respud

A respud may be required for a number of reasons, such as if the conductor or well head slumps or fails installation criteria (typically during top hole drilling). Respudding involves moving the MODU to a suitably close location (e.g. ~50 m from the original location) to recommence drilling. A respud activity would result in repeating top hole drilling (Section 3.8.3).

The environmental aspects of respudding are the same as those for drilling and are considered to be adequately addressed by this EP (Section 6.6.6), with no significant changes to existing environmental risks or any additional environmental risks likely. The net environmental effect will be limited to an increase in the volume of cuttings generated (Table 6-4) and discharged at the seabed, from the repeat drilling of the top hole section, and a slight increase in emissions (e.g. atmospheric, light, noise, vessel discharges) associated with an extended drilling program.

3.10.3 Sidetrack

The option of a sidetrack instead of a respud may be determined, if operational issues are encountered. The environmental aspects of a sidetrack well are the same as those for undertaking routine drilling activities, which are considered to be adequately addressed by this EP (Section 6.6.6), with no significant changes to existing environmental risks or any additional environmental risks likely. The net environmental effect will be limited to an increase in the volume of cuttings generated (Table 6-3), potential increase in the use of WBM and the additional emissions (atmospheric and waste) associated with an extended drilling program.

3.10.4 Well Suspension

During drilling activities, the well may need to be temporarily suspended. Suspension involves establishing suitable barriers, removing the riser and disconnecting the MODU from the well. The BOP may sometimes be left in place to act as a barrier. For the Gemtree exploration well, the suspension may be short term (e.g. in the case of a cyclone, major equipment failures). On return to a well after temporary suspension, the MODU reconnects to the well via the riser, and with BOP in place, barriers are removed and drilling activity resumes.

3.10.5 Wellhead Assembly Left *In-situ*

The wellhead assembly, installed either from a respud or the intended well, may be left in-situ if recognised removal techniques are ineffective. Well abandonment activities would be performed as outlined in Section 3.8.7, but the wellhead assembly would remain. The integrity of the wellbore is not affected by the wellhead assembly remaining *in-situ*. The environmental aspects of the wellhead assembly remaining *in-situ* are considered to be adequately addressed by this EP, with no significant changes to existing environmental risks or any additional environmental risks likely.

3.10.6 Sediment Mobilisation and Relocation

If required, an ROV-mounted suction pump/dredging unit may be used to relocate sediment/cuttings around the wellhead or other seabed infrastructure, to keep the area clear and safe for operations and equipment. This activity has the potential to generate plumes of suspended sediment during pumping and disturb benthic fauna in the immediate area.

3.10.7 Venting

During drilling of the well, a kick may occur. A kick is an undesirable influx of formation fluid into the wellbore. To maintain well integrity in this situation, a small volume of greenhouse gases is released to the atmosphere via the degasser, in a well control operation known as ‘venting’.

3.10.8 Emergency Disconnect Sequence

An emergency disconnect sequence (EDS) may be implemented if the MODU is required to rapidly disengage from the well. The EDS closes the BOP (i.e. shutting in the well) and disconnects the riser to break the conduit between the wellhead and MODU. Common examples of when this system may be initiated include when moving the MODU outside of its operating circle (e.g. due to a failure of one or more of the moorings) or moving the MODU to avoid a vessel collision (e.g. third-party vessel on a collision course with the MODU). EDS aims to leave the wellhead in a secure condition, but will result in the loss of drilling fluids/cuttings in the riser after disconnection.

4. DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulation 13(2) and 13(3) of the Environment Regulations, a description of the existing environment that may be affected (EMBA) by the activity (planned and unplanned activities, as defined in Section 2.4.1 and described in Section 3), including details of the particular relevant values and sensitivities of the environment, is provided in this section and has been used for the risk assessment.

For the purposes of this EP, Woodside has identified the EMBA by combining the potential spatial extent of surface and in-water (dissolved and entrained) hydrocarbons and accumulated hydrocarbons on shorelines above threshold concentrations, resulting from a worst-case credible spill, loss of well integrity.

Hydrocarbon exposure thresholds used to define the EMBA are outlined in Table 4-1 and shown in Figure 4-1. It should be noted that the EMBA presented does not represent the predicted coverage of any one hydrocarbon spill or a depiction of a slick or plume at any particular instance in time. Rather, the contours are a composite of a large number of theoretical slick paths, integrated over the full duration of the simulations under various metocean conditions.

Woodside recognises that surface hydrocarbons may be present at lower concentrations than the EMBA threshold value of 10 g/m^2 (Table 4-1), that may be visible, but are not expected to cause ecological impacts. Surface oil may be visible to a concentration of approximately 1 g/m^2. Woodside has therefore used this as a threshold to define an additional boundary within which socio-cultural impacts to the visual amenity of the marine environment may occur. This additional area is referred to as the socio-cultural EMBA for surface hydrocarbons in this EP. Socio-cultural values described for the socio-cultural EMBA include the following:

- Protected areas;
- National and Commonwealth Heritage Listed places;
- Tourism and recreation; and
- Fisheries.

It is noted that the socio-cultural EMBA for surface hydrocarbons in this EP is fully within the boundaries of the EMBA for ecological impacts (based on the extent of both surface and in-water hydrocarbons and accumulated hydrocarbons on shorelines). No additional values and sensitivities for the socio-cultural EMBA for surface hydrocarbons are therefore described.

Table 4-1 Hydrocarbon Spill Thresholds used to Define EMBA for Surface and In-water Hydrocarbons

Hydrocarbon Type	EMBA[1]	Socio-cultural EMBA
Surface	$10\ g/m^2$ This represents the minimum oil thickness (0.01 mm) at which ecological impacts (e.g. to birds and marine mammals) are expected to occur.	$1\ g/m^2$ This represents a wider area where a visible sheen may be present on the surface but is below concentrations at which ecological impacts are expected to occur.
Dissolved	50 ppb This represents potential toxic effects, particularly sublethal effects to highly sensitive species. It is a highly conservative threshold given that the lowest 'no effect concentration' (NOEC) observed in Woodside's ecotoxicity testing for a suitable surrogate is 123 ppb (refer to Section 6.7.1.3 for details). It is noted that any ecological impacts may also result in socio-cultural impacts from dissolved hydrocarbons.	N/A
Entrained	100 ppb This represents potential toxic effects, particularly sublethal effects to sensitive species. It is a conservative threshold in relation to the lowest 'no effect concentration' (NOEC) observed in Woodside's ecotoxicity testing (refer to Section 6.7.1.3 for details). It is noted that any ecological impacts may also result in socio-cultural impacts from entrained hydrocarbons.	N/A

[1] Further details including the source of the thresholds used to define the EMBA in this table are provided in Section 6.7.1.

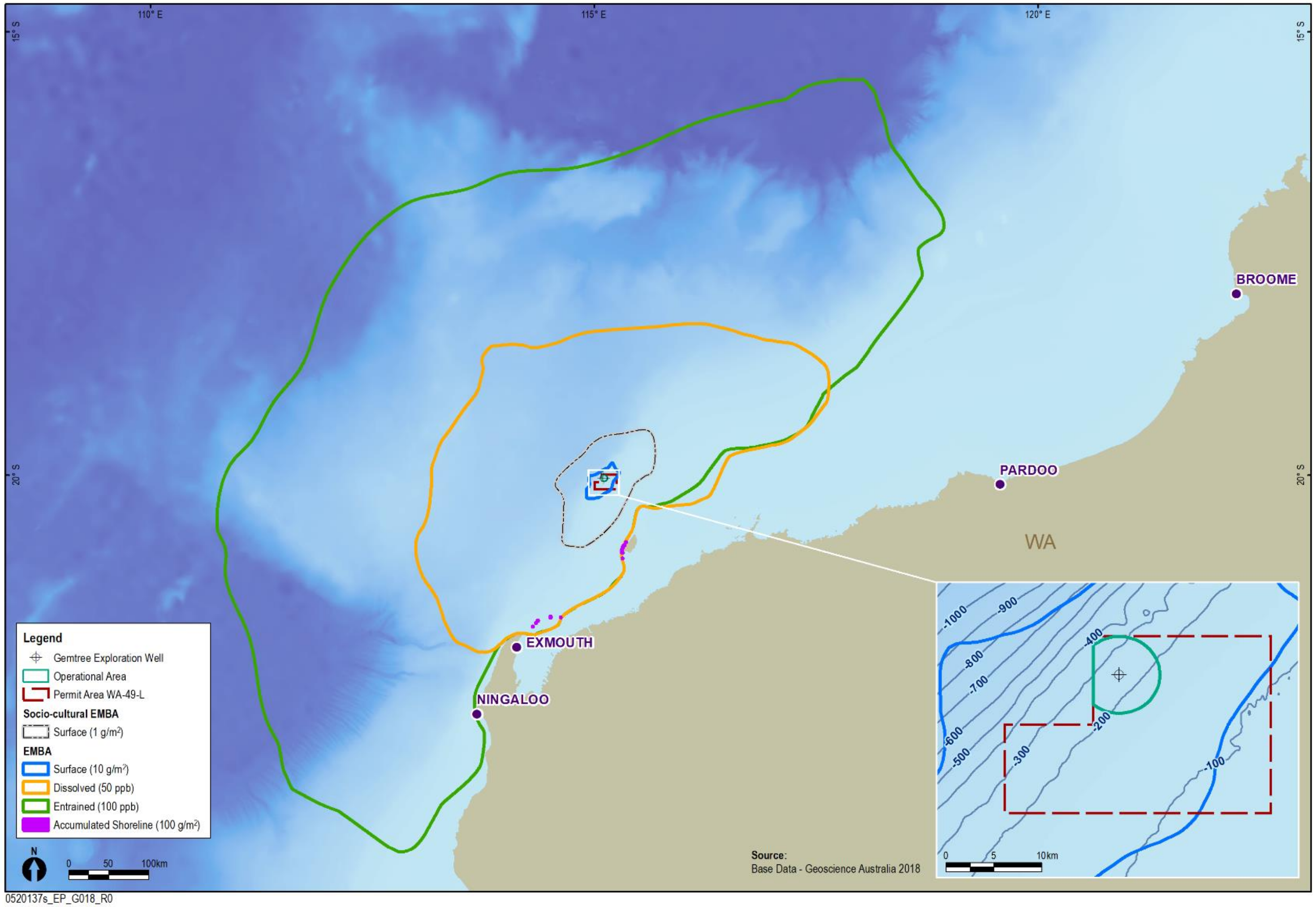


Figure 4-1 EMBA including socio-cultural EMBA for Surface Hydrocarbons

4.2 Summary of Key Existing Environment Characteristics

A summary of the key existing environment characteristics, consistent with the process of identifying and describing the existing environment in relation to the 'nature and scale' of the activity (refer Section 2.4.2) is provided in Table 4-2. The key existing environment characteristics in Table 4-2 are described in terms of the Operational Area and the EMBA (as described in Section 4.1).

Table 4-2: Summary of key existing environment characteristics

	Sensitive receptor	EP section	Description
Physical Habitats	***Climate and meteorology***	***4.4.1***	***Operational Area and EMBA*** • Dry tropical climate with hot summers and mild winters. • Tropical monsoon climate, with distinct wet (October to April) and dry (May to September) seasons. • Winds vary seasonally, with a tendency for winds from the south-west during summer months (September to March) and the south-east in autumn and winter months (April to August). • Tropical cyclone activity can occur between November and April (summer period) and is most frequent during January to March.
	Oceanography and seawater characteristics	***4.4.3***	***Operational Area*** • Water quality is expected to reflect the offshore oceanic conditions of the Northwest Shelf Province and wider region. • Surface water temperatures are relatively warm, ranging seasonally from about 24.3 to 28.5 °C. • Offshore waters are expected to be of high quality, given the distance from shore and lack of terrigenous inputs. ***EMBA*** • Water quality is regulated by the Indonesian Throughflow (ITF), which plays a key role in initiating the Leeuwin Current and brings warm, low-nutrient, low-salinity water to the North-west Marine Region (NWMR). It is the primary driver of the oceanographic and ecological processes in the Northwest Shelf Province. • Variation in surface salinity throughout the year is minimal (35.2 and 35.7 practical salinity units (PSU)). • During summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwelling of cold, nutrient-rich waters up onto the NWS. • Other areas of localised upwelling in the NWMR include the Wallaby Saddle and the northern and southern margins of the Exmouth Plateau, where these seabed topographical features and internal waves force the surrounding deeper, cooler, nutrient-rich waters up into the photic zone. • Turbidity is primarily influenced by sediment transport by oceanic swells and primary productivity.
	Bathymetry and seabed habitats	***4.4.4***	**Bathymetry and Seabed Features** ***Operational Area*** • Located in waters about 166–511 m deep along the middle continental shelf. • The seabed generally comprises a relatively flat and featureless habitat with noted features being: – The north-east portion of the Operational Area overlaps with an area known as the ‘upper slope,’ at which the continental shelf transitions to the continental slope. – The Operational Area overlaps the continental slope demersal fish communities key ecological feature (KEF) (Section 4.7.1); however the KEF is located more than 1 km from the proposed well location.

	Sensitive receptor	EP section	Description
			EMBA • The EMBA includes a number of topographic features including submerged banks, shoals and valleys, including Rankin Bank and Glomar Shoal. • It is characterised by the inner continental shelf, the middle continental shelf, the outer shelf/continental slope and the abyssal plain. • Broad-scale, biologically important deep-sea seabed habitat includes abyssal plains, marginal plateaus and submarine canyons. **Marine Sediment** ***Operational Area*** • The Operational Area is dominated by soft sediment (muddy substrates to coarse sands). ***EMBA*** • Sediments are relatively homogenous and are typically dominated by sands and a small portion of gravel. • Rankin Bank and Glomar Shoal are comprised predominantly of sand (similar to other shoal ecosystems on the NWS) and are considered pristine marine environments.
	Air quality	***4.4.5***	There is limited air quality data for the Northwest Shelf Province and EMBA but ambient air quality in the Operational Area and EMBA is expected to be of high quality.
	Critical habitat – EPBC listed	***4.5.1***	No Critical Habitats or Threatened Ecological Communities, as listed under the EPBC Act, are known to occur within, or in proximity to, the Operational Area or EMBA.
	Marine primary producers	***4.5.1***	**Coral Reefs** ***Operational Area*** • No coral reefs have been identified within or adjacent to the Operational Area. ***EMBA*** • The nearest coral reef habitat to the Operational Area is at Rankin Bank, about 40 km to the north-east. Within the EMBA, coral reefs exist in coastal waters of the Montebello/Barrow/Lowendal Islands Group, Southern Pilbara Island Group), Glomar Shoal, Muiron Islands and Ningaloo Coast. **Seagrass/Macroalgae** ***Operational Area*** • No seagrass beds or macroalgal habitat has been identified in the Operational Area.

	Sensitive receptor	EP section	Description
			EMBA • The nearest seagrass/macroalgal habitat is about 50 km south-east of the Operational Area in coastal waters of the Montebello/Barrow/Lowendal Islands Group and present in coastal waters of some islands within the Southern Pilbara Island Groups, Muiron Islands and the Ningaloo Coast. **Mangroves** ***Operational Area*** • No mangrove habitat has been identified within the Operational Area. ***EMBA*** • The closest mangrove habitats to the Operational Area are along the shorelines of the Montebello/Barrow/Lowendal Islands Group and are also at locations along the Ningaloo Coast.
	Other communities and habitats	***4.5.1***	**Plankton** ***Operational Area*** • Plankton communities in the Operational Area are likely to reflect the broader NWMR. ***EMBA*** • Offshore phytoplankton communities are characterised by smaller taxa (e.g. bacteria) whereas shelf waters are dominated by larger taxa such as diatoms. • Peak primary productivity along the shelf edge of the Ningaloo Reef occurs in late summer/early autumn. **Pelagic and Demersal Fish Communities** ***Operational Area*** • Fish communities in the Operational Area comprise small and large species of pelagic fish, as well as demersal species. • The Continental Slope Demersal Fish Communities KEF (overlapping the Operational Area) supports a high biodiversity of demersal fish species. • Demersal fish biodiversity correlates with habitat complexity, with more complex habitat supporting greater species richness and abundance compared to bare areas. ***EMBA*** • Both Rankin Bank and Glomar Shoal support high demersal fish richness and abundance compared to the surrounding habitats of the NWS. • Key demersal fish biodiversity areas are likely to occur in other complex habitats, such as coral reefs, and therefore likely includes the Montebello/Barrow/Lowendal Islands Group, the Ningaloo Coast and Muiron Islands.

	Sensitive receptor	EP section	Description
			Benthic Fauna Communities (including filter feeders) ***Operational Area*** • Soft sediment communities located within and adjacent to the Operational Area include sparse (<5% cover) epibenthic fauna comprising occasional anemones, urchins, sea whips, sea pens, feather stars and glass sponges. Infauna are diverse and dominated by polychaete worms and crustaceans. • The benthic (epifauna and infauna) biota associated with the soft sediment habitat of the Operational Area is expected to be relatively homogenous across the region. This habitat is considered to be of relatively low environmental sensitivity. ***EMBA*** • Hard coral and macroalgae communities of Rankin Bank and Glomar Shoal (refer to Sections 4.7.8 and 4.7.7, respectively). • Filter feeding communities associated with cemented sediment outcropping and other hard substrate habitats are recorded throughout the EMBA. Recorded locations of such communities include the deeper waters surrounding Rankin Bank and Glomar Shoal, Ningaloo Coast and the Muiron Islands.
Protected Species	***Biologically important areas (BIAs)***	***4.5.2***	***Operational Area*** • Overlaps the periphery of a flatback turtle internesting zone, which is about 80 km buffer zone from the nearest foraging, mating and nesting sites for flatback turtles on Barrow, the Montebello and Lowendal Islands during summer (peak period in December and January). • Overlaps the whale shark foraging BIA extending north of Ningaloo Reef/North West Cape along the 200 m isobath (July–November). • Overlaps a foraging area for the wedge-tailed shearwater during its breeding season (August–April). • Overlaps a small portion of the pygmy blue whale migration corridor, which extends northward from the Perth canyon towards Indonesia (northward migration April–August; southern migration October–January). ***EMBA*** • There are a large number of BIAs within the EMBA (refer to Section 4.5.2.3).
	Marine mammals	***4.5.2***	***Operational Area*** • Marine mammals identified from the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring in the Operational Area include four species of Threatened and Migratory cetaceans (the pygmy blue, humpback, sei and fin whale) and four species of Migratory cetaceans. • Species that may be present include blue whale, humpback whale, sei whale, fin whale, Bryde's whale, killer whale, sperm whale, spotted bottlenose dolphin (Arafura/Timor Sea populations). • Partial overlap with the pygmy blue whale migration corridor (northward migration occurs past Exmouth from April-August and the southern migration occurs from October-January). • The Operational Area does not contain any known critical habitat for any species of marine mammal.

	Sensitive receptor	EP section	Description
			EMBA • Marine mammals identified from the EPBC Act Protected Matters Search Tool as potentially occurring in the EMBA (in addition to the Operational Area) include the southern right whale, Antarctic minke whale, Indo-Pacific humpback dolphin and dugong. • Possible pygmy blue whale foraging area adjacent to Ningaloo Reef / North West Cape. See Section 4.7.1 to Section 4.7.8 for the location of identified values and sensitivities, related to marine mammals, which are protected within the jurisdiction of Commonwealth and State managed areas.
	Marine turtles	***4.5.2***	***Operational Area*** • Five species of Threatened marine turtles (loggerhead, green, leatherback, hawksbill and flatback) may occur in the Operational Area. • The Operational Area partially overlaps an internesting buffer (60 km) for flatback turtles around Montebello Islands, listed as habitat critical to the survival of marine turtles. This area has also been defined as an internesting BIA for flatback turtles which extends about 80 km from the Montebello Islands. • The presence of marine turtles within the Operational Area is likely to be infrequent and limited to individuals or small numbers transiting through the area. ***EMBA*** • Marine turtles may forage around Rankin Bank and Glomar Shoal, given the relatively shallow depths and suitable foraging habitat. • Green, loggerhead, flatback and hawksbill turtles have significant nesting rookeries on beaches near Montebello/Barrow/Lowendal Islands Group, Muiron Islands and Ningaloo Reef. • Leatherback turtles may occur within the EMBA but there are no known nesting beaches in Western Australia.
	Seasnakes	***4.5.2***	***Operational Area*** • Given the offshore location and deeper water depths of the Operational Area, seasnake sightings will likely be infrequent and comprise a few individuals. ***EMBA*** • Seasnakes frequent the waters of the continental shelf area (between 10 and 120 m) in the Northwest Shelf Province and around offshore islands. • The short-nosed seasnake (Critically Endangered) was identified by the EPBC Act PMST as potentially occurring within the EMBA.

	Sensitive receptor	EP section	Description
	Seahorses and pipefish	***4.5.2***	***Operational Area*** • Seahorses, pipehorses and pipefishes are uncommon in deeper continental shelf waters (50–200 m) and therefore unlikely to occur within the Operational Area. ***EMBA*** • Seahorses, pipehorses and pipefishes occur in both temperate and tropical waters throughout the NWMR and are commonly found among seagrass, mangrove, coral reef and sandy habitats around coastal islands and shallow reef areas.
	Sharks, fish and rays	***4.5.2***	***Operational Area*** • The EPBC Act PMST identified three species of Threatened and Migratory sharks (whale shark, great white shark and green sawfish), one species of Threatened shark (grey nurse shark), three species of Migratory sharks (shortfin mako, longfin mako and narrow sawfish) and two Migratory ray species (giant manta ray and reef manta ray) that may occur in the Operational Area. • The Operational Area does not contain any known critical habitat for any species of shark or ray. However, a BIA representing a foraging area for whale sharks overlaps the Operational Area; therefore, whale sharks may traverse the Operational Area during their migration between Australia and Indonesia each year. • The presence of EPBC-listed sharks, fish and rays is likely to be infrequent and limited to individuals or small numbers transiting through the area. ***EMBA*** • Whale sharks are known to aggregate annually, from March to July, in areas off Ningaloo and North West Cape, within the EMBA. After the aggregation period, the distribution of the whale sharks is largely unknown but surveys suggest the group disperses widely and up to 1800 km away to areas in Indonesia, Christmas Island and Coral Sea. • Grey nurse sharks are likely to be found in shallow waters of the EMBA. • Great white sharks, shortfin makos and longfin makos are all known to occur within the EMBA. • Green sawfish may be found within the EMBA, traversing from coastal waters along the mainland Pilbara (outside of the EMBA). • Ningaloo Reef is an important area for manta rays in autumn and winter, and they are known to occur in tropical waters throughout the EMBA. See Section 4.7.1 to Section 4.7.8 for the location of identified values and sensitivities, related to sharks, fish and rays, which are protected within the jurisdiction of Commonwealth and State managed areas.
	Seabirds and/or migratory shorebirds	***4.5.2***	***Operational Area*** • Eleven listed bird species were identified in the EPBC Protective Matters Search Tool as potentially occurring within the Operational Area, four of which are listed as Threatened. No critical habitat associated with these species has been identified for the Operational Area. • A BIA for wedge-tailed shearwaters, during their breeding season (August to April), overlaps the Operational Area.

	Sensitive receptor	EP section	Description
			EMBA • There are several BIAs (key breeding/nesting, roosting, foraging and resting areas) for seabirds and migratory shorebirds in the EMBA, including areas on the islands of the Montebello/Barrow/Lowendal Islands Group, the Pilbara Southern Island Group, Ningaloo Coast and Muiron Islands. Seabird and shorebird habitats are discussed further as key environmental sensitivities in Section 4.7.1 to Section 4.7.8.
Socio-economic	***Cultural heritage***	***4.6.1***	***Operational Area*** • There are no known sites of Indigenous or European cultural or heritage significance within or in the vicinity of the Operational Area. • There are no heritage listed sites within or immediately adjacent to the Operational Area. ***EMBA*** • Barrow Island, Montebello Islands and the adjacent foreshore contain several registered Aboriginal heritage sites (based on results from Department of Aboriginal Affairs (DAA) searches, Appendix G). • The closest historic shipwrecks to the Operational Area are at Tryal Rocks, about 65 km south-east of the Operational Area. • The Ningaloo Coast World Heritage Area is a National Heritage Place and is located within the EMBA. • The Ningaloo Marine Area – Commonwealth waters, is a Commonwealth Heritage listed place and is located within the EMBA.
	Ramsar wetlands	***4.6.2***	No Ramsar wetlands occur within or nearby the Operational Area or EMBA.
	Fisheries – commercial	***4.6.3***	***Operational Area*** There are a number of fisheries extending over the Operational Area; however, only the North West Slope Trawl Fishery and Pilbara Line Fishery are expected to be active nearby, or within the Operational Area: • Commonwealth fisheries are: – North West Slope Trawl Fishery – Western Tuna and Billfish Fishery – Western Skipjack Fishery – Southern Bluefin Tuna Fishery. • State fisheries are: – West Australian Mackerel Fishery – Pearl Oyster Managed Fishery – Beche-de-mer Fishery – Marine Aquarium Managed Fishery – Specimen Shell Managed Fishery

	Sensitive receptor	EP section	Description
			– Pilbara Demersal Scalefish Fisheries (Pilbara Trawl, Trap and Line) – Onslow Prawn Managed Fishery – West Coast Deep Sea Crustacean Managed Fishery – Southwest Coast Salmon Managed Fishery – Abalone Fishery. • There are no aquaculture activities within or adjacent to the Operational Area. ***EMBA*** • Commonwealth fisheries are: – Western Deepwater Trawl Fishery. • State fisheries are: – Nickol Bay Prawn Managed Fishery – Exmouth Gulf Prawn Fishery – Gascoyne Demersal Scalefish Fishery – West Coast Rock Lobster Fishery – West Coast Demersal Scalefish Fisheries • Aquaculture operations are typically restricted to coastal shallow waters and primarily consist of pearl oyster production at the Montebello Islands.
	Fisheries – traditional	***4.6.4***	***Operational Area*** • There are no traditional or customary fisheries within or adjacent to the offshore Operational Area. ***EMBA*** • Traditional fisheries are typically restricted to shallow coastal waters and/or areas with structures such as reef. • Barrow Island, Montebello Islands and Ningaloo Reef and the adjacent foreshores have a known history of fishing, when areas were occupied (as identified from historical records). • Areas covered by registered native title claims are likely to practice Aboriginal fishing techniques at various sections of the WA coastline.
	Tourism and Recreation	***4.6.5***	***Operational Area*** • No tourism activities are known to take place specifically within the Operational Area due to water depths and distance offshore. ***EMBA*** • Recreational fishing occasionally occurs at Rankin Bank and Glomar Shoal and is also expected to occur around the Montebello/Barrow/Lowendal Islands Group and the Pilbara Southern Islands Group (including the Mackerel Islands).

	Sensitive receptor	EP section	Description
			• The Montebello Islands and Ningaloo Marine Park are popular for marine nature-based tourism activities.
	Shipping	***4.6.6***	***Operational Area*** • No Australian Maritime Safety Authority (AMSA) shipping fairways overlap the Operational Area. • AMSA data indicates light shipping traffic within the Operational Area. ***EMBA*** • The coastal and offshore waters of the region support significant commercial shipping activity, the majority of which is associated with the mining and oil & gas industries. • Major shipping routes are associated with entry to the ports of Port Hedland, Dampier and Barrow Island.
	Oil & gas and other infrastructure	***4.6.7***	***Operational Area*** • The Operational Area is located within an area of established oil and gas operations, including subsea infrastructure associated with the Brunello field development located within the north end of the Operational Area. ***EMBA*** • The Pluto Platform and the Wheatstone Platform are located 23 km and 27 km from the Operational Area respectively. • John Brookes Platform, Goodwyn Facility, East Spar Platform and North Rankin Complex are between 35 and 113 km from the Operational Area.
	Defence	***4.6.8***	***Operational Area*** • The Operational Area overlaps with the northern tip of one of the Department of Defence's practice areas. ***EMBA*** • There are designated defence practice areas in the offshore marine waters off Ningaloo and the North West Cape.

	Sensitive receptor	EP section	Description
Protected Areas	*The following Protected Areas and sites of high conservation value are located within the Operational Area and/or are considered due to the extent of the EMBA and Socio-cultural EMBA:*		
	Montebellos/ Barrow/Lowendal Islands	***4.7.2*** ***4.7.3***	• Montebello Australian Marine Park (AMP) (see Section 4.7.2) • Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area • Barrow Island Nature Reserve • Lowendal Islands Nature Reserves.
	Pilbara Islands	***4.7.4***	• Pilbara Islands (Southern Group).
	Ningaloo Coast and Gascoyne	***4.7.5***	• Ningaloo Coast World Heritage Area • Ningaloo AMP • Ningaloo Marine Park and Muiron Island Marine Park and Management Area • Gascoyne AMP.
	Key Ecological Features	***4.7.7***	***Operational Area*** • Continental slope demersal fish communities, listed as a KEF due to the notable diversity of the demersal fish assemblages and high levels of endemism. ***EMBA*** • Ancient coastline at the 125 m depth contour. • Exmouth Plateau • Glomar Shoal • Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula • Commonwealth waters adjacent to Ningaloo Reef • Mermaid Reef and Commonwealth waters surrounding Rowley Shoals.
	Other sensitive areas	***4.7.8***	Other sensitive areas within the EMBA include: • Rankin Bank.

4.3 Regional Context

The Operational Area is located in Commonwealth waters within the North West Shelf, in water depths of about 166–511 m. The Operational Area is located predominantly within the Northwest Province but also overlaps the Northwest Shelf Province (Figure 4-2), as defined under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA v4.0). Both Provinces are part of the wider NWMR. The Northwest Province encompasses Commonwealth waters of the continental slope between Exmouth and Port Hedland, covering 16.7% of the NWMR at depths predominantly between 1000 and 3000 m. The Northwest Shelf Province encompasses the continental shelf between North West Cape and Cape Bougainville and varies in width from about 50 km at Exmouth Gulf to greater than 250 km off Cape Leveque. It includes water depths of 0–200 m (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2008a).

The Northwest Province is characterised by the following biophysical features (DEWHA, 2008a):

- Transitional climatic conditions occur between dry tropics to the south and humid tropics to the north.
- There are strong seasonal winds and moderate offshore tropical cyclone activity, with cyclone frequency and intensity increases in summer.
- Narrowing of the continental shelf at North West Cape consolidates southward moving surface waters and begins the Leeuwin Current. The Leeuwin Current is 50–100 km wide and less than 300 m deep, and is undercut by the Leeuwin Undercurrent which flows northward between 250 and 450 m deep.
- The ITF is the dominant surface flow within the bioregion, which is influenced by seasonal and inter-annual variations described above.
- The Exmouth Plateau is the largest topographic feature of this bioregion, covering an area of 50,000 km² (Baker et al., 2008). The surface of the plateau is generally rough and undulating with water depths of about 500–5000 m, and is thought to modify the flow of deep waters and potentially uplift deep nutrient-rich waters to the surface. (Brewer et al., 2007).
- The North West Cape is a boundary point for a transition in demersal shelf and slope fish communities, with temperate communities to the south and tropical dominated communities to the north (Last et al., 2005).
- The Montebello Trough occurs on the eastern side of the Exmouth Plateau and represents more than 90% of the area of troughs in the NWMR (Baker et al., 2008).
- With over 500 fish species, 76 of which are endemic, the continental slope between the North West Cape and the Montebello Trough has been identified as one of the most diverse slope habitats of Australia.
- Benthic communities likely include filter feeders and epifauna, such as sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens. These epibenthos are likely to have a patchy distribution across soft-bottom environments within the region.
- Internationally significant migratory routes, resident populations, breeding and/or feeding grounds for a number of EPBC Act listed Threatened and Migratory marine species are present, including humpback whales, marine turtles, whale sharks, seabirds and migratory shorebirds.
- Other NWMR bioregions within the EMBA include the Northwest Transition, Central Western Transition, the Central Western Shelf Transition and the Central Western Shelf Province.

The Northwest Shelf Province is characterised by the following biophysical features (DEWHA, 2008a):

- Transitional climatic conditions occur between dry tropics to the south and humid tropics to the north.
- There are strong seasonal winds and moderate offshore tropical cyclone activity, with cyclone frequency and intensity increases in summer.
- Deeper surface waters are tropical year-round and highly stratified during summer months (thermocline occurring at water depths between 30 and 60 m). In winter, surface waters are well mixed with thermoclines occurring at about 120 m depth.
- Surface ocean circulation is strongly influenced by the ITF via the Eastern Gyre. During the summer when the ITF is weaker, south-west winds cause intermittent reversals in currents. These events may be associated with occasional weak, shelf upwellings.
- The seabed in the region consists of sediments that generally become finer with increasing water depth, ranging from sand and gravels on the continental shelf to mud on the slope and abyssal plain. About 60–90% of the sediments in the region are carbonate derived (Brewer et al., 2007). The distribution and resuspension of sediments on the inner shelf is strongly influenced by the strength of tides across the continental shelf as well as episodic cyclones. Further offshore, on the mid to outer shelf and on the slope, sediment movement is primarily influenced by ocean currents and internal tides, the latter causing resuspension and net downslope deposition of sediments.
- The region has high species richness but a relatively low level of endemism, i.e. species particular to the region in comparison to other areas of Australian waters. Furthermore, the majority of the region's species are tropical and are recorded in other areas of the Indian Ocean and Western Pacific Ocean.
- Benthic communities within the region range from nearshore benthic primary producer habitats such as seagrass beds, coral communities and mangrove forests to offshore soft sediment seabed habitats associated with low density sessile and mobile benthos such as sponges, molluscs and echinoids (with noted areas of sponge hotspot diversity).
- Presence of internationally significant migratory routes, resident populations, breeding and/or feeding grounds for a number of EPBC Act listed Threatened and Migratory marine species, including humpback whales, marine turtles, whale sharks, seabirds and migratory shorebirds.

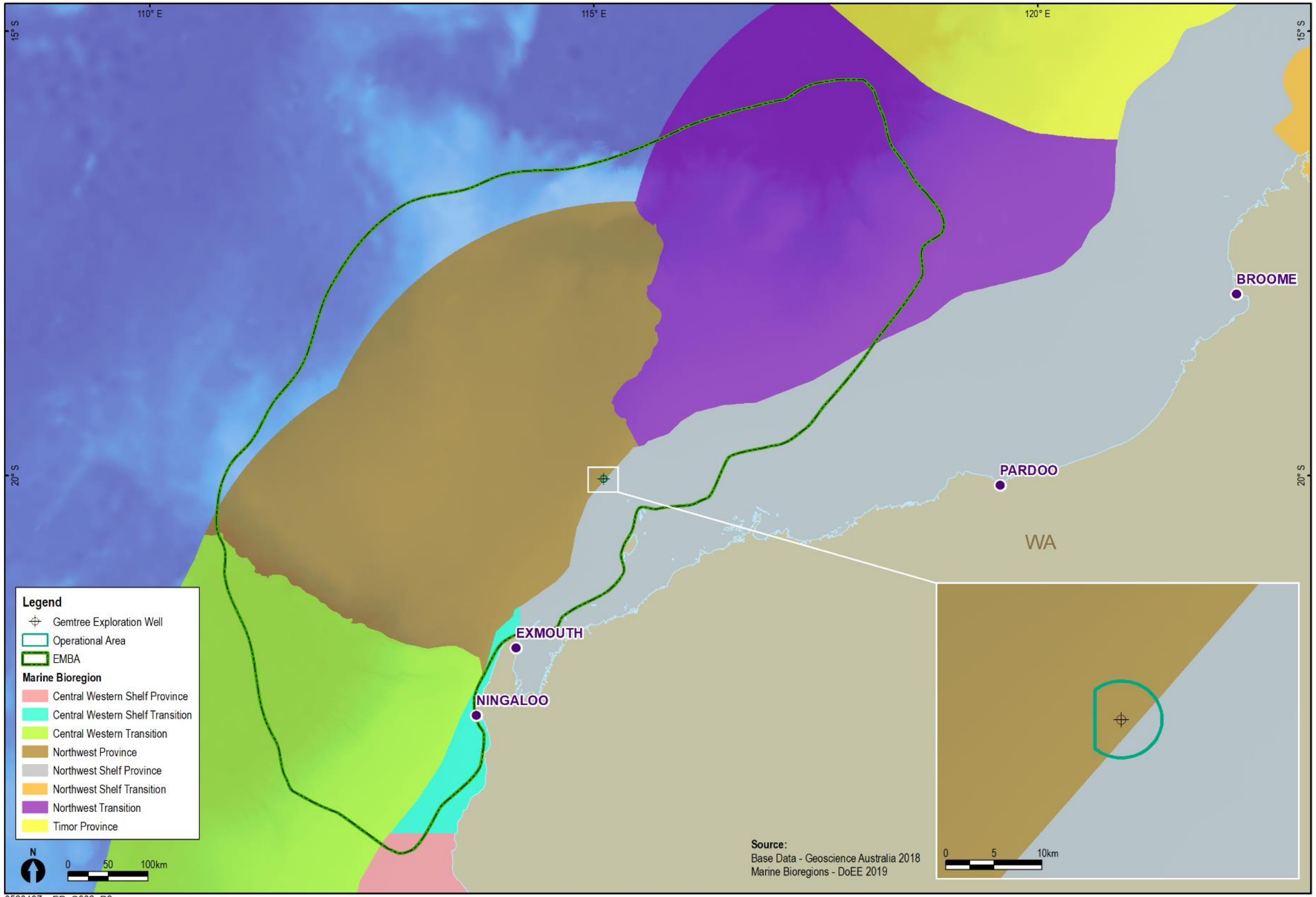


Figure 4-2: North-west Marine Region and the location of the Operational Area

4.4 Physical Environment

4.4.1 Climate and Meteorology

4.4.1.1 Seasonal Patterns

The climate of the NWMR is dry tropical, exhibiting a hot summer season from October to April and a milder winter season between May and September (Figure 4-3) (Bureau of Meteorology (BoM), 2019). There are often distinct transition periods between the summer and winter regimes, which are characterised by periods of relatively low winds (Pearce et al., 2003).

Air temperatures in the region, as measured at the Karratha Aerodrome (about 184 km from the Operational Area), indicate maximum average temperatures during summer of 35.9 ºC and minimum temperatures of 15.1 ºC in winter (BoM, 2019).

The region experiences a tropical monsoon climate, with distinct wet (November to April) and dry (May to October) seasons. Rainfall in the region typically occurs during the wet season (summer), with highest falls observed during late summer (BoM, 2019), often associated with the passage of tropical low pressure systems and cyclones (Pearce et al., 2003). Rainfall outside of this period is typically low.

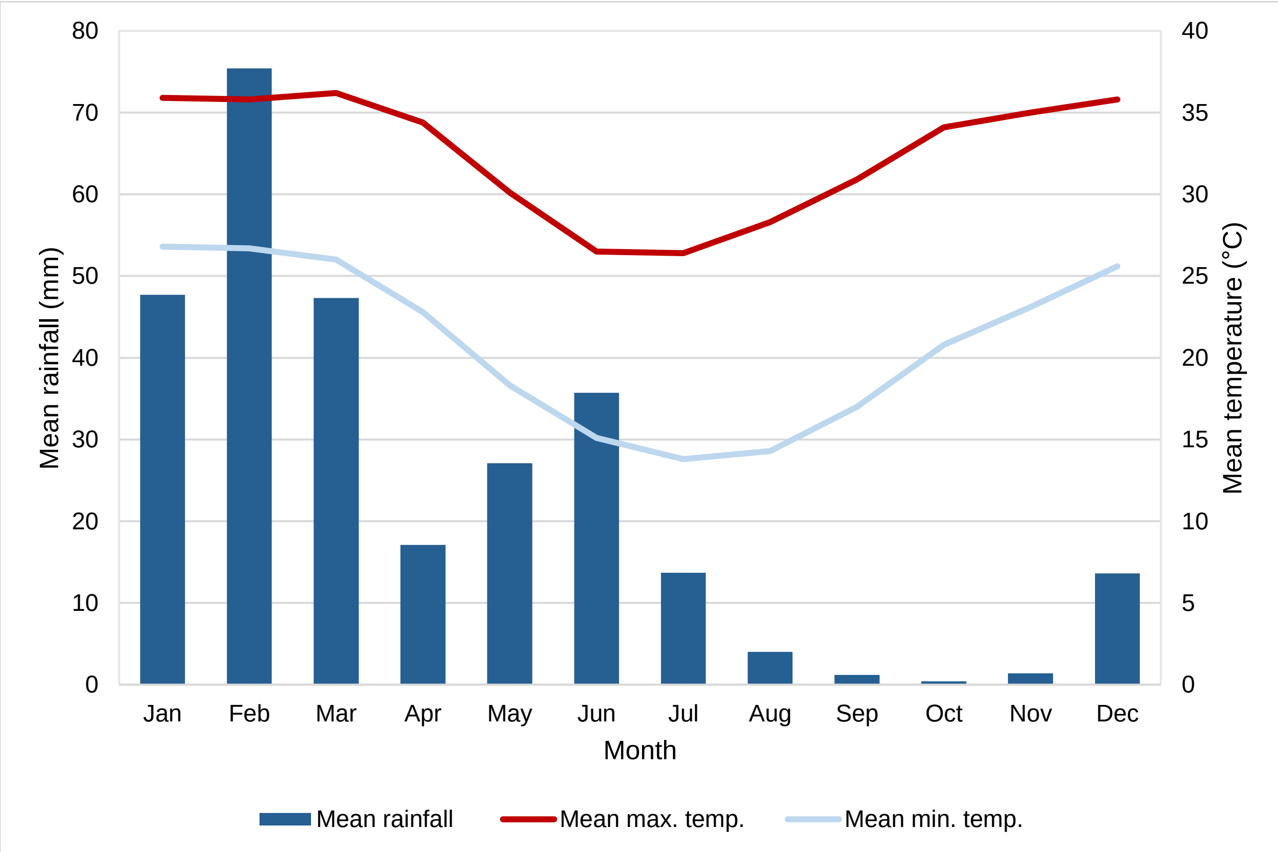


Figure 4-3: Mean monthly maximum temperature, minimum temperature and rainfall from Karratha Aerodrome meteorological station from January 1993 to October 2019 (BoM, 2019)

4.4.1.2 Wind

Winds vary seasonally, with a tendency for winds from the south-west quadrant during summer and the south-east quadrant in winter (Figure 4-4). The summer south-westerly winds are driven by high pressure cells that pass from west to east over the Australian continent. During winter months, the relative position of the high pressure cells moves further north, leading to prevailing south-easterly winds blowing from the mainland (Pearce et al., 2003). Winds typically weaken and are more variable during the transitional period between the summer and winter regimes, generally between April and August (Figure 4-4).

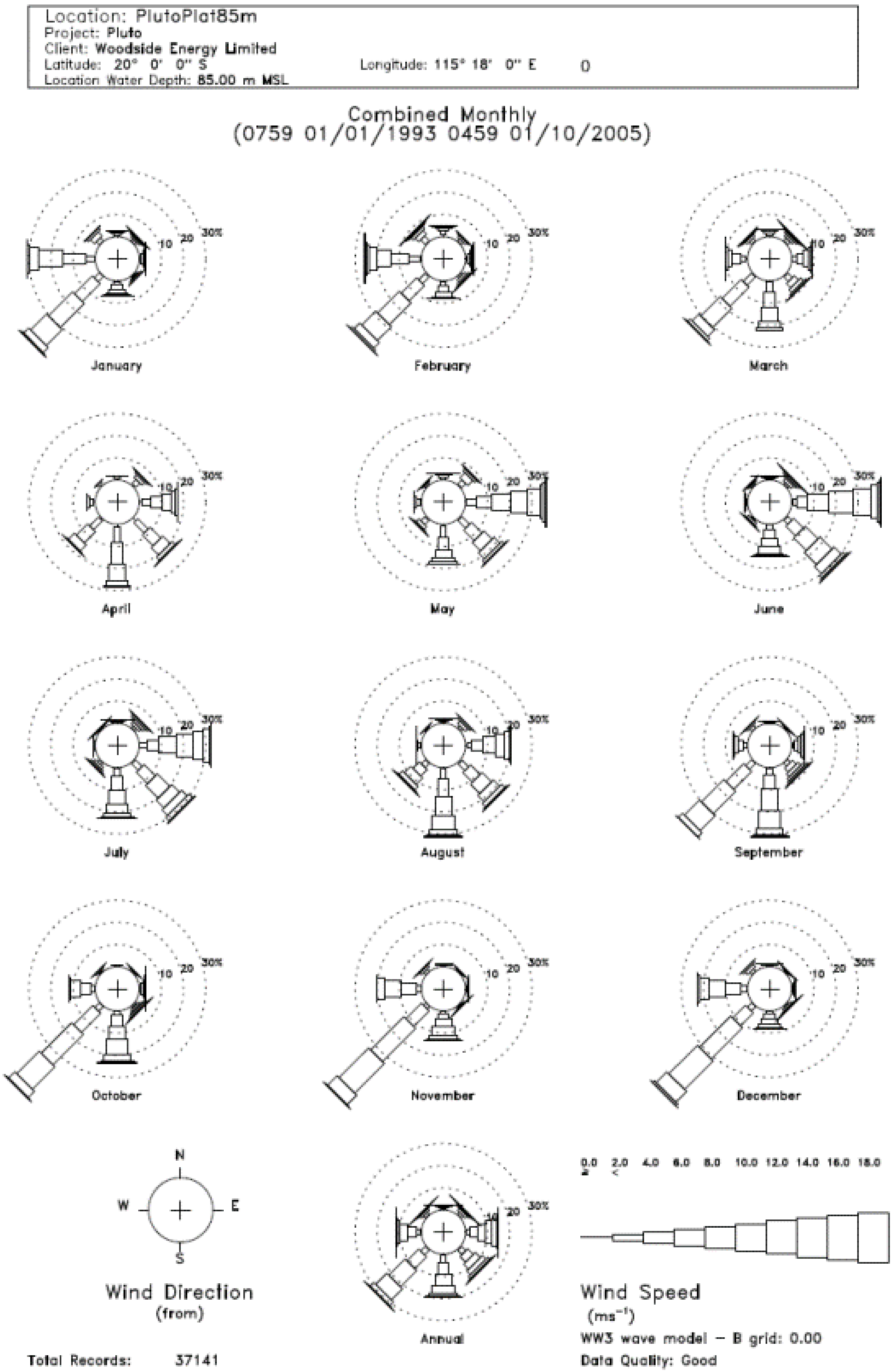


Figure 4-4: Non-cyclonic monthly wind-roses measured at the Pluto Facility location from 1993 to 2005

4.4.1.3 Tropical Cyclones

Tropical cyclones are a relatively frequent event for the region (Figure 4-5), with the Pilbara coast experiencing more cyclonic activity than any other region of the Australian mainland coast (BoM, 2012). Tropical cyclone activity can occur between November and April and is most frequent in the region during January to March, with an annual average of about one storm per month. Cyclones are less frequent in the months of November, December and April but historically the worst storms have occurred in April.

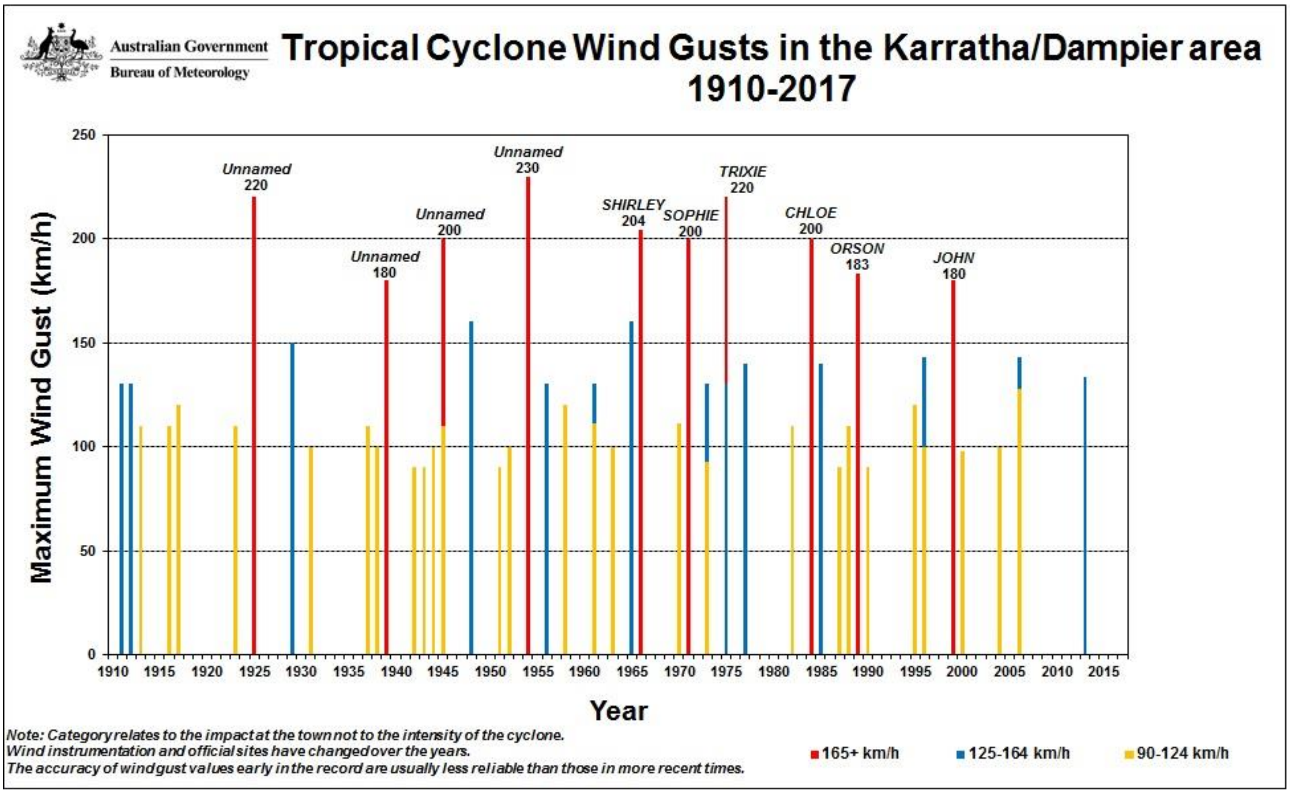


Figure 4-5: Tropical cyclone activity in the Dampier/Karratha region, 1910–2017 (source: BoM, n.d.)

4.4.2 Oceanography

4.4.2.1 Currents and Tides

The large-scale ocean circulation of the region is primarily influenced by the ITF (Meyers et al., 1995; Potemra et al., 2003), and the Leeuwin Current (Godfrey & Ridgway, 1985; Holloway & Nye, 1985; Batteen et al., 1992; James et al., 2004) (Figure 4-6). Both of these currents are significant drivers of the region's ecosystems. The currents are driven by pressure differences between the equator and the higher density cooler and more saline waters of the Southern Ocean, strongly influenced by seasonal change and El Niño and La Niña episodes (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012a). The ITF and Leeuwin Current are strongest during late summer and winter (Holloway & Nye, 1985; James et al., 2004). Flow reversals to the north-east associated with strong south-westerly winds are typically weak and short lived, but can generate upwelling of cold deep water onto the shelf (Holloway & Nye, 1985; James et al., 2004; Condie et al., 2006).

The Leeuwin Current, which originates in the region, flows southward along the edge of the continental shelf and is primarily a surface flow (between 250–450 m deep) and is strongest during winter (DSEWPaC, 2012a). The Ningaloo Current flows in the opposite direction to the Leeuwin Current, running northward along the outside of Ningaloo Reef and across the inner shelf from

September to mid-April (Figure 4-6). In March, on the termination of the Northwest Monsoon, an ‘extended Leeuwin Current’, currently known as the Holloway Current, develops, flowing to the south-east along the NWS (DSEWPaC, 2012a).

In addition to the synoptic-scale current dynamics, tidally-driven currents are a significant component of water movement along the NWS. Wind-driven currents become dominant during the neap tide (Pearce et al., 2003). In summer, the stratified water column and large tides can generate internal waves over the upper slope of the NWS (Craig, 1988). As these waves pass the shelf break at about 125 m depth, the thermocline may rise and fall by up to 100 m in the water column (Holloway & Nye, 1985; Holloway, 1983). Internal waves of the NWS region are confined to water depths between 70 and 1000 m; the dissipation energy from such waves can enhance mixing in the water column (Holloway et al., 2001).

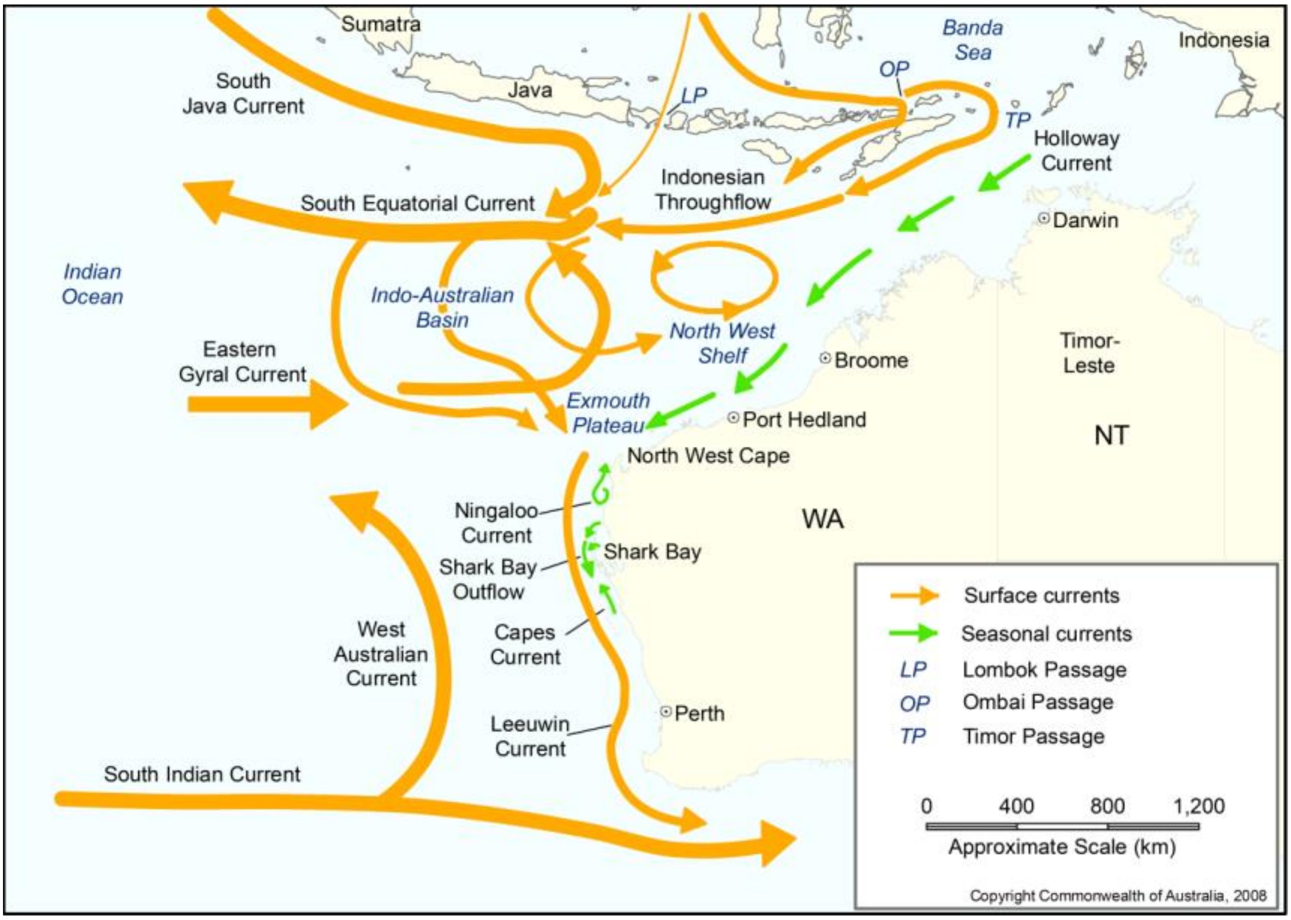
Tides in the NWS region are semi-diurnal and have a pronounced spring-neap cycle, with tidal currents flooding towards the south-east and ebbing towards the north-west (Pearce et al., 2003). The region exhibits a considerable range in tidal height, from microtidal ranges (<2 m) south-west of Barrow Island to macrotidal (>6 m) north of Broome (Holloway, 1983; Brewer et al., 2007). Storm surges and cyclonic events can also significantly raise sea levels above predicted tidal heights (Pearce et al., 2003).

Within the Operational Area, south-westerly currents are dominant throughout the year (RPS, 2019). Figure 4-7 illustrates the monthly distribution of current speeds and direction from the BRAN (Bluelink ReANalysis) ocean model for the period 1997 to 2006 in the region of the Gemtree-A well (data sourced from RPS, 2019). The current roses in Figure 4-7 indicate that higher average current speeds are characteristic of the February to July period, while lower average current speeds are more common during the July to December period (RPS, 2019).

4.4.2.2 Wave Height

Datawell waverider buoys measured wave height from 1993 to 2005 near the Pluto Platform (23 km from the Operational Area), recording a maximum measured non-cyclonic significant wave height of 6.2 m and a combined non-cyclonic and cyclonic maximum wave height of 11.4 m (Woodside, 2007).

Waves within the NWS reflect the direction of the synoptic winds and flow predominantly from the south-west in the summer and from the east in winter (Pearce et al., 2003). Only 10% of significant wave heights off Dampier exceed 1.2 m, with the average wave height being 0.7 m (Pearce et al., 2003). Storms and cyclones may generate swells up to 8.0 m high (Pearce et al., 2003).



Source: DEWHA (2008)

Figure 4-6: Generalised schematic of ocean circulation for the wider Western Australian marine region

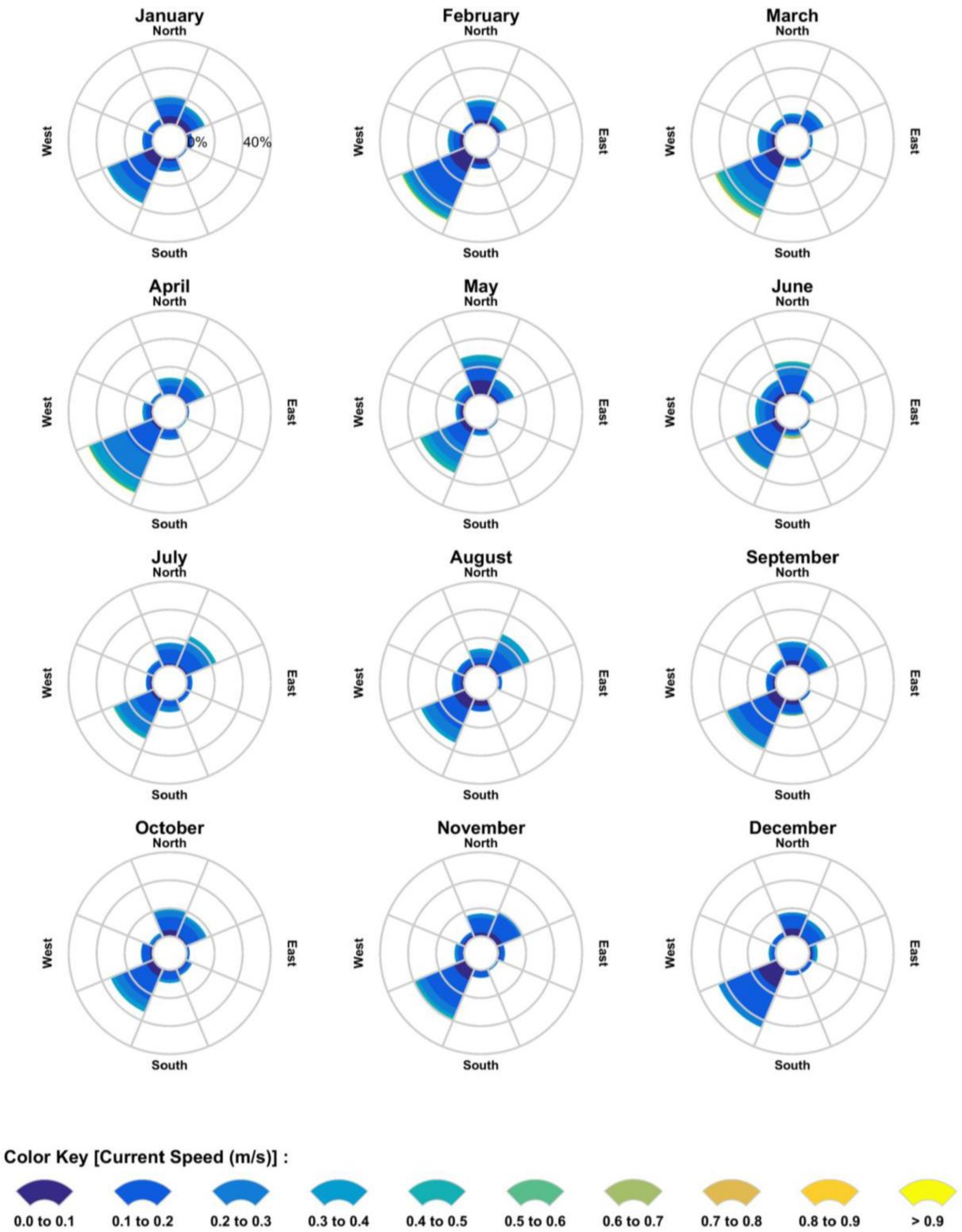


Figure 4-7: Monthly current distribution (1997-2006, inclusive) derived from the BRAN database around the Operational Area (source: RPS, 2019). The colour key shows the current magnitude, the compass direction provides the direction towards which the current is flowing, and the size of the wedge gives the percentage of the record

4.4.3 Seawater Characteristics

4.4.3.1 Open Water

Seawater temperature records at the Pluto Platform (23 km from the Operational Area) over a period of 13 months from December 2005 to January 2007 show surface waters reach their maximum average temperatures in March and April (average about 28.5 °C) and are coolest in August, September and October (average about 24.3 °C). These temperatures are also reflected in more recent publicly available data (National Oceanic and Atmospheric Administration (NOAA), 2019).

The offshore oceanic seawater characteristics of the NWS exhibit seasonal and water depth variation in temperature and salinity, being greatly influenced by major currents in the region (see Section 4.4.2). Surface waters are relatively warm year round due to the tropical water supplied by the ITF and the Leeuwin Current, with temperatures reaching 30 °C in summer and dropping to 22 °C in winter (Pearce et al., 2003). Near seabed, temperatures have low interannual variability, changing by ±1.5 °C at depths of 150 m, and become more stable with increasing depth.

During summer, the water column is thermally stratified due to surface heating, with the thermocline occurring between 30 and 60 m water depth (James et al., 2004). Surface waters are relatively well mixed in winter due to a weaker thermal gradient and persistent south-easterly winds promoting mixing, with the thermocline occurring at around 120 m depth (DEWHA, 2008a; James et al*.,* 2004).

Variation in surface salinity along the NWS throughout the year is minimal (between 35.2 and 35.7 PSU), with slight increases occurring during the summer months due to intense coastal evaporation (Pearce et al., 2003; James et al., 2004). This small increase in salinity during summer is then countered by the arrival of the lower salinity waters of the Leeuwin Current and ITF in autumn and winter (James et al., 2004).

Turbidity is primarily influenced by sediment transported by oceanic swells and primary productivity (Semeniuk et al., 1982; Pearce et al., 2003). Upwelling of nutrient-rich waters may increase phytoplankton productivity in the photic zone, which may increase local turbidity (Semeniuk et al., 1982; Wilson et al., 2003). In nearshore areas, turbidity is highly variable due to storm runoff, wind-generated waves and large tidal ranges (Pearce et al., 2003). Periodic events, such as major sediment transport associated with tropical cyclones, may influence turbidity on a regional scale (Brewer et al., 2007).

Water quality in the NWMR within the EMBA is regulated by the ITF, a low-salinity water mass that plays a key role in initiating the Leeuwin Current (DSEWPaC, 2012a). It brings warm, low-nutrient, low-salinity water from the western Pacific Ocean through the Indonesian archipelago to the Indian Ocean. It is the primary driver of the oceanographic and ecological processes in the region (DEWHA, 2008a). South of the NWMR, the Leeuwin Current continues to bring warm, low-nutrient, low-salinity water further south. Eddies formed by the Leeuwin Current transport nutrients and plankton communities offshore (DEWHA, 2008a). During summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwellings of cold, nutrient-rich waters up onto the NWS (DSEWPaC, 2012a). Other areas of localised upwelling in the NWMR include the Wallaby Saddle and the northern and southern margins of the Exmouth Plateau, where these seabed topographical features and internal waves force the surrounding deeper, cooler, nutrient-rich waters up into the photic zone (DSEWPaC, 2012a).

4.4.4 Bathymetry and Seabed Habitats

The Operational Area is located in waters about 166–511 m deep at the transition between the continental shelf and continental slope. Bathymetry surveys indicate that the south-west portion of the Operational Area, including the proposed Gemtree-A exploration well site, is located on the outer continental shelf and is predominantly flat and featureless. The north-east portion of the Operational Area overlaps with an area of seabed known as the ‘upper slope’ (water depth of 225–500 metres) and forms part of the Continental Slope Demersal Fish Communities KEF. The proposed location of the Gemtree-A exploration well is located about 1 km from the upper slope and the Continental Slope Demersal Fish Communities KEF.

Within the broader NWMR, the Northwest Shelf Province encompasses more than 60% of the continental shelf in the NWMR (Baker et al., 2008), gradually sloping from the coastline to the shelf break at the edge of the region and includes water depths of 0–200 m. About half of the province is in water depths of 50–100 m (DEWHA, 2008a). The Northwest Shelf Province includes a number of seafloor features such as submerged banks and shoals, and valley features that are thought to be morphologically distinct from other features of these types in different regions of the NWMR (DEWHA, 2008a). The Northwest Province covers 16.7% of the NWMR, occurring entirely on the continental slope at depths predominantly between 1000 and 3000 m. Topographic features include terraces, canyons, deep holes and valleys on the inner slope, and the Exmouth Plateau.

Within the EMBA, the bathymetry of the NWMR is characterised by four distinct zones: the inner continental shelf, the middle continental shelf, the outer shelf/continental slope and the abyssal plain. These divisions are made on the basis of water depth and geomorphic features in the region (Heap & Harris, 2008). The inner continental shelf is the area from the coast to about 30 m water depth; the middle continental shelf is the area between 30 and 120 m water depth. Several deep-sea geomorphic features in the form of abyssal plains, marginal plateaus and sub-marine canyons provide broad-scale, biologically important seabed habitat in the EMBA. These have been defined as KEFs by the Commonwealth Government, and are described in Section 4.7.7.

Several steps and terraces caused by Holocene sea level changes are present in the NWMR, with the most prominent of these features occurring as an escarpment along the North West Shelf and Sahul Shelf at a depth of 125 m. This escarpment is related to an ancient sub-aerially exposed land surface and coastline (beach and dune deposits), known as the ancient coastline. The ancient coastline at the 125 m depth contour is designated as a KEF and is located 4 km south-east of the Operational Area. A description of the Ancient Coastline KEF is provided in Section 4.7.7 Rankin Bank is the next closest complex bathymetry feature to the Operational Area within the EMBA (about 40 km to the north-east).

Previous movements in sea-level have had a significant influence on the geology of the Operational Area, as well as the regional NWS area. Between 21,000 and 19,000 years Before Present, the sea level was about 120 to 125 m lower than present day, due to glacio-eustatic (ice equivalent) sea level changes (Lewis et al., 2013). Therefore, the processes responsible for the formations present in the region include sub-aerial exposure of sediment and processes associated with land and coastal environments. Across the NWS region, the occurrence of an undulating cemented surface, expressed at the seabed as a series of ridges interspersed with sediment ponds infilling hollows and troughs, is related to an ancient sub-aerially exposed land surface and coastline (beach and dune deposits). Other coastal features including sand bars and river outlets are also present in this region, complicating the geology and geological sequence adjacent (seaward) to the area of ridges.

Figure 4-8: Bathymetry of the Operational Area

4.4.4.1 Marine Sediment

Sediments of the NWMR (and within the EMBA) are comprised of bio-clastic, calcareous and organogenic sediments (Baker et al., 2008). On the continental shelf, sediment is primarily sand and gravels, while the slope and deep ocean seabed is primarily mud.

A benthic survey conducted as part of the Julimar Operations EP (directly adjacent to the Operational Area) found that the area is dominated by soft sediment (fine to coarse sands) (Neptune Geomatics, 2010; RPS, 2010a, 2011a), similar to previous surveys within the Northwest Shelf Province and nearby fields at similar water depths (RPS et al., 2004; Chevron 2005, 2010; RPS 2010b, 2011b). Seabed relief in areas of bare sediment consisted mainly of ‘small ripples’ less than 0.1 m high, which is consistent with tidally-driven bottom currents. Sediments at the nearby Balnaves field, about 4 km south-east of the Operational Area and in 135 m water depth, are fine silt and mud (RPS, 2011b). The north-west portion of the Operational Area that overlaps with the Northwest Province is expected to comprise of muddy substrates typically found on the upper slope (DEWHA, 2008a).

4.4.5 Air Quality

There is a lack of air quality data for the offshore NWS air shed. Studies have been undertaken for the nearshore Pilbara environment to monitor known sources of potential air pollution for locations such as the Burrup Peninsula and Port Hedland, but no monitoring is undertaken offshore.

Due to the extent of the open ocean area and the activities that are currently performed, the ambient air quality in the Operational Area and wider offshore region is considered to be of high quality.

4.5 Biological Environment

4.5.1 Habitats

4.5.1.1 Critical Habitat – EPBC Listed

No Critical Habitats or Threatened Ecological Communities as listed under the EPBC Act are known to occur within the Operational Area or EMBA, as indicated by the EPBC Act Protected Matters Reports produced on 5 November 2019 (Appendix C).

4.5.1.2 Marine Primary Producers

Seabed communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or reef-building corals. Given the depth of water at the Operational Area (about 166–511 m), these benthic primary producer groups will not occur in the area. A number of surveys (Neptune Geomatics, 2010; RPS, 2010a, 2011a) near the Operational Area and in similar water depths have confirmed that benthic primary producer habitat is not present.

A number of benthic primary producer habitats are present in the EMBA and are described in the next sections.

Coral Reef

Coral reef habitats have a high diversity of corals and associated fish and other species of both commercial and conservation importance. Coral reef habitats are an integral part of the marine environment within the NWMR. The nearest coral reef habitat is located at Rankin Bank, about 40 km north-east of the Operational Area. Other coral reef habitats in the EMBA include Montebello/Barrow/Lowendal Islands Group, Pilbara South Island Group, Glomar Shoal, Muiron Islands, Ningaloo Coast. Further information on coral reef habitats at these locations is provided in Section 4.7.1 to Section 4.7.8.

Seagrass Beds/Macroalgae

Seagrass beds and macroalgal habitats represent a food source for many marine species and also provide key habitats and nursery grounds (Department of Fisheries (DoF), 2011a).

Seagrass beds and macroalgal habitats are present in several locations within the Northwest Shelf Province. The nearest seagrass habitats to the Operational Area are located within the Montebello Australian Marine Park (AMP) and may occur within the EMBA. Seagrass beds and macroalgae habitat can also be found in the EMBA at some islands within the Southern Pilbara Island Groups, the Muiron Islands and Ningaloo Coast.

Further information on seagrass and macroalgal habitats at these locations is provided in Section 4.7.1 to Section 4.7.8.

Mangroves

Mangrove systems provide complex structural habitats that act as nurseries for many marine species as well as nesting and feeding sites for many birds, reptiles and insects. Mangroves also maintain sediment, nutrient and water quality within habitats and minimise coastal erosion.

The closest mangrove habitats to the Operational Area are located at the Montebello/Barrow/ Lowendal Islands Group, about 52 km to the south-east. Mangrove communities of the Montebello Islands are considered scientifically important, representing an unusual occurrence of mangrove communities within lagoons on offshore islands (Chevron, 2013). Also within the EMBA, several mangrove habitats occur along the Ningaloo Coast, including at Yardie Creek and Mangrove Bay.

Further information on locations with mangrove habitats is provided in Section 4.7.1 to Section 4.7.8.

4.5.1.3 Lifecycle Stages ‘Critical’ Habitats

Spawning, Nursery, Resting and Feeding Areas

Critical habitat for species conservation include spawning, nursery, resting and feeding areas. These critical habitats will vary for each species. Any critical habitat for a protected species within the Operational Area, as identified by the EPBC Protected Matters Searches (Appendix C), is outlined in Section 4.5.2 within the relevant species sections, or described in Section 4.7.1 to Section 4.7.8.

Migration Corridors

Many marine species including cetaceans, whale sharks and migratory seabirds and shorebirds migrate seasonally between feeding, breeding and nursery habitats by using migration corridors. Any migration corridor for a protected species that passes through or close to the Operational Area, or within other areas close by, is outlined in Section 4.5.2 within the relevant species section.

4.5.1.4 Other Communities/Habitats

Plankton

Phytoplankton within the Operational Area is generally expected to reflect the conditions of the NWMR. Primary productivity of the NWMR appears to be largely driven by offshore influences (Brewer et al., 2007), with periodic upwelling events and cyclonic influences driving coastal productivity with nutrient recycling and advection. There is a tendency for offshore phytoplankton communities in the NWMR to be characterised by smaller taxa (e.g. bacteria), whereas shelf waters are dominated by larger taxa such as diatoms (Hanson et al., 2007).

Zooplankton within the Operational Area may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and

April) (Rosser & Gilmour, 2008; Simpson et al., 1993b) and fish larvae abundance can occur throughout the year.

Within the EMBA, peak primary productivity occurs in late summer/early autumn along the shelf edge of the Ningaloo Reef. It also links to a larger biologically productive period in the area that includes mass coral spawning events, peaks in zooplankton and fish larvae abundance (MPRA, 2005) with periodic upwelling throughout the year.

Pelagic and Demersal Fish Populations

Fish species in the NWMR (including the Operational Area and the EMBA) comprise small and large pelagic fish, as well as demersal species. Small pelagic fish inhabit a range of marine habitats, including inshore and continental shelf waters. They feed on pelagic phytoplankton and zooplankton and represent a food source for a wide variety of predators including large pelagic fish, sharks, seabirds and marine mammals (Mackie et al., 2007). Large pelagic fish in the NWMR include commercially targeted species such as mackerel, wahoo, tuna, swordfish and marlin. Large pelagic fish are typically widespread, found mainly in offshore waters (occasionally on the shelf) and often travel extensively.

Demersal fish live and feed on or near the seabed and are associated with a wide range of habitats in the NWMR including coastal and estuarine ecosystems, macroalgal and seagrass communities, and coral reefs (Hutchins, 2001; Blaber et al., 1985). Demersal fish also include commercially important species such as groper, cod and snapper. Fish species richness has been shown to correlate with habitat complexity, with more complex habitat supporting greater species richness and abundance than bare areas (Gratwicke & Speight, 2005). Studies at Glomar Shoal and Rankin Bank found that species richness and abundance decreased with water depth, with the highest diversity found in water depths less than 40 m (Australian Institute of Marine Science (AIMS), 2014). Cemented sediment outcrops that may occur within the Operational Area would provide habitat for sessile filter feeding communities and would likely provide habitat for demersal fish populations.

The Continental Slope Demersal Fish Communities KEF overlaps the north-west portion of the Operational Area and is identified as one of the most diverse slope assemblages in Australian waters (see Section 4.7.1). Diversity of demersal fish assemblages on the continental slope between North West Cape and the Montebello Trough is the highest in Australia (>500 species of which 76 are endemic) (DEWHA, 2008a). Demersal fish species occupy two distinct demersal community types (biomes) associated with the upper continental slope (water depth of 225–500 m) and the mid continental slope (750–1000 m) rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fish, molluscs and crustaceans (Brewer et al., 2007). Higher-order consumers may include carnivorous fish, deepwater sharks, large squid and toothed whales (Brewer et al., 2007).

Within the EMBA, Rankin Bank and Glomar Shoal (40 km and 153 km north-east from the Operational Area, respectively) are the closest areas identified as supporting high demersal fish richness and abundance despite their isolated locations. The fish communities at Rankin Bank and Glomar Shoal are comparable to other shoals and reef locations within the NWMR (AIMS, 2014). Further information on the fish communities of Rankin Bank and Glomar Shoal is provided in Section 4.7.7 and Section 4.7.8. Key demersal fish biodiversity areas are likely to occur in other complex habitats, such as coral reefs, and therefore likely include the Montebello/Barrow/Lowendal Island Group, the Ningaloo Coast and the Muiron Islands.

Soft Sediments and Benthic Fauna

Benthic communities associated with the soft sediment seabed habitat within the Operational Area include fauna living within the sediments (infauna) and those living on or above the seabed (sessile and mobile epifauna). These fauna are predominantly mobile and or burrowing species including molluscs, crustaceans (crabs, shrimps and smaller related species), polychaetes, sipunculid and platyhelminth worms, asteroids (sea stars), echinoids (sea urchins) and other small animals.

A benthic survey conducted 4 km south-east of the Operational Area as part of the Balnaves Development (within Permit Area WA-49-L) recorded sparse (less than 5% cover) epibenthic fauna comprising occasional anemones, urchins, sea whips, sea pens, feather stars and glass sponges (RPS, 2011b). Video surveys of the benthic habitats found similar sparse epibenthic communities to those reported in the sampling for the Balnaves Development in proximity to the Operational Area. Infauna were diverse and dominated by polychaete worms and crustaceans (RPS, 2011b). Similarly, at the Pluto Platform (about 23 km from the Operational Area), sampling revealed a sparsely abundant, variable and diverse infauna community dominated by polychaetes, nemerteans, sipunculids and crustaceans (SKM, 2006).

These results support the findings of other NWS sampling programs, which indicate a widespread and well represented infauna assemblage along the continental shelf and upper slopes (Rainer, 1991; Le Provost et al., 2000; Woodside, 2004; Brewer et al., 2007). Additionally, it is expected that these infauna communities will be widely represented within the EMBA.

Small areas of cemented sediments (which can also be described as limestone pavement with a sand veneer) have been recorded during seabed surveys in various locations throughout the NWS (AIMS, 2014). Such habitat may occur in the Operational Area and could provide habitat for sessile filter feeding communities comprising gorgonians (sea whips and fans) and sponges. These areas support a higher diversity and abundance of epifauna (including mobile invertebrates such as crustacea and echinoderms) and fishes as compared to soft sediment habitats (RPS, 2011a).

4.5.2 Protected Species

The EPBC Act Protected Matters Search Tool was used to identify species listed under the EPBC Act that may occur within and adjacent to the Operational Area and EMBA. The results of the search inform the assessment of planned events as well as unplanned events in Section 6. It should be noted that the EPBC Act Protected Matters Search Tool is a general database that conservatively identifies areas in which protected species have the potential to occur.

A total of 62 EPBC Act listed species were identified as potentially occurring within the Operational Area (Appendix C). Of those listed, 17 are considered Threatened marine species (MNES) and 32 migratory species under the EPBC Act (Table 4-3).

A total of 114 EPBC Act listed marine species were identified as potentially occurring within the EMBA (Appendix C). Of those listed, 31 species within the EMBA are considered Threatened marine species (MNES) and 57 migratory species under the EPBC Act (Table 4-3). Two conservation dependent species have also been identified with a potential to occur within the Operational Area and EMBA.

The full list of species identified from the Protected Matters Search is provided in the EPBC Act Protected Matters Search Report (Appendix C). A description of EPBC Act listed species that may be present in the Operational Area and/or EMBA is provided below.

Table 4-3: Threatened and migratory marine species under the EPBC Act potentially occurring with the Operational Area and EMBA

Species	Common name	Threatened status	Migratory status	Potential occurrence	
				Operational Area	EMBA
Mammals					
Balaenoptera musculus	Blue Whale	Endangered	Migratory	✓	✓
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	✓	✓
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	✓	✓
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	✓	✓
Balaenoptera edeni	Bryde's Whale	N/A	Migratory	✓	✓
Orcinus orca	Killer Whale, Orca	N/A	Migratory	✓	✓
Physeter macrocephalus	Sperm Whale	N/A	Migratory	✓	✓
Tursiops aduncus	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	N/A	Migratory	✓	✓
Eubalaena australis	Southern Right Whale	Endangered	Migratory	x	✓
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory	x	✓
Sousa chinensis	Indo-Pacific Humpback Dolphin	N/A	Migratory	x	✓
Dugong dugon	Dugong	N/A	Migratory	x	✓
Reptiles					
Caretta caretta	Loggerhead Turtle	Endangered	Migratory	✓	✓
Chelonia mydas	Green Turtle	Vulnerable	Migratory	✓	✓
Dermochelys coriacea	Leatherback Turtle	Endangered	Migratory	✓	✓
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	Migratory	✓	✓
Natator depressus	Flatback Turtle	Vulnerable	Migratory	✓	✓
Aipysurus apraefrontalis	Short-nosed Seasnake	Critically Endangered	N/A	x	✓

Species	Common name	Threatened status	Migratory status	Potential occurrence	
				Operational Area	EMBA
Sharks, Fish and Rays					
Rhincodon typus	Whale Shark	Vulnerable	Migratory	✓	✓
Carcharius taurus	Grey Nurse Shark	Vulnerable	N/A	✓	✓
Carcharodon carcharias	Great White Shark	Vulnerable	Migratory	✓	✓
Pristis zijsron	Green Sawfish	Vulnerable	Migratory	✓	✓
Anoxypristis cuspidata	Narrow Sawfish	N/A	Migratory	✓	✓
Isurus oxyrinchus	Shortfin Mako	N/A	Migratory	✓	✓
Isurus paucus	Longfin Mako	N/A	Migratory	✓	✓
Manta birostris	Giant Manta Ray	N/A	Migratory	✓	✓
Manta alfredi	Reef Manta Ray	N/A	Migratory	✓	✓
Pristis clavata	Dwarf Sawfish	Vulnerable	Migratory	x	✓
Lamna nasus	Porbeagle Shark	N/A	Migratory	x	✓
Sphyrna lewini	Scalloped Hammerhead	Conservation Dependent	N/A	✓	✓
Thunnus maccoyii	Southern Bluefin Tuna	Conservation Dependent	N/A	✓	✓
Birds					
Macronectes giganteus	Southern Giant-Petrel	Endangered	Migratory	✓	✓
Calidris canutus	Red Knot	Endangered	Migratory	✓	✓
Numenius madagascariensis	Eastern Curlew	Critically Endangered	Migratory	✓	✓
Sternula nereis	Australian Fairy Tern	Vulnerable	N/A	✓	✓
Anous stolidus	Common Noddy	N/A	Migratory	✓	✓
Calonectris leucomelas	Streaked Shearwater	N/A	Migratory	✓	✓

Species	Common name	Threatened status	Migratory status	Potential occurrence	
				Operational Area	EMBA
Fregata ariel	Lesser Frigatebird	N/A	Migratory	✓	✓
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory	✓	✓
Pandion haliaetus	Osprey	N/A	Migratory	✓	✓
Actitis hypoleucos	Common Sandpiper	N/A	Migratory	✓	✓
Calidris acuminate	Sharp-tailed Sandpiper	N/A	Migratory	✓	✓
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory	x	✓
Limosa lapponica baueri	Bar-tailed Godwit	Vulnerable	Migratory	x	✓
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically Endangered	Migratory	x	✓
Malurus leucopterus edouardi	White-winged Fairy-wren (Barrow Island)	Vulnerable	N/A	x	✓
Papasula abbotti	Abbott’s Booby	Endangered	N/A	x	✓
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	N/A	x	✓
Thalassarche cauta	Tasmanian Shy Albatross	Vulnerable	Migratory	x	✓
Thalassarche cauta steadi	White-capped Albatross	Vulnerable	Migratory	x	✓
Thalassarche impavida	Campbell Albatross	Vulnerable	Migratory	x	✓
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Migratory	x	✓
Rostratula australis	Australian Painted Snipe	Endangered	N/A	x	✓
Apus pacificus	Fork-tailed Swift	N/A	Migratory	x	✓
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory	x	✓
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory	x	✓
Fregata minor	Great Frigatebird	N/A	Migratory	x	✓
Hydroprogne caspia	Caspian Tern	N/A	Migratory	x	✓
Onychoprion anaethetus	Bridled Tern	N/A	Migratory	x	✓

Species	Common name	Threatened status	Migratory status	Potential occurrence	
				Operational Area	EMBA
Phaethon lepturus	White-tailed Tropicbird	N/A	Migratory	x	✓
Sterna dougallii	Roseate Tern	N/A	Migratory	x	✓
Sternula albifrons	Little Tern	N/A	Migratory	x	✓
Charadrius veredus	Oriental Plover	N/A	Migratory	x	✓
Glareola maldivarum	Oriental Pratincole	N/A	Migratory	x	✓
Thalasseus bergii	Crested Tern	N/A	Migratory	x	✓
Tringa nebularia	Common Greenshank	N/A	Migratory	x	✓

4.5.2.1 Listed Threatened Species Recovery Plans and Conservation Advice

The requirements of the species recovery plans and conservation advices (Table 4-4) will be considered to identify any requirements that may apply to the risk assessment (Section 6). Recovery plans are enacted under the EPBC Act and remain in force until the species is removed from the threatened list. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be performed to facilitate the conservation of a listed species or ecological community.

Table 4-4 outlines the recovery plans and conservation advices relevant to those species identified by the EPBC Protected Matters search (Appendix C) as potentially occurring within or using habitat in the Operational Area and EMBA, and summarises the key threats to those species, as described in relevant recovery plans and conservation advices.

Table 4-4: Conservation advice for EPBC Act listed species considered during environmental risk assessment and their relevance to the Operational Area and EMBA

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 (DoEE, 2018)	Marine debris	Identifies offshore installations such as oil rigs as a potential source of marine debris.
Marine mammals			
Sei whale	Conservation advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015a)	Noise interference	Assess and manage acoustic disturbance.
		Vessel disturbance	Assess and manage physical disturbance and development activities.
Blue whale	Conservation management plan for the blue whale: *A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999* 2015-2025 (Commonwealth of Australia, 2015a)	Noise interference	Assess and address anthropogenic noise.
		Vessel disturbance	Minimise vessel collision.
Fin whale	Conservation advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015b)	Noise interference	Once the spatial and temporal distribution (including biologically important areas) of fin whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development) on this species.

Species/sensitivity	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions
		Vessel disturbance	Develop a national vessel strike strategy that investigates the risk of vessel strikes on fin whales and also identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Vessel Strike Database.
Humpback whale	Approved conservation advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee, 2015c)	Noise interference	For actions involving acoustic impacts (example pile driving, explosives) on humpback whale calving, resting, feeding areas, or confined migratory pathways, perform site-specific acoustic modelling (including cumulative noise impacts).
		Vessel disturbance	Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required, appropriate mitigation measures are implemented to reduce the risk of vessel strike.
Southern right whale	Conservation management plan for the southern right whale: a recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011–2021 (DSEWPaC, 2012b)	Noise interference	Assess and address anthropogenic noise: shipping, industrial and seismic surveys.
		Vessel disturbance	Address vessel collisions.
Reptiles			
Loggerhead turtle, hawksbill turtle, green turtle and flatback turtle	Recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017)	Vessel disturbance	No specific management actions in relation to vessels prescribed in the plan; vessel interactions identified as a threat.
		Light pollution	Minimise light pollution. Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.
		Acute chemical discharge (oil pollution)	Ensure spill risk strategies and response programs include management for turtles and their habitats.
Leatherback turtle, leathery turtle	Approved conservation advice for *Dermochelys coriacea* (leatherback turtle) (DEWHA, 2008b)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat.
	Recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017)		

Species/sensitivity	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions
Short-nosed seasnake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (DSEWPaC, 2011a)	Habitat degradation/ modification	None applicable.
Sharks, fish and rays			
Great white shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	No additional threats identified (ex. marine debris)	None applicable.
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 threats.
	Sawfish and river shark multispecies recovery plan (DoE, 2015a)		Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.
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 threats.
	Sawfish and river shark multispecies recovery plan (DoE, 2015a)		Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.
Whale shark	Conservation advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee, 2015d)	Vessel disturbance	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations and along the northward migration route that follows the northern Western Australian coastline along the 200 m isobath.
	Whale shark (*Rhincodon typus*) recovery plan 2005-2010[4] (DEH, 2005a)	Habitat degradation/ modification	No explicit relevant management actions; seasonal aggregations of Ningaloo recognised as important habitat.
Grey nurse shark (west coast population)	Recovery plan for the grey nurse shark (*Carcharias taurus*) (DoE, 2014a)	No additional threats identified (ex. marine debris)	None applicable.
Seabirds			
Red knot	Conservation advice *Calidris canutus* red knot (Threatened Species Scientific Committee, 2016a)	Habitat degradation/ modification	No explicit relevant management actions; oil pollutions recognised as a threat.

[4] While the Whale shark (*Rhincodon typus*) recovery plan ceased to be in effect on 1 October 2015, the conservation advice in this plan was considered to inform the context of the environmental risk assessment for the Petroleum Activities Program.

Species/sensitivity	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions
Eastern curlew	Conservation advice *Numenius madagascariensis* eastern curlew (DoE, 2015b)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil pollutions recognised as a threat.
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (DoE, 2015c)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil pollutions recognised as a threat.
Albatrosses	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPaC, 2011b)	No additional threats identified (ex. marine debris)	No explicit relevant management actions; oil pollutions recognised as a threat.
Soft-plumaged petrel	Conservation advice *Pterodroma mollis* soft-plumage petrel (Threatened Species Scientific Committee, 2015e)	Habitat degradation and modifications	No explicit relevant management actions.
Australian fairy tern	Conservation advice for *Sterna nereis* (fairy tern) (DSEWPaC, 2011c)	Habitat degradation/ modification (oil pollution)	Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills.
Common sandpiper, red knot, pectoral sandpiper, sharp-tailed sandpiper, bar-tailed godwit, oriental pratincole, oriental plover, common greenshank	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia, 2015b)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil spills recognised as a threat.
Northern Siberian bar-tailed godwit	Conservation advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberian) (Threatened Species Scientific Committee, 2016b)	Habitat degradation and modifications (oil pollution)	No explicit relevant management actions; oil spills recognised as a threat.
White-winged fairy-wren (Barrow Island)	Approved conservation advice for *Malurus leucopterus edouardi* (White-winged Fairy-wren (Barrow Island)) (DEWHA, 2008d)	No additional threats identified	No explicit relevant management actions.
Abbott's booby	Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee, 2015f)	Habitat degradation/ modification	No explicit relevant management actions.

4.5.2.2 Habitat Critical to the Survival of a Species

In accordance with the EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance, an action is deemed to have a significant impact if there is a real chance or possibility that it will adversely affect habitat critical to the survival of a species.

Habitat critical to the survival of marine turtles has been identified as nesting and internesting habitat for each genetic stock, based on a set criterion outlined in the Recovery Plan for Marine Turtles in Australia 2017 – 2027 (Commonwealth of Australia, 2017).

The Operational Area overlaps a small portion of habitat critical to the survival of flatback turtles identified for internesting turtles utilising nesting beaches at the Montebello Islands (Figure 4-9). The EMBA overlaps with areas identified as habitat critical to the survival of a marine turtle species and is described below in Table 4-5 and refer to Figure 4-9.

Table 4-5 Habitat critical to the survival of a marine turtle species within the Operational Area and EMBA

Species	Nesting Location	Major nesting area	Internesting buffer	Nesting period	Hatching period	Overlap with Operational Area	Overlap with EMBA
Flatback turtle	Montebello Islands (all with sandy beaches)		60 km	Oct-Mar	Feb-Mar	✓	✓
	Barrow Island	✓	60 km	Oct-Mar	Feb-Mar	X	✓
	Coastal islands from Cape Preston to Locker Island		60 km	Oct-Mar	Feb-Mar	X	✓
Green turtle	Barrow Island	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
	Montebello Islands (all with sandy beaches)	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
	Serrurier Island		20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
	Thevenard Island		20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
	Northwest Cape	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
	Ningaloo Coast		20 km	Nov-Mar	Jan-May (peak: Feb-Mar)	X	✓
Loggerhead turtle	Dirk Hartog Island	✓	20 km	Nov-May	Jan-May	X	✓
	Muiron Islands	✓	20 km	Nov-May	Jan-May	X	✓
	Gnaraloo Bay	✓	20 km	Nov-May	Jan-May	X	✓
	Ningaloo Coast		20 km	Nov-May	Jan-May	X	✓
Hawksbill turtle	Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)	✓	20 km	Oct-Feb	all year (peak: Dec-Feb)	X	✓

	Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island)		20 km	Oct-Feb	all year (peak: Dec-Feb)	X	✓

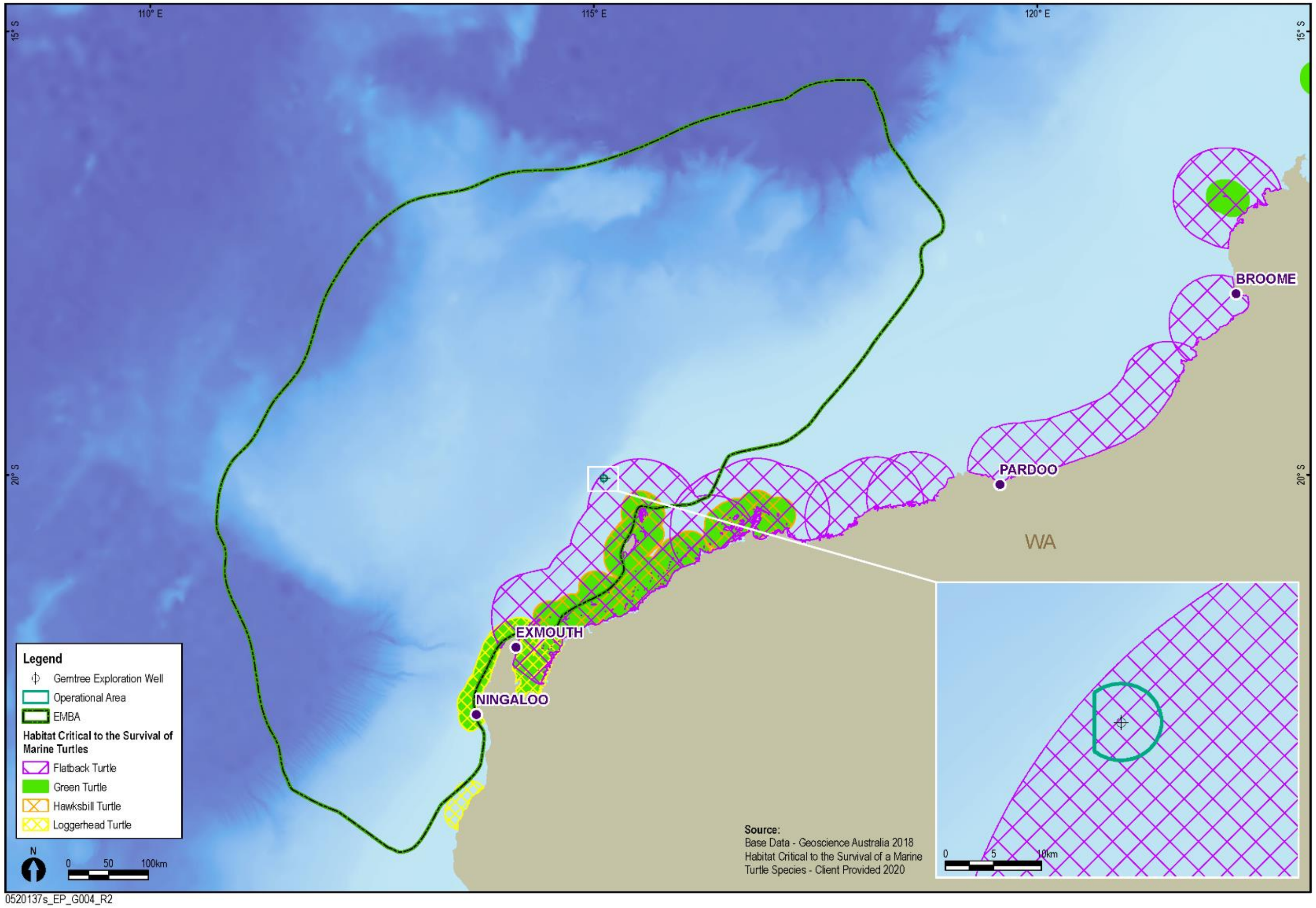


Figure 4-9: Habitat critical to the survival of marine turtles

4.5.2.3 Biologically Important Areas

A review of the National Conservation Values Atlas (NCVA) identified that the following BIAs as overlap spatially with the Operational Area:

- Flatback turtle internesting buffer zone, maximum 80 km buffer zone from the nearest foraging, mating and nesting sites for flatback turtles on Barrow, the Montebello and Lowendal Islands during summer (peak period in December and January) (Figure 4-13).
- Whale shark foraging northward from the Ningaloo Marine Park along the 200 m isobath (July–November) (Figure 4-14).
- Pygmy blue whale migration BIA extending northward form the Perth canyon towards Indonesia (Figure 4-11). The seasonal migration of pygmy blue whales off Western Australia is generally described as: northbound migration occurs from April to August and the southbound migration occurs from October to late January.
- Wedge-tailed shearwater foraging extending from breeding grounds at Barrow Island, present as a breeding visitor arriving in mid-August and leaving in April.

BIAs not within the Operational Area but within the EMBA are listed in Table 4-6.

Table 4-6: BIAs beyond the Operational Area but within the EMBA

Species	BIA type	Approximate distance from the Operational Area (km)
Mammals		
Humpback whale	Migration (North and South)	28
	Resting (Exmouth Gulf)	208
Pygmy blue whale	Possible Foraging Area (Ningaloo Coast)	226
Dugong	Multi-use (breeding/calving/foraging/nursing) (Exmouth Gulf and Ningaloo Reef)	200
Reptiles		
Flatback turtle	Multi-use (foraging/mating/nesting/aggregation) (Montebello Islands)	50
	Internesting (Pilbara Southern Island Group)	56
	Internesting (Dampier Archipelago)	75
	Multi-use (foraging/mating/nesting/) (Barrow Island)	63
	Nesting (Pilbara Southern Island Group)	136
Loggerhead turtle	Internesting (Montebello Islands)	38
	Nesting (Montebello Islands)	59
	Internesting (Muiron Islands)	165
	Nesting (Muiron Islands)	185
	Internesting (Ningaloo Coast)	192
	Nesting (Ningaloo Coast)	212

Species	BIA type	Approximate distance from the Operational Area (km)
Green turtle	Internesting (Montebello Islands)	26
	Multi-use (foraging/internesting/mating/nesting) (Montebello Islands)	46
	Internesting (Barrow Island)	52
	Multi-use (foraging/mating/nesting/basking) (Barrow Island)	72
	Internesting (Muiron Islands)	164
	Nesting (Muiron Island)	186
	Internesting (North West Cape)	190
	Nesting (Thevenard Island)	210
Hawksbill turtle	Internesting (Montebello/Lowendal/Barrow Island Group)	32
	Multi-use (mating/nesting/foraging) (Montebello/Lowendal/Barrow Island Group)	50
	Internesting (Thevenard Island)	128
	Nesting (Thevenard Island)	148
	Internesting (Ningaloo Coast)	192
	Nesting (Ningaloo Coast)	212
Sharks, Fish and Rays		
Whale shark	Foraging (Ningaloo)	221
Avifauna		
Australian Fairy tern	Breeding and foraging (Montebello Island)	48
	Breeding and foraging (Barrow Island)	64
	Breeding and foraging (Thevenard Island)	131
	Breeding (North West Cape)	220
Lesser crested tern	Breeding and foraging (Lowendal Island)	46
	Breeding and foraging (Thevenard Island)	121
Little tern	Resting (Rowley Shoals)	446
Roseate tern	Breeding and foraging (Lowendal Island)	49
	Breeding and foraging (Thevenard Island)	95
	Breeding (Ningaloo)	282
While-tailed tropicbird	Foraging (Rowley Shoals)	372
Wedge-tailed shearwater	Breeding (Montebello)	71
	Breeding and foraging (Pilbara South Island Group)	43
	Breeding (Pilbara South Island Group)	129

4.5.2.4 Seasonal Sensitivities of Protected Species

Periods of the year coinciding with key environmental sensitivities in and around the Operational Area, including EPBC Act listed threatened and/or migratory species potentially occurring within the Operational Area, are presented in Table 4-7. These relate to breeding, foraging or migration of the indicated fauna.

The following species were listed in the EPBC Act Protected Matters Search (see Table 4-3 and Appendix C) but have been excluded from Table 4-7:

- Antarctic minke whale, Bryde's whale and sperm whales may occasionally transit the North West Shelf (NWS) Province. However, information is not available to define known seasonal occurrence within the NWS Province.
- The leatherback turtle is not confirmed as a nesting species within WA (Limpus, 2008; Commonwealth of Australia, 2017).
- Great white, shortfin mako and longfin mako sharks have not been included as seasonality is not defined, as they are ocean-going and can be present at any time, but are not known to have significant populations with regular migratory routes or breeding/foraging aggregations within the Operational Area.

Table 4-7: Key environmental sensitivities and timings for fauna (indicative). Migratory whale periods are specific to the NWS Region based on scientific literature. Timing will vary with geographic location along the WA coast.

Species	January	February	March	April	May	June	July	August	September	October	November	December
Blue whale – northern migration (North West Cape, Montebello, Scott Reef)[1]												
Blue whale – southern migration (North West Cape, Montebello, Scott Reef)[1]												
Humpback whale – northern migration (Jurien Bay to Montebello)[2]												
Humpback whale – southern migration (Jurien Bay to Montebello)[3]												
Green turtle – Barrow Island, Montebello Islands, Thevenard Island, Northwest Cape, Ningaloo coast[4]												
Flatback turtle – Montebello Islands, Barrow Island[4]												
Loggerhead turtle – Muiron Islands, Ningaloo coast [4]												
Hawksbill turtle – Montebello Islands, Lowendal Islands[4]												
Manta ray – presence/ aggregation/breeding (Ningaloo)[5]												
Whale shark* – foraging/ aggregation near Ningaloo[6]												
Caspian tern – breeding (Ningaloo)[7]												
Crested tern – breeding (Ningaloo)[7]												

Species	January	February	March	April	May	June	July	August	September	October	November	December
Australian fairy tern – breeding (Ningaloo)[7]												
Osprey – breeding (Ningaloo)[7]												
Roseate tern – breeding (Ningaloo)[7]												
Wedge-tailed shearwater – various breeding sites[7]												

	Species likely to be present in the region
	Peak period. Presence of animals reliable and predictable each year

References for species seasonal sensitivities:

1. DoE, 2016; McCauley & Jenner, 2010; McCauley & Duncan, 2011; McCauley et al., 2018; Joliffee et al., 2019; Gavrilov et al., 2018
2. Department of Conservation and Land Management (CALM), 2005; Environment Australia, 2002; Jenner et al., 2001a; McCauley & Jenner, 2001
3. McCauley & Jenner, 2001
4. Commonwealth of Australia, 2017; Chevron, 2015; CALM, 2005; DSEWPaC, 2012
5. CALM, 2005; DSEWPaC, 2012a; Environment Australia, 2002; Sleeman et al., 2010
6. Environment Australia, 2002; DSEWPaC, 2012c
7. Commonwealth of Australia, 2007; DSEWPaC, 2012d

** Periods of sensitivity include whale shark foraging off Ningaloo coast and foraging northward from the Ningaloo Marine Park along the 200 m isobath.*

4.5.2.5 Marine Mammals

This section provides a description of EPBC Act listed threatened marine mammal species that may occur within the Operational Area and/or EMBA.

Cetaceans – Migratory Whales

<u>Blue Whale</u>

There are two recognised subspecies of blue whale in the Southern Hemisphere, which are both recorded in Australian waters. These are the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the ‘pygmy' blue whale (*Balaenoptera musculus brevicauda*) (DoE, 2016). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic) (Department of Environment and Heritage (DEH), 2005b). Recent assessment of the distribution and population parameters of the pygmy blue whale in Australian waters found that whales in WA waters utilise the full latitude range of the Indian Ocean, from northern Indonesia to the Southern Ocean (McCauley et al., 2018). This has allowed further delineation of stock structure, and this sub-population is now recognised as the Eastern Indian Ocean pygmy blue whale population. On this basis, blue whales seasonal presence in the NWS Region are likely to be Eastern Indian Ocean pygmy blue whales.

The Conservation Management Plan for the Blue Whale 2015-2025 (Commonwealth of Australia, 2015a) describes the recognised subspecies, their distribution in Australian waters and the areas defined by the plan relating to known high use foraging, known foraging and possible foraging areas and areas known and likely to occur (Figure 4-10) , breeding, and migration. In addition, the National Conservation Values Atlas spatially defines a number of BIAs for the pygmy blue whale. The Operational Area overlaps with area known to occur (as per the Conservation Plan) and two of the

BIAs: the known area for distribution and the migration corridor. Within the EMBA, a possible foraging area for blue whales is defined at Ningaloo Reef/North West Cape in the Conservation Management Plan and is identified as a foraging BIA. These areas of biological importance are described below.

The East Indian Ocean pygmy blue whale population undertakes an annual migration through the offshore waters of WA, completing a northbound migration through the NWMR between mid-April to early August, and southbound migration from October to January (McCauley & Jenner, 2010; McCauley & Duncan, 2011; McCauley et al., 2018; Jolliffe et al., 2019; Gavrilov et al., 2018) (Figure 4-11). Satellite tagging (2009–2012) indicated that the general distribution of East Indian Ocean pygmy blue whales is offshore in water depths over 200 m and commonly over 1000 m (Double et al., 2012a) (Figure 4-8), generally west of the Operational Area within the NWMR and EMBA. Whales tagged in WA during March and April migrated northwards post tag deployment. The tagged whales travelled relatively near to the Australian coastline (100.0 ± 1.7 km) in water depths of 1369.5 ± 47.4 m, until reaching the North West Cape, after which they travelled offshore (238.0 ± 13.9 km) into progressively deeper water (2617.0 ± 143.5 m). Whales reached the northern terminus of their migration and potential breeding grounds in Indonesian waters by June (Double et al., 2014). Noise logger data collected on the Exmouth Plateau during the southbound migration in 2014 found that the whales tend to travel southward at much greater distances from the coast than during the northbound migration, at distances up to 400 km from the shoreline (Gavrilov et al., 2018). Therefore, although the BIA for this species has been spatially defined as the migration corridor centred between the 500 m and 1000 m depth contours, these data suggest individuals transit the deeper waters to the west of the Operational Area during the northbound and southbound migrations.

The Conservation Management Plan for the Blue Whale identifies a possible foraging area at Ningaloo Reef/North West Cape (Commonwealth of Australia, 2015a), approximately 200 km south-west of the Operational Area but within the EMBA, where evidence for feeding is based on limited or direct observations or indirect evidence, such as prey occurring close to the whale or satellite tracks showing circling tracks for one individual. Satellite tracks of the pygmy blue whale's northern migration (Double et al., 2012a, 2014) showed that most of the tagged whales (n=3) continued past the North West Cape with little directional variation, while one tagged whale showed circling tracks (Figure 4-11). As such, it is possible that pygmy blue whales feed opportunistically while transiting the region.

Since the Operational Area overlaps with a small portion of the defined migration corridor (BIA) and the known distribution of the pygmy blue whale, it is possible that individuals may transit the Operational Area during their northbound or southbound migration. However, satellite tracks and noise logging data (described above) suggest the Operational Area is not located within the main corridor transited by East Indian Ocean pygmy blue whales. Therefore, presence within the Operational Area is considered to be infrequent.

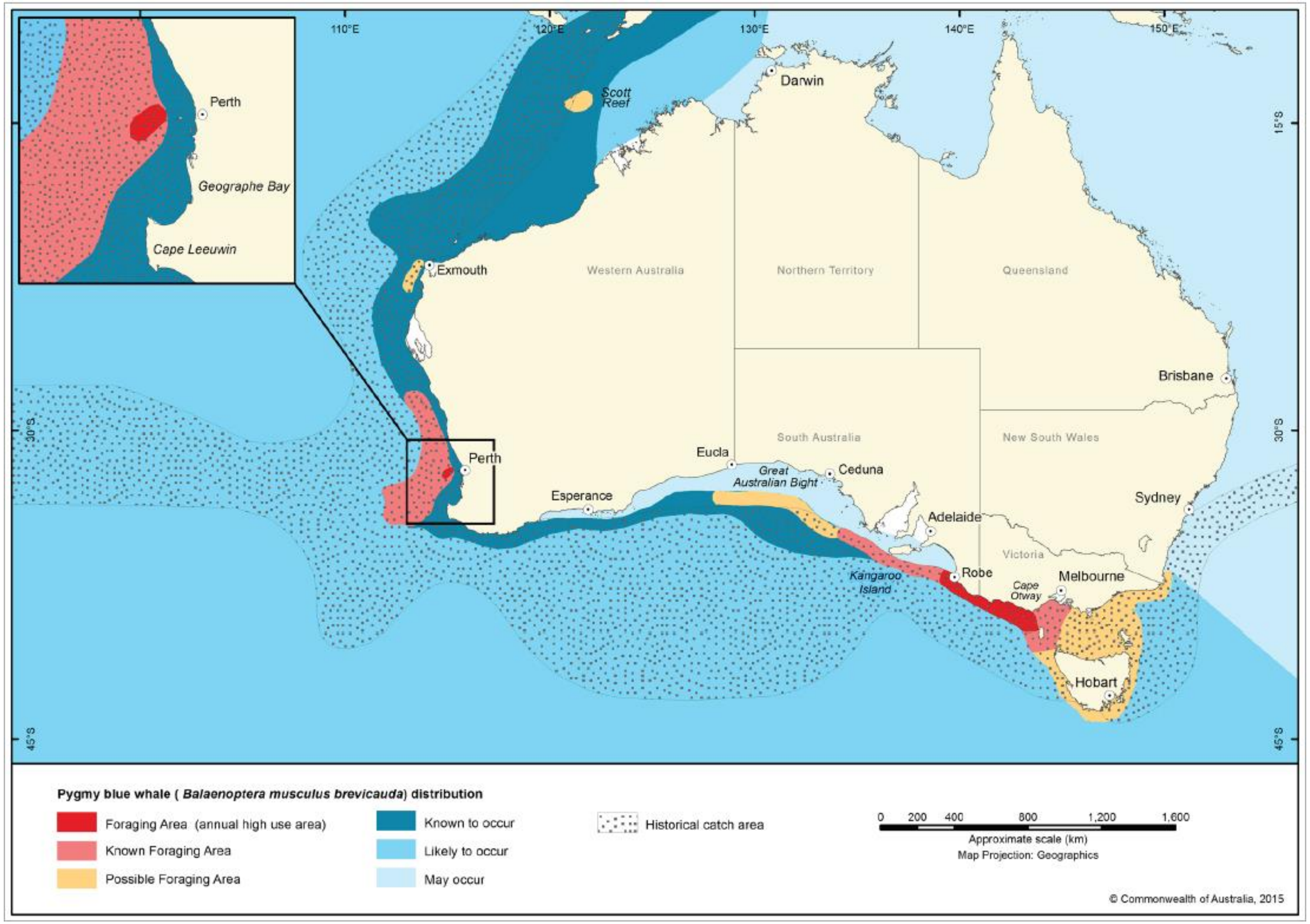


Figure 4-10: Pygmy blue whale distribution in Australian waters as defined by Conservation Management Plan for the Blue Whale 2015-2025.

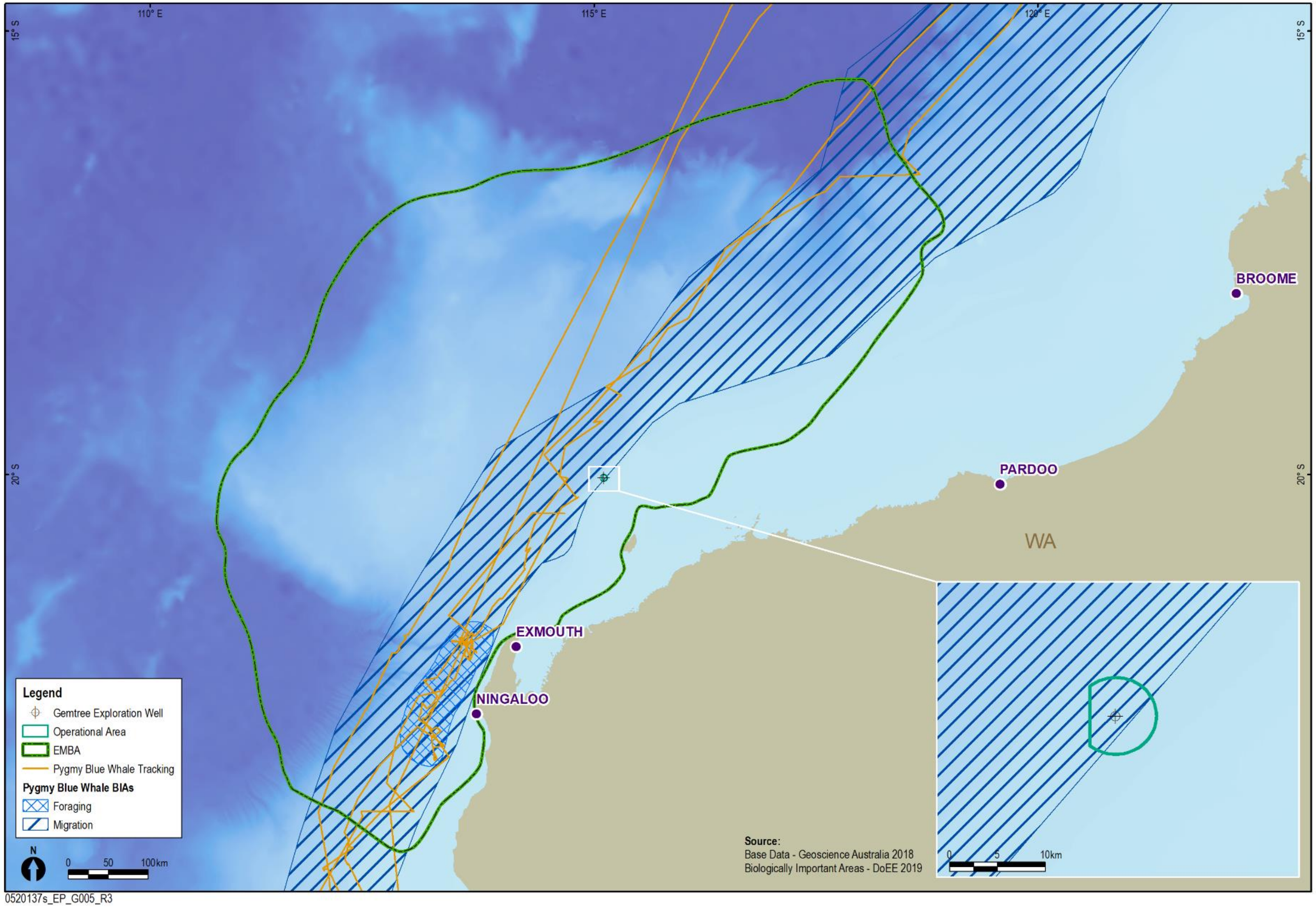


Figure 4-11: Pygmy blue whale BIAs and satellite tracking, illustrating migration route

Humpback Whale

The humpback whale migrates along the WA coastline annually as this EPBC Act listed Vulnerable and Migratory marine species completes its seasonal northern and southern migration to and from high latitude feeding grounds to low latitude breeding and calving areas (Commonwealth of Australia, 2015c). Humpback whales travel to and from the southern Kimberley to the northern end of Camden Sound (the main breeding and calving area) in the winter and spring months (Jenner et al., 2001; Commonwealth of Australia, 2015a), after feeding in Antarctic waters during the summer months (Bannister & Hedley, 2001). The Commonwealth of Australia's Conservation Advice for humpback whales (October 2015), identifies the humpback whale's distribution on the west and east coasts of Australia. Calving occurs at the northern extent of the migration corridor (outside of the EMBA for the Petroleum Activities Program). The DAWE has defined the migration corridor (both north and south bound) as a BIA for humpback whales. The BIA is located about 25 km south-east of the Operational Area and within the EMBA (Figure 4-12).

Woodside has conducted marine megafauna aerial surveys that have confirmed that the temporal distribution of migrating humpback whales off the North West Cape, in the EMBA, has remained consistent since baseline surveys were first conducted in 2000 to 2001 (RPS, 2010c). The majority of the whales occurred in depths less than 500 m, with the greatest density of whales concentrated in water depths of 200–300 m. Only small numbers of whales were observed to occur in the deeper offshore waters. These surveys are consistent with satellite tagging studies (Double et al. 2012b, 2010; Figure 4-12). Current population growth for the humpback whale population that migrates along the WA coast is estimated to be between 9.7 and 13% per annum (Threatened Species Scientific Committee, 2015c). Using the Salgado-Kent et al., (2012) estimate in 2008 of 26,100 individuals and an annual population growth rate of 10%, 2019 population estimates could be greater than 75,000 individuals.

From the North West Cape, north-bound humpback whales travel along the edge of the continental shelf passing to the west of the Muiron, Barrow and Montebello Islands. The southern migratory route follows a relatively narrow track between the Dampier Archipelago and Montebello Islands, south of the Operational Area (Figure 4-12). Within the EMBA, Exmouth Gulf is a known resting/aggregation areas for southbound humpback whales. In particular, cow/calve pairs may stay for up to two weeks in Exmouth Gulf. The Exmouth Gulf resting/aggregation BIA lies about 208 km from the Operational Area and partially overlaps the EMBA.

The southbound migration of cow/calf pairs is generally during October (extending into November and December). The peak of the northward migration within/near the Operational Area is during July, while the southern migration peak is late August/early September.

Given these data and the location of the Operational Area in relation to the known humpback migration route (Figure 4-12), it is considered that humpback whale migratory corridors are generally to the west of the Operational Area, however, their presence while transiting the NWS may occur within the Operational Area between June and October, during northern and southern migrations. The Operational Area is not located in or adjacent to any known critical habitat areas for this protected migratory whale species (e.g. feeding, breeding or calving). Observed whales are most likely to be transiting between the known aggregation areas of Camden Sound (about 1015 km north-east) and Exmouth Gulf (about 208 km south-west), rather than feeding, resting or breeding.

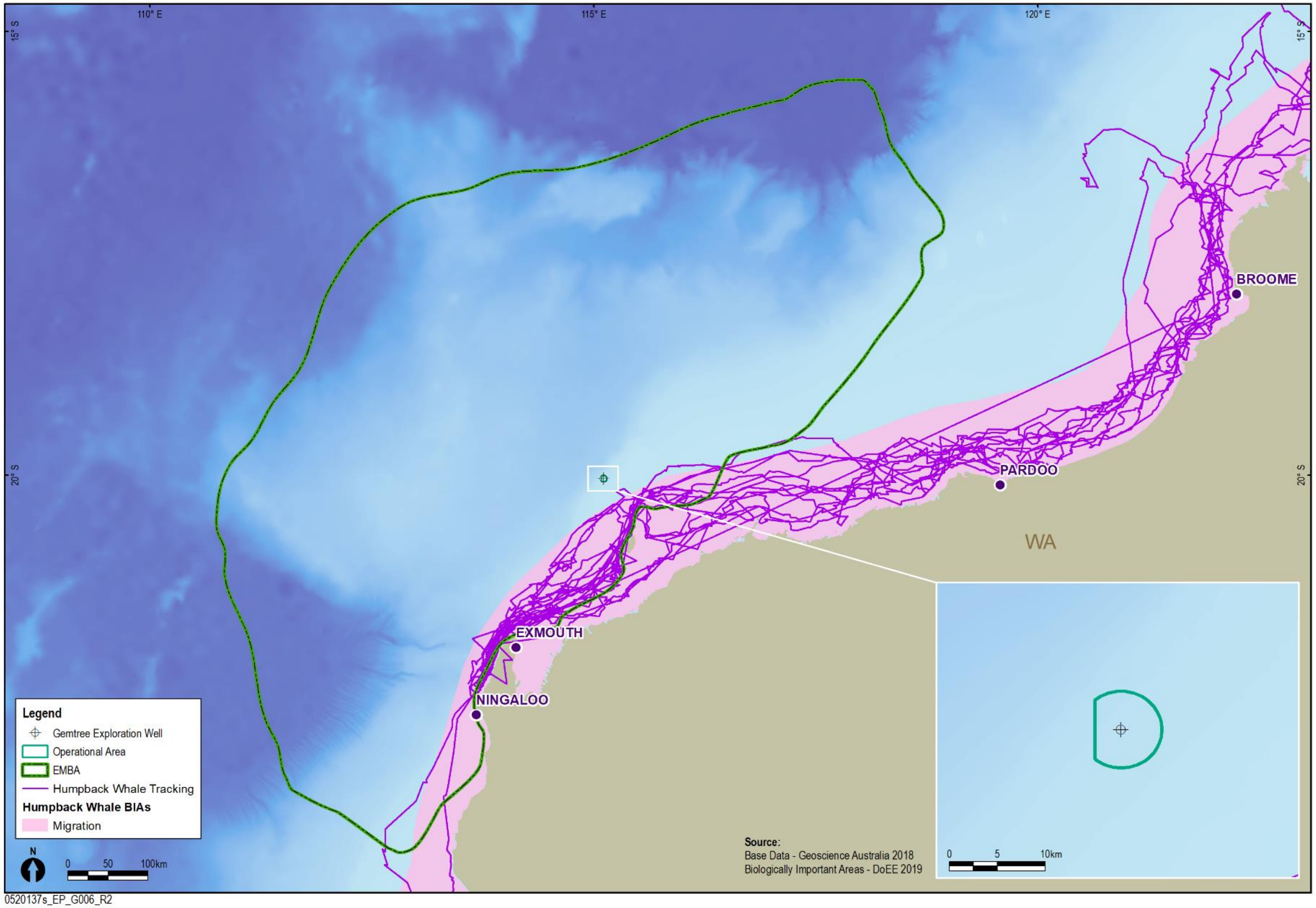


Figure 4-12: Humpback whale migration BIA and satellite tracking (Double et al. 2012b, 2010), illustrating migration routes in the region of the Operational Area

Bryde's Whale

The Bryde's whale occurs in tropical and temperate waters off all Australian states (Bannister et al., 1996). Bryde's whales occur in both oceanic and inshore waters, with the only key localities recognised in WA being in the Abrolhos Islands and north of Shark Bay (Bannister et al., 1996). Two forms are recognised: inshore and offshore Bryde's whales. It appears that the offshore form may migrate seasonally, heading towards warmer tropical waters during the winter; however, information on migration is not well known.

Within the EMBA, Bryde's whales tend to transit seasonally through a broad area of the continental shelf (McCauley & Duncan, 2011; RPS, 2010c). This species has been detected within the Northwest Shelf Province from mid-December to mid-June, peaking in late February to mid-April (RPS, 2010c). Given the distribution of Bryde's whales, the Operational Area is unlikely to represent an important habitat for this species so their presence is considered unlikely and limited to a few individuals infrequently transiting the area.

Sperm Whale

The sperm whale has a worldwide distribution in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges, averaging 20–30 nautical miles offshore (Bannister et al., 1996).

Within the EMBA, sperm whales have been recorded in deep water off North West Cape (Jenner et al., 2010; RPS, 2010c) and appear to occasionally venture into shallower waters in other areas (RPS, 2010c). The only key locality recognised in WA waters for sperm whales is along the southern coastline between Cape Leeuwin and Esperance (Bannister et al., 1996), outside of the EMBA for the Petroleum Activities Program.

There is limited information about sperm whale distribution in Australian waters; Off the Western Australian coast, where the continental shelf slopes less steeply, sperm whales appear to be less concentrated close to the shelf edge and more widely dispersed offshore (DoEE, 2019). The species may occur in severely fragmented populations. In Western Australia, sperm whales have two BIAs recognised for foraging activities. These two areas are located west of Rottnest Island and along the southern coastline between Cape Leeuwin and Esperance (outside the EMBA). There are no known BIAs for sperm whales in the NWMR. In the open ocean, there is a general movement of sperm whales southwards in summer, and corresponding movement northwards in winter, particularly for males (DoEE, 2019). Detailed information about the distribution and migration patterns of sperm whales off the WA coast is not available.

Females with young may reside within the NWMR all year round, and males may migrate through the region, and the species may be associated with canyon habitats (Ceccarelli et al., 2011). Sperm whales have been recorded in deep waters off North West Cape (Jenner et al., 2010) and appear to occasionally venture into shallower waters in other areas. Twenty-three sightings of sperm whales (variable pod sizes, ranging from one to six animals) were recorded by marine mammal observers (MMOs) during the North West Cape MC3D marine seismic survey conducted between December 2016 and April 2017. These animals were observed in deep, continental slope waters of the Montebello Saddle (maximum distance of about 90 km from North West Cape), and the waters overlying the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF.

Given the wide distribution of sperm whales and their preference for deeper oceanic waters, the Operational Area is unlikely to represent an important habitat for this species. Their presence is likely to be a rare occurrence and limited to a few individuals infrequently transiting the area.

Sei Whale

The sei whale is a baleen whale which, like many species of baleen whales, was significantly reduced in numbers by commercial whaling operations. The species has a worldwide oceanic distribution, and is expected to seasonally migrate between low latitude wintering areas and high latitude summer feeding grounds (Bannister et al., 1996; Prieto et al., 2012). Sei whales have been infrequently recorded in Australian waters (Bannister et al., 1996), which could be due to the similarity in appearance of sei whales and Bryde's whales leading to incorrect recordings.

There are no known mating or calving areas, or other BIAs for sei whales in Australian waters (DoE, 2016). The species has a preference for deep waters, and typically occurs in oceanic basins and continental slopes (Prieto et al., 2012); records of the species occurring on the continental shelf (<200 m water depth) are uncommon in Australian waters (Bannister et al., 1996). Given the Operational Area is located in deeper waters on the continental shelf and continental slope, sei whales may infrequently occur within the Operational Area, mainly during winter months when the species may move away from Antarctic feeding areas.

Fin Whale

The fin whale is a large baleen whale with a cosmopolitan distribution in all ocean basins between 20 and 75°S (DEH, 2005b). The global population of fin whales was reduced significantly by commercial whaling, with the species being targeted due to its large size and broad distribution. Like other baleen whales, fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister et al., 1996).

Fin whales are thought to follow oceanic migration paths, and are uncommonly encountered in coastal or continental shelf waters. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice et al., 2004). There are no known BIAs for fin whales in the NWMR. As such, the species is likely to infrequently occur within the Operational Area, mainly during winter months when the species may move away from Antarctic feeding areas.

Antarctic Minke Whale

Antarctic minke whales were identified as occurring within the EMBA, but not within the Operational Area. The Antarctic minke whale is distributed worldwide and has been recorded off all Australian states, feeding in cold waters and migrating to warmer waters to breed. It is thought that the Antarctic minke whale migrates up the WA coast to about 20°S to feed and possibly breed (Bannister et al., 1996). However, detailed information on timing and location of migrations and breeding grounds is not well known. Given the wide distribution of Antarctic minke whale, the Operational Area is unlikely to represent an important habitat for this species. Their presence is likely to be a remote occurrence within the EMBA, limited to a few individuals infrequently transiting the area.

Southern Right Whale

Southern right whales were identified as occurring within the EMBA, not within the Operational Area. The southern right whale occurs primarily in waters between about 20°S and 60°S and moves from high latitude feeding grounds in summer to warmer, low latitude, coastal locations in winter (Bannister et al., 1996). Southern right whales aggregate in calving areas along the south coast of WA, such as Doubtful Island Bay, east of Israelite Bay and to a lesser extent Twilight Cove (DoE, 2016). During the calving season, between May and November, female southern right whales that are either pregnant or with calf can be in shallow protected waters along the entire southern Western Australian coast and west up to about Two Rocks, north of Perth. Sightings in more northern waters are relatively rare; however, they have been recorded as far north as Exmouth (Bannister et al., 1996). Southern right whales are therefore unlikely to occur within the EMBA.

Cetaceans – Toothed Whales and Dolphins

Killer Whale

The killer whale has a widespread distribution from polar to equatorial regions of all oceans and has been recorded off all states of Australia (Bannister et al., 1996). Killer whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf (Bannister et al., 1996), as well as in shallow coastal areas of WA (RPS, 2010c). Anecdotal evidence suggests killer whales may feed on dugongs in Shark Bay but there are no recognised key localities or important habitats for killer whales within the Operational Area or EMBA.

Given the wide distribution of killer whales and their preference for colder waters, the Operational Area is unlikely to represent an important habitat for this species. Their presence is likely to be a rare occurrence and limited to a few individuals infrequently transiting the area.

Spotted Bottlenose Dolphin (Arafura/Timor Sea Populations)

The spotted bottlenose dolphin is generally considered to be a warm water subspecies of the common bottlenose dolphin. Distribution is primarily in inshore waters, often in depths of less than 10 m (Bannister et al., 1996). They are known to occur from Shark Bay, north to the western edge of the Gulf of Carpentaria. Given the distribution of spotted bottlenose dolphins and their preference for shallow coastal waters, the Operational Area is unlikely to represent an important habitat for this species. Their presence is likely to be a rare occurrence and limited to infrequent transiting of the area. The spotted bottlenose dolphin is likely to be present in nearshore and coastal waters, within the EMBA.

Indo-Pacific Humpback Dolphin

The Indo-Pacific humpback dolphin is not expected to occur in the Operational Area based on an EPBC Act Protected Matters search, but may be present in the EMBA. It is now recognised as two distinct species; the Indo-Pacific humpback dolphin (*Sousa chinensis*) and the Australian humpback dolphin (*S. sahulensis*) (Jefferson & Rosenbaum, 2014). Although the EPBC Act Protected Matters Search Tool lists the Indo-Pacific humpback dolphin (*S. chinensis*), which is found in waters around India, China and south-east Asia, this EP will herein refer to the Australian humpback dolphin (*S. sahulensis*) that is known to occur in waters of the NWS and Sahul Shelf from northern Australia to New Guinea. Distribution of the humpback dolphin in Australia is linked to the warm eastern boundary current, with resident groups within Ningaloo Reef (Bannister et al., 1996). Humpback dolphins inhabit shallow coastal, estuarine habitats in tropical and subtropical regions, generally in depths of less than 20 m (Corkeron et al., 1997; Jefferson, 2000; Jefferson & Rosenbaum, 2014). Given their preference for shallow coastal habitats, the Australian humpback dolphin is likely to occur within the nearshore margins of the EMBA.

Other Marine Mammals

Dugong

Dugongs (*Dugong dugon*) are not expected to occur in the Operational Area based on an EPBC Act Protected Matters search, but may be present in the EMBA. They are large herbivorous marine mammals that generally inhabit coastal areas. Key populations along the WA coast are located at Shark Bay (the largest resident population in Australia), Ningaloo Marine Park and Exmouth Gulf, the Pilbara coast and offshore areas, and further north at Eighty Mile Beach and off the Kimberley Coast region coastline (Marsh et al., 2002; DoE, 2015a). Dugong distribution is determined by the location of foraging habitat which is specific to certain seagrass species and the size of seagrass meadows. Dugongs are known to migrate hundreds of kilometres between seagrass habitats.

4.5.2.6 Marine Reptiles

This section provides a description of EPBC Act listed marine reptile species that may occur within the Operational Area and/or EMBA.

Marine Turtles

Five of the six marine turtle species recorded for the NWS have the potential to occur within the Operational Area (Appendix C): the loggerhead, green, leatherback, hawksbill and flatback turtles.

There is no emergent habitat within the Operational Area. Therefore, nesting aggregations of marine turtles would not be expected. A flatback turtle internesting BIA and habitat critical to the survival of flatback turtles, extending from nesting locations at the Montebello Islands overlaps with part of the Operational Area. The BIA and habitat critical to the survival of flatback turtles are considered very conservative as they are based on the maximum range of internesting females. However, many turtles are likely to remain near their nesting beaches, and as they leave beaches they typically spread out and consequently, density decreases rapidly with increasing distance from a nesting beach.

Flatback turtles internest in shallow waters and generally on the eastern side of the offshore islands of Barrow, Montebellos and the Lowendals. Whittock et al. (2014) tracked flatback turtles from beaches on the east coast of Barrow Island, with the range and preference for shallow waters demonstrated. Dr Pendoley (K. Pendoley, personal communication 16 December 2015) has observed across all flatback rookeries in the region, behaviours that show internesting flatbacks moving towards shallow, coastal waters. There has been no observations of flatbacks moving offshore to deeper waters during the internesting period. For flatback turtles associated with the Montebello Islands, it is considered that during internesting they will move either towards Barrow Island or towards shallower coastal waters (K. Pendoley, personal communication 16 December 2015).

Although the 80 km buffer identified as a BIA and 60 km buffer identified as habitat critical to the survival of flatback turtles (Commonwealth of Australia, 2017) for internesting flatback turtles during summer overlaps with the Operational Area, the distance offshore (about 53 km north-west of the Montebello Islands), the depth range of the offshore waters of the Operational Area (about 166–511 m), internesting range and patterns in shallow and coastal waters, and the absence of potential nesting sites (i.e. no emergent islands, reef habitat or shallow shoals) indicate that it is highly unlikely flatback turtles will be encountered in the Operational Area.

Four of the turtle species (green, loggerhead, flatback and hawksbill) have significant nesting rookeries on beaches along the mainland coast and islands in the EMBA region including the Montebello/Barrow/Lowendal Islands, Muiron Islands, North West Cape and Ningaloo Reef (Environment Australia, 2003; Commonwealth of Australia, 2017). Table 4-8 provides additional details of the marine turtle species identified, including breeding and nesting seasons, diet and key habitats (including BIAs) within the NWMR (including areas outside of the EMBA region).

Table 4-8: Key information on marine turtles in the North West Marine Region

Turtle species	Key seasons within the Northwest Shelf Province	Diet	Key habitats
Green turtle – North West Shelf genetic stock	**Breeding:** About September to March **Nesting**: November to March. Peak period from January to February	Seagrasses and algae	**Preferred habitat**: Nearshore reef habitats in the photic zone. **Distribution**: Ningaloo Coast to Lacepede Islands. **Major nesting sites**: Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, Northwest Cape, Ningaloo Coast (Commonwealth of Australia, 2017) **Internesting habitat**: Generally within 10 km of nesting beaches (Waayers et al., 2011). **Nearest BIA**: Nesting on the Montebello Islands during summer, with a 20 km internesting buffer, therefore the key habitat is outside the Operational Area but within the EMBA. **Nearest habitat critical to the survival of green turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 31 km from the 20 km internesting buffer around Montebello Islands.
Loggerhead turtle – Western Australia genetic stock	**Breeding:** About September to March **Nesting**: October to March. Peak period from late December to early January	Carnivorous – feeding mainly on molluscs and crustaceans	**Preferred habitat**: Nearshore and island coral reefs, bays and estuaries in tropical and warm temperate latitudes. **Distribution:** Shark Bay to North West Cape and as far north as Muiron Islands and Dampier Archipelago. **Major nesting sites**: Principally from Dirk Hartog Island, along the Gnarloo and Ningaloo coast to North West Cape and the Muiron Islands. There have been occasional records from Varanus and Rosemary Islands in the Pilbara. Late summer nesting recorded for Barrow Island, Lowendal Islands and Dampier Archipelago. **Internesting habitat:** Limited data on Australian loggerhead turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (Commonwealth of Australia, 2017). **Nearest BIA**: Nesting on the Montebello Islands (peak late December–early January) with a 20 km internesting buffer. Loggerhead nesting turtle habitat is outside the Operational Area but within the EMBA. **Nearest habitat critical to the survival of loggerhead turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 188 km from the 20 km internesting buffer around the Muiron Islands. **Nearest habitat critical to the survival of a species** (Commonwealth of Australia, 2017): The Operational Area lies about 31 km from the 20 km internesting buffer around the Montebello Islands.
Hawksbill turtle – Western Australia genetic stock	**Nesting**: October to February with a peak period in December and January	Mainly sponges – also seagrasses, algae, soft corals and shellfish	**Preferred Habitat:** Nearshore and offshore reef habitats. **Distribution:** Shark Bay north to Dampier Archipelago. **Major nesting sites:** The most significant rookery in WA is at Rosemary Island. Other rookeries include Varanus

Turtle species	Key seasons within the Northwest Shelf Province	Diet	Key habitats
			Island in the Lowendal group, some islands in the Montebello group and along the Ningaloo Coast. **Internesting habitat:** Limited data on Australian hawksbill turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (Commonwealth of Australia, 2017). **Nearest BIA**: Nesting on the Montebello Islands in spring and early summer (peak October) with a 20 km internesting buffer. Hawksbill turtle nesting habitat is outside the Operational Area but within the EMBA. **Nearest habitat critical to the survival of hawksbill turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 31 km from the 20 km internesting buffer around the Montebello Islands.
Flatback turtle – Pilbara genetic stock	**Nesting**: October to March with peak period in December and January	Carnivorous – feeding mainly on soft bodied prey such as sea cucumbers, soft corals and jellyfish	**Preferred Habitat**: Nearshore and offshore sub-tidal and soft bottomed habitats of offshore islands. **Distribution:** Shark Bay north to Dampier Archipelago. **Major nesting sites**: The largest nesting sites of the Pilbara region are Barrow Island and the mainland coast (Mundabullangana Station near Cape Thouin and smaller nesting sites at Cemetery Beach in Port Hedland and Bell's Beach near Wickham). Other significant rookeries include Thevenard Island, the Montebello Islands, Varanus Island, the Lowendal Islands, and islands of the Dampier Archipelago. **Internesting habitat:** Up to 70 km from nesting beaches (Waayers et al., 2011). Satellite tracking of flatback turtle nesting populations at Barrow Island indicates this species travels to the east of Barrow Island, towards WA mainland coastal waters, between nesting events (Chevron, 2009; RPS, 2010d). **Nearest BIA:** Foraging, mating and nesting at the Montebello Islands in summer with an 80 km internesting buffer. Therefore this key habitat overlaps the Operational Area. **Nearest habitat critical to the survival of flatback turtles** (Commonwealth of Australia, 2017): A 60 km internesting buffer surrounding nesting locations at Barrow Island and Montebello Islands overlaps with the Operational Area.
Leatherback turtle – Australia genetic stock	No confirmed nesting activity in Western Australia	Carnivorous – feeding mainly in the open ocean on jellyfish and other soft-bodied invertebrates	**Preferred Habitat**: Nearshore, coastal tropical and temperate waters, may be encountered within the Northwest Shelf Province but noted that there are no known nesting sites within the Province.

Source: DEC (2012), DSEWPaC (2012a), DoEE (2017), Commonwealth of Australia (2017)

Post-nesting migratory routes for green, hawksbill and flatback turtles recorded for the Northwest Shelf Province (Barrow Island and mainland sites) (Chevron, 2012) and green turtle tracking for post-nesting individuals from Scott Reef (Guinea, 2011), outside the EMBA, indicate no overlap with the Operational Area. Green, flatback and hawksbill turtles travelling from nesting sites to foraging grounds generally travelled east or south of Barrow Island, around or through the Dampier Archipelago and along the coast towards foraging grounds to the north (north of Broome). The hawksbill turtle is an exception as it tends to travel south to the coastal island chain south of Barrow

Island (Chevron, 2012). Tracking data indicates the three marine turtle species recorded for the Northwest Shelf Province travel and forage in coastal waters that are relatively shallow (Chevron, 2012) as follows:

- hawksbill turtles – less than 10 m deep
- green turtles – less than 25 m deep
- flatback turtles – less than 70 m deep.

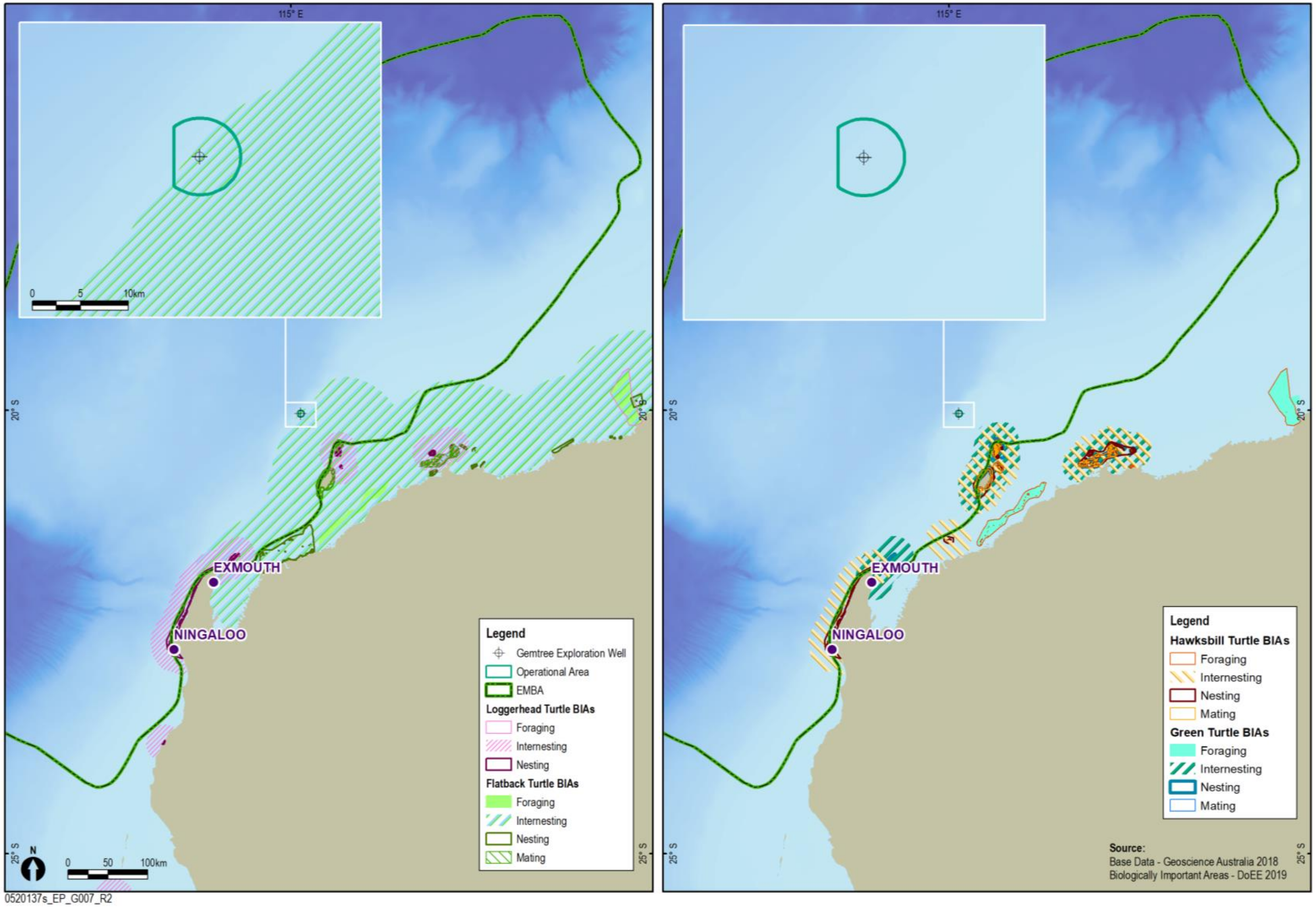


Figure 4-13: BIAs for marine turtles in the region of the Operational Area

Seasnakes

Seasnakes occur across the NWMR and are reported to occur in offshore and nearshore waters. They occupy diverse habitats including coral reefs, turbid water habitats and deeper water (Guinea et al*.,* 2004). Species exhibit habitat preferences depending on water depth, benthic habitat, turbidity and season (Heatwole & Cogger, 1993).

The short-nosed seasnake, listed as Critically Endangered under the EPBC Act, was identified as potentially occurring within the EMBA (although not within the Operational Area). There are a small number of records of individuals collected along the Western Australian coast from the Exmouth Gulf to Broome (Storr et al., 2002; Kangas et al., 2018). The origin of these specimens has not been determined, but they may have been vagrants or they may represent a population which has not yet been identified. This species may have a wider distribution; however, there are no conclusive records relating to the species distribution outside Australian waters (DSEWPaC, 2011a).

Seasnakes of the families *Hydrophidae* and *Laticaudidae* are widespread in the EMBA and are protected under the EPBC Act. The Protected Matters Search identified 17 species of seasnake listed as marine under the EPBC Act within the EMBA (Appendix C). The most commonly sighted seasnake in the region is the olive seasnake (*Aipysurus laevis*), which is generally found along lower reef edges and upper lagoon slopes of leeward reefs. The olive seasnake is associated with shallow water, as large, deep water expanses create a significant barrier to movement.

Most seasnake species have depth distributions <50 m (Cook et al., 2016; Heatwole & Seymour 1975), however recent ROV surveys in the Browse Basin have sighted sea snakes of the genus *Hydrophis* at depths >200 m (Crowe-Riddell, 2019). Given the water depth of the Operational Area, seasnake sightings will be infrequent and likely comprise few individuals. Seasnakes have a higher likelihood of occurrence in shallower (< 100 m deep) waters such as the Montebello AMP, within the EMBA.

4.5.2.7 Fishes and Elasmobranchs

This section provides a description of EPBC Act listed fish and elasmobranch species that may occur within the Operational Area and/or EMBA.

Seahorses, Pipehorses and Pipefishes

A search of the EPBC Act Protected Matters database identified the potential for 29 species of pipehorses and pipefishes and six species of seahorse to occur in the Operational Area (Appendix C). However, by-catch data (DoF, 2010) indicates they are uncommon in deeper continental shelf waters (50–200 m) and therefore are unlikely to occur within the Operational Area.

This family (*Syngnathidae*) are commonly found within the nearshore and coastal waters of the EMBA, especially in seagrass and sandy habitats around coastal islands and shallow reef areas along the NWS. *Syngnathidae* are likely to be found in coastal areas including the Ningaloo area and the Dampier Archipelago. Recent data collected using BRUVS at Rankin Bank and Glomar Shoal did not record any seahorses, pipehorses or pipefishes (AIMS, 2014).

Sharks and Rays

Whale Shark

The DAWE has defined a BIA for foraging whale sharks (post aggregation at Ningaloo) centred on the 200 m isobath from July to November (Commonwealth of Australia, 2015d; Figure 4-14). This area extends northward from the Ningaloo aggregation area and partially overlaps with the south-east portion of the Operational Area. Anecdotal evidence from sightings data collected from the Woodside offshore facilities on the NWS indicate whale sharks are present on the NWS in the months of April, July, August, September and October, corresponding with the whale shark's seasonal migration to and from the Ningaloo Reef. However, the numbers of individual whale sharks that transit through the Operational Area is expected to be low, based on the number of whale sharks aggregating at Ningaloo and on the different migration paths that the sharks may follow (see below).

In the EMBA, whale sharks aggregate annually to feed in the waters around Ningaloo Reef (about 206 km south-west of the Operational Area) from March to July, with the largest numbers recorded in April and May (Sleeman et al., 2010). However, seasonal aggregation can be variable, with individual whale sharks recorded at other times of the year. The super-population (comprising individuals that visit the reef at some point during their lifetime) has been estimated to range between 300 and 500 individuals. It is expected that the number visiting Ningaloo Reef in any given year will be somewhat smaller (Meekan et al., 2006). Timing of the whale shark migration to and from Ningaloo coincides with the coral mass spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef. At Ningaloo Reef, whale sharks stay within a few kilometres of the shore and in waters about 30–50 m deep (Woodside, 2002; Wilson et al., 2006).

After the aggregation period, the distribution of the whale sharks is largely unknown. Tagging, aerial and vessel surveys suggest that the group disperses widely, up to 1800 km away into Indonesian waters. Satellite tracking has shown that the sharks may follow three migration routes from Ningaloo:

1. north-west, into the Indian Ocean
2. directly north, towards Sumatra and Java
3. north-east, passing through the NWS and Browse, travelling along the shelf break and continental slope (Meekan & Radford, 2010) (Figure 4-14).

Though the BIA has been defined as foraging for whale sharks, based on the literature it is more likely to be a migration pathway with whale sharks undertaking opportunistic foraging. Given the BIA for whale sharks spatially overlaps the Operational Area, it is expected that whale sharks may traverse the vicinity of the Operational Area during their migrations to and from Ningaloo Reef. However, it is expected that whale shark presence within the area would be of a relatively short duration and not in significant numbers, given the main aggregations are recorded in coastal waters, particularly the Ningaloo Reef edge (Marine Park Reserves Authority (MPRA), 2005).

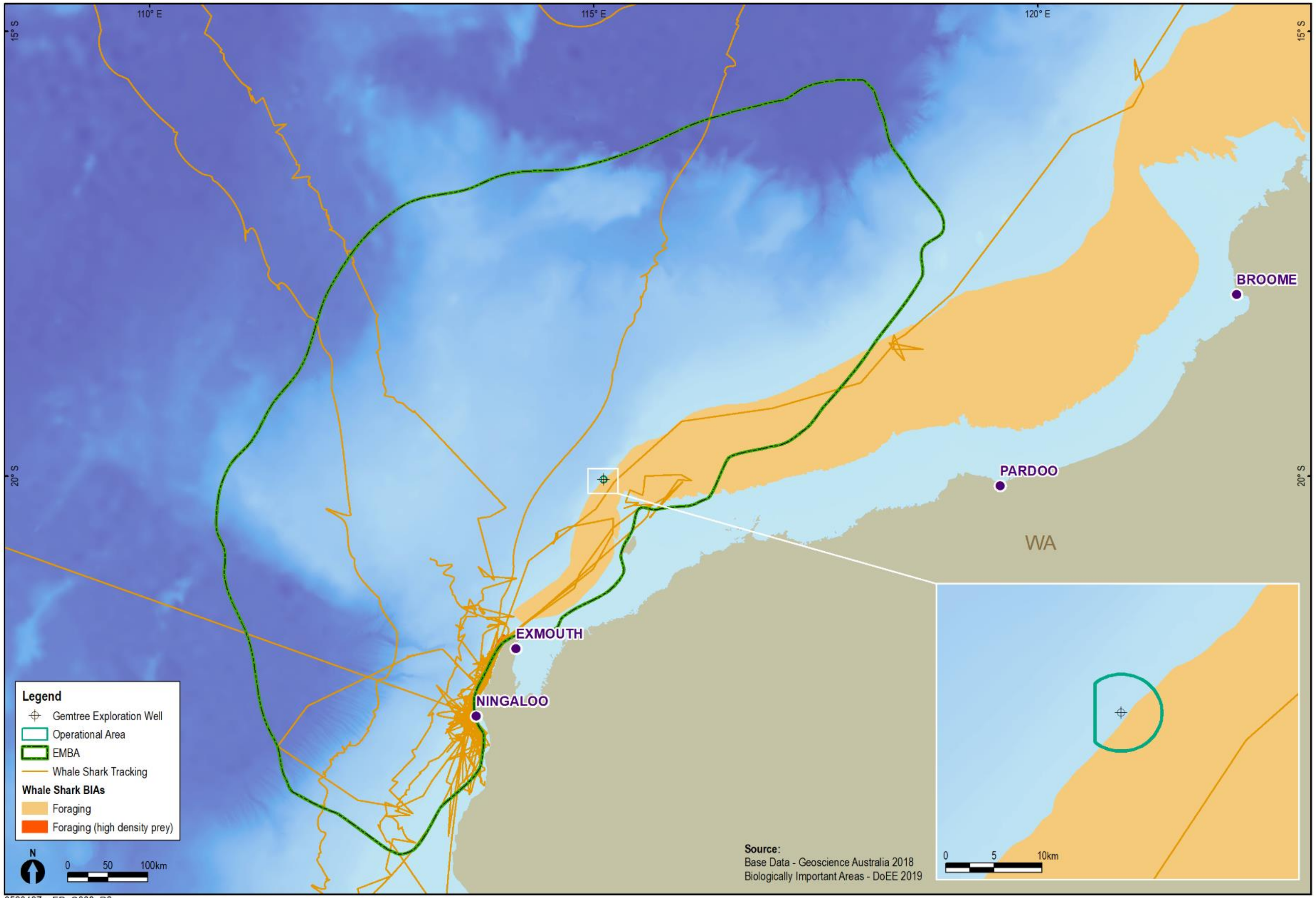


Figure 4-14: Whale shark BIAs and short- and long-term satellite tracking of 15 whale sharks tagged between 2005 and 2008

Grey Nurse Sharks

The grey nurse shark has a broad inshore distribution, primarily in sub-tropical to cool temperate waters (Last & Stevens, 1994) and is predominantly found in the south-west coastal waters of WA and as far north as the NWS (Stevens, 1999; Pogonoski et al., 2002). The grey nurse shark is generally found between 15 and 40 m (Otway & Parker, 2000). The Operational Area is in offshore waters and as such, sightings of grey nurse sharks are considered highly unlikely to occur in the Operational Area. However, grey nurse sharks are likely to be found within the EMBA.

Great White Shark

The great white shark typically occurs between the coast and the 100 m depth contour, although adults and juveniles have been recorded diving to depths of 1000 m (Bruce et al., 2006; Bruce & Bradford, 2008). They are also known to make open ocean excursions of several hundred kilometres and can cross ocean basins (for instance from South Africa to the western coast of Australia) (Weng et al., 2007). Along the WA coastline, great white sharks occur from the Montebello Islands in north-western Western Australia, south around the coast to central Queensland (CSIRO, 2018). Great white sharks are often found in regions with high prey density, such as pinniped colonies (DEWHA, 2009b). Occurrence of great white sharks within the Operational Area is likely to be infrequent and restricted to transiting individuals.

Dwarf Sawfish

The dwarf sawfish is found in Australian coastal waters extending north from Cairns around the Cape York Peninsula in Queensland to the Pilbara coast (Commonwealth of Australia, 2015e). Dwarf sawfish typically inhabit shallow (2 to 3 m) silty coastal waters and estuarine habitats, occupying relatively restricted areas and moving only small distances (Stevens et al., 2008). The majority of capture locations for the species in WA waters have occurred within King Sound and the lower reaches of the major rivers that enter the sound, including the Fitzroy, Mary and Robinson rivers (Morgan et al., 2009). Individuals have also been recorded from Eighty Mile Beach in the Pilbara. Occasional individuals have also been taken from considerably deeper water from trawl fishing (Morgan et al., 2009). The dwarf sawfish was identified as occurring within the EMBA, but not within the Operational Area. The species may be present within shallower waters of the EMBA around the Pilbara coastline.

Green Sawfish

Green sawfish were once widely distributed in coastal waters along the northern Indian Ocean, although it is believed that northern Australia may be the last region where significant populations exist (Stevens et al., 2005). Within Australia, green sawfish are currently distributed from around the Whitsundays in Queensland, across northern Australian waters to Shark Bay in Western Australia (Commonwealth of Australia, 2015e). Green sawfish are present in coastal waters and tidal creeks and, despite records for deeper offshore waters, their range is mostly restricted to the inshore fringe with a strong association to mangroves and adjacent mudflat habitats (Commonwealth of Australia, 2015e). The Multi-species Recovery Plan for Sawfish and River Sharks indicates ‘known to occur’ distribution includes offshore waters of the North West Shelf, with pupping ‘likely to occur’ south of Port Hedland, Exmouth Gulf and North West Cape (Commonwealth of Australia, 2015e). The Operational Area is not considered a sensitive area for the green sawfish.

Based on the distance from preferred shallow coastal habitats and the water depth of the Operational Area (about 166–511 m), it is highly unlikely that green sawfish will occur within the Operational Area, although they may be present within the EMBA.

Narrow Sawfish

The narrow sawfish occurs from the northern Arabian Gulf to Australia and north to Japan. The species inhabits inshore and estuarine waters and offshore waters up to depths of 100 m (D'Anastasi et al., 2013) and are most commonly found in sheltered bays with sandy bottoms. They are not currently listed as threatened but are commonly caught as by-catch, and constituted over half of sawfish by-catch in the Northern Prawn Fishery in 2013 (Morgan et al., 2010). The species was identified as potentially occurring within the Operational Area; however, due to water depths are unlikely to be present at the depths associated with the Operational Area. Narrow sawfish may occur in the EMBA, particularly in nearshore estuarine environments.

Shortfin Mako

The shortfin mako is a wide-ranging oceanic pelagic shark that is widespread in Australian waters, though rarely recorded in water temperatures below 16 °C (DEWHA, 2010). Recently tagged shortfin makos spent most of their time in water less than 50 m deep but with occasional dives up to 880 m deep (Stevens et al., 2010; Abascal et al., 2011). Little is known about the population size and distribution of shortfin mako sharks in WA; however, it is possible they will transit the Operational Area. It is expected that the number of individuals encountered will be low due to their preference for shallow waters (<50 m) but it is likely they will be within the broader EMBA.

Longfin Mako

The longfin mako is a widely distributed but rarely encountered oceanic tropical shark found in Australian waters south to Geraldton in WA (outside the EMBA) and to at least Port Stephens in New South Wales (DEWHA, 2010). The longfin mako is often confused with the shortfin mako. There is very little information about these sharks in Australia, with no available population estimates or distribution trends. Occurrence within the Operational Area is likely to be infrequent and restricted to transiting individuals. However, it is likely they will be within the broader area including the NWS region and the EMBA.

Porbeagle Shark

The porbeagle shark is found in temperate, sub-Arctic and sub-Antarctic waters worldwide. The porbeagle shark has a wide vertical range within the water column, with tagging studies recording the species between the surface and >700 m water depth (Saunders et al., 2011). Given its preference for cooler waters (Bruce, 2013), the porbeagle shark is unlikely to occur even in the southern portion of the EMBA. The species was not identified as occurring within the Operational Area.

Giant Manta Ray

The giant manta ray is very common in tropical waters of Australia, including the Ningaloo Marine Park, Muiron Islands Marine Park and Management Area, and the Montebello Islands Marine Park/Barrow Island Marine Management Area, all located within the EMBA. The giant manta ray primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall et al., 2018). The Operational Area is not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). However, Ningaloo Reef, over 206 km south-west of the Operational Area (but within the EMBA) is an important area for giant manta rays in autumn and winter (Preen et al., 1997). Occurrence of giant manta rays within the Operational Area is likely to be infrequent, and restricted to individuals transiting the area.

<u>Reef Manta Ray</u>

The reef manta ray is globally distributed in tropical and subtropical waters. It is a planktivorous species and is thought to migrate relatively long distances, travelling up to 70 km per day and moving between specific productive areas (Couturier et al., 2011; van Duinkerken, 2010). The reef manta ray is most often sighted inshore, around coastal areas and coral reefs. Species residency has been recorded along the Western Australian coastline, most notably at Ningaloo Marine Park. The Operational Area is not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). Occurrence of giant manta rays within the Operational Area is likely to be infrequent, and restricted to individuals transiting the area.

4.5.2.8 Birds

Seabirds and/or Migratory Shorebirds within the Operational Area

11 species of listed birds (described in detail below) were identified by the EPBC Act Protected Matters Search (Appendix C) as potentially occurring within the Operational Area (Table 4-3), being:

- southern giant petrel (*Macronectes giganteus*) – Endangered and Migratory
- red knot (*Calidris canutus*) – Endangered
- eastern curlew (*Numenius madagascariensis*) – Critically Endangered
- Australian fairy tern (*Sternula nereis nereis*) – Vulnerable
- common noddy (*Anous stolidus*) – Migratory
- streaked shearwater (*Calonectris leucomelas*) – Migratory
- lesser frigatebird (*Fregata ariel*) – Migratory
- pectoral sandpiper (*Calidris melanotos*) – Migratory
- osprey (*Pandoin heliaetus*) – Migratory
- common sandpiper (*Actitis hypoleucos*) – Migratory
- sharp-tailed sandpiper (*Calidris acuminate*) – Migratory.

The Operational Area may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be used as roosting or nesting habitat. It contains no known critical habitats (including feeding) for any species. However, a BIA defined by the DAWE for the migratory wedge-tailed shearwater during its breeding period in the region (August to April) overlaps the Operational Area. The wedge-tailed shearwater is a breeding visitor to the Kimberley, Pilbara and Gascoyne coasts and is listed as Migratory under the EPBC Act. Note that the EPBC PMST did not identify wedge-tailed shearwaters as potentially occurring within the Operational Area.

There is a National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011–2016, which identifies foraging in waters south of 25 degrees as habitat critical to the survival of albatrosses and giant petrels (DSEWPaC, 2011b). No habitat critical to the survival of the southern giant-petrel has been identified to overlap the Operational Area; therefore the presence of this species within the Operational Area is likely to be infrequent as individuals traverse the area.

Based on the results of two survey cruises and other unpublished records, Dunlop et al. (1995) recorded the occurrence of 18 species of seabirds over the Northwest Shelf Province. These included a number of species of petrel, shearwater, tropicbird, frigatebird, booby and tern, as well as the silver gull. Of these, eight species occur year-round, and the remaining ten are seasonal visitors. From these surveys, it was noted that seabird distributions in tropical waters were generally patchy, except near islands. Migratory shorebirds may be present in or fly through the region between July and December, and again between March and April, as they complete migrations between Australia and offshore locations (Environment Australia, 2002).

Southern Giant Petrel

The southern giant petrel is the largest species of petrel, and is listed as Endangered and Migratory under the EPBC Act. The southern giant-petrel occurs in Antarctic to subtropical waters, and breeds on six sub-Antarctic and Antarctic islands, which are all outside the EMBA. The species is thought to travel varied and potentially long migratory pathways between foraging and breeding habitat (DSEWPaC, 2012d). Due to preferred habitat and known movement patterns, the species is not expected to occur within the Operational Area, but may be in the southern region of the EMBA.

Red Knot

The red knot is listed as Endangered and Migratory under the EPBC Act. The species undertakes long distance migrations from breeding grounds in high northern latitudes, where it breeds during the boreal summer, to the southern hemisphere during the austral summer. Both Australia and New Zealand host significant numbers of red knots during their non-breeding period (Bamford et al., 2008). As with other migratory shorebirds, the species occurs in coastal wetland and intertidal sand or mudflats throughout the EMBA, but is unlikely to occur in the Operational Area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Eastern Curlew

The eastern curlew is Australia's largest shorebird, and is listed as Critically Endangered and Migratory under the EPBC Act. The eastern curlew is a coastal species with a continuous distribution north from Barrow Island to the Kimberley region. The species is endemic to the East Asian–Australasian Flyway. The species is a non-breeding visitor to Australia from August to March, primarily foraging on crabs and molluscs in intertidal mudflats. Due to the lack of emergent habitat, the eastern curlew is not expected to occur within the Operational Area; however, will potentially be present at coastal locations within the EMBA, particularly at the peak of migration during the Australian summer.

Australian Fairy Tern

The Australian fairy tern is listed as Vulnerable under the EPBC Act. It has a coastal distribution from Sydney, south to Tasmania and around southern Western Australia up to Dampier. The Australian fairy tern feeds on small baitfish and roosts and nests on sandy beaches below vegetation (Higgins & Davies, 1996; Van de Kam et al., 2004). Although identified by the EPBC search as occurring within the Operational Area, due to the coastal distribution of the species the Australian fairy tern is unlikely to occur within the Operational Area. However, it is likely to occur in the coastal regions of the EMBA.

Common Noddy

The common noddy is the largest species of noddy found in Australian waters, and is listed as Migratory under the EPBC Act. The species is widespread in tropical and subtropical areas beyond Australia. This seabird typically forages in coastal waters around nesting sites, taking prey such as small fish, but may occur longer distances out to sea. Nesting occurs broadly across tropical and subtropical Australia in coastal areas, particularly on islands such as the Houtman Abrolhos island group (Johnstone et al., 2013). The common noddy is thought to undertake seasonal movements, with some nesting sites abandoned during the non-breeding season (which is protracted between spring and autumn). The species is unlikely to occur within the Operational Area, aside from individuals occasionally transiting through during migration periods. The species will occur within the EMBA, particularly around offshore and coastal islands.

Streaked Shearwater

The streaked shearwater is listed as Migratory under the EPBC Act. It is most commonly found in pelagic and inshore waters of the Pacific Ocean. Within Australian waters, the species is commonly distributed from Exmouth, across northern Australia to Queensland, south to New South Wales (DSEWPaC, 2012). Its diet consists of invertebrates and epipelagic fishes (Atlas of Living Australia, 2019). The species breeds in temperate regions of east and south-east Asia before migrating to tropical regions near the equator; however, little is known about their movements during the non-breeding period (Yamamoto et al., 2010).

Lesser Frigatebird

The lesser frigatebird is listed as Migratory under the EPBC Act. This seabird is the most widely distributed frigatebird in Australian tropical seas, and is the smallest species of frigatebird. The species is well-adapted for an aerial existence and may range considerable distances from land. Food consists largely of fish taken at the sea surface or stolen from other birds. Beyond Australia, the lesser frigatebird occurs throughout the tropical Indian Ocean, the western tropical Pacific Ocean, and the south-western tropical Atlantic Ocean. The lesser frigatebird may occur within the Operational Area and the tropical seas of the EMBA.

Pectoral Sandpiper

The pectoral sandpiper is listed as Migratory under the EPBC Act. As with other species of sandpiper, the pectoral sandpiper breeds in the northern hemisphere during the boreal summer, before undertaking long distance migrations to feeding grounds in the southern hemisphere. The species occurs throughout mainland Australia between spring and autumn. The pectoral sandpiper prefers coastal and near-coastal environments such as wetlands, estuaries and mudflats. Given the species' preferred habitat the pectoral sand piper is not expected to occur within the Operational Area, but is expected to occur in suitable habitats within the EMBA.

Osprey

Ospreys are listed as Migratory under the EPBC Act. Within Australia, Ospreys are most commonly found in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. In Australia, Ospreys breed from April to February in individual pairs. Ospreys are mostly resident around breeding territories, foraging more widely during non-breeding season and feeding primarily on fish. Due to the lack of emergent habitat, Ospreys are not expected to occur within the Operational Area; however, will potentially be present at fragmented coastal locations within the EMBA.

Common Sandpiper

The common sandpiper is listed as Migratory under the EPBC Act. The species is a small, migratory sandpiper with a very large range through which it migrates annually between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford et al., 2008). The species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al., 2008). The common sandpiper may be present in coastal wetland and intertidal sand or mudflats throughout the EMBA, but is unlikely to occur in the Operational Area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Sharp-Tailed Sandpiper

The sharp-tailed sandpiper is listed as Migratory under the EPBC Act. Like other species of sandpiper, the sharp-tailed sandpiper is a migratory wading shorebird and seasonally migrates long distances between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford et al., 2008). The species may occur in Australia between spring and autumn. The species is unlikely to occur within the Operational Area due to the lack of suitable habitat, but may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the EMBA.

Seabirds and/or Migratory Shorebirds within the EMBA

Thirty-six listed species of seabird and shorebirds were identified as potentially occurring within the EMBA, including 11 Threatened species (Table 4-3). There are several important habitats for seabirds and migratory shorebirds within the EMBA, including key breeding/nesting areas, roosting areas and surrounding waters, important foraging and resting areas. These include the islands of the Montebello/Barrow/Lowendal Islands Group (including known nesting habitats on Boodie, Double and Middle islands), the Pilbara Southern Island group, Ningaloo Coast and Muiron Islands. These habitats are discussed further as key environmental sensitivities in Section 4.7. BIAs for seabirds and migratory shorebirds within the EMBA are described at the beginning of this section.

4.6 Socio-economic and Cultural

4.6.1 Cultural Heritage

4.6.1.1 European Sites of Significance

There are no known sites of Indigenous or European cultural heritage significance within the vicinity of the Operational Area.

4.6.1.2 Indigenous Sites of Significance

Within the EMBA, Barrow Island, Montebello Islands, Exmouth, Ningaloo Reef and the adjacent foreshores have a long history of occupancy by Aboriginal communities. Indigenous heritage places are protected under the *Aboriginal Heritage Act 1972* (WA) or EPBC Act. The DPLH Heritage Inquiry System was searched from the Pilbara Southern Island Group to the Montebello/Barrow Islands (Appendix G). The search indicated several registered sites, including artefacts and rock shelters. The exact location, access and traditional practices for a number of these sites are not disclosed and if required, such as in the event of a major oil spill, would involve prioritising further consultation with key contacts within DPLH and local Aboriginal communities.

4.6.1.3 Historic Shipwrecks

Historic shipwrecks and sunken aircraft are protected and managed under the *Underwater Cultural Heritage Act 2018*.

A search of the National Shipwreck Database (DoE, 2019a) indicates there are no known historic shipwrecks within the Operational Area. The closest known wreck to the Operational Area is the Trial, wrecked at Trial Rocks about 35 km south-east of the Operational Area and within the EMBA.

Table 4-9: Recorded shipwrecks in the Montebello/Barrow/Lowendal Islands area

Vessel Name	Year Wrecked	Wreck Location*	Latitude**	Longitude**
Wild Wave (China)	1873	Montebello Islands	20.0ºS***	115.17ºE***
Curlew	1911	At Onslow, Montebello Group	20.0ºS***	115.17ºE***
Marietta	1905	Montebello Islands	20.0ºS***	115.17ºE***
Vianen	1628	Barrow Island	20.0ºS***	115.17ºE***
Tanami	1622	Trial Rocks 16 km NW of Montebello Islands	20.28ºS	115.37ºE
Trial	1622	Trial Rocks	20.29ºS	115.38ºE
Unidentified boat	1893	Montebello Islands	16.75ºS	122.0ºE

** Wreck location names are as stated by DoEE (2019a). ** WGS84. *** Considered an unreliable generic location – refer to stated wreck location.*

4.6.1.4 National and Commonwealth Heritage Listed Places

There are no heritage listed sites within or immediately adjacent to the Operational Area. Within the EMBA, two National Heritage listed places occurs: the Ningaloo Coast (about 175 km from the Operational Area), and the Barrow Island and Montebello-Barrow Islands Marine Conservation Reserves.

There is one place on the Commonwealth Heritage list within the EMBA, the Ningaloo Marine Area – Commonwealth waters.

The significant values of the National Heritage and Commonwealth Heritage Listed Places are outlined in Section 4.7.

4.6.2 Ramsar Wetlands

Ramsar wetlands are sites that have been included on the List of Wetlands of International Importance on the basis of representativeness or uniqueness or of biodiversity values. There are no Ramsar wetlands within or immediately adjacent to the Operational Area. The closest Ramsar wetland occurs at Eighty Mile Beach, over 475 km east of the Operational Area and beyond the EMBA.

4.6.3 Fisheries – Commercial

4.6.3.1 Commonwealth and State Fisheries

A number of Commonwealth and State fisheries are located within, adjacent to, or in the region of the Operational Area. Table 4-10 provides further detail on the fisheries that have been identified through desk based assessment and consultation (Section 5).

Figure 4-15 and Figure 4-16 provide the designated fisheries management areas in relation to the location of the Operational Area.

Table 4-10: Commonwealth and State fisheries within or adjacent to the Operational Area

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Commonwealth				
North West Slope Trawl Fishery	✓	✓	✓	**Description:** The North West Slope Trawl Fishery (NWSTF) management area occurs from 114°E to 125°E and between the 200 m isobath to the outer limit of the Australian Fishing Zone (Figure 4-15). The NWSTF management area partially overlaps the Operational Area. The NWSTF traditionally targets scampi and deepwater prawns. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350–600 m using demersal trawl gear on the continental slope (DAFF, 2014). The major landing ports for the NWSTF include Darwin and Point Samson. Four vessels were active in the 2017-18 season, an increase from two vessels active in the 2016-17 season. Accordingly, total scampi catch in the fishery increased in 2017-18 than in the previous year, 57.7 t up to 79.7 t (Patterson et al., 2019). Fishing effort often increases when boats cease to operate in the Northern Prawn Fishery in a given season and move to the NWSTF. Fishing effort from the NWSTF may occur within the Operational Area and wide EMBA. **Fishing boundary distance from the Operational Area:** The NWSTF management boundary partially overlaps with the Operational Area. **Active vessels:** Four vessels (Patterson et al., 2019).
Western Tuna and Billfish Fishery	✓	✓	X	**Description:** The Western Tuna and Billfish Fishery management area extends west from the Gulf of Carpentaria to the South Australian/Victorian border. Fisheries data indicates that this long-line fishery has been declining since 2001, with a total of 95 statutory fishing rights and fewer than five active vessels since 2005 (Patterson et al., 2019). The majority of fishing effort occurs off south-west Australia, distant from the Operational Area and outside the EMBA. (Figure 4-15). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** Three vessels (two pelagic longline, one minor longline).

Fishery	Management area overlap with: Operational Area	Management area overlap with: EMBA	Potential for interaction within Operational Area	Description
Southern Bluefin Fishery and Western Skipjack Fishery	✓	✓	X	**Description:** The Southern Bluefin Tuna Fishery management area and the Western Skipjack Tuna Fishery (WSTF) management area covers the entire Australian Fishing Zone. Both fisheries constitute a single, highly migratory stock that spawns in the north-east Indian Ocean and migrates throughout the temperate southern oceans. Tuna is one of the most highly valued fish species and is targeted by fishing fleets from a number of nations, both on the high seas and within the Exclusive Economic Zones of Australia, New Zealand, Indonesia and South Africa. The majority of the fishing effort for the Southern Bluefin Tuna Fishery occurs in the Great Australian Bight and north-east of Eden in New South Wales (Patterson et al., 2019). No fishing activity for the WSTF has been recorded since the 2008–2009 fishing season as a result of the natural variability of skipjack tuna stocks in Australian waters and low unit price for this species (Patterson et al., 2019; Georgeson et al., 2014). Fishing activity for either of these tuna fisheries is not expected within the Operational Area. **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Active vessels:** Seven purse seine vessels and 31 longline vessels active in the SBTF (Patterson et al., 2019). No vessels are active in the WSTF.
Western Deepwater Trawl Fishery	X	✓	X	**Description:** 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, outside of the Operational Area but within the EMBA (Figure 4-15). This fishery targets a number of deep water, demersal finfish and crustacean species. The nominated fishing grounds are extensive; however, most of the fishing effort is south and offshore of the North West Cape. Effort increased from one vessel spending 11 days fishing in the 2017-17 season, to three vessels spending 100 days fishing in the 2017-18 season (Patterson et al., 2019). Areas of medium and high density fishing activity are located to the south of Ningaloo Reef and west of Shark Bay, beyond the 200 m isobath (Patterson et al., 2019). **Fishing boundary distance from the Operational Area:** The Western Deepwater Trawl Fishery management boundary is located about 70 km west of the Operational Area. **Active vessels:** Three vessels (Patterson et al., 2019).
State				
West Australian Mackerel Managed Fishery	✓	✓	X	**Description:** The West Australian Mackerel Managed Fishery (MMF) operates in waters along the North West Shelf, outside the Operational Area but within the EMBA. The MMF targets Spanish mackerel (*Scomberomorus commerson*) using near-surface trolling gear from small vessels in coastal areas around reefs, shoals and headlands (Lewis & Brand-Gardner, 2019). Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), with other species from the genera *Scomberomorus* (Molony et al., 2014). Spanish mackerel is found in Australian waters from Geographe Bay in south-west Western Australia, throughout northern Australian waters and down the east coast as far as St. Helens in Tasmania (DoF, 2004). The commercial fishery extends from Geraldton to the Northern Territory border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West Coast (Area 3). The majority of the catch is taken in the

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
				Kimberley region, reflecting the tropical distribution of mackerel species (Lewis & Brand-Gardner, 2019). The Operational Area is located in the Pilbara fishing area (Area 2), where the majority of fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, away from the Operational Area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development prior to spawning (Molony et al., 2014). The EMBA extends into Area 3, which extends from the Gascoyne to Cape Leeuwin. The commercial fishery takes place over about six months from May – November, when Spanish mackerel are abundant in coastal areas (Lewis & Brand-Gardner, 2019). Spanish mackerel spawn between September and January when inhabiting coastal reef areas of the North West Shelf, with females exhibiting serial spawning behaviour (spawning every one to three days) over the spawning period. Outside the main fishing season it is unclear where the mackerel populations inhabit, although there is anecdotal evidence to suggest populations move into deeper offshore waters (Fletcher & Santoro, 2014). The Mackerel Managed Fishery does not fish within the Operational Area, but is active within this EMBA (Department of Primary Industries and Regional Development (DPIRD), 2019a). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Active vessels:** 13 vessels fished during the 2017 mackerel fishing season, employing about 30 people, primarily from May to November (Lewis & Brand-Gardner, 2017).
Pearl Oyster Managed Fishery, Pearl Leases	✓	✓	X	**Description:** The fishery is separated into four zones. The Operational Area and EMBA overlaps the Pearl Oyster Zone 1, which extends from North West Cape (including Exmouth Gulf) (119°30´E) to Cape Thouin (118°20´E). Fishing in Zone 1 has occurred as a low proportion (<1%) of the total annual catch after a hiatus from 2008–2013 (Hart et al., 2018a), and in 2017 there was no fishing undertaken in Zone 1 (Hart et al., 2019a). The number of wild-caught pearl oyster shell in Zone 2 and 3 was 468,573 combined in 2017. The annual value of the total industry in 2017 was estimated to be $53 million, which is lower than 2016 when it was $71 million. Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Hart et al., 2014). The Western Australian Pearl Oyster Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world (Hart et al., 2019a). The species targeted is the Indo-Pacific silver-lipped pearl oyster (*Pinctada maxima*), which is collected in shallow coastal waters along the NWS using divers, and are mainly used to culture pearls. No fishing effort occurs within or nearby the Operational Area (DPIRD, 2019a). Within the EMBA, in the Gascoyne region, oysters are produced in hatcheries. Hatcheries in Carnarvon and Exmouth supply significant quantities of *P. maxima* spat to pearl farms in Exmouth Gulf and the Montebello Islands, while several hatcheries supply juveniles of the blacklip pearl oyster (*P. margaritifera*) to the region's developing black pearl farms. **Fishing boundary distance from the Operational Area:** The Operational Area overlaps the Pearl Oyster Zone 1. **Divers:** 12,845 diver hours and 468,573 shells (Hart et al., 2019a).

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Beche-de-mer Fishery	✓	✓	X	**Description:** The sea cucumber or 'Beche-de-mer' fishery is a hand-harvested fishery that can be conducted within all Western Australian waters (Hart et al., 2019b). Collection methods are limited to shallow, coastal waters (methods principally by diving or wading) and no effort occurs within the Operational Area (DPIRD, 2019a). This nearshore fishery is predominantly a single species fishery with 99% of the catch being sandfish (*Holothuria scabra*). The fishery was worth an estimated $400,000 in 2017 (Hart et al., 2018b) with a total catch of 135 tonnes (Hart et al., 2019b). There are specific areas closed to this fishery including the Dampier Archipelago and Rowley Shoals. Less than three licences have been active at the Montebello/Barrow Islands Group (within the EMBA) between 2014 and 2018 (DPIRD, 2019a). Fishing is usually concentrated in the Kimberley region, outside the EMBA (Gaughan & Santoro, 2018). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** Not applicable (shore-based).
Marine Aquarium Fish Managed Fishery	✓	✓	X	**Description:** The Marine Aquarium Fish Managed Fishery (MAFMF) can be conducted in Western Australia state waters, within the Operational Area and EMBA. The MAFMF is primarily a dive-based fishery that uses hand-held nets to capture target species operating from boats up to 8 m in length. The fishery is typically active from Esperance to Broome, with popular areas including the coastal waters of the Capes region, Dampier and Exmouth. The landed catch was predominantly ornamental fish but also included seahorses, invertebrates, corals and live rock (Newman et al., 2019a). No effort form the MAFMF occurs within the Operational Area, and the MAFMF has not been active in the Montebello/Barrow Island area since 2013, when less than three vessels were active (DPIRD, 2019b). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Licences:** 11 licences were active in 2017 (Newman et al., 2019a).

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Specimen Shell Managed Fishery	✓	✓	X	**Description:** The Specimen Shell Managed Fishery can operate in Western Australia state waters, within the Operational Area and EMBA. Effort is concentrated in the areas adjacent to the largest population centres, such as Broome, Karratha, Exmouth, Carnarvon and Perth (Fletcher & Santoro, 2014). The Specimen Shell Managed Fishery collects specimen shells for display, collection, cataloguing and sale. Collection is predominantly by hand when diving or wading in shallow coastal waters. However, deeper water collection has recently commenced with the employment of ROVs at water depths up to 300 m. No fishing effort from the Specimen Shell Managed Fishery occurs within or nearby the Operational Area (DPIRD 2019c). The Specimen Shell Managed Fishery consistently fishes around the Montebello/Barrow Island area, with less than three licences fishing in the area between 2013 and 2017 (DPIRD, 2019c). In 2017 there were 31 licence holders in the fishery, with 23 of these being active in 2017 (Hart et al., 2018c). The Specimen Shell Managed Fishery reported a total catch of 7806 shells in 2017, with a catch rate of 10–40 shells per day. **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** 31 authorisation holders in this fishery with around nine licences recording consistent activity. The number of people employed regularly in the fishery is likely to be around 20 (Hart et al, 2018c).
Onslow Prawn Managed Fishery	✓	✓	X	**Description:** The Onslow Prawn Managed Fishery encompasses a portion of the Pilbara region including nearshore waters and offshore waters within the Operational Area and EMBA (Figure 4-16). However, trawling activity is only permitted in seven managed nearshore areas, with strict seasonal fishing and voluntary moon closure periods for three days around the full moon period (Sporer et al. 2014). Only 5 days of fishing effort was undertaken by one boat in 2017 (Kangas et al. 2019). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** One vessel (Kangas et al., 2019).

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Pilbara Demersal Scalefish Fisheries (Pilbara Trawl, Trap and Line)	✓	✓	✓	**Description:** The State-regulated North Coast Demersal Fisheries comprise several management units in the Pilbara and Kimberley regions targeting a range of low and high value finfish species using several gear types (trawl, trap and line). Within the Pilbara, the Pilbara Demersal Scalefish Fisheries include the Pilbara Fish Trawl (Interim) Managed Fishery, the Pilbara Trap Managed Fishery and the Pilbara Line Fishery. The highest effort for these fisheries occurs between September and May (Fletcher & Santoro, 2014). The bulk of the catch consists of small, low value fish (spangled emperor, flagfish, threadfin bream). However, larger and more valuable fish such as red emperor, jobfish and rankin cod are also targeted. The Pilbara Fish Trawl Managed Fishery lands the largest component of the catch, operating in depths between 50 and 200 m (Fletcher & Santoro, 2014). The Pilbara Fish Trawl Managed Fishery is of high intensity and is divided into two zones: Zone 1 is closed to trawling and Zone 2 comprises six management areas, with Areas 3 and 6 closed to trawling (DoF, 2010). The Operational Area is located at the northern extent of Zone 1 (Figure 4-16). While no fishing is permitted within the Operational Area, the Pilbara Fish Trawl Managed Fishery is expected to fish within the EMBA. The Pilbara Trap Managed Fishery covers the area from Exmouth northwards and eastwards to the 120° line of longitude, and offshore to about the 200 m isobath. This fishery targets high value species such as red emperor and goldband snapper. It includes six licences consolidated onto three vessels, operating principally from Onslow. Traps are limited in number with the greatest effort in waters less than 50 m depth. Due to water depths, the Pilbara Trap Managed Fishery is not expected to fish within the Operational Area, but may fish in the EMBA. The Pilbara Line Fishery encompasses all of the 'Pilbara waters' and is the smallest fishery in terms of monetary value (Fletcher & Santoro, 2014), and by annual catch (Newman et al., 2019b). Area 3 is closed to line fishing. There are no stated depth limits and the western extent of the fishery is the boundary of the Australian Fishing Zone. The Pilbara Line Fishery may operate within the Operational Area and EMBA. The proposed timing of the Petroleum Activities Program may overlap with the spawning times for a number of key fish species that have the potential to spawn within the region (red emperor *Lutjanus sebae*, Sept-June, with bimodal peaks from Sept-Nov and Jan-Mar; baldchin groper *Choerodon rubescens*, Sep–Feb; spangled emperor *Lethrinus nebulosus*, Sep–Dec; goldband snapper *Pristipomoides multidens,* Oct-May; rankin cod *Epinephelus multinotatus*, June-Dec and Mar, peak spawning period Aug-Oct); blue spotted emperor *Lethrinus punctulatus,* Jul-Mar). **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** Ten active in 2017 (2 trawl, 3 trap and 5 line fishery vessels), employing about 33 people.

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
South-west Coast Salmon Managed Fishery	✓	✓	X	**Description:** The South-west Coast Salmon Managed Fishery operates on various beaches south of metropolitan Perth and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. This fishery uses beach seine nets to take Western Australian salmon (*Arripis truttaceus*). No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to the Western Australia/Northern Territory border. No interactions with participants in the fishery will occur during the Petroleum Activities Program. **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** Not applicable (shore-based).
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	X	**Description:** The West Coast Deep Sea Crustacean Managed Fishery operates outside of the Operational Area but within the EMBA, targeting crystal (snow) crabs (*Chaceon albus*), giant (king) crabs (*Pseudocarcinus gigas*) and champagne (spiny) crabs (*Hypothalassia acerba*) using baited pots operated in a long-line formation in the shelf edge waters (>150 m but mostly in depths of 500–800 m) of the west coast. In 2017, the total reported catch was 164.4 t (How & Orme, 2019). **Fishing boundary distance from the Operational Area:** Partially overlaps the Operational Area. **Vessels:** Six active in 2017 (How & Orme, 2019).
Abalone Fishery	✓	✓	X	**Description:** The Western Australian Abalone Fishery includes all coastal waters from the Western Australian and South Australian border to the Western Australian and Northern Territory border. Shark Bay is considered the northern range limit for the commercial abalone species (DoF, 2004) and therefore operates outside of the EMBA. In addition, abalone is harvested by hand using an abalone iron from reefs and rock shelves within Western Australian waters (DoF, 2004), limiting the fishery to shallow waters. The abalone fishery targets the greenlip abalone (*Haliotis laevigata*), brownlip abalone (*H. conicopora*) and Roe's abalone (*H. roei*) (DoF, 2004). The commercial fishery reported a total commercial catch of 49 t in 2017. **Fishing boundary distance from the Operational Area:** Overlaps the Operational Area. **Vessels:** 23 vessels active in Roe's abalone fishery (Strain et al., 2018).

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Nickol Bay Prawn Managed Fishery	X	✓	X	**Description:** The Nickol Bay Prawn Managed Fishery operates in nearshore and offshore waters of the Pilbara region along the NWS, outside of the Operational Area but within the EMBA region (Figure 4-16). The major species caught for this fishery are the banana prawn, king prawn and tiger prawn. The season for this fishery extends from March to November, with several specific areas restricted to May to September to protect nursery areas (Sporer et al., 2014). Trawling has been reported to occur at several locations along the Pilbara coast to the east of the Burrup Peninsula including within the waters of Nickol Bay (Fletcher & Santoro, 2014). **Fishing boundary distance from the Operational Area:** 168 km east of the Operational Area. **Vessels:** The precise number of vessels is unreported, though fishing effort increased to 281 boat days and produced a catch of 227.1 t, the highest catch since 2006 (Kangas et al., 2019).
Exmouth Gulf Prawn Managed Fishery	X	✓	X	**Description:** The Exmouth Gulf Prawn Managed Fishery is a limited entry fishery comprising about 16 vessels operating outside of the Operational Area but within the EMBA region out of Exmouth and bases to the south. The fishery occupies a total area of 4000 km² with only half of this area being trawled (Sporer et al., 2014). The major species caught in Exmouth Gulf are western king prawn, tiger prawn, endeavour prawn and banana prawn. Coral prawns are also caught and sold but are considered a by-product of the fishery. The fishing season extends from April to mid-November, with activities within the fishing area being further restricted by sequential closures to protect the permanent prawn nursery area. In the 2017 season, fishing effort of 18 people resulted in a catch of 713 t, worth about $9.8 million (Kangas et al., 2017). **Fishing boundary distance from the Operational Area:** 174 km south-west of the Operational Area. **Vessels:** The number of active vessels is unreported; however, 18 people (including skippers and other crew) are employed in this fishery (Kangas et al., 2017).

Fishery	Management area overlap with:		Potential for interaction within Operational Area	Description
	Operational Area	EMBA		
Gascoyne Demersal Scalefish Fishery	x	✓	X	**Description:** The Gascoyne Demersal Scalefish Fishery (GDSF) is located between the southern Ningaloo Coast to south of Shark Bay (23°07.30'S to 26°30'S) with a closure area at Point Maud to Tantabiddi (21°56.30'S). The GDSF comprises commercial and recreational fishing for demersal scalefish in the continental waters of the Gascoyne Coast Bioregion (Fletcher & Santoro, 2014), operating outside of the Operational Area but within the EMBA. Since November 2010, the GDSF has incorporated vessels that previously operated as the Shark Bay Snapper Fishery, a limited number of open-access wetline vessels and recreational fishing vessels, both licensed charter and private (Fletcher & Santoro, 2014). Commercial vessels have traditionally targeted the oceanic stocks of pink snapper (*Pagrus auratus*) during the winter months (fishing spawning aggregations in the peak season of June–July). The present GDSF continues with this pink snapper fishery and, in addition, fisheries operating throughout the year targeting other demersal species including the goldband snapper (*Pristipomoides* spp.), red emperor (*Lutjanus sebae*), emperors and cod. The GDSF reported a total commercial catch of 270 t in 2016. **Fishing boundary distance from the Operational Area:** 365 km south of the Operational Area. **Vessels:** 16 vessels fished at some point during the 2017 season (Jackson et al. 2018).
West Coast Rock Lobster Fishery	x	✓	X	**Description:** The West Coast Rock Lobster Fishery operates outside of the Operational Area but within the EMBA, targeting the western rock lobster (*Panulirus cygnus*) from Shark Bay south to Cape Leeuwin using baited traps (pots). In 2008, it was determined that the allocated shares of the West Coast Rock Lobster resource would be 95% for the commercial sector, 5% to the recreational sector, and one tonne to customary fishers. The commercial fishery has been Australia's most valuable single-species wild capture fishery. In 2012/2013, the fishery moved to an Individually Transferable Quota fishery. The fishery is managed using zones, seasons and total allowable catch. The recreational fishery targets the western rock lobsters using baited pots and by diving between North West Cape and Augusta in water depths of less than 20 m. In 2017, 234 vessels reported a total catch of 6400 t (De Lastang et al. 2018). **Fishing boundary distance from the Operational Area:** 305 km south-west of the Operational Area. **Vessels:** 234 vessels (De Lastang et al. 2018).

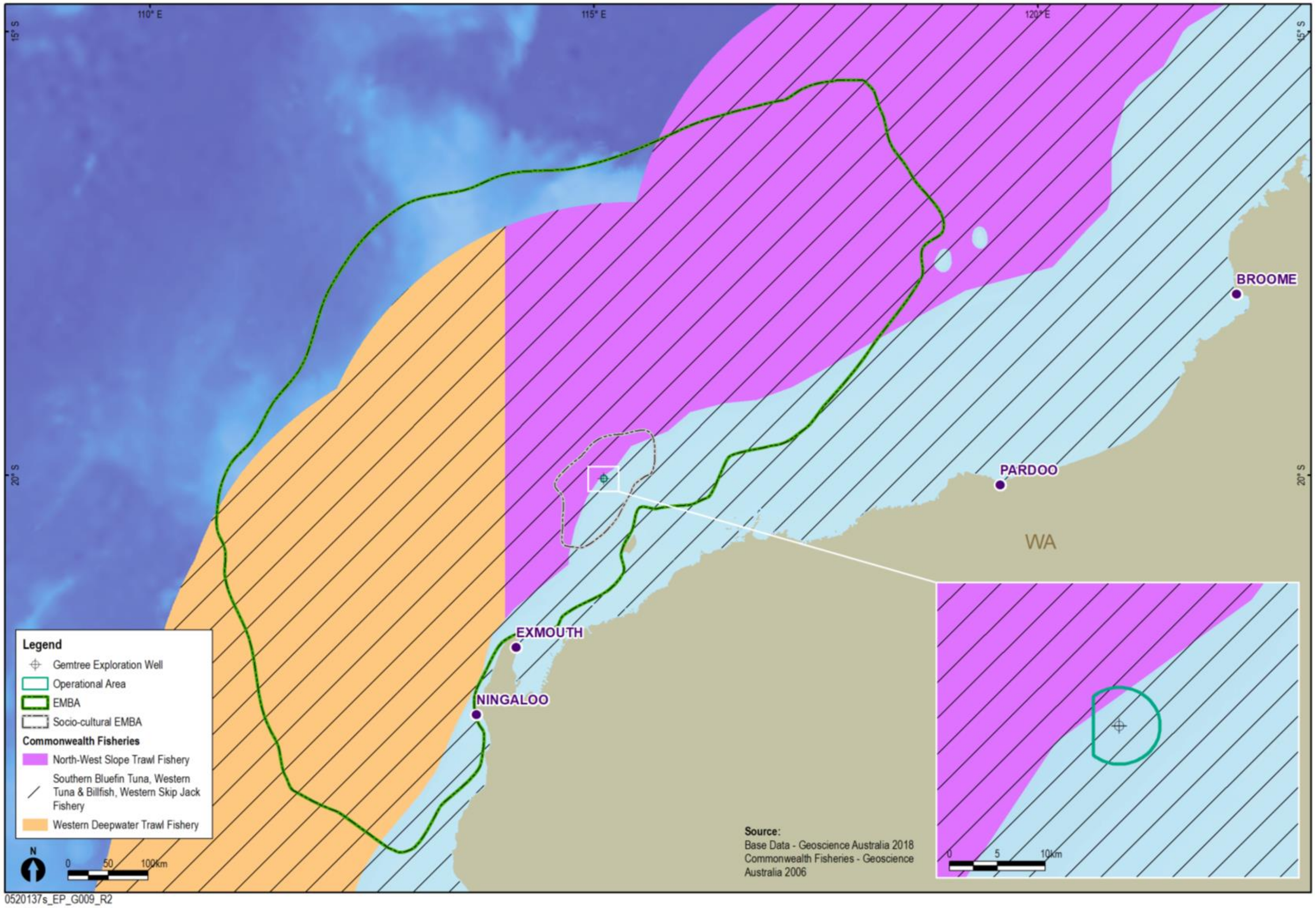


Figure 4-15: Location of Commonwealth fisheries in relation to the Operational Area

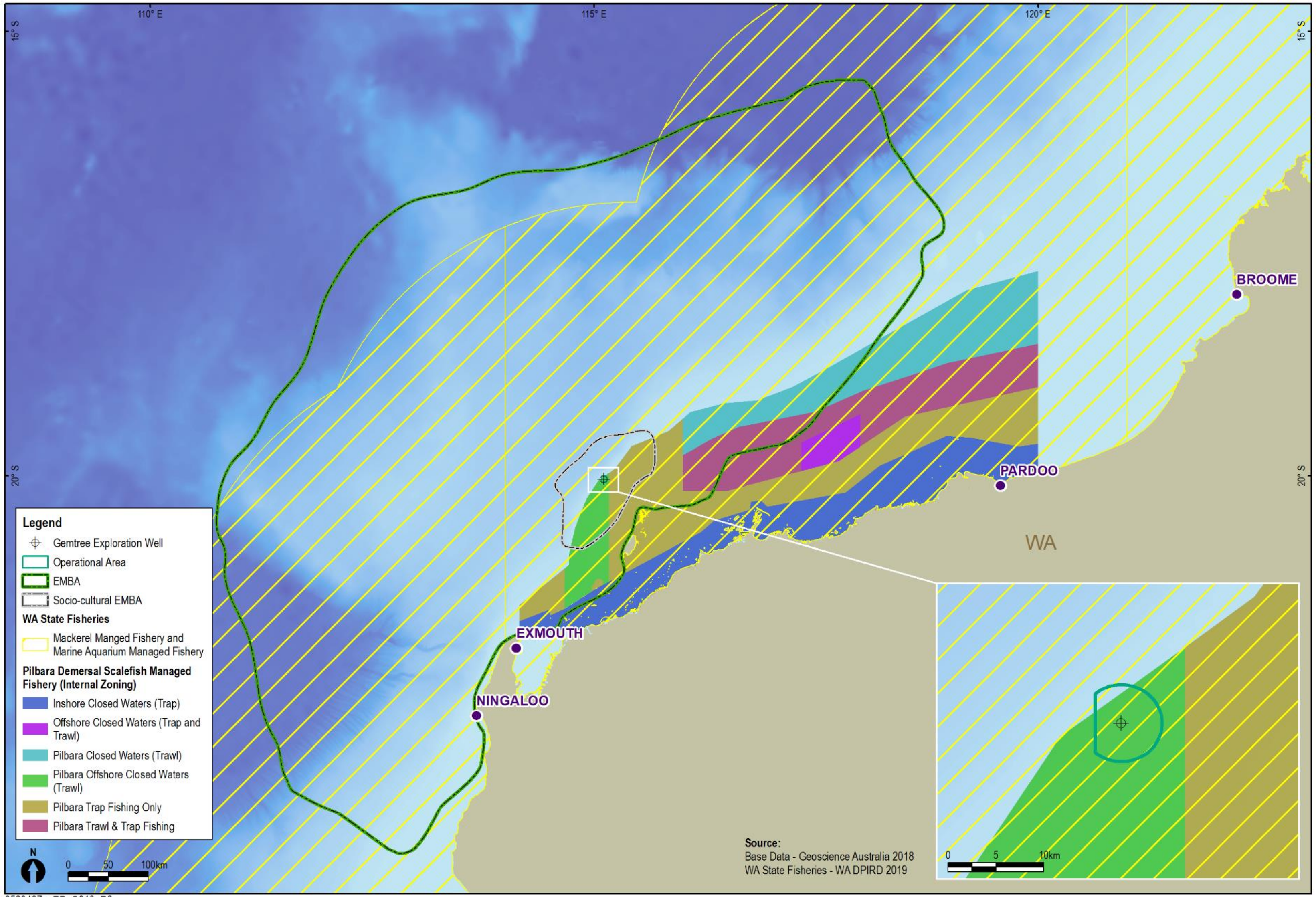


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Figure 4-16: Location of State fisheries in relation to the Operational Area (1 of 2)

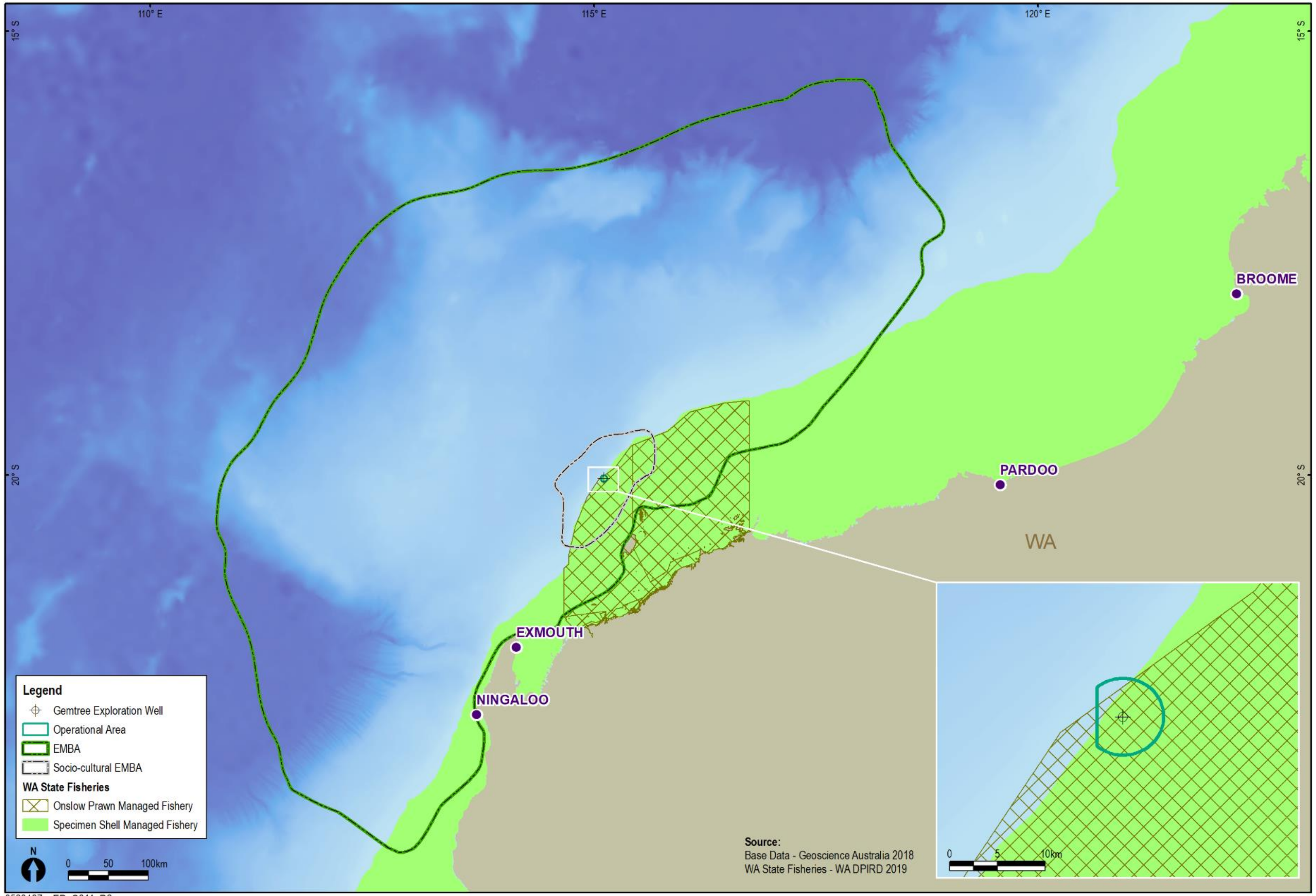

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Figure 4-17: Location of State fisheries in relation to the Operational Area (2 of 2)

Aquaculture

There are no aquaculture activities within or adjacent to the Operational Area. Aquaculture in the wider region is typically restricted to shallow coastal waters and consists primarily of culturing hatchery, reared and wild caught oysters (*Pinctada maxima*) for pearl production.

Pearl farm site locations nearest to the Operational Area, in the EMBA, are those at the Montebello Islands. In the Gascoyne Coast region, oyster hatcheries are important, with those located in Carnarvon and Exmouth supplying significant quantities of *P. maxima* spat to pearl farms in Exmouth Gulf and Montebello Islands (DoF, 2011b). Leases typically occur in shallow coastal waters at depths of less than 20 m (DoF, 2011b).

Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Fletcher & Santoro, 2012).

4.6.4 Fisheries – Traditional

There are no traditional, or customary, fisheries within the Operational Area, as these are typically restricted to shallow coastal waters and/or areas with structures such as reef. However, it is recognised that Barrow Island, Montebello Islands, Exmouth, Ningaloo Reef and the adjacent foreshores have a known history of fishing when areas were occupied (as from historical records). Areas that are covered by registered native title claims are likely to practice Aboriginal fishing techniques at various sections of the Western Australia coastline.

4.6.5 Tourism and Recreation

No tourism activities take place specifically within the Operational Area but it is acknowledged that there are growing tourism and recreational sectors in Western Australia. These sectors have expanded in area over the last couple of decades. Potential for growth and further expansion in tourism and recreational activities in the Pilbara and Gascoyne regions is recognised, particularly with the development of regional centres and a workforce associated with the resources sector (Gascoyne Development Commission, 2012).

Recreational fishing in the Northwest Shelf Province is mainly concentrated around the coastal waters and islands (including Dampier Archipelago, Ningaloo Marine Park, North West Cape area, the Montebello Islands, and other islands and reefs in the region) (DoF, 2011b). It has grown exponentially with the expanding regional centres and increasing residential and fly in/fly out work force, particularly in the Pilbara region. Occasional recreational fishing occurs at Rankin Bank and Glomar Shoal (located about 40 km and 153 km north-east of the Operational Area, respectively). The Montebello Islands (52 km from the Operational Area) are the next closest location for tourism, with some charter boat operators taking visitors to these remote islands (DBCA, 2017).

Within the EMBA, tourism is one of the major industries of the Gascoyne region and contributes significantly to the local economy in terms of both income and employment. The main marine nature-based tourist activities are concentrated around and within the Ningaloo Marine Park and North West Cape area. Activities include recreational fishing, snorkelling and scuba diving, whale shark encounters (April to August) and manta rays (September to November), whale watching (July to October) and turtle watching (all year round) (Shire of Exmouth). Recreational use of the Ningaloo Marine Park varies in intensity throughout the year, depending on school holidays and seasonal peaks of marine fauna being observed. Coral Bay is documented as one of the most heavily used areas (MPRA, 2005).

4.6.6 Shipping

The region supports commercial shipping activity, the majority of which is associated with the mining and oil & gas industries (Figure 4-18). AMSA has introduced a network of marine fairways on the NWS of WA to reduce the risk of vessel collisions with offshore infrastructure. The fairways are not mandatory but AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. None of these fairways intersect with the Operational Area and only light traffic occurs in the Operational Area as a whole (Figure 4-18). Major shipping routes in the area are associated with entering the ports of Dampier and Barrow Island. Shipping activities in the region include:

- international bulk freighters/tankers arriving and departing from Dampier including mineral ore, hydrocarbons (LNG, liquefied petroleum gas, condensate) and salt carriers
- domestic support/supply vessels servicing offshore facilities and Barrow Island development
- construction vessels/barges/dredges
- offshore survey vessels.

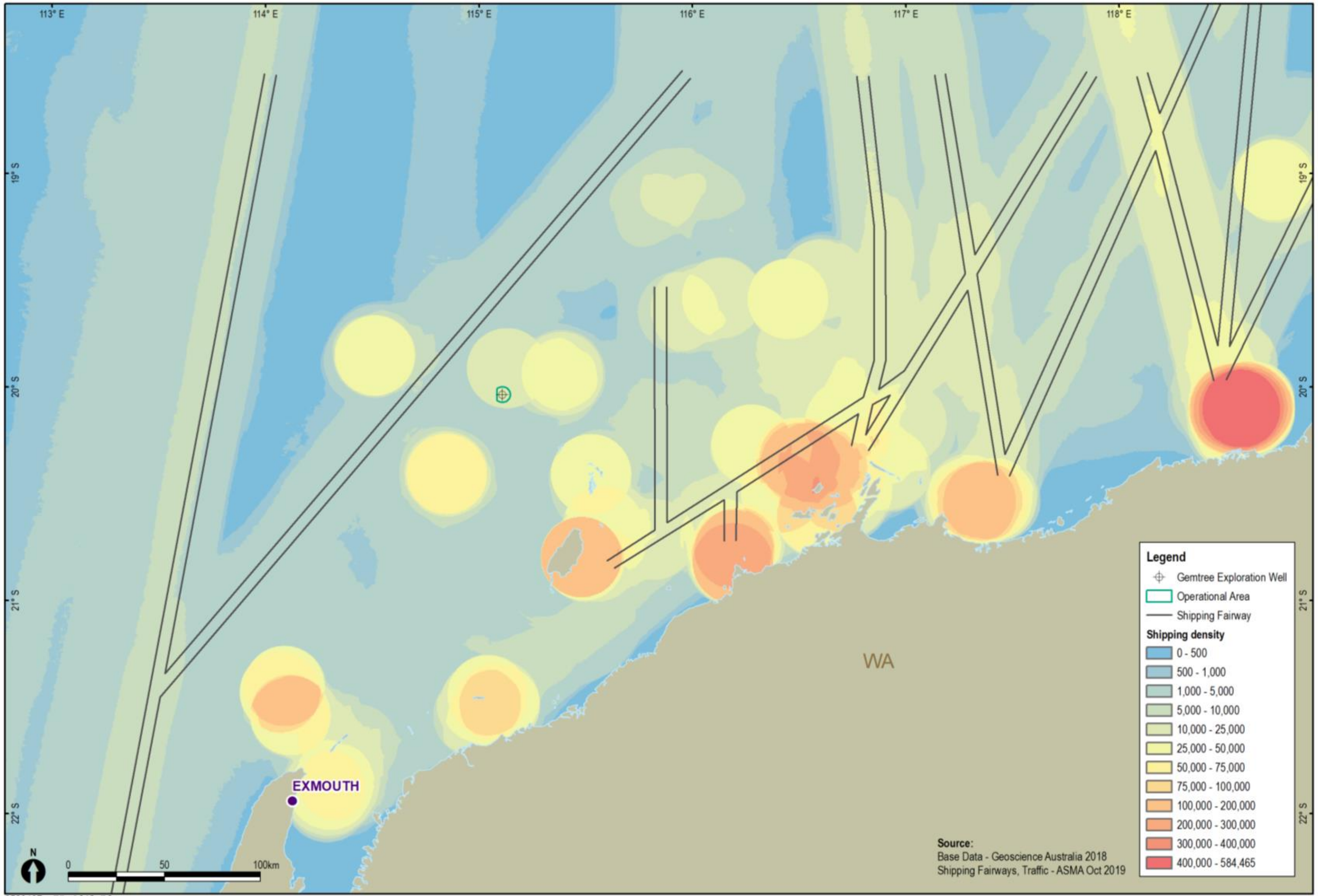

Figure 4-18: Vessel density map for the Operational Area from 2013, derived from AMSA satellite tracking system data

4.6.7 Existing Oil and Gas Infrastructure

The Operational Area is located within an area of established oil and gas operations, with additional infrastructure in the broader North West Shelf region (Figure 3-1). Table 4-11 details other facilities located in proximity to the Operational Area. Six abandoned appraisal wells with wellheads are also located in Permit Area WA-49-L.

Adjacent to the Operational Area, Woodside's Julimar Development Phase 2 has commenced and is anticipated to be completed in 2022. This development will include subsea infrastructure installation, including wellheads, umbilicals and production flowlines. Six abandoned appraisal wells with wellheads are also located in Permit Area WA-49-L.

Table 4-11: Other oil and gas operations located within the area

Facility name and operator	Approximate distance from Operational Area	Direction
Pluto Platform (Woodside)	23 km	East-north-east
Wheatstone Platform (Chevron)	27 km	North-east
John Brookes (Quadrant Energy, now Santos)	35 km	South
East Spar (Quadrant Energy, now Santos)	61 km	South
Goodwyn (Woodside)	91 km	North-east
North Rankin (Woodside)	113 km	North-east

4.6.8 Defence

There are designated defence practice areas in the offshore marine waters off Ningaloo and the North West Cape in the EMBA. The Operational Area lies within the northern tip of one of these defence practice areas, the Royal Australian Air Force Base Learmonth (Figure 4-19). The closest site where unexploded ordinance is known to occur is 8 km east of Trimouille Island in depths of about 40 m, located about 75 km south-east of the Operational Area.

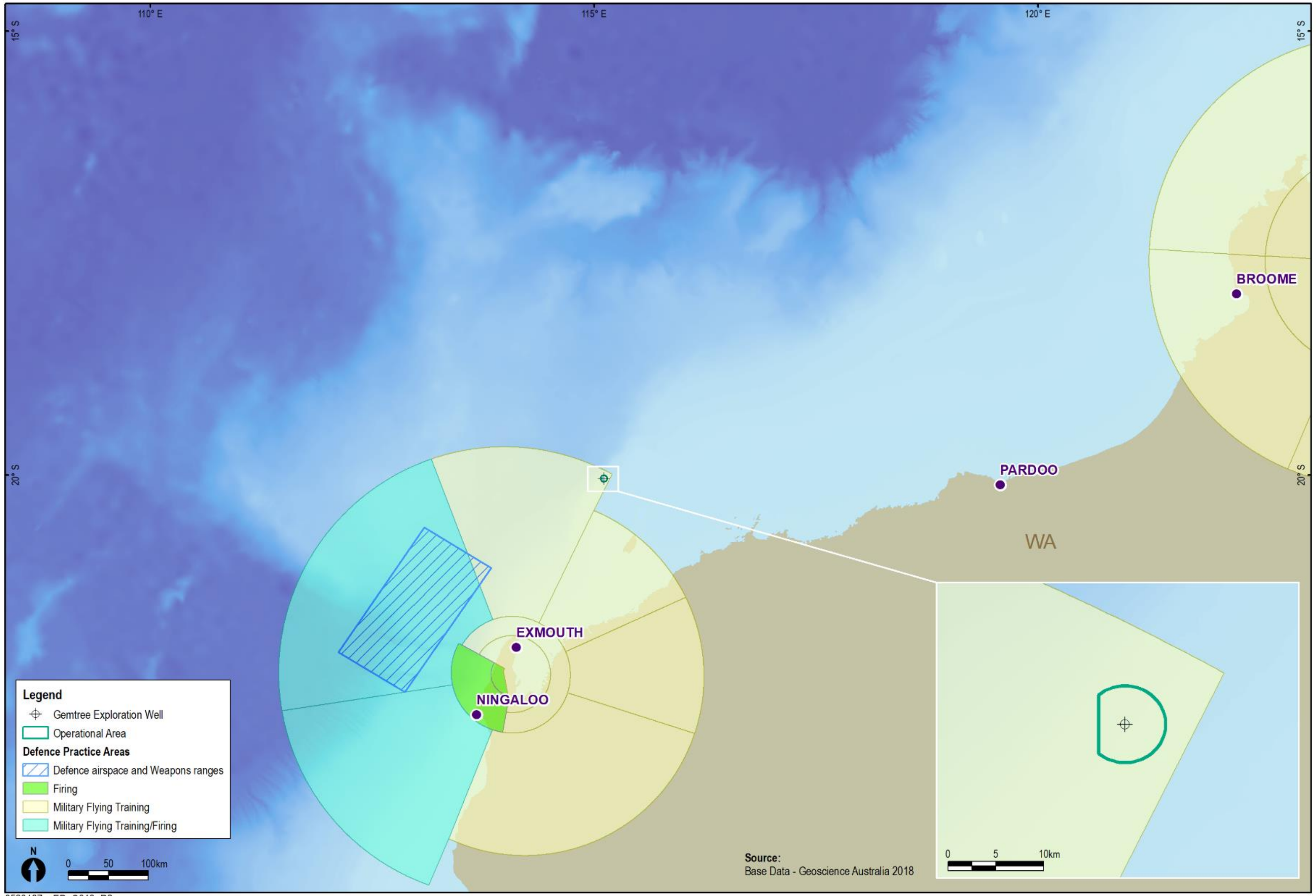

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Figure 4-19: Department of Defence demarcated marine offshore areas for military and defence practice with reference to the location of the Operational Area

4.7 Values and Sensitivities

The values and sensitivities of the Operational Area and wider regional perspective are presented in this section.

The nearest habitat of significant conservation value to the Operational Area is the Continental Slope Demersal Fish Communities KEF, which spatially overlaps the Operational Area. In close proximity to the Operational Area is the Ancient Coastline at 125 m Depth Contour KEF. The offshore environment of the Northwest Shelf Province contains environment (such as habitat and species) of high value or sensitivity including Commonwealth offshore waters, as well as the wider regional context including coastal waters and habitats such as the Montebello/Barrow/Lowendal Island Group. Sensitivities include the associated resident, temporary or migratory marine life including EPBC Act species such as marine mammals, turtles and birds. The marine environment of these offshore locations is pristine and many sensitive receptor locations are protected as part of Commonwealth and State managed areas, including the 2017 proclaimed network of North-west Marine Bioregion AMPs.

The following sections outline the values and sensitivities of the established Marine Protected Areas (MPAs) and other sensitive areas in the wider regional environmental setting (listed in Table 4-12 and illustrated in Figure 4-20) that may be impacted by the Petroleum Activities Program (planned and unplanned).

Table 4-12: Summary of established and proposed MPAs and other sensitive locations in the region relating to the Operational Area

	Distance from Operational Area to values/sensitivity boundaries (km)	International Union for Conservation of Nature (IUCN) Protected Area Category
Established Australian Marine Parks		
Montebello AMP	11	VI – Multiple Use Zone
Gascoyne AMP	156	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone
Ningaloo AMP	200	II – Recreational Use Zone II – Marine National Park Zone
Argo-Rowley Terrace AMP	283	VI – Multiple Use Zone
State Marine Parks and Nature Reserves		
Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area	44	Ia – Sanctuary Zone
Lowendal Islands Nature Reserve	76	Ia – Sanctuary Zone
Barrow Island Nature Reserve (including the Boodie, Double, North Sandy and Middle Islands Nature Reserve)	73	Ia – Sanctuary Zone
Pilbara Islands – Southern Island Group (Serrurier, Thevenard, Bessieres, Airlie and Round Islands Nature Reserves)	151	Ia – Sanctuary Zone
Ningaloo Marine Park	200	Ia – Sanctuary Zone II – Marine National Park Zone
Muiron Islands Marine Management Area*	182	Ia – Sanctuary Zone (islands) II – Marine National Park Zone

	Distance from Operational Area to values/sensitivity boundaries (km)	International Union for Conservation of Nature (IUCN) Protected Area Category
World Heritage Areas (WHA)		
The Ningaloo Coast WHA	182	N/A
KEFs		
Continental Slope Demersal Fish Communities	Overlaps	N/A
Ancient Coastline at 125 m Depth Contour	4	N/A
Exmouth Plateau	84	N/A
Glomar Shoal	156	N/A
Canyons Linking the Cuvier Abyssal Plain and the Cape Range Peninsula	157	N/A
Commonwealth Waters Adjacent to Ningaloo Reef	200	N/A
Other Sensitivities		
Rankin Bank	55	N/A

** Muiron Islands (Marine Management Area) is managed under the same management plan as the State Reserve of Ningaloo (MPRA, 2005)*

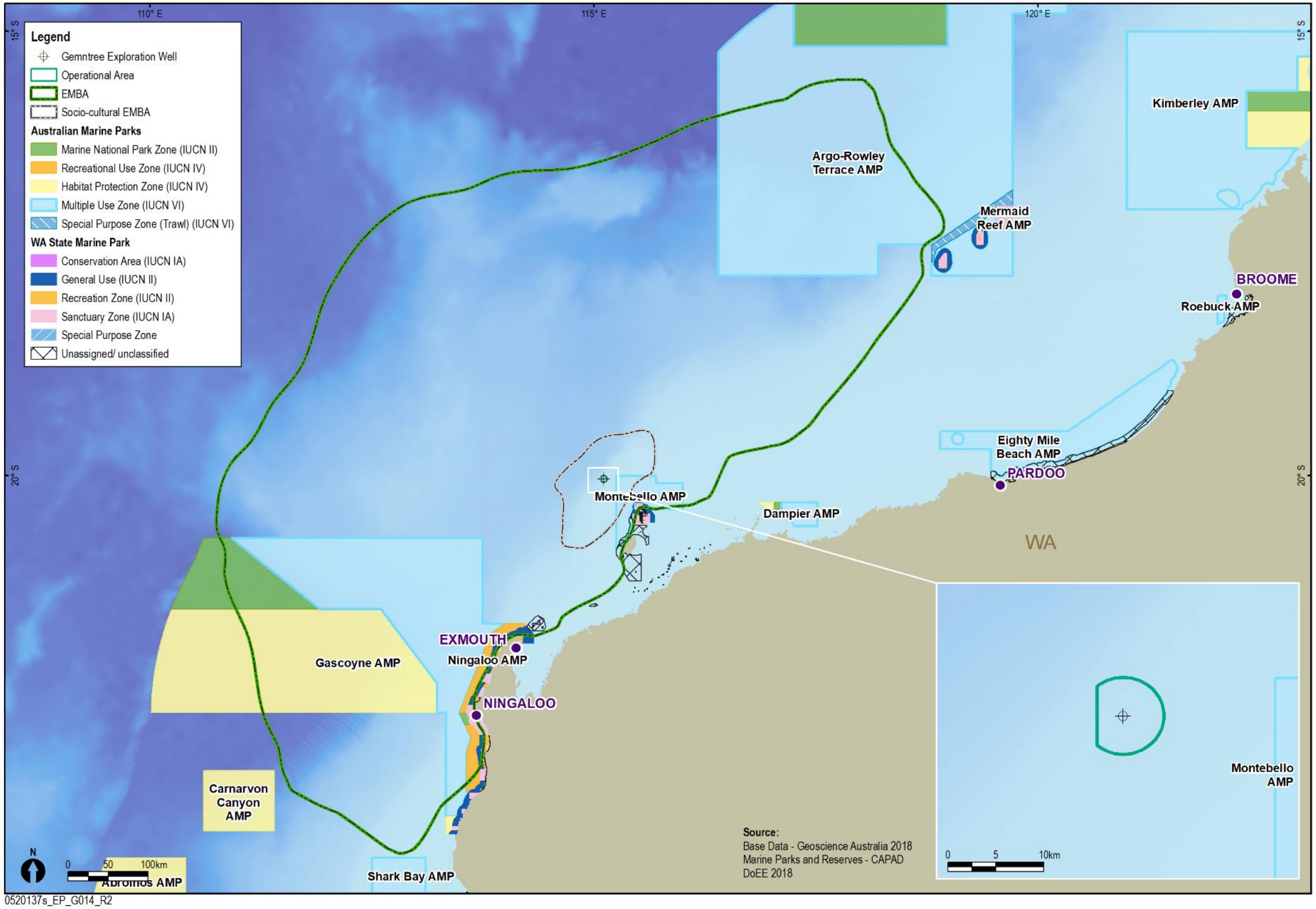

Figure 4-20: Commonwealth and State MPAs in relation to the Operational Area

4.7.1 Sensitive Receptors within the Operational Area

4.7.1.1 Continental Slope Demersal Fish Communities

The Continental Slope Demersal Fish Communities is listed as a KEF in the Operational Area EPBC Act Protected Matters Search Report (Appendix C) and partially overlaps the Operational Area. The conservation and environmental values of this KEF are detailed in Section 4.7.7.

4.7.2 Montebello Australian Marine Park

The Montebello AMP covers about 3413 km² and ranges in depth from less than 15 to 150 m (Director of National Parks, 2018). At its closest point, the Montebello Marine Park lies about 11 km east of the Operational Area (Figure 4-20). The AMP lies about 20 km north of Barrow Island and 125 km west of Dampier, and contains several natural values including:

- foraging and staging areas adjacent to important breeding areas for migratory seabirds
- breeding habitat for seabirds (includes the largest breeding population of roseate terns in western Australia) (DSEWPaC, 2012d)
- foraging areas for Vulnerable and Migratory whale sharks
- foraging areas adjacent to important nesting sites for marine turtles
- part of the migratory pathway and resting area of the protected humpback whale (DSEWPaC, 2012e)
- heritage site the wreck of the Trial – the earliest known shipwreck in Australian waters (Director of National Parks, 2018)
- one KEF for the region, the Ancient Coastline at 125 m Depth Contour (Section 4.7.7).

The AMP includes shallow shelf environments and provides protection for shelf and slope habitats, as well as pinnacle and terrace seabed features. Examples of the seabed habitats and communities of the NWS as well as the Pilbara (offshore) meso-scale bioregion (Heap et al., 2005) are found within the Marine Park. The Montebello Marine Park also includes a small portion of the Ancient Coastline at 125 m Depth Contour KEF, which is a unique seabed feature that provides areas of enhanced biological productivity.

The Montebello AMP is zoned as a multiple use zone (IUCN VI), allowing for long-term protection and maintenance of the AMP in conjunction with sustainable use, including oil and gas exploration activities. The AMP is contiguous with the existing Montebello Marine Park in State waters.

4.7.3 Montebello/Barrow/Lowendal Islands

The marine and coastal environments of the Montebello/Barrow/Lowendal Islands region represent a unique combination of offshore islands, intertidal and subtidal coral reefs, mangroves, macroalgal communities and sheltered lagoons, and are considered a distinct coastal type with very significant conservation values (Department of Environment and Conservation (DEC), 2007).

4.7.3.1 Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area

The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are jointly managed and cover a combined area of 1770 km², located about 44 km south-east of the Operational Area. The reserves' park area encompasses a complex seabed and island topography with coastlines dominated by cliffs, beaches, sheltered lagoons and channels. As a result of this complexity, the park area is characterised by a diverse range of communities including subtidal coral reefs, macroalgal and seagrass communities, subtidal soft-bottom communities, rocky shores, intertidal reef platforms and mangrove communities (MPRA, 2007). A Sanctuary Zone covers the entire Barrow Island Marine Park, giving the 4100 ha park the highest percentage of 'no take' areas of any marine park in WA (Chevron, 2010). The Barrow Island Marine Management Area covers 114,500 ha and includes most of the waters surrounding Barrow Island and Lowendal Islands, except for the port areas around Barrow and Varanus islands. Key conservation and environmental values within the reserves include (DEC, 2007):

- a complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches, cliffs and rocky shores
- pristine sediment and water quality, supporting a healthy marine ecosystem
- undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals
- important mangrove communities, particularly along the Montebello Islands, which are considered globally unique as they occur in offshore lagoons
- extensive subtidal macroalgal and seagrass communities
- important habitat for cetaceans and dugongs
- nesting habitat for marine turtles
- important feeding, staging and nesting areas for seabirds and migratory shorebirds
- rich finfish fauna with at least 456 species
- culture of the pearl oyster (*Pinctada maxima*) in the reserves, producing some of the highest quality pearls in the world (DEC, 2007).

These islands support significant colonies of wedge-tailed shearwaters and bridled terns. The Montebello Islands support the biggest breeding population of roseate terns in Western Australia. Ospreys, white-bellied sea-eagles, eastern reef egrets, Caspian terns, and lesser crested terns also breed in this area. Observations suggest an area to the west of the Montebello Islands may be a minor zone of upwelling in the region, supporting large feeding aggregations of terns. There is also some evidence that the area is an important feeding ground for Hutton's shearwaters and soft-plumaged petrels. Barrow Island is ranked equal tenth among 147 sites in Australia that are important for migratory shorebirds. Barrow, Lowendal and Montebello islands are internationally significant sites for six species of migratory shorebirds, supporting more than 1% of the East Asian–Australasian Flyway population of these species (DSEWPaC, 2012d).

The Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area is contiguous with the Montebello Australian Marine Park. The intertidal habitats of the Montebello/Barrow/Lowendal Islands region are influenced by the passage of regular tropical cyclones that shape sandy beaches (RPS, 2005). The dominant habitats on the exposed west coasts of islands in the area are sandy beaches, rocky shores and cliffs. The predominant physical habitats of the sheltered east coasts of islands are sand flats, mud flats, rocky pavements and platforms (RPS, 2005).

4.7.3.2 Barrow Island Nature Reserve

The Barrow Island Nature Reserve is a Class A Nature Reserve covering about 235 km^2 and extends to the low water mark adjacent to the Montebello Islands/Barrow Island Marine Parks. The Reserve lies about 73 km from the Operational Area and adjoins the EMBA. The islands surrounding Barrow Island including Boodie, Double and Middle Islands make up the Boodie, Double and Middle Islands Nature Reserve, covering 587 ha (DPaW, 2015). Together, these two nature reserves are commonly referred to as the Barrow Group Nature Reserves (DPaW, 2015).

The Barrow Island coastline consists of dry creek beds, beaches, clay and salt flats, mangroves, intertidal flats and reefs and is bordered by high cliffs on the western side (DoE, 2014c). Key conservation values within the reserves include (DEC, 2011):

- significant habitat values, such as intertidal mudflats, rock platforms, mangroves, rock piles and cliffs, clay pans and caves
- diverse range of marine habitats and associated primary producer communities, including corals, seagrasses and macroalgae
- important biological refuge, as it contains an array of endemic species (some of which are extinct or near-extinct on the mainland)
- significant number of fauna species with high conservation values (e.g. turtles and birds)
- important mammal conservation area
- important habitat and migration terminus for migratory shorebirds
- regionally and nationally significant turtle rookeries (especially green and flatback turtles).

4.7.3.3 Lowendal Islands Nature Reserve

The Barrow Island Marine Management Area includes the waters around the Lowendal Islands, which covers 114,500 ha. The Lowendal Islands Nature Reserve incorporates the islands of the Lowendal Archipelago, about 73 km south-east of the Operational Area and 15 km south of Montebello Islands. The Lowendal Islands Group is made up of 34 islands and islets, with the largest being Varanus Island at 83 ha. The islands are limestone rocks that extend a few metres above the sea level and have sparse vegetation (DSEWPaC, 2012a).

Key conservation values within the reserve include:

- feeding and breeding habitat for the shorebirds including the common greenshank, common sandpiper and the red-necked stint
- foraging habitat for hawksbill turtles
- support for resident populations of common bottlenose dolphins and Indo-Pacific humpback dolphins
- critical nesting and internesting habitat for hawksbill turtles (Varanus Island), and support for an important flatback turtle rookery
- support for seabird colonies for species such as the wedge-tailed shearwaters and bridled terns
- foraging and staging area for migratory shorebirds (DSEWPaC, 2012a) and internationally significant site for six species of migratory shorebirds, supporting more than 1% of the East Asian–Australasian Flyway population for these species
- seagrass habitat for dugongs.

4.7.4 Pilbara Islands

Within the nearshore waters between the Muiron Islands and the Dampier Archipelago are a series of islands collectively termed the Northern, Middle and Southern Island Groups. This area has been defined as the Pilbara offshore region (greater than 10 m water depth) and includes islands, shoals and rocky outcrops.

The Northern Island Group and Middle Island Group, including the Great Sandy Islands Nature Reserve, the Passage Islands, the Mary Anne Reefs and neighbouring small islands, are outside the EMBA and will therefore not be discussed further in this EP. The Southern Island Group includes

Serrurier, Bessieres and Thevenard Islands Nature Reserves, which lie about 151 km from the Operational Area but within the EMBA. The nearshore habitats of these islands generally consist of fringing reefs on the seaward side and wide intertidal sand flats on the leeward side. Despite generally high turbidity in the area and relatively low abundance, hard coral biodiversity is high (Chevron, 2010). The coral community structure within this area, and others within the region, is highly temporally variable due to cyclonic activity.

The large islands of the groups provide important nesting habitat for seabirds and marine turtles (Chevon, 2010). In the Southern Island Group, a number of seabirds, including Caspian terns, little terns, wedge-tailed shearwaters and ospreys breed on Serrurier Island and nearby Airlie Island. Serrurier Island also is a major nesting area for green turtles and may also be a foraging area for this species. Thevenard Island supports a significant flatback turtle rookery, along with small numbers of green turtles and a known feeding area for green turtles.

Chevron (2010) documented the key subtidal habitats of the Pilbara offshore region as:

- limestone pavement supporting dense macroalgae
- biogenic fringing coral reefs
- coral communities associated with hard substrate (shoals and rocky outcrops)
- filter feeding communities (sponges and ascidians) on sand veneered pavement
- sand/gravel plains and shoals supporting sparse foliose macroalgae.

4.7.5 Ningaloo Coast and Gascoyne

4.7.5.1 The Ningaloo Coast World Heritage Area

The Ningaloo Coast WHA includes North West Cape and the Muiron Islands, and was inscribed under criteria (vii) and criteria (x) by the World Heritage Committee onto the World Heritage Register in June 2011. The Ningaloo Coast WHA is located about 182 km south-west of the Operational Area but within the EMBA. The statement of Outstanding Universal Value for the Ningaloo Coast was based on the natural criteria and recognised that it contained:

- land seascapes comprised of mostly intact and large-scale marine, coastal and terrestrial environments
- lush and colourful underwater scenery and its contrast with the arid and rugged land
- annual aggregation of whale sharks, one of the largest in the world
- important aggregations of other fish species and marine mammals
- high marine diversity, including an unusual diversity of marine turtle species
- rare and diverse subterranean creatures found nowhere else in the southern hemisphere
- diversity of reptiles and vascular plants in the drylands.

The Ningaloo Coast WHA is recognised as being of outstanding conservation value, supporting a rich array of habitats and a diverse and abundant marine life (DoE, 2014d). The region has a high diversity of marine habitats including coastal mangrove systems, lagoons, coral reef, open ocean, continental slope and the continental shelf (MPRA, 2005). The dominant feature of the Ningaloo Coast WHA is Ningaloo Reef, the largest fringing reef in Australia. Ningaloo Reef supports both tropical and temperate species of marine fauna and flora and more than 300 species of coral (MPRA, 2005).

The Ningaloo Coast WHA provides important nesting habitat for four species of marine turtle found in Western Australia. The North West Cape and Muiron Islands are major nesting sites for loggerhead turtles, with about 400 and 600 females nesting annually on the Ningaloo Coast (particularly North West Cape area) and Muiron Islands, respectively (Department of Environmental Protection, 2001). The North West Cape is also a major nesting habitat for hawksbill and green turtles, with an estimated 1000–1500 green turtles nesting in the area annually (DEC, 2009). The Muiron Islands are minor nesting sites for flatback and hawksbill turtles (DEC, 2009).

Each year, the largest congregation of whale sharks anywhere in the world takes place off the coast of the Ningaloo WHA. It is estimated that between 300 and 500 whale sharks visit each year between March and July, coinciding with the annual mass coral spawning events.

It is these natural heritage values, iconic wilderness, seascapes, wildlife and biodiversity which are major attractions of the WHA and therefore the main driver for tourism on the North West Cape. All properties inscribed on the World Heritage List must have adequate management to ensure their protection, thus the Ningaloo WHA is managed via the Australian Marine Park and State Marine Park (see subsections below).

Ningaloo Australian Marine Park

The Ningaloo AMP covers 2435 km² and is about 10 km north of Exmouth. It is contiguous with the Western Australian Ningaloo Marine Park. The Ningaloo AMP is located about 200 km south-west of the Operational Area but within the EMBA. The Ningaloo AMP adds additional protection to the Ningaloo Reef, which lies in State waters within the State managed Marine Park. Water depths range from shallow water of 30 m depth to oceanic waters at 1000 m deep. Major natural values of the AMP include (Director of National Parks, 2018):

- foraging areas adjacent to important breeding areas for migratory seabirds, whale sharks and marine turtles
- important nesting sites for marine turtles
- part of the migratory pathway of the humpback whale
- shallow shelf environments with depths ranging from 15 to 150 m, providing protection for the shelf and slope habitats, as well as pinnacle and terrace sea-floor features
- examples of the seafloor habitats and communities of the Central Western Shelf Transition.

Ningaloo AMP has international and national significance due to its diverse range of marine species and unique geomorphic features. The AMP provides essential biological and ecological links that sustain the biodiversity and ecological processes, including supplying nutrients to reef communities from deeper waters further offshore, to the Ningaloo Reef ecosystem.

4.7.5.2 Ningaloo Marine Park and Muiron Islands Marine Management Area

The Ningaloo Marine Park (State waters) was established in 1987 and stretches 300 km from the North West Cape to Red Bluff. It encompasses the State waters covering the Ningaloo Reef system and a 40 m strip along the upper shore. The State Marine Park is located about 200 km south-west of the Operational Area but within the EMBA. The Muiron Islands Marine Management Area is managed under the same management plan as for the Ningaloo State Marine Park (MPRA, 2005). The Ningaloo Marine Park is part of the Ningaloo Coast WHA.

Ecological and conservation values of the Ningaloo Marine Park and Muiron Islands are summarised below. Generally, all ecological values are presumed to be in an undisturbed condition except for some localised high use areas (MPRA, 2005). The ecological and conservation values include:

- Unique geomorphology has resulted in a high habitat and species diversity.
- There is high sediment and water quality.
- Subtidal and intertidal coral reef communities provide food, settlement substrate and shelter for marine flora and fauna.

- Filter feeding communities (sponge gardens) occur in the northern part of the North West Cape and the Muiron and Sunday Islands.
- Shoreline intertidal reef communities provide feeding habitat for larger fish and other marine animals during high tide.
- Soft sediment communities are found in deeper waters, characterised by a surface film of microorganisms that provide a rich source of food for invertebrates.
- Macroalgae and seagrass communities are an important primary producer, providing habitat for vertebrate and invertebrate fauna.
- Mangrove communities occur only in the northern part of the Ningaloo Marine Park and are important for reef fish communities (Cassata & Collins, 2008) and support a high diversity of infauna, particularly, molluscs (600 mollusc species).
- There is diverse fish fauna (about 460 species).
- Foreshores and nearshore reefs of the Ningaloo coast and Muiron/Sunday islands provide internesting, nesting and hatchling habitat for several species of marine turtles including the loggerhead, green, flatback and hawksbill turtles.
- Whale sharks aggregate annually to feed in the waters around Ningaloo Reef, from March to July, with the largest numbers recorded around April and May (Sleeman et al., 2010). The season can be variable, with individual whale sharks being recorded at other times of the year. Timing of the whale sharks' migration to and from Ningaloo coincides with the mass coral spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef. At Ningaloo Reef, whale sharks stay within a few kilometres of the shore and in waters less than 50 m depth (Woodside, 2002).
- Seasonal shark aggregations and manta rays are commonly found in the area with a permanent population of manta rays (*Manta alfredi*) inhabiting the Ningaloo Reef. Numbers are boosted periodically by roaming and seasonal animals. Small aggregations coincide with small pulses of target prey and the spawning events of many reef inhabitants, while larger aggregations coincide with major seasonal spawning events. The number of species in the Ningaloo Reef area peaks during autumn, which corresponds to coral spawning, and during spring, which corresponds with the crab spawning event (McGregor, 2004).
- Annual mass coral spawns on Ningaloo Reef. Synchronous, multi-specific spawning of tropical reef corals occurs during a brief predictable period in late summer/early autumn, generally seven to nine nights after a full moon on neap, nocturnal ebb tides March/April each year (Simpson, 1991).
- Large coral slicks generally form over shallow reef areas in calm conditions. It is noted that there are minor spawning activities on the same nights after the February and April full moons, and in some years the mass spawning event occurs after the April full moon (Simpson et al., 1993).
- Marine mammals such as dugong and small cetacean populations frequent or reside in nearshore waters. Dugong numbers in Ningaloo Marine Park are considered to be in the order of about 1000 individuals, with a similar number in Exmouth Gulf (MPRA, 2005). The Ningaloo/Exmouth Gulf region supports a significant population of dugongs which is interconnected with the Shark Bay resident population (which represents less than 10% of the world's dugongs).
- Nesting and foraging habitat occurs for seabirds and shorebirds. About 33 species of seabirds are recorded in the Ningaloo Marine Park (13 resident and 20 migratory) and

there are five known rookeries as well as isolated rookeries on the Muiron and Sunday Islands.

In addition to the ecological and conservation values, the Ningaloo AMP has a number of social values including culture heritage (both Aboriginal and maritime; Section 4.6.1) and marine-based tourism and recreation (water-sports and fishing; Section 4.6.5). The Ningaloo Marine Park (State waters) is contiguous with the Ningaloo AMP (Figure 4-20).

Ningaloo Shoreline, Shallow Subtidal Reef and Intertidal Habitats

The Ningaloo Marine Park reef and lagoonal systems comprise a variety of shallow subtidal and intertidal communities that comprise shallow outer reef slope (spur and groove habitat), reef crest (emergent at low tide), reef flat (coralline algae and high cover tabular *Acropora* coral communities), back reef lagoon (coral, soft sediment and macro-algal communities), sublittoral limestone platform (turf algae/molluscs/echinoderm community), and intertidal mangrove, mud flat and salt marsh communities (Cassata & Collins, 2008).

The area seaward of the reef crest is characterised by a coralline algae/coral community (spur and groove reef slope). The area has a series of perpendicular spur and grooves from 5 to 40 m depth range consisting of narrow, deep channels filled with sand and coral rubble and rock spurs with diverse hard coral communities (with dominant tabular *Acropora* growing in small, compact colonies), together with soft corals, *Millepora* (fire coral), sponges and macroalgae. Coralline algae encrust dead corals, rocks and coral rubble. Coral growth is most prolific between 5 and 10 m depth.

On the landward side of the reef crest is a reef flat habitat and back reef lagoon with a number of subtidal and intertidal habitats (Cassata & Collins, 2008) as follows:

- Outer reef flat (very shallow, less than 1 m depth) at the back of the reef crest: Coralline algae/coral community (spur and groove). Similar morphology to the reef slope.
- Rocky middle/inner reef flat (about 1 m depth): Tabular Acropora community.
- Back reef lagoon (greater than 2 m depth): Patchy staghorn, massive and sub-massive coral community.
- Lagoonal sand flat (1–2 m depth): Sparse corals and algae community. This habitat is characterised by sheltered areas of limestone pavement with a veneer of sand and small outcrops of corals (*Porites*, *Acropora*) with scattered patches of macroalgae (*Sargassum*, *Halimeda*, *Caulerpa*) or seagrass (*Halophila*).
- Lagoonal and inter-reef sandy depressions (3–15 m depth): Coral ‘bommies’ and algal patch community. A distinctive habitat type composed of sandy depressions either found as large deep regions within the lagoon or small depressions/channels inside the reef flat.
- Lagoon, shoreward reef channels (shallow): Macroalgal community. Fleshy algae colonising subtidal limestone pavement that is covered in sand with *Sargassum* up to 0.5 m high and other red and green algal species. There are also small patches of hard and soft corals, sponges and ascidians.
- Sublittoral limestone platform: Turf algae/mollusc/echinoderm community. This habitat is composed of a flat limestone pavement often contiguous with the rocky shoreline, and supports intertidal and subtidal fauna comprising molluscs (limpets, chitons, small mussels, cowries and giant clams) and echinoderms (sea cucumbers, starfish and sea urchins) with isolated hard and soft coral colonies. The limestone pavement also has a ubiquitous coverage of turf algae.
- Mangrove coastal swamps: Although not a common habitat type within Ningaloo Marine Park, there are mangrove stands in the upper intertidal zone on a muddy substrate of carbonate silt and clay. The mangrove communities are located within the Mangrove Sanctuary Zone (where they occupy a large section of coast between Low Point and

Mangrove Bay) and sporadically within the Osprey Sanctuary Zone on the Yardie Creek banks. There are three species of mangrove: *Avicennia marina*, *Rhizophora stylosa* and *Bruguiera exaristata*. *Avicennia marina* is most common and widespread. This habitat supports a diverse community of invertebrate fauna including gastropods, crabs and burrowing worms and is also a nursery area for the juveniles of many species of reef fish.

- Intertidal mud flats: Mud flats occur in the lower intertidal zone of the lagoon, formed from the deposition of mud in the sheltered tidal waters.
- Salt marshes: The salt marsh habitat is seaward of the mangroves and is represented by salt tolerant vegetation and sandy patches.

Muiron Islands: Shallow Subtidal, Intertidal and Shoreline Habitats

Coastal sensitivity mapping identified the onshore sensitivities to be turtle rookeries and turtle nesting occurring from October to April (Joint Carnarvon Basin Operators, 2012). Most of the western coast consists of limestone coastal cliffs interspersed with sandy beaches and intertidal rock platforms. The nearshore sensitivities include the intertidal/nearshore reef (Joint Carnarvon Basin Operators, 2012). Soft coral communities dominate the reefs on the western side of the Muiron Islands. Habitats on the eastern side of the Muiron Islands are more sheltered, consisting of sandy beaches and shallow lagoons with diverse soft and hard coral communities (Cassata & Collins, 2008).

4.7.5.3 Gascoyne Australian Marine Park

The Gascoyne AMP covers about 81,766 km² and includes waters from less than 15 m depth to 6000 m depth. The Gascoyne AMP lies about 156 km south-west of the Operational Area but within the EMBA. Natural values identified within the AMP include:

- foraging areas for migratory seabirds (including the wedge-tailed shearwater), hawksbill and flatback turtles and whale sharks
- a continuous connectivity corridor from 15 to over 5000 m
- seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise
- sponge gardens in the south of the reserve adjacent to Western Australian coastal waters
- examples of the ecosystems of the Central Western Shelf Transition, the Central Western Transition and the North West Province provincial bioregions as well as the Ningaloo meso-scale bioregion (Director of National Parks, 2018).

The AMP contains four key ecological features for the region:

1. canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula (associated enhanced productivity, aggregations of marine life and unique sea-floor feature)
2. Exmouth Plateau (unique seafloor feature associated with internal wave generation)
3. continental slope demersal fish communities (high species diversity and endemism which is the most diverse slope bioregion in Australia with over 500 species recorded of which 76 are endemic to the area)
4. Commonwealth waters adjacent to Ningaloo Reef (an area where the Leeuwin and Ningaloo currents interact resulting in enhanced productivity and aggregations of marine life).

The AMP boundary is adjacent to the existing Commonwealth portion of the Ningaloo MPA.

4.7.6 Argo-Rowley Terrace Australian Marine Park

The Argo-Rowley Terrace AMP covers 146,099 km² of the MPA network, including the Commonwealth waters surrounding the Rowley Shoals (each reef managed as separate State and Australian Marine Parks). The Argo-Rowley Terrace AMP encompasses water depths from about 220–6000 m. The AMP is located 283 km north-east of the Operational Area. The natural values of the Argo-Rowley Terrace AMP include (Director of National Parks, 2018):

- important foraging areas for migratory seabirds and, reportedly, the loggerhead turtle
- support for relatively large populations of sharks (compared with other areas in the region)
- a range of seafloor features such as canyons, continental rise and the terrace, among others
- connectivity between the reefs of the Rowley Shoals
- linkage of the Argo Abyssal Plain with the Scott Plateau through canyons.

4.7.7 Key Ecological Features

KEFs were identified in the Operational Area and EMBA using the EPBC Protected Matters Search Tool (Appendix C). One KEF, the continental slope demersal fish communities, overlaps with the Operational Area (Figure 4-21). An additional five KEFs are located within the EMBA, described below.

4.7.7.1 Key Ecological Features Within the Operational Area

Continental Slope Demersal Fish Communities

The continental slope demersal fish communities in the region have been identified as a KEF of the Northwest Shelf Province (DoEE, 2019b) (Appendix C), and overlaps with the north-west extent of the Operational Area. The continental slope between North West Cape and the Montebello Trough has been identified as one of the most diverse slope assemblages in Australian waters, with over 508 fish species and the highest number of endemic species (76) of any Australian slope habitat (DEWHA, 2008a). Additional features relating to the fish populations of this area are as follows:

- Continental slope demersal fish communities of the NWS Province have been identified as a KEF of the NWMR due to the notable diversity of the demersal fish assemblages and high levels of endemism (DoEE, 2019b).
- The North West Cape marine region is a transition area for demersal shelf and slope fish communities between the tropical dominated communities to the north and temperate communities to the south (Last et al., 2005). The benthic shelf and slope communities offshore of the North West Cape comprise both tropical and temperate fish species with a north-south gradient (DEWHA, 2008).
- The fish fauna of the North West Cape area, like the ichthyofauna of many regions, exhibits decreasing species richness with depth (Last et al., 2005). Fish species diversity has been shown to be positively correlated with habitat complexity, with more complex habitats (e.g. coral reefs) typically hosting higher species richness than simpler habitats such as bare, unconsolidated muddy sediments (Gratwicke & Speight, 2005). A total of 500 finfish species from 234 genera and 86 families have been recorded within the Ningaloo Marine Park, and 393 species were identified at study sites of the Muiron Islands (MPRA, 2005). The offshore sediment habitats of the Operational Area are expected to support lower fish species richness than other shallower, more complex habitats in the coastal areas of the region.

4.7.7.2 Key Ecological Features Within the EMBA

Ancient Coastline at the 125 m Depth Contour (KEF)

Located 4 km south-east of the Operational Area, the 'ancient coastline at 125 m depth contour' is defined as the depth range 115–135 m in the Northwest Shelf Province and NWS Transition provincial bioregions. Several steps and terraces as a result of Pleistocene sea level changes occur in the region, with the most prominent of these features occurring as an escarpment along the NWS and Sahul Shelf at a water depth of 125 m. The ancient coastline is not continuous and is fragmented along the 125 m depth contour. Where the ancient submerged coastline provides areas of hard substrate, it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat (DEWHA, 2008a).

The ancient submerged coastline is an important divide between carbonate, cemented sands and the fine, less cemented slope materials offshore. It is valued as a unique seafloor feature with ecological properties of regional significance. Parts of the ancient coastline, represented as rocky escarpment, are considered to provide biologically important habitat in an area predominantly made up of soft sediment. The escarpment type features may also potentially facilitate mixing within the water column due to upwelling, providing a nutrient-rich environment.

Exmouth Plateau

The Exmouth Plateau is a large, mid-slope, continental margin plateau that lies off the north-west coast of Australia, located to the west of the Operational Area with its closest point about 84 km north-west of the Operational Area. It ranges in depth from about 800 to 3500 m and is a major structural element of the Carnarvon Basin (Geoscience Australia, 2013). The plateau is bordered by the Rankin Platform and the Exmouth sub-basin of the Northern Carnarvon Basin to the east, the Argo Abyssal Plain to the north, and the Gascoyne and Cuvier Abyssal Plains to the north-west and south-west. The plateau is recognised as a KEF because it is an area of enhanced biological productivity that supports a range of species (Brewer et al., 2007).

The Exmouth Plateau has a relatively uneven seabed, which includes pinnacles and canyon systems in the northern section. The canyon systems are recognised as a distinct feature and are localised areas of high biological productivity (Brewer et al., 2007). Biological productivity on the top of the Exmouth Plateau is comparatively low due to tropical oligotrophic waters, with increased productivity identified around the plateau boundaries as a result of internal waves and upwelling (Brewer et al., 2007). The sediments of the plateau are assumed to consist of abyssal red clays, which indicate that benthic communities are likely to include filter feeders and epifauna, including sea cucumbers, polychaetes and sea-pens (Brewer et al. 2007). Pelagic species are likely to include nekton, small pelagic fish and large predators such as billfish, sharks and dolphins (Brewer et al., 2007). Protected and migratory species are also known to pass through the region including whale sharks, cetaceans and marine turtles.

Glomar Shoal

Glomar Shoal is about 156 km north-east of the Operational Area but within the EMBA. The submerged shoal is a large (768 km^2), complex bathymetrical features on the outer western shelf of the West Pilbara. The shoal rises on all sides from 80 m depth and shallows gradually to include a plateau region situated within 40 m of the surface. The shoal is relatively shallow with water depths reaching 22–28 m at its shallowest point. Together with Rankin Bank, these remote shallow water areas represent regionally unique habitats and are likely to play an important role in the productivity of the Pilbara regions (AIMS, 2014; Abdul Wahab et al., 2018).

Glomar Shoal has been identified as a KEF of the continental shelf within the NWMR, based on its regionally important habitat supporting high biological diversity and high localised productivity (Falkner et al., 2009). On a regional level, Glomar Shoal is also known to be an important area for a number of commercial and recreational fish species (DSEWPaC, 2012a).

Glomar Shoal was surveyed by AIMS in 2013 as part of a co-investment project between Woodside and AIMS to better understand the habitats and complexity of Rankin Bank and Glomar Shoal. The research included collecting continuous coverage multibeam data to produce a bathymetry dataset, underwater towed camera transects to assess benthic communities, and BRUVS sampling of the fish assemblages (AIMS, 2014; Abdul Wahab et al., 2018).

The shoal has relatively high seafloor temperatures and high biological productivity. The benthic community composition and distribution of Glomar Shoal was assessed, quantitatively, using the images from the towed video system. Results from the 2013 AIMS survey show that the benthic habitats of Glomar Shoal are characterised by sand/silt substrate and low epibenthic cover (about 53% total cover), with soft corals and sponges the most abundant fauna. The most abundant benthic organisms were plants, with turf algae present on many substrates. Hard corals at Glomar Shoal are not a major habitat type and overall abundance is very low (0.4%), with small patches of 10% cover in its shallowest regions. Corals appeared healthy, with no areas of coral mortality identified (AIMS, 2014; Abdul Wahab et al 2018). Overall, the benthic habitats of Glomar Shoal are considered pristine and similar to other shoals within the NWMR.

The fish abundance and diversity of the demersal fish communities of Glomar Shoal are influenced by the seabed habitat type, with genera associated with sandy habitats common, including threadfin breams (*Nerripterus* spp.) and triggerfish (*Abalisters* spp.). Species richness and abundance are influenced by habitat depth and the degree of coral cover. In general, the fish abundance and diversity of Glomar Shoal are considered comparable with other regional Australian reefs and the North West submerged shoals and banks.

Canyons Linking the Cuvier Abyssal Plain with the Cape Range Peninsula

The canyons that link the Cuvier Abyssal Plain with the Cape Range Peninsula lie off the north-west coast of Australia, over 157 km south-west of the Operational Area but within the EMBA. The canyons are believed to support the productivity and species richness of Ningaloo Reef (Commonwealth of Australia, 2012). Interactions with the Leeuwin current and strong internal tides are thought to result in upwelling at the canyon heads, thus creating conditions for enhanced productivity in the region (Brewer et al., 2007). As a result, aggregations of whale sharks, manta rays, humpback whales, seasnakes, sharks, predatory fish and seabirds are known to occur in the area due to the enhanced productivity (Sleeman et al., 2007).

Commonwealth Waters Adjacent to Ningaloo Reef

The Commonwealth waters adjacent to Ningaloo Reef KEF lies adjacent to the 3 nm State waters limit along Ningaloo Reef and includes the Ningaloo AMP. See Section 4.7.5 for further information for the values and sensitivities associated with this KEF.

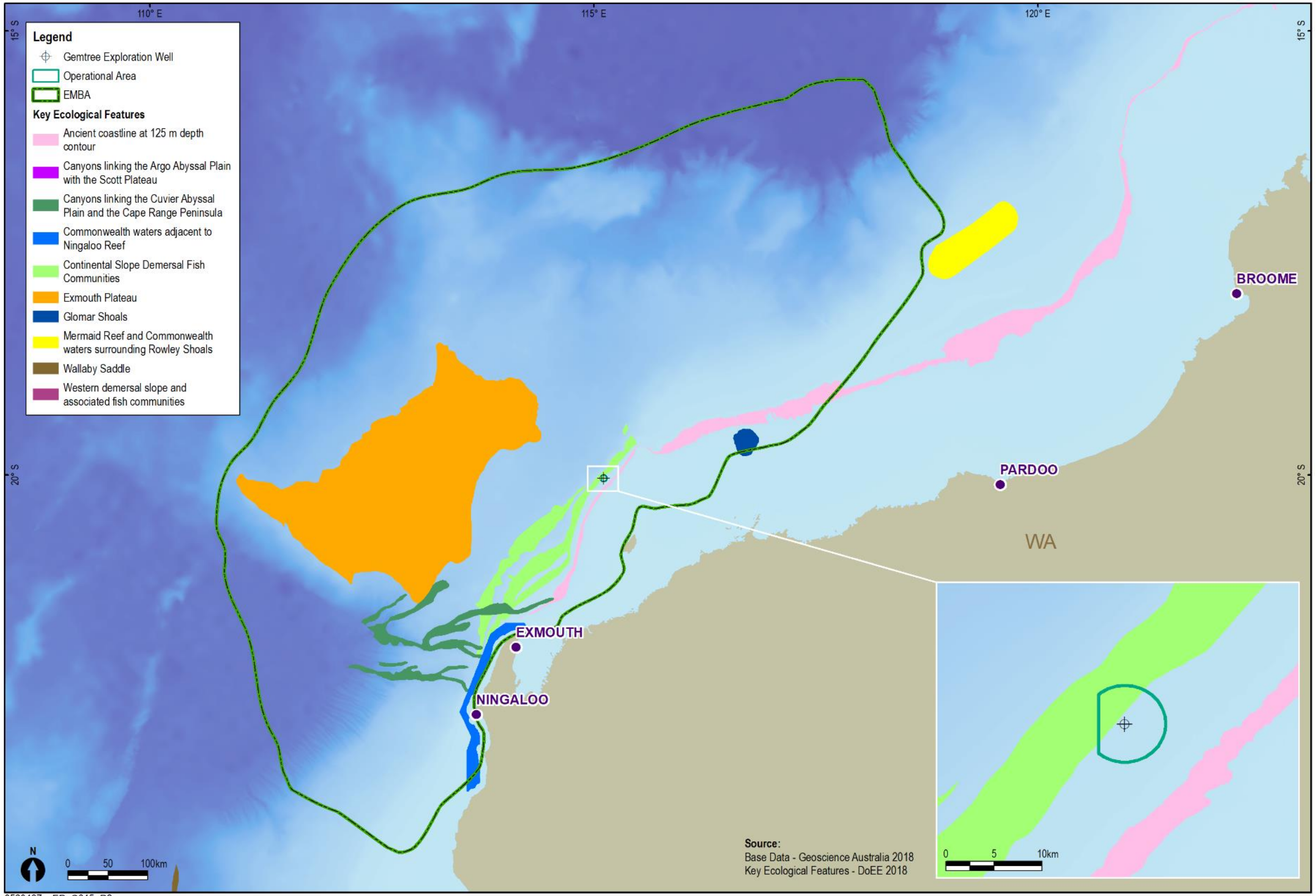

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Figure 4-21: KEFs in relation to the Operational Area and EMBA

4.7.8 Rankin Bank

Rankin Bank is on the continental shelf, about 40 km north-east of the Operational Area and within the EMBA. While Rankin Bank is not protected and is not a KEF, along with Glomar Shoal it is the only large, complex bathymetrical feature on the outer western shelf of the West Pilbara and represents habitats that are likely to play an important role in the productivity of the Pilbara region (AIMS, 2014). Rankin Bank consists of three submerged shoals delineated by the 50 m depth contour with water depths of about 18–30.5 m (AIMS, 2014; Abdul Wahab et al., 2018).

Rankin Bank, along with the Glomar Shoal, was surveyed by AIMS in 2013 as part of a co-investment project between Woodside and AIMS to better understand the habitats and complexity of the submerged shoal ecosystems. Rankin Bank represents a diverse marine environment, predominantly composed of consolidated reef and algae habitat (~55% cover), followed by hard corals (~25% cover), unconsolidated sand/silt habitat (~16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (~3% cover) (AIMS, 2014). Hard corals are a significant component of the benthic community of some parts of the bank, with abundance in the upper end of the range observed elsewhere on the submerged shoals and banks of North West Australia (Heyward et al., 2011).

In shallower reef habitats (20–30 m depth), patches of high coral cover (exceeding 80%) extended for lengths up to 500 m, although patches with cover of 40–50% extending for shorter lengths (40–70 m) were more common (AIMS, 2014). Extensive hard coral habitats were also present in deeper waters (40–80 m), where the solitary mushroom coral *Diaseris* sp. formed large beds, some extending for more than a kilometre with an average of about 50% cover (AIMS, 2014; Abdul Wahab et al 2018).

Overall, Rankin Bank has a higher cover of hard corals, macroalgae and unconsolidated reef than Glomar Shoal. Hard coral communities were more diverse at Rankin Bank (33 genera) than at Glomar Shoal (21 genera) but soft corals were more diverse at Glomar Shoal than at Rankin Bank (AIMS, 2014; Abdul Wahab et al., 2018).

Other key characteristics of the Rankin Bank include:

- The fish abundance and diversity of the demersal fish communities of Rankin Bank are comparable with other regional Australian reefs and the NW submerged shoals and banks.
- Over 200 fish species were recorded at Rankin Bank and were generally classified as reef-associated species including surgeonfishes, emperors and coronation trout (AIMS, 2014).
- Species richness and abundance were influenced by depth, with shallower areas (<40 m) supporting the most species and highest number of individuals found in <20 m.
- Sediment at Rankin Bank is predominantly sand, with an increase in mud at deeper, more protected areas (AIMS, 2014). Sediment quality is considered pristine and unpolluted by anthropogenic impacts (AIMS, 2014).

5. STAKEHOLDER CONSULTATION

5.1 Summary

Woodside is committed to consulting relevant stakeholders to ensure stakeholder feedback informs its decision making and planning for proposed petroleum activities and builds upon Woodside's extensive and ongoing stakeholder consultation for its offshore petroleum activities in the region.

5.2 Stakeholder Consultation Guidance

Woodside has followed the requirements of Subregulation 11A (1) of the Environment Regulations to identify relevant stakeholders, these being:

- Each Department or agency of the Commonwealth Government to which the activities to be carried out under the Environment Plan, or the revision of the Plan, may be relevant.
- Each Department or agency of a State or the NT Government to which the activities to be carried out under the Environment Plan, or the revision of the Plan, may be relevant.
- The Department of the responsible State Minister, or the responsible NT Minister.
- A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the Environment Plan, or the revision of the Plan.
- Any other person or organisation that the Titleholder considers relevant.
- Woodside's assessment of stakeholder relevance is outlined in Table 5-1.

5.3 Stakeholder Consultation Objectives

In support of this EP, Woodside has sought to:

- Ensure all relevant stakeholders are identified and engaged in a timely and effective manner.
- Develop and make available communications material to stakeholders that is relevant to their interests and information needs.
- Incorporate stakeholder feedback into the management of the proposed activity where practicable.
- Provide feedback to stakeholders on Woodside's assessment of their feedback and keep a record of all engagements.
- Make available opportunities to provide feedback during the life of this EP.

5.4 Stakeholder Expectations for Consultation

Stakeholder consultation for this activity has also been guided by stakeholder organisation expectations for consultation on planned activities. This guidance includes:

NOPSEMA:

- GL1721 - Environment plan decision making - Rev 5 - June 2018
- GN1847 - Responding to public comment on environment plans - Rev 0 - April 2019
- GN1344 - Environment plan content requirements - Rev 4 - April 2019
- GN1488 - Oil pollution risk management - Rev 2 - February 2018

Commonwealth Government:

- Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area

AFMA:

- Petroleum industry consultation with the commercial fishing industry

Commonwealth Department of Agriculture and Water Resources:

- Fisheries and the Environment – Offshore Petroleum and Greenhouse Gas Act 2006
- Offshore Installations Biosecurity Guide

WA Department of Primary Industries and Regional Development:

- Guidance statement for oil and gas industry consultation with the Department of Fisheries

WA Department of Transport

- Offshore Petroleum Industry Guidance Note

Woodside acknowledges that additional relevant stakeholders may be identified prior to or during the proposed activity. These stakeholders will be contacted, provided relevant information to their interests and invited to provide feedback about the proposed activity. Woodside will assess their feedback, respond to the stakeholder and incorporate feedback into the management of the proposed activity where practicable.

Woodside consultation arrangements typically provide stakeholders up to 30 days (unless otherwise agreed) to review and respond to proposed activities where stakeholders are potentially affected. Woodside considers this consultation period an adequate timeframe in which stakeholders can assess potential impacts of the proposed activity and provide feedback.

5.5 Stakeholder Consultation

Consultation activities conducted for the proposed activity are outlined in Table 5-2. The Consultation Information Sheet (Appendix F, ref 1.2) is published on the Woodside website and includes a toll free 1800 phone number.

Table 5-1: Assessment of relevant stakeholders for the proposed activity

Stakeholder	Relevant to activity	Reasoning
Commonwealth Government department or agency		
Australian Customs Service - Border Protection Command (ACS)	Yes	Responsible for coordinating maritime security.
Australian Fisheries Management Authority (AFMA)	Yes	Responsible for the management of Commonwealth fisheries. No potential for interaction with Commonwealth fisheries in the Operational Area.
Australian Hydrographic Office (AHO)	Yes	Response for maritime safety and Notice to Mariners.
Australian Maritime Safety Authority (AMSA)	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth waters. Proposed activity has a hydrocarbon spill risk, which may require AMSA assistance for pollution response.
Department of Agriculture and Water Resources (DAWR)	Yes	Responsible for implementing Commonwealth policies and programmes to support the agriculture, fisheries, food and forestry industries. The proposed activity has the potential impact to DAWR's interests in the prevention of introduced marine species. No impacts are expected on commercial fishing operators licenced to fish in Commonwealth Fisheries that would impact the functions, interests or activities of DAWR.
Department of Defence (DoD)	Yes	Responsible for defending Australia and its national interests. The proposed Operational Area overlaps a Defence training area.
Department of the Agriculture, Water and the Environment (DAWE)	No	Responsible for designing and implementing Australian Government policy and programs to protect and conserve the environment, water and heritage, promote climate action, and provide adequate, reliable and affordable energy. The proposed activity does not trigger any of the DAWE's functions, interests or activities.
Department of Industry, Innovation and Science (DIIS)	Yes	Department of relevant Commonwealth Minister and is required to be consulted under the Regulations.

Stakeholder	Relevant to activity	Reasoning
Director of National Parks (DNP)	No	Responsible for the management of Commonwealth parks and conservation zones. Whilst planned activities do not affect the functions, interests or activities of the DNP, Woodside has chosen to provide information on arrangements for unplanned events, such as an oil spill, which have potential to impact the values within a Commonwealth marine park.
WA Government department or agency		
Department of Biodiversity, Conservation and Attractions (DBCA)	No	Responsible for the management of Western Australia’s parks, forests and reserves. Planned activities do not impact DBCA’s functions, interests or activities.
Department of Mines, Industry Regulation and Safety (DMIRS)	Yes	Department of relevant State Minister and is required to be consulted under the Regulations.
Department of Primary Industries and Regional Development (DPIRD)	Yes	Responsible for the management of State fisheries. Potential for interaction during proposed activities with State fisheries in the Operational Area.
Department of Transport (DoT)	Yes	Legislated responsibility for oil pollution response in State waters. Proposed activity has a hydrocarbon spill risk, which may require DoT response in State waters.
Commonwealth fisheries*		
North-West Slope Trawl Fishery	Yes	The fishery overlaps the Operational Area and there is potential for interaction with licence holders.
Southern Bluefin Tuna Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Western Tuna and Billfish Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
State fisheries*		
Abalone Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.

Stakeholder	Relevant to activity	Reasoning
Beche-de-mer Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Mackerel Managed Fishery – Pilbara (Area 2)	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Marine Aquarium Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Onslow Prawn Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Pearl Oyster Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Pilbara Demersal Scalefish Fishery		
- Pilbara Trawl Fishery	No	The Operational Area is outside of the Pilbara Trawl Fishery.
- Pilbara Trap Fishery	Yes	The fishery overlaps the Operational Area and DPIRD data indicates active fishing within the Operational Area.
- Pilbara Line Fishery	Yes	The fishery overlaps the Operational Area and DPIRD data indicates active fishing within the Operational Area.
South West Coast Salmon Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Specimen Shell Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
West Coast Deep Sea Crustacean Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Industry		
Chevron	Yes	Adjacent Titleholder.
Industry representative organisations		

Stakeholder	Relevant to activity	Reasoning
Australian Petroleum Production and Exploration Association (APPEA)	Yes	Represents the interests of oil and gas explorers and producers in Australia.
Commonwealth Fisheries Association (CFA)	Yes	Represents the interests of commercial fishers with licences in Commonwealth waters.
Pearl Producers Association (PPA)	Yes	Although interactions with licence holders in the Pearl Oyster Managed Fishery are unlikely, PPA has requested to be informed of Woodside's planned activities.
Recfishwest	No	Represents the interests of recreational fishers in Western Australia. Recfishwest has provided feedback for previous consultation for activities in WA-49-L that interaction with recreational fishers is unlikely given the distance from shore.
Western Australian Fishing Industry Council (WAFIC)	Yes	Represents the interests of commercial fishers with licences in State Waters. There is potential for interaction with commercial fishers in the Pilbara Line Fishery.

** Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed Operational Area, as well as consideration of fishing effort data, fishing methods and water depth. Table 4-10 provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Area.*

Table 5-2: Stakeholder consultation plan activities

Stakeholder	Information provided	Stakeholder response	Woodside response
Australian Government department or agency			
ACS	On 24 October 2019 Woodside emailed ACS advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	No feedback received.	Woodside has addressed maritime security-related issues in Section 6 of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
AFMA	On 23 October 2019 Woodside emailed AFMA advising of the proposed activity (App F, ref 1.7) and provided a Commonwealth Fisheries map relevant to the proposed activity (App F, ref 1.9) and a consultation Information Sheet.	No feedback received.	Email, Consultation Information Sheet and Commonwealth fisheries map provided. Woodside considers the level of consultation to be adequate.
AHO	On 23 October 2019 Woodside emailed AHO advising of the proposed activity (App F, ref 1.16) and provided a shipping fairways map (App F, ref 1.17) and a consultation Information Sheet.	On 24 October 2019 AHO emailed Woodside acknowledging receipt of Woodside's correspondence.	Based on feedback provided by AMSA, Woodside will notify the AHO no less than four working weeks before operations commence. Woodside considers the level of consultation to be adequate.
AMSA (marine safety)	On 23 October 2019 Woodside emailed AMSA advising of the proposed activity (App F, ref 1.16) and provided a shipping fairways map (App F, ref 1.17) and a consultation Information Sheet.	On 24 October 2019 AMSA emailed Woodside requesting the Master to email AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence and provided details of information required by the Centre in that communication. AMSA requested that the AHS be contacted through	Woodside will notify AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence.

Stakeholder	Information provided	Stakeholder response	Woodside response
		datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners. AMSA provided advice on obtaining vessel traffic plots, including digital data sets and maps.	Woodside will notify the AHO no less than four working weeks before operations commence. Woodside notes AMSA's advice on vessel traffic information.
AMSA (marine pollution)	On 23 October 2019 Woodside emailed AMSA advising on its consultation approach for the Oil Pollution First Strike Plan (App F, ref 1.18) consultation Information Sheet.	No feedback received.	No response required.
	On 3 December Woodside emailed AMSA a copy of the Oil Pollution First Strike Plan (App F, ref 1.20).	No feedback received	Woodside considers the level of consultation to be adequate
DAWR	On 23 October 2019 Woodside emailed DAWR advising of the proposed activity and provided information on invasive marine species (App F, ref 1.14), a Commonwealth Fisheries map (App F, ref 1.15) and a consultation Information Sheet.	On 28 October 2019 DAWR emailed Woodside acknowledging receipt of its consultation information and that a response will be provided within 10 business days.	Woodside notes DAWR's advice.
		No feedback received.	Woodside has addressed maritime biosecurity and Commonwealth fishing related issues in Section 6 of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
DoD	On 23 October 2019 Woodside emailed DoD advising of the	No feedback received.	Consultation Information Sheet, and defence map provided. Woodside

Stakeholder	Information provided	Stakeholder response	Woodside response
	proposed activity (App F, ref 1.10) and provided a defence map (App F, ref 1.11) and a consultation Information Sheet.		considers the level of consultation to be adequate.
DIIS	On 23 October 2019 Woodside emailed DIIS advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
DNP	On 5 November 2019 Woodside emailed DNP advising of the proposed activity (App F, ref 1.19) and provided a consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Western Australian Government department or agency or advisory body			
DBCA	On 23 October 2019 Woodside emailed DMIRS advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	On 24 October 2019 DBCA emailed Woodside acknowledging receipt of Woodside's correspondence, advising it had no comments to provide in relation to its responsibilities under the *Biodiversity Conservation Act 2016 and the Conservation and Land Management Act 1984.*	No further action.
DMIRS	On 23 October 2019 Woodside emailed DMIRS advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
DPIRD	On 23 October 2019 Woodside emailed DPIRD advising of the proposed activity (App F, ref 1.3)	No feedback received.	Woodside to follow up with stakeholder.

Stakeholder	Information provided	Stakeholder response	Woodside response
	and provided a State Fisheries map relevant to the proposed activity (App F, ref 1.5) and a consultation Information Sheet		
	On 25 November 2019 Woodside called DPIRD and sought feedback on a number of EP consultation activities, including this EP. On 25 November 2019 Woodside emailed DPIRD providing information on EPs currently under consultation (App F, ref 1.6).	On 25 November 2019 DPIRD thanked Woodside by way of an email response.	Woodside has attempted on a number of occasions to contact and consult DPIRD via email and phone calls and considers the level of consultation appropriate.
DoT	On 23 October Woodside emailed DoT advising on its consultation approach for the Oil Pollution First Strike Plan (App F, ref 1.18) consultation Information Sheet	On 24 October 2019 DoT emailed Woodside requesting to be consulted in line with its Guidance Note with a six-week review period from receipt of consultation materials.	No further action.
	On 5 December 2019 Woodside emailed DoT a copy of the Oil Pollution First Strike Plan (App F, ref 1.21)	On 20 December 2019 DoT emailed Woodside providing comments on the Oil Pollution First Strike Plan, seeking clarification on: Document formatting and referencing • Forward Operating Bases, Incident Control Centres and Staging areas • Amenability of oil to dispersants • Description of the existing environment and protection	On 2 January 2020 Woodside emailed DoT providing feedback on DoT's comments and committed to providing a final version of the Oil Pollution First Strike Plan once accepted by NOPSEMA.

Stakeholder	Information provided	Stakeholder response	Woodside response
		priorities/outcomes of oil spill trajectory modelling Initial response actions and key activation timeframes	
		On 2 January 2020 DoT emailed Woodside advising it had no further comments.	Woodside notes DoT's feedback.
Commonwealth Fisheries			
North West Slope Trawl Fishery	On 19 November Woodside emailed licence holders in the North West Slope Trawl fishery advising of the proposed activity (App F, ref 1.8) and provided a State Fisheries map relevant to proposed activity (App F, ref 1.9) and a consultation Information Sheet	No feedback received.	Email, consultation Information Sheet and Commonwealth fisheries map provided. Woodside considers the level of consultation to be adequate.
State Fisheries			
Pilbara Line Fishery Pilbara Trap Fishery	On 19 November Woodside emailed licence holders in the Pilbara Line and Trap Fisheries advising of the proposed activity (App F, ref 1.4) and provided a State Fisheries map relevant to proposed activity (App F, ref 1.5) and a consultation Information Sheet	No feedback received.	Email, consultation Information Sheet and Commonwealth fisheries map provided. Woodside considers the level of consultation to be adequate.
Industry			
Chevron	On 23 October 2019 Woodside emailed Chevron advising of the proposed activity (App F, ref 1.12) and provided a titles map relevant to the proposed activity (App F, ref	No feedback received.	Email, titles map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
	1.13) and a consultation Information Sheet.		
Industry representative organisations			
APPEA	On 24 October Woodside emailed APPEA advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
PPA	On 23 October 2019 Woodside emailed PPA advising of the proposed activity (App F, ref 1.3) and provided a State Fisheries map relevant to the proposed activity (App F, ref 1.5) and a consultation Information Sheet.	No feedback received.	Email, State Fisheries map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Recfishwest	On 23 October 2019 Woodside emailed WAFIC advising of the proposed activity (App F, ref 1.1) and provided a consultation Information Sheet.	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate as interaction is unlikely given distance from shore. Consultation information sheet provided on an information basis.
WAFIC	On 23 October 2019 Woodside emailed WAFIC advising of the proposed activity (App F, ref 1.3) and provided a State Fisheries map relevant to the proposed activity (App F, ref 1.5) and a consultation Information Sheet.	WAFIC emailed Woodside on 21 November 2019 and provided the following feedback: WAFIC confirmed Woodside's assessment that the Pilbara Line Fishery was a relevant potentially affected party. WAFIC disagreed with Woodside's assessment that the Pilbara Trap Fishery was a relevant potentially	 Woodside notes WAFIC's advice. Woodside notes WAFIC's advice.

Stakeholder	Information provided	Stakeholder response	Woodside response
		affected party, given the water depth at the proposed well location.	
		WAFIC provided advice on Woodside's communications to improve understanding by commercial fishers on proposed activities.	Woodside notes WAFIC's advice.
		WAFIC requested clarity on exclusion and cautionary zones for the activity.	On 9 December 2019 Woodside emailed WAFIC noting its advice, as well as confirming amendments had been made to consultation material with respect to exclusion zones, with the updated materials re-posted on Woodside's web site.

5.6 Ongoing Stakeholder Consultation

Woodside is committed to the engagements listed in Table 5-3, based on stakeholder feedback.

Table 5-3: Assessment ongoing stakeholder consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSA’s Joint Rescue Coordination Centre at least 24–48 hours before operations commence.
	Woodside will notify the AHO no less than four working weeks before operations commence.

6. ENVIRONMENTAL RISK ASSESSMENT, PERFORMANCE OUTCOMES, STANDARDS AND MEASUREMENT CRITERIA

6.1 Overview

This section presents the environmental impact and risk analysis, evaluation and environment performance outcomes, environmental performance standards and measurement criteria for the Petroleum Activities Program, using the methodology described in Section 2 of the EP.

6.2 Impact and Risk Analysis and Evaluation

As required by Regulations 13(5) and 13(6) of the Environment Regulations, the following analysis and evaluation demonstrates that the identified impacts and risks associated with the Petroleum Activities Program are reduced to ALARP, are of an acceptable level and consider all operations of the activity, including potential emergency conditions. The impact assessment for planned activities has been based on the size of the Operational Area, which is defined by a 4 km radius around the proposed well location, within the Permit Area WA-49-L.

The impacts and risks identified during the ENVID workshop (including decision type, current risk level, acceptability of impacts and risks, and tools used to demonstrate acceptability and ALARP) have been divided into two broad categories:

- planned activities (routine and non-routine) which have the potential for inherent environmental impacts
- unplanned events (accidents, incidents or emergency situations) with an environmental consequence are termed risks.

Within these categories, impact and risk assessment groupings are based on environmental aspects[5] e.g. emissions, physical presence, etc. In all cases, the worst case risk was assumed.

The ENVID (performed in accordance with the methodology described in Section 2) identified 21 sources of environmental impacts and risks. A summary of the ENVID is provided in Table 6-1.

The impact and risk analysis and evaluation for the Petroleum Activities Program indicate that all current environmental impacts and risks associated with the activity are reduced to ALARP and are of an acceptable level, as discussed further in Sections 6.6 and 6.7.

6.2.1 Cumulative Impacts

Existing subsea infrastructure within the Permit Area and nearby petroleum facilities are described in Section 4.6.7. Woodside has assessed the cumulative impacts of the Petroleum Activities Program in relation to other relevant petroleum activities which could realistically result in overlapping temporal and spatial extents. Other facilities located in proximity to the Operational Area were identified within Section 4.6.7, with the closest being the Pluto and Wheatstone platforms which are located about 23 and 27 km, respectively, north-east of the Operational Area.

Given the distance between the location of the Operational Area and other nearby petroleum facilities and activities, no cumulative risks or impacts will credibly occur.

[5] An environmental aspect is an element of the activity that can interact with the environment.

Table 6-1: Environmental impact and risk analysis and summary

Aspect	EP Section	Consequence	Potential Consequence level of impact	Likelihood	Current Risk Rating	Acceptability of Risk / Impact
Physical presence: Displacement of other users	6.6.1	F	Social and Cultural – no lasting effect (<1 month), localised impact not significant to areas/items of cultural significance.	-	-	Broadly Acceptable
Physical presence: Disturbance to benthic habitat from MODU anchoring, drilling operations and ROV operations	6.6.2	E	Environment – slight, short term local impact (< 1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly Acceptable
Routine acoustic emissions: Generation of noise from VSP	6.6.3	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. protected species).	-	-	Broadly Acceptable
Routine acoustic emissions: Generation of noise from support vessels, MODU, positioning equipment and helicopter transfers	6.6.4	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. protected species).	-	-	Broadly Acceptable
Routine and non-routine discharges to the marine environment: MODU and support vessels	6.6.5	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. water quality).	-	-	Broadly Acceptable
Routine and non-routine discharges to the marine environment: Drill cuttings and drilling fluids	6.6.6	E	Environment – slight, short term local impact (< 1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly Acceptable
Routine and non-routine discharges to the marine environment: Cement, cementing fluids, grout, subsea well fluids and unused bulk products	6.6.7	E	Environment – slight, short term local impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly Acceptable
Routine atmospheric emissions: Fuel combustion, incineration and venting	6.6.8	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. air quality).	-	-	Broadly Acceptable

Aspect	EP Section	Consequence	Potential Consequence level of impact	Likelihood	Current Risk Rating	Acceptability of Risk / Impact
Routine light emissions: External lighting on MODU and support vessels	6.6.9	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. species).	-	-	Broadly Acceptable
Accidental hydrocarbon release: Loss of well integrity	6.7.2	B	Environment – major, long term impact (10–50 years) on highly valued ecosystems, species, habitat, physical or biological attributes. Reputation/brand – national concern and/or international interest. Medium to long-term impact (5–20 years) to reputation and brand. Venture and/or asset operations restricted.	2	H	Acceptable if ALARP
Accidental hydrocarbon release: Vessel collision	6.7.2	D	Environment – minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Broadly Acceptable
Accidental hydrocarbon release: Bunkering	6.7.4	E	Environment – slight, short term local impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	2	M	Broadly Acceptable
Unplanned discharges: Drilling fluids	6.7.3	E	Environment – slight, short term local impact (<1 year) on species, habitat (but not affecting ecosystems function), physical and biological attributes.	1	L	Broadly Acceptable
Unplanned discharges: Deck and subsea spills	6.7.6	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly Acceptable
Unplanned discharges: Loss of solid hazardous and non-hazardous wastes/equipment	6.7.7	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly Acceptable
Physical presence: Vessel collision with marine fauna	6.7.8	E	Environment – slight, short term local impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly Acceptable
Physical presence: Disturbance to seabed from loss of station keeping	6.7.9	E	Environment – slight, short term local impact (<1 year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	2	M	Broadly Acceptable
Physical presence: Dropped object resulting in seabed disturbance	6.7.10	F	Environment – no lasting effect (<1 month), localised impact not significant to environmental receptors (e.g. benthic habitats).	2	L	Broadly Acceptable

Aspect	EP Section	Consequence	Potential Consequence level of impact	Likelihood	Current Risk Rating	Acceptability of Risk / Impact
Physical presence: Accidental introduction and establishment of invasive marine species	6.7.11	D	Environment – no credible risk identified. Reputation and Brand – minor, short-term impact (1–2 years) to reputation and brand. Close scrutiny of asset level operations or future proposals.	0	L	Broadly Acceptable

6.3 Environmental Performance Outcomes, Standards and Measurement Criteria

Regulation 13(7) of the Environment Regulations requires that an EP includes environmental performance outcomes, environmental performance standards and measurement criteria that address legislative and other controls to manage the environmental impacts and risks of the activity to ALARP and Acceptable levels.

Environmental performance outcomes, standards and measurement criteria for the Petroleum Activities Program have been identified to allow the measurement of Woodside's environmental performance and the implementation of this EP to determine whether the environmental performance outcomes and standards have been met.

The environmental performance outcomes, standards and measurement criteria specified are consistent with legislative requirements and Woodside's standards and procedures. They have been developed based on the Codes and Standards, Good Industry Practices and Professional Judgement outlined in Section 3, as part of the acceptability and ALARP justification process.

The environmental performance outcomes, environmental performance standards and measurement criteria are presented throughout this section and in Appendix D (Oil Spill Preparedness and Response). A breach of these environmental performance outcomes or standards constitutes a 'Recordable Incident' under the Environment Regulations (refer to Section 7.8.4).

6.4 Presentation

The environmental impact and risk analysis and evaluation (ALARP and acceptability), environmental performance outcomes, standards and measurement criteria are presented in the following tabular form throughout this section. Italicised/green text in the following example denotes the purpose of each part of the table with reference to the relevant sections of the Environment Regulations and/or this EP.

Context <Description of the context for the impact/risk. Regulation 13(1, 13(2) and 13(3)>		
Description of the Activity – Regulation 13(1)	*Description of the Environment – Regulations 13(2)(3)*	*Consultation – Regulation 11A*

Impacts and Risks Evaluation Summary – ***Summary of ENVID outcomes***														
Source of impact/risk *Regulation 13(1)*	**Environmental Value Potentially Impacted** *Regulations 13(2)(3)*							**Evaluation** ***Section 2.6*** *and* ***Section 2.7***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Summary of source of impact/risk														
Description of Source of Impact/Risk														
Description of the identified impact/risk including sources or threats that may lead to the risk or identified event. Regulation 13(1).														
Impact Assessment														
Environmental Value/s Potentially Impacted														
Discussion and assessment of the potential impacts to the identified environment value(s). Regulations 13(5)(6). *Potential impacts to environmental values have been assigned and discussed based on Woodside's Environmental Consequence Definitions for Use in Environmental Risk Assessments (**Table 2-3**).*														

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[6]	***Benefit in Impact/Risk Reduction***[7]	***Proportionality***	***Control Adopted***
ALARP Tool Used – Section 2.7				
Summary of control considered to ensure the impacts and risks are continuously reduced to ALARP. *Regulation 13(5)(c).*	*Technical/logistical feasibility of the control.* *Cost/sacrifice required to implement the control (qualitative measure).*	*Quantum of impact/risk that could be averted (measured in terms of reduction of likelihood, consequence and current risk rating) if the cost/sacrifice is made and the control is adopted.*	*Proportionality of cost/sacrifice vs environmental benefit. If proportionate (benefits outweigh costs) the control will be adopted. If disproportionate (costs outweigh benefits) the control will not be adopted.*	*If control is adopted: Reference to Control # provided.*
ALARP Statement *Made on the basis of the environmental risk assessment outcomes, use of the relevant tools appropriate to the decision type (Section 2.6.1 and Figure 2-4) and a proportionality assessment. Regulation 10A(b).*				

[6] Qualitative measure

[7] Measured in terms of reduction of likelihood (L), consequence (C) and current risk rating (CRR)

Demonstration of Acceptability
Acceptability Statement *Made on the basis of the application of the process described in Section 2.7.2 and Figure 2-7, taking into account internal and external expectations, risk to environmental thresholds and use of environment decision principles. Regulation 10A(c).*

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO# **S:** *Specific performance which addresses the legislative and other controls that manage the activity and against which performance by Woodside in protecting the environment will be measured.* M: *Performance against the outcome will be measured by measuring implementation of the controls via the measurement criteria.* A: *Achievability/feasibility of the outcome demonstrated via discussion of feasibility of controls in ALARP demonstration. Controls are directly linked to the outcome.* R: *The outcome will be relevant to the source of risk and the potentially impacted environmental value.* T: *The outcome will state the timeframe during which the outcome will apply or by which it will be achieved.*	**C#** *Identified control adopted to ensure the impacts and risks are continuously reduced to ALARP.* *Regulation 13(5)(c).*	**PS#** *Statement of the performance required of a control measure. Regulation 13(7)(a)*	**MC#** *Measurement criteria for determining whether the outcomes and standards have been met. Regulation 13(7)(c)*

6.5 Potential Environmental Risks Not Included Within the Scope of the Environmental Plan

The ENVID identified a number of environmental risks that were assessed as not being applicable or not credible (refer Section 2.5) within or outside the Operational Area as a result of the Petroleum Activities Program. Therefore, they were determined to not form part of this EP. These are described in the following sections for information only.

6.5.1 Shallow/Near-shore Activities

The Petroleum Activities Program is located in water depths of about 166–511 m and at a distance of about 50 km from the nearest landfall (this being the Montebello Islands). Consequently, risks associated with shallow/near-shore activities such as anchoring and vessel grounding were assessed as not credible.

6.5.2 Helicopter Interference With Other Users

Aerial interference with other users is not considered credible as the Operational Area is more than 139 km from mainland Australia and there are no other identified users of the airspace over the Operational Area, e.g. Royal Australian Air Force.

6.5.3 Loss of Containment of Existing Subsea Infrastructure

As described in Section 4.6.7, there is no existing infrastructure present within the Operational Area. This risk is therefore not assessed as part of this EP.

6.5.4 Loss of Containment from Abandoned Wellheads

No existing wellheads occur in the Operational Area. Therefore, the scenario of loss of containment from existing wellheads is not considered credible and is not assessed further as part of this EP.

6.5.5 Benthic Disturbance from Anchor Hold Testing

Anchor hold testing is not covered in the scope of this EP. It is included as an activity under a separate EP which assesses seabed disturbance associated with deployment and retrieval of anchors to identify suitable mooring locations. Therefore, impacts associated with anchor hold testing are not assessed further as part of this EP.

6.6 Planned Activities (Routine and Non-routine)

6.6.1 Physical Presence: Displacement of Other Users

Context														
Project vessels – Section 3.5 Wellhead assembly left in-situ – Section 3.10.5	Socio-economic environment – Section 4.6							Stakeholder consultation – Section 5						
Impacts and Risks Evaluation Summary														
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Displacement of other users – proximity of MODU and support vessels interfering with or displacing third party vessels (commercial fishing, recreational fishing and commercial shipping)							X	A	F	-	-	GP PJ	Broadly Acceptable	EPO 1 & 2
Presence of subsea infrastructure (i.e. wellhead left in-situ) interfering with or displacing third party vessels (commercial/ recreational fishing)							X	A	F	-	-			
Description of Source of Impact														

Activities that are potential sources of displacement of other users are:

- MODU; and
- support vessels.

Drilling of the exploration well is expected to take about 50 days to complete. While drilling is expected to commence in Q3 of 2020, the timing of the activity could occur at any time of the year (refer to Section 3.4).

Support vessels will assist the MODU. If required, one of the vessels will be at the MODU to perform standby duties as stipulated in the OneMarine Charterers Instructions, and others will transit in and out of the Operational Area to port for routine, non-routine and emergency operations. The support vessels will make about two to four trips per week.

The presence of the MODU and support vessel movements could present a navigational hazard to shipping and commercial fishing activities in the Operational Area. Activities will be 24 hours per day, seven days per week.

As outlined in Section 3.8.7, upon well abandonment the marine riser and BOP will be removed and every reasonable attempt made to retrieve the wellhead. However, the wellhead assembly may be left in-situ if routine removal techniques are unsuccessful. If the wellhead is left in-situ, it could potentially interfere with third party activities (particularly fishing activities).

Impact Assessment

Potential Impacts to Socio-Economic Environment

Displacement of Commercial Fishing Activities

A number of Commonwealth and State managed fisheries overlap the Operational Area (Section 4.6.3). The proposed well is situated within three Commonwealth and ten State managed fisheries. However, only two fisheries, the North West Slope Trawl Fishery (NWSTF) and Pilbara Line Fishery (PLF) are considered to be potentially active in the vicinity of the Operational Area.

The north-west portion of the Operational Area overlaps with a very small portion of the NWSTF management area (about 1.9 km^2 of the 400,913 km^2 management area). The fishery is active along the 200 m isobath, however fishing effort is located to the north of the Operational Area (Patterson et al., 2018; Patterson at al., 2019). It is noted that the proposed Gemtree-A well is located about 3.5 km south-east of the NWSTF management area and the 500 m petroleum safety zone does not overlap with management area. The Pilbara Line Fishery encompasses all of the 'Pilbara waters' and is the smallest fishery in terms of monetary value (Fletcher & Santoro, 2014), and by annual catch (Newman et al., 2019b). There are no stated depth limits and the western extent of the fishery is the boundary of the Australian Fishing Zone. The Pilbara Line Fishery may operate within the Operational Area. The Operational Area is located in water depths ranging from about 166–511 m, which is beyond the upper depth limit where typical Mackerel Managed Fishery effort occurs (up to about 100 m). The Operational Area is located within a closed (indefinite) area of the Pilbara Trawl and Pilbara Trap Fishery, and therefore effort from these fisheries is not expected within the Operational Area. Although overlapping with the boundaries of the Beche-de-mer, Pearl Oyster, Specimen Shell Fishery, Onslow Prawn Fishery or Marine Aquarium Managed Fisheries, the Operational Area is considered too far offshore to credibly impact these fisheries. Potential impacts to commercial fishing if the well is abandoned during drilling and the wellhead remains in-situ (Section 3.8.7 and Section 3.10.5), are snag hazards to fishing equipment such as trawl nets that operate along the seabed. The one fishery that uses trawl practices and overlaps with the Operational Area is the North West Slope Trawl Fishery (NWSTF). However, the proposed Gemtree-A well is located about 3.5 km south-east of the NWSTF management area and the 500 m petroleum safety zone does not overlap with management area. Impacts to commercial fishing activities if the wellhead remains in-situ are therefore not expected. Given the low level of fishing activity expected in the Operational Area, potential impacts are expected to be limited to localised displacement/avoidance by commercial fishing vessels within the immediate vicinity of the MODU or support vessels. During the stakeholder consultation period, WAFIC confirmed that the Pilbara Line Fishery was a relevant potentially affected party. However, there was no direct response from commercial fisheries, and as such any potential impact is considered to be temporary with no lasting effects. ***Displacement of Recreational Fishing*** Stakeholder consultation did not identify any key recreational fishing activity within the Operational Area. Recreational fishing in the region is concentrated around the coastal waters and islands of the NWMR such as the Montebello Islands. Due to the distance offshore and water depths, recreational fishing is unlikely to occur in the Operational Area. If recreational fishing effort occurred within the Operational Areas while drilling is being performed, displacement as a result of the Petroleum Activities Program would be minimal and relate only to the 500 m petroleum safety zone around the MODU. Additionally, fishing activity may be excluded from the immediate area around support vessels. Therefore, potential impacts are expected to be localised with no lasting effects. Given the distance of the Operational Area offshore and water depth of the exploration well (201 m), snagging hazards to recreational fishing equipment as a result of the wellhead remaining in-situ are highly unlikely. ***Displacement to Commercial Shipping*** The presence of the MODU and support vessels could potentially cause temporary disruption to commercial shipping. The Operational Area lies beyond designated shipping fairways in the region and is not subject to significant commercial vessel traffic (Figure 4-18). During the stakeholder consultation period AMSA requested that Woodside contact the AHS no less than four working weeks before operations commence for the promulgation of related notices to mariners, and contact AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence. The potential impacts associated with this Petroleum Activities Program include displacement of vessels as they make slight course alteration to avoid the MODU or support vessels. Therefore, the potential impact is considered to be isolated and temporary with no lasting effect. Given the water depth of the exploration well (201 m), impacts to commercial shipping as a result of the wellhead remaining in-situ are not considered credible.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that physical presence of the MODU, support vessels and the potential presence of the wellhead left in-situ (if required) will not result in a potential impact greater than localised and temporary displacement of shipping and commercial/recreational fishing interests, with no lasting effect (i.e. Social and Cultural – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)*** [8]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
Australian Hydrographic Service (AHS) will be notified of activities and movements no less than 4 working weeks prior to scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHS will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 1.1
Notify DPIRD (Western Australia) (formerly the WA Department of Fisheries) of activities within three months of drilling.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 1.2
Notify AMSA Joint Rescue Coordination Centre (JRCC) of activities and movements 24-48 hours before operations commence.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 1.3
Undertake consultation with relevant stakeholders for activities and movements that commence more than a year after EP acceptance.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 1.4
Routine removal of the wellhead will be attempted following abandonment of the well or respud.	F: Yes. CS: Additional cost. Standard practice.	Routine removal of the wellhead may reduce the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 2.1

[8] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[8]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Limit drilling activities to avoid peak shipping and commercial fishing activities.	F: No. Shipping occurs year-round and cannot be avoided. SIMOPS with fishing seasons cannot be eliminated as exact timings for the activity is not confirmed. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Over-trawl protection on subsea infrastructure.	F: Yes. Over-trawl protection could mitigate the potential for commercial fishing trawl gear to damage subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional cost.	Reduces the potential for snagging trawl nets if the wellhead is left in-situ following abandonment. However, given that trawling activity is not expected over the Gemtree-A well location (outside the NWSTF Management Area), the benefit is low.	Disproportionate. Significant additional costs.	No

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of the physical presence of the MODU, support vessels and potentially the wellhead left in-situ (if required) on other users, such as commercial fisheries, recreational fishing and shipping.

As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, physical presence of the MODU, support vessels and potentially the wellhead left in-situ (if required) is unlikely to result in potential impact greater than isolated and short-term impacts to commercial fishing, recreational fishing and shipping. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet requirements of Australian Marine Orders, and expectations of AMSA and AHS provided in consultation with stakeholders.

The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of physical presence of the Petroleum Activities Program to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 1 Marine users aware of the Petroleum Activities Program.	**C 1.1** Notify AHS of activities and movements no less than four working weeks prior to the scheduled activity commencement date.	**PS 1.1** Notification to AHS of activities and movements to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	**MC 1.1.1** Consultation records demonstrate that AHS has been notified before commencing an activity to allow generation of navigation warnings (MSIN and NTM (including AUSCOAST warnings where relevant)).
	C 1.2 Notify DPIRD (Western Australia) (formally the WA Department of Fisheries) of activities within three months of drilling.	**PS 1.2** Notification to DPIRD to inform other marine users of the activities to reduce activities interfering with other marine users for longer than necessary.	**MC 1.2.1** Consultation records demonstrate that DPIRD has been notified prior to commencing drilling.
	C 1.3 Notify AMSA JRCC of activities and movements 24–48 hours before operations commence.	**PS 1.3** Notification to AMSA JRCC to prevent activities interfering with other marine users. AMSA's JRCC will require the MODU's details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and need to be advised when operations start and end.	**MC 1.3.1** Consultation records demonstrate that AMSA JRCC has been notified before commencing the activity within required timeframes.
	C 1.4 Undertake consultation with relevant stakeholders for activities and movements that commence more than a year after EP acceptance.	**PS 1.4** Relevant stakeholders consulted no less than 4 working weeks prior to scheduled activity commencement date.	**MC 1.4.1** Consultation records demonstrate relevant stakeholders have been consulted.
EPO 2 Routine removal of the wellhead will be attempted during the Petroleum Activities Program.	**C2.1** Routine removal of the wellhead will be attempted following abandonment of the well or respud.	**PS.2.1** Removal of wellhead attempted following abandonment of the well or in the event of a respud.	**MC 2.1.1** Records demonstrate routine removal of wellhead was attempted.

6.6.2 Physical Presence: Disturbance to Benthic Habitat from MODU Anchoring, Drilling Operations and ROV Operations

Context	
Mooring installation– Section 3.5.1.1 Project vessels – Section 3.5 Other support – Section 3.6 Drilling activities – Section 3.8 Wellhead assembly left in-situ – Section 3.10.5	Biological environment – Section 4.5 Values and sensitivities – Section 4.7

Impacts and Risks Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Disturbance to seabed from drilling, including MODU station holding (MODU mooring)					X			A	E	-	-	GP PJ	Broadly Acceptable	EPO 2 & 3
Disturbance to seabed from positioning equipment					X			A	E	-	-			
Disturbance to seabed from ROV operation (including localised sediment relocation from jetting activities)					X			A	E	-	-			
Disturbance to seabed from wellhead remaining in-situ (if required)					X			A	E	-	-			

Description of Source of Impact

Drilling

Drilling activities will result in direct seabed disturbance of up to 100 m radius around the well location due to the installation of the BOP and conductor. The generation and discharge of cuttings and drilling fluids are not considered in this section; refer to Section 6.6 for an assessment of drill cuttings and drilling fluids.

MODU Anchoring

The use of a moored MODU requires a 8–12 point mooring system spread from the well location, which will be pre-laid or partially pre-laid prior to the arrival of the MODU. Suction piling may be required for installing the anchors.

The MODU mooring will result in seabed disturbance from the anchor mooring system, including placement of anchors and chain/wire on the seabed, potential dragging during tensioning and recovery of anchors. Overall, the mooring of the MODU will result in localised, small scale seabed disturbance relating to the spatial extent of the benthic habitats described in Section 4.4.4.

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) for all anchoring activities performed by vessels and floating facilities (excluding floating production, storage and offtake vessels and floating LNG vessels) while performing petroleum activities including:

- locations of water depth greater than 70 m (this boundary is set to exclude areas of sensitive primary producer habitats, such as coral and seagrass, that occur in shallower waters)
- installation of moorings, buoys, equipment or other infrastructure for a period of up to two years
- wet storage on seabed of anchor chains, etc., during activities up to two years
- activities with total areas of seabed disturbance less than 13,000 m².

Note, anchor hold testing is not covered under the Petroleum Activities Program proposed in this EP. It is subject to a separate EP, which assesses seabed disturbance associated with deployment and retrieval of anchors to identify suitable mooring locations for the MODU prior to drilling of the Gemtree-A exploration well.

Positioning Equipment

An array of underwater acoustic positioning transponders will be placed on the seafloor and are critical for accurate positioning. LBL transponders may be moored to the seabed by a clump weight. The standard clump weights used will likely weigh about 80 kg. When installation activities are complete, the LBL transponders will be recovered via an acoustic release mechanism, leaving only the concrete clump weight on the seafloor. Steel chains are used as they rust and gradually degrade in seawater over time.

The installation of positioning equipment may result in localised disturbance to benthic habitats in the form of a scour around the subsea infrastructure.

ROV

Use of the ROV during Petroleum Program Activities may result in temporary seabed disturbance and suspension of sediment, causing increased turbidity as a result of working close to or occasionally on the seabed. ROV used 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. Additionally, the ROV may be used to relocate small amounts of sediment material (known as jetting) to create a stable, level surface and reduce the potential for scouring from subsea equipment (e.g. BOP). This will cause localised and temporary impacts to water quality from increased turbidity and may cause localised and temporary impacts to benthic habitats.

Wellhead Remains In-situ

As outlined in Section 3.8.7 and 3.10.5, the well will be abandoned at the end of the drilling program and routine techniques will be used to remove the wellhead. The wellhead assembly may be left in-situ if these routine removal techniques are unsuccessful. If the wellhead is left in-situ, there would be localised seabed disturbance around the wellhead location.

Impact Assessment

Potential Impacts to Ecosystems/Habitats

Deepwater Benthic Habitats

Drilling operations, MODU mooring, installation of the wellhead and BOP and ROV operations are likely to result in localised physical modification to a small area of the seabed and disturbance to soft sediment. Bathymetry surveys indicate that the south-west portion of the Operational Area, including the proposed Gemtree-A exploration well site, is located on the outer continental shelf and is predominantly flat and featureless. The north-east portion of the Operational Area overlaps with an area of seabed known as the ‘upper slope’ (water depth of 225–500 metres) and forms part of the Continental Slope Demersal Fish Communities KEF. The proposed location of the Gemtree-A exploration well is located about 1 km from the upper slope and the Continental Slope Demersal Fish Communities KEF, as described below.

The Operational Area is expected to consist primarily of soft, fine unconsolidated sediments, which are typical of the broader NWMR. As such, physical impacts to the seabed are expected to be highly localised, non-significant disturbance to deepwater soft sediments. Due to the presence of soft sediments and lack of hard substrate, the seabed is likely to be inhabited by a low abundance of patchy distributions of filter feeders and other epifauna, including mobile epibenthos (e.g. sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens, characteristic of the wider NWMR (Brewer et al., 2007). Impacts from drilling activities are expected to be confined to sediment-burrowing infauna and surface epifauna invertebrates, particularly filter feeders, inhabiting the seabed directly around the well location, typically within 100 m of the well (Gates & Jones, 2012; Hughes et al., 2010). Impacts to these broadly represented communities are expected to be highly localised with no significant impact to environment receptors.

The Continental Slope Demersal Fish Communities KEF (Section 4.7.1) overlaps the Operational Area, but is about 1 km from the proposed Gemtree-A exploration well location. Any impact to the benthic habitat of the KEF would be limited to minor disturbance from potentially overlapping anchor spreads. However, such impacts would be minor and temporary and are not expected to impact the ecological values of the KEF as described in Section 4.7.1.

ROV activities near the seafloor and small amounts of sediment relocation may result in slight and short-term impacts to deepwater biota, detailed above, as a result of elevated turbidity and the clogging of respiratory and feeding parts (turbidity) of filter feeding organisms. However, elevated turbidity would only be expected to be very short-term and temporary, and is therefore, not expected to have any significant impact to environment receptors.

In the unlikely event that the wellhead cannot be removed following abandonment, over time the cement surrounding the wellhead will likely become buried in sediment as a result of prevailing ocean currents. The steel wellhead structure will also corrode over time and marine fouling is expected to accumulate, whereby a marine life structure may remain above the seafloor. If the wellhead remains in-situ, it is expected to have a localised impact not significant to environment receptors. No further impacts to benthic habitats are likely.

Summary of Potential Impacts to Environmental Values
Given the adopted controls, seabed disturbance from the Petroleum Activities Program will result in localised, slight and short-term impacts to benthic habitat and communities (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Project-specific Basis of Well Design, which includes an assessment of seabed sensitivity.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of anchoring occurring in areas of high sensitivity. Assessment of seabed topography reduces the likelihood of anchor drag leading to seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes C 3.1
LBL or USBL positioning technology used.	F: Yes. CS: Minimal cost. Standard practice.	Using positioning technology to accurately position infrastructure on the seabed will reduce seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes C 3.2
Environmental monitoring of the seabed before and after the Petroleum Activities Program to assess any impacts to seabed.	F: Yes. CS: Significant. Monitoring of the seabed, particularly the deep waters of the Operational Area, would have significant additional costs to obtain and analyse data with the spatial resolution to accurately assess changes to the seabed habitat.	Environmental monitoring would not result in any additional information of the seabed above that already collected. Therefore, no additional reductions in likelihood or consequence would occur.	Control grossly disproportionate. Monitoring will not reduce the consequence or likelihood of any impacts to the seabed, and the cost associated with the level of monitoring required to accurately assess any impacts greatly outweighs the benefits gained. Although adopting this control could be used to verify EPOs, alternative controls identified also allow demonstration that the environmental outcome has been met based on the nature of the activity (i.e. predictable impacts) and relatively low sensitivity of the area.	No
Routine removal of wellheads will be attempted following	F: Yes. CS: Additional cost. Standard practice.	Routine removal of the wellhead may reduce the likelihood of	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 2.1

[9] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
abandonment of the well or respud.		interfering with other marine users.		
Professional Judgement – Eliminate				
Only use DP MODU (no anchoring required).	F: No. CS: It is not technically feasible for the MODU to use DP in the water depth of the well location (about 201 m). Woodside has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Do not use ROV close to, or on, the seabed.	F: No. The use of ROVs (including work close to or occasionally landed on the seabed) is critical as the ROV is the main tool used to guide and manipulate equipment during drilling. ROV usage is already limited to only that required to conduct the work effectively and safely. Due to visibility and operational issues, ROV work on or close to the seabed is avoided unless necessary. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of benthic habitat disturbance from MODU station holding, drilling operations and ROV operations. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, disturbance to benthic habitats is unlikely to result in a potential impact greater than a slight and temporary effect on habitat (but not affecting ecosystems function). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet the requirements of Woodside's relevant systems and procedures. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Routine removal of the wellhead will be attempted during the Petroleum Activities Program.	**C2.1** Routine removal of the wellhead will be attempted following abandonment of the well or respud.	**PS.2.1** Removal of wellhead attempted following abandonment of the well or in the event of a respud.	**MC 2.1.1** Records demonstrate routine removal of wellhead was attempted.
EPO 3 No impact to benthic habitats greater than a consequence level of E inside the Operational Area during the Petroleum Activities Program.[10]	**C 3.1** Project-specific Basis of Well Design, which includes an assessment of seabed sensitivity.	**PS 3.1** MODU well site location consider seabed sensitivities.	**MC 3.1.1** Records confirm Basis of Well Design includes the assessment of seabed sensitivities.
	C 3.2 LBL or USBL positioning technology used.	**PS 3.2** Infrastructure positioned in the planned location[11] where impacts have been assessed.	**MC 3.2.1** Records confirm LBL transponders or USBL in place and functioning correctly.

[10] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in Figure 2-6/Section 2.6.3.

[11] Acceptable tolerance is considered to be ±150 m, given the homogenous and low sensitivity habitat.

6.6.3 Routine Acoustic Emissions: Generation of Noise from VSP

Context														
Project vessels – Section 3.5							Biological environment – Section 4.5							
Impacts and Risks Evaluation Summary														
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Generation of acoustic signals from VSP					X	X		A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 4

Description of Source of Impact
Vertical seismic profiling (VSP) operations can generate noise that could exceed ambient levels generated by wind and wave action and biological noise (ambient noise levels range from about 90 dB re 1 µPa under very calm, low wind conditions, to 120 dB re 1 µPa under windy conditions) (McCauley, 2005).
VSP is a standard method used during well logging (as described in Section 3.10.1). The duration of VSP is short, up to 24 hours, and uses relatively small airguns that generate impulsive low frequency noise.
The VSP source (typically 750 cui and comprising three 250 cui airguns) is expected to generate a peak pressure around 239 dB re 1 µPa pk @ 1 m, a sound pressure level (SPL) of 224 dB re 1 µPa SPL (root mean square, or 'rms') and sound exposure level (SEL) of 225 dB re 1 µPa2.s @ 1 m, with the majority of the noise concentrated at low (<100 Hz) frequencies (Jimenez-Arranz et al., 2017).

Impact Assessment

Potential Impacts to Protected Species

To determine impacts to EPBC listed species, an assessment was performed of the expected ranges of noise levels that could result in impacts. When acoustic waves propagate through water, there is a significant loss of intensity due to geometric spreading, reflection, absorption and scattering (International Association of Oil and Gas Producers (IOGP), 2008). The sum of these losses is referred to as 'transmission loss'. The short range spherical spreading loss component of this can be estimated to determine expected noise levels at short range using the spherical spreading loss calculation below:

$$\text{Transmission Loss (TL)} = 20 \log10(r) + \alpha r$$

Where:

- r is the slant range between the source and the receiver
- α is the frequency dependent absorption coefficient for seawater (dependent on temperature, pH and salinity) calculated using the equation of Fisher and Simmons (1977); estimated to be 0.001 for typical seawater in the Operational Area. Note that for low frequency sound, such as VSP, the contribution of α to transmission loss is small compared to the geometric spreading term.

Based on this equation, the expected range where noise levels will be equal to or greater than the relevant thresholds is detailed in Table 6-2.

Table 6-2: Noise level thresholds for cetaceans, marine turtles and whale sharks and expected distance from the source where noise levels will dissipate to below the relevant thresholds

Species Group	Threshold		Expected range of noise levels ≥ thresholds
Cetaceans	Permanent threshold shift (PTS)	230 dB re 1 µPa (pk) OR 198 dB re 1 µPa^2.s SEL (m-weighted)	~3 m ~23 m
	Behavioural response	160 dB re 1 µPa SPL (rms)	~1600 m
Marine turtles	Permanent threshold shift	No data available	NA
	Behavioural response	166 dB re 1 µPa SPL (rms)	~800 m
Whale sharks	Permanent threshold shift	>213 dB re 1 µPa SPL (rms) OR >216 dB re 1 µPa^2.s SEL	~20 m OR ~3 m
	Behavioural response	No data available	NA
Fish (where swim bladder is involved in hearing)	Permanent threshold shift	203 dB re 1 µPa^2.s (cSEL) OR >207 dB re 1 µPa (pk)	<10 m
	Temporary threshold shift (TTS)	186 dB re 1 µPa^2.s (cSEL)	<150 m

Marine Fauna (Cetaceans)

Elevated underwater noise can affect marine fauna, such as whales, in three main ways (*Oceans of noise*, 2004; Richardson et al., 1995; Southall et al., 2007):

- by causing direct physical effects on hearing or other organs (injury)
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
- through disturbance leading to behavioural changes or displacement from important areas.

Available data on marine mammal behavioural responses to pulsed sounds are highly variable and context-specific. Recent studies on the behavioural response of humpback whales to seismic airguns has demonstrated a behavioural response to seismic airguns above received SELs of 140 dB re 1 µPa^2.s (Dunlop et al., 2017). This study used the behavioural response of humpback whales to noise from two different moving airgun arrays (20 and 140 cubic inch airgun array) to determine whether a dose–response relationship existed. To do this, a measure of avoidance of the source was developed, and the magnitude (rather than probability) of this response was tested against dose. The proximity to the source, and the vessel itself, was included within the one analysis model. Humpback whales were more likely to avoid the airgun arrays (but not the controls) within 3 km of the source at SELs over 140 dB re 1 µPa^2.s, meaning that both the proximity and the received level were important factors and the relationship between dose (received level) and therefore the 140 dB re 1 µPa^2.s cannot be adopted as a standalone threshold if the source proximity is greater than 3 km. This study tested towing an airgun source directly into the incoming path of a southern humpback migration which included mother and calf humpback whales. Therefore, the context and applicability of these results may not be directly relevant to the behavioural response to all cetaceans in every context and has not been adopted for the assessment of potential behavioural impacts from VSP, due to that fact that the source is stationary. It should be noted that Dunlop et al. (2017) makes reference that their result are surprisingly consistent with previous studies with humpback whales in different behavioural contexts. For example, feeding humpback whales responded at ranges up to 3 km from the source, at levels of 150–169 dB re 1 µPa (Malme et al., 1985) and resting female humpback whales with calves displayed avoidance reactions at 140 dB re 1 µPa, though other cohorts reacted at higher levels (157–164 dB re 1 µPa; McCauley et al., 2003).

The United States (US) National Marine Fisheries Service guidance (NMFS, 2005) sets the Level B harassment threshold for marine mammals at 160 dB re 1 µPa (rms) for impulsive noise. The value for impulsive sound sits in the upper-mid range for disturbance impacts identified in Southall et al. (2007) and in alignment with other studies referred above (McCauley et al., 2003; Malme et al., 1985); consequently, this criterion has been used (in lieu of more suitable up to date criteria) for assessing onset of potentially strong behavioural reaction in this assessment.

The relevant criteria proposed by Southall et al. (2007) for assessing the potential for PTS due to multiple and single pulse sounds are considered to be an un-weighted peak pressure level of 230 dB re 1 µPa (pk) and an m-weighted SEL of 198 dB re 1 µPa^2.s for all cetaceans. These injury criteria values are derived from values for onset of TTS with an additional allowance of +6 dB for peak sound and +15 dB for SEL to estimate the potential onset of PTS (Southall et al., 2007).

Marine Fauna (Fish and Marine Turtles)
Popper et al. (2014) investigated, through a literature review, mortality, impairment and behaviour thresholds for fishes, and found greater than 186 dB re 1 µPa².s was required to elicit even a temporary threshold shift for fish. It is expected that potential impacts to the most sensitive fish species (fish with swim bladder involved in hearing) from VSP will be limited to 150 m from the source for TTS and less than 10 m for PTS. There is a paucity of data regarding responses of marine turtles, whale sharks and rays to underwater noise. Finneran et. al. (2017) defined PTS and TTS thresholds of 232 dB re 1 µPa and 226 dB re 1 µPa, respectively for turtles. The Popper et al. (2014) review also assessed thresholds for marine turtles and found qualitative results that TTS was only high for near-field exposure, while TTS was low for both intermediate and far-field exposure (Popper et al., 2014). McCauley et al. (2000) noted that sea turtles exhibit increased swimming activity at 166 dB re 1 µPa. To assess the potential impacts to whale sharks, the fish (no swim bladder) threshold (Popper et al., 2014) was adopted whereby potential impacts are expected to be limited to within 20 m from the source.
Impact to EPBC Listed Species
Controls including marine fauna observers, pre-start visual observations and operational procedures, as described below in the demonstration of ALARP, will reduce potential impacts by allowing animals to move from the source of the sound to beyond the 1600 m threshold zone (behavioural response for cetaceans). Any impacts to whale sharks, cetaceans and marine turtles is expected to be limited to short-term avoidance of a localised area with no long-term impacts.
Seasonal Sensitivities of Marine Fauna
The use of VSP has the potential to cause temporary (up to about 24 hours) and localised disturbance to marine fauna in response to received noise levels of about 160 dB re 1 µPa SPL (rms). As the Petroleum Activities Program may take place at any time, VSP may overlap with the migration seasons for pygmy blue whales, humpback whales, sei whales, fin whales and whale sharks. The Operational Area overlaps the migration BIA for pygmy blue whales and other whale species may also occur in the vicinity of the Operational Area at various times during the year, with increased numbers during peak periods (Section 4.5.2). Given the Operational Area overlaps with the whale shark foraging BIA, presence of this species during peak periods (May to July, Section 4.5.2) is expected. VSP may also overlap with nesting seasons for marine turtles at the Montebello Islands (about 52 km southeast of the Operational Area). It is possible that these species will occur, in small numbers, in the vicinity of the Operational Area at various times during the year, with increased numbers during peak periods (Section 4.5.2). However, even with an increased likelihood of interaction, the potential impacts are considered to be localised, temporary and not significant to environmental receptors (as described above). It is reasonable to expect that cetaceans, whale sharks, rays and marine turtles may demonstrate avoidance or attraction behaviour in the vicinity of the VSP activity. However, any avoidance or attraction behaviours displayed by these transient animals resulting from the VSP activity are expected to be localised and temporary, based on the short duration of the VSP activity. The intensity of noise dissipates with distance from its source. Based on the likely low abundance of MNES species in close proximity to the Operational Area during VSP activity and the properties of the noise emissions, it is considered unlikely that there will be any significant impacts.
Other Ecological Communities (Zooplankton)
Zooplankton in the Operational Area is expected to include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs (Section 4.5.1). Experiments by McCauley et al (2017) indicated that seismic activity, based on the use of a 150 cui airgun, may significantly decrease abundance of some zooplankton (copepods, cladocerans and euphausiids larvae) and increase the mortality rate. However, zooplankton populations are expected to recover quickly due to their fast growth rates and the dispersal and mixing of zooplankton from outside the impacted area (Richardson et al., 2017). Therefore, due to the short duration of the use of the VSP (up to about 24 hours) and the expected rapid recovery, impacts are expected to be localised with no lasting effect.
Summary of Potential Impacts to Environmental Values
VSP may be conducted for up to 24 hours during the Petroleum Activities Program. Given the short duration and adopted controls, it is considered that VSP operations will not result in a potential impact greater than localised disruption with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
VSP pre-start visual observations and operating procedures for whales. This includes requirements for: • **Pre-start visual observations:** Whales must be observed visually to the extent of the observation zone (3 km from VSP source) by a suitably trained crew member for at least 30 minutes before operations commence. • **Operating procedures:** While the VSP acoustic source is operating: – visual observations of the observation zone (3 km from VSP source) must be maintained continuously to identify if there are any whales present – if a whale is sighted within the caution zone (1 km from VSP source), the operator of the acoustic source must be placed on standby to power down the acoustic source – if a whale is sighted within the shutdown zone (500 m from the VSP source), the acoustic source must be shut down. • **Low visibility operating procedures**: During periods of low visibility (where the observation zone cannot be clearly viewed), including night time, the VSP source may be used as described in operating procedures, provided that during the preceding 24-hour period: – there have not been three or more whale instigated shut down situations; AND – a two-hour period of continual observation was undertaken in good visibility and no whales were sighted in the observation zone.	F: Yes. Measures consistent with industry standards. CS: Minimal. Bridge crews already maintain a constant watch during operations (including during VSP activities).	The likelihood of VSP emissions leading to long term disturbance or harm to species or ecosystems is reduced by implementing measures such as constant bridge watch and shutdown procedures which are consistent with industry standards.	Benefits outweigh cost/sacrifice.	Yes C 4.1

[12] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Good Practice				
VSP pre-start visual observations and operating procedures for whale sharks and turtles: • **Pre-start visual observations:** Whale sharks and turtles must be observed visually to the extent of the shutdown zone (500 m from VSP source) by a suitably trained crew member for at least ten minutes before operations commence. • **Operating procedures:** While the VSP acoustic source is operating: – visual observations of the shutdown zone must be maintained continuously to identify if there are any whale sharks or turtles present – if a whale shark or turtle is sighted beyond the shutdown zone, the operator of the acoustic source must be placed on standby to shut down the acoustic source – if a whale shark or turtle is sighted within the shutdown zone, the acoustic source must be shut down. • **Low visibility operating procedures**: During periods of low visibility (where the observation zone cannot be clearly viewed), including night time, the VSP source may be used as described in operating procedures, provided that during the preceding 24-hour period: – a two-hour period of continual observation was undertaken in good visibility and no whale sharks or turtles were sighted in the shutdown zone.	F: Yes. CS: Minimal. Bridge crews already maintain a constant watch during operations (including during VSP activities).	Reduces the likelihood of individuals of cetacean, turtle or whale shark species being within proximity of the acoustic source where behavioural impact could occur.	Benefits outweigh cost/sacrifice.	Yes C 4.2

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
The use of additional dedicated Marine Fauna Observers (MFO) on the MODU and/or support vessels during VSP.	F: Yes. However, vessel crews already maintain a constant safety watch during operations (including during VSP activities). CS: Additional cost of MFOs.	Given the constant bridge watch performed as part of the Procedure, additional MFOs would not further reduce the likelihood of an individual being within close proximity of the acoustic source during start-up or during operations.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Eliminate				
Eliminate VSP from Petroleum Activities Program.	F: Not feasible – VSP required for well logging, considered critical for well safety. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Application of soft start procedures for VSP.	F: Not feasible. When using lower power sources such as VSP, there is limited ability to ramp up pulses, so doing a soft start at lower sound level is physically not possible. When applying a soft start control to VSP activities, the soft start ends up cumulatively more noise to be emitted into the marine environment. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Only conduct VSP activities outside peak sensitivity periods for sound-sensitive marine fauna.	F: Not feasible – Timing of activities is linked to MODU schedule. Timing of the activity is currently not determined, and due to MODU availability and operational requirements, undertaking activities during migration and/or nesting seasons may not be able to be avoided. VSP is required for well logging which could take place at any time. VSP is considered critical for well data interpretation. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Substitute VSP with other well logging techniques.	F: Not feasible – no other methods available for capturing required formation information. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls were identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of VSP. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, noise emissions from VSP are unlikely to result in a potential impact greater than localised impacts and no lasting effect on species or other communities (zooplankton). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of VSP noise emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 4 No prolonged exposure of whales, whale sharks and turtles to VSP once detected, during the Petroleum Activities Program.	**C 4.1** VSP pre-start visual observations and operating procedures for whales. This includes requirements for: • **Pre-start visual observations:** Whales must be observed visually to the extent of the observation zone (3 km from VSP source) by a suitably trained crew member for at least 30 minutes before operations commence. • **Operating procedures:** While the VSP acoustic source is operating: – visual observations of the observation zone (3 km from VSP source) must be maintained continuously to identify if there are any whales present – if a whale is sighted within the caution zone (1 km from VSP source), the operator of the acoustic source must be placed on standby to power down the acoustic source – if a whale is sighted within the shutdown zone (500 m from the VSP source), the acoustic source must be shut down. • **Low visibility operating procedures**: During periods of low visibility (where the observation zone cannot be clearly viewed), including night time, the VSP source may be used as described in operating procedures, provided that during the preceding 24-hour period: – there have not been three or more whale instigated shut down situations; AND – a two-hour period of continual observation was undertaken in good visibility and no whales were sighted in the observation zone.	**PS 4.1** Attenuation buffer established and maintained between VSP source and whales.	**MC 4.1.1** Records demonstrate compliance with described prestart visual observations, and operating procedures for whales.

<table>
<tr><th colspan="4">Environmental Performance Outcomes, Standards and Measurement Criteria</th></tr>
<tr><th>Outcomes</th><th>Controls</th><th>Standards</th><th>Measurement Criteria</th></tr>
<tr><td></td><td>C 4.2
VSP pre-start visual observations and operating procedures for whale sharks and turtles:
• Pre-start visual observations: Whale sharks and turtles must be observed visually to the extent of the shutdown zone (500 m from VSP source) by a suitably trained crew member for at least ten minutes before operations commence.
• Operating procedures: While the VSP acoustic source is operating:
– visual observations of the shutdown zone (500 m from VSP source) must be maintained continuously to identify if there are any whale sharks or turtles present
– if a whale shark or turtle is sighted beyond the shutdown zone, the operator of the acoustic source must be placed on standby to shut down the acoustic source
– if a whale shark or turtle is sighted within the shutdown zone, the acoustic source must be shut down.
• Low visibility operating procedures: During periods of low visibility (where the observation zone cannot be clearly viewed), including night time, the VSP source may be used as described in operating procedures, provided that during the preceding 24-hour period:
– a two-hour period of continual observation was performed in good visibility and no whale sharks or turtles were sighted in the shutdown zone.</td><td>PS 4.2
Attenuation buffer established and maintained between VSP source and whale sharks and turtles.</td><td>MC 4.2.1
Records demonstrate compliance with described prestart visual observations, and operating procedures for whale sharks and turtles.</td></tr>
</table>

6.6.4 Routine Acoustic Emissions: Generation of Noise from Support Vessels, MODU, Positioning Equipment and Helicopter Transfers

Context	
Project vessels – Section 3.5 Other support – Section 3.6	Biological environment – Section 4.5

Impacts and Risks Evaluation Summary														
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome[13]***
Generation of acoustic signals from MODU, drilling and support vessels during normal operations						X		A	F	-	-	GP PJ	Broadly Acceptable	N/A
Generation of acoustic signals from dynamic positioning systems on support vessels						X		A	F	-	-			
Generation of airborne noise from helicopter transfers						X		A	F	-	-			

Description of Source of Impact

The MODU, support vessels, helicopters and positioning transponders will generate noise both in the air and underwater, due to the operation of thrusters, engines, propeller movement, drilling operations, etc. These noises will contribute to and can exceed ambient noise levels which range from around 90 dB re 1 µPa (rms) under very calm, low wind conditions, to 120 dB re 1 µPa (rms) under windy conditions (McCauley, 2005).

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); with noise likely to be between 100 to 190 dB re 1 µPa at 1 m SPL (rms) during drilling and between 85 to 135 dB re 1 µPa at 1 m SPL (rms) when not actively drilling. 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). The MODU will be moored and therefore there will be no additional noise from using DP equipment.

The MODU is expected to be on location for about 50 days.

Project Vessel Noise

Support vessels will use DP while the vessel is maintaining position. The main source of noise from a vessel using DP relates to using vessel thrusters. 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 support vessels used for this Petroleum Activities Program.

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 6.7.8). 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.

[13] There are no specific controls and EPOs identified for generation of noise from project vessels, MODU, positioning equipment and helicopter transfers. However, MODU and vessel power generation equipment will be maintained in accordance with preventative maintenance programs to optimise equipment efficiency and thus reduce excess noise generation e.g. MODU and vessel engines to be maintained as per manufacturer's specification.

Generation of Noise From Helicopter Transfers

Helicopter engines and rotor blades are recognised as a source of noise emissions, which may constitute a source of environmental risk resulting in behavioural disturbance to marine fauna. Activities relevant to the Operational Area will relate to the landing and take-off of helicopters on the MODU or vessel helidecks. Helicopter flights are at their lowest (i.e. closest point to the sea surface) during these periods of take-off and landing from helidecks, which constitutes a relatively short phase of routine flight operations. During these critical stages of helicopter operations, safety takes precedence.

Noise levels for typical helicopters used in offshore operations (AW139, AW189 and S92) at 150 m separation distance have been measured at up to a maximum of 99.1 EPNdB. Unconstrained point source noise in the atmosphere (such as helicopter noise) spreads spherically (Truax, 1978), with noise received at the sea surface decreasing with increasing distance from the aircraft (Nowacek et al., 2007). Based on spherical geometric spreading (and not considering transmission loss from atmospheric absorption), the sound level is expected to decrease by 6 dB for every doubling of the distance from the source (Truax, 1978). Using this model, a maximum sound level of about 90 dB at 150 m would be reduced to about 76 dB directly below a helicopter travelling at an altitude of 500 m.

Generation of Underwater Noise from Positioning Equipment

An array of LBL and/or USBL transponders may be installed on the seabed for metrology and positioning. Transponders typically emit pulses of medium frequency sound, generally within the range 21 to 31 kHz. The estimated SPL would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al., 2017).

Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds. Transponders will not emit any sound when on standby. When required for general positioning they will emit one chirp every five seconds (estimated to be required for four hours at a time). When required for precise positioning they will emit 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 where positioning is required.

Impact Assessment

Potential Impacts to Protected Species

The Operational Area is located in waters about 166–511 m deep. The fauna associated with this area will be predominantly pelagic and demersal species of fish, with migratory species such as turtles, cetaceans and whale sharks present in the area seasonally.

Elevated underwater noise can affect marine fauna, including cetaceans, fish, turtles, sharks and rays in three main ways (Richardson et al., 1995; Simmonds et al., 2004):

- by causing direct physical effects on hearing or other organs (injury)
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
- through disturbance leading to behavioural changes or displacement from important areas.

The thresholds that could result in behavioural response for cetaceans is expected to be 120 dB re 1 µPa SPL (rms) for continuous noise sources, and 160 dB re 1 µPa SPL (rms) for impulsive noise sources. These thresholds are adopted by the US NOAA and are consistent with the levels presented by Southall et al. (2007). Potential for injury to hearing would be expected to occur at 230 dB re 1 µPa (pk) (Southall et al., 2007). Typical noise levels generated by a support vessel using DP do not exceed that level, so injury to protected species is not anticipated.

Listed Threatened and listed Migratory species that could be potentially impacted by underwater noise may be present within the Operational Area, and primarily include cetaceans as well as whale sharks, rays and turtles. The Operational Area overlaps the migration BIA for pygmy blue whales, which are seasonally present in the area from April to August (northbound) and October to January (southbound). The Operational Area also overlaps with the whale shark foraging BIA (with peak numbers expected March to July), an internesting BIA for flatback turtles and designated habitat critical to the survival of flatback turtles for internesting at the Montebello Islands (with peak nesting in December and January). However, it is noted that the BIA and habitat critical to the survival of flatback turtles are considered very conservative as they are based on the maximum range of internesting females and many turtles are more likely to remain near their nesting beaches.

MODU and Support Vessels

It is likely that there may be increased numbers of pygmy blue whales, humpback whales, whale sharks and turtles within the Operational Area during migratory/nesting periods. However, even with an increased likelihood of interaction the potential impacts are considered to be not significant to environmental receptors, given the noise levels associated with routine operations of vessels and the MODU. It is reasonable to expect that fauna may demonstrate avoidance or attraction behaviour to the noise generated by the Petroleum Activities Program. For example, when transiting through the area, pygmy blue whales may deviate slightly from their migration route, but continue on their migration pathway. Note that the Operational Area is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal’s ability to avoid the activities. Potential impacts from predicted noise levels from the MODU and support vessels are not considered to be ecologically significant at a population level.

Other fauna associated with the Operational Area will be predominantly pelagic and demersal species of fish, with migratory species such as whale sharks, rays, marine turtles and other cetacean species migrating through or present in the Operational Area. Therefore, potential impacts from vessel noise are likely to be restricted to temporary avoidance behaviour to individuals transiting through the Operational Area, and are therefore considered localised with no lasting effect.

Helicopter Noise

Water has a very high acoustic impedance contrast compared to air, and the sea surface is a strong reflector of noise energy (i.e. very little noise energy generated above the sea surface crosses into and propagates below the sea surface (and vice versa) – the majority of the noise energy is reflected). The angle at which the sound path meets the surface influences the transmission of noise energy from the atmosphere through the sea surface; angles ±>13° from vertical being almost entirely reflected (Richardson et al., 1995). Given this, and the typical characteristics of helicopter flights within the Operational Area (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance are not considered to be credible. Note that helicopter noise during approach, landing and take-off is more likely to propagate through the sea surface due to the reduced air speed and lower altitude. However, helicopter noise during approach, landing and take-off will be mingled with underwater noise generated by the facility hosting the helipad (e.g. thruster noise from vessels, machinery noise from MODU, etc.). Additionally, approach, landing and take-off are relatively short phases of the flight, resulting in little opportunity for underwater noise to be generated.

Given the standard flight profile of a helicopter transfer, maintenance of a >500 m horizontal separation from cetaceans (as per the EPBC Regulations), and the predominantly seasonal presence of whales within the Operational Area, interactions between helicopters and cetaceans resulting in behavioural impacts are considered to be highly unlikely. In the highly unlikely event that cetaceans are disturbed by helicopters, responses are expected to consist of short-term behavioural responses, such as increased swimming speed; the consequence of such disturbance is considered to have no lasting effect and be of no significance.

Turtles may be present in low numbers within the Operational Area, and may be exposed to helicopter noise when on the sea surface (e.g. when basking or breathing). Typical startle responses occur at relatively short ranges (tens of metres) (Hazel et al., 2007) and as such, startle responses during typical helicopter flight profiles are considered to be remote. In the event of a behavioural response to the presence of a helicopter, turtles are expected to exhibit diving behaviour, which is of no lasting effect.

Seabirds within the Operational Area may avoid helicopters. Given the expected low density of seabirds within the Operational Area, the relative infrequency of helicopter flights and lack of lasting effect of potential behavioural responses to helicopter noise, the likelihood and consequence of subsequent impacts are considered to be highly unlikely and result in no lasting effect, respectively.

Positioning Equipment Noise

Transponders used for positioning of subsea equipment have the potential to cause some temporary behavioural disturbance to marine fauna, but noise levels will be well below injury thresholds. Due to the short duration chirps, the temporary and intermittent use and the mid frequencies used by positioning equipment, the acoustic noise from the transponders is unlikely to have a substantive effect on the behavioural patterns of marine fauna. The Operational Area overlaps with seasonal BIAs for pygmy blue whales and whale sharks (as described above). Should the short period during which transponders are in use (at the commencement of drilling) overlap with the seasonal timing of these BIAs, individual animals at most may deviate slightly from their migration route, but continue on their migration pathway. The Operational Area is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal's ability to avoid the activities.

Summary of Potential Impacts to Environmental Values

It is considered that noise generated by MODU, drilling activities, support vessels, helicopters and positioning transponders will not result in a potential impact greater than localised impacts with no lasting effect, not significant to marine fauna (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
The use of dedicated MFOs on support vessels for the duration of the Petroleum Activities Program to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes. However, support vessel bridge crews already maintain a constant watch during operations. CS: Additional cost of MFOs.	Given that support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not further reduce the likelihood or consequence of impact.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Eliminate				
Removal of support vessel on standby at the Petroleum Activities Program location.	F: No. Activity support vessel required for safety reasons, particularly for maintaining the 500 m petroleum safety zone around the MODU. CS: Introduces unacceptable safety risk.	Not considered – control not feasible.	Not considered – control not feasible.	No
Elimination of noise from the MODU, support vessels or survey positioning equipment.	F: No. The generation of noise from these sources cannot be eliminated due to operating requirements. Note that vessels operating on DP may be a safety-critical requirement. CS: Inability to conduct the Petroleum Activities Program. Loss of project.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Management of vessel noise by varying the timing of the Petroleum Activities Program to avoid migration periods.	F: Not feasible. Variation of timing of specific activities is not feasible as activity is subject to schedule constraints and vessel availability. CS: Significant cost and schedule impacts if activities avoid specific timeframes.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

[14] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the potential impacts from MODU drilling activities, support vessels, helicopters and positioning transponder noise emissions to be ALARP. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that MODU, drilling activities, support vessels, helicopters and positioning transponder noise disturbance is unlikely to result in a potential impact greater than localised impacts not significant to marine fauna, with no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The potential impacts and risks are considered broadly acceptable. Therefore, Woodside considers standard operations appropriate to manage the impacts and risks of MODU, drilling activities, support vessels, helicopters and positioning transponder noise emissions to a level that is broadly acceptable.

6.6.5 Routine and Non-routine Discharges to the Marine Environment MODU and Support Vessels

Context	
Project vessels – Section 3.5	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine discharge of sewage, grey water and putrescible wastes to marine environment from MODU and support vessels.			X					A	F	-	-	LCS PJ	Broadly Acceptable	EPO 5
Routine discharge of deck and bilge water to marine environment from MODU and support vessels.			X					A	F	-	-			
Routine discharge of cooling water or brine to the marine environment from MODU and support vessels.			X					A	F	-	-			

Description of Source of Impact

The MODU and support vessels routinely generate/discharge the following:

- Small volumes of treated sewage and putrescible wastes to the marine environment – The impact assessment based on a maximum approximate discharge of 15 m³ per MODU/vessel per day, using an average volume of 75 L/person/day and a maximum of 200 persons on board. However, it is noted that support vessels will have considerably less persons on board.
- Routine/periodic discharge of relatively small volumes of bilge water – Bilge tanks receive fluids from many parts of a MODU or vessel. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals.
- Variable water discharge from MODU/vessel decks directly overboard or via deck drainage systems – Water sources could include rainfall events and/or deck activities such as cleaning/wash-down of equipment/decks.
- Cooling water from machinery engines or mud cooling units and brine water produced during the desalination process of reverse osmosis to produce potable water on board the MODU and support vessels.

Environmental risk relating to unplanned (non-routine/accidental) disposal/discharge of waste is addressed in Section 6.7.7.

Impact Assessment

Potential Impacts to Water Quality and Marine Fauna

The main environmental impact associated with ocean disposal of sewage and other organic wastes (i.e. putrescible waste) is eutrophication. Eutrophication occurs when the addition of nutrients, such as nitrates and phosphates, causes adverse changes to the ecosystem, such as oxygen depletion and phytoplankton blooms. Other contaminants of concern occurring in these discharges may include ammonia, E. coli, faecal coliform, volatile and semi-volatile organic compounds, phenol, hydrogen sulphide, metals, surfactants and phthalates.

Woodside monitored sewage discharges at its Torosa-4 Appraisal Drilling campaign which demonstrated that a 10 m³ sewage discharge reduced to about 1% of its original concentration within 50 m of the discharge location. In addition to

this, monitoring at distances of 50, 100 and 200 m downstream of the discharge and at five different water depths confirmed that discharges were rapidly diluted and no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside Energy Limited, 2011). Mixing and dispersion would be further facilitated in deep offshore waters, consistent with the location of the Operational Area, through regional wind and large scale current patterns resulting in the rapid mixing of surface and near surface waters where sewage discharges may occur. Studies investigating the effects of nutrient enrichment from offshore sewage discharges indicate that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed areas (McIntyre & Johnston, 1975). Furthermore, open marine waters do not typically support areas of increased ecological sensitivity, due to the lack of nutrients in the upper water column and lack of light penetration at depth. Therefore presence of other receptors such as fish, reptiles, birds and cetaceans in significant numbers, and in close proximity to the Operational Area, is unlikely. Research also suggests that zooplankton composition and distribution are not affected in areas associated with sewage dumping grounds (McIntyre & Johnston, 1975). Plankton communities are expected to rapidly recover from any such short-term, localised impact, as they are known to have naturally high levels of mortality and a rapid replacement rate. Additional discharges outlined, which may include other non-organic contaminants (e.g. bilge water), will be rapidly diluted through the same mechanisms as above and are expected to be in very small quantities and concentrations as to not pose any significant risk to any relevant receptors. As such, no significant impacts from the planned (routine and non-routine) discharges that are listed above are anticipated because of the minor quantities involved, the expected localised mixing zone and high level of dilution into the open water marine environment of the Operational Area. The Operational Area is located more than 12 nm from land, which exceeds the exclusion zones required by Marine Order 96 (Marine pollution prevention – sewage) 2018 and Marine Order 95 (Marine pollution prevention – garbage) 2018. Due to the relatively short duration of the Petroleum Activities Program and intermittent nature of these routine and non-routine discharges, cumulative impacts to water quality within the Operational Area are expected to be localised and short-term with no lasting effect. It is possible that protected marine fauna transiting the localised area may come into contact with these discharges (e.g. pygmy blue whales, whale sharks and turtles as they traverse the Operational Area during their seasonal migrations (Section 4.5.2). However, given the localised extent of cumulative impacts from multiple vessel discharges within the Operational Area, significant impacts to marine fauna are not expected.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that routine or non-routine discharges described will not result in a potential impact greater than localised contamination not significant to environmental receptors, with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 5.1

[15] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 nm from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 nm from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (> 4 knots), to avoid discharges in environmentally sensitive areas.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 5.2
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 5.3
Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water prior to discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to be less than 15 ppm prior to discharge.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes C 5.4

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
• IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed onshore. • Valid International Oil Pollution Prevention Certificate.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Storage, transport & treatment/disposal onshore of sewage, greywater, putrescible and bilge wastes.	F: Not feasible. Would present additional safety and hygiene hazards resulting from the storage, loading and transport of the waste material. Distance of activity offshore also makes implementing this control not feasible. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of planned (routine and non-routine) discharges. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, planned discharges (routine and non-routine) are unlikely to result in a potential impact greater than localised impacts not significant to environmental receptors and no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet legislative requirements under Marine Orders 91, 95 and 96. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 5 No impact to water quality greater than a consequence level of F[16] from discharge of sewage, greywater, putrescible wastes, bilge and deck drainage to the marine environment during the Petroleum Activities Program.	**C 5.1** Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	**PS 5.1** MODU and support vessels compliant with Marine Order 95 – pollution prevention – garbage.	**MC 5.1.1** Records demonstrate MODU and support vessels are compliant with Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class).
	C 5.2 Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 nm from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 nm from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (>4 knots), to avoid	**PS 5.2** MODU and support vessels compliant with Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class).	**MC 5.2.1** Records demonstrate MODU and support vessels are compliant with Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class).

[16] Defined as ‘ No lasting effect, localised impact not significant to environmental receptors’ as in Figure 2-6/Section 2.6.3

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	discharges in environmentally sensitive areas.		
	C 5.3 Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning deck drainage water management system.
	C 5.4 Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water prior to discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure OIW content to be less than 15 ppm prior to discharge. • IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed onshore. • Valid International Oil Pollution Prevention Certificate.	**PS 5.4** Discharge of machinery space bilge/oily water meets oil content standard of <15 ppm without dilution.	**MC 5.4.1** Records demonstrate discharge specification met for MODU and support vessels.

6.6.6 Routine and Non-routine Discharges to the Marine Environment: Drill Cuttings and Drilling Fluids (WBM)

Context	
Drilling activities – Section 3.8 Project fluids – Section 3.9	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Impact	Environmental Value Potentially Impacted							Evaluation						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socio-Economic	Decision Type	Consequence	Likelihood	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Routine discharge of WBM drill cuttings to the seabed and the marine environment		X	X		X			A	E	-	-	GP PJ	Broadly Acceptable	EPO 6
Routine discharge of drilling muds (WBM) to the seabed and the marine environment		X	X		X			A	E	-	-			
Non-routine discharge of wash water from mud pits and vessel tank wash fluids		X	X		X			A	E	-	-			
Discharge of well annular fluids from abandoned well		X	X		X			A	E	-	-			

Description of Source of Impact

Drilling Program

The proposed Petroleum Activities Program includes the drilling of a single exploration well, at a seabed depth of 201 m (Table 3-2).

Drilling activities are described in Section 3.8. The well will be drilled as a series of sections, as detailed in Table 6-3. The top hole section of the well will be drilled without a riser in place (i.e. riserless drilling). Upon drilling of the top hole section, a casing will be cemented in place, a BOP installed and a riser put in place between the BOP and the MODU. The riser remains in place during drilling of the bottom hole sections and facilitates the circulation of drilling fluids and cuttings between the well bore and the MODU.

The following describes the source of impact with respect to discharge of drill cuttings and muds only (see Section 6.6.7 for cement, cementing fluids and subsea control fluids). The base case (e.g. typical drilling operations) for managing cuttings is to discharge into the marine environment along with WBMs which are used to transport the cuttings out of the well.

For the purposes of this impact assessment, the indicative dimensions, discharge locations and approximate cuttings volumes provided in Table 6-3 represent the worst case for a single section of the well.

Table 6-3: Estimated worst case discharges of cuttings and volumes of drilling fluids used for the Petroleum Activities Program[17]

	Well section width (inches)	Cuttings volume (m^3)	Drilling fluid type	Drilling fluid ~ volume (m^3)	Hole section	Discharge point
	42	62	Seawater* with pre-hydrated bentonite sweeps/XC polymer	238	Top	Seabed
	17.5	371	Seawater* with pre-hydrated bentonite sweeps/XC polymer	3,317	Top	Seabed
	12.25	58	WBM	626	Bottom	Surface
	8.5	16	WBM	498	Bottom	Surface
	Total Planned Activities	507 m^3		4,679 m^3 per well		
Indicative Contingent Activities (single respud)	42” + 17.5“ sections	433	Seawater with pre-hydrated bentonite sweeps/XC polymer	3,555	Top	Seabed
Indicative Contingent Activities (sidetrack one section)	12.25” section (indicative)	58	WBM	626	Bottom	Surface

** Seawater volume not included in the estimated ‘Drilling Fluid Volume’*

Drill Cuttings

Indicative drill cuttings generated from the well have been estimated to comprise a total volume of about 507 m^3. Typically, drilling generates drill cuttings ranging in size from clay-sized particles (~0.002 mm) to coarse gravel (>30 mm) (IOGP, 2016). Cuttings size is determined by TD, lithology, drill bit employed and SCE specifications. Indicative volumes of drill cuttings for the well are outlined in Table 6-3.

Cuttings resulting from drilling the top hole section are drilled using a seawater, pre-hydrated bentonite sweeps drilling fluid (WBM) system, discharging the cuttings to the seabed at the well site where they will accumulate on the seabed surrounding the wellhead (Section 3.8.3).

The bottom hole sections will be drilled with a marine riser in place that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the SCE. The SCE uses shale shakers to remove coarse cuttings from the drilling fluids. After processing by the shale shakers, the recovered fluids from the cuttings may be directed to centrifuges, which are used to remove fine solids (~4.5 to 6 µm). The cuttings with retained fluids are discharged below the water line and the mud is recirculated into the fluid system (Section 3.8.5). Cuttings will typically drop out of suspension in the vicinity of the well site (as coarser materials), while the fluids if not flocculated with the cuttings may disperse further, temporarily elevating TSS within the water column and gradually settling as a very thin veneer of sediment deposition offset from the well site, based on prevailing metocean conditions.

Drilling Fluids

WBM will be operationally discharged to the marine environment at the location of the well during the Petroleum Activities Program under the following scenarios:

- at the seabed when drilling the top hole (riser less) sections
- below sea surface as fluid remaining on drill cuttings, after passing through the SCE (bottom hole sections, drilled with riser in place)
- from the mud pits from a pipe below the sea surface, if the WBM cannot be re-circulated/re-used through the drilling fluid system (due to deterioration/contamination), re-used on the well or on another well, or stored.

In addition, wells will be displaced from one drilling fluid system to another as required throughout activities with the riser connected. A chemical clean out pill or fluids train will be circulated between different fluids. This will result in a discharge of operational fluids in accordance with the Woodside internal guidelines.

Chemicals used in WBM are assessed using a defined framework and set of tools to ensure the potential impacts of the chemicals selected are acceptable, ALARP and meet Woodside's expectation for environmental performance. (Section 3.9.1).

Drilling fluids are contained within the drilling fluids circulation system. Mud pits (tanks) within this system provide capacity for storing drilling fluids. The mud pits are cleaned out when drilling operations are complete.

Base oil may be used for inflow testing prior to abandonment of the well, to verify barrier integrity. Base oil would be pumped down the drill string and reverse circulated back to the rig, with fluids collected for disposal onshore. If stored in a mud pit, the base oil and other fluids associated with the test may result in pit wash water contaminated with hydrocarbons. If this is the case, mud pit wash water would be discharged in accordance with requirements in this EP; with a hydrocarbon content <1% by volume. Well abandonment activities are conducted in accordance with Woodside's internal standards.

Contingent Activities

<u>Respud</u>

The requirement to respud the well is overall a low likelihood event. If required, the most likely scenario is that the decision to respud is made when drilling the top hole section of the well. Therefore, the incremental increase in cuttings and fluid discharges are associated with the repeat drilling of the same top hole sections for the respudded well with the same associated discharges. A respud once drilling of the bottom hole sections has commenced is far less likely given the time and effort already committed to the well. However, if this was to occur the associated discharges would also be a repeat of the discharges as per Table 6-3, to re-drill the same sections of the respudded well.

<u>Sidetrack</u>

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 WBM. Additional drill cuttings volumes are estimated in Table 6-3.

<u>Well Annular Fluids</u>

After drilling is complete, some wellbore fluids will remain in the annular spaces between the casing. Upon wellhead removal small volumes (~1.5 m^3) of fluid exchange between the annular spaces and the ocean may occur. The exchange will not be instantaneous as the annular spaces are small and the fluids are typically heavier than seawater.

Impact Assessment

Potential Impacts to Water Quality, Marine Sediment Quality and Habitats and Communities

The identified potential impacts associated with the discharge of drill cuttings and fluids include a localised and temporary decrease in water quality and localised change in seabed sediment quality as well as localised burial of benthic biota (species) and change to ecosystems/habitat.

A number of direct and indirect impact pathways are identified for drill cuttings and drilling fluids as follows:

- temporary increase in TSS in the water column
- attenuation of light penetration as an indirect consequence of the elevation of TSS and the rate of sedimentation
- sediment deposition to the seabed leading to the alteration of the physico-chemical composition of sediments, and burial and potential smothering effects to sessile benthic biota
- potential contamination and toxicity effects to benthic and in-water biota.

The Gemtree-A exploration well will be drilled in Permit Area WA-49-L, situated in offshore waters (~50 km from the nearest coastline at the Montebello Islands) in water depths of ~201 m. The physical habitat in the area comprises deep, soft, unconsolidated sediment which is relatively flat and featureless.

The top hole sections drilling (riser-less) generates drill cuttings and unrecovered fluids that are discharged at the seabed surrounding the well site and typically result in a localised area of sediment deposition (known as a cuttings pile) close to the well site. Top hole cuttings discharged to the seabed will account for about 85% of the total cuttings discharged (up to about 433 m^3). Depending on prevailing seabed current regimes, a greater spread of cuttings with WBMs may occur down current from the well site. Given the location of the Gemtree-A exploration well, the dispersion and fate of deposited drilling discharges is expected to be influenced by prevailing currents which include tidally-driven bottom currents in a northwest/southeast directions and the predominant south-westerly upper surface layer current direction (Section 4.4.2.1).The spread of cuttings and WBMs will be highly localised and is expected to extend to a maximum distance from the well site of approximately 150 – 200 m, based on a review of WBM drill cuttings deposition studies summarised by IOGP (2016).

The bottom hole sections are drilled after the BOP stack and marine riser is installed on the well head. Cuttings and unrecovered fluids are discharged below the water line of the MODU site, resulting in drill cuttings and drilling fluids rapidly dispersing through the water column. Bottom hole drill cuttings will account for about 15% of the total cuttings

[17] Volumes described are approximate and may be subject to change due to well design and operational requirements.

discharged (up to about 74 m^3) The larger cuttings particles will drop out of suspension and deposit on the seabed in proximity to the well site (within tens of metres and final deposition offset from the well location driven by prevailing metocean conditions and with potential for localised spreading). The finer particles associated with the WBM will remain in suspension longer and will be transported away from the well site, rapidly diluting and eventually depositing as a very thin veneer over an extended distance downstream from the well site (hundreds of metres), predominantly in a south-westerly direction. The rate of sediment particle sinking depends on the particle size and density. Predicted impacts for bottom hole WBM cuttings are expected to comprise: localised deposition of the cuttings with retained WBM close to the top hole cuttings pile with some WBM fines dispersed further from the well site and extendingto a maximum distance of approximately in the range of several kilometres (<5 km) from the discharge point (IOGP, 2016). Any deposition of fine particles and residual fluids at this distance are expected to have a negligible ecological impact given the WBM additives (including barite) will be of low toxicity and not bioavailable (see below).

Potential impacts from the discharge of cuttings range from the complete burial of benthic biota in the immediate vicinity of the well site due to sediment deposition (mainly top hole cuttings), smothering effects from raised sedimentation concentrations as a result of elevated TSS, changes to the physico-chemical properties of the seabed sediments (particle size distribution, elevated metals such as Barium and potential for decrease in oxygen levels (anoxic conditions) within the surface sediments due to organic matter degradation by aerobic bacteria) and subsequent changes to the composition of infauna communities to minor sediment loading above background and no associated ecological effects.

The Montebello Australian Marine Park (IUCN Category VI – Multiple Use Zone) is the closest MPA to the Operational Area, at a distance of about 15 km to the east of the well location. The discharge of drill cuttings is therefore not expected to impact this Marine Park. The north-east portion of the Operational Area overlaps with an area of seabed known as the ‘upper slope’ (water depth of 225–500 metres) and forms part of the Continental Slope Demersal Fish Communities KEF. The proposed location of the Gemtree-A exploration well is located more than 1 km from the upper slope and the Continental Slope Demersal Fish Communities KEF (Figure 4-21). Given the area potentially impacted by drill cuttings discharge described above and the distance between the well location and the KEF, the discharge of drill cuttings is not expected to influence the ecological values of the KEF.

Habitats and Communities (Physical Impact of Cuttings)

Cuttings discharged at the seabed while drilling the well will result in localised cuttings piles on the seabed surrounding the well head, as discussed above, with a greater spread of cuttings expected to occur down-current from the well site (influenced by tidally driven bottom currents and surface layer currents predominantly in a south-westerly direction). Cuttings discharged to the seabed from top-hole drilling will account for about 85% of total cuttings discharged (up to 433 m^3). The cuttings pile will vary in particle size distribution from the surrounding seabed. Benthic organisms below this cuttings pile will be smothered; however, the cuttings pile is expected to be recolonised over time. Ecological impacts to benthic biota is predicted when sediment deposition is equal to or greater than 6.5 mm in thickness (IOGP, 2016). This amount of sediment deposition from the combined top hole and bottom hole cuttings with retained WBM is expected to be confined to within a few hundred metres around the well location. ,. Low levels of sediment deposition away from the immediate area of the well site may occur and would represent a thin layer of settled drill cuttings, which will likely be naturally reworked into surface sediment layers through bioturbation (US Environmental Protection Agency, 2000). Mobile benthic fauna, such as demersal fish, may be temporarily displaced from areas where cuttings discharges accumulate.

Furthermore, ecological impacts are not expected for mobile benthic fauna such as crabs and shrimps or pelagic and demersal fish, given their mobility (IOGP, 2016). Balcom et al. (2012) concluded that impacts associated with discharging cuttings are minimal, with impacts highly localised to the area of the discharge. Changes to benthic communities are normally not severe. Organic enrichment can occur, leading to anoxic conditions in the surface sediments and a loss of infauna species that have a low tolerance to low oxygen concentrations, and to a lesser extent chemical toxicity near the well location. These impacts are highly localised with short-term recovery that may include changes in community composition with the replacement of infauna species that are hypoxia-tolerant (IOGP, 2016). Recovery of affected benthic infauna, epifauna and demersal communities is expected to occur quickly, given the short duration of sediment deposition and the widely represented benthic and demersal community composition.

Water Quality

The discharge of drill cuttings and unrecovered fluids is expected to increase turbidity and TSS levels in the water column, for short, temporary periods. Drill cuttings discharge is generally intermittent and of short duration (over a total period of about 50 days) during the drilling of a well. Nelson et al. (2016) identified a sedimentation rate of <10 mg/L as having no effect or sub-lethal minimal effect concentration and given the generally low concentration of TSS (due to rapid dispersion from the well site), the offshore open ocean site in conjunction with rapid dispersion of sediment particles and the short period of intermittent discharge, the plume is not expected to exceed this further than tens of metres from the discharge point at the time of actual discharge. Drilling discharges released below the water line will not have more than a very highly localised potential area of ecological impact and it is not predicted to impact productivity of the water column.

Furthermore, there are no likely impacts expected for pelagic fauna. While very high concentrations of suspended sediments have been shown to result in mortality of pelagic animals (>1830 mg/L), such concentrations do not occur as a result of drill cuttings discharges (IOGP, 2016). In addition, fish are likely to move away when elevated TSS concentrations are detected, while air breathing megafauna such as cetaceans and turtles are not expected to be in direct contact with the TSS plume, given its proximity to the MODU. Any potential contact would be of a short duration,

given the rapid dispersion of the plume and the expected transient movement of megafauna in this offshore area. Light-dependent benthic primary producer habitats are not located in the Operational Area. Given the composition and wider representation of the expected benthic communities in the vicinity of the Operational Area, the potential for gradual settling of fines over an extended distance from the well outside the localised physical footprint of the cuttings pile leading to a thin veneer of sediment deposition, no potential ecological impacts are predicted to occur in the wider area of influence. This may extend over the Continental Slope Demersal Fish Communities KEF at negligible deposition but not affect the values of the KEF. ***Sediment Quality and Habitats and Communities (Contamination and Toxicity Effects from Drilling Fluids)*** Indicative components of the WBM system outlined in Section 3.9.1, have a low toxicity. Bentonite and chemicals from the family of XC polymers (Xanthan Gum or similar) are listed as 'E' category fluids under the OCNS and considered to 'pose little or no risk to the environment'. Metals such as barium from these additives will be present, primarily as insoluble mineralised salts, and consequently are not released in significant amounts to the pore water of marine sediments and have low bioavailability to those benthic fauna which may come into contact with the discharged barite (Crecelius et al., 2007; Neff, 2008). The XC polymer and bentonite sweeps have very low toxicities and are considered by OSPAR to pose little or no risk to the environment. They may, however, cause physical damage to benthic organisms by abrasion or clogging, or through changes in sediment texture that can inhibit the settlement of planktonic polychaete and mollusc larvae (Swan et al., 1994). However, these impacts are not expected to be significant due to the rapid biodegradation and dispersion of WBM (Terrens et al., 1998) and no significant habitats/biota are considered to be present in the Operational Area. The dilution of solid elements of the WBM into substrate largely depends on the energy level of the local environment and the 'mixing' that takes place, but is expected to occur rapidly following release (especially with WBM). The low sensitivity of the benthic communities/habitats combined with the low toxicity of WBM and low physical impacts are unlikely to result in a significant environmental impact. The low sensitivity of the benthic communities/habitats within and in the vicinity of the Operational Area, combined with the low toxicity of WBMs and the highly localised nature and scale of predicted physical impacts to seabed biota, affirm that any impact is considered to be of a slight environmental consequence. ***Well Annular Fluids*** The non-instantaneous nature of the release of the well annular fluids is expected to result in rapid dilution to a no-effect concentration within metres of the release location.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that the drill cuttings and drilling fluid discharges described will not result in a potential impact greater than localised burial and smothering of benthic habitats and slight/short term effects to water quality (e.g. turbidity increase) (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Drilling fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no	Benefits outweigh cost/sacrifice.	Yes C 6.1

[18] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
		reduction in likelihood can occur.		
Six-monthly chemical reviews will be performed to confirm potential chemical impacts are reduced to ALARP.	F: Yes. CS: Minimal cost. Standard practice.	Regular reviews will ensure chemicals selected for drilling fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes C 6.2
Bulk operational discharges will be conducted under MODU's PTW system (to operate discharge valves/pumps).	F: Yes. CS: Minimal cost. Standard practice.	The MODU's PTW may slightly reduce the likelihood of bulk discharges occurring, but it is unlikely to be significant given bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes C 6.3
Professional Judgement – Eliminate				
None identified				
Professional Judgement – Substitute				
The Petroleum Activities Program will use a water based drilling fluid system.	F: Yes. Analysis of the formation and the proposed well design for the Gemtree-A exploration well allows for the use of WBM only in the drilling program. CS: Minimal cost.	The use of WBM only in the drilling program will reduce the consequence of impacts by eliminating hydrocarbon residue on cuttings that would result from the use of non-water based mud.	Benefits outweigh cost/sacrifice.	Yes C 6.4
Professional Judgement – Engineered Solution				
Drill cuttings returned to the MODU will be discharged below the water line to reduce carriage and dispersion of cuttings by surface currents.	F: Yes. CS: Minimal cost. Standard practice.	Discharging drill cuttings below the water line will reduce carriage and dispersion of cuttings. thereby reducing the consequence of cuttings discharges during the Petroleum Activities Program.	Benefits outweigh cost/sacrifice.	Yes C 6.5
Cuttings reinjection into formation. Cuttings are to be crushed, slurrified and pumped to a desired geological structure with a suitable seal, below the seabed through an annulus or tubing.	F: No. No concurrent drilling or direct sequential drilling planned which would require cuttings to be stored prior to reinjection. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Riserless mud recovery (RMR) system to return top hole cuttings/mud from the riserless section of the well to the MODU prior to treatment onboard and	F: Yes. RMR in the water depth where this Petroleum Activities Program will take place (201 m) is technically feasible with a specially	Potential environmental benefit from disposing top hole cuttings/fluid from the MODU below the surface, instead of directly to seafloor,	Disproportionate to implement RMR for environmental reasons. Although use of the RMR system to bring	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
discharge from the MODU (below the water line). Note: RMR may be used for technical reasons if a weighted fluid is required to successfully drill a top hole section (such as mitigating against shallow hazards or unstable formations).	designed/ engineered solution. RMR may be required for technical reasons during the Petroleum Activities Program. CS: Primary cost/ sacrifice of this option is the installation of RMR equipment including the footprint of equipment onboard the rig, POB for operation/ maintenance and risks associated with operational reliability of the installed system (particularly in the deeper waters of the Petroleum Activities Program).	includes a reduction in the consequence of environmental impacts from smothering surrounding benthic fauna (due to a larger extent but lower thickness of deposited cuttings on the seafloor). The magnitude of this reduction in smothering potential could depend upon metocean factors such as tide at the time of discharge (which impact dispersion efficacy and patterns). Because RMR allows for fluid recovery, mud is able to be reused down-hole, reducing the total volume of mud used for that section. The net environmental benefit for this option is reduced or neutral due to the introduction of suspended sediment impact potential for in-water fauna, which doesn't exist to the same extent for disposal of top hole cuttings/fluids at seafloor. The transfer of environmental consequence from reducing cuttings/mud discharged at the well location (i.e. less potential for smothering benthic fauna at seafloor) to reductions in water quality for in-water fauna by suspended sediment and final sedimentation levels, means the consequence of discharging cuttings to the marine environment during the Petroleum Activities Program is not reduced.	mud/fluids back to the MODU (rather than discharging at seabed) includes a reduction in the likelihood of environmental impacts from smothering of proximate benthic fauna, environmental impact potential is then transferred to in-water fauna from suspended sediment, rather than reduced by applying this control. Considering the already low level of impact from cuttings/fluid discharge predicted, the outcomes of the impact assessment described above which determined no sensitive benthic receptors in the vicinity of the Petroleum Activity Program, and transfer of environmental impacts to another receptor, any minor environmental benefits gained from implementing this control are considered disproportionate to the costs and risks associated with RMR system installation and use.	
RMR system to return top hole cuttings from the riserless section of the well to the MODU prior to transport to an alternative	F: Yes. RMR in the water depth where this Petroleum Activities Program will take place (201 m) is technically feasible with a specially	As described above with additional environmental benefits of discharge at an alternative location or transported back to shore.	Disproportionate. The cost/sacrifice outweighs the benefit gained over the duration of the	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
discharge location or back to shore for disposal.	designed/ engineered solution. CS: Primary cost/ sacrifice of this option is the additional handling required to transport mud/cuttings to an alternative disposal location. Particularly the health and safety risks associated with high frequency of support vessel activity alongside the rig and the amount of lifting operations required if a cuttings skip/drilling waste container system were employed. The installation of RMR equipment including the footprint of equipment onboard the rig, POB for operation/ maintenance and risks associated with operational reliability of the installed system (particularly in the deeper waters of the Petroleum Activity Program). Other cost/sacrifice elements which are considered include: • further treatment of cuttings onshore is required to ensure a standard suitable for landfill: Class II disposed locally (e.g. Karratha); Class III landfill requires transport to Geraldton or Perth • increased risk of unplanned vessel collision or loss of cuttings during transfer activities • environmental impact (suspended sediment/ sedimentation) of discharging cuttings at new location and other regulatory	With cuttings removed from the location, possible environment benefit comes from reduced smothering/ burial potential for local benthic habitat in the direct vicinity of the well, where cuttings would normally be discharged on the seafloor. Fluids are still discharged on location (from the MODU) in accordance with requirements in this EP. The net environmental benefit for this option is reduced due to the introduction of suspended sediment impact potential for in-water fauna with the sub-surface discharge of fluids from the top hole, which doesn’t exist to the same extent for disposal of top hole fluids at seafloor. Discharging at a different location reduces the consequence to environmental sensitivities in the Operational Area. However, the small risk of impact is transferred to an alternate site. Given the relatively low biological significance of sensitivities in the Operational Area, no environmental benefit is gained overall. Transportation of cuttings for onshore disposal eliminates any consequence of discharging cuttings. This only provides a small environmental benefit, given the low consequence of discharging cuttings on location.	Petroleum Activities Program. The potential environmental benefits derived from using RMR to bring cuttings/fluids back to the MODU (rather than discharging at seabed) are limited. The potential reduction in likelihood of burial/ smothering due to removing cuttings for one hole section is offset by cuttings/ fluids discharged on location through drilling the rest of the well (i.e. discharges from the other well sections). There is also a transfer of risk and new risks introduced; bringing fluids back to the MODU and disposal at surface has an impact potential for in-water fauna compared to discharge at seabed. Considering the already low level of impact from cuttings/fluid discharge predicted and the outcomes of the impact assessment described above which determined no sensitive benthic receptors in the vicinity of the Petroleum Activity Program, any environmental benefits gained from implementing this control are considered disproportionate to the costs and risks introduced by onshore cuttings relocation or disposal	

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
	approvals may also be required (e.g. sea dumping permit) • potential halt to drilling activity if transfer operations are delayed due to weather or operational issues • additional environmental impact incurred (air emissions) from vessel use and onshore trucking for transportation of cuttings.		at alternative offshore location.	
Return riser-in-place (bottom-hole) cuttings for disposal at another marine location or onshore for processing and land disposal (skip and ship) for whole well to reduce risk of benthic disturbance.	F: Yes. CS: Primary cost/ sacrifice of this option is the additional handling required to transport cuttings to an alternative disposal location. Particularly the health and safety risks associated with high frequency of support vessel activity alongside the rig and the amount of crane lifting required if a cuttings skip/drilling waste container system were employed. Other cost/sacrifice elements which are considered include: • further treatment of cuttings onshore is required to ensure a standard suitable for landfill: Class II disposed locally (e.g. Karratha); Class III landfill requires transport to Geraldton or Perth • increased risk of unplanned vessel collision or loss of cuttings during transfer activities • environmental impact (suspended sediment/ sedimentation) of	Compared to adopted control, return riser-in-place cuttings would reduce cuttings/ mud discharged (although discharge would still occur during riserless drilling on the basis that this control is not adopted) at the well location; however, given current impact assessment and controls adopted, this would not result in a significant reduction of consequence.	Disproportionate. Given the adopted controls and low current risk rating, the high cost/ sacrifice outweighs the benefit gained over the duration of the Petroleum Activities Program. Impact assessment has determined no sensitive benthic receptors in the vicinity and a low level of impact potential from overall cuttings/mud discharge; therefore, benefit to be gained from cuttings/mud recovery is disproportionate to the risks introduced by relocating cuttings (including if an alternative system which doesn't use transport containers was implemented).	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
	discharging cuttings at new location and other regulatory approvals may also be required (e.g. sea dumping permit) • potential halt to drilling activity if transfer operations are delayed due to weather or operational issues • additional environmental impact incurred (air emissions) from vessel use and onshore trucking for transporting cuttings • disposal via landfill and/or treatment does not eliminate an environmental impact. These options have their own impacts and therefore disadvantages if implemented.			
Reduce total drill cuttings by implementing slim well design	F: No. Slim well design is not considered feasible based on the following factors: • The well to be drilled in the Petroleum Activities Program is expected to be deep. Design has been optimised to minimise the size of hole drilled while still being able to reach the target and meet development objectives. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Water quality and/or sediment monitoring of drill cuttings or drilling fluids to verify impact during activity.	F: Yes. CS: • for in-water sampling using ROV – time and	No environmental benefit would be gained by implementing monitoring during the activity. Monitoring could be used to inform additional	Disproportionate. Cost/sacrifice outweigh benefit to be gained in the context of existing environment (deep	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
	logistics for tool change-out from operational tools to specialised scientific sampling tools • additional personnel on board to operate ROV and coordinate sampling program • low ROV availability due to operations can limit time to monitor environment • if additional ROV is required on the MODU, deck space and resources to run/store/service ROV • resources for sample processing (space/equipment/ personnel).	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. Furthermore, it is not guaranteed that additional controls would be feasible, or if they would provide any environmental benefit.	water, open ocean communities with no proximity to sensitive benthic communities or receptors). Although adopting this control could be used to verify EPOs associated with drilling mud and cutting discharge, alternative controls identified achieve an appropriate outcome.	
WBM drill cuttings returned to the MODU will be processed using SCE. In event of SCE failure while drilling, the initial action will be to cease drilling and determine whether to repair SCE or drill ahead until next practicable opportunity to trip out of the hole.	F: Yes CS: Minimal cost. Standard practice	Using the SCE equipment for WBM will allow the reuse of muds and therefore potentially reduce the volume discharged.	Benefits outweigh cost/sacrifice.	Yes C 6.6

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Time-restricted discharge of WBM and/or cuttings to align with tide/current or other oceanographic events.	F: Yes. CS: Disruption to drilling operations in having to stop drilling at time when discharge of WBM and/or cuttings might not be permitted. Additional mud storage volume required.	Given the offshore location, oceanographic changes are unlikely to significantly affect the dispersion of cuttings; therefore, no environmental benefit would be gained.	Disproportionate. The cost/sacrifice outweighs the benefit gained – No hard coral or other photo-sensitive benthic communities in the vicinity of wells to rationalise phased/timed discharge.	No

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision A type), Woodside considers the adopted, standard 'good practice' controls appropriate to manage the impacts of drill cuttings and drilling fluid discharges. A range of engineered solutions and other elimination options were considered to further reduce the impact of planned discharge of drill cuttings and drilling fluids to ALARP; however, technical and operational challenges, safety and environmental risk and additional financial costs resulted in these options being rejected on the basis that they were grossly disproportionate to the potential environmental benefit gained. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks, which are already low due to the low sensitivity of the environment, without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, drill cuttings and drilling fluid discharges are unlikely to result in a potential impact greater than slight, short-term, highly localised impact on habitat (but not affecting ecosystem function), biological and physical attributes. Further opportunities to reduce the impacts and risks have been investigated above.

The adopted controls are considered good oil-field practice/industry best practice to prevent the generation of significant volumes of drill cuttings. Other engineered solutions to manage drill cuttings and fluids were considered; however, these represented costly 'end of pipe' solutions rather than a preventative approach, with additional safety and environmental risks. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges, which due to the low sensitivity of the environment are low, to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 6 No impact to water quality or marine biota greater than a consequence level of E[19] from discharging drilling	**C 6.1** Drilling fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** All chemicals intended or likely to be discharged to the marine environment reduced to ALARP using the chemical assessment process.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.

[19] Defined as ' Slight and short term impact on species or habitat but not affecting ecosystem function' as in **Figure 2-6/Section 2.6.3**.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
cuttings or fluids during the Petroleum Activities Program.	**C 6.2** Six-monthly chemical reviews will be performed to confirm potential chemical impacts are reduced to ALARP.	**PS 6.2** Acceptability of previously approved chemicals are re-evaluated six-monthly to confirm ALARP and alternatives considered.	**MC 6.2.1** Records confirm six-monthly reviews have taken place, and any actions/changes are being tracked to closure.
	C 6.3 Bulk operational discharges will be conducted under MODU's PTW system (to operate discharge valves/pumps).	**PS 6.3** All bulk operational discharges conducted under MODU's PTW system. .	**MC 6.3.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 6.4 The Petroleum Activities Program will use a water based drilling fluid system.	**PS 6.4** The drilling fluids used will be water based.	**MC 6.4.1** Records demonstrate that water based fluids are used.
	C 6.5 Drill cuttings returned to the MODU will be discharged below the water line to reduce carriage and dispersion of cuttings by surface currents.	**PS 6.5** Drill cuttings discharged below the water line.	**MC 6.5.1** Records confirm cuttings discharge chute/line is below the water line.
	C 6.6 WBM drill cuttings returned to the MODU will be processed using SCE. In event of SCE failure while drilling, the initial action will be to cease drilling and determine whether to repair SCE or drill ahead until next practicable opportunity to trip out of the hole.	**PS 6.6** WBM drill cuttings returned to the MODU processed using SCE equipment, allowing reuse of mud prior to discharge. The decision whether to repair SCE or drill ahead will consider the estimated time for repairs and the amount of drilling until next planned trip out of hole and the associated environmental impacts.	**MC 6.6.1** Records demonstrate that operational SCE is in use. **MC 6.6.2** Records demonstrate that in the event of shaker failure (where no redundancy is available), active drilling is initially stopped as soon as safe to do so. Evidence of the decision to drill ahead with failed SCE can be produced.

6.6.7 Routine and Non-routine Discharges to the Marine Environment: Cement, Cementing Fluids, Subsea Well Fluids and Unused Bulk Products

Context	
Drilling activities – Section 3.8 Project fluids – Section 3.9	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary														
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine discharge of cement, cementing fluids, subsea well fluids (BOP control fluids and well displacement fluids) and other down-well products to the seabed and the marine environment		X	X		X			A	E	-	-	GP PJ	Broadly Acceptable	EPO 7

Description of Source of Impact

Cementing Fluids and Cement

Cementing fluids may require discharge to the marine environment under various scenarios. When cementing the conductor and surface casings after top-hole sections of the well have been drilled, cement must be circulated to the seabed to ensure structural integrity of the well. Excess cement is pumped to ensure structural integrity is achieved.

If the hole is completely in-gauge and there are no downhole losses while running the cement, a maximum average volume of 55 m³ is estimated to be circulated to the seafloor at the well location, which forms a thin concrete film on the seabed in close proximity to the well.

After each cement job, left over cement slurry in the cement pump unit and the surface lines is flushed and discharged to the sea to prevent clogging of the lines and equipment. This is estimated at about 15 m³ (based on three cement jobs × 5 m³ discharged per job).

Cement spacers can be used as part of the cementing process, within the well casing, to assist with cleaning the casing sections prior to cement flow-through. The spacers may consist of either seawater or a mixture of seawater and dye. The dye is used to provide a pre-indicator of cement overflow to the seabed surface, to ensure adequate cement height.

Excess cement (dry bulk, after well operations are completed) will either be: used for subsequent wells; provided to the next operator at the end of the drilling program (as it remains on the rig); or, if these options aren't practicable, discharged to the marine environment as a slurry or blown as dry bulk.

Upon arrival on location at the Operational Area, the rig may be required to perform a cement unit test, or 'dummy cement job'. Discharges from the test are either made through the usual cement unit discharge line, which may be up to 10 m above the sea level or through drill pipe below sea level, and occur as a cement slurry. The slurry is usually a mix of cement and water; however, may sometimes contain stabilisers or chemical additives.

Subsea Fluids – BOP Control Fluids

BOP control fluids are likely to be released during drilling. The BOP is required to be regularly function tested when sub-sea, as defined by legislative requirements. The BOP is function-tested during assembly and maintenance and during operation on the seabed. As part of this testing, small volumes of BOP control fluid (generally consisting of water mixed with a glycol based detergent or equivalent water based anti-corrosive additive) is released to the marine environment. The BOP will be function-tested about every seven days (when a pressure test is not occurring) and pressure tested about every 21 days as per API 53 (an American Petroleum Institute standard for Well Control Equipment Systems for Drilling Wells). This will result in discharges of about 90 L of BOP control fluids per test.

Subsea Fluids – Displacement Fluids

As required throughout activities with the riser connected, wells will be displaced from one drilling fluid system to another. A chemical clean-out pill or fluids train will be circulated between the different fluids. This will result in a discharge of operational fluids in accordance with the Woodside internal guidelines.

Other Down-Well Products

Additional products such as barite and bentonite may be discharged in bulk during or at the end of the activity if they cannot be reused or taken back to shore. Use and discharge of all chemicals will be performed in line with Woodside's internal guidelines (Section 3.9.1). Discharge may be in the form of dry bulk or as a slurry; however, discharges will not be contaminated with hydrocarbons.

Impact Assessment

Potential Impacts to Water Quality, Sediment Quality and Other Habitats and Communities

Pelagic and benthic habitats in the Operational Area are considered to be of low sensitivity (no known significant benthic habitat or infauna habitat). The north-east portion of the Operational Area overlaps with an area of seabed known as the 'upper slope' (water depth of 225–500 metres) and forms part of the Continental Slope Demersal Fish Communities KEF. The proposed location of the Gemtree-A exploration well is located about 1 km from the upper slope and the Continental Slope Demersal Fish Communities KEF (Figure 4-21). Given that the area potentially impacted by cement discharges will be highly localised, similar to drill cuttings and drilling fluids (up to approximately 200 m, as described above) and the distance between the well location and the KEF, the discharge of cement is not expected to influence the ecological values of the KEF. Impacts to the values and sensitivities of the KEF are therefore are not expected. Coupled with the low toxicity of the fluids to be used for the Petroleum Activities Program, the likelihood of any significant impact to marine biota is considered to be low.

Cement

Impacts of cement on the marine environment are associated mainly with smothering surrounding benthic and/or infauna communities. Cement is the most common material currently used in artificial reefs around the world (OSPAR, 2010) and is not expected to pose any toxicological impacts to receptors from leaching or direct contact. A minimum cement volume is required to be stored on the MODU for use in well control and plug & abandon activities. While cement volumes are calculated prior to use to minimise excess, the requirement for additional volumes on the MODU means some cement may require discharge if options for reuse on other wells is not possible. Discharge of excess cement may occur as dry bulk or as a slurry. Dry bulk has the potential to disperse across a wider area, but at lower concentration, compared to slurry which would have a greater tendency to settle on the seafloor closer to the well location. In either case, discharges are not expected to widely disperse before settling on the seabed.

The impact of cement discharge at the seabed will therefore be limited to any surrounding benthic and/or infauna communities, in a small localised area immediately around the well and likely within the area previously impacted by drill cuttings (see Section 6.6.6).

Cementing Fluids, Subsea Well Fluids (BOP Control Fluids and Well Displacement Fluids) and Other Down-Well Products

All chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program are evaluated using a defined framework and set of tools to ensure the potential impacts of the chemicals selected are acceptable, ALARP and meet Woodside's expectation for environmental performance. Therefore, any chemicals selected and potentially released are expected to be of low toxicity and biodegradable. Additionally, where cements have been mixed in excess and cannot be reused or returned to shore, these will be turned into a slurry. As chemicals have initially been chosen based on the environmental performance and based on an ALARP assessment, additional dilution prior to discharge further reduces the environment impact to water quality, sediment quality and marine benthic and/or infauna communities. Given the minor quantities of routine and non-routine planned discharges, short discharge durations and the low toxicity and high dispersion in the open, offshore environment, any impacts on the marine environment are expected to be slight and localised.

Given the highly localised nature of these discharges and potential impacts, cumulative impacts to marine biota, water quality and sediments are not expected.

Summary of Potential Impacts to Environmental Values

Given the adopted controls, it is considered that the routine discharge of cement, cementing fluid, subsea well fluid and other down-well products described will not result in a potential impact greater than localised, slight and short term impacts to infauna and benthic communities, water quality and marine sediment (but not affecting ecosystems function) (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[20]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Drilling, cementing and subsea control fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes C 7.1
Six-monthly chemical reviews will be performed to confirm potential chemical impacts are reduced to ALARP.	F: Yes. CS: Minimal cost. Standard practice.	Regular reviews will ensure chemicals selected for drilling, cementing and subsea control fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes C 7.2
Bulk operational discharges will be conducted under MODU's PTW system (to operate discharge valves/pumps).	F: Yes. CS: Minimal cost. Standard practice.	The MODU's PTW may slightly reduce the likelihood of bulk discharges occurring, but it is unlikely to be significant given bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes C 7.3
Options for use of excess bulk cement, bentonite or barite will be assessed prior to discharge to the marine environment.	F: Yes. CS: Minimal cost. Standard practice.	Review of options for excess bulk cement, bentonite or barite may reduce requirement for bulk discharges, although bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes C 7.4
Professional Judgement – Eliminate				
Do not use BOP control fluids.	F: No. BOP control fluids are critical to the operation of the BOP. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Return cement and other down-well products onshore for treatment/disposal.	F: Yes. However, cement slurry may harden during transport, introducing difficulty in handling and transportation. CS: The cost involved in transporting cement for	Not discharging cement to the marine environment would eliminate the likelihood and consequence of impacts from such activities.	Disproportionate. Given the non-toxic nature of cement, the cost/sacrifice outweighs the benefit gained.	No

[20] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[20]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
	shore-based disposal is significant.			
Use excess bulk cement and other down-well products on subsequent wells or pass onto subsequent operator.	F: Yes. However the cement may not meet the required technical specifications and hence not be usable. At the time of EP submission, the drilling schedule is unknown and hence a commitment to reuse cement may not be feasible. CS: Minor.	Using excess bulk cement on subsequent wells would eliminate the bulk discharge of cement to the marine environment and would eliminate the likelihood and consequence of impacts from such activities.	Disproportionate. Given the risk of the cement discharge and other down-well products to the environment is low due to the benign nature of the substance and the low sensitivity of the receiving environment, it is considered a negligible environmental risk. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of cement, cementing fluids, subsea well fluids and unused bulk products. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, routine cement, cementing fluids, subsea well fluids and unused bulk products is unlikely to result in a potential impact greater than localised, slight and short term impacts to infauna and benthic communities, water quality and marine sediment (but not affecting ecosystems function). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 7 No impact to water quality or marine biota greater than a consequence level	**C 7.1** Drilling, cementing and subsea control fluids and additives will have an environmental assessment completed prior to use.	**PS 7.1** All chemicals intended or likely to be discharged to the marine environment reduced to ALARP using the chemical assessment process.	**MC 7.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
of E[21] from discharging cement, cementing fluids, subsea well fluids and unused bulk products during the Petroleum Activities Program.	**C 7.2** Six-monthly chemical reviews will be performed to confirm potential chemical impacts are reduced to ALARP.	**PS 7.2** Acceptability of previously approved chemicals are re-evaluated six-monthly to confirm ALARP and alternatives considered.	**MC 7.2.1** Records confirm six-monthly reviews have taken place for drilling, cementing and subsea control fluids, and any actions/changes are being tracked to closure.
	C 7.3 Bulk operational discharges will be conducted under MODU's PTW system (to operate discharge valves/pumps).	**PS 7.3** All bulk operational discharges conducted under MODU's PTW system.	**MC 7.3.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 7.4 Options for use of excess bulk cement, bentonite or barite will be assessed prior to discharge to the marine environment.	**PS 7.4** No bulk cement, bentonite or barite discharged without documented assessment.	**MC 7.4.1** Records demonstrate that, prior to discharge of excess bulk cement, bentonite or barite options for use were assessed.

[21] Defined as ' Slight and short term impact on species or habitat but not affecting ecosystem function' as in Figure 2-6/Section 2.6.3.

6.6.8 Routine Atmospheric Emissions: Fuel Combustion, Incineration and Venting

Context	
Project vessels – Section 3.5 Venting – Section 3.10.7	Physical environment – Section 4.4

Impacts and Risks Evaluation Summary

Source of Impact	Environmental Value Potentially Impacted							Evaluation						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socio-Economic	Decision Type	Consequence	Likelihood	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Internal combustion engines and incinerators on MODU and support vessels				X				A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 8 & 9
Contingent venting of gas during drilling (i.e. well kick)				X				A	F	-	-			

Description of Source of Impact

Atmospheric emissions will be generated by the project vessels from internal combustion engines (including all equipment and generators) and incineration activities (including on-board incinerators) during the Petroleum Activities Program. Emissions will include SO_2, NO_x, ozone-depleting substances, CO_2, particulates and volatile organic compounds (VOCs).

During drilling of the well, a 'kick' may occur in the reservoir. A kick is an undesirable influx of formation fluid into the wellbore. The resultant effect would be a release of a small volume of greenhouse gases via the degasser to the atmosphere during well control operations, known as 'venting'. Venting is required to ensure well integrity is maintained in the event of a kick, thereby avoiding an emergency condition.

Impact Assessment

Potential Impacts to Air Quality

Fuel combustion and incineration have the potential to result in a localised, temporary reduction in air quality. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. Given the short duration and exposed location of the MODU and support vessels, which will lead to the rapid dispersion of the low volumes of atmospheric emissions, the potential impacts are expected to have no lasting effect, with no cumulative impacts when considered in the context of existing or future oil and gas operations in the region.

Venting may result in a localised and temporary reduction in air quality as the gas vents to the atmosphere, and a localised and temporary contribution to greenhouse gas emissions. There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. However, the closest sensitive populated receptor is on Barrow Island, about 70 km south-east of the Operational Area; therefore, any risks associated with off-site human health effects are negligible beyond the immediate zone of release and dispersion. Given the short duration and isolated location of the Petroleum Activities Program (which will lead to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to be localised with no lasting effect.

Summary of Potential Impacts to Environmental Values

Given the adopted controls, it is considered that fuel combustion, incineration and venting emissions will not result in a potential impact greater than a temporary decrease in local air quality and/or water quality standards, with no lasting effect and no significant impact to environmental receptors (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[22]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 97 (marine pollution prevention – air pollution).	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed may slightly reduce the likelihood of air pollution.	Control based on legislative requirements – must be adopted.	Yes C 8.1
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted WOMP and application to drill.	F: Yes. CS: Minimal cost. Standard practice.	The accepted WOMP will manage the risk of well kicks, reducing the likelihood of occurrence. No reduction in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes C 9.1
Good Practice				
Subsea BOP installed and function tested during drilling operations.	F: Yes. CS: Standard practice. Required by Woodside standards.	BOP testing reduces the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes C 9.2
Process conducted to calculate, update and monitor kick tolerance for use in well design and while drilling.	F: Yes. CS: Minimal cost. Standard practice for Woodside activities.	Processes will reduce the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes C 9.3
Well control bridging document for alignment of Woodside and the MODU Contractor in order to manage the equipment and procedures for preventing and handling a well kick.	F: Yes. CS: Minimal cost. Standard practice for Woodside activities.	Implementing equipment and procedures in the well control bridging document will reduce the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes C 9.4
Professional Judgement – Eliminate				
Do not combust fuel.	F: No. There are no MODUs or vessels that do not use internal combustion engines. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Do not vent during well kick.	F: No. Venting is a critical safety activity required in the event of a kick to reduce pressure build-up. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				

[22] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[22]***	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of fuel combustion, incineration and venting emissions. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, fuel combustion, incineration and venting emissions are unlikely to result in a potential impact greater than a temporary decrease in local air quality and/or water quality standards, with no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The controls adopted meet the legislative requirements within Marine Order 97. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 8 Fuel combustion and incineration emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity.	**C 8.1** Marine Order 97 (marine pollution prevention – air pollution) which details requirements for: • International Air Pollution Prevention Certificate, required by vessel class • use of low sulphur fuel when available • Ship Energy Efficiency Management Plan, where required by vessel class • onboard incinerator to comply with Marine Order 97.	**PS 8.1** MODU and support vessels compliant with Marine Order 97 (marine pollution prevention – air pollution) to restrict emissions to those necessary to perform the activity. Vessel marine assurance process conducted prior to contracting vessels, to ensure suitability and compliance with vessel combustion certification/ Marine Order requirements.	**MC 8.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 97.
EPO 9 Emissions to air as a result of venting from well kick are restricted to those necessary to maintain well integrity.	**C 9.1** Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted WOMP, which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • All permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid	**PS 9.1** Wells drilled in compliance with the accepted WOMP, including implementation of barriers to prevent a loss of well integrity.	**MC 9.1.1** Acceptance letter from NOPSEMA demonstrates the WOMP and application to drill were accepted by NOPSEMA prior to the drilling activity commencing. **MC 9.1.2** Records demonstrate minimum of two verified barriers (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study). • Discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required. • All normally pressured permeable water-bearing formations shall be isolated from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction • (fluid barriers) remain monitored and provide sufficient pressure to counter pore pressure during well construction • (cementing barriers including conductor, casing and liners) conform to the relevant minimum standards set out in the Woodside Engineering Standard – Well Cementation. Verification: • Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the drilling of the well.		confirmed by a shallow hazard study) were in place for all permeable zones penetrated by the wellbore. **MC 9.1.3** Records demonstrate composition and weight of drilling fluids were applicable to down hole conditions.
	C 9.2 Subsea BOP installed and function tested during drilling operations. The BOP shall include (at a minimum): • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	**PS 9.2** Subsea BOP specification, installation and function testing compliant with internal Woodside Standards and international requirements (API Standard 53 5th Edition) as agreed by Woodside and MODU Contractor.	**MC 9.2.1** Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected drilling conditions as agreed by Woodside and the MODU Contractor.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 9.3 Process conducted to calculate, update and monitor kick tolerance for use in well design and while drilling, including: • The BOP shall be closed upon detecting a positive well influx. • The shut-in procedure shall be according to the rig contractor procedures or as the well conditions dictate. • Kick tolerance calculations will be made for drilling all hole sections based on the weakest known point in the well. Kick detection techniques will be adjusted based on the level of kick tolerance through management of change (MOC). • The manual also includes requirements for kick tolerance management in the event of down-hole losses.	**PS 9.3** Kick tolerance is calculated, managed, monitored and updated while drilling.	**MC 9.3.1** Records demonstrate well kick tolerance is calculated, managed, monitored and updated while drilling. **MC 9.3.2** Records demonstrate shut-in procedures followed in the event of a potential well kick.
	C 9.4 Well control bridging document for alignment of Woodside and the MODU Contractor in order to manage the equipment and procedures for preventing and handling a well kick.	**PS 9.4** Well is drilled in accordance with an agreed well control bridging document.	**MC 9.4.1** Records demonstrate well drilled in accordance with well control bridging document.

6.6.9 Routine Light Emissions: External Lighting on MODU and Support Vessels

Context	
Project vessels – Section 3.5	Physical environment – Section 4.4

Impacts and Risks Evaluation Summary

Source of Impact	Environmental Value Potentially Impacted							Evaluation						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socio-Economic	Decision Type	Consequence	Likelihood	Current Risk Rating	ALARP Tools	Acceptability	Outcome[23]
External light emissions on-board MODU and support vessels						X		A	F	-	-	PJ	Broadly Acceptable	N/A

Description of Source of Impact

The MODU and support vessels will have external lighting to facilitate navigation and safe operations at night throughout the Petroleum Activities Program. External light emissions from the MODU and support vessels are typically managed to maintain good night vision for crew members.

Lighting on the MODU is used to allow safe operations during night hours, as well as to communicate the MODU's presence and activities to other marine users (i.e. navigation lights). Lighting is required for safely operating the MODU and cannot reasonably be eliminated.

External lighting is 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. The distance to the horizon at which components of the MODU will be directly visible can be estimated using the formula of:

$$horizon\ distance = 3.57 \times \sqrt{height}$$

Where 'horizon distance' is the distance to the horizon at sea level in kilometres and 'height' is the height above sea level of the light source in metres. Using this formula, the approximate distances at which various MODU components (and associated light sources) will be visible at sea level are:

- Main deck (~20 m above sea level): about 16 km from MODU
- Derrick top (~50 m above sea level): about 25 km from MODU.

Impact Assessment

Potential Impacts to Protected Species

Light emissions can affect fauna in two main ways:

- *Behaviour*: Many organisms are adapted to natural levels of lighting and the natural changes associated with the day and night cycle as well as the night time phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can override these natural levels and cycles.
- *Orientation*: Organisms such as marine turtles and birds may also use lighting from natural sources to orient themselves in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may act to override natural cues, leading to disorientation.

Fauna within the Operational Area are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as marine turtles, whale sharks, whales and migratory sea birds transiting through the Operational Area. There is no known critical habitat within the Operational Area for EPBC listed species, although there is overlap with

[23] There are no specific controls and EPOs identified for external lighting on MODU and project vessels. However, minimum lighting aboard the MODU and support vessels will be maintained to facilitate safe operations and navigation.

BIAs for flatback turtle internesting, whale shark foraging and pygmy blue whale migration. The Operational Area also overlaps with designated habitat critical to the survival of flatback turtles for internesting at the Montebello Islands (with peak nesting in December and January). Pygmy blue whales and whale sharks are not expected to be impacted by above-surface light emissions beyond opportunistic feeding that may occur as a result of prey aggregations around the light source. Given the fauna expected to occur within the Operational Area, impacts from light emissions are considered to be highly unlikely. ***Marine Turtles – Adults*** Artificial lighting may affect the location that turtles emerge to the beach, the success of nest construction, whether nesting is abandoned, and even the seaward return of adults (Salmon et al., 1995a, 1995b; Salmon & Witherington, 1995). However, such lighting is typically from residential and industrial development overlapping the coastline, rather than offshore from nesting beaches. While the Operational Area overlaps with the north-west extent of a BIA and habitat critical to the survival of flatback turtles for internesting (described in Section 4.5.2), the nearest landfall for this BIA occurs at North West Island of the Montebello Islands, about 55 km south-east of the Operational Area. The BIA and habitat critical to the survival of flatback turtles are considered very conservative as they are based on the maximum range of internesting females and many turtles are more likely to remain near their nesting beaches. Impacts to nesting turtles are therefore not expected. Given the water depth of the Operational Area (at least ~166 m), turtles are unlikely to be foraging. However, it is acknowledged that marine turtles may be present transiting the Operational Area in low densities. ***Migratory Birds*** The Operational Area may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be used as roosting or nesting habitat and contains no known critical habitats (including feeding for any species. Seabird surveys over the Northwest Shelf Province have noted that seabird distributions in tropical waters were generally patchy, except near islands (Dunlop et al., 1988). Given the Operational Area lies offshore with the closest island 47 km away, seabirds are likely to only transit over the Operational Area when travelling between emergent land and important habitats. Migratory shorebirds may be present in or fly through the region between July and December and again between March and April as they complete migrations between Australia and offshore locations (DSEWPaC, 2012d). The risk associated with collision from seabirds attracted to the light is considered to be low, given the low numbers expected to transit the area and that there is no critical habitat for these species within the Operational Area, as well as the slow moving speeds associated with the MODU and support vessels. ***Fish*** Lighting from the presence of a vessel may result in the localised aggregation of fish below the vessel. These aggregations of fish are considered localised and temporary and any long term changes to fish species composition or abundance is considered highly unlikely. This localised increase in fish extends to those comprising the whale shark's diet. However, given that a large proportion of the diet comprises krill and other planktonic larvae, it is unlikely that a light source will lead to a significant increase in whale shark abundance in the vicinity of the MODU and support vessels.
Summary of Potential Impacts to Environmental Values
Light emissions from the MODU and support vessels will not result in an impact greater than localised and temporary disturbance to fauna in the vicinity of the Operational Area, with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[24]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
Substitute external lighting with 'turtle friendly' light sources (reduced emissions in turtle visible spectrum).	F: Yes. Replacing external lighting with turtle friendly lighting is technically feasible, although is not considered to be practicable. CS: Significant cost sacrifice. The retrofitting of all external lighting on the MODU, etc.,	Given the potential impacts to turtles during this activity is insignificant, implementing this control would not result in a reduction in consequence.	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal environmental benefit.	No

[24] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[24]	***Benefit in Impact Reduction***	***Proportionality***	***Control Adopted***
	would result in considerable cost and time expenditure. Considerable logistical effort to source sufficient inventory of the range of light types onboard the MODU.		The cost/sacrifice outweighs the benefit gained.	
Vary the timing of the Petroleum Activities Program to avoid peak turtle internesting periods (December to January).	F: No. The Operational Area has a minor overlap with the flatback turtle internesting BIA and habitat critical to the survival of flatback turtles in an area not known to provide foraging habitat. Given the low potential for internesting turtles to be present within the Operational Area, the risk of potential impacts from vessel light emissions on adult turtles is considered to be low. CS: Significant cost and schedule impacts due to delays in securing vessels/MODU for specific timeframes.	Not considered – control not feasible.	Not considered, control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the potential impacts from routine light emissions from the MODU and support vessels to be ALARP in its current risk state. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, in its current state, routine light emissions from the MODU and support vessels are unlikely to result in a potential impact greater than localised behavioural disturbance to fauna within the Operational Area, with no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The potential impacts and risks are consistent with good oil-field practice/industry best practice and are considered to be broadly acceptable in its current state. Therefore, Woodside considers standard operations appropriate to manage the impacts and risks of routine light emissions to a level that is broadly acceptable.

6.7 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.7.1 Quantitative Spill Risk Assessment Methodology

Quantitative hydrocarbon spill modelling was performed by RPS, on behalf of Woodside, using a three-dimensional hydrocarbon spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program). The model is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under different environmental conditions (both meteorological and oceanographic). Near-field subsurface discharge modelling was performed using OILMAP, which predicts the droplet sizes that are generated by the turbulence of the discharge as well as the centreline velocity, buoyancy, width and trapping depth (if any) of the rising gas and oil plumes. The OILMAP output parameters were used as input into SIMAP.

The algorithms in the SIMAP model are based on the best available scientific knowledge, and are updated when necessary in response to significant advances in knowledge. Recent improvements have been implemented to the entrainment algorithm, which have been adjusted to implement the findings of published data based on field research performed during the Macondo spill event in the Gulf of Mexico (Spaulding et al., 2017; Li et al., 2017; French-McCay et al., 2018).

Stochastic modelling was conducted, which compiled data from 200 hypothetical spills under different environmental conditions to determine the widest extent of possible oil dispersion. The environmental conditions for each of the hypothetical spills were selected randomly from an historic time-series of wind and current data representative of the study area. Results of the replicate simulations were then statistically analysed and mapped to define contours of percentage probability of contact at identified thresholds around the hydrocarbon release point. The simulations that show something unusual or unexpected make an important contribution to the overall outcomes and fate of the hydrocarbon.

The model simulates surface releases and uses the unique physical and chemical properties of a representative hydrocarbon type to calculate rates of evaporation and viscosity change, including the tendency to form oil-in-water emulsions. Moreover, the unique transport and dispersion of surface slicks and in-water components (entrained and dissolved) are modelled separately. Thus, the model can be used to understand the wider potential consequences of a spill, including direct contact of hydrocarbons due to surface slicks (floating hydrocarbon) and exposure of organisms to entrained and dissolved aromatic hydrocarbons in the water column. The model also calculates the accumulation of hydrocarbon mass that arrives on each section of shoreline over time, taking into account any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

All hydrocarbons spill modelling assessments performed by RPS undergo initial sensitivity modelling to determine appropriate time to add to the simulation after the cessation of the spill. The amount of time following the spill is based on the time required for the modelled concentrations to practically drop below threshold concentrations anywhere in the model domain in the test cases.

In addition to the stochastic modelling, single-trajectory modelling (deterministic) was conducted to assess potential worst-case trajectories based on the stochastic modelling runs. The deterministic simulations are therefore representative of single spill events under certain wind and current conditions. The deterministic simulations were performed to represent the fastest time to shoreline contact and the largest volume ashore from a single model run.

6.7.1.1 Environment that May Be Affected and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling are used to assess the environmental risk, if a credible hydrocarbon spill scenario occurred, by delineating which areas of the marine environment could be exposed to hydrocarbon levels exceeding hydrocarbon threshold concentrations. The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the ‘environment that may be affected’ (EMBA), which is driven by the worst-case credible hydrocarbon spill scenario. In this instance the worst-case credible scenario is the loss of well integrity resulting in a release of condensate. Julimar condensate was selected as the representative hydrocarbon for the Gemtree exploration proposed under this EP.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, the EMBA combines the potential spatial extent of the different fates. The EMBA also includes areas that are predicted to experience shore-line contact with hydrocarbons above threshold concentrations.

The EMBA covers a larger area than the area that is likely to be affected during any single spill event, as the model was run for a variety of weather and metocean conditions (100 simulations in total). The EMBA therefore represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs.

Surface and accumulated shoreline hydrocarbon concentrations are expressed as grams per square metre (g/m^2), with entrained and dissolved aromatic hydrocarbon concentrations expressed as parts per billion (ppb). A conservative approach adopting accepted contact thresholds that are documented to impact the marine environment is used to define the EMBA. These hydrocarbon thresholds are presented in Table 6-4 and described in the following subsections.

Woodside recognises that surface hydrocarbons may be present at lower concentrations than the EMBA threshold value of 10 g/m^2 (Table 6-4), that may be visible, but are not expected to cause ecological impacts. Surface oil may be visible to a concentration of approximately 1 g/m^2. Woodside has therefore used this as a threshold to define an additional boundary within which socio-cultural impacts to the visual amenity of the marine environment may occur. This additional area is referred to as the socio-cultural EMBA for surface hydrocarbons in this EP. Socio-cultural values described for the socio-cultural EMBA include the following:

- protected areas;
- National and Commonwealth Heritage Listed places;
- tourism and recreation; and
- fisheries.

It is noted that the socio-cultural EMBA for surface hydrocarbons in this EP is fully within the boundaries of the EMBA for ecological impacts (based on the extent of both surface and in-water hydrocarbons and accumulated hydrocarbons on shorelines). No additional values and sensitivities for the socio-cultural EMBA for surface hydrocarbons are therefore described.

Table 6-4: Summary of environmental impact thresholds applied to the quantitative hydrocarbon spill risk modelling results

EMBA	Surface hydrocarbon (g/m^2)	Entrained hydrocarbon (ppb)	Dissolved aromatic hydrocarbon (ppb)	Accumulated hydrocarbon (g/m^2)
Condensate	1 and 10	100	50	100
Diesel	10	500	500	100

6.7.1.2 Surface Hydrocarbon Threshold Concentrations

The spill modelling outputs defined the EMBA for surface hydrocarbons resulting from a spill (contact on surface waters) using a threshold of ≥10 g/m^2 for both condensate and diesel. This is equivalent to dull metallic colours based on the relationship between film thickness and appearance (Bonn Agreement, 2015) (Table 6-5). This threshold concentration is geared towards informing potential oiling impacts for wildlife groups and habitats that may break through the surface slick from the water or the air (for example: emergent reefs, vegetation in the littoral zone and air-breathing marine reptiles, cetaceans, seabirds and migratory shorebirds).

Thresholds for registering biological impacts resulting from contact of surface slicks have been estimated by different researchers at about 10–25 g/m² (French et al., 1999; Koops et al., 2004; NOAA, 1996). Potential impacts of surface slick concentrations in this range for floating hydrocarbons may include harm to seabirds through ingestion from preening contaminated feathers, or the loss of the thermal protection of their feathers. The 10 g/m² threshold is the reported level of oiling to instigate impacts to seabirds and is also applied to other wildlife, though it is recognised that 'unfurred' animals, where hydrocarbon adherence is less, may be less vulnerable. 'Oiling' at this threshold is taken to be of a magnitude that can cause a response to the most vulnerable wildlife such as seabirds. Due to weathering processes, surface hydrocarbons will have a lower toxicity due to change in their composition over time. Potential impacts to shoreline sensitive receptors may be markedly reduced in instances where there is extended duration until contact. The 10 g/m² threshold is considered appropriate for both Julimar condensate and diesel delineating potential chronic and acute effects to ecosystems.

A lower concentration of 1 g/m², which represents a rainbow sheen on the surface (Table 6-5), has also been used to define a wider area within which socio-cultural impacts to the visual amenity of the marine environment may occur.

Table 6-5: The Bonn Agreement Oil Appearance Code (BAOAC)

Appearance (following BAOAC visibility descriptors)	Mass per area (g/m²)	Thickness (μm)	Volume per area (L/km²)
Discontinuous true oil colours	50 to 200	50 to 200	50,000 to 200,000
Dull metallic colours	5 to 50	5 to 50	5000 to 50,000
Rainbow sheen	0.30 to 5.00	0.30 to 5.00	300 to 5000
Silver sheen	0.04 to 0.30	0.04 to 0.30	40 to 300

6.7.1.3 Accumulated Hydrocarbon Threshold Concentrations

Owens and Sergy (1994) define accumulated hydrocarbon <100 g/m² to have an appearance of a stain on shorelines. French-McCay (2009) defines accumulated hydrocarbons ≥100 g/m² to be the threshold that could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat. A threshold of ≥100 g/m² has therefore been adopted to define the EMBA for both a condensate and diesel spill. Further, any ecological impacts at the accumulated thresholds concentration EMBA may also result in socio-cultural impacts.

6.7.1.4 Dissolved Aromatic Hydrocarbon Threshold Concentrations

Condensate

The condensate threshold concentration value for dissolved aromatic hydrocarbons (i.e. 50 ppb) is considered conservative and has been set with reference to the dissolved exposure values detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), and in context of ecotoxicity test results from Balnaves-3 crude oil. Balnaves-3 crude is considered a suitable (albeit conservative) surrogate for Julimar condensate in lieu of reservoir specific toxicity results, given both hydrocarbons exhibit similar boiling point (BP) distributions and volatility. This suggests that the potential for toxicity of both hydrocarbons is comparable, although the Julimar condensate is characterised by lower aromatic content, indicating it may be less toxic. Table 6-6 compares the characteristics of Julimar condensate and Balnaves-3 crude oil (a light crude).

Table 6-6: Comparison of Julimar condensate and Balnaves-3 crude characteristics

Hydrocarbon Type	Initial Density (g/cm³)	Viscosity (cP @ 20˚C)	Component BP (˚C)	Volatiles <180˚C	Semi volatiles 180–265 °C	Low Volatility (%) 265–380 °C	Residual (%) >380 °C	Aromatic (%) of whole oil <380 °C BP
				Non-Persistent			Persistent	
Julimar Condensate	0.7885 at 15 °C	1.248	% of total	48.8	21.3	29.5	0.4	11.5
Balnaves-3 Crude	0.780	1.399	% of total	46	20	23	11	14.2

The ecotoxicity tests were performed on a broad range of taxa of ecological relevance for which accepted standard test protocols are well-established. These ecotoxicology tests are focused on the early life stages of test organisms, when organisms are typically at their most sensitive. The ecotoxicology tests were conducted on six mainly tropical-subtropical species representatives from six major taxonomic groups. The six species were tested for chronic (function of life) effects of immobilisation, early life stage development/growth and acute toxicity (i.e. mortality).

The laboratory-based ecotoxicology tests used a range of water accommodated fraction (WAF) concentrations to expose the different test organisms. For each ecotoxicity test, samples of the WAF were analysed to determine the TPH concentration of the solution. The ecotoxicology testing focusses on the total petroleum hydrocarbons (TPH) concentration of the WAF of the hydrocarbon and includes the carbon chains C_6 to C_{36}. Typically, C_4 to C_{10} compounds are volatile (boiling point (BP) <180°C), C_{11} to C_{15} compounds are semi-volatile (BP 180–265°C), C_{16} to C_{20} compounds have low volatility (265–380°C) and C_{21} compounds and above are residual (BP >380°C) (Ecotox Services Australia, 2013).

Table 6-7 presents the results of no observed effect concentrations (NOECs) for the Balnaves crude oil WAFs tested. The lowest NOEC reported is 123 ppb, from the amphipod acute toxicity tests. All other toxicity tests indicated NOECs ranging from 610 to 6640 ppb, with a median value of 2695 ppb. Based on these ecotoxicology tests, the selected dissolved aromatic hydrocarbon threshold of 50 ppb has been conservatively adopted for Julimar condensate. This 50 ppb threshold is significantly below the NOEC for all six sensitive organisms tested (Table 6-7) and is considered to be conservative.

Table 6-7: Summary of total recoverable hydrocarbons NOECs for key life-histories of different biota based on toxicity tests for WAF of Balnaves-3 crude condensate

Biota and Life Stage	Exposure duration	NOEC – TRH concentration of unweathered Balnaves Crude Oil showing no direct biological effect (ppb)
Sea urchin larval development	72 hours	4850
Milky oyster larval development	48 hours	4580
Microalgal growth test	72 hours	810
Copepod acute toxicity test	48 hours	670
Amphipod acute toxicity test	96 hours	123
Larval fish imbalance	96 hours	6640

Source: Ecotox Services Australia, 2013

Diesel

The threshold concentration value for dissolved diesel has been established with reference to results from Woodside-commissioned ecotoxicity tests on Marine Diesel Oil (Ecotox Services Australia (ESA 2013)).

The ecotoxicity tests were undertaken on a broad range of taxa and focused on the early life stages of test organisms, when organisms are typically at their most sensitive. The eight ecotoxicology tests were conducted on seven mainly tropical-subtropical species representatives from six major taxonomic groups. The seven species were tested for chronic (function of life) effects of immobilisation, early life stage development/growth and acute toxicity (i.e. mortality).

The laboratory-based ecotoxicity tests used a range of water accommodated fraction (WAF) concentrations to expose the different test organisms. For each ecotoxicity test, samples of the WAF were analysed to determine the TPH concentration of the solution. The ecotoxicity testing focusses on the total petroleum hydrocarbons (TPH) concentration of the WAF of the hydrocarbon and includes the carbon chains C_6 to C_{36}, as described above in relation to ecotoxicity test on Balnaves crude.

Table 6-8 presents the results of the 'no-observed-effect concentrations' (NOEC) for the marine diesel WAFs. The reported NOECs for organisms tested ranged from 520 ppb to 3500 ppb. For seven of the nine tests, no statistically significant effect on the test organisms was observed even at the highest WAF concentration used in the testing (denoted with the symbol # in Table 6-8).

Based on these ecotoxicology tests, a conservative threshold of 500 ppb has been adopted. This 500 ppb threshold is below the lowest NOEC for the most sensitive organism tested. These thresholds are calculated based on exposure of organisms to dissolved aromatic hydrocarbons for periods of 1 to 96 hours and are, therefore, conservative when used for instantaneous contact.

Table 6-8: Summary of Total Petroleum Hydrocarbons (TPH) NOECs for key life histories of different biota based on Toxicity tests for WAF of marine diesel (ESA 2013)

Biota and life stage	Exposure duration	NOEC TPH (ppb)
Sea urchin fertilisation	1 hours	3500 #
Sea urchin larval development	72 hours	3500 #
Milky oyster larval development	48 hours	3500 #
Micro-algal growth test	72 hours	520
Macro-algal (kelp) germination test	72 hours	2530 #
Rock oyster larval spat	48 hours	3500 #
Amphipod juvenile survival	96 hours	520
Copepod juvenile survival	48 hours	2530 #
Larval fish imbalance test	96 hours	2530 #

Lowest-observable-effect concentration (LOEC) was not reached during test.

6.7.1.5 Entrained Hydrocarbon Threshold Concentrations

The spill modelling outputs are used to define the EMBA by defining the spatial variability of entrained hydrocarbons above a set concentration threshold contacting sensitive receptors (expressed in ppb).

Entrained hydrocarbons present a number of possible mechanisms for toxic exposure to marine organisms. The entrained hydrocarbon droplets may contain soluble compounds, hence have the potential for generating elevated concentrations of dissolved aromatic hydrocarbons (e.g. if mixed by breaking waves against a shoreline). Physical and chemical effects of the entrained hydrocarbon droplets have also been demonstrated through direct contact with organisms; for example, through physical coating of gills and body surfaces and accidental ingestion (National Research Council, 2005).

Condensate

The condensate threshold concentration value for entrained hydrocarbons (i.e. 100 ppb) is considered conservative and has been set with reference to the entrained exposure values detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), and in context of ecotoxicity tests results from Balnaves-3 crude oil, as a suitable surrogate for Julimar condensate (see above).

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for WAF of oil hydrocarbons (Table 6-7). However, it is likely this data specific to dissolved oil hydrocarbon represents a worst-case scenario. This is owing to the fact that entrained oil hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved hydrocarbons. The selected threshold of 100 ppb is below the NOEC for the six sensitive organisms tested in relation to dissolved hydrocarbons and is therefore considered to be conservative.

Diesel

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for WAF of hydrocarbons (Table 6-8). However, entrained hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved aromatic hydrocarbons. Therefore adoption of a threshold based on WAF toxicity data will be a conservative approach. The selected threshold of 500 ppb is below the NOEC for the seven sensitive organisms tested in relation to dissolved hydrocarbons.

The modelling of entrained hydrocarbons specifically represents the total volume of diesel predicted to be entrained under metocean conditions. As discussed above, the dissolved threshold is based on the exposure of organisms for periods of 1 to 96 hours and therefore is highly conservative when used for instantaneous contact.

6.7.1.6 Scientific Monitoring

A planning area for scientific monitoring is also described in Section 5.7 of the Oil Spill Preparedness and Response Mitigation Assessment (Appendix D). This planning area has been set with reference to the low exposure entrained value of 10 ppb detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019).

A scientific monitoring program would be activated following a Level 2 or 3 unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socio-economic) for the entire predicted EMBA and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the worst-case credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities.

6.7.2 Accidental Hydrocarbon Release: Loss of Well Integrity

Context		
Drilling activities – Section 3.8	Physical environment – Section 4.4 Biological environment – Section 4.5 Socio-economic environment – Section 4.6 Values and sensitivities – Section 4.7	Stakeholder consultation – Section 5

Impacts and Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Loss of hydrocarbons to marine environment due to loss of well integrity		X	X	X	X	X	X	C	B	2	**H**	LCS GP PJ RBA CV SV	Acceptable if ALARP	EPO 10

Description of Source of Risk

Loss of Well Integrity – Background

Woodside has identified a well blowout as the scenario with the worst case credible environmental outcome as a result of loss of well integrity. A blowout is an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers (e.g. the BOP) or activation of the same have failed.

Industry Experience

A risk assessment by AMSA of oil spills in Australian ports and waters (Det Norske Veritas, 2011) concluded that:

- overall national exceedance frequency for oil spills from offshore drilling in Australia is 0.033 for spills >1 tonne/year decreasing to 0.008 for spills >100 tonnes/year (Det Norske Veritas, 2011)
- the estimated blow-out probability adopted for drilling and completing a development well is 2.5 × 10-4 per well (Det Norske Veritas, 2011). This is based on data from the Gulf of Mexico, United Kingdom and Norway from 1980–2004, including wells that had BOPs installed.

Woodside has a good history of implementing industry standard practice in well design and construction. In the company's 60 year history, it has not experienced any well integrity events that have resulted in significant releases or significant environmental impacts.

Therefore, in accordance with the Woodside Risk Matrix, a loss of well integrity and resulting blowout event corresponds to an 'unlikely' event as it has occurred many times in the industry, but not in the Company.

Drilling Timeframe

Drilling is scheduled to occur at any time throughout the year (all seasons), to provide operational flexibility for requirements and schedule changes and vessel/MODU availability.

Credible Scenario – Loss of Well Integrity

The Petroleum Activities Program consists of one exploration well. Woodside identified the worst case credible spill scenario for a well blowout to be an uncontrolled surface release for five days, when the MODU would provide a conduit to the surface for the uncontrolled flow, followed by a 56 day uncontrolled seabed release as the MODU would no longer be present to provide a conduit.

The MODU would no longer be present after five days for the following reasons:

- In a non-explosion scenario, the MODU is likely to be moved off location as soon as is practicable to prevent escalation and further harm to personnel.

- In an explosion scenario, the MODU is expected to sink due to an anticipated compromise in structural integrity and stability after a period of time. The most recent example of a similar scenario is the Deepwater Horizon incident, when the semi-submersible MODU sank after 36 hours following the uncontrolled loss of well control in the Gulf of Mexico in April 2010. Noting that the MODU used in the Deepwater Horizon event is comparable in size, weight and capability to the MODUs that will conduct well construction activities.
- Studies of the North Sea and US Gulf of Mexico Outer Continental Shelf events support that the majority of blowout durations are less than five days (Holland, 1997).

The 61-day release duration assumes the maximum depth of the hydrocarbon reservoir would be open and takes into account the estimated time to drill a relief well under the Mutual Aid Memorandum of Understanding (MoU) (discussed further in Appendix D).

A number of Woodside procedures were followed to identify credible spill scenarios, including spill duration. The process followed is outlined in Figure 6-1, with a breakdown of timeframes and justification for the reduced relief well drill time provided in Table 6-9.

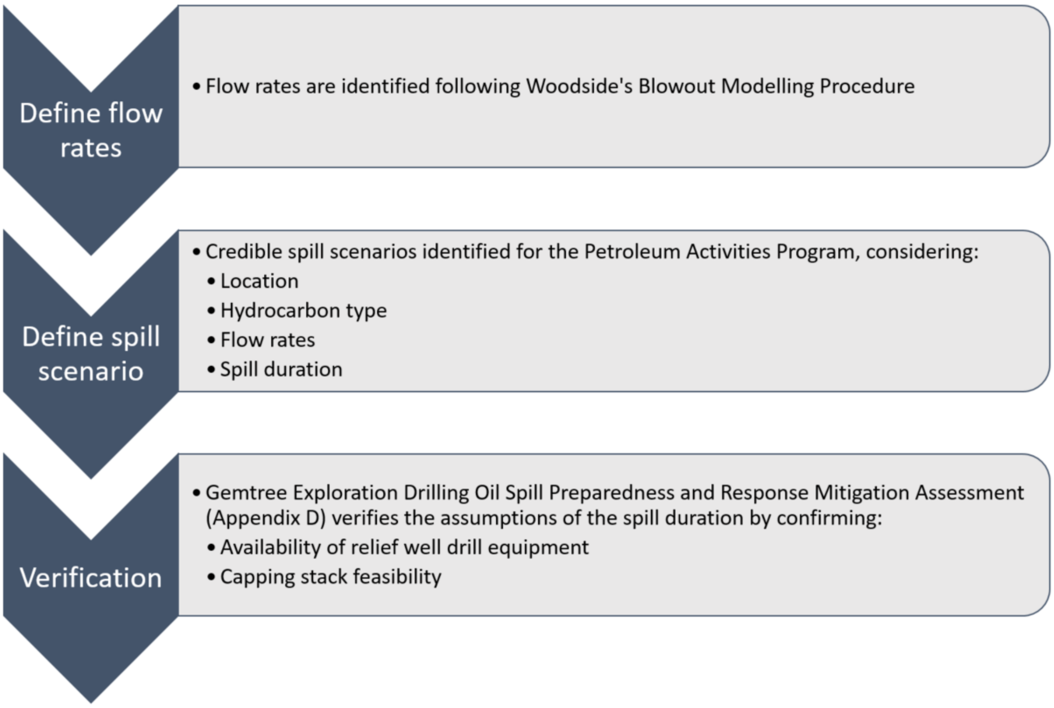

Figure 6-1: Credible oil spill scenario identification process

Table 6-9: Relief well drill times

Phase	Description	Time for completion (days)
Mobilisation	Sourcing a MODU through APPEA MoU and mobilisation	21
Mooring	Mooring of the MODU	3
Drill relief well	Drilling of relief well	23
Intersect and kill	Relief well intersects uncontrolled well, kills well, ceasing release of hydrocarbons	14
	Total days	**61 days**

Blowout Volume

Woodside has determined that a blowout from the Gemtree-A exploration well location could have an estimated volume of approximately 87,400 m^3. This volume is calculated based on an estimated release rate and time to drill a relief well, considering well characteristics including total vertical depth and time to mobilise a relief MODU.

Quantitative Spill Risk Assessment – Well Blowout

Spill modelling was performed by RPS, on behalf of Woodside, to determine the fate of hydrocarbon released for the 61 day blowout scenario at the Gemtree-A exploration well location, based on the assumptions in Table 6-10. RPS performed the modelling based on a volume of approximately 90,114 m³.

The 90,114 m³ was based on the original reservoir calculations however during the modelling process it was determined that the actual worst case volume was 87,400 m³, based on revised calculations. Modelling was not updated, as the original calculations resulted in a larger release volume. The 90,114 m³ is conservative and allows an assessment of the potential environmental consequences in the event of a well blow out.

Table 6-10: Summary of modelled credible scenario – well blowout

	Loss of well integrity
Total discharge[25] at surface	5 days 8035 m³
Total discharge at seabed	56 days 82,079 m³
Water depth	201 m
Fluid	Julimar condensate

Hydrocarbon Characteristics

Julimar condensate was selected as the representative hydrocarbon for the Gemtree-A exploration well proposed under this EP (Section 6.7.1).

Julimar Condensate (API 47.9) contains a low proportion (0.4% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 48.8% of the condensate mass should evaporate within the first 12 hours (BP <180 °C); a further 21.3% should evaporate within the first 24 hours (180 °C < BP <265 °C); and a further 29.5% should evaporate over several days (265 °C < BP <380 °C). The whole condensate has low asphaltene content (<0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Weathering processes under realistic variable wind conditions are illustrated in the example mass balance weathering graph for a discrete spill of 50 m³ of Julimar condensate released at the surface, which is considered informative for this scenario (Figure 6-2). The graph demonstrates that the majority of evaporation would take place within the first 24 hours, with about 64% of the released hydrocarbons expected to evaporate after seven days. Under these conditions, a large proportion of remaining hydrocarbons is expected to entrain, with less than 1% persisting on the sea surface after 24 hours. During calm conditions, 74% of hydrocarbons are predicted to evaporate within 24 hours and 92% evaporation after seven days, with negligible levels of entrainment.

[25] The discharge volumes in Table 6-10 are predicted using reservoir modelling software packages that consider a number of factors (well design, reservoir properties and environmental conditions such as water depth, temperature and pressure) to provide a production profile over the oil spill modelling period.

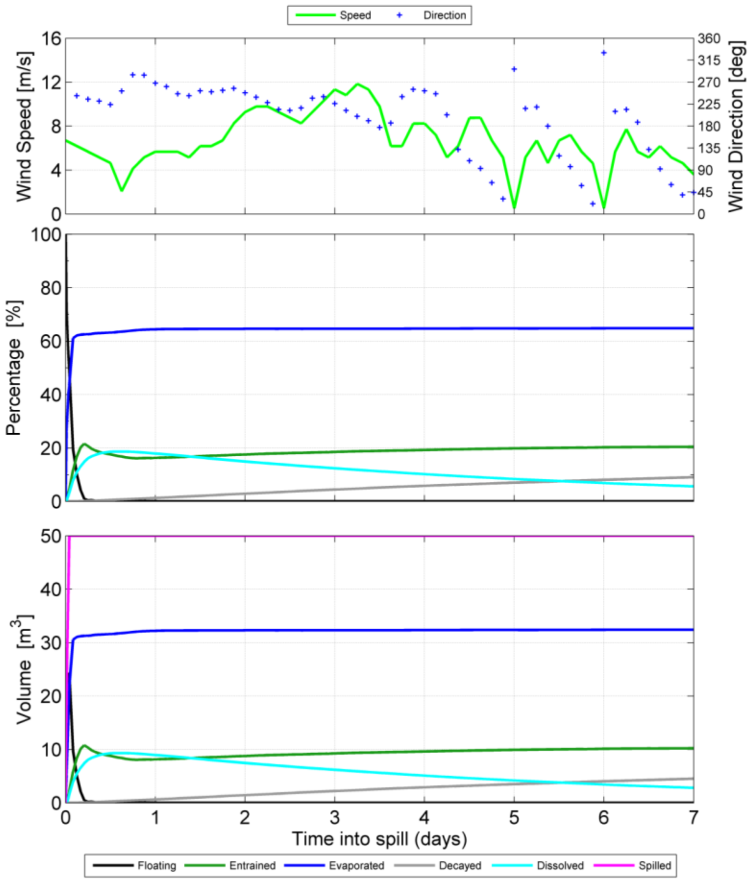

Figure 6-2: Proportional mass balance plot representing the weathering of 50 m³ from a surface spill of Julimar condensate spilled onto the water surface and subject to variable wind at 27 °C water temperature and 25 °C air temperature

Subsea Plume Dynamics

The well blowout surface/subsea release that has been modelled forecasts the size of the hydrocarbon droplets that would be released from the well as determined by the OILMAP model. Table 6-11 summarises the results of the OILMAP modelling for the well blowout.

Table 6-11: Range of assumed inputs and range of calculated outputs, by OILMAP model for the surface/subsea well loss of containment

	Variable	Julimar condensate
Assumed discharge	Release depth (m)	Surface (initial) 201 m (seabed release phase)
	Hydrocarbon temp (C°)	53.3 - 65.0°C
	Gas:condensate ratio (scf/bbl)	~ 147,918
	Hydrocarbon flow rate (bbl/day)	956–1,669
	Diameter of exit hole (m)	0.3 m
Calculated gas plume dynamics	Plume diameter (m)	25.9 m
	Plume trapping height (m ASB)	200 m (surface)
Calculated droplet size distribution (week 1)	20% droplets of size (µm)	59.75 µm
	20% droplets of size (µm)	87.25 µm
	20% droplets of size (µm)	113.41 µm
	20% droplets of size (µm)	147.41 µm
	20% droplets of size (µm)	215.25 µm

The results of the OILMAP simulation predict that the discharge will generate a cone of rising gas that will entrain the hydrocarbon droplets and ambient sea water up to the water surface. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of around 14 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and hydrocarbon at the point of surfacing is predicted to be about 26 m.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate relatively small hydrocarbon droplets between 57 µm and 369 µm in diameter. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. Therefore, despite reaching the surface due to the lift produced by the rising plume, the droplets will then tend to remain within the wave-mixed layer of the water column (3-10 m deep, depending on the conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of the response operations at or near the blowout site.

Impact Assessment

Potential Impacts Overview

Environment that May Be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling which compiles data from 100 hypothetical worst-case spill simulations under a variety of weather and metocean conditions (as described in Section 6.7.1). The EMBA therefore covers a larger area than the area that would be affected during any single spill event, and therefore represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs. The trajectory of a single spill would have a considerably smaller footprint.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is discussed for each fate.

Surface Hydrocarbons: Quantitative hydrocarbon spill modelling result outputs for surface hydrocarbons are shown in Table 6-12. If this scenario occurred, a surface hydrocarbon slick would form down-current of the well site, with the trajectory dependent on prevailing wind and current conditions at the time. The slick is likely to drift in north-easterly and south-westerly directions. The modelling indicates the EMBA for surface hydrocarbons up to 10 g/m^2 would be restricted to Commonwealth waters in the open ocean, and may extend for up to 33 km from the release site. The modelling did not predict contact by surface hydrocarbons above 10 g/m^2 for any sensitive receptor due to the rapid weathering (evaporation/entrainment) of the hydrocarbon, as shown in Table 6-12.

A wider socio-cultural EMBA for surface hydrocarbons is defined by the threshold for visible surface hydrocarbons of 1 g/m^2. The socio-cultural EMBA for surface hydrocarbons may extend up to about 102 km from the release site and may reach the Montebello AMP, with a probability of 10% after 32 hours.

Entrained Hydrocarbons: Quantitative hydrocarbon spill modelling results for entrained hydrocarbons are shown in Table 6-12. If the loss of well integrity scenario occurred, entrained hydrocarbons are forecast to potentially drift in all directions, with the most likely directions of travel being to the north-east and south-west of the release site. The entrained hydrocarbon EMBA above the 100 ppb threshold concentration is predicted to occur to a maximum water depth of about 50 m and extend up to a maximum of about 526 km from the release site (<1% probability). Contact by entrained hydrocarbons at concentrations equal to or greater than 100 ppb is predicted at the Montebello AMP (61% probability) and Gascoyne AMP (35% probability), as well as several other receptors with probabilities less than 20% (refer to Table 6-12). The maximum entrained hydrocarbon concentration forecast for any receptor is predicted as 2.7 ppm (2,760 ppb) at the Montebello AMP.

Dissolved Aromatic Hydrocarbons: Quantitative hydrocarbon spill modelling results for dissolved aromatic hydrocarbons are shown in Table 6-12. If the loss of well integrity scenario occurred, dissolved hydrocarbons are forecast to potentially drift in all directions, with the most likely direction of travel being to the south-west of the release site. The modelling indicates the EMBA may extend for up to about 345 km. Contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 50 ppb is predicted at Montebello AMP (41% probability), as well as several other receptors with probabilities of less than 10% (refer to Table 6-12). The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 633 ppb at Montebello AMP.

Accumulated Hydrocarbons: No receptors are predicted to be contacted by shoreline hydrocarbons at or above the 100 g/m2 threshold.

Single-Trajectory (Deterministic) Modelling

In addition to the stochastic modelling, single-trajectory (deterministic) modelling was performed to assess potential worst-case trajectories based on the stochastic modelling runs. Deterministic simulations were performed to represent the fastest time to shoreline contact and the largest volume ashore from a single model run. Full results of the deterministic modelling are presented in Appendix D.

Summary of Potential Impacts

Table 6-12 presents the full extent of the EMBA (including socio cultural EMBA for surface hydrocarbons); i.e. the sensitive receptors and their locations that may be exposed to hydrocarbons (surface, entrained, dissolved and

accumulated) at or above the set threshold concentrations in the unlikely event of a major hydrocarbon release from a loss of well integrity during the Petroleum Activities Program. Details of these receptors are outlined in Section 4. The potential biological and ecological impacts of an unplanned hydrocarbon release as a result of a loss of well integrity during the Petroleum Activities Program are presented in the following sections.

Table 6-12: Probability of hydrocarbon spill contact above impact thresholds within the EMBA with key receptor locations and sensitivities for a 61 day subsea blowout of Julimar condensate

Environmental setting	Location/name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions in Woodside's Risk Management Procedure																													Probability of hydrocarbon contact (condensate) (%) Note: the probability is based on stochastic modelling of 300 hypothetical worst-case spills under a variety of weather and metocean conditions				
		Physical		Biological																						Socio-economic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities/Habitats								Protected Species									Other Species											
		Open water (pristine)	Marine sediment (pristine)	Coral reef	Seagrass beds/macroalgae	Mangroves	Spawning/nursery areas	Open water – productivity/ upwelling	Non-biogenic coral reefs	Offshore filter feeders and/or deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries/tributaries/creeks/ lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Seasnakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident/demersal fish	Fisheries – commercial	Fisheries – traditional	Tourism and recreation	Protected areas/heritage – European and Indigenous/shipwrecks	Offshore oil & gas infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²)	Surface hydrocarbon (1 to 10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥50 ppb)	Accumulated hydrocarbons (>100 g/m²)
Offshore[26]	Argo-Rowley Terrace AMP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓				4		
	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓*			10	61	41	
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			35	4	
	Ningaloo AMP	✓						✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓				13		
Submerged shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓						5	
Islands	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				4	1	
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			8	1	
	Lowendal Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓				8	1	
	Muiron Islands (including WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓				16	1	

[26] Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent

Environmental setting	Location/name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions in Woodside's Risk Management Procedure																													Probability of hydrocarbon contact (condensate) (%) Note: the probability is based on stochastic modelling of 300 hypothetical worst-case spills under a variety of weather and metocean conditions				
		Physical		Biological																						Socio-economic and Cultural									
		Water Quality	*Sediment Quality*	*Marine Primary Producers*			*Other Communities/Habitats*								*Protected Species*									*Other Species*											
		Open water (pristine)	*Marine sediment (pristine)*	*Coral reef*	*Seagrass beds/macroalgae*	*Mangroves*	*Spawning/nursery areas*	*Open water – productivity/ upwelling*	*Non-biogenic coral reefs*	*Offshore filter feeders and/or deepwater benthic communities*	*Nearshore filter feeders*	*Sandy shores*	*Estuaries/tributaries/creeks/ lagoons (including mudflats)*	*Rocky shores*	*Cetaceans – migratory whales*	*Cetaceans – dolphins and porpoises*	*Dugongs*	*Pinnipeds (sea lions and fur seals)*	*Marine turtles (including foraging and internesting areas and significant nesting beaches)*	*Seasnakes*	*Whale sharks*	*Sharks and rays*	*Sea birds and/or migratory shorebirds*	*Pelagic fish populations*	*Resident/demersal fish*	*Fisheries – commercial*	*Fisheries – traditional*	*Tourism and recreation*	*Protected areas/heritage – European and Indigenous/shipwrecks*	*Offshore oil & gas infrastructure (topside and subsea)*	Surface hydrocarbon (≥10 g/m²)	Surface hydrocarbon (1 to 10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥50 ppb)	Accumulated hydrocarbons (>100 g/m²)
	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓				10	1	
	Ningaloo Coast (North, Middle, South; WHA and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				13	1	

Summary of Potential Impacts to Environmental Values	
Summary of Potential Impacts to Protected Species	
Setting	**_Marine Mammals_** *The sections below describe potential impacts to cetaceans and dugong in offshore and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity.*
Offshore, Oceanic Reefs and Islands	**Cetaceans:** Marine mammals that have direct physical contact with surface, entrained or dissolved aromatic hydrocarbons may suffer surface fouling, ingestion of hydrocarbons (from prey, water and sediments), aspiration of oily water or droplets, and inhalation of toxic vapours (DWH Natural Resource Damage Assessment Trustees, 2016). This may result in the irritation of sensitive membranes such as the eyes, mouth, digestive and respiratory tracts and organs, impairment of the immune system, neurological damage (Helm et al., 2015), reproductive failure, adverse health effects (e.g. lung disease, poor body condition) and potentially mortality (DWH Natural Resource Damage Assessment Trustees, 2016). In a review of cetacean observations relating to a number of large scale hydrocarbon spills, Geraci (1988) found little evidence of mortality associated with hydrocarbon spills. However, it was concluded that exposure to oil from the DWH resulted in increased mortality to cetaceans in the Gulf of Mexico (DWH Natural Resource Damage Assessment Trustees, 2016). Geraci (1988) did identify behavioural disturbance (i.e. avoiding spilled hydrocarbons) in some instances for several species of cetacean, suggesting that cetaceans have the ability to detect and avoid surface slicks. However, observations during spills have recorded larger whales (both mysticetes and odontocetes) and smaller delphinids travelling through and feeding in oil slicks. During the DWH spill, cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al., 2017). Impacts to cetaceans will depend on the exposure pathway; with exposure to entrained hydrocarbons and surface slicks not expected to result in significant impacts due to the relatively volatile, non-persistent nature of the hydrocarbons. Direct toxic effects from external exposure are not expected to occur, although mucous membranes and eyes may become irritated. Indirect toxic effects, such as hydrocarbon ingestion through accumulation in prey, may occur. Baleen whales feeding within entrained hydrocarbon plumes may ingest hydrocarbons, potentially resulting in toxic effects (particularly fresh hydrocarbons near the release location). This is expected to be limited in migrating baleen whales, such as pygmy blue and humpback whales, which are known to primarily feed in the Southern Ocean (although may opportunistically feed during migrations). A range of cetaceans were identified as potentially occurring within the Operational Area and EMBA (Section 4.5.2). In the event of a well blowout, surface, entrained and dissolved hydrocarbons exceeding threshold concentrations may drift across habitat for oceanic cetacean species and the migratory routes and BIAs of cetaceans considered to be MNES (Section 4.5.2), including humpback whales and pygmy blue whales (northbound and southbound migrations). Pygmy blue whales and humpback whales are known to migrate seasonally through the potential spill-affected area for surface, dissolved and entrained hydrocarbons (Section 4.5.2). A major spill in May to November would coincide with humpback whale migration through the waters off the Kimberley, Pilbara, North West Cape (Ningaloo) and Shark Bay (open ocean). A major spill in April to August or October to January would coincide with pygmy blue whale migration. Passive acoustic monitoring and satellite tagging suggest that pygmy blue whales migrate in offshore waters in the region of the Operational Area in about 200 m to more than 1000 m of water (refer to Section 4.5.2). The pygmy blue whale migration BIA overlaps the Operational Area; and the humpback whale migration BIA within the EMBA may be overlapped by a worst-case hydrocarbon spill. Feeding during migrations is generally low level and opportunistic, reducing the potential for ingestion of hydrocarbons. Sub-lethal impacts from external exposure are therefore more likely. However, it is noted that there is a BIA for pygmy blue whale foraging off Ningaloo Reef/North West Cape. The Blue Whale Conservation Management Plan 2015–2025 (Commonwealth of Australia, 2015a) describes this BIA as a possible foraging area. There is potential for these waters to be contacted by entrained (13% probability) and dissolved (1% probability) hydrocarbons above the threshold values. Although, any hydrocarbons that may reach this area will be in an advanced state of weathering and at concentrations typically associated with impacts to only the most sensitive marine organisms. Migrations of both pygmy blue whales and humpback whales are protracted through time and space (i.e. the whole population will not be within the EMBA), and as such, a spill from the loss of well integrity is unlikely to affect an entire population. Cetacean populations that are resident within the potential EMBA may be susceptible to impacts from spilled hydrocarbons if they interact with an area affected by a spill. Such species are more likely to occupy coastal waters (refer to the *Mainland and Islands* section below for more information). Impacts from physical contact with hydrocarbons are likely to be in the form of irritation and sub-lethal biological effects (e.g. skin irritation, reproductive failure) and in rare circumstances, death. Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins (e.g. spinner dolphin) is broadly distributed

	throughout the region and as such, impacts from the spatial extent of a single spill trajectory (as opposed to the full EMBA) are unlikely to affect an entire population. Other species identified in Section 4.5.2 may also have possible transient interactions with the EMBA (refer Table 6-12 for the list of receptor locations important for cetaceans). Physical contact with hydrocarbons to these species may result in biological consequences. However, it is noted spilled hydrocarbon is expected to weather quickly beyond the release location, thereby reducing the potential for impact with increasing distance. Based on the assessment above, a loss of well integrity resulting in a well blowout could disrupt a considerable number of migrating humpback or pygmy blue whales, or other cetaceans. Such disruption could include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and, in rare circumstances, death. Given that impacts are expected to be largely sub-lethal, such disruptions or impacts are not predicted to impact on the overall population viability of cetaceans within offshore waters of the EMBA.
Mainland and Islands (Nearshore Waters)	**Cetaceans and Dugongs:** In addition to a number of whale species that may occur in nearshore waters, coastal populations of small cetaceans (such as spotted bottlenose dolphins and Indo-Pacific humpback dolphins) and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands and the Pilbara Southern Island Groups (see Table 6-12), which may be potentially impacted by entrained hydrocarbons exceeding threshold concentrations in the event of a loss of well integrity. Refer to Section 4.5.2 and Table 4-3 for the full list of EPBC listed cetacean species identified by the Protected Matters Search Tool with potential to occur within the EMBA. BIAs for dugong and cetaceans that overlap with the EMBA are outlined in Section 4.5.2. Exmouth Gulf is a known humpback whale aggregation areas during their annual southern migration (September to December); therefore, humpbacks moving into this area may be exposed to hydrocarbons above threshold levels. Surface, hydrocarbons concentrations above thresholds are not expected anywhere near the coast, including Exmouth Gulf. No hydrocarbon contact at or above threshold concentrations for surface, dissolved or entrained hydrocarbons is expected for Camden Sound, an important calving area for humpback whales. The potential impacts of exposure are as discussed above in *Offshore – Cetaceans*. However, nearshore populations of cetaceans and dugongs are known to exhibit site fidelity and are often resident populations. The potential for sustained exposure may therefore be greater. In the Gulf of Mexico, nearshore bottlenose dolphins experienced mortality, reproductive failure and adverse health effects at higher levels than those of oceanic stocks (DWH Natural Resource Damage Assessment Trustees, 2016) during the DWH spill. Additional environment impacts also include the potential for dolphins to ingest hydrocarbons when feeding on contaminated prey (fish and shellfish) or through contact with contaminated sediments. Dugongs may ingest hydrocarbons when feeding on oiled seagrass. There are also potential indirect impacts to dugongs due to loss of this food source as a result of dieback in worse affected areas. Therefore, a hydrocarbon spill may have an impact on feeding habitats and disrupt a considerable portion of the local population. However, it is noted that hydrocarbons reaching these environments will be highly weathered, with volatile and water soluble (often the most toxic components) expected to have dissipated before reaching nearshore waters. Potential impacts on coastal cetaceans and dugong in the area affected by a spill could be major in the unlikely event of a loss of well control. A loss of well integrity resulting in a well blowout could disrupt a considerable number of coastal cetaceans or dugong. As described above, impacts are expected to be largely sub-lethal and are therefore not predicted to impact on the overall population viability of cetaceans or dugong within coastal waters of the EMBA.
Setting	**Marine Reptiles** *The sections below describe potential impacts to marine turtles and sea snakes in offshore, submerged shoals and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Marine Turtles:** Adult turtles exhibit no avoidance behaviour when they encounter hydrocarbon slicks (NOAA, 2010). Contact with surface slicks, or entrained hydrocarbon, can therefore result in hydrocarbon adherence to body surfaces (Gagnon & Rawson, 2010) irritating mucous membranes in the nose, throat and eyes leading to inflammation and infection (NOAA, 2010). Oiling can result in ingestion of hydrocarbons; indicators of polycyclic aromatic hydrocarbons (PAH) were higher in tissues, stomach content, colon content and faeces of visibly oiled turtles compared to non-visibly oiled turtles (Ylitalo et al., 2017). A stress response associated with this exposure pathway includes an increase in the production of white blood cells, and even a short exposure to hydrocarbons may affect the functioning of their salt gland (Lutcavage et al., 1995). Oiling can result in mortality depending on the extent of oiling and the size of the marine turtle (DWH Natural Resource Damage Assessment Trustees, 2016). Hydrocarbons in surface waters may also impact turtles when they surface to breathe and inhale toxic vapours. Their breathing pattern, involving large ‘tidal’ volumes and rapid inhalation before diving,

	results in direct exposure to petroleum vapours which are the most toxic component of the hydrocarbon spill (Milton & Lutz, 2003). This can lead to lung damage and congestion, interstitial emphysema, inhalant pneumonia and neurological impairment (NOAA, 2010). Contact with entrained hydrocarbons can result in hydrocarbon adhering to body surfaces (Gagnon & Rawson, 2010), irritating mucous membranes in the nose, throat and eyes leading to inflammation and infection (Gagnon & Rawson, 2010). The Petroleum Activities Program may coincide with the nesting season for marine turtles in the region. Due to the absence of potential nesting habitat and location offshore, the Operational Area is unlikely to represent important habitat for marine turtles. However, turtles may be present transiting through the Operational Area and foraging within the EMBA. The EMBA overlaps with habitat critical to the survival of flatback turtles for internesting and BIAs identified in Section 4.5.2, particularly the internesting BIAs for flatback turtles which extend for ~80 km from known nesting locations. The Operational Area also overlaps with an internesting BIA for flatback turtles and designated habitat critical to the survival of flatback turtles for internesting at the Montebello Islands (with peak nesting in December and January). However, it is noted that the BIA and habitat critical to the survival of flatback turtles are considered very conservative as they are based on the maximum range of internesting females and many turtles are more likely to remain near their nesting beaches. In the event of a loss of well integrity, there is a potential that surface, entrained and dissolved hydrocarbons exceeding impact threshold concentrations (10 g/m^2, 100 ppb and 50 ppb respectively) will be present in offshore waters extending up to 33 km, 526 km and 345 km, respectively, from the release site. It is therefore not expected to form surface slicks in areas where turtles are likely to occur in high densities (e.g. near nesting areas, foraging habitat, etc.). Inhalation of harmful concentrations of hydrocarbon vapour by turtles is therefore expected to be limited. Furthermore, toxicity of hydrocarbons will be significantly reduced by weathering at such distances, with the volatile and water soluble (often the most toxic) components expected to have dissipated beyond the vicinity of the spill site. A hydrocarbon spill has the potential to result in sub-lethal and lethal impacts to turtles in offshore waters over a wide area in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of marine turtle populations in the broader region. Potential impacts to internesting marine turtles are discussed in the *Mainland and Islands (nearshore)* impacts discussion below. **Seasnakes:** Impacts to seasnakes from direct contact with hydrocarbons are likely to result in similar physical effects to those recorded for marine turtles and may include potential damage to the dermis and irritation to mucus membranes of the eyes, nose and throat (International Tanker Owners Pollution Federation (ITOPF), 2011). They may also be impacted when they return to the surface to breathe and inhale the toxic vapours associated with the hydrocarbons, damaging their respiratory system. In general, seasnakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals (water depths <100 m; see *Submerged Shoals* below). While individuals may be present in the offshore oceanic waters, their abundance is not expected to be high, given the deep water and offshore location of the activity. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population in offshore oceanic waters.
Submerged Shoals	**Marine Turtles:** There is the potential for marine turtles to be present at submerged shoals such as Rankin Bank. Rankin Bank may be contacted by dissolved hydrocarbons above impact thresholds but with a very low probability (5%). A hydrocarbon spill is therefore expected to result in sub-lethal effects with a minor disruption to a portion of the population (see *Offshore* section above). **Seasnakes:** There is the potential for seasnakes to be present at submerged shoals such as Rankin Bank. The potential impacts of exposure are as discussed previously in *Offshore – Seasnakes*. A hydrocarbon spill may have a minor disruption to a portion of the population.
Mainland and Islands (Nearshore Waters)	**Marine Turtles:** Several marine turtle species use nearshore waters and shorelines for foraging and breeding (including internesting), with significant nesting beaches along the mainland coast and islands in potentially impacted locations such as the Ningaloo Coast, Muiron Islands, Montebello/Barrow/ Lowendal Islands, Pilbara Islands (Southern Island Groups). There are distinct breeding seasons as detailed in Section 4.5.2. The nearshore waters of these turtle habitat areas may be exposed to entrained hydrocarbons exceeding threshold concentrations, with a low probability (4 to 16%). No shoreline accumulation of hydrocarbons above the impact threshold of 100 g/m^2 is predicted by the modelling. The potential impacts of exposure are as discussed previously in *Offshore – Marine Turtles*. In the nearshore environment, turtles can ingest hydrocarbons when feeding (e.g. on oiled seagrass stands/macroalgae) or can be indirectly affected by loss of food source (e.g. seagrass due to dieback from hydrocarbon exposure) (Gagnon & Rawson, 2010). In addition, hydrocarbon exposure could impact turtles during the breeding season near nesting beaches. If entrained hydrocarbons reach

	internesting coastal waters (refer to Table 6-12 for receptor locations), there is the potential for impacts to turtles using the affected area. Animals that lay eggs have been shown to pass metabolised oil related compounds into their offspring which has the potential to be toxic to the developing embryos. Similarly, adult female turtles can pass metabolised oil and related products to their eggs, thereby potentially exposing developing embryos and impairing the development and survival of embryos (DWH Natural Resource Damage Assessment Trustees, 2016). During the breeding season, turtle aggregations near nesting beaches within the EMBA are most vulnerable due to greater turtle densities. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of marine turtle populations in the wider region. **Seasnakes:** As discussed previously (see '*Submerged Shoals – Seasnakes*') impacts to seasnakes for the mainland and island nearshore waters (including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands and Southern Pilbara Island Groups) from direct contact with hydrocarbons may occur but there is expected to be no threat to overall population viability.
Setting	**Sharks and Rays** *The sections below describe potential impacts to sharks and rays in offshore, submerged shoals and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Sharks (including Whale Sharks) and Rays:** Hydrocarbon contact may affect whale sharks through ingestion (entrained/dissolved hydrocarbons), particularly if feeding. Whale sharks may transit offshore open waters, including the Operational Area, when migrating to and from Ningaloo Reef (Figure 4-14), where they aggregate for feeding from March to July (see *Mainland and Islands (Nearshore Waters)* below). Whale sharks may also opportunistically feed in offshore waters and the EMBA overlaps the whale shark migration BIA identified in Section 4.5.2. Whale sharks are seasonally present within the BIA between April and October and the EMBA overlaps an aggregation area at Ningaloo. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman & Wilson, 2004). Therefore, individual whale sharks that have direct contact with hydrocarbons within the spill-affected area may be impacted. Impacts to sharks and rays (including giant manta rays) may occur through direct contact with hydrocarbons and contaminate the tissues and internal organs, either through direct contact or via the food chain (consumption of prey). As gill breathing organisms, sharks and rays may be vulnerable to toxic effects of dissolved hydrocarbons (entering the body via the gills) and entrained hydrocarbons (coating of the gills, inhibiting gas exchange). The potential impacts are expected to vary depending on the weathered state of the hydrocarbon. In the offshore environment, it is probable that pelagic shark species are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Therefore, any impact on sharks and rays is predicted to be minor and localised.
Submerged Shoals	**Sharks and Rays:** There is the potential for resident shark and ray populations to be impacted directly by hydrocarbon contact or indirectly through contaminated prey or loss of habitat. Spill model results indicate a low probability (5%) of potential impacts to the benthic communities of Rankin Bank from dissolved hydrocarbons, which may host shark and ray populations along with Glomar Shoal (156 km from the Operational Area)[27]. Pelagic and transient sharks and rays are expected to move away from areas affected by spilled hydrocarbons. Impacts to such species are expected to be limited to behavioural responses/ displacement. Shark and ray species that have associations with submerged shoals and oceanic atolls may not move in response to such habitat being contacted by spilled hydrocarbons. Such species may be more susceptible to a reduction in habitat quality resulting from a hydrocarbon spill. Impacts to sharks and rays at Rankin Bank are likely to be localised. Surface and entrained hydrocarbons above threshold levels are not expected to reach this area, and dissolved hydrocarbons will have experienced considerable weathering.
Mainland and Islands (Nearshore Waters)	**Sharks and Rays:** Whale sharks and manta rays are known to frequent the Ningaloo Reef system and the Muiron Islands (and form feeding aggregations in late summer/autumn). Whale sharks and manta rays generally transit along the nearshore coastline and are vulnerable to surface, entrained and dissolved aromatic hydrocarbon spill impacts, with both taxa having similar modes of feeding. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman & Wilson, 2004). Whale sharks at Ningaloo Reef have been observed using two different feeding strategies, including passive sub-surface ram-feeding and active surface feeding (Taylor, 2007). Passive feeding consists of swimming slowly at the surface

[27] While Glomar Shoal was not predicted to be contacted by hydrocarbons above threshold values in the stochastic modelling, it is included in the EMBA given its close proximity to predicted spill extents for entrained and dissolved hydrocarbons.

	with the mouth wide open. During active feeding, sharks swim high in the water with the upper part of the body above the surface and the mouth partially open (Taylor, 2007). These feeding methods would result in the potential for individuals that are present in worse affected spill areas to ingest potentially toxic amounts of surface, entrained or dissolved aromatic hydrocarbons into their body. Large amounts of ingested hydrocarbons may affect their endocrine and immune system in the longer term. The presence of hydrocarbons may displace whale sharks from the area where they normally feed and rest, and potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by surface, entrained or dissolved aromatic hydrocarbons through the contamination of their prey. The preferred food of whale sharks are fish eggs and phytoplankton which are abundant in the coastal waters of Ningaloo Reef in late summer/autumn, driving the annual arrival and aggregation of whale sharks in this area. If the spill event were to occur during the spawning season, this important food supply (in worse spill affected areas of the reef) may be diminished or contaminated. The contamination of their food supply and the subsequent ingestion of this prey by the whale shark may also result in long term impacts as a result of bioaccumulation. There is the potential for other resident shark and ray populations (e.g. sawfish species identified in Table 4-3 and Section 4.5.2) to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. However, it is probable that shark species will move away from the affected areas, although sawfish may exhibit high habitat fidelity. Table 6-12 indicates the receptor locations predicted to be impacted from entrained and/or dissolved hydrocarbons in nearshore waters and it is considered that there is the potential for habitat loss to occur. Shark populations displaced or no longer supported due to habitat loss would be expected to redistribute to other locations. Potential impacts on sharks and rays may be major and long-term in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of shark and ray populations in the wider region.
Setting	**Seabirds and Migratory Shorebirds** *The sections below describe potential impacts to seabirds and migratory shorebirds in offshore and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Seabirds and/or Migratory Shorebirds:** Offshore waters are potential foraging grounds for seabirds associated with coastal roosting and nesting habitat. There are confirmed foraging grounds off the Ningaloo coast and the Barrow/Montebello/Lowendal Island Group. There are a number of BIAs for seabirds and migratory shorebirds that overlap the EMBA, as provided in Section 4.5.2. Seabirds generally do not exhibit avoidance behaviour to floating hydrocarbons. Physical contact of seabirds with surface slicks is by several exposure pathways, primarily immersion, ingestion and inhalation. Such contact with hydrocarbons may result in plumage fouling and hypothermia (loss of thermoregulation), decreased buoyancy and potential to drown, inability to fly or feed, anaemia, pneumonia and irritation of eyes, skin, nasal cavities and mouths (AMSA, 2013; International Petroleum Industry Environmental Conservation Association (IPIECA), 2004) and result in mortality due to oiling of feathers or the ingestion of hydrocarbons. Longer term exposure effects that may potentially impact seabird populations include a loss of reproductive success (loss of breeding adults) and malformation of eggs or chicks (AMSA, 2013). The extent of the EMBA for surface hydrocarbon concentration of >10 g/m^2, as a result of a loss of well integrity, is simulated by stochastic modelling to extend about 33 km from the release location (at 1% probability and above). Therefore, a hydrocarbon spill is unlikely to disrupt a significant portion of the offshore foraging habitat for seabirds in the region.
Mainland and Islands (Nearshore Waters)	**Seabirds and/or Migratory Shorebirds:** In the unlikely event of a loss of well integrity, there is the potential for seabirds, and resident and non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to surface, entrained and dissolved hydrocarbons. This could result in lethal or sub-lethal effects. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in nearshore waters near their breeding colony, resulting in intensive feeding by higher seabird densities in these areas during the breeding season and making these areas particularly sensitive in the event of a spill. Nearshore waters of the Ningaloo Coast, Muiron Islands, Montebello/Barrow/ Lowendal Islands and Pilbara Islands (Southern Island Groups) potentially may be exposed to entrained hydrocarbons exceeding threshold concentrations, with a low probability (4 to 16%). These are identified as important nesting and resting areas (Section 4.5.2). Surface and dissolved hydrocarbons are not predicted to contact nearshore waters. Furthermore, no shoreline accumulation of hydrocarbons above the impact threshold of 100 g/m^2 is predicted by the modelling, therefore no direct oiling in these habitats is expected. Pathways of biological exposure that could result in impact may occur through ingesting contaminated fish in nearshore waters. Ingestion can lead to internal injury to sensitive membranes and organs (IPIECA, 2004). However, based on the assessment above and given the volatile and non-persistent

	nature of the hydrocarbons, a spill is unlikely to disrupt a significant portion of the foraging habitat in nearshore waters for seabirds and migratory shorebirds in the region.
Summary of Potential Impacts to Other Species	
Setting	**Pelagic and Demersal Fish**
All Settings	**Pelagic and Demersal Fish:** Fish mortalities are rarely observed to occur as a result of hydrocarbon spills (ITOPF, 2011). This has generally been attributed to the possibility that pelagic fish are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Fish that have been exposed to dissolved aromatic hydrocarbons are capable of eliminating the toxicants once placed in clean water, hence individuals exposed to a spill are likely to recover (King et al., 1996). Where fish mortalities have been recorded, the spills (resulting from the groundings of the tankers Amoco Cadiz in 1978 and the Florida in 1969) have occurred in sheltered bays (Conan, 1982; Sanders et al., 1980). Laboratory studies have shown that adult fish are able to detect hydrocarbons in water at very low concentrations, and large numbers of dead fish have rarely been reported after oil spills (Hjermann et al., 2007). This suggests that juvenile and adult fish are capable of avoiding water contaminated with high concentrations of hydrocarbons. However, sub-lethal impacts to adult and juvenile fish may be possible, given long-term exposure (days to weeks) to PAH concentrations (Hjermann et al., 2007). While modelling of the loss of well integrity indicates the potential EMBA for dissolved hydrocarbons is extensive, no time-integrated exposure metrics were modelled. Given the oceanographic environment within the EMBA, PAH exposures in the order of weeks for pelagic fish are not considered credible. The effects of exposure to oil on the metabolism of fish appears to vary according to the organs involved, exposure concentrations and route of exposure (waterborne or food intake). Oil reduces the aerobic capacity of fish exposed to aromatics in the water and to a lesser extent affects fish consuming contaminated food (Cohen et al., 2005). The liver, a major detoxification organ, appears to be the organ where anaerobic activity is most impacted, probably increasing anaerobic activity to facilitate the elimination of ingested oil from the fish (Cohen et al., 2005). Fish are perhaps most susceptible to the effects of spilled oil in their early life stages, particularly during egg and planktonic larval stages, which can become entrained in spilled oil. Contact with oil droplets can mechanically damage feeding and breathing apparatus of embryos and larvae (Fodrie & Heck, 2011). The toxic hydrocarbons in water can result in genetic damage, physical deformities and altered developmental timing for larvae and eggs exposed to even low concentrations over prolonged timeframes (days to weeks) (Fodrie & Heck, 2011). More subtle, chronic effects on the life history of fish as a result of exposing early life stages to hydrocarbons include disruption to complex behaviour such as predator avoidance, reproductive and social behaviour (Hjermann et al., 2007). Prolonged exposure of eggs and larvae to weathered concentrations of hydrocarbons in water has also been shown to cause immunosuppression and allows expression of viral diseases (Hjermann et al., 2007). 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). However, the effect of a hydrocarbon spill on a population of fish in an area with fish larvae and/or eggs, and the extent to which any of the adverse impacts may occur, depends greatly on prevailing oceanographic and ecological conditions at the time of the spill and its contact with fish eggs or larvae. Demersal fish species are associated with the Continental Slope Demersal Fish Communities KEF and Ancient Coastline at 125 m Depth Contour KEF, which provide habitat for demersal fish species. Rankin Bank and Glomar Shoal (about 55 and 156 km from the Operational Area respectively) also hosts a diverse demersal fish assemblage. Fish associated with these features may be exposed to entrained and/or hydrocarbons above impact thresholds. Mortality and sub lethal effects may impact populations located close to the well blowout and within the EMBA for entrained/dissolved aromatic hydrocarbons (≥100 ppb and 50 ppb respectively). Additionally, if prey (infauna and epifauna) surrounding the well location and within the EMBA is contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs), potentially impacting fish populations that feed on these. These impacts may result in localised medium/long term impacts on demersal fish habitat, such as the sea floor.

Summary of Potential Impacts to Marine Primary Producers	
Setting	***Receptor Group***
Submerged Shoals	The waters overlying the submerged Rankin Bank and Glomar Shoal[28] have the potential to be exposed to dissolved hydrocarbons above threshold concentrations (at or greater than 50 ppb). The permanently submerged habitats of Rankin Bank and Glomar Shoal represent sensitive open water benthic community receptors, extending from deep depths to relatively shallow water. Given the depths of these habitats, it is likely the potential for biological impact is significantly reduced when compared to the upper water column layers. However, potential biological impacts could include sub-lethal stress and in some instances total or partial mortality of sensitive benthic organisms such as corals and the early life stages of resident fish and invertebrate species. The submerged shoals are areas associated with sporadic upwelling and associated primary productivity events. Impacts to plankton communities from exposure to entrained hydrocarbons above threshold concentrations may result in short-term changes in plankton community composition but recovery would occur. Hydrocarbon contact during the spawning seasons for resident shoal community benthos and fish (meroplankton), particularly exposure to in-water toxicity effects to biota, may result in the loss of a discrete cohort population but would not affect the longer term viability of resident populations. Therefore, any impacts to resident shoal community benthos and fish (meroplankton) are likely to be localised at the shoals and temporary. Hydrocarbon exposure to offshore filter-feeding communities may occur depending on the depth of the dissolved hydrocarbons. Exposure to dissolved (aromatic) hydrocarbons (≥50 ppb) has potential to result in lethal or sub-lethal toxic effects. Sub-lethal impacts, including mucus production and polyp retraction, have been recorded for gorgonians exposed to hydrocarbon (White et al., 2012). Shoals that are exposed to dissolved hydrocarbons are expected to result in localised, potentially medium to long-term effects.
Mainland and Islands (Nearshore Waters)	**Coral Reef:** The reef communities fringing the offshore Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands Group and Pilbara Southern Islands Groups may be exposed to entrained and dissolved hydrocarbons (at or above 100 ppb and 50 ppb respectively), depending on the trajectory of the spill. Exposure may induce toxicity effects, particularly for reproductive and juvenile stages of invertebrate and fish species. The probability of exposure to these habitats above the threshold value for entrained hydrocarbons is low, ranging from 4 to 16%. The probability of exposure to dissolved hydrocarbons above the threshold concentration is 1% for all locations. Exposure to entrained and dissolved hydrocarbons above threshold concentrations has the potential to result in lethal or sub-lethal toxic effects to corals and other sensitive sessile benthos within the upper water column, including upper reef slopes (subtidal corals), reef flat (intertidal corals) and lagoonal (back reef) coral communities (with reference to Ningaloo Coast). Mortality in a number of coral species is possible and would result in the reduction of coral cover and change in the composition of coral communities. Sub-lethal effects to corals may include polyp retraction, changes in feeding, bleaching (loss of zooxanthellae), increased mucous production resulting in reduced growth rates and impaired reproduction (Negri & Heyward, 2000). This could impact the shallow water fringing coral communities/reefs of the offshore islands (e.g. Muiron Islands, Barrow/Montebello/Lowendal Islands and Pilbara Southern Island Groups) and also the mainland coast (e.g. Ningaloo Coast). With reference to Ningaloo Reef, wave-induced water circulation flushes the lagoon and may promote removal of entrained hydrocarbons from this particular reef habitat. Under typical conditions, breaking waves on the reef crest induce a rise in water level in the lagoon, creating a pressure gradient that drives water in a strong outward flow through channels. In the unlikely event of a spill occurring at the time of coral spawning at potentially affected coral locations or in the general peak period of biological productivity, there is potential for a significant reduction in successful fertilisation and coral larval survival due to the sensitivity of coral early life stages to hydrocarbons (Negri & Heyward, 2000). Such impacts are likely to result in the failure of recruitment and settlement of new population cohorts. In addition, some non-coral species may be affected via direct contact with entrained and dissolved aromatic hydrocarbons, resulting in sub-lethal impacts and in some cases mortality. This is with particular reference to the early life stages of coral reef animals (reef attached fishes and reef invertebrates), which can be relatively sensitive to hydrocarbon exposure. Coral reef fish are site-attached, have small home ranges and as reef residents they are at higher risk from hydrocarbon exposure than non-resident, more wide-ranging fish species. The exact impact on resident coral communities (which may include fringing reefs of the offshore islands and/or the Ningaloo reef system) will be entirely dependent on actual hydrocarbon concentration, duration of exposure and water depth of the affected communities.

[28] While Glomar Shoal was not predicted to be contacted by hydrocarbons above threshold values in the stochastic modelling, it is included in the EMBA given its close proximity to predicted spill extents for entrained and dissolved hydrocarbons.

	Over the worst affected sections of reef habitat, coral community live cover, structure and composition is predicted to reduce, manifested by loss of corals and associated sessile biota. Recovery of these impacted reef areas relies on coral larvae from neighbouring coral communities that have either not been affected or only partially impacted. For example, there is evidence that Ningaloo Reef corals and fish are partly self-seeding (Underwood, 2009), with the supply of larvae from locations within Ningaloo Reef of critical importance to the healthy maintenance of the coral communities. Recovery at other coral reef areas may not be aided by a large supply of larvae from other reefs, with levels of recruits after a disturbance event only returning to previous levels after the numbers of reproductive corals had also recovered (Gilmour et al., 2013). While a hydrocarbon spill has the potential for impacts to coral reefs, with medium to long-term effects (recovery >10 years) possible, the extent of impacts will depend on exposure concentration, duration and degree of weathering of hydrocarbons. Furthermore the spill modelling presented above predicts a low likelihood of contact, particularly with dissolved hydrocarbons.
	Seagrass Beds/Macroalgae and Mangroves: Spill modelling has predicted entrained and dissolved hydrocarbons (≥100 ppb and 50 ppb respectively) have the potential to contact a number of shoreline sensitive receptors such as those supporting biologically diverse, shallow subtidal and intertidal communities. The variety of habitat and communities types, from the upper subtidal to the intertidal zones, support a high diversity of marine life and are used as important foraging and nursery grounds by a range of invertebrate and vertebrate species. Depending on the trajectory of the spill, macroalgal/seagrass communities including the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), Muiron Islands (associated with limestone pavements), the Barrow/Montebello/Lowendal Islands Group and the Pilbara Southern Island Group (documented as low and patchy cover) have the potential to be exposed (see Table 6-12 for a full list of receptors within the EMBA). Seagrass in the subtidal and intertidal zones have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is generally considered much less vulnerable to hydrocarbon spills than intertidal seagrass, primarily because freshly spilled hydrocarbons float under most circumstances. Dean et al. (1998) found that oil mainly affects flowering; therefore, species that are able to spread through apical meristem growth are not as affected (such as *Zostera*, *Halodule* and *Halophila* species). Seagrass and macroalgal beds occurring in the intertidal and subtidal zone may be susceptible to impacts from entrained hydrocarbons. 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. Exposure to entrained/dissolved aromatic hydrocarbons may result in mortality, depending on actual entrained aromatic hydrocarbon concentration received and duration of exposure. Physical contact with entrained hydrocarbon droplets could cause sub-lethal stress, causing reduced growth rates and a reduction in tolerance to other stress factors (Zieman et al., 1984). Impacts on seagrass and macroalgal communities are likely to occur in areas where hydrocarbon threshold concentrations are exceeded. Mangroves and associated habitat are not expected to be impacted in the event of a spill as accumulation of hydrocarbons on shorelines above the impact threshold of 100 g/m^2 is not predicted by the stochastic modelling.
Summary of Potential Impacts to Other Habitats and Communities	
Setting	***Receptor Group***
Offshore	**Benthic Fauna Communities:** In the event of a major release at the seabed, the stochastic spill model predicted hydrocarbon droplets would be entrained, transporting them to the sea surface. As a result, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) associated with the consolidated sediment habitat within and outside the Operational Area are not expected to have widespread exposure to released hydrocarbons. A localised area relating to the hydrocarbon plume at the point of release is predicted, which would result in a small area of seabed and associated epifauna and infauna exposed to hydrocarbons.
	Open Water – Productivity/Upwelling: Primary production by plankton (triggered by sporadic upwelling events in the offshore waters of the NWS) is an important component of the primary marine food web. Planktonic communities are generally mixed including phytoplankton (cyanobacteria and other microalgae) and secondary consuming zooplankton (crustaceans (e.g. copepods) and the eggs and larvae of fish and invertebrates (meroplankton)). Exposure to hydrocarbons in the water column can change species composition, with declines or increases in one or more species or taxonomic groups (Batten et al., 1998). Phytoplankton may also experience decreased rates of photosynthesis (Tomajka, 1985). For zooplankton, direct effects of contamination may include suffocation, changes in behaviour, or environmental changes that make them more susceptible to predation. Impacts on plankton communities are likely to occur in areas where surface, entrained or dissolved aromatic

	hydrocarbon threshold concentrations are exceeded, but communities are expected to recover relatively quickly (within weeks or months). This is due to high population turnover with copious production within short generation times that also buffers the potential for long-term (i.e. years) population declines (ITOPF, 2011). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary.
	Open Water – Physical Displacement of Fauna from Gas Plume: The effect of the physical extent of the gas plume in the environment is expected to have a limited and localised effect on identified receptors such as the physical barrier created by the gas plume, which may displace transient and/or mobile biota such as pelagic fish, megafauna species (migratory whales) and plankton. It is acknowledged that the physical extent of the plume may displace some open water species transiting the offshore waters of this area of the NWS. The extent of the plume is relatively small in comparison to the surrounding offshore environment and the overall impact to the in-water biota and the marine environment in general is expected to be slight to minor short-term impact to communities in the EMBA.
Mainland and Islands (Nearshore Waters)	**Open Water – Productivity/Upwelling:** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Barrow and Montebello Islands) and to the west of the Ningaloo reef system are known locations of seasonal upwelling events and productivity. The seasonal productivity events are critical to krill production, which supports megafauna aggregations such as whale sharks and manta rays in the region. This has the potential to result in lethal and sub-lethal impacts to a certain portion of plankton in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. However, recovery would occur (see Offshore description above). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary in nature.
	Spawning/Nursery Areas: Fish (and other commercially targeted taxa) in their early life stages (eggs, larvae and juveniles) are at their most vulnerable to lethal and sub-lethal impacts from exposure to hydrocarbons, particularly if a spill coincides with spawning seasons or if a spill reaches nursery areas close to the shore (e.g. seagrass and mangroves) (ITOPF, 2011). Fish spawning (including for commercially targeted species such as snapper and mackerel) occurs in nearshore waters at certain times of the year. Nearshore waters are also inhabited by higher numbers of juvenile fishes than offshore waters. Modelling indicated that in the unlikely event of a major spill, there is potential for entrained and dissolved hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters, including the Muiron Islands, Ningaloo Coast, Montebello/Barrow/Lowendal Islands Group and Pilbara Southern Islands Group. This has the potential to result in lethal and sub-lethal impacts to a certain portion of fish larvae in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. Losses of fish larvae in worse affected areas are unlikely to be of major consequence to fish stocks compared with significantly larger losses through natural predation, and the likelihood that most nearshore areas would be exposed is low (i.e. not all areas in the region would be affected). This is supported by a recent study in the Gulf of Mexico which used juvenile abundance data, from shallow-water seagrass meadows, as indices of the acute, population-level responses of young fishes to the DWH spill. Results indicated there was no change to the juvenile cohorts following the DWH spill. Additionally there were no significant post-spill shifts in community composition and structure, nor were there changes in biodiversity measures (Fodrie & Heck, 2011). Any impacts to spawning and nursery areas are expected to be minor and short term, as would flow-on effects to adult fish stocks into which larvae are recruited.
	Filter Feeders: Hydrocarbon exposure to offshore, filter-feeding communities (e.g. deepwater communities of Ningaloo Coast and the Muiron Islands in 20–200 m) may occur depending on the depth of the entrained and dissolved aromatic hydrocarbons. See discussion above on potential impacts.
	Sandy Shores/Estuaries/Tributaries/Creeks (including Mudflats)/Rocky Shores: No accumulation of hydrocarbons above the 100 g/m^2 impact threshold are predicted at any shoreline location. However, potential impacts may occur due to entrained contact with shallow, subtidal and intertidal zones of the Ningaloo Coast, Muiron Islands and Montebello/Barrow/Lowendal Islands albeit at low probabilities (4-16%). In-water toxicity of the dissolved and entrained hydrocarbons reaching these shores will determine impacts to the marine biota, such as sessile barnacle species and/or mobile gastropods, and crustaceans such as amphipods. Lethal and sub-lethal impacts may be expected where the entrained hydrocarbon concentration threshold is >100 ppb. Impacts may result in localised changes to the community structure of these shoreline habitats which would be expected to recover in the medium term (2–5 years).
Key Ecological Features	**KEFs** potentially impacted by the hydrocarbon spill from a loss of well integrity are: • Continental Slope Demersal Fish Communities • Ancient Coastline at 125 m Depth Contour

	• Exmouth Plateau • Glomar Shoal • Canyons that link the Cuvier Abyssal Plan with the Cape Range Peninsula • Commonwealth waters adjacent to Ningaloo Reef. Although these KEFs are primarily defined by seabed geomorphological features, they are described to identify the potential for increased biological productivity and, therefore, ecological significance. The consequences of a hydrocarbon spill from a loss of well integrity event are predicted to result in moderate impacts with values of the KEF areas affected (for the values of each KEF see Section 4.7.7). Potential impacts include: the contamination of sediments, impacts to benthic fauna/habitats, associated impacts to demersal fish populations, and reduced biodiversity as described above and below. Most of the KEFs within the EMBA have relatively broad-scale distributions and are unlikely to be significantly impacted.
Summary of Potential Impacts to Water Quality	
Setting	***Aspect***
Offshore	**Open Water – Water Quality:** Water quality would be affected due to hydrocarbon contamination which is described in terms of the biological effect concentrations. These are defined by the EMBA descriptions for each of entrained and dissolved hydrocarbon fates and their predicted extent (refer to Table 6-12). Furthermore, given the volatile nature and rapid weathering and dispersal of condensate, water quality is predicted to have only minor long term and/or significant short term hydrocarbon contamination above background and/or national/international quality standards.
Submerged Shoals	**Open Water – Water Quality:** Water quality would be reduced due to hydrocarbon contamination that is predicted to be at or above biological effect concentrations for the surrounding marine waters over Rankin Bank and potentially Glomar Shoal[29]. The submerged Rankin Bank has the potential to be exposed to dissolved hydrocarbons aromatics at or greater than 50 ppb with a probability of 5%. Entrained hydrocarbons are not predicted to contact Rankin Bank at the depth of the feature (>18 m). The waters surrounding the permanently submerged habitat of Rankin Bank and Glomar Shoal would potentially show a reduction in quality due to hydrocarbon contamination above background and/or national/international quality standards.
Mainland and Islands (Nearshore Waters)	**Open Water – Water Quality:** Water quality would potentially be affected/reduced due to hydrocarbon contamination, with modelling predictions indicating that hydrocarbon contact could be at or above biological effect concentrations for entrained and dissolved hydrocarbons in nearshore waters of identified islands and the mainland coast (refer to Table 6-12). Such reduction in water quality is predicted to have minor long term or significant short term hydrocarbon contamination above background and/or national/international quality standards.
Summary of Potential Impacts to Marine Sediment Quality	
Setting	***Receptor Group***
Offshore	**Marine Sediment Quality:** In the event of a major hydrocarbon release at the seabed, modelling indicates that a pressurised release of condensate would atomise into droplets that would be rapidly transported into the water column to the surface. As a result, the extent of potential impacts to the seabed area at and surrounding the release site would be confined to a localised footprint. Marine sediment quality would be reduced (contamination above national/international quality standards) as a consequence of hydrocarbon contamination for a small area within the immediate release site for a medium to long term. With increased distance from the release site, the maximum depths in the water column of entrained and dissolved hydrocarbons exceeding threshold concentrations (100 ppb and 50 ppb respectively) are predicted to be about 20 m for entrained and 60 m for dissolved. Therefore, there is limited potential for the seabed to be exposed to hydrocarbons in offshore continental shelf waters beyond the vicinity of the release location. It is noted that hydrocarbon contact may only lead to reduced marine sediment quality through processes, such as deposition on the seabed and adherence. Given the nature and weathering of the hydrocarbon, long-term or widespread contamination above national/international quality standards is not expected in seabed sediments at distance from the release site.
Submerged Shoals	**Marine Sediment Quality:** There is potential for the reduction of marine sediment quality due to contact of dissolved hydrocarbons with seabed sediments of Rankin Bank (5% probability of contact) and potentially Glomar Shoal[30]. There is potential for marine sediment quality to be reduced

[29] While Glomar Shoal was not predicted to be contacted by hydrocarbons above threshold values in the stochastic modelling, it is included in the EMBA given its close proximity to predicted spill extents for entrained and dissolved hydrocarbons.

	(contamination above national/international quality standards). However, any contamination of sediments at submerged shoals is expected to be limited and short term.
Mainland and Islands (Nearshore Waters)	**Marine Sediment Quality:** Entrained and dissolved hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines, with a low probability (4-16% for entrained and 1% for dissolved). Hydrocarbons may occur (at or above the ecological impact thresholds) at the Montebello Islands, islands along the Pilbara coast and the Ningaloo Coast Table 6-12). However, given the nature of the hydrocarbon and degree of weathering that is expected prior to contact with nearshore seabed habitats, contamination of sediments is expected to be limited and short term.
Summary of Potential Impacts to Air Quality	
A hydrocarbon release during a loss of well integrity has the potential to result in a localised, temporary reduction in air quality, primarily associated with methane, volatile organic carbon (VOC) vapours released from fresh surface hydrocarbons near the release site. Potential impacts are expected to be a slight and temporary localised effect to ecosystems, species and/or habitats in the area. There is potential for effects to air-breathing marine fauna and avifauna (as assessed above). There is also the potential for human health effects for workers in the immediate vicinity of atmospheric emissions. The ambient concentrations of methane and VOCs released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments as it is dispersed rapidly by meteorological factors such as wind and temperature. Methane and VOC emissions from a hydrocarbon release in such environments are rapidly degraded in the atmosphere by reaction with photo-chemically-produced hydroxyl radicals. In the unlikely occurrence of a loss of well integrity, the temporary nature of any methane or VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons); the predicted behaviour and fate of methane and VOCs in open offshore environments; and the significant distance from the Operational Area to the nearest sensitive air shed (town of Dampier about 180 km away), the potential impacts are expected to be minor and temporary.	
Summary of Potential Impacts to Protected Areas (including AMPs)	
The quantitative spill risk assessment results indicate that the open water environment protected within the Australian Marine Parks (AMPs) listed in Table 6-12 may be affected by the released hydrocarbons. In the unlikely event of a major spill, entrained hydrocarbons and/or dissolved hydrocarbons may contact the identified key receptor locations of islands and mainland coastlines, resulting in the actual or perceived contamination of the protected areas identified in Table 6-12. The Montebello AMP has the greatest potential to be contacted by surface hydrocarbons, dissolved aromatic hydrocarbons and entrained hydrocarbons at or above the defined ecological effect concentrations. Hydrocarbons at or exceeding impact thresholds also have the potential to contact other protected areas, including the Argo-Rowley Terrace AMP, Gascoyne AMP and Ningaloo AMP and WHA. In most cases, the hydrocarbons that are predicted to reach these protected areas will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. The potential (albeit low probability) of visible surface hydrocarbons exceeding 1 g/m^2 reaching the Montebello AMP may result in a perception from stakeholders and the public of more significant impacts than actually occur. Objectives in the management plans for protected areas within the EMBA, including AMPs (Appendix B) require consideration of a number of physical, ecological, socio-economic and heritage values identified in these areas (Section 4.7). Impact on the values of these protected areas are discussed in the relevant sections above for ecological and physical values and below for socio-economic and heritage values. Additionally, such hydrocarbon contact may alter stakeholder understanding and/or perception of the protected marine environment, given these represent areas largely unaffected by anthropogenic influences and contain biological diverse environments.	
Summary of Potential Impacts to Socio-economic Values	
Setting	***Receptor Group***
Offshore	**Fisheries – Commercial:** Spill scenarios modelled are unlikely to cause significant direct impacts on the target species of Commonwealth and offshore State fisheries within the defined EMBA, except for those occurring in close proximity to the release location. Indirect impacts may occur through the contamination of prey organisms near the release site and the subsequent ingestion of this prey, which could result in long term impacts to fish as a result of bioaccumulation. Further details are provided below (impact assessment relating to spawning is discussed above under *Summary of Potential Impacts to Other Habitats and Communities*). ***General Fisheries*:** Fish exposure to hydrocarbon can result in ‘tainting’ of their tissues. Even very low levels of hydrocarbons can impart a taint or ‘off’ flavour or smell in seafood. Tainting is reversible through the process of depuration which removes hydrocarbons from tissues by metabolic processes, although it is dependent upon the magnitude of the hydrocarbon contamination. Fish have a high capacity to metabolise these hydrocarbons while crustaceans (such as prawns) have a reduced ability

	(Yender et al., 2002). Seafood safety is a major concern associated with spill incidents. Therefore, actual or potential contamination of seafood can affect commercial and recreational fishing, and can impact seafood markets long after any actual risk to seafood from a spill has subsided (Yender et al., 2002). A major spill may result in the establishment of a fishing exclusion zone around the spill-affected area. There would be a temporary prohibition on fishing activities for a period of time and subsequent potential for economic impacts to affected commercial fishing operators. Additionally, hydrocarbons can foul fishing equipment such as traps and trawl nets, requiring cleaning or replacement. ***Western Tuna and Billfish, Southern Bluefin Tuna, Western Skipjack and West Australian Mackerel Fisheries:*** The Commonwealth-managed tuna and billfish fisheries (Western Tuna and Billfish, Western Skipjack Southern Bluefin Tuna fisheries, for which limited fishing activity has occurred in this area in recent years) and the Western Australian Mackerel Fishery target pelagic fish species. Adult fish are highly mobile and able to move away from the spill-affected area or avoid the surface waters; however, hydrocarbon concentrations in the upper water column could lead to potential exposure through direct absorption of hydrocarbons and indirectly by the consumption of contaminated prey (Merkel et al., 2012). Given these pelagic species are distributed over a wide geographical area, the impacts at the population or species level are considered minor in the unlikely event of a spill. The Western Tuna and Billfish Fishery targets waters near Carnarvon, and the WA Mackerel Managed Fishery targets nearshore waters. In both cases, in the event that these waters are exposed to hydrocarbons, they will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. Therefore, there is limited potential for impacts or tainting to target fish species in these waters. ***Western Deep Trawl and Northwest Slope Trawl Fisheries:*** The predicted EMBA resulting from an uncontrolled loss of hydrocarbon from a loss of well integrity overlaps with waters fished by the Commonwealth-managed Northwest Slope Trawl Fishery and Western Deep Trawl Fishery. These fisheries target demersal and benthic species (demersal finfish and crustaceans) in greater than 200 m water depth. Hydrocarbons are not predicted to occur in these water depths and so target species are not expected to be impacted. The North West Slope Trawl Fishery may be temporarily affected by the establishment of a fishing exclusion zone for an extended period, however, the fishery typically comprises one or two vessels that target waters along more than 1,000 km of the continental slope. Any fishing exclusion zone would apply to a more localised area, therefore, fishing vessels may initially need to move to alternative fishing grounds but fishing would not be prevented completely. ***Other State-Managed Fisheries*****:** The predicted EMBA resulting from a major spill may impact the area fished by a number of State fisheries (refer Table 4-10). These fisheries generally use a range of gear types (trawl, trap and line) and operate from shallow inshore water to water depths up to 200 m, targeting demersal and pelagic finfish species and prawns. In the unlikely event of a major hydrocarbon spill, there is the potential for the targeted fish species to be exposed to entrained and/or dissolved aromatic hydrocarbons in the water column. However, the potential for direct impact would be reduced, as target species such as mackerel and snapper are likely to avoid the surface water layer underneath oil slicks. Demersal and benthic species (such as finfish and crustaceans) have limited mobility and therefore will not be able to easily move away from a spill. Mortality/sub-lethal effects may impact populations located close to the loss of well integrity location. A major loss of hydrocarbons from the Petroleum Activities Program may lead to an exclusion of fishing from the spill-affected area for an extended period. A number of other State and Commonwealth fisheries, further afield in the EMBA (refer Table 4-10), may also be affected by a major spill. However, the impacts to these far field fisheries will be similar to that described above for 'General Fisheries Impacts'.
	Offshore Oil and Gas Infrastructure: In the unlikely event of a major spill, surface hydrocarbons may affect production from existing petroleum facilities (platforms and floating production, storage and offtake vessels). For example, facility water intakes for cooling and fire hydrants could be shut off which could in turn lead to the temporary cessation of production activities. Spill exclusion zones established to manage the spill could also prohibit support vessel access. The impact on ongoing operations of regional production facilities would be determined by the nature and scale of the spill and metocean conditions. Furthermore, decisions on the operation of production facilities in the event of a spill would be based primarily on health and safety considerations. The closest production is the Pluto Platform (operated by Woodside). Other nearby facilities include the Chevron-operated Wheatstone Platform. Operation of these facilities is likely to be affected in the event of a loss of well integrity spill.
Submerged Shoals	**Tourism and Recreation:** In the unlikely event of a major spill, a temporary prohibition on charter boat recreational fishing trips and any other marine nature-based tourism trips to Rankin Bank and Glomar Shoal could be put into effect, depending on the trajectory of the plume and duration/ time of year may result in a loss of revenue for operators.
	Fisheries – Commercial:

Mainland and Islands (Nearshore Waters)	***Nearshore Fisheries and Aquaculture:*** In the unlikely event of a loss of well integrity, there is the possibility that target species in some areas used by a number of State fisheries, prawn fisheries, pearl oyster fisheries and aquarium fisheries in nearshore waters of the mainland coast and islands that are within the EMBA could be affected. Targeted fish, prawn, mollusc and lobster species could experience sub-lethal stress, or in some instances mortality, depending on the concentration and duration of hydrocarbon exposure and its inherent toxicity. The hydrocarbons predicted to reach these nearshore water locations will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. Therefore, direct impacts may be limited to sub-lethal impacts only. However, there is also the potential for tainting of target species and for negative public perception. ***Prawn Managed Fisheries:*** In a major spill, the modelling indicated the entrained EMBA may extend to nearshore waters closest to the mainland Pilbara and Gascoyne coasts, including the actively fished areas of the designated Onslow Prawn Managed Fishery, Exmouth Gulf Prawn Managed Fishery and Nickol Bay Prawn Managed Fishery. Note that the majority of the demarcated area for the prawn managed fishery in the Exmouth Gulf (proper) is outside the EMBA. Those fisheries that occur within the EMBA occur in shallow, nearshore waters where limited hydrocarbon exposures are predicted to occur. Prawn habitat utilisation differs between species in the post-larval, juvenile and adult stages (Dall et al., 1990). Direct impacts to benthic habitat due to a major spill has the potential to impact prawn stocks. For example, juvenile banana prawns are found almost exclusively in mangrove-lined creeks (Rönnbäck et al., 2002), whereas juvenile tiger prawns are most abundant in areas of seagrass (Masel and Smallwood, 2000). Adult prawns also inhabit coastline areas but tend to move to deeper waters to spawn. In a major spill, the model predicted shallow subtidal habitats at the Muiron Islands, Montebello Islands, Barrow Island, Lowendal Islands, Pilbara Southern Islands Group and the Ningaloo Coast are located within the EMBA and could be exposed to entrained and/or dissolved hydrocarbon concentrations above threshold concentrations, depending on the trajectory of the plume. Localised loss of juvenile prawns in worse spill affected areas is possible. Whether lethal or sub-lethal effects occur will depend on duration of exposure, hydrocarbon concentration, weathering stage of the hydrocarbon and its inherent toxicity. Furthermore, seafood consumption safety concerns and a temporary prohibition on fishing activities may lead to subsequent potential for economic impacts to affected commercial fishing operators.
	Fisheries – Traditional: Although no designated traditional fisheries have been identified, it is recognised that Aboriginal communities fish in the shallow coastal and nearshore waters of Barrow Island, Montebello Islands and Ningaloo Reef, and therefore may be potentially impacted if a hydrocarbon spill from a loss of well integrity were to occur. Impacts would be similar to those identified for commercial fishing in the form of a potential exclusion zone and contamination/tainting of fish stocks.
	Tourism and Recreation: Within the EMBA, tourism is one of the major industries of the region and contributes significantly to the local economy in terms of both income and employment. Nature based tourist activities include activities such as recreational fishing, snorkelling and scuba diving. Recreational fishers predominantly target tropical species such as emperor, snapper, grouper, mackerel, trevally and other game fish. Recreational angling activities include shore-based fishing, private boat and charter boat fishing, with the peak in activity between April and October (Smallwood et al., 2011). In the unlikely event of a major spill, the nearshore waters of island groups including the Muiron Islands, Barrow/Lowendal/Montebellos, Pilbara islands (Southern Island group) and the Ningaloo coast, could be reached by entrained and/or dissolved hydrocarbons above threshold concentrations depending on prevailing wind and current conditions. No shoreline accumulation above threshold concentrations is predicted. These locations offer a number of amenities such as fishing and swimming. Utilisation of beaches and surrounds have a recreational value for local residents and visitors (regional, national and international). In a major spill, tourists and recreational users may avoid areas due to perceived impacts, including after the hydrocarbon spill has dispersed. A major loss of hydrocarbons may lead to exclusion of recreational fishing and marine nature-based tourist activities in nearshore waters for an extended period, resulting in a loss of revenue for operators. There is potential for stakeholder perception that this remote environment will be contaminated over a large area and for the longer term, resulting in a prolonged period of tourism decline. Oxford Economics (2010) assessed the duration of hydrocarbon spill related tourism impacts and found that on average, it took 12 to 28 months to return to baseline visitor spending. There is potential for impacts to the tourism industry in terms of economic loss as a result of spill impacts to tourism. Recovery and return of tourism to pre-spill levels will depend on the size of the spill, effectiveness of the spill response and change in any public misconceptions regarding the spill (Oxford Economics, 2010).

	Cultural Heritage: There are a number of historic shipwrecks identified in the vicinity of the Operational Area (Table 4-9). The closest known wrecks are the four wrecks of the *Curlew*, the *Wild Wave (China*), the *Marietta*, and the *Vianen*, near the Montebello Islands and about 50 km from the Operational Area. The modelling results do not predict surface slicks contacting the identified wrecks, and the majority of entrained hydrocarbons are expected to occur close to the surface (in the top 20 m). However, shipwrecks in the subtidal zone could be exposed to entrained and dissolved hydrocarbons. Marine life that shelter and take refuge in and around these wrecks may be affected by in-water toxicity of dispersed hydrocarbons. The consequences of such hydrocarbon exposure may include all or some of: large fish species moving away and/or resident fish species and sessile benthos such as hard corals exhibiting sub-lethal and lethal impacts (which may range from physiological issues to mortality). Within the EMBA, a number of places are designated on the National Heritage List (Section 4.6.1). These places are also covered by other designations such as WHA, marine parks and listed shipwrecks. Potential impacts have therefore been discussed in the sections above. No accumulated hydrocarbons above threshold concentrations (> 100 g/m²) are predicted at any location. Therefore impacts to onshore sites of cultural heritage importance are not expected.

Worst case Potential Impacts to Social and Environmental Values

In the unlikely event of a major hydrocarbon spill due to a loss of well integrity, the EMBA (including the socio-cultural EMBA) includes the areas listed in Table 6-12. This incorporates AMPs as well as other sensitive marine environments and associated receptors of the Muiron Islands, Ningaloo Coast, Montebello/Barrow/Lowendal Islands Group, the Pilbara Southern Islands Group, Rankin Bank and Glomar Shoal. Long term impacts could potentially occur at these locations including socio-cultural effects as a result of a major spill of condensate from drilling activities within the Operational Area, depending on the trajectory of the spill.

Potential impacts on species and habitats may also be major and long-term. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of species populations in the wider region.

As such, the overall environmental consequence is defined as B ‘Major, long term impact (10-50 years) on highly valued ecosystem, species, habitat, physical or biological attributes’ (Table 2-3). The likelihood of the event is defined as a 2 ‘Unlikely’, resulting in a risk rating of high.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[30]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted WOMP, which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • all permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) • discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required • all normally pressured permeable water-bearing formations shall be isolated from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction • (fluid barriers) remain monitored and provide sufficient pressure to counter pore pressure during well construction • (cementing barriers, including conductor, casing and liners) conform to the relevant minimum Woodside standards. Verification: • effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during drilling of the well.	F: Yes. CS: Minimal cost. Standard practice.	Compliance with an accepted WOMP will ensure a number of barriers are in place and verified, reducing the likelihood of loss of well integrity occurring. Although the consequence of a blowout would not be reduced, the reduction in likelihood reduces the overall risk.	Benefits outweigh cost/sacrifice.	Yes C 10.1

[30] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[30]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Implement requirements for permanent well abandonment: • well barrier as per the internal Woodside Standard and Procedure • placement, length, material and verification of a permanent barrier.	F: Yes. CS: Minimal cost. Standard practice.	This procedure will reduce the likelihood of a spill occurring from a suspended/ abandoned well. Although changes in consequence would occur, the reduction in likelihood results in a reduction in overall risk.	Benefits outweigh cost/sacrifice.	Yes C 10.2
An approved Blowout Contingency Plan shall exist prior to drilling the well, including feasibility and any specific considerations for relief well kill.	F: Yes. CS: Minimal cost. Standard practice.	Assessment of the feasibility considerations for relief well kill will reduce the duration of a spill, resulting in a reduction in consequence and overall risk.	Benefits outweigh cost/sacrifice.	Yes C 10.3
Good Practice				
Subsea BOP installed and function tested during drilling operations. The BOP shall include (at a minimum): • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	F: Yes. CS: Standard practice. Required by Woodside standards.	Testing of the BOP will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment. In the event of a blowout, this control would not reduce the consequence, although the reduction in likelihood reduces the overall risk ranking.	Benefits outweigh cost/sacrifice.	Yes C 10.4
Project-specific Mooring Design Analysis.	F: Yes. CS: Standard practice. Required by Woodside standards.	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.	Benefits outweigh cost/sacrifice.	C 10.5

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[30]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Do not drill well.	F: No. CS: Inability to produce hydrocarbons. Loss of the project.	All risk would be eliminated.	Disproportionate. Given the extremely low likelihood of a loss of well integrity due to the systematic implementation of Woodside's policies, standards, procedures and processes relating to drilling activities, the cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
Risk Based Analysis				
A quantitative spill risk assessment was performed (refer Section 6.7.1).				
Company Values				
Corporate values require all personnel at Woodside to comply with appropriate policies, standards, procedures and processes while being accountable for their actions and holding others to account in line with the Woodside Compass. As detailed above, the Petroleum Activities Program will be performed in line with these policies, standards and procedures that include suitable controls to prevent loss of well integrity, and response should a loss of well integrity occur.				
Societal Values				
Due to the Petroleum Activities Program's potential extent of the EMBA, the loss of well integrity current risk rating presents a Decision Type C, in accordance with the decision support framework described in Section 2.6. Extensive consultation was conducted for this program to identify the views and concerns of relevant stakeholders, as described in Section 5. Woodside sent an Activity Factsheet in 2019 to all identified relevant stakeholders regarding the Petroleum Activities Program (Section 5 and Appendix F). Woodside has consulted with AMSA and WA DoT on spill response strategies. In accordance with the MoU between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan was provided to AMSA.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type C), Woodside considers the adopted controls appropriate to manage the impacts and risks of an extremely low likelihood unplanned hydrocarbon release as a result of a loss of well integrity. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement Loss of well integrity has been evaluated as having a high level of current risk rating due to the scale of potential environmental impacts. However, the likelihood of a loss of well integrity occurring is considered extremely low. As per

Demonstration of Acceptability
Section 2.7, Woodside considers high current risk ratings as acceptable, if ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for, and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the following considerations: <u>Principles of Ecological Sustainable Development</u> Woodside is a proud Australian company that is here for the long term. Woodside has a strong history of exploration and development of oil and gas reserves in the North West of Western Australia, with an excellent environmental record, while providing revenue to State and Commonwealth Governments, returns to shareholders, jobs and support to local communities. Titles for oil and gas exploration are released based on commitments to explore with the aim of uncovering and developing resources. It is under the lease agreement that Woodside has determined the potential to develop the hydrocarbon fields for which acceptance of this EP is sought under the Environment Regulations. Woodside has established a number of research projects in order to understand the marine environments in which it operates, notably in the Exmouth Region, Dampier Archipelago and the Kimberley Region, including Rankin Bank and Scott Reef. Where scientific data does not exist, Woodside assumes a pristine natural environment exists and, therefore, implements all practicable steps to prevent damage. Woodside's corporate values (Appendix A) require that we consider the environment and communities in which we operate when making decisions. Woodside looks after the communities and environments in which it operates. Risks are inherent in petroleum activities; however through sound management and systematic application of policies, standards, procedures and processes, Woodside considers that despite this risk, the extremely low likelihood of loss of well integrity is acceptable. <u>Internal Context</u> The Petroleum Activities Program is consistent with Woodside corporate policies, standards, procedures, processes and training requirements as outlined in the Demonstration of ALARP and Environmental Performance Outcomes, including: • Woodside Health, Safety, Environment and Quality Policy (Appendix A) • Woodside Risk Management Policy (Appendix A) Oil spill preparedness and response strategies are considered applicable to the nature and scale of the risk and associated impacts of the response are reduced to ALARP (Appendix D). Monitoring and Evaluation (operational monitoring) as a key response in the unlikely event of a hydrocarbon release will assess and track the extent of the hydrocarbon contact and revise the predicted extent of impact. In addition, the Planning Area for scientific monitoring (refer to Section 5.7 of the Oil Spill Assessment and Mitigation Plan) can be re-assessed in the unlikely event of hydrocarbon release with consideration of the conservation values and social-cultural values of state and commonwealth protected areas (including AMPs), National and Commonwealth Heritage Listed places; tourism and recreation; and fisheries. The post-response SMP will consider assessment and monitoring in line with the affected receptors such as habitat and species, AMPs, fisheries. Woodside corporate values include working sustainably with respect to the environment and communities in which we operate, listening to internal and external stakeholders, and considering HSE when making decisions. Stakeholder consultation, outlined below, has been performed prior to the Petroleum Activities Program. <u>External Context – Societal Values (includes environmental consequence and stakeholder expectations)</u> Woodside recognises that its licence to operate from a regulator and societal perspective is based on historical performance, complying with appropriate policies, standards and procedures, and understanding the expectations of external stakeholders. External stakeholder consultation, outlined below, has been undertaken prior to the Petroleum Activities Program: • Woodside has consulted with AMSA and WA DoT on spill response strategies. In accordance with the MoU between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan was provided to AMSA and WA DoT. • Other relevant stakeholders have been consulted (Section 5) and their feedback incorporated into this EP where appropriate. • The impact assessment has determined that the likelihood of a major long-term environmental impact on the offshore environment or sensitive nearshore and shoreline habitats from a loss of well integrity is unlikely. • By providing additional measures to prevent loss of well integrity, in addition to oil spill response measures that are commensurate with the current risk rating, location and sensitivity of the receiving environment (including social and aesthetic values), Woodside believes this addresses societal concerns to an acceptable level. <u>Other Requirements (includes laws, policies, standards and conventions)</u> The Petroleum Activities Program is consistent with laws, policies, standards and conventions, including: • subsea BOP function testing in accordance with API Standard 53, 5th Edition

Demonstration of Acceptability
• mutual aid MoU in place for relief well drilling: Woodside develops a Well Blowout Contingency Plan for each well, which is signed off by the Drilling Engineering Manager and maintains a list of rigs that are currently operating in Western Australia • Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted WOMP and application to drill • notification of reportable and recordable incidents to NOPSEMA, if required, in accordance with Section 7.8.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 10 No loss of well integrity resulting in loss of hydrocarbons to the marine environment during Petroleum. Activities Program.	**C 10.1** • Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted WOMP, which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • All permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study). • Discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required. • All normally pressured permeable water-bearing formations shall be isolated from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction • (fluid barriers) remain monitored and provide sufficient pressure to counter pore pressure during well construction • (cementing barriers including conductor, casing and liners) conform to the relevant minimum Woodside standards. Verification: • effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the drilling of the well.	**PS 10.1** Well drilled in compliance with the accepted WOMP, including implementation of barriers to prevent a loss of well integrity.	**MC 10.1.1** Acceptance letter from NOPSEMA demonstrates the WOMP and application to drill were accepted by NOPSEMA prior to the drilling activity commencing. **MC 10.1.2** Records demonstrate minimum of two verified barriers (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) were in place for all permeable zones penetrated by the wellbore. **MC 10.1.3** Records demonstrate composition and weight of drilling fluids were applicable to down hole conditions.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 10.2 Implement requirements for permanent well abandonment: • well barrier as per the internal Woodside Standard and Procedure • placement, length, material and verification of a permanent barrier.	**PS 10.2** Woodside abandons the well according to internal Woodside Procedure.	**MC 10.2.2** Records demonstrate well acceptance criteria have been met.
	C 10.3 An approved Blowout Contingency Plan shall exist prior to drilling the well, including feasibility and any specific considerations for relief well kill.	**PS 10.3** Ensures feasibility of performing a well kill operation.	**MC 10.3.1** An approved Well Blowout Contingency Plan.
	C 10.4 Subsea BOP installed and function tested during drilling operations. The BOP shall include (at a minimum): • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	**PS 10.4** Subsea BOP specification, installation and function-testing compliant with internal Woodside Standards and international requirements (API Standard 53 5th Edition) as agreed between Woodside and MODU Contractor.	**MC 10.4.1** Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected drilling conditions as agreed between Woodside and MODU Contractor.
	C 10.5 Project-specific Mooring Design Analysis.	**PS 10.5** Anchors installed as per Mooring Design Analysis to ensure adequate MODU station holding capacity.	**MC 10.5.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
For oil spill response outcomes, standards and measurement criteria refer to Appendix D.			

6.7.3 Accidental Hydrocarbon Release: Vessel Collision

Context		
Project vessels – Section 3.5	Physical environment – Section 4.4 Biological environment – Section 4.5 Socio-economic environment – Section 4.6 Values and sensitivities – Section 4.7	Stakeholder consultation – Section 5

Impacts and Risks Evaluation Summary														
	Environmental Value Potentially Impacted							***Evaluation***						
Source of Risk	***Soil and Groundwater***	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons to marine environment due to a vessel collision (e.g. support vessels or other marine users)			X		X	X	X	A	D	1	**M**	LCS GP PJ	Broadly Acceptable	EPO 11

Description of Source of Risk

Background

The temporary presence of the MODU and support vessels in the Operational Area will result in a navigational hazard for commercial shipping within the immediate area (as discussed in Section 6.6.1). This navigational hazard could result in a third party vessel colliding with the MODU or a support vessel which could release hydrocarbons.

Support vessels have multiple isolated diesel tanks typically located mid-ship, and can range in typical size from 22 to 275 m³.

The MODU has a total marine diesel capacity of about 966–1400 m³ that is distributed through a number of isolated tanks. MODU fuel tanks are located in the MODU pontoons, typically located on the inner sides of pontoons, and can be over 10 m below the waterline.

In the unlikely event of a vessel collision involving the MODU during the Petroleum Activities Program, the MODU will have the capability to pump fuel from a ruptured tank to a tank with spare volume in order to reduce the potential volume of fuel released to the environment.

Industry Experience

Registered vessels or foreign flag vessels in Australian waters are required to report events to the Australian Transport Safety Bureau (ATSB), AMSA or Australian Search and Rescue (AusSAR).

From a review of the ATSB marine safety and investigation reports relevant to oil and gas industry vessels conducted for this EP (ATSB, 2013), one vessel collision occurred in 2011/12 that resulted in a spill of 25–30 L of oil into the marine environment as a result of a collision between a tug and support vessel off Barrow Island. Two other vessel collisions occurred in 2010, one in the port of Dampier, where a support vessel collided with a barge being towed. Minor damage was reported and no significant injury to personnel or pollution occurred. The second 2010 vessel collision involved a vessel under pilot control in port connecting with a vessel alongside a wharf, causing it to sink. No reported pollution resulted from the sunken vessel. These incidents demonstrate the likelihood of only minor volumes of hydrocarbons being released during the highly unlikely event of a vessel collision.

From 2010 to 2011, the ATSB's annual publication defines the individual safety action factors identified in marine accidents and incidents: 42% related to navigation action (2011). Of those, 15% related to poor communication and 42% related to poor monitoring, checking and documentation (ATSB, 2011). The majority of these related to the grounding instances.

Credible Scenario

For a vessel collision to result in the worst-case scenario of a hydrocarbon spill potentially impacting an environmental receptor, several factors must align as follows:

- The identified causes of vessel interaction must result in a collision.
- The collision must have enough force to penetrate the vessel hull.
- The collision must be in the exact location of the fuel tank.
- The fuel tank must be full, or at least of volume which is higher than the point of penetration.

The probability of the chain of events described above aligning, to result in a breach of fuel tanks resulting in a spill that could potentially affect the marine environment, is considered remote. Given the offshore location of the Operational Area, vessel grounding is not considered a credible risk.

The environmental risk analysis and evaluation identified and assessed a range of potential scenarios that could result in a loss of vessel structural integrity, resulting in damage to fuel storage tank(s) and a loss of marine diesel to the marine environment. The scenarios considered damage to single and multiple fuel storage tanks in the support vessel and MODU due to dropped objects and various combinations of vessel to vessel and vessel to MODU collisions. In summary:

- It is not a credible scenario that the total storage volume of the MODU would be lost, as fuel is stored in more than one tank.
- It is not a credible scenario that a storage tank on the MODU would be damaged due to the location of the tanks within the hull, behind the bilge tanks, below the waterline.
- It is not a credible scenario that a collision between the support vessel and MODU would damage any storage tanks, due to the location of the tanks on both vessel types and secondary containment.

A collision between a support vessel and a third party was considered credible, although unlikely given the slow speeds of support vessels when relocating within the Operational Area or providing stand-by cover. The maximum volume to be assumed in the assessment is therefore 275 m^3 of marine diesel, which corresponds to rupture of the largest single tank inventory of a support vessel.

Quantitative Hydrocarbon Risk Assessment

Modelling of a 550 m^3 surface release of marine diesel was available for Woodside's Balnaves Development, conducted in 2016. The release location used for the spill modelling is located about 51 km north-west of the Montebello Islands and about 5 km from the Operational Area. The modelled spill volume of 550 m^3 is greater than the worst-case credible release volume of 275 m^3 for this hydrocarbon spill risk assessment. However, the results of the modelling can be used to demonstrate that a much larger marine diesel spill in the vicinity of the Operational Area has an EMBA that is not predicted to include any surface slicks above threshold volumes entering WA state waters, or any shoreline contact or accumulation. Basing the impact assessment for a vessel collision scenario on this modelling is considered highly conservative and consequently, the EMBA for a 275 m^3 surface release of marine diesel within the Operational Area would be considerably smaller than the EMBA described in this EP.

The modelling assessed the extent of a marine diesel spill volume of 550 m^3 for all seasons, using an historic sample of wind and current data for the region. A total of 50 simulations for each season were modelled (four seasons in total). The modelling was conducted by RPS using a three-dimensional hydrocarbon spill trajectory and weathering model (SIMAP, Spill Impact Mapping and Analysis Program) (RPS, 2016).

Hydrocarbon Characteristics

Marine diesel is a mixture of both volatile and persistent hydrocarbons. Predicted weathering of marine diesel, based on typical conditions in the region, indicates that about 35% by mass would be expected to evaporate over the first 24 hours (Figure 6-3) (RPS, 2019). After this time the majority of the remaining hydrocarbon is entrained into the upper water column, leaving only a small proportion of the oil floating on the water surface (<1%). Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay and/or evaporate over time scales of several weeks to a few months, thereby extending the area of potential effect.

Given the environmental conditions experienced in the Operational Area, marine diesel is expected to undergo rapid spreading and this, together with evaporative loss, is likely to result in a rapid dissipation of the spill. Marine diesel distillates tend not to form emulsions at the temperatures found in the region. The characteristics of the marine diesel are given in Table 6-13.

Table 6-13: Characteristics of the marine diesel

Hydrocarbon type	Initial density (g/cm^3) at 25 ºC	Viscosity (cP @ 25 ºC)	Component BP (ºC)	Volatiles %<180	Semi volatiles % 180–265	Low volatility (%) 265-380	Residual (%) >380
				Non-Persistent			Persistent
Marine diesel	0.829	4.0	% of total	6	34.6	54.4	5

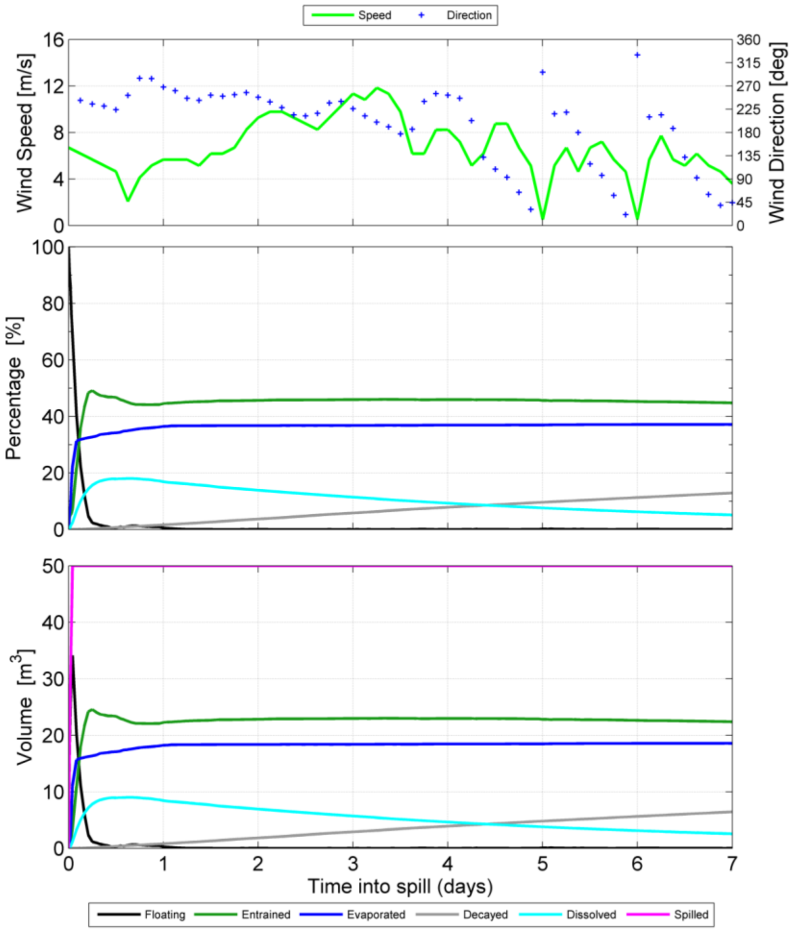

Figure 6-3: Proportional mass balance plot representing weathering of a 2000 m³ surface spill of marine diesel as a one-off release (at a rate of 50 m³/hr) and subject to variable wind at 27 °C water temperature and 25 °C air temperature (RPS, 2019)

Impact Assessment

Potential Impacts Overview

Environment that May Be Affected

Surface Hydrocarbons: Quantitative hydrocarbon spill modelling results for surface hydrocarbons are shown in Table 6-14. If this scenario occurred, a surface hydrocarbon slick would form down-current of the release location, with the trajectory dependent on prevailing wind and current conditions at the time. The modelling indicates that the EMBA would be confined to open water, with surface hydrocarbons extending up to about 85 km from the release location at or above the 10 g/m² impact threshold.

A socio-cultural EMBA for surface hydrocarbons which includes the threshold for visible surface hydrocarbons of 1 g/m² may extend up to about 180 km from the release site.

Entrained Hydrocarbons: Quantitative hydrocarbon spill modelling results are shown in Table 6-14. If this vessel collision scenario occurred, a plume of entrained hydrocarbons would form down-current of the release location, with the trajectory dependent on prevailing current conditions at the time. The modelling indicates that locations exposed to entrained hydrocarbons at or above the threshold concentration of 500 ppb are restricted to offshore areas up to about 160 km from the release site. Table 6-14 provides details of receptors potentially contacted by entrained diesel at 500 ppb.

Dissolved Hydrocarbons: Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 500 ppb threshold are predicted to be limited to the immediate vicinity of the spill site and are not expected to reach any sensitive receptor habitats (Table 6-14).

Accumulated Hydrocarbons: Accumulated hydrocarbons above threshold concentrations (≥100 g/m²) were not predicted by the modelling to occur at any location.

Taking into consideration the EMBA derived from hydrocarbon spill modelling for a marine diesel spill, the environment that may be affected will fall within the EMBA of the condensate spill from a loss of well integrity outlined in Section 6.7.2

Table 6-14: Probability of hydrocarbon spill contact above impact thresholds within the EMBA with key receptor locations and sensitivities for a 550 m³ Instantaneous release of marine diesel

Environmental setting	Location/name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions in Woodside's Risk Management Procedure																													Probability of hydrocarbon contact (diesel) (%) note: the probability is based on stochastic modelling of 200 hypothetical worst-case spills under a variety of weather and metocean conditions				
		Physic-al		Biological																						Socio-economic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities/Habitats								Protected Species									Other Species											
		Open water (pristine)	Marine sediment (pristine)	Coral reef	Seagrass beds/macroalgae	Mangroves	Spawning/nursery areas	Open water – productivity/ upwelling	Non-biogenic coral reefs	Offshore filter feeders and/or deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries/tributaries/creeks/ lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Seasnakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident/demersal fish	Fisheries – commercial	Fisheries – traditional	Tourism and recreation	Protected areas/heritage – European and Indigenous/shipwrecks	Offshore oil & gas infrastructure (topside and subsea)	Surface hydrocarbon (1-10 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥500 ppb)	Dissolved aromatic hydrocarbon (≥500 ppb)	Accumulated hydrocarbons (>100 g/m²)
Offshore	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓*		12	9	2		
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			1		
Submerged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			1				

Summary of Potential Impacts to Protected Species, Other Habitats and Communities, Water Quality and Socio-economic Values

Modelling of a 550 m³ release of marine diesel spill due to vessel collision predicts that no receptors would be contacted by dissolved aromatic hydrocarbons >500 ppb or accumulated oil concentrations equal to or greater than 100 g/m². Entrained hydrocarbons >500 ppb are predicted to have a very low probability of contact with the outer boundaries of the Montebello AMP and Gascoyne AMP in open waters (1-2% probability of contact). Surface hydrocarbons are predicted to have a 13% probability of contact with the outer boundary of the Montebello AMP in open waters at or above 1 g/m^2, and a 10 % probability at or above 10 g/m^2. Further, hydrocarbons reaching these environments will be highly weathered, with the volatile and water soluble (often the most toxic) components expected to have dissipated.

The potential impacts of spilled hydrocarbons to species (protected and otherwise), marine primary producers, other habitats and communities, water quality, marine sediment quality, air quality, protected areas and socio-economic values are described in Section 6.7.2. The loss of well integrity EMBA is larger spatially than the marine diesel EMBA; therefore, the potential impacts of entrained hydrocarbons provided in Section 6.7.2, and the scale of impact described, provides a conservative assessment for potential impacts of a 550 m³ release of marine diesel. Impacts specific to a spill of marine diesel are summarised below. It is noted that the toxic components in marine diesel include alkylated naphthalenes which can be rapidly accumulated by marine biota including invertebrates such as marine oysters, clams, shrimp, as well as a range of vertebrates, such as finfish. Marine diesel also contains additives that contribute to its toxicity.

Given the localised area of the potential EMBA and the rapid dispersion, dilution and weathering of a marine diesel spill, it is expected that any potential impacts will be low magnitude and temporary in nature.

Protected Species

As identified in Section 4.5.2, protected species including migrating pygmy blue whales and humpback whales may be encountered near the Operational Area, and therefore could be impacted in close proximity to the marine diesel spill location, where the volatile, water soluble and most toxic components of the diesel may be present. However, the window for exposure to hydrocarbons with the potential for any toxicity effects in these waters would be limited to a few days following the spill. Potential impacts may include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and, in rare circumstances, organ or neurological damage leading to death. Given the absence of critical habitats or aggregation areas, cetaceans in the area are expected to be transient, and impacts are expected to be limited to individuals or small groups of animals. Impact on the overall population viability of cetaceans are not predicted.

The EMBA overlaps with habitat critical to the survival of flatback turtles for internesting and BIAs identified in Sec Section 4.5.2, particularly the internesting BIAs for flatback turtles which extend for ~80 km from known nesting locations. The Operational Area also overlaps with an internesting BIA for flatback turtles and designated habitat critical to the survival of flatback turtles for internesting at the Montebello Islands (with peak nesting in December and January). However, it is noted that the BIA and habitat critical to the survival of flatback turtles are considered very conservative as they are based on the maximum range of internesting females and many turtles are more likely to remain near their nesting beaches. In the event of a worst case vessel spill of MDO, there is a potential that surface and entrained hydrocarbons exceeding impact threshold concentrations (10 g/m^2 and 500 ppb respectively) will be present in offshore waters extending up to 85 km and 160 km respectively, from the release site. Toxicity of hydrocarbons will be significantly reduced by weathering at over such distances, with the volatile and water soluble (often the most toxic) components expected to have dissipated beyond the vicinity of the spill site. Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 500 ppb threshold are predicted to be limited to the immediate vicinity of the spill site. Low concentrations are only capable of causing sublethal impacts to the most sensitive marine organisms and no lethal or sub-lethal impacts to marine turtles are expected in the BIAs. The potential for lethal and sub-lethal impacts to marine turtles is limited to small numbers of transient individuals that may be present in offshore waters near the release location.

Seabirds may also be exposed to marine diesel on the sea surface or upper water column, if resting or foraging in waters near to the spill. Impacts may include mortality due to oiling of feathers or the ingestion of hydrocarbons. However, due to the limited spatial extent of a marine diesel spill and limited window for exposure, population level impacts are not expected.

Other protected species that may occasionally transit through the area and may potentially be exposed to a marine diesel spill, include shark and ray species such as whale sharks and manta rays. The EMBA overlaps the whale shark foraging BIA along the North-west shelf, but does not overlap the foraging (high density prey) BIA along the Ningaloo coast. Should sharks or rays be present in offshore waters near the Operational Area during the spill, direct impacts may occur if foraging within surface slicks or in the upper 20 to 30 m of the water column containing entrained hydrocarbons and dissolved aromatics. Contamination of their food supply and the subsequent ingestion of this prey may also result in long term impacts as a result of bioaccumulation. Impacts are again predicted to be limited to a small number of animals given the low numbers of animals that may transit through the area during the short period when spilled hydrocarbons are present.

Given the limited number of animals that may be impacted and the rapid dispersion of marine diesel, it is considered that any potential impacts will be minor.

Other Habitats, Species and Communities

Within the EMBA for a marine diesel spill resulting from a vessel collision, there is the potential for plankton communities to potentially be impacted where entrained or dissolved hydrocarbon threshold concentrations are exceeded. A range of lethal and sublethal impacts may occur to plankton exposed to entrained or dissolved hydrocarbons within the EMBA. Communities are expected to recover quickly (weeks/months) due to high population turnover (ITOPF, 2011). It is therefore considered that any potential impacts would be low magnitude and temporary in nature.

Pelagic fish populations in the open water offshore environment of the EMBA are highly mobile and have the ability to move away from a marine diesel spill. The spill-affected area would be confined to the surface layer and upper 20 to 30 m of the water column. It is therefore unlikely that fish populations would be exposed to widespread hydrocarbon contamination. Pelagic fish populations are distributed over a wide geographical area so impacts on populations or species level are considered to be negligible. Combined with these factors and the rapid dispersion of marine diesel, it is considered that any potential impacts will be minor.

Other communities (e.g. demersal fish, benthic infauna and epifauna) and key sensitivities (e.g. KEFs identified in Section 4.7.7) occur within the EMBA, however they will not be directly exposed or impacted by a marine diesel spill as hydrocarbons are confined to the upper layers of the water column.

Water Quality

It is likely that water quality will be reduced at the release location of the spill; however, such impacts to water quality would be temporary and localised in nature due to the rapid dispersion and weathering of marine diesel. The potential impact is therefore expected to be low.

Protected Areas

Surface and entrained hydrocarbons at or exceeding impact thresholds have a low probability of contacting the outer boundaries of the Montebello AMP and Gascoyne AMP. Surface and entrained hydrocarbons are only predicted within the deep open waters of these protected areas, with minimal overlap and no contact to seabed habitats or to shorelines. Potential impacts to water quality and the natural values (e.g. mobile protected species) in these areas would be temporary and localised in nature due to the rapid dispersion and weathering of the marine diesel, as described above. Dissolved hydrocarbons (at or exceeding 500 ppb) are not predicted to reach any protected areas.

Socio-economic

A marine diesel spill is considered unlikely to cause significant direct impacts on the target species fished by Commonwealth and State fisheries (see Section 4.6.3) which overlap with the EMBA. The fisheries that operate within the EMBA predominantly target demersal fish species (demersal finfish and crustaceans) that inhabit waters in the range of >60–200 m depth, or pelagic species which are highly mobile. Therefore, a marine diesel spill is expected to only result in negligible impacts, considering that hydrocarbons are confined to the upper layers of the water column. Visible surface hydrocarbons at or exceeding 1 g/m^2 may also occur up to 180 km from the release site, which may result in fouling of fishing gear and a perception of impacts to fish stocks by fisheries stakeholders and the public. There is the potential that a fishing exclusion zone would be applied in the area of the spill, which would put a temporary ban on fishing activities and therefore potentially lead to subsequent economic impacts on commercial fishing operators if they were planning to fish within the area of the spill. Such measures would likely be in place for less than a week and would not result in widespread or long term impacts to fishing activities.

Summary of Potential Impacts to Environmental Values

In the unlikely event of an unplanned hydrocarbon release to the marine environment due to vessel collision, combined with the adopted controls, it is considered that any potential impact to water quality would be minor, localised and temporary in nature in comparison to background levels and/or international standards, with localised and temporary impacts to habitats, populations and shipping/fishing concerns.

The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision, as classified in Figure 2-6, is defined as D, which equates to minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystems), physical or biological attributes.

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[31]	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 30 (prevention of collisions) 2016, including:	F: Yes.	Legislative requirements to be followed reduce the	Controls based on legislative	Yes C 11.1

[31] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[31]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
• adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity • adherence to navigation sound signals as required.	CS: Minimal cost. Standard practice.	likelihood of interference with other marine users resulting in a collision.	requirements – must be adopted.	
Marine Order 21 (safety and emergency arrangements) 2016, including: • adherence to minimum safe manning levels • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of *Safety of Life at Sea* • Automatic Identification System (AIS) that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users and thus the likelihood of a collision.	Controls based on legislative requirements – must be adopted.	Yes C 11.2
• Establishment of a 500 m petroleum safety zone around MODU and communicated to marine users.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of a collision with a third party vessel.	Controls based on legislative requirements – must be adopted.	Yes C 11.3
Good Practice				
A support vessel is on standby as required during drilling activities to assist in third-party vessel interactions (including warning to vessels approaching the 500 m petroleum safety zone).	F: Yes. CS: Minimal cost – support vessels available routinely in Operational Area during Petroleum Activities Program. Standard practice.	Provides a small reduction in likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 11.4
When a support vessel is designated for standby it will undertake actions to prevent unplanned interactions, such as:	F: Yes. CS: Minimal cost – support vessels available routinely in	Provides a reduction in likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes C 11.5

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[31]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
• Maintain a 24 hour radio watch on designated radio channel(s). • Perform continuous surveillance and warn the MODU of any approaching vessels reaching 500 m petroleum safety zone. Surveillance shall be conducted by a combination of: – visual lookout – radar watch – other electronic systems available including AIS – monitoring any additional/agreed radio communications channels – all other means available. • While complying with Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS), approach any vessel attempting to transit through the 500 m zone and contact vessel by all available means. • Monitor and advise the MODU if: – MODU navigation signals are defective – visibility becomes restricted. • Advise if any buoys in the area are not holding position or are not working as expected. • Supply vessel, while operating in DP inside the 500m, shall comply to Activity Specific Operating Guidelines (ASOG	Operational Area during Petroleum Activities Program. Standard practice.			
Notify AHS of activities and movements no less than four working weeks prior to the scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHS will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes C 1.1
Notify AMSA JRCC of activities and movements of the activity 24–	F: Yes.	Communication of the Petroleum Activities Program to	Benefits outweigh cost/sacrifice. Control is also	Yes C 1.3

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[31]	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
48 hours before operations commence.	CS: Minimal cost. Standard practice.	other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Standard Practice.	
Mitigation: Oil spill response.	Refer to Appendix D.			
Professional Judgement – Eliminate				
Eliminate use of vessels.	F: No. The use of vessels is required to conduct the Petroleum Activities Program. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
Risk Based Analysis				
A quantitative spill risk assessment was performed (see detail above).				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of an unplanned loss of hydrocarbon as a result of vessel collision. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that an unplanned loss of hydrocarbon as a result of a vessel collision represents a low current risk rating that is unlikely to result in potential impact greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines, good oil-field practice/industry best practice, and in some cases are above industry best practice and meet legislative requirements of Marine Orders 30 and 21. The potential impacts and risks are considered acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of a loss of vessel structural integrity to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 11 No release of hydrocarbons to the marine environment	**C 11.1** Marine Order 30 (prevention of collisions) 2016, including:	**PS 11.1** Support vessels and MODU compliant with Marine Order 30 (which	**MC 11.1.1** Marine Assurance inspection records demonstrate compliance

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
due to a vessel collision during the Petroleum activities Program.	• adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display requirements, including visibility, light position/shape appropriate to activity • adherence to navigation sound signals as required.	requires vessels to be visible at all times) to prevent unplanned interaction with marine users.	with standard maritime safety procedures (Marine Orders 21 and 30).
	C 11.2 Marine Order 21 (safety and emergency arrangements) 2016, including: • adherence to minimum safe manning levels • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of *Safety of Life at Sea* • AIS that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	**PS 11.2** Support vessels and MODU compliant with Marine Order 21 to prevent unplanned interaction with marine users.	
	C 11.3 Establishment of a 500 m petroleum safety zone around MODU and communicated to marine users.	**PS 11.3** No entry of unauthorised vessels within the 500 m safety exclusion zone.	**MC 11.3.1** Records demonstrate breaches by unauthorised vessels within the petroleum safety zone are recorded.
			MC 11.3.2 Consultation records demonstrate that AHS has been notified before commencing the activity to allow generation of navigation warnings (MSIN and NTM (including AUSCOAST warnings where relevant)), which communicate safety exclusion zones to marine users.
	C 11.4	**PS 11.4**	**MC 11.4.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	Support vessel on standby as required during drilling activities to assist in third party vessel interactions (including warning to vessels approaching the 500 m petroleum safety zone).	Communicate with third-party vessels, prevent unplanned interaction and assist in emergencies, as required.	Records demonstrate an activity support vessel was on standby if required.
	C 11.5 When a support vessel is designated for standby it will undertake actions to prevent unplanned interactions, such as: • Maintain a 24 hour radio watch on designated radio channel(s). • Perform continuous surveillance and warn the MODU of any approaching vessels reaching the 500 m petroleum safety zone. Surveillance shall be conducted by a combination of: – visual lookout – radar watch – other electronic systems available including AIS – monitoring any additional/agreed radio communications channels – all other means available. • While complying with COLREGS, approach any vessel attempting to transit through the 500 m zone and contact vessel by all available means. • Monitor and advise the MODU if: – MODU navigation signals are defective – visibility becomes restricted. • Advise if any buoys in the area are not holding position or are not working as expected. • Supply vessel, while operating in DP inside the 500m, shall comply to Activity Specific Operating Guidelines (ASOG)	**PS 11.5** Define role of support vessels in maintaining petroleum safety zone, preventing unplanned third party vessel interactions, monitoring the effectiveness of navigation controls (e.g. signals), and warning third party vessels of navigation hazards.	**MC 11.5.1** Records of non-conformance against controls maintained.
	C 1.1 Notify AHS of activities and movements no less than four working weeks before prior to the scheduled activity commencement date.	**PS 1.1** Notification to AHS of activities and movements to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including	**MC 1.1.1** Consultation records demonstrate that AHS has been notified before commencing the activity to allow generation of navigation warnings (MSIN and NTM (including AUSCOAST warnings where relevant)), which communicate safety

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		AUSCOAST warnings where relevant)).	exclusion zones to marine users.
	C 1.3 Notify AMSA JRCC of activities and movements of the activity 24–48 hours before operations commence.	**PS 1.3** Notification to AMSA JRCC to prevent activities interfering with other marine users. AMSA's JRCC will require the MODU's details (including name, callsign and MMSI), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and need to be advised when operations start and end.	**MC 1.3.1** Consultation records demonstrate that AMSA JRCC has been notified before commencing the activity within required timeframes.
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in Appendix D.			

6.7.4 Accidental Hydrocarbon Release: Bunkering

Context		
Project vessels – Section 3.5 Helicopters – Section 3.6.2 Refuelling – Section 3.7.1	Physical environment – Section 4.4 Biological environment – Section 4.5	Stakeholder consultation – Section 5

Impacts and Risks Evaluation Summary														
Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons to marine environment from bunkering/refuelling			X			X		A	E	2	**M**	LCS GP	Broadly Acceptable	EPO 12

Description of Source of Risk

Bunkering of marine diesel between the support vessel(s) and the MODU will occur at the drilling location. Bunkering for a moored MODU is expected to be required about once per month or as required (Section 3.7.1). Additionally, refuelling of helicopters using aviation jet fuel may take place onboard the MODU.

Three credible scenarios for the loss of containment of marine diesel during bunkering operations were identified:

- Partial or total failure of a bulk transfer hose or fittings during bunkering, due to operational stress or other integrity issues, could spill marine diesel to the deck and/or into the marine environment. This would be in the order of less than 200 L, based on the likely volume of a bulk transfer hose (assuming a failure of the dry break coupling and complete loss of hose volume).
- Partial or total failure of a bulk transfer hose or fittings during bunkering, combined with a failure in procedure to shutoff fuel pumps, for a period of up to five minutes, could result in about 8 m^3 marine diesel loss to the deck and/or into the marine environment.
- Partial or total failure of a bulk transfer hose or fittings during helicopter refuelling could spill aviation jet fuel to the helicopter deck and/or into the marine environment. All helicopter refuelling activities are closely supervised and leaks on the helideck are considered to be easily detectable. In the event of a leak, transfer would cease immediately. The credible volume of such a release during helicopter refuelling would be in the order of <100 L.

Quantitative Spill Risk Assessment

Woodside has commissioned RPS to model several small marine diesel spills, including surface spill volumes of 8 m^3 in the offshore waters of northwest WA. The results of these models have indicated that exposure to surface hydrocarbons above the 10 g/m^2 threshold is limited to the immediate vicinity of the release site, with little potential to extend beyond 1 km. Therefore, it is considered that exposure to thresholds concentrations from an 8 m^3 surface spill from bunkering activities would be well within the EMBA for the vessel collision scenario detailed in Section 6.7.2. Given this, the offshore location of the Operational Area, and the fact that the same hydrocarbon type is involved for both scenarios, specific modelling for an 8 m^3 marine diesel release was not performed for this Petroleum Activities Program.

Given the physical and chemical similarities, and the relatively small credible spill volumes, marine diesel is considered to be a suitable substitute for aviation jet fuel for the purposes of this environmental risk assessment.

Hydrocarbon Characteristics

Refer to Section 6.7.2 for a description of the characteristics of marine diesel, including detail on the predicted fate and weathering of a spill to the marine environment.

Impact Assessment
Potential Impacts Overview
Previous modelling studies for 8 m^3 marine diesel releases, spilled at the surface as a result of bunkering activities, indicated that the potential for exposure to surface hydrocarbons exceeding 10 g/m^2 was confined to within the immediate vicinity (about 1 km) of the release sites. Based on the previous modelling studies and the modelling presented in Section 6.7.2, it is considered that there is limited potential for contact with sensitive receptor locations above surface (1 g/m^2 and 10 g/m^2), entrained (500 ppb) or dissolved (500 ppb) threshold concentrations from an 8 m^3 spill of marine diesel within the Operational Area. The modelling presented in Section 6.7.2 for a much larger volume diesel spill (550 m^3) predicted the diesel spill to be mainly restricted to open offshore waters, with a low probability of contacting any protected areas (the highest was a probability of 13% for surface hydrocarbons to contact the Montebello AMP at or above the threshold of 1 g/m^2 for the socio-cultural EMBA).
Summary of Potential Impacts to Protected Species and Water Quality
The potential biological and ecological impacts associated with much larger hydrocarbon spills are presented in Section 6.7.2 and Section 6.7.2; further detail on impacts specific to a spill of marine diesel from a bunkering loss are provided below. The biological consequences of such a small volume spill on identified open water sensitive receptors relate to the potential for minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill affected area. No impacts to commercial fisheries are expected. Refer to Section 6.7.2 (potential impacts of unplanned hydrocarbon release to the marine environment from vessel collision) for the detailed potential impacts. However, the extent of the EMBA associated with a marine diesel spill from loss during bunkering will be much reduced in terms of spatial and temporal scales, and hence, potential impacts from bunkering are considered very minor.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[32]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 91 (marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill entering the marine environment. Although no significant reduction in consequence could result, the overall risk is reduced.	Controls based on legislative requirements – must be adopted.	Yes C 12.1
Good Practice				
Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be linked to the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations) and	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes C 12.2

32 Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[32]	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
re-certified annually as a minimum. • There shall be dry-break couplings and flotation on fuel hoses. • There shall be an adequate number of appropriately stocked, located and maintained spill kits.				
Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • A completed PTW and/or Job Safety Analysis (JSA) shall be implemented for the hydrocarbon bunkering/ refuelling operation. • Visual monitoring of gauges, hoses, fittings and the sea surface during the operation. • Hose checks prior to commencement. • Bunkering/refuelling will commence in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Hydrocarbons shall not be transferred in marginal weather conditions.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes C 12.3
Mitigation: Oil spill response	Refer to Appendix D.			
Professional Judgement – Eliminate				
No refuelling of helicopter on MODU.	F: No. Given the distance of the Operational Area from the airports suitable for helicopter operations, and the endurance of available helicopters, eliminating helicopter refuelling is not feasible. Helicopter flights cannot be eliminated, and may be required in emergency situations. CS: Not assessed, control cannot feasibly be implemented.	Not considered – control not feasible.	Not considered – control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[32]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
The MODU brought into port to refuel.	F: No. Does not eliminate the fuel transfer risk. It is not operationally practical to transit MODU back to port for refuelling, based on the frequency of the refuelling requirements and distance from the nearest port (Dampier 180 km). CS: Significant due to schedule delay and vessel transit costs and day rates.	Eliminates the risk in the Operational Area; however, moves risk to another location. Therefore, no overall benefit.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of a bunkering spill. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement Loss of hydrocarbons to the marine environment during bunkering has been evaluated as having a low current risk rating that is unlikely to result in potential impact greater than minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill-affected area, and no impacts to commercial fisheries. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 12 No unplanned loss of hydrocarbons to the marine environment from bunkering greater than a consequence level of E[33] during the Petroleum Activities Program.	**C 12.1** Marine Order 91 (marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	**PS 12.1** Appropriate initial responses prearranged and drilled in case of a hydrocarbon spill, as appropriate to vessel class.	**MC 12.1.1** Marine assurance inspection records demonstrate compliance with Marine Order 91.
	C 12.2 Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be linked to the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations) and re-certified annually as a minimum. • There shall be dry-break couplings and flotation on fuel hoses. • There shall be an adequate number of appropriately stocked, located and maintained spill kits.	**PS 12.2.1** Ensure damaged equipment is replaced prior to failure.	**MC 12.2.1** Records confirm the MODU bunkering equipment is subject to systematic integrity checks.
		PS 12.2.2 Minimise inventory loss in the event of a failure.	**MC 12.2.2** Records confirm presence of dry break of couplings and flotation on fuel hoses.
		PS 12.2.3 Ensure adequate resources are available to allow implementation of SOPEP.	**MC 12.2.3** Records confirm presence of spill kits.
	C 12.3 Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • Implement a completed PTW and/or JSA for the hydrocarbon bunkering/refuelling operation. • Visually monitor gauges, hoses, fittings and the sea surface during the operation. • Check hoses prior to commencement. • Commence bunkering/refuelling in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Do not transfer hydrocarbons in marginal weather conditions.	**PS 12.3** Comply with Contractor procedures for managing bunkering/refuelling operations.	**MC 12.3** Records demonstrate bunkering/refuelling performed in accordance with contractor bunkering procedures.

[33] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in Figure 2-6/Section 2.6.3.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in Appendix D.			

6.7.5 Unplanned Discharges: Drilling Fluids

Context	
Project fluids – Section 3.9	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	Environmental Value Potentially Impacted							Evaluation						
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems/Habitat	Species	Socio-Economic	Decision Type	Consequence	Likelihood	Current Risk Rating	ALARP Tools	Acceptability	Outcome
Accidental discharge of drilling fluids (WBM/base oil) to marine environment due to failure of slip joint packers, bulk transfer hose/fitting, emergency disconnect system or from routine MODU operations		X	X		X	X		A	E	1	**L**	LCS GP PJ	Broadly Acceptable	EPO 13

Description of Source of Risk

Transfers

A support vessel will bulk transfer WBM or base oil to the MODU, if and when required. Failure of a transfer hose or fittings during a transfer or backload, as a result of an integrity or fatigue issue, could result in a spill of WBM or base oil to either the bunded deck or into the marine environment.

Similar to a spill event during refuelling (Section 6.7.4), the most likely spill volume of mud or base oil is likely to be less than 0.2 m³, based on the volume of the transfer hose and the immediate shutoff of the pumps by personnel involved in the bulk transfer process. However, the worst-case credible spill scenario could result in up to 8 m³ of mud or base oil being discharged. This scenario represents a complete failure of the bulk transfer hose combined with a failure to follow procedures requiring transfer activities to be monitored, coupled with a failure to immediately shut off pumps (e.g. WBM or base oil pumped through a failed transfer hose for a period of about five minutes).

Slip Joint Packer Failure

The slip joint packer enables compensation for the dynamic movement of the MODU (heave) in relation to the static location of the BOP. A partial or total failure of the slip joint packer could result in a loss of mud to the marine environment. The likely causes of this failure include a loss of pressure in the pneumatic (primary) system combined with loss of pressure in the back-up (hydraulic) system.

Catastrophic sequential failure of both slip joint packers (pneumatic and hydraulic) would trigger the alarm and result in a loss of the volume of fluid above the slip joint (conservatively 1.5 m³) plus the volume of fluid lost in the one minute (maximum) taken to shut down the pumps. At a flow rate of 1000 gallons per minute, this volume would equate to an additional 3.8 m³. In total, it is expected that this catastrophic failure would result in a loss of 5.2 m³.

Failure of either of the slip joint packers at a rate not large enough to trigger the alarms could result in an undetected loss of 20 bbl (3 m³) maximum, assuming a loss rate of 10 bbl/hr and that MODU personnel would likely walk past the moon pool at least every two hours.

Activation of the Emergency Disconnect Sequence

The EDS is an emergency system that provides a rapid means of shutting in the well (i.e. BOP closed) and disconnecting the MODU from the BOP. There are two main scenarios where the EDS could be activated: (1) automatic activation of the EDS due to a loss of MODU station keeping from the loss of multiple moorings; and (2) manual activation of the EDS due to an identified threat to the safety of the MODU, including potential collision by a third-party vessel or a loss of well integrity.

The activation of the EDS can result in the release of the entire volume of the marine riser to the marine environment. When drilling, this could result in a subsurface release of a combination of mud and cuttings at the seabed. The volume of material released depends on the water depth and hence the length of the riser (the entire riser volume would be lost). The potential impacts from a hydrocarbon loss of well integrity are discussed in Section 6.7.2.

Base Oil

Base oil (e.g. Saraline 185 V or linear alpha olefin) may be used for inflow testing prior to abandonment, to verify barrier integrity, which may result in contamination of the muds pits. A small quantity of base oil residue may be discharged at the sea surface while cleaning the mud pit (<1%) at the conclusion of the activity. Saraline 185 V, for example, is a mixture of volatile to low volatility hydrocarbons. Predicted weathering of base oil, based on typical conditions in the region, indicates that about 50% by mass is predicted to evaporate over the first day or two (refer to Table 6-15, using Saraline 185 V as an example). At this time the majority of the remainder could be entrained into the water column. In calm conditions, entrained hydrocarbons are likely to resurface with up to 100% able to evaporate over time.

Table 6-15: Characteristics of Saraline 185 V base oil

Oil type	Initial density (kg/m³)	Viscosity (cP @ 20˚C)	Volatiles (%) <180	Semi volatiles (%) 180-265	Low volatility (%) 265-380	Residual (%) >380	Aromatic (%) of whole oil < 380 °C BP
			Non-Persistent		*Persistent*		
Base oil (Saraline 185 V)	0.7760	2.0 @ 40 ºC	8.5	41.1	50.4	0	0

Impact Assessment

Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species

Base oil generally has a high volatile to semi-volatile fraction. If released to the marine environment at the surface, this generally evaporates within the first 48 hours, with the remaining fraction being on the sea surface and weathering at a slower rate. As a result of this volatility, combined with the worst-case credible spill scenario volumes (8 m³), and based on Woodside's experience of modelling base oil, it is considered there would be an extremely small footprint area associated with any release. Therefore, any surface oil would be confined to open waters with a minor surface slick that would not reach any sensitive receptors. Impacts on water quality would be minor and temporary in nature. For example, the safety data sheet for Saraline 185 V indicates that it is readily biodegradable, non-toxic in the water column and has low sediment toxicity (Shell, 2014). Marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area), but due to the small footprint of such a spill, it is anticipated that any impacts would be negligible and temporary in nature.

WBM is made up of a number of components detailed in Section 3.9.2, including a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements. If released to the marine environment at surface, there would be an extremely small impact footprint area associated with a release. Any release would be confined to the open waters of the Petroleum Activities Program Operational Area that would not reach any sensitive receptors. Components of the WBM would settle out in the water column and be subject to dilution. Given the low toxicity of WBM and its planned discharge during drilling, any impacts on water quality would be minor and temporary in nature.

The EMBA associated with the release of base oil or WBM from the activation of the EDS would be small and limited to deeper water seabed surrounding the well site (the release point). The environmental consequence of such a release would include a highly localised area at the discharge location. It is likely that any impacts to water quality would be short term, localised and a full recovery expected.

Summary of Potential Impacts to Environmental Values

Given the adopted controls, it is considered that accidental discharge of WBM or base oil will not result in a potential impact to protected species and water quality greater than slight and short term (<1 year) local impacts (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[34]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. e.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 5.3
Marine riser's telescopic joint to be: • comprised of a minimum of two packers (one hydraulic and one pneumatic) • pressure-tested in accordance with manufacturer's recommendations.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of equipment failure leading to an unplanned release of drilling fluids. Although the consequence of an unplanned release would be reduced, the reduction in likelihood reduces the overall risk providing an overall environmental benefit.	Benefits outweigh cost/sacrifice.	Yes C 13.1
Good Practice				
Drilling fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in	Benefits outweigh cost/sacrifice.	Yes C 6.1

[34] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[34]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		likelihood can occur.		
Bulk base oil will not be disposed overboard.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the consequence of the release on the environment. Although no change in likelihood is provided, the decrease in consequence results in an environmental benefit.	Benefits outweigh cost/sacrifice.	Yes C 13.2
Contractor procedure for managing drilling fluids transfers onto, around and off the MODU, which requires: • emergency shutdown systems for stopping losses of containment (e.g. burst hoses) • break-away dry-break couplings for oil based mud hoses • transfer hoses to have floatation devised to allow detection of a leak • the valve line-up will be checked prior to commencing mud transfers • constant monitoring of the transfer process • direct radio communications • completed PTW and JSA showing contractor procedures are implemented • recording and verification of volumes moved to identify any losses • mud pit dump valves locked closed when not in use for mud transfers and operated under a PTW.	F: Yes. CS: Minimal cost. Standard practice for Woodside to review contractor systems prior to performing activity.	Reduces the likelihood of an unplanned release occurring. Although no change in consequence would occur, the reduction in likelihood decreases the overall risk, providing environmental benefit.	Benefits outweigh cost/sacrifice.	Yes C 13.3
Check the functionality of: • additional SCE (augers and cuttings dryers) • mud tanks • mud tank room • transfer hoses • base oil transfer lines • base oil transfer station • base oil storage.	F: Yes. CS: Minimal cost. Standard practice	Reduces the likelihood of an event occurring and reduces the potential consequences (by limiting volume released).	Benefits outweigh cost/sacrifice.	Yes C 13.4
Mud pits contaminated with hydrocarbons will be treated prior to discharge or contained.	F: Yes. CS: Minimal cost. Standard practice	Reduces the consequence of the release on the environment, resulting in an	Benefits outweigh cost/sacrifice.	Yes C 13.5

Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/ Sacrifice (CS)[34]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
If discharge specification not met the fluid will be returned to shore.		environmental benefit.		
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Use a MODU which may have a larger tank storage capacity for WBM. As such, there would be fewer bulk transfer movements.	F: Not feasible. The use of a MODU with greater storage capacity cannot be confirmed. CS: Significant cost and schedule delay would occur if the MODU was limited to greater storage capacity.	Not considered – control not feasible.	Not considered – control not feasible.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of the accidental discharge of drilling fluids (WBM and base oil), described above. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, unplanned discharges of drilling fluids represent a low current risk rating that is unlikely to result in a potential impact greater than slight and short term contamination above background levels and/or national/international quality standards and/or known biological effect concentrations on a localised scale. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of an unplanned discharge of WBM or base oil to a broadly acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 13 No unplanned loss of WBM/ base oil greater than a consequence level of E[35] during the Petroleum Activities Program.	**C 5.3** Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning deck drainage management system**.**
	C 6.1 Drilling fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** All chemicals intended or likely to be discharged to the marine environment reduced to ALARP using the chemical assessment process.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 13.2 Bulk base oil will not be disposed overboard.	**PS 13.2** No bulk base oil discharged to the marine environment.	**MC 13.2.1** Incident reports of any unplanned discharges of base oil.
	C 13.1 Marine riser's telescopic joint to be: • comprised of a minimum of two packers (one hydraulic and one pneumatic) • pressure tested in accordance with manufacturer's recommendations.	**PS 13.1** MODU's joint packer designed and maintained to reduce hydrocarbons discharged to the environment.	**MC 13.1.1** Records demonstrate that MODU's joint packer is compliant.
	C 13.3 Contractor procedure for managing drilling fluids transfers onto, around and off the MODU, which requires: • emergency shutdown systems for stopping losses of containment (e.g. burst hoses) • break-away dry-break couplings for oil based mud hoses • transfer hoses to have flotation devised to allow detection of a leak • the valve line-up will be checked prior to	**PS 13.3** Contractor procedures to limit accidental loss to the marine environment are complied with.	**MC 13.3.1** Records demonstrate drilling fluid transfers are performed in accordance with the applicable contractor procedures.

[35] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in Figure 2-6/Section 2.6.3.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	commencing mud transfers • constant monitoring of the transfer process • direct radio communications • completed PTW and JSA showing contractor procedures are implemented • recording and verification of volumes moved to identify any losses • mud pit dump valves locked closed when not in use for mud transfers and operated under a PTW.		
	C 13.4 The functionality of: • additional SCE (augers and cuttings dryers) • mud tanks • mud tank room • transfer hoses • base oil transfer lines • base oil transfer station • base oil storage. Will be confirmed to prevent unacceptable use or discharge of base oil.	**PS 13.4** Functionality checks will be done on: • additional SCE (augers and cuttings dryers) • mud tanks • mud tank room • transfer hoses • base oil transfer lines • base oil transfer station • base oil storage.	**MC 13.4.1** Records demonstrate the presence and functionality of the specified equipment.
	C 13.5 Mud pits contaminated with hydrocarbons will be treated prior to discharge or contained. If discharge specification not met the fluid will be returned to shore.	**PS 13.5** Achieve oil concentration <1% by volume prior to discharge.	**MC 13.5** Records demonstrate that discharge criteria was met prior to discharge or contained.

6.7.6 Unplanned Discharges: Deck and Subsea Spills

Context	
Project fluids – Section 3.9	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Accidental discharge to the ocean of other hydrocarbons/ chemicals from MODU or support vessel deck activities and equipment (e.g. cranes), including helicopter refuelling and subsea spills			X		X	X		A	F	2	**L**	LCS GP PJ	Broadly Acceptable	EPO 14

Description of Source of Risk

Deck spills can result from spills from stored hydrocarbons/chemicals or equipment. The MODU and support vessels will typically store hydrocarbon/chemicals in various volumes (20 L, 205 L; up to about 4000–6000 L). Storage areas are typically set up with effective primary and secondary bunding to contain any deck spills. Releases from equipment are predominantly from the failure of hydraulic hoses, which can either be located within bunded areas or outside of bunded or deck areas (e.g. over water on cranes or subsea during installation activities). Helicopter refuelling may also take place within the Operational Area, on the helipad of the MODU.

Subsea spills can result from a loss of containment of fluids from subsea equipment including the BOP or ROVs. The ROV hydraulic fluid is supplied through hoses containing about 20 L of fluid. Hydraulic lines to the ROV arms and other tooling may become caught, resulting in minor leaks to the marine environment. Small volume hydraulic leaks may occur from equipment operating via hydraulic controls subsea (subsea control fluid). These include the diamond wire cutter, bolt tensioning equipment, ROV tooling, etc.

There is a potential for minor leaks to occur during wireline activities (Section 3.8.6) with a live well as described below (although it is noted that these sources of potential leaks relate to contingent wireline activities and typical wireline on an exploration well will not require this equipment):

- leaks from the lubricator, stuffing box and hose or fitting failure, which are expected to be less than 10 L (0.01 m^3)
- stuffing box leak/under pressure
- draining of lubricator contents
- lubricant used to lubricate hole
- excess grease/lubricant leaking from the grease injection head. Wind-blown lubricant dripping from cable/on deck.

Woodside's operational experience demonstrates that spills are most likely to originate from hydraulic hoses and have been less than 100 L, with an average volume <10 L.

Impact Assessment
Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species
Accidental spills of hydrocarbons or chemicals from the MODU or support vessels would decrease the water quality in the immediate area of the spill; however, the impacts would be expected to be temporary and very localised due to dispersion and dilution in the open ocean environment. Given the offshore/open water location, receptors such as marine fauna may only be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area). If marine fauna come into contact with a release they could suffer fouling, ingestion, inhalation of toxic vapours, irritation of sensitive membranes in the eyes, mouth, digestive and respiratory tracts and organ or neurological damage. Cetaceans may exhibit avoidance behaviour patterns and given they are smooth skinned, hydrocarbons and other chemicals are not expected to adhere. Given the small area of the potential spill and the dilution and weathering of any spill, the potential for ecological impacts to marine fauna (protected species), other communities and habitats is likely to be highly localised with no lasting effects. No impacts on socio-economic receptors are expected due to the low levels of fishing activity in the Operational Area, the small volumes of hydrocarbons/chemicals that could be accidentally spilled, and the localised and temporary nature of the impacts.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that deck or subsea hydrocarbon/chemical spills to the marine environment will not result in a potential impact greater than localised with no significant impact to environmental receptors (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 12.1
Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/moved temporarily.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Controls based on legislative requirements – must be adopted.	Yes C 14.1
Good Practice				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Benefits outweigh cost/sacrifice.	Yes C 5.3
Spill kits positioned in high risk locations around the MODU (near potential spill points such as transfer stations).	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment. The consequence is unchanged.	Benefits outweigh cost/sacrifice.	Yes C 14.2
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in Appendix D.				

[36] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Below-deck storage of all hydrocarbons and chemicals.	F: Not feasible. During operations there is a need to keep small volumes near activities and within equipment requiring use of hydrocarbons and chemicals and can result in increased risk of leaks from transfers via hose or smaller containers. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
A reduction in the volumes of chemicals and hydrocarbons stored onboard the vessel.	F: Yes. Increases the risks associated with transportation and lifting operations. CS: Project delays if required chemicals not on board. Increases the risks associated with transportation and lifting operations.	No reduction in likelihood or consequence since chemicals will still be required to enable drilling activities to occur.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of the potential unplanned accidental deck and subsea spills described above. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that an unplanned minor discharge of hydrocarbons as a result of minor deck and subsea spills represents a low current risk rating that is unlikely to result in potential impact greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines and good oil-field practice/industry best practice. The potential impacts and risks are considered acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of minor unplanned deck and subsea spills to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 No unplanned spills to the marine environment from deck activities greater than a consequence level of F[37] during the Petroleum Activities Program.	**C 5.3** Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning deck drainage management system.
	C 12.1 Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	**PS 12.1** Appropriate initial responses prearranged and drilled in case of a hydrocarbon spill, as appropriate to vessel class.	**MC 12.1.1** Marine assurance inspection records demonstrate compliance with Marine Order 91.
	C 14.1 Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/ moved temporarily.	**PS 14.1** Failure of primary containment in storage areas does not result in loss to the marine environment.	**MC 14.1.1** Records confirms all liquid chemicals and fuel are stored in bunded/ secondarily contained areas when not being handled/moved temporarily.
	C 14.2 Spill kits positioned in high risk locations around the rig (near potential spill points such as transfer stations).	**PS 14.2** Spill kits to be available for use to clean up deck spills.	**MC 14.2.1** Records confirms spill kits are present, maintained and suitably stocked.

[37] Defined as 'Slight, short term local impact (< 1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in Figure 2-6/Section 2.6.3.

6.7.7 Unplanned Discharges: Loss of Solid Hazardous and Non-hazardous Wastes/Equipment

Context	
Project vessels – Section 3.5	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Accidental loss of hazardous or non-hazardous wastes/ equipment to the marine environment (excludes sewage, grey water, putrescible waste and bilge water)			X		X	X		A	F	2	**L**	LCS GP PJ	Broadly Acceptable	EPO 15

Description of Source of Risk

The MODU and support vessels will generate a variety of solid wastes including packaging and domestic wastes such as aluminium cans, bottles, paper and cardboard. Hence, there is the potential for solid wastes to be lost overboard to the marine environment. Equipment that has been recorded as being lost on previous vessel campaigns (primarily windblown or dropped overboard) has included the loss of a metal pole and hardhat. Loss of solid wastes has potential to occur during backloading activities, periods of adverse weather and incorrect waste storage.

Hazardous Waste is defined as any waste that if not handled, stored, or disposed of in an appropriate manner presents a significant risk with regards to health, safety and environment. Hazardous solid waste includes but not is limited to oily rags, batteries, empty drums, empty paint tins etc.

Impact Assessment

Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species

The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the environment and secondary impacts relating to potential contact of marine fauna with wastes, resulting in entanglement or ingestion and leading to injury and death of individual animals. The temporary or permanent loss of waste materials into the marine environment is not likely to have a significant environmental impact, based on the location of the Operational Area, the types, size and frequency of wastes that could occur and species present.

Summary of Potential Impacts to Environmental Values

Given the adopted controls, it is considered that the accidental discharge of solid waste described will result in localised impacts not significant to environmental receptors (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[38]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class), prescribes matters necessary to give effect to Annex V of MARPOL, which prohibits the discharge of all garbage into the sea, except as provided otherwise.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduces the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 5.1
Good Practice				
MODU waste arrangements, which require: • dedicated space for waste segregation bins and skips to be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) to be transported from the MODU and disposed onshore.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes C 15.1
Support vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes C 15.2

[38] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[38]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
MODU ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable, this activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release of solid waste and therefore no change to the likelihood. Since the waste objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost sacrifice.	Yes C 15.3
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharges of waste. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, accidental discharge of solid waste represents a low current risk rating that is unlikely to result in a potential impact above slight, short term impacts on species, habitat (but not affecting ecosystems function), physical and biological attributes. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet legislative requirements (Marine Order 95). The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 No unplanned releases of solid hazardous or non-hazardous waste to the marine environment greater than a consequence level of F[39] during the Petroleum Activities Program.	**C 5.1** Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class), prescribes matters necessary to give effect to Annex V of MARPOL, which prohibits the discharge of all garbage into the sea, except as provided otherwise.	**PS 5.1** MODU and support vessels compliant with Marine Order 95 – pollution prevention – garbage.	**MC 5.1** Records demonstrate MODU and support vessels are compliant with Marine Order 95 – pollution prevention (as appropriate to vessel class).
	C 15.1 MODU waste arrangements, which require: • dedicated space for waste segregation bins and skips to be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) to be transported from the MODU and disposed onshore.	**PS 15.1** Hazardous and non-hazardous waste will be managed in accordance with the Drilling waste arrangements.	**MC 15.1.1** Records demonstrate compliance against Drilling waste arrangements.
	C 15.2 Support vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	**PS 15.2** Hazardous and non-hazardous waste will be managed in accordance with the support vessel waste arrangements.	**MC 15.2.1** Records demonstrate compliance against support vessel waste arrangements.

[39] Defined as ‘ No lasting effect, localised impact not significant to environmental receptors’ as in Figure 2-6/Section 2.6.3

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 15.3 MODU ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes[40] lost overboard. Where safe and practicable, this activity will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment or, ROV availability and suitable weather).	**PS 15.3** Any hazardous solid waste dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 15.3.1** Records detail the recovery attempt consideration and status of any hazardous waste lost to marine environment.

[40] Hazardous waste is defined as any waste that if not handled, stored, or disposed of in an appropriate manner presents a significant risk with regards to health, safety and environment. Hazardous solid waste includes but is not limited to oily rags, batteries, empty drums, empty paint tins etc.

6.7.8 Physical Presence: Vessel Collision with Marine Fauna

Context	
Project vessels – Section 3.5	Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Accidental collision between MODU/support vessels and protected marine fauna						X		A	E	1	**L**	LCS GP PJ	Broadly Acceptable	EPO 16

Description of Source of Risk

The MODU and support vessels operating in and around the Operational Area may present a potential hazard to protected marine fauna, including cetaceans (e.g. pygmy blue whales), whale sharks and marine turtles. 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) and mortality. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth), the type of animal potentially present and their behaviours. Support vessels are typically stationary or moving at low speeds when supporting drilling operations; support vessels typically transit to and from the Operational Area between two and four trips per week (e.g. to port) when the MODU is present in the Operational Area.

Impact Assessment

Potential Impacts to protected species

The likelihood of vessel/whale collision being lethal is influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality (Jensen & 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. At a speed of four knots, the risk was estimated to be less than 10%. Vessel–whale collisions at this speed are uncommon and, based on reported data contained in the US NOAA database (Jensen & Silber, 2004), there are only two known instances of collisions when the vessel was travelling at less than six knots. Both of these were from whale watching vessels that were deliberately placed among whales.

Support vessels in the Operational Area are likely to be travelling less than eight knots; therefore, the chance of a vessel collision with protected species resulting in a lethal outcome is significantly reduced versus faster moving vessels. No known key aggregation areas (resting, breeding or feeding) for protected species are located within or immediately adjacent to the Operational Area; however, the following BIAs and habitat critical to the survival of a species overlap with the Operational Area (refer to Table 4-6 for more detail of seasonal timings):

- Pygmy blue whale, partial overlap with the migration BIA (Figure 4-11). Seasonally present April to August (north bound migration) and October to January (south bound migration).
- Whale shark foraging BIA (Figure 4-14). Seasonally present between March and July during migrations to and from Ningaloo Reef. Occasionally individuals may occur at other times of the year.

- Internesting habitat critical to the survival of flatback turtles and internesting BIA (Figure 4-13). Seasonally present during the nesting season between October and March. Occasionally individuals may occur at other times of the year.

The timing of the activity could occur at any time throughout the year (all seasons); therefore, it is possible that activity will overlap with the migration seasons or seasonal presence of the species above and it is likely that there may be increased numbers of individuals of these species within the Operational Area during the seasonal periods described above.

Whale sharks are at risk from vessel strikes when feeding at the surface or in shallow waters (where there is limited option to dive). Whale sharks may traverse offshore NWS waters including the Operational Area during their migrations to and from Ningaloo Reef and whale sharks have been tracked moving across the Operational Area. However, it is expected that whale shark presence within the Operational Area would not comprise significant numbers, given there is no main aggregation area within the vicinity of the Operational Area, and their presence would be transitory and of a short duration.

The 60 km internesting buffer identified as habitat critical to the survival of flatback turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) is based primarily on the movements of tagged internesting flatback turtles along the North West Shelf reported by Whittock et al. (2014), which found that flatback turtles may demonstrate internesting displacement distances up to 62 km from nesting beaches. However, these movements were confined to longshore movements in nearshore coastal waters or travel between island rookeries and the adjacent mainland (Whittock et al. 2014). A more recent paper by the same authors (Whittock et al. 2016) has more precisely defined flatback turtle internesting habitat along the North West Shelf. Whittock et al. (2016) defined suitable internesting habitat as water 0–16 m deep and within 5–10 km of the coastline, while unsuitable internesting flatback habitat was defined as waters >25 m deep and >27 km from the coastline. There is no evidence to date to indicate flatback turtles swim out into deep offshore waters during the internesting period.

With consideration of the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and the water depth (at least 166 m), it is considered that the Operational Area is highly unlikely to represent important internesting or foraging habitat for any species of marine turtle. It is acknowledged that there are significant nesting sites along the mainland coast and islands of the region.

It is unlikely that vessel movement associated with the Petroleum Activities Program will have a significant impact on marine fauna populations, given: (1) the low presence of transiting individuals; (2) avoidance behaviour commonly displayed by whales, whale sharks and turtles; and (3) low operating speed of the MODU (when in transit) and support vessels (generally less than eight knots or stationary in the Operational Area, unless operating in an emergency).

Summary of Potential Impacts to Environmental Values

Given the adopted controls, it is considered that a collision, were it to occur, will not result in a potential impact greater than slight, short term impact on species (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[41]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[42]: • Support vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Support vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale	F: Yes. CS: Minimal cost. Standard practice.	Implementation of these controls will reduce the likelihood of a collision between a cetacean, whale shark or turtle occurring. The consequence of a collision is unchanged.	Controls based on legislative requirements – must be adopted.	Yes C 16.1

[41] Qualitative measure.

[42] For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[41]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
(with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, support vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale shark and not allow the vessel to approach closer than 30 m of a whale shark.				
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid whale migration periods.	F: Not feasible. Timing of activities is linked to MODU schedule. Timing of all activities is currently not determined, and due to MODU availability and operational requirements, conducting activities during migration/ nesting seasons may not be able to be avoided. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
The use of dedicated MFOs on support vessels for the duration of the activity to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes, however vessel bridge crews already maintain a constant watch during operations, and crew complete specific cetacean observation training. CS: Additional cost of MFOs considered unnecessary.	Given support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not significantly further reduce the risk.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[41]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of potential vessel collision with protected marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a low current risk rating that is unlikely to result in a potential impact greater than minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet the requirements of Part 8 (Division 8.1) of the EPBC Regulations 2000. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of vessel collision with marine fauna to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 16 No vessel strikes with protected marine fauna (whales, whale sharks, turtles) during the Petroleum Activities Program.	**C 16.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[43]: • Support vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Support vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, support vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale	**PS 16.1.1** Compliance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to minimise potential for vessel strike.	**MC 18.1.1** Records demonstrate no breaches of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.
		PS 16.1.2 All vessel strike incidents with cetaceans will be reported in the National Ship Strike Database (as outlined in the Conservation Management Plan for the Blue Whale—A Recovery Plan under the EPBC Act 1999, Commonwealth of Australia, 2015).	**MC 16.1.1** Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database.

[43]For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	shark and not allow the vessel to approach closer than 30 m of a whale shark.		

6.7.9 Physical Presence: Disturbance to Seabed from Loss of Station Keeping

Context	
Project vessels – Section 3.5	Physical environment – Section 4.4 Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Loss of station keeping of MODU leading to seabed disturbance					X			A	E	2	M	GP PJ RBA	Broadly Acceptable	EPO 17

Description of Source of Risk

A moored MODU is planned to be used for drilling the well. The rig will be secured on station by a number of mooring lines, as dictated by the mooring analysis, which are held in place by anchors deployed to the seabed (Section 3.5.1). High energy weather events such as cyclones, while the MODU is on station, can lead to excessive loads on the mooring lines resulting in failure (either anchor(s) dragging or mooring lines parting). A failure of mooring integrity may lead to the MODU losing station, which may lead to the mooring lines and anchors attached to the MODU being trailed across the seabed.

For a moored MODU, personnel on-board the MODU are typically evacuated during cyclones. Woodside implements a risk-based assessment process to aid in decision-making for cyclone evacuations, with the well suspended prior to MODU evacuation. Support vessels also demobilise from the Operational Area during the passage of a cyclone. While the MODU is temporarily abandoned, the position of the MODU is monitored remotely for any deviation. Support vessels and MODU personnel return to the Operational Area as soon as safe to do so after a cyclone evacuation. Operational experience indicates cyclone evacuations typically last for seven days.

Industry statistics from the North Sea show that a single mooring line failure for MODUs is the most common failure mechanism (33×10^{-4} per line per year), followed by a double mooring line failure (11×10^{-4} per line per year) (Petroleumstilsynet, 2014). Note that single and double mooring line failures do not typically result in the loss of station keeping. In the event of partial or complete mooring failures that are sufficient to result in a loss of station keeping, industry experience indicates that MODUs may drift considerable distances from their initial position (Offshore: Risk & Technology Consulting Inc., 2002). Partial mooring failures leading to a loss of station keeping resulted in smaller MODU displacements due to the remaining anchors dragging along the seabed when compared to complete mooring failures; complete mooring failures resulted in a freely drifting MODU (Offshore: Risk & Technology Consulting Inc., 2002).

NOPSEMA recorded four cases of anchor drag due to loss of MODU holding station during cyclone activity between 2004 and 2015 (NOPSEMA, 2015).

Impact Assessment
Potential Impacts to Other Benthic Communities
Benthic habitats in the Operational Area are expected to largely consist of fine grained muddy sands and silts with an absence of hard substrate. In the unlikely event of a cyclone resulting in the MODU breaking its moorings, the anchors could cause physical damage to soft sediment and potentially limited hard bottom habitats (including in the Continental Slope and Demersal Fish Communities KEF which has minor overlap with the Operational Area; and the Ancient Coastline at 125 m Depth Contour KEF which is 4 km from the Operational Area) and associated benthic communities (e.g. epifauna and infauna). This would result in localised short-term impacts to habitat and biological attributes. Given the low abundance, diversity and broad-scale distribution of the benthic habitat types within and adjacent to the Operational Area, the scale of impact will not be significant.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, seabed disturbance from a loss of station keeping would result in only slight, short-term local impacts to soft sediment benthic communities (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[44]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Specifications and requirements for station keeping equipment (mooring systems) require that: • systems are tested and inspected in accordance with API RP 2I • systems have sufficient capability such that a failure of any single component will not cause progressive failure of the remaining anchoring arrangement.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of mooring failure leading to loss of station keeping. Should mooring failure occur, no significant reduction in consequence could occur.	Benefit outweighs cost sacrifice.	Yes C 17.1
Professional Judgement – Eliminate				
Only use a DP MODU (no anchoring required).	F: No. CS: It is not technically feasible for the MODU to use DP in the water depth of the well location (about 201 m). Woodside has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Eliminates the risk.	Disproportionate. The cost/sacrifice associated with only using a DP-capable MODU outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				

[44] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[44]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Engineered Solution				
MODU tracking equipment operational when the MODU unmanned.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a loss of station keeping occurring. Although no reduction in consequence could occur, the overall risk is reduced.	Benefit outweighs cost sacrifice.	Yes C 17.2
Risk Based Analysis				
Project-specific Mooring Design Analysis.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of mooring failure occurring. Although no reduction in consequence would occur, the overall risk is reduced.	Benefit outweighs cost sacrifice.	Yes C 10.5
Mooring system is tested to recommended tension as per API RP 2SK.	F: Yes. CS: Minimal cost. Standard practice	Reduces the likelihood of anchor drag leading to seabed disturbance.	Benefit outweighs cost sacrifice.	C 17.3
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from a loss of station holding. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, seabed disturbance from a loss of station keeping will not result in a potential impact greater than localised effects to benthic habitat, with impacts to soft sediment benthic communities expected to be localised and short-term with no significant impacts to environmental receptors. Further opportunities to reduce impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from a loss of station keeping to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 No mooring failure for the MODU during the Petroleum Activities Program.	**C 17.1** Specification and requirements for station keeping equipment (mooring systems) require that: • systems are tested and inspected in accordance with API RP 2I • systems have sufficient capability such that a failure of any single component will not cause progressive failure of the remaining anchoring arrangement.	**PS 17.1** MODU mooring system tested and in place to ensure no complete mooring failure.	**MC 17.1.1** Records demonstrate mooring system tests and inspection.
	C 17.2 MODU tracking equipment operational when the MODU unmanned.	**PS 17.2** Tracking of the MODU is possible when the MODU is unmanned.	**MC 17.2.1** Records show the MODU has functional tracking equipment for instances when MODU is unmanned.
	C 10.5 Project-specific Mooring Design Analysis.	**PS 10.5** Anchors installed as per Mooring Design Analysis to ensure adequate MODU station holding capacity.	**MC 10.5.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
	C 17.3 Mooring system is tested to recommended tension as per API RP 2SK.	**PS 17.3** Monitoring compliant with ISO 19901-7:2013.	**MC 17.3.1** Records confirm mooring system is tested to recommended tension as per API RP 2SK.

6.7.10 Physical Presence: Dropped Object Resulting in Seabed Disturbance

Context	
Project vessels – Section 3.5 Drilling activities – Section 3.8	Biological environment – Section 4.5

Impacts and Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and Groundwater	*Marine Sediment*	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Dropped objects resulting in seabed disturbance		X			X			A	F	2	**L**	LCS GP PJ	Broadly Acceptable	EPO 18

Description of Source of Risk
There is the potential for objects to be dropped overboard from the MODU and support vessels to the marine environment. Objects that have been dropped during previous offshore projects include small numbers of personnel 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).

Impact Assessment
Potential Impacts to Other Benthic Communities
In the unlikely event of loss of equipment or materials to the marine environment, potential environmental effects would be limited to localised physical impacts on benthic communities. As a result of recovery of any dropped objects, this impact will be temporary in nature. However, if the object cannot be recovered due to health and safety, operational constraints and other factors (locating dropped objects at depth) then the impact will be long term. The temporary or permanent loss of dropped objects into the marine environment is not likely to have a significant environmental impact, as the benthic communities associated with the Operational Area are of low sensitivity and are broadly represented throughout the NWMR (Section 4.4.4). One KEF – the Continental Slope Demersal Fish Communities – has been identified as overlapping the Operational Area, as described in Section 4.7.1. Given only a small proportion of the KEF is overlapping the Operational Area, and the nature and scale of impacts and risks from dropped objects, seabed sensitivities associated with this KEF will not be significantly impacted. Further, considering the types, size and frequency of dropped objects that could occur, it is unlikely that a dropped object would have a significant impact on any benthic community.
Summary of Potential Impacts to Environmental Values
Given the adopted controls and the predicted small footprint of a dropped object, it is considered that a dropped object will result in only localised impacts to a small area of the seabed and a small proportion of the benthic population; however, no significant impact to environmental receptors and with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[45]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
The MODU/support vessel work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked prior to commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks of that lift, including consideration of weather and sea state.	F: Yes. CS: Minimal cost. Standard practice.	Occurs after a dropped object event and therefore no change to the likelihood. Since the object may be recovered, a reduction in consequence is possible.	Benefits outweigh cost/sacrifice.	Yes C 18.1
MODU/support vessel inductions include control measures and training for crew in dropped object prevention.	F: Yes. CS: Minimal cost. Standard practice.	By ensuring crew are appropriately trained in dropped object prevention, the likelihood of a dropped object event is reduced. No change in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes C 18.2
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from dropped objects. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

[45] Qualitative measure

Demonstration of Acceptability
Acceptability Statement
The impact assessment has determined that, given the adopted controls, dropped objects will not result in a potential impact greater than minor and temporary disruption to a small area of the seabed, a small proportion of the benthic population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from dropped objects to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 No incidents of dropped objects to the marine environment greater than a consequence level of F[46] during the Petroleum Activities Program.	**C 18.1** The MODU/support vessel work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked prior to commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks of that lift, including consideration of weather and sea state.	**PS 18.1** All lifts conducted in accordance with applicable MODU/ support vessel work procedures to limit potential for dropped objects.	**MC 18.1.1** Records show lifts conducted in accordance with the applicable MODU/support vessel work procedures.
	C 18.2 MODU/support vessel inductions include control measures and training for crew in dropped object prevention.	**PS 18.2** Awareness of requirements for dropped object prevention.	**MC 18.2.1** Records show dropped object prevention training is provided to the MODU/support vessels.

[46] Defined as ‘No lasting effect, localised impact not significant to environmental receptors’ as in Figure 2-6/Section 2.6.3.

6.7.11 Physical Presence: Accidental Introduction and Establishment of Invasive Marine Species

Context		
Project vessels – Section 3.5	Physical environment – Section 4.4 Biological environment – Section 4.5	Stakeholder consultation – Section 5

Impacts and Risks Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Introduction of invasive marine species (IMS)					X	X	X	A	D	0	L	LCS	Broadly Acceptable	EPO 19

Description of Source of Risk

IMS are a subset of Non-indigenous Marine Species (NIMS) that have been introduced into a region beyond their natural biogeographic range, resulting in impacts to social/cultural, human health, economic and/or environmental values. NIMS are species that have the ability to survive, reproduce and establish founder populations. However, not all NIMS introduced into an area will thrive or cause demonstrable impacts. The majority of NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours (Lewis & Coutts, 2010).

During the Petroleum Activities Program, 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 and support vessels (Section 3.5). There is therefore the potential for the MODU and support vessels to transfer IMS from either international waters or Australian waters into the Operational Area.

All vessels are subject to some level of marine fouling. Organisms attach to the vessel hull, particularly 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.). Commercial vessels typically maintain anti-fouling coatings to reduce the build-up of fouling organisms. Organisms can also be drawn into ballast tanks during onboarding of ballast water required to maintain safe operating conditions.

During the Petroleum Activities Program, project vessels have the potential to introduce IMS to the Operational Area through biofouling (containing IMS) on vessels, as well as ballast water exchange (as described above). Cross-contamination between vessels can also occur (e.g. IMS translocated between project vessels).

Impact Assessment

Potential Impacts to Ecosystems/Habitats, Species and Socio-economic Values

Potential IMS have historically been introduced and translocated around Australia by a variety of natural and human means including biofouling and ballast water. Potential IMS vary from one region to another depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type, which dictate their survival and invasive capabilities. IMS typically require hard substrate in the photic zone, therefore requiring shallow waters to become established. Highly-disturbed, shallow-water environments such as shallow coastal waters, ports and marinas are more susceptible to IMS colonisation, whereas IMS are generally unable to successfully establish in deep water ecosystems and open-water environments where the rate of dilution and the degree of dispersal are high (Williamson & Fitter, 1996; Paulay et al., 2002; Geiling, 2014). The undisturbed, deep water, offshore location of the Operational Area is therefore unlikely to represent suitable habitat for the establishment of IMS.

Once introduced, IMS may pose a considerable threat to the Australian marine environment, including commercial fisheries. IMS may prey on local species (which had previously not been subject to this kind of predation and therefore have not evolved protective measures), they may outcompete indigenous species for food, space or light, and can also interbreed with local species, creating hybrids such that the endemic species is lost. These changes to the local marine environment result in changes to the natural ecosystem.

IMS have also proven economically damaging to areas where they have been introduced and established. Such impacts include direct damage to assets (fouling of vessel hulls and infrastructure) and depletion of commercially harvested marine life (e.g. shellfish stocks). IMS have proven particularly difficult to eradicate from areas once established. If the introduction is detected early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life.

While the MODU and support vessels have the potential to introduce IMS into the Operational Area, the deep offshore open waters of the Operational Area (166–511 m) are not conducive to the settlement and establishment of IMS. Furthermore, the Operational Area is away from shorelines and/or critical habitat. The nearest sensitive receptor is the Montebello Marine Park located 11 km to the east of the Operational Area at its nearest point. The northern portion of the Montebello AMP closest to the Operational Area is in water depths greater than 50 m, with the shallower nearshore waters of the Montebello Islands about 50 km from the Operational Area. It is therefore not expected that settlement and establishment of IMS within the Marine Park could occur as a result of the Petroleum Activities Program. The likelihood of IMS being introduced and establishing viable populations within the Operational Area or surrounds is considered remote.

Summary of Potential Impacts to Environmental Values

In support of Woodside's assessment of the impacts and risks of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of a marine pest translocation. The results of this assessment are presented in Table 6-16.

As a result of this assessment, Woodside has presented the highest potential consequence as a D and likelihood as Remote (0), resulting in an overall low risk following the implementation of identified controls.

Table 6-16: Evaluation of risks and impacts from marine pest translocation

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Area and establishment on the seafloor or subsea structures.	**Not Credible** The deep offshore open waters of the Operational Area are located away from shorelines and/or critical habitat, more than 25 nm from a shore and in waters 166–511 m deep; they are therefore not conducive to the settlement and establishment of IMS.		
Introduced to Operational Area and establishment on the MODU or a support vessel.	**Credible** There is potential for the transfer of marine pests between the MODU and support vessels within the Operational Area.	**Environment – Not Credible** The translocation of IMS from a colonised MODU or support vessel to shallower environments via natural dispersion is not considered credible, given the distances of the Operational Area from nearshore environments (i.e. greater than 12 nm/50 m water depth). There is therefore no credible environmental risk and the assessment is limited to Woodside's reputation and brand. **Reputation – D** If IMS were to establish on the MODU or a support vessel this could potentially impact the vessel operationally through the fouling of intakes, result in translocation of an IMS into the Operational Area and, depending on the species, potentially transfer of an IMS to other support vessels, which would likely result in the quarantine of the vessel until eradication could occur (through cleaning and treatment of infected areas), which would be costly to perform. Such introduction would be expected to have minor impact to Woodside's reputation, particularly with Woodside's contractors, and would likely have a reputational impact on future proposals.	**Remote (0)** Interactions between the MODU and support vessels will be limited during the Petroleum Activities Program, with 500 m safety exclusion zones being adhered to around the MODU, and interactions limited to short periods of time alongside (i.e. during backloading, bunkering activities). There is also no direct contact (i.e. they are not tied up alongside) during these activities. Spread of marine pests via ballast water in these open ocean environments is also considered remote due to lack of suitable habitat for settlement and establishment.

Transfer between the MODU and support vessels and by extension from support vessels to other marine environments beyond the Operational Area (i.e. transfer of IMS from offshore MODU to a support vessel and then to another environment).	**Not Credible** This risk is considered so remote that it is not credible for the purposes of the activity. The transfer of a marine pest between the MODU and support vessels was already considered remote, given the offshore open ocean environment (i.e. transfer pathway discussed above). For a marine pest to then establish into a mature spawning population on the new project vessel (which would have been through Woodside's risk assessment process) and then transfer to another environment is not considered credible (i.e. beyond the Woodside risk matrix). The MODU and support vessels will be located in an offshore, open ocean, deep environment, where IMS survival is implausible. Furthermore this marine pest once transferred would need to survive on a new vessel with good vessel hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from the Operational Area to shore. In the event it was to survive this trip, it would then need to establish a viable population in nearshore waters.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[47]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
The MODU and support vessels will manage their ballast water using one of the approved ballast water management options, as specified in the Australian Ballast Water Management Requirements.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of transferring marine pests between project vessels within the Operational Area. No change in consequence would occur.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	Yes C 19.1
Good Practice				
Woodside's IMS risk assessment process[48] will be applied to the MODU, project vessels and immersible equipment. Assessment will consider the following risk factors: For vessels: • vessel type • previous IMS inspection and cleaning history, including for internal niches • out-of-water period prior to mobilisation • age and suitability of antifouling coating at mobilisation date • internal treatment systems and history	F: Yes. CS: Minimal cost. Good practice implemented across all Woodside Operations.	Identifies potential risks and additional controls implemented accordingly. In doing so, the likelihood of transferring marine pests between the MODU and support vessels within the Operational Area is reduced. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes C 19.2

[47] Qualitative measure.

[48] Woodside's IMS risk assessment process was developed with regard to the National biofouling management guidelines for the petroleum production and exploration industry and Guidelines for the control and management of a ships' biofouling to minimise the transfer of invasive aquatic species (IMO Guidelines, 2011).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[47]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
• origin and proposed area of operation • number of stationary/slow speed periods greater than seven days • region of stationary or slow periods • type of activity – contact with seafloor. For immersible equipment • region of deployment since last thorough clean, particularly coastal locations • duration of deployments • duration of time out-of-water since last deployment • transport conditions during mobilisation • post-retrieval maintenance regime. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.				
Professional Judgement – Eliminate				
No discharge of ballast water during the Petroleum Activities Program.	F: No. Ballast water discharges are critical for maintaining vessel stability. Given the nature of the Petroleum Activities Program, the use of ballast (including the potential discharge of ballast water) is considered to be a safety-critical requirement. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Eliminate use of MODU/vessels.	F: No. Given vessels must be used to implement the project, there is no feasible means to eliminate the source of risk.	Not assessed, control not feasible.	Not assessed, control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[47]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Loss of the project.			
Professional Judgement – Substitute				
Source the MODU and support vessels based in Australia only.	F: Potentially. Limiting activities to only use local vessels could potentially pose a significant risk in terms of time and duration of sourcing a vessel, as well as the ability of the local vessels to perform the required tasks. For example there are limited MODUs vessels based in Australian waters. While the project will attempt to source support vessels locally, it is not always possible. Availability cannot always be guaranteed when considering competing oil and gas activities in the region. In addition, sourcing Australian based vessels only will cause increases in cost due to pressures of vessel availability. CS: Significant cost and schedule impacts due to restrictions of vessel hire opportunities.	Sourcing vessels from within Australia will reduce the likelihood of IMS from outside Australian waters; however, it does not reduce the likelihood of translocation of species native to Australia but alien to the Operational Area and NWMR, or of IMS that have established elsewhere in Australia. The consequence is unchanged.	Disproportionate. Sourcing vessels from Australian waters may result in a reduction in the likelihood of IMS introduction to the Operational Area; however, the potential cost of implementing this control is grossly disproportionate to the minor environmental gain (or reducing an already remote likelihood of IMS introduction) potentially achieved by using only Australian based vessels. Consequently, this risk is considered not reasonably practicable.	No
IMS Inspection of all vessels.	F: Yes. Approach to inspect vessels could be a feasible option. CS: Significant cost and schedule impacts. In addition, the IMS risk assessment process (C 21.2) is seen to be more cost effective, as this control allows Woodside to manage the introduction of marine pests through biofouling, while targeting its efforts and resources to areas of greatest concern.	Inspection of all vessels for IMS would reduce the likelihood of IMS being introduced to the Operational Area. However, this reduction is unlikely to be significant given the other control measures implemented. No change in consequence would occur.	Disproportionate. The cost outweighs the benefit gained, as other controls will be implemented to achieve an ALARP position.	No
Professional Judgement – Engineered Solution				
None identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[47]***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (e.g. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of IMS introduction. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, translocation of IMS may result in a minor, short-term (1–2 years) impact with no lasting effect and the likelihood of introducing IMS to the Operational Area is considered remote[49]. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of invasive marine species to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria

Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 No introduction and establishment of invasive marine species into the Operational Area as a result of the Petroleum Activities Program.	**C 19.1** The MODU and support vessels will manage their ballast water using one of the approved ballast water management options, as specified in the Australian Ballast Water Management Requirements.	**PS 19.1** Project vessels manage ballast water in accordance with Australian Ballast Water Management Requirements.	**MC 19.1.1** Ballast Water Records System maintained by vessels which verifies compliance against Australian Ballast Water Management Requirements.
	C 19.2 Woodside's IMS risk assessment process will be applied to the MODU, project vessels and immersible equipment. Assessment will consider the following risk factors: For vessels: • vessel type • previous IMS inspections and cleaning history, including for internal niches • out-of-water period prior to mobilisation • age and suitability of antifouling coating at mobilisation date • internal treatment systems and history	**PS 19.2a** Prior to entering the Operational Area MODUs, project vessels and relevant immersible equipment are determined to be low risk[51] of introducing IMS of concern, and maintain this low risk from determination to mobilisation.	**MC 19.2.1** Records of IMS risk assessments maintained for the MODU and support vessels conducting the Petroleum Activities Program.
		PS 19.2b In accordance with Woodside's IMS risk assessment process, the IMS risk assessments will be undertaken by an authorised Environment Advisor who has completed relevant Woodside IMS training or by qualified and experienced IMS inspector.	**MC 19.2.2** Records confirm that the IMS risk assessments undertaken by an Environment Adviser or IMS inspector (as relevant).

[49] All project vessels including the MODU will undergo Woodside's IMS risk assessment process; therefore, the risk of introducing IMS to the Operational Area and then onto nearshore or coastal areas was considered not credible.

[51] Low risk of introducing IMS of concern is defined as either no additional management measures required or, management measures have been applied to reduce the risk.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• origin and proposed area of operation • number of stationary/slow speed periods greater than seven days • region of stationary or slow periods • type of activity – contact with seafloor. For immersible equipment • region of deployment since last thorough clean, particularly coastal locations • duration of deployments • duration of time out-of-water since last deployment • transport conditions during mobilisation • post-retrieval maintenance regime. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections[50] or cleaning) will be implemented to minimise the likelihood of IMS being introduced.		

[50] IMS inspections will be undertaken by a qualified and experienced IMS inspector.

7. IMPLEMENTATION STRATEGY

7.1 Overview

Regulation 14 of the Environment Regulations requires an EP to contain an implementation strategy for the activity. The Implementation Strategy for the Petroleum Activities Program confirms fit-for-purpose systems, practices and procedures are in place to direct, review and manage the activities so environmental risks and impacts are continually being reduced to ALARP and are Acceptable, and that environmental performance outcomes and standards outlined in this EP are achieved.

Woodside, as nominated titleholder, is responsible for ensuring the Petroleum Activities Program is managed in accordance with this Implementation Strategy and the WMS (see Section 1.8).

7.2 Systems, Practice and Procedures

All operational activities are planned and performed in accordance with relevant legislation, standards and management measures identified in this EP, and internal environment standards and procedures (**Section 4**).

Processes are implemented to verify that:

- controls to manage environmental impacts and risks to ALARP and Acceptable are effective
- environmental performance outcomes are met
- standards defined in this EP are complied with.

The systems, practices and procedures that will be implemented are listed in the Performance Standards (PS) contained in this EP. Document names and reference numbers may be subject to change during the statutory duration of this EP and is managed through a changes register and update process.

7.3 Roles and Responsibilities

Key roles and responsibilities for Woodside and Contractor personnel relating to implementing, managing and reviewing this EP are described in Table 7-1. Roles and responsibilities for oil spill preparation and response are outlined in Appendix D and the Woodside Oil Pollution Emergency Arrangements (Australia).

Table 7-1: Roles and responsibilities

Title (role)	Environmental Responsibilities
Office-based Personnel	
Woodside Project Manager	• Monitor and manage the activity so it is conducted as per the relevant standards and commitments in this EP. • Notify the Woodside Environmental Adviser of any scope changes in a timely manner. • Liaise with regulatory authorities as required. • Review this EP as necessary and manage change requests. • Ensure all project and support vessel crew members complete an HSE induction. • Verify that contractors meet environmental-related contractual obligations. • Confirm environmental incident reporting meets regulatory requirements (as outlined in this EP) and Woodside internal event recording, investigation and learning requirements. • Monitor and close out corrective actions identified during environmental monitoring or audits.

Title (role)	Environmental Responsibilities
Woodside Well Delivery Manager	• Ensure drilling operations are conducted as per this EP and approval conditions. • Provide sufficient resources to implement the drilling-related management measures (i.e. controls, EPOs, PSs and MC) in this EP. • Ensure MODU and support vessel personnel are given an Environmental Induction as per Section 7.4.2 of this EP at the start of the drilling program. • Confirm controls and performance standards in this EP are actioned, as required, before drilling commences. • Ensure the MODU start-up meets the requirements of Woodside's drilling and managing MODU operations process.
Woodside Drilling Superintendent	• Ensure the drilling program meets the requirements detailed in this EP. • Ensure changes to the drilling program are communicated to the Woodside Environmental Adviser. • Ensure Woodside's Well Site Manager is provided with the resources required to ensure the management measures (i.e. controls, EPOs, EPs and MC) in this EP are implemented. • Confirm environmental incident reporting meets regulatory requirements (as outlined in this EP) and Woodside internal Event recording, investigation and learning requirements. • Monitor and close out corrective actions identified during environmental monitoring or audits.
Woodside Drilling Engineers	• Ensure changes to the drilling program are communicated to the Woodside Environmental Adviser. • Ensure all drilling fluid chemical components and other fluids that may be used downhole have been reviewed by the Woodside Environmental Adviser.
Woodside Environmental Adviser	• Verify relevant Environmental Approvals for the activities exist prior to commencing activity. • Track compliance with performance outcomes and performance standards as per the requirements of this EP. • Prepare environmental component of relevant Induction Package. • Assist with reviewing, investigating and reporting environmental incidents. • Ensure environmental monitoring and inspections/audits are conducted as per the requirements of this EP. • Liaise with relevant regulatory authorities as required. • Assist in preparing external regulatory reports required, in line with environmental approval requirements and Woodside external regulatory reporting obligations. • Monitor and close out corrective actions (Campaign Action Register) identified during environmental monitoring or audits. • Provide advice to relevant Woodside personnel and contractors to assist them to understand their environment responsibilities.
Woodside Corporate Affairs Adviser	• Prepare and implement the Stakeholder Consultation Plan for the Petroleum Activities Program. • Report on stakeholder consultation. • Perform ongoing liaison and notification as outlined in the EP.
Woodside Marine Assurance Superintendent	• Conduct relevant audit and inspection to confirm vessels are in compliance with relevant Marine Orders and Woodside requirements to meet safety, navigation and emergency response requirements.
Woodside Corporate Incident Coordination Centre (CICC) Duty Manager	On receiving notification of an incident: • Establish and take control of the Incident Management Team (IMT) and establish an appropriate command structure for the incident. • Assess the situation and identify risks and actions to minimise the risk. • Communicate impact, risk and progress to the Crisis Management Team and stakeholders.

Title (role)	Environmental Responsibilities
	• Develop the incident action plan, including setting objectives for action. • Approve, implement and manage the incident action plan. • Communicate within and beyond the incident management structure. • Manage and review safety of responders. • Address the broader public safety considerations. • Conclude and review activities.
MODU-based Personnel	
MODU Offshore Installation Manager	• Ensure the MODU's management system and procedures are implemented. • Ensure the personnel starting work on the MODU receive an environmental induction that meets the requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure emergency drills are conducted as per the MODU's schedule. • Ensure the MODU's Emergency Response Team has been given sufficient training to implement the MODU's SOPEP. • Ensure any environmental incidents or breaches of outcomes or standards are reported immediately to the Well Site Manager. • Ensure corrective actions for incidents or breaches are developed, communicated to the Well Site Manager, and tracked to close-out in a timely manner. Close-out of actions is communicated to the Well Site Manager.
Woodside Well Site Manager	• Ensure the drilling program is conducted as detailed in this EP. • Ensure the management measures (i.e. controls, EPOs, PSs and MC) detailed in this EP (relevant to offshore activities) are implemented on the MODU (other controls will be implemented onshore). • Ensure environmental incidents or breaches of outcomes or standards are reported as per the Woodside event notification requirements. Corrective actions for incidents and breaches must be developed, tracked and closed out in a timely manner. • Ensure actions in the Drilling and Completions HSE Improvement Plan are performed. • Ensure periodic environmental inspections/reviews are completed. Corrective actions from inspections must be developed, tracked and closed out in a timely manner.
Woodside Offshore HSE Adviser	• Support the Well Site Manager to ensure the controls detailed in this EP relevant to offshore activities are implemented on the MODU, and assist in collecting and recording evidence of implementation (other controls are implemented and evidence collected onshore). • Support the Well Site Manager to ensure the environmental performance outcomes are met and the performance standards detailed in this EP are implemented on the MODU. • Confirm actions in the Drilling and Completions HSE Improvement Plan are performed. • Support the Well Site Manager to ensure environmental incidents or breaches of outcomes or standards outlined in this EP are reported, and corrective actions for incidents and breaches are developed, tracked and closed out in a timely manner. • Ensure periodic environmental inspections/reviews are completed and corrective actions from inspections are developed, tracked and closed out in a timely manner. • Review Contractors' procedures, input into Toolbox talks and JSAs. • Provide day-to-day environmental support for activities in consultation with the Woodside Environmental Adviser.
Drilling Logistics Coordinator	• Ensure waste is managed on the MODU and sent to shore as per relevant Waste Management Plan.
Vessel-based Personnel	
Support Vessel Master	• Ensure the vessel management system and procedures are implemented.

Title (role)	Environmental Responsibilities
	• Ensure personnel commencing work on the vessel receive an environmental induction that meets the relevant requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure SOPEP drills are conducted as per the vessel's schedule. • Ensure the vessel Emergency Response Team has been given sufficient training to implement the SOPEP. • Ensure any environmental incidents or breaches of relevant environmental performance outcomes or performance standards detailed in this EP are reported immediately to the Woodside Well Site Manager. Corrective actions for incidents or breaches must be developed, communicated to the Well Site Manager, and tracked to close-out in a timely manner. Close-out of actions must be communicated to the Well Site Manager.
Vessel Logistics Coordinators	• Ensure waste is managed on the relevant support vessels and sent to shore as per the relevant Waste Management Plan.
Vessel HSE Advisers	Refer to Woodside HSE Offshore Adviser responsibilities detailed above under MODU-based personnel.
Contractor Project Manager	• Confirm that activities are conducted in accordance with this EP, as detailed in the Woodside-approved Contactor environmental management plan (or equivalent). • Ensure personnel commencing work on the project receive a relevant environmental induction that meets the requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure any environmental incidents or breaches of objectives, standards or criteria outlined in this EP are reported immediately to the Woodside Responsible Engineer or Vessel Master.

It is the responsibility of all Woodside employees and contractors to implement the *Woodside Corporate Health, Safety, Environment and Quality Policy* (Appendix A) in their areas of responsibility and that the personnel are suitably trained and competent in their respective roles.

7.4 Training and Competency

7.4.1 Overview

Woodside as part of its contracting process assesses a proposed Contractor's environmental management system to determine the level of consistency with the standard AS/NZ ISO 14001. This assessment is conducted for the Petroleum Activities Program as part of the pre-mobilisation process. The assessment determines whether there is an organisational structure that clearly defines the roles and responsibilities for key positions. The assessment also determines whether there is an up-to-date training matrix that defines any corporate and site/activity-specific environmental training and competency requirements.

As a minimum, environmental awareness training is required for all personnel, detailing awareness and compliance with the Contractor's environmental policy and environmental management system.

7.4.2 Inductions

Inductions are provided to all relevant personnel (e.g. Contractors and Company representatives) before mobilising to or on arrival at the activity location. The induction covers the HSE requirements and environmental information specific to the activity location. Attendance records will be maintained.

The Petroleum Activities Program induction may cover information about:

- description of the activity
- ecological and socio-economic values of the activity location

- regulations relevant to the activity
- Woodside's Environmental Management System – Health Safety, Environment and Quality Policy
- EP importance/structure/implementation/roles and responsibilities
- main environmental aspects/hazards and potential environmental impacts and related performance outcomes
- oil spill preparedness and response
- monitoring and reporting on performance outcomes and standards using measurement criteria
- incident reporting.

7.4.3 Petroleum Activity Specific Environmental Awareness

Before commencing drilling, a pre-activity meeting will be held on the MODU /support installation vessels with all relevant personnel. The pre-activity meeting provides an opportunity to reiterate specific environmental sensitivities or commitments associated with the activity. Relevant sections of the pre-activity meeting will also be communicated to the support vessel personnel. Attendance lists are recorded and retained.

During operations, regular HSE meetings will be held on the MODU and support vessels. During these meetings, recent environmental incidents are reviewed and awareness material presented regularly.

7.4.4 Management of Training Requirements

All personnel on the MODU and support vessels are required to be competent to perform their assigned positions. This may be in the form of external or 'on-the-job' training. The vessel Safety Training Coordinator (or equivalent) is responsible for identifying training needs, keeping records of training undertaken, and identifying minimum training requirements.

7.5 Monitoring, Auditing, Management of Non-Conformance and Review

7.5.1 Monitoring

Woodside and its Contractors will conduct a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion. This information will be collected using the tools and systems outlined below, developed based on the environmental performance outcomes, controls, standards and measurement criteria in this EP. The tools and systems will collect, as a minimum, the data (evidence) referred to in the measurement criteria in Section 6.6 and Section 6.7 and Appendix D.

The collection of this data (against the measurement criteria) will form part of the permanent record of compliance maintained by Woodside. It will form the basis for demonstrating that the environmental performance outcomes and standards are met, which will be summarised in a series of routine reporting documents.

7.5.1.1 Source-Based Impacts and Risks

The tools and systems to monitor environmental performance, where relevant, will include:

- daily reports, which include leading indicator compliance
- periodic review of waste management and recycling records

- use of Contractor's risk identification program that requires personnel to record and submit safety and environment risk observation cards on a routine basis (frequency varies with contractor)
- collection of evidence of compliance with the controls detailed in the EP relevant to offshore activities by the Woodside/Contractor Offshore HSE Adviser (other compliance evidence is collected onshore)
- environmental discharge reports that record volumes of planned and unplanned discharges downhole (in the well), to ocean and atmosphere
- monitoring of progress against the Drilling and Completions function scorecard for key performance indicators
- internal auditing and assurance program as described in Section 7.5.2.

Throughout this activity, Woodside will continuously identify new source-based risks and impacts through the Monitoring and Auditing systems and tools described above and in Section 7.5.2.

7.5.1.2 Key Sensitive Receptor-Based Environmental Knowledge Updates

Under the Woodside Environmental Knowledge Management System, regular checks and updates to maintain currency of key sensitive receptor environmental baseline knowledge are performed as follows:

- Quarterly reviews of the EPBC Act listed species status, listed species Recovery/Management and Conservation plans, and other environmental matters are completed and recorded by the Environmental Science Team. The outcome of each review is summarised and issued to the relevant Environment leads responsible for the petroleum activities program for their consideration.
- The preparedness commitments as per the Environmental Performance Outcomes (EPOs) of the Woodside Oil Spill Scientific Monitoring Program (presented in the OSPRMA) include an annual review and update to the Corporate Environment Baseline Database, a dedicated Woodside resource to track and document environmental baseline studies for a targeted suite of key sensitive receptors relevant to the assessment of hydrocarbon spill impacts.
- Periodic location-focused environmental studies and baseline data gap analyses are completed and documented. Any subsequent studies scoped and executed as a result of such gap analyses are managed by the Environmental Science Team and tracked via the Corporate Environment Baseline Database.

7.5.2 Auditing

Environmental performance auditing will be performed to:

- identify changes to existing or potential new environmental impacts and risk, and methods for reducing those to ALARP
- confirm that mitigation measures detailed in this EP are effectively reducing environmental impacts and risk, that mitigation measures proposed are practicable, and provide appropriate information to verify compliance
- confirm compliance with the commitments (performance outcomes, controls and standards) detailed in this EP.

Internal auditing will be performed to cover each key project activity as summarised below.

7.5.2.1 MODU Activities

Internal auditing is performed on a MODU-specific schedule, rather than a schedule to align with each well. This enables continuous review and improvement of environmental performance over the term of the MODU contract. The following internal audits, inspections and reviews will be performed to review the environmental performance of the activities:

- Survey environment MODU equipment for a newly contracted MODU (if not previously contracted to Woodside within the last two years) against the Woodside Engineering Standard – MODU Equipment, which covers functional and technical requirements for Woodside-contracted MODU and their associated equipment. An environment MODU equipment survey scope typically includes mud and solids control systems, environmental discharge control (including drainage management), and loss of containment management.
- Complete a minimum of monthly environmental inspection (conducted by offshore Woodside personnel or delegate), which may include verifying
  - bunkering/transfers between support vessels and MODU
  - environment containment including chemical storage, spill response equipment and housekeeping
  - general MODU environment risks including waste management, drilling fluids oil/water separation and inspection of subsea and moonpool areas.
- Perform at least one environment audit during the Petroleum Activities Program, while the MODU is on location (by a Woodside Environmental Adviser or delegate), which may include:
  - operational compliance audits relevant to environmental risk of activities which may include compliance with training commitments, discharge requirements, bunkering activities verification of use of approved chemicals, and satisfactory close-out of items from previous audits
  - inspection of selected risk areas/activities (which may include shaker house, drill floor and mud management during commencement of riser drilling or reservoir interception) during routine MODU visits throughout the MODU campaign, determined by risk, previous incidents or operation specification requirements.

7.5.3 Marine Assurance

Woodside's marine assurance process is managed by the Marine Assurance Team of the Marine Services Group. The Woodside process is based on industry standards and consideration of guidelines and recommendations from recognised industry organisations such as Oil Companies International Marine Forum and International Maritime Contractors Association.

The process is mandatory for all vessels hired for Woodside operations, including for short term hires (i.e. <3 months in duration). It defines applicable marine offshore assurance activities, ensuring that all vessel operators operate seaworthy vessels that meet the requirements for a defined scope of work and are managed with a robust safety management system.

The process is multi-faceted and encompasses the following marine assurance activities:

- Offshore Vessel Safety Management System Assessment (OVMSA)
- DP system verification
- offshore vessel inspection (OVID)
- project support for tender review, evaluation, pre/post contract award.

OVID inspections are objective in nature and reflect what was observed by the Inspector while conducting the inspection. The inspection provides observations as opposed to non-conformities.

Where an OVID inspection and/or OVMSA Verification Review is not available and all reasonable efforts based on time and resource availability to complete an OVID inspection and/or OVMSA Verification Review are performed (i.e. short term vessel hire), the Marine Assurance Specialist Offshore may approve the use of an alternate means of inspection, known as a risk assessment.

7.5.3.1 Risk Assessment

Woodside conducts a risk assessment of vessels where either an OVMSA Verification Review and/or an OVID inspection cannot be completed. This is not a regular occurrence and is typically used when the requirements of the assurance process are unable to be met or the processes detailed are not applicable to a proposed vessel(s).

The risk assessment is a semi-quantitative method of determining what further assurance process activity, if any, is required to assure a vessel for a particular task or role. The process compares the level of management control a vessel is subject to, against the risk factors associated with the activity or role.

Several factors are assessed as part of a vessel risk assessment, including:

- management control factors:
  - Company audit score (i.e. management system)
  - vessel HSE incidents
  - vessel Port State Control deficiencies
  - instances of Port State Control vessel detainment
  - years since previous satisfactory vessel inspection
  - age of vessel
  - contractors' prior experience operating for Woodside.
- activity risk factors:
  - people health and safety risks (a function of the nature of the work and the area of operation)
  - environmental risks (a function of environmental sensitivity, activity type and magnitude of potential environment damage (e.g. largest credible oil spill scenario))
  - value risk (likely time and cost consequence to Woodside if the vessel becomes unusable)
  - reputation risk
  - exposure (i.e. exposure to risk based on duration of project)
  - industrial relations risk.

The acceptability of the vessel or requirement for further vessel inspections or audits is based on the ratio of vessel score to activity risk. If the vessel management control is not deemed to appropriately manage activity risk, then a satisfactory company audit and/or vessel inspection may be required before awarding work.

The risk assessment is valid for the period a vessel is on hire and for the defined scope of work.

7.5.4 Management of Non-conformance

Woodside classifies non-conformances with environmental performance outcomes and standards in this EP as environmental incidents. Woodside employees and Contractors are required to report all environmental incidents, and these are managed as per Woodside's internal event recording, investigation and learning requirements.

An internal computerised database called First Priority is used for the recording and reporting of these incidents. Details of the event, immediate action taken to control the situation, investigation outcomes and corrective actions to prevent reoccurrence are all recorded. Corrective actions are monitored using First Priority and closed out in a timely manner.

Woodside uses a consequence matrix for classification of environmental incidents, with the significant categories being A, B and C (as detailed in Section 2.6). Detailed investigations are completed for all categories A, B, C and high potential environmental incidents.

7.5.5 Review

7.5.5.1 Management Review

Within the Environment function, senior management regularly monitors and reviews environmental performance and the effectiveness of managing environmental risks and performance. Within each Function and Business Unit Leadership Team (e.g. Drilling and Completions), managers review environmental performance regularly, including through quarterly HSE review meetings.

Woodside's Drilling and Completions Environment Team will perform six-monthly reviews of the effectiveness of the implementation strategy and associated tools. This will involve reviewing the:

- Drilling and Completions environment key performance indicators (leading and lagging)
- tools and systems to monitor environmental performance (detailed in Section 7.5.1)
- lessons learned about implementation tools and throughout each campaign.

Reviews of oil spill arrangements and testing are performed in accordance with Section 7.9.

7.5.5.2 Learning and Knowledge Sharing

Learning and knowledge sharing occurs via a number of different methods including:

- event investigations
- event bulletins
- after action review conducted at the end of each well, including review of environmental incidents as relevant
- ongoing communication with MODU operators
- formal and informal industry benchmarking
- cross-asset learnings
- Engineering and Technical Authorities discipline communications and sharing.

7.5.5.3 Review of Impacts, Risks and Controls Across the Life of the EP

In the unlikely case that activities described in this EP do not occur continuously or sequentially, before recommencing activities after a cessation period greater than 12 months, impacts, risks and controls will be reviewed.

The process will identify or review impacts and risks associated with the newly-commencing activity, and will identify or review controls to ensure impacts and risks remain/are reduced to ALARP and acceptable levels. Information learned from previous activities conducted under this EP will be considered. Controls which have previously been excluded on the basis of proportionality will be reconsidered. Any required changes will be managed by the Management of Change (MOC) process outlined below (Section 7.6).

7.6 Environment Plan Management of Change and Revision

Management of changes relevant to this EP concerning the scope of the activity description (Section 3), including review of advances in technology at stages where new equipment may be selected such as vessel contracting, changes in understanding of the environment, including all current advice from DAWE on species protected under EPBC Act and current requirements for Australian Marine Parks (Section 4), and potential new advice from external stakeholders (Section 7), will be managed in accordance with Regulation 17 of the Environment Regulations.

Risk will be assessed in accordance with the Environmental Risk Management Methodology (Section 2.2) to determine the significance of any potential new environmental impacts or risks not provided for in this EP. Risk assessment outcomes are reviewed in compliance with Regulation 17 of the Environment Regulations.

Minor changes where a review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, under Regulation 17 of the Environment Regulations, will be considered a ‘minor revision’. Minor administrative changes to this EP, where an assessment of the environmental risks and impacts is not required (e.g. document references, phone numbers), will also be considered a ‘minor revision’. Minor revisions as defined above will be made to this EP using Woodside’s document control process. Minor revisions will be tracked in an MOC register to ensure visibility of cumulative risk changes, as well as enable internal EP updates/reissuing as required. This document will be made available to NOPSEMA during regulator environment inspections.

7.7 Record Keeping

Compliance records (outlined in Measurement Criteria in Section 7.10) will be maintained.

Record keeping will be in accordance with Regulation 14(7) which addresses maintaining records of emissions and discharges.

7.8 Reporting

To meet the environmental performance outcomes and standards outlined in this EP, Woodside reports at a number of levels, as outlined in the next sections.

7.8.1 Routine Reporting (Internal)

7.8.1.1 Daily Progress Reports and Meetings

Daily reports for project activities are prepared and issued to key support personnel and stakeholders, by relevant managers responsible for the project. The report provides performance information on project activities, HSE, and current and planned work activities.

Meetings between key personnel are used to transfer information, discuss incidents, agree plans for future activities and develop plans and accountabilities for issue resolution.

7.8.1.2 Regular HSE Meetings

Regular dedicated HSE meetings are held with the offshore and Perth-based management and advisers to address targeted HSE incidents and initiatives. Minutes of these meetings are produced and distributed as appropriate.

7.8.1.3 Performance Reporting

Monthly and quarterly performance reports are developed and reviewed by the Function and Business Unit Leadership Teams (e.g. Drilling and Completions). These reports cover a number of subjects, including:

- HSE incidents (including high potential incidents and those related to this EP) and recent activities
- Corporate Key Performance Indicator targets, which include environmental metrics
- outstanding actions as a result of audits or incident investigations
- technical high and low lights.

7.8.2 Routine Reporting (External)

7.8.2.1 Start and End Notifications of the Petroleum Activities Program

In accordance with Regulation 29, Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences and will notify NOPSEMA and DMIRS within ten days of completing the activity.

7.8.2.2 Environmental Performance Review and Reporting

In accordance with applicable environmental legislation for the activity, Woodside is required to report information on environmental performance to the appropriate regulator. Regulatory reporting requirements are summarised in Table 7-2.

Table 7-2: Routine external reporting requirements

Report	Recipient	Frequency	Content
Monthly Recordable Incident Reports (**Appendix E**)	NOPSEMA	Monthly, by the 15th of each month.	Details of recordable incidents that have occurred during the Petroleum Activities Program for the previous month (if applicable).
Environmental Performance Report	NOPSEMA	Annually, with the first report submitted within 12 months of commencing the Petroleum Activities Program covered by this EP, as per the requirements of Regulation 14(2).	Compliance with environmental performance outcomes, controls and standards outlined in this EP, in accordance with the Environment Regulations.

7.8.2.3 End of the Environment Plan

The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended and all of the obligations identified in this EP have been fulfilled, and NOPSEMA has accepted the notification, in accordance with Regulation 25A of the Environment Regulations.

7.8.3 Incident Reporting (Internal)

Woodside has a defined process for the internal reporting of incidents. It is the responsibility of the Woodside Project Manager to ensure that reporting of environmental incidents meets the internal reporting requirements as defined in the Woodside HSE event notification matrix.

7.8.4 Incident Reporting (External) – Reportable and Recordable

7.8.4.1 Reportable Incidents

Definition

A reportable incident is defined under Regulation 4 of the Environment Regulations as:

- *'an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage'.*

A reportable incident for the Petroleum Activities Program is:

- an incident that has caused environmental damage with a Consequence Level of Moderate (C) or above, as defined under Woodside's Risk Table (refer to Figure 2-6)
- an incident that has the potential to cause environmental damage with a Consequence Level of Moderate (C) or above, as defined under Woodside's Risk Table (refer to Figure 2-6).

The environmental risk assessment (Section 6) for the Petroleum Activities Program identifies those risks with a potential consequence level of Moderate (C) or above for environment. The only incident identified that has the potential to cause this level of impact is hydrocarbon loss of containment to the marine environment resulting from a loss of well integrity.

Any such incidents represent potential events which would be reportable incidents. Incidents are reporting with consideration of NOPSEMA (2014) guidance stating, 'if in doubt, notify NOPSEMA', and assessed case-by-case to determine if they trigger a reportable incident as defined in this EP and by the Regulations.

Notification

NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations. Woodside will:

- report all reportable incidents to the regulator (orally) as soon as practicable, but within two hours of the incident or of its detection by Woodside
- provide a written record of the reported incident to NOPSEMA, the National Offshore Petroleum Titles Administrator and the Department of the responsible State Minister (DMIRS) as soon as practicable after the oral reporting of the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0831 – Reportable Environmental Incident which must be submitted to NOPSEMA as soon as practicable, but within three days of the incident or of its detection by Woodside
- provide a copy of the written report to the National Offshore Petroleum Titles Administrator and DMIRS, within seven days of the written report being provided to NOPSEMA.

AMSA will be notified of oil spill incidents as soon as practicable following their occurrence, and DAWE if MNES are to be affected by the oil spill incident.

7.8.4.2 Recordable Incidents

Definition

A recordable incident is defined under Regulation 4 of the Environment Regulations as an incident arising from the activity that:

- *'breaches an environmental performance outcome or environmental performance standard, in the EP that applies to the activity, that is not a reportable incident'*.

Notification

NOPSEMA will be notified of all recordable incidents, according to the requirements of Regulation 26B(4), not later than 15 days after the end of the calendar month using the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (Appendix E) detailing:

- a record of all recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that the operator knows or is able, by reasonable search or enquiry, to find out
- any action taken to avoid or mitigate any adverse environment impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to prevent similar recordable incidents
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

7.8.4.3 Other External Incident Reporting Requirements

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, Table 7-3 describes the incident reporting requirements that also apply in the Permit Area.

Table 7-3: External incident reporting requirements

Incident	Responsible	Notifiable party	Notification Requirements	Contact	Contact Details
Any marine incidents during Petroleum Activities Program, as per AMSA requirements	Vessel Master	AMSA	Incident Alert Form 18 as soon as reasonably practicable* Within 72 hours after becoming aware of the incident, submit Incident Report Form 19	AMSA	reports@amsa.gov.au
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA RCC	As per Article 8 and Protocol I of MARPOL within two hours via the national emergency 24-hour notification contacts and a written report within 24 hours of the request by AMSA	AMSA RCC	If the ship is at sea, reports are to be made to: Free call: 1800 641 792 Phone: 08 9430 2100 (Fremantle)
Oil pollution incident in Commonwealth waters	Vessel Master	AMSA	Without delay as per protection of the *Sea Act*, part II, section 11(1), verbally notify AMSA RCC via the national emergency 24-hour notification contact of the hydrocarbon spill Follow up with a written Pollution Report as soon as practicable following verbal notification	Rescue Coordination Centre (RCC) Australia	Phone: 1800 641 792 or +61 2 6230 6811 AFTN: YSARYCYX
Any oil pollution incident which has the potential to enter a National Park or requires oil spill response activities to be conducted within a National Park		Department of Agriculture, Water and the Environment	Reported verbally, as soon as practicable	Director of National Parks	Phone: 02 6274 2220
Activity causes unintentional death of or injury to fauna species listed as Threatened or Migratory under the EPBC Act	Vessel Master	Department of Agriculture, Water and the Environment	Within seven days of becoming aware	Secretary of the DAWE	Phone: 1800 803 772 Email: protected.species@environment.gov.au

Additionally, the following pollution activity should also be reported to AMSA via RCC Australia by the Vessel Master:

- any loss of plastic material
- garbage disposed of in the sea within 12 nm of land (garbage includes food, paper, bottles, etc.)
- any loss of hazardous materials.

For oil spill incidents, other agencies and organisations will be notified as appropriate to the nature and scale of the incident as per procedures and contact lists in the Oil Pollution Emergency Arrangements (Australia) and the WA-49-L Gemtree Exploration Drilling Oil Pollution First Strike Plan.

External incident reporting requirements required under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations including under sub regulation 2.42, notices and reports of dangerous occurrences will be reported to NOPSEMA under the approved activity safety cases.

7.9 Emergency Preparedness and Response

7.9.1 Overview

Under Regulation 14(8), the implementation strategy must contain an oil pollution emergency plan (OPEP) and provide for updating the OPEP. Regulation 14(8AA) outlines the requirements for the OPEP which must include adequate arrangements for responding to and monitoring oil pollution.

A summary of how this EP and supporting documents address the various requirements of Environment Regulations relating to oil pollution response arrangements is shown in Table 7-4.

Table 7-4: Oil pollution and preparedness and response overview

Content	Environment Regulations Reference	Document/Section Reference
Details of (oil pollution response) control measures that will be used to reduce the impacts and risks of the activity to ALARP and an acceptable level	Regulation 13(5), (6), 14(3)	Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling EP (Appendix D)
Description of the OPEP	Regulation 14(8)	Environment Plan: Woodside's OPEP has the following components: • Woodside Oil Pollution Emergency Arrangements (Australia) • WA-49-L Gemtree Exploration Drilling Oil Pollution First Strike Plan • Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling EP (Appendix D). In accordance with Regulation 31 of the Environmental Regulations the Woodside Oil Pollution Emergency Arrangements (Australia) was provided with the Julimar Phase 2 Drilling and Subsea Installation EP, accepted by NOPSEMA on 8 November 2019.
Details of the arrangements for responding to and monitoring oil pollution (to inform response activities), including control measures	Regulation 14(8AA)	Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling EP (Appendix D) WA-49-L Gemtree Exploration Drilling Oil Pollution First Strike Plan
Details of the arrangements for updating and testing the oil pollution response arrangements	Regulation 14(8), (8A), (8B), (8C)	Environment Plan: Section 7.9.3 Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling EP (Appendix D)
Details of provision, monitoring impacts to the environment from oil pollution and response activities	Regulation 14(8D)	Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling EP (Appendix D)
Demonstration that the oil pollution response arrangements are consistent with the national system for oil pollution preparedness and control	Regulation 14(8E)	Woodside Oil Pollution Emergency Arrangements (Australia)

7.9.2 Emergency Response Preparation

The Corporate Incident Coordination Centre, based in Woodside's head office in Perth, is the onshore coordination point for an offshore emergency. The CICC is staffed by a roster of appropriately skilled personnel available on call 24 hours a day. The CICC, under the leadership of the CICC Duty Manager, supports the site-based IMT by providing, operations, logistics, planning, people management and public information (corporate affairs) support. A description of Woodside's Incident Command Structure and arrangements is further detailed in the Woodside Oil Pollution Emergency Arrangements (Australia).

An Emergency Response Plan (ERP) will be drafted for the Petroleum Activities Program covered by this EP. The ERP provides procedural guidance specific to the MODU and location of operations to control, coordinate and respond to an emergency or incident. For a drilling activity, the ERP will be a bridging document to the contracted MODU's emergency documentation. This document summarises the emergency command, control and communications processes for the integrated operation and management of an emergency. It is developed in collaboration with the contracted MODU and ensures roles and responsibilities between the contracted MODU and Woodside personnel are identified and understood. The ERP will contain instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification, contact information and activation of the Contractor's emergency centre and Woodside Communication Centre (WCC).

In the event of an emergency of any type:

- On the MODU, the Offshore Installation Manager will assume overall onsite command and act as the Incident Controller (IC). All persons aboard the MODU/activity support vessels will be required to act under the IC's directions. The MODU/activity support vessels will maintain communications with the onshore Drilling Superintendent and/or other emergency services in the event of an emergency. Emergency response support can be provided by the Contractor's emergency centre or WCC if requested by the IC.
- The Vessel Master (depending on the location of the emergency) will assume overall onsite command and act as the IC. All persons will be required to act under the IC's directions. The vessels will maintain communications with the onshore project manager and/or other emergency services in the event of an emergency. Emergency response support can be provided by the Contractor's emergency centre or WCC if requested by the IC.
- The MODU and support vessels will have on-board equipment for responding to emergencies including medical, fire-fighting and oil spill response equipment.

7.9.3 Oil and Other Hazardous Materials Spill

A significant hydrocarbon spill during the proposed Petroleum Activities Program is unlikely, but should such an event occur, it has the potential to cause a serious safety incident, environmental, asset and reputational damage if not managed properly. The Woodside Oil Pollution Emergency Arrangements (Australia) document, supported by the WA-49-L Gemtree Exploration Drilling – Oil Pollution First Strike Plan which provides tactical response guidance to the activity/area and Appendix D of this EP, cover spill response for this Petroleum Activities Program.

The Oil Spill Preparedness Manager is responsible for managing Woodside's oil spill response equipment, and for maintaining oil spill preparedness and response documentation. In the event of a major spill, Woodside will request that AMSA (administrator of the National Plan) provides support to Woodside through advice and access to equipment, people and liaison. The interface and responsibilities, as defined under the National Plan, are described in the Woodside Oil Pollution Emergency Arrangements (Australia). AMSA and Woodside have an MoU in place to support Woodside in the event of an oil spill.

The WA-49-L Gemtree Exploration Drilling – Oil Pollution First Strike Plan provides immediate actions required to commence a response.

The MODU and support vessels will have SOPEPs in accordance with the requirements of MARPOL 73/78 Annex I. These plans outline responsibilities, specify procedures and identify resources available in the event of a hydrocarbon or chemical spill from vessel activities. The Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs, if hydrocarbons are released to the marine environment from a vessel.

Woodside has established environmental performance outcomes, performance standards and measurement criteria to be used for oil spill response during the Petroleum Activities Program, as detailed in Appendix D.

7.9.4 Emergency and Spill Response Drills and Exercises

Woodside categorises incidents and emergencies in relation to response requirements as follows:

7.9.4.1 Level 1

Level 1 incidents are those that can be resolved using existing resources, equipment and personnel. A Level 1 incident is contained, controlled and resolved by site/regionally based teams using existing resources and functional support services.

7.9.4.2 Level 2

Level 2 incidents are characterised by a response that requires external operational support to manage the incident. It is triggered in the event the capabilities of the tactical level response are exceeded. This support is provided to the activity via the activation of all, or part of, the responsible CICC.

7.9.4.3 Level 3

A Level 3 incident or crisis is identified as a critical event that seriously threatens the organisation's People, the Environment, company Assets, Reputation, Livelihood or essential Services. At Woodside, the Crisis Management Team (CMT) manages the strategic impacts in order to respond to and recover from the threat to the company (material impacts, litigation, legal & commercial, reputation etc.). The ICC may also be activated as required to manage the operational response to the Level 3 Incident.

7.9.5 Emergency and Spill Response Drills and Exercises

Woodside's capability to respond to incidents will be tested, with the frequency of these tests conducted as prescribed in Table 7-5. The company emergency response testing regime is aligned to existing or developing risks associated with Woodside's operations and activities. Corporate hazards/risks outlined in the corporate risk register, respective Safety Cases or project Risk Registers, are the key reference point for developing emergency management and crisis management exercises. External participants may be invited to attend crisis exercises and may include government agencies, specialist service providers, oil spill response organisations or industry members with which Woodside has mutual aid arrangements.

The objective is to exercise procedures, skills and teamwork of the Emergency Response and Command Teams in their ability to respond to Major Accident Events and Major Environment Events. After each exercise, the team holds a debrief session, during which the exercise is reviewed. Any lessons learned or areas for improvement are identified and incorporated into emergency procedures where appropriate.

Table 7-5: Testing of response capability to incidents

Level 1 Response	One Level 1 emergency drill to be conducted per week, during the drilling activity.
	One oil spill response themed level 1 drill to be conducted within two weeks of commencing drilling. This drill should test elements of the recommended response identified in the WA-49-L Gemtree Exploration Drilling Exploration Drilling Oil Pollution First Strike Plan, in relation to the level of the incident.
Level 2 Response	Minimum of one Emergency Management exercise per MODU per year; and one within one month of commencing a new activity in a new region.
Level 3 Response	The number of Crisis Management Team (CMT) exercises conducted each year is determined by the CEO, in consultation with the VP Security & Emergency Management. .

7.9.5.1 Testing of Oil Spill Response Arrangements

There are a number of arrangements which in the event of a spill will underpin Woodside's ability to implement a response across its petroleum activities. To ensure each of these arrangements is adequately tested, the Security and Emergency Management Capability and Development Team ensures tests are conducted in alignment with Woodside's testing schedule.

Woodside's testing schedule aligns with international good practice for spill preparedness and response management. The testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook.

Woodside's testing schedule identifies the type of test which will be conducted annually for each arrangement, and how this type will vary over a five year rolling schedule. Testing methods may include audits, drills, field exercises, functional workshops, assurance reporting, assurance monitoring and reviews of key external dependencies.

Activity-specific Oil Spill Pollution First Strike Plans are developed to meet the response needs of that particular activity's Worst Credible Spill Scenario (WCCS). The ability to implement these plans may rely on specific arrangements or those common to other Woodside activities. Regardless of their commonality, each arrangement will be tested in at least one of the methods annually. The activity-specific Hydrocarbon Pollution First Strike Plan will be tested in alignment with Table 7-5. This ensures personnel are familiar with spill response procedures, reporting requirements and roles/responsibilities.

At the completion of testing, a report is produced to demonstrate the outcomes achieved against the tested objectives. The report will include the lessons learned, any improvement actions and a list of the participants. Alternatively an assurance report, assurance records or audit report may be produced. These reports record findings and include any recommendations for improvement. Improvement actions and their close-out are actively recorded and managed.

7.9.6 Cyclone and Dangerous Weather Preparation

As the timing of some activities associated with the Petroleum Activities Program are not yet determined, it is possible drilling activities will overlap with the cyclone season (November to April, with most cyclones occurring between January and March). If drilling in cyclone season, the MODU Contractor and vessel contractors must have a Cyclone Contingency Plan (CCP) in place outlining the processes and procedures that would be implemented during a cyclone event, which will be reviewed and accepted by Woodside.

The MODU and support vessels will receive daily forecasts from the BoM. If a cyclone (or severe weather event) is forecast, the path and its development will be plotted and monitored using the BoM data. If there is the potential for the cyclone (severe weather event) to affect the Petroleum Activities Program, the CCP will be actioned. If required, vessels can transit from the proposed track of the cyclone (severe weather event).

7.10 Implementation Strategy and Reporting Commitments Summary

Table 7-6 summarises key components within the implementation strategy.

Table 7-6: Implementation strategy and reporting commitments summary

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-1 All crew will be aware of their roles and responsibilities regarding environmental risks throughout the Petroleum Activities Program.	**PS IS-1.1** All personnel are required to attend an induction before commencing work. These inductions cover health, safety and environmental requirements for the MODU and support vessels, and environmental information specific to the Petroleum Activities Program location.	**MC IS-1.1.1** Induction attendance records.
	PS IS-1.2 A pre-activity meeting will be held on the MODU with relevant personnel before conducting the Petroleum Activities Program, focusing on any specific environmental sensitivities associated with the activity.	**MC IS-1.1.2** Pre-activity meeting attendance records and minutes.
	PS IS-1.3 During campaign execution, regular HSE meetings will be held on the MODU and support vessels which cover all crew. Recent environmental incidents will be reviewed and awareness material presented regularly.	**MC IS-1.3.1** Attendance is recorded and lists retained on the MODU/support vessels.
	PS IS-1.4 The MODU Contractor and vessel contractors must have a CCP accepted by Woodside, outlining the processes and procedures that would be implemented during a cyclone event, if drilling is to take place during cyclone season.	**MC IS-1.4.1** Record of Woodside-approved Contractor CCP in place prior to activities commencing.
PO IS-2 Woodside and its Contractors will perform a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion.	**PS IS-2.1** Monitoring information will be collected using Woodside tools and systems	**MC-IS 2.1.1** Monitoring reports including daily reports, periodic reports, risk observation cards, environmental discharge reports
	PS IS-2.2 Periodic review of the Woodside Environmental Knowledge Management System to maintain currency of receptor knowledge.	**MC-IS 2.2.1** Review records Corporate Environment Baseline Database
PO IS-3 Woodside will audit environmental performance.	**PS IS-3.1** Any newly contracted MODU will have a start-up or pre-mobilisation audit performed, if not previously contracted to Woodside within the last two years.	**MC IS-3.1.1** Woodside’s start up or pre-mobilisation report for the MODU.
	PS IS-3.2 Offshore Woodside personnel must conduct a minimum of monthly environmental inspections.	**MC IS-3.2.1** Completed environmental inspection checklists.
	PS IS-3.3 Woodside Environmental Adviser (or delegate) must complete at least one quarterly environment audit during the Petroleum Activities Program.	**MC IS-3.3.1** Quarterly Environment Audit report.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
	PS IS-3.6 Contractor-specific HSE audits will be conducted of the support vessel.	**MC IS-3.6.1** Completed HSE audits report.
	PS IS-3.7 Vessel based HSE inspections will be conducted fortnightly by vessel HSE personnel	**MC IS-3.7.1** Completed HSE inspection checklists.
	PS IS-3.8 Audit findings relevant to continuous improvement of environmental performance will be tracked through the MODU or vessel compliance action register, a contractor register between the MODU operator or vessel contractor and Woodside.	**MC IS-3.8.1** MODU or vessel compliance action register records that demonstrate tracking of audit findings.
	PS IS-3.9 Marine assurance will be undertaken in accordance with Woodside's internal assurance process and is mandatory for all vessels hired for Woodside.	**MC IS-3.9.1** Records demonstrate marine assurance reviews conducted as required.
PO IS-4 Woodside employees and Contractors will report all environmental incidents and non-conformance with environmental performance outcomes and standards in this EP.	**PS IS-4.1** Non-conformances to be notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.	**PS IS-4.1.1** Records demonstrate Non-conformances are notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.
PO IS-5 Woodside will perform regular reviews to monitor environmental performance and share knowledge and learning.	**PS IS-5.1** Woodside is to hold quarterly HSE Review meetings.	**PS IS-5.1.1** Records demonstrate meetings reviewed HSE performance.
	PS IS-5.2 Woodside's Drilling and Completions Environment Team is to perform six-monthly reviews of the effectiveness of the implementation strategy and associated tools.	**PS IS-4.2.1** Records demonstrate six-monthly reviews of the effectiveness of the implementation strategy.
	PS IS-5.3 After action review conducted at the end of each well for learning and knowledge sharing, including review of environmental incidents as relevant.	**PS IS-5.3.2** After action review report
PO IS-6 Changes in activity scope, understanding of the environment and potential new advice from external stakeholders will be tracked and the EP updated as required.	**PS IS-6.2** Management of change relevant to this EP to be managed in accordance with Regulation 17 of the Environment Regulations.	**PS IS-6.2.1** Records of minor revisions to the EP tracked in an MOC Register. Revision and resubmission of the EP as required.
PO IS-7 All internal and external reporting requirements relevant to this EP will be met.	**PS IS-7.1** Regular HSE meetings Monthly and quarterly HSE performance reports	**MC IS-7.1.1** HSE performance reports. Minutes of HSE meetings

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
	PS IS-7.2 Woodside will submit an environmental performance report to NOPSEMA (annually, with the first report submitted within 12 months of commencing the activity).	**MC IS-7.2.1** Record of submission of environmental performance reports to NOPSEMA.
	PS IS-7.3 Woodside will submit a monthly recordable incident report to NOPSEMA.	**MC IS-7.3.1** Record of submission of monthly recordable incident report to NOPSEMA.
PO IS-8 All external notification requirements, as applicable to this EP, will be met.	**PS IS-8.1** Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences. Woodside will notify NOPSEMA and DMIRS within ten days of completing the activity.	**MC IS-8.1.1** Record of notification to NOPSEMA. Record of notification to DMIRS.
	PS IS-8.2 The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended and all of the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A.	**MC IS-8.2.1** Record of notification to NOPSEMA.
	PS IS-8.3 NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations.	**MC IS-8.3.1** Record of notifications to NOPSEMA
	PS IS-8.4 DAWE (if MNES affected) will be notified of oil spill incidents as soon as practicable following the occurrence.	**MC IS-8.4.1** Record of notification to DAWE if MNES is affected.
	PS IS-8.6 Any oil pollution incidents in Commonwealth waters will be reported without delay (by the vessel master) to AMSA RCC as per the *Protection of the Sea (Prevention of Pollution from Ships) Act*, Part II, Section 11(1). The verbal report shall be made via the national emergency 24-hour notification contact, and if AMSA requests a written report, it should be provided within 24 hours of the request.	**MC IS 8.6.1** Records of notification to AMSA.
PO IS-9 Planned and unplanned emissions and discharges will be documented and records maintained.	**PS IS-9.1** The volumes of planned and unplanned emissions and discharges that could result from the risks described in Section 6.6 and 6.7 are documented.	**MC IS-9.1.1** Records of planned and unplanned emissions and discharges are maintained.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-10 Personnel holding responsibilities in a response will test the arrangements supporting the activities OPEP to ensure they are effective and communicated.	**PS IS-10.1** Exercises will be conducted in alignment with the frequency identified in Table 7-4. These arrangements are conducted in accordance with Regulation 14(8B) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.* • Arrangements are tested when introduced. • Arrangements are tested in accordance with Woodside's Hydrocarbon Spill Arrangements Testing Schedule as per the frequency identified in Table 7-5. • Arrangements will be tested when the OPEP is significantly amended, and further testing will occur if a new activity location is added to the EP.	**MC IS-10.1.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in Hydrocarbon Spill Preparedness Unit (HSPU) Testing of Arrangements Register.
	PS IS-10.2 Post exercise reports will be developed for each exercise to measure performance against the objectives, and the learnings from the plan updated in the OPEP following these learnings.	**MC IS-10.2.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in HSPU Testing of Arrangements Register.
	PS IS-10.3 Close-out of HSPU actions from exercising are managed in the HSPU Testing of Arrangements Register.	**MC IS-10.3.1** Records managed in HSPU Testing of Arrangements Register.
PO IS-11 Woodside will ensure that the arrangements supporting the activities OPEP are validated.	**PS IS-11.1** Activity OPEPs will be revised at a minimum every five years.	**MC IS-11.1.1** OPEP current and available.
PO IS-12 The OPEP will only be updated under specific circumstances to ensure the information is current.	**PS IS-12.1** Relevant documents from the OPEP will be reviewed when: • implementing an improved preparedness measure • the availability of equipment stockpiles changes • the availability of personnel changes that reduces or improves preparedness and the capacity to respond • a new or improved technology is introduced that may be considered in a response for this activity • incorporating, where relevant, lessons learned from exercises or events • national or state response frameworks and Woodside's integration with these frameworks changes.	**MC IS-12.1.1** The following records will be maintained: • Woodside's HSPU Testing of arrangements register • Woodside's Internal Equipment Maintenance Register • OPEP current and available.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-13 Woodside will perform a vessel risk assessment where an OVID inspection and/or OVMSA Verification Review is not available (i.e. short term vessel hire).	**PS IS-13.1** The Marine Vessel Risk Assessment will be conducted by the Marine Assurance Superintendent, or the nominated deputy, where the vessel meets the short term hire prerequisites.	**MC IS-13.1.1** Marine Vessel Risk Assessment sheet demonstrates the assessment has been conducted.
PO IS-14 Prior to recommencing activities after a cessation period greater than 12 months, Woodside will review impacts, risks and controls.	**PS IS-14.1** Impacts and risks associated with recommencing activities (if commencing after a cessation period greater than 12 months) must remain/be reduced to ALARP and acceptable levels.	**MC IS-14.1.1** Records demonstrate impacts, risks and controls are reviewed before recommencing activities (if commencing after a cessation period greater than 12 months).

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8.1 Glossary

Term	Meaning
(the) Regulator	The Government Agency (State or Commonwealth) that is the decision maker for approvals and undertakes ongoing regulation of the approval once granted.
Acceptability	The EP must demonstrate that the environmental impacts and risks of an activity will be of an acceptable level as per Regulation 10A(c).
ALARP	A legal term in Australian safety legislation, it is taken here to mean that all contributory elements and stakeholders have been considered by assessing costs and benefits, and which identifies a preferred course of action.
API (gravity)	A measure of how heavy or light a petroleum liquid is compared to water.
Australian Standard	An Australian Standard which provides criteria and guidance on design, materials, fabrication, installation, testing, commissioning, operation, maintenance, re-qualification and abandonment.
Ballast	Extra weight taken on to increase a ship's stability to prevent rolling and pitching. Most ships use seawater as ballast. Empty tank space is filled with inert (non-combustible) gas to prevent the possibility of fire or explosion.
Bathymetry	Related to water depth – a bathymetry map shows the depth of water at a given location on the map.
Benthos/Benthic	Relating to the seabed, and includes organisms living in or on sediments/rocks on the seabed.
Biodiversity	Relates to the level of biological diversity of the environment. The EPBC Act defines biodiversity as: "the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part) and includes: (a) diversity within species and between species; and (b) diversity of ecosystems".
Biota	The animal and plant life of a particular region, habitat or geological period.
Cetacean	Whale and dolphin species.
Consequence	The worst-case credible outcome associated with the selected event, assuming some controls (prevention and mitigation) have failed. Where more than one impact applies (e.g. environmental and legal/compliance), the consequence level for the highest severity impact is selected.
Coral	Anthozoa that are characterised by stone-like, horny or leathery skeletons (external or internal). The skeletons of these animals are also called coral.
Coral Reef	A wave-resistant structure resulting from skeletal deposition and cementation of hermatypic corals, calcareous algae, and other calcium carbonate-secreting organisms.
Crustacean	A large and variable group of mostly aquatic invertebrates which have a hard external skeleton (shell), segmented bodies, with a pair of often very modified appendages on each segment, and two pairs of antennae (e.g. crabs, crayfish, shrimps, wood lice, water fleas and barnacles).
Cyclone	A rapidly-rotating storm system characterised by a low-pressure centre, strong winds, and a spiral arrangement of thunderstorms that produce heavy rain.
Datum	A reference location or elevation which is used as a starting point for subsequent measurements.
dB	Decibel – a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (that is, 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Term	Meaning
dB re 1 μPa²	Measure of underwater noise, in terms of sound pressure. Because the dB is a relative measure, rather than an absolute measure, it must be referenced to a standard “reference intensity”, in this case 1 micro Pascal (1 mPa), which is the standard reference that is used. The dB is also measured over a specified frequency, which is usually either a one Hertz bandwidth (expressed as dB re 1 m Pa2/Hz), or over a broadband which has not been filtered. Where a frequency is not specified, it can be assumed that the measurement is a broadband measurement.
dB re 1 μPa².s	Normal unit for sound exposure level.
Demersal	Living close to the floor of the sea (typically of fish).
Drill casing	Tubing that is set inside the drilled well to protect and support the well stream.
Drilling fluids	The main functions of drilling fluids include providing hydrostatic pressure to prevent formation fluids from entering into the well bore, keeping the drill bit cool and clean during drilling, performing drill cuttings, and suspending the drill cuttings while drilling is paused and when the drilling assembly is brought in and out of the hole. The drilling fluid used for a particular job is selected to avoid formation damage and to limit corrosion. The three main categories of drilling fluids are water based muds (which can be dispersed and non-dispersed), non-aqueous muds, usually called oil-based mud, and gaseous drilling fluid, in which a wide range of gases can be used.
DRIMS	Woodside’s internal document management system.
Dynamic positioning	In reference to a marine vessel that uses satellite navigation and radio transponders in conjunction with thrusters to maintain its position.
EC_{50}	The concentration of a drug, antibody or toxicant which induces a response halfway between the baseline and maximum after a specified exposure time.
Echinoderms	Any of numerous radially symmetrical marine invertebrates of the phylum *Echinodermata*, which includes starfishes, sea urchins and sea cucumbers, which have an internal calcareous skeleton and are often covered with spines.
Endemic	A species that is native to or confined to a certain region.
Environment	The surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelations (Source: ISO 14001).
Environment Plan	Prepared in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, which must be assessed and accepted by the Designated Authority (NOPSEMA) before any petroleum-related activity can be conducted.
Environment Regulations	OPGGS (Environment) Regulation 2009.
Environmental approval	The action of approving something, which has the potential to adversely impact the environment. Environmental impact assessment is generally required before environmental approval is granted.
Environmental Hazard	The characteristic of an activity or event that could potentially cause damage, harm or adverse effects on the environment .
Environmental impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation’s activities, products or services (Source: HB 203:2006).
Environmental impact assessment	An orderly and systematic process for evaluating a proposal or scheme (including its alternatives), and its effects on the environment, and mitigation and management of those effects (Source: Western Australian *Environmental Impact Assessment Administrative Procedures 2010*).
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth legislation designed to promote the conservation of biodiversity and protection of the environment.
Epifauna	Benthic animals that live on the surface of a substrate.
Fauna	Collectively, the animal life of a particular region.
Flora	Collectively the plant life of a particular region.

Term	Meaning
IC_{50}	A measure of the effectiveness of a compound in inhibiting biological or biochemical function.
Infauna	Aquatic animals that live in the substrate of a body of water, especially in a soft sea bottom.
ISO 14001	ISO 14001 is an international standard that specifies a process (called an Environmental Management System or EMS) for controlling and improving a company's environmental performance. An EMS provides a framework for managing environmental responsibilities so they become more efficient and more integrated into overall business operations.
Jig fishing	Fishing with a jig, which is a type of fishing lure. A jig consists of a lead sinker with a hook moulded into it and usually covered by a soft body to attract fish.
LC_{50}	The concentration of a substance that is lethal to 50% of the population exposed to it for a specified time.
Likelihood	The description that best fits the chance of the selected consequence actually occurring, assuming reasonable effectiveness of the prevention and mitigation controls.
MARPOL (73/78)	The International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978. MARPOL 73/78 is one of the most important international marine environmental conventions. It was designed to minimise pollution of the seas, including dumping, oil and exhaust pollution. Its stated object is to preserve the marine environment through the complete elimination of pollution by oil and other harmful substances and the minimisation of accidental discharge of such substances.
Meteorology	The study of the physics, chemistry and dynamics of the earth's atmosphere, including the related effects at the air–earth boundary over both land and the oceans.
Mitigation	Management measures which minimise and manage undesirable consequences.
Oligotrophic	Low in plant nutrients and having a large amount of dissolved oxygen throughout.
pH	Measure of the acidity or basicity of an aqueous solution.
Protected Species	Threatened, vulnerable or endangered species which are protected from extinction by preventive measures. Often governed by special Federal or State laws.
Putrescible	Refers to food scraps and other organic waste associated with food preparation that will be subject to decay and rot (putrefaction).
Risk	The combination of the consequences of an event and its associated likelihood. For guidance see Environmental Guidance on Application of Risk Management Procedure.
Sessile	Organism that is fixed in one place; immobile.
Teleost	A fish belonging to the Teleostei or Teleostomi, a large group of fishes with bony skeletons, including most common fishes. The teleosts are distinct from the cartilaginous fishes such as sharks, rays and skates.
Thermocline	A temperature gradient in a thermally stratified body of water.
Zooplankton	Plankton consisting of small animals and the immature stages of larger animals.

Abbreviation	Meaning
µm	Micrometer
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AHS	Australian Hydrographic Service
AHV	Anchor Handling Vessel
AIMS	Australian Institute of Marine Science
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
AS/NZS	Australian/New Zealand Standard
ATSB	Australian Transport Safety Bureau
AusSAR	Australian Search and Rescue
bbl	Oil barrel
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blow-Out Preventer
BP	Boiling Point
BRUVS	Baited Remote Underwater Video System
CALM	Department of Conservation and Land Management
CCP	Cyclone Contingency Plan
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CICC	Corporate Incident Communication Centre
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea, 1972
CRA	Corrosion-Resistant Alloy
CS	Cost/Sacrifice
Cth	Commonwealth
CV	Company Values
DAA	Department of Aboriginal Affairs
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water and the Environment
DDR	Deep Directional Resistivity
DEC	Department of Environment and Conservation
DEH	Department of Environment and Heritage
DEWHA	Department of the Environment, Water, Heritage and the Arts
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Department of Mine and Petroleum
DNP	Director of National Parks

Abbreviation	Meaning
DNV	Det Norsk Veritas
DoD	Department of Defence
DoEE	Department of the Environment and Energy
DoF	Department of Fisheries
DoT	WA Department of Transport
DP	Dynamic Positioning
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWH	Deepwater Horizon
EC_{50}	Half maximal effective concentration
eCAR	Environmental Commitments and Actions Register
EDS	Emergency Disconnect Sequence
EHU	Electrical Hydraulic Umbilical
EMS	Environmental Management System
ENVID	Environmental Hazard Identification
EP	Environment Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPNdB	Effective perceived noise in decibels
EPO	Environmental Performance Outcome
ERP	Emergency Response Plan
F	Feasibility
FEWD	Formation Evaluation While Drilling
GDSF	Gascoyne Demersal Scalefish Fishery
GP	Good Practice
g/m^2	Grams per square metre
HAZID	Hazard Identification
HOCNF	Harmonised Offshore Chemical Notification Format
HQ	Hazard Quotient
HSE	Health, Safety and Environment
HSPU	Hydrocarbon Spill Preparedness Unit
Hz	Hertz
IC	Incident Controller
IMO	International Maritime Organization
IMS	Invasive Marine Species
IMT	Incident Management Team
IC_{50}	Half maximal inhibitory concentration
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association

Abbreviation	Meaning
ISO	International Standards Organization
ITF	Indonesian Throughflow
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
kHz	Kilohertz
km	Kilometre
kPa	Kilopascal
L	Litres
LBL	Long Base Line
LC_{50}	Lethal Concentration, 50%
LCS	Legislation, Codes and Standards
LNG	Liquefied Natural Gas
m/s	Metres per second
MAF	Marine Aquarium Fishery
MC	Measurement Criteria
MEG	Monoethylene Glycol
MFO	Marine Fauna Observer
MMscf	Million Standard Cubic Feet
MMSI	Maritime Mobile Service Identity
MNES	Matters of National Environmental Significance
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MoU	Memorandum of Understanding
MPA	Marine Protected Areas
MPRA	Marine Parks and Reserves Authority
MSIN	Maritime Safety Information Notifications
NIMS	Non-indigenous Marine Species
nm	Nautical mile (1852 m) a unit of distance on the sea
NMFS	US National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NPS	Non-Pressure Seal
NTM	Notice to Mariners
NWMR	North West Marine Region
NWS	North West Shelf
NWSTF	North West Slope Trawl Fishery

Abbreviation	Meaning
OCNS	Offshore Chemical Notification Scheme
OCS	Outer Continental Shelf
OIW	Oil in Water
OMR	Opportunity to Modify Request
OOC	Oil On Cuttings
OPEP	Oil Pollution Emergency Plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 1999*
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-east Atlantic
OVID	Offshore Vessel Inspection Database
OVMSA	Offshore Vessel Safety Management System Assessment
PAH	Polycyclic Aromatic Hydrocarbon
PJ	Professional Judgement
Pow	Octanol-Water Partition
PPA	Pearl Producers Association
ppb	Parts per Billion
ppm	Parts per Million
PS	Performance Standard
psi	Pounds per square inch
PSU	Practical Salinity Unit
PTS	Permanent Threshold Shift
PTW	Permit to Work
RBA	Risk Based Analysis
RCC	Rescue Coordination Centre
RFI	Request for Information
RMR	Riserless Mud Recovery
rms	Root Mean Square
ROV	Remotely Operated Vehicle
SCE	Solids Control Equipment
SEL	Sound Exposure Level
SIMAP	Spill Impact Mapping and Analysis Program
SIMOPS	Simultaneous Operations
SMPEP	Spill Monitoring Programme Execution Plan
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SV	Societal Values
Stb	Stock tank barrel
TD	Total Depth
TL	Transmission Loss
TPH	Total Petroleum Hydrocarbons

Abbreviation	Meaning
TPS	Well Test Package
TTS	Temporary Threshold Shift
UK	United Kingdom
US	United States of America
USBL	Ultra-Short Baseline
UTA	Umbilical Termination Assemblies
VOC	Volatile Organic Compound
VSP	Vertical Seismic Profiling
WA	Western Australia
WAF	Water Accommodated Fraction
WAFIC	Western Australian Fishing Industry Council
WBM	Water Based Mud
WCBD	Well Control Bridging Document
WCC	Woodside Communication Centre
WCSS	Worst Credible Spill Scenario
WSTF	Western Skipjack Tuna Fishery
WHA	World Heritage Area
WMS	Woodside Management System
WOMP	Well Operations Management Plan
Woodside	Woodside Energy Julimar Pty Ltd

APPENDIX A: WOODSIDE ENVIRONMENT & RISK MANAGEMENT POLICIES

WOODSIDE POLICY

Woodside

Risk Management Policy

OBJECTIVES

Woodside recognises that risk is inherent to its business and that effective management of risk is vital to delivering on our objectives, our success and our continued growth. We are committed to managing all risk in a proactive and effective manner.

Our approach to risk enhances opportunities, reduces threats and sustains Woodside's competitive advantage.

The objective of our risk management system is to provide a consistent process for the recognition and management of risks across Woodside's business. The success of our risk management system lies in the responsibility placed on everyone at all levels to proactively identify, manage, review and report on risks relating to the objectives they are accountable for delivering.

PRINCIPLES

Woodside achieves these objectives by:

- Applying a structured and comprehensive risk management system across Woodside which establishes common risk management understanding, language and methodology
- Identifying, assessing, monitoring and reporting risks to provide management and the Board with the assurance that risks, including contemporary and emerging risks, are being effectively identified and managed, and that Woodside is operating with due regard to the risk appetite set by the Board
- Ensuring risks consider impacts across the following key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural
- Understanding our exposure to risk and applying this to our decision making
- Embedding risk management into our critical business activities and processes
- Assuring the effectiveness of risk controls and of the risk management process
- Building our internal resilience to the effects of adverse business impacts in order to sustain performance.

APPLICATION

The Managing Director of Woodside is accountable to the Board of Directors for ensuring this policy is effectively implemented.

Managers are responsible for promoting and applying the Risk Management Policy. Responsibility for the effective application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control.

This policy will be reviewed regularly and updated as required.

Revised by the Woodside Petroleum Ltd Board on 6 December 2019.

APPROVED

WOODSIDE POLICY

Woodside

Health, Safety, Environment and Quality Policy

OBJECTIVES

Strong health, safety, environment and quality (HSEQ) performance is essential for the success and growth of our business. Our aim is to be recognised as an industry leader in HSEQ through managing our activities in a sustainable manner with respect to our workforce, our communities and the environment.

At Woodside we believe that process and personal safety related incidents, and occupational illnesses, are preventable. We are committed to managing our activities to minimise adverse health, safety or environmental impacts, incorporating a right first time approach to quality.

PRINCIPLES

Woodside will achieve this by:

- implementing a systematic approach to HSEQ risk management
- complying with relevant laws and regulations and applying responsible standards where laws do not exist
- setting, measuring and reviewing objectives and targets that will drive continuous improvement in HSEQ performance
- embedding HSEQ considerations in our business planning and decision making processes
- integrating HSEQ requirements when designing, purchasing, constructing and modifying equipment and facilities
- maintaining a culture in which everybody is aware of their HSEQ obligations and feels empowered to speak up and intervene on HSEQ issues
- undertaking and supporting research to improve our understanding of HSEQ and using science to support impact assessments and evidence based decision making
- taking a collaborative and pro-active approach with our stakeholders
- requiring contractors to comply with our HSEQ expectations in a mutually beneficial manner
- publicly reporting on HSEQ performance

APPLICATION

Responsibility for the application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control. Woodside managers are also responsible for promotion of this policy in non-operated joint ventures.

This policy will be reviewed regularly and updated as required.

Reviewed in December 2019

APPROVED

APPENDIX B: RELEVANT REQUIREMENTS

This appendix refers to Commonwealth Legislation related to the Petroleum Activities Program. Western Australian State Legislation relevant to an accidental release of hydrocarbons in WA State waters is outlined in the WA-49-L Gemtree Exploration Drilling Oil Pollution Emergency Plan.

Commonwealth Legislation	Legislation Summary
Australian Maritime Safety Authority Act 1990	This Act establishes a legal framework for the Australian Maritime Safety Authority (AMSA), which represents the Australian Government and international forums in the development, implementation and enforcement of international standards including those governing ship safety and marine environment protection. AMSA is responsible for administering the Marine Orders in Commonwealth waters.
Biosecurity Act 2015 • *Quarantine Regulations 2000* • *Biosecurity Regulations 2016* Australian Ballast Water Management Requirements 2017	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers.
Environment Protection and Biodiversity Conservation Act 1999 *Environment Protection and Biodiversity Conservation Regulations 2000*	This Act protects matters of national environmental significance (NES). It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and culturally significant places. Under this Act, actions that may be likely to have a significant impact on matters of NES must be referred to the Commonwealth Environment Minister.
Environment Protection (Sea Dumping) Act 1981 • *Environment Protection (Sea Dumping) Regulations 1983*	This Act provides for the protection of the environment by regulating dumping matter into the sea, incineration of waste at sea and placement of artificial reefs.
Industrial Chemicals (Notification and Assessment Act) 1989 • *Industrial Chemicals (Notification and Assessment) Regulations 1990*	This Act creates a national register of industrial chemicals. The Act also provides for restrictions on the use of certain chemicals which could have harmful effects on the environment or health.
National Environment Protection Measures (Implementation) Act 1998 • *National Environment Protection Measures (Implementation) Regulations 1999*	This Act and Regulations provide for the implementation of National Environment Protection Measures (NEPMs) to protect, restore and enhance the quality of the environment in Australia and ensure that the community has access to relevant and meaningful information about pollution. The National Environment Protection Council has made NEPMs relating to ambient air quality, the movement of controlled waste between states and territories, the national pollutant inventory, and used packaging materials.
National Greenhouse and Energy Reporting Act 2007 *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	This Act and associated Rule establishes the legislative framework for the NGER scheme for reporting greenhouse gas emissions and energy consumption and production by corporations in Australia. The requirements of this Act apply to the burning of reservoir gas during well appraisal.
Navigation Act 2012 • *Marine order 12 – Construction – subdivision and stability, machinery and electrical installations* • *Marine order 30 - Prevention of collisions* • *Marine order 57 - Helicopter operations*	This Act regulates navigation and shipping including Safety of Life at Sea (SOLAS). The Act will apply to some activities of the project vessels. This Act is the primary legislation that regulates ship and seafarer safety, shipboard aspects of marine environment protection and pollution prevention.

Commonwealth Legislation	Legislation Summary
• *Marine order 91 - Marine pollution prevention—oil* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 96 - Marine pollution prevention—sewage* • *Marine order 97 - Marine pollution prevention—air pollution*	
Offshore Petroleum and Greenhouse Gas Storage Act 2006 • *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* • *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011* • *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009*	This Act is the principal Act governing offshore petroleum exploration and production in Commonwealth waters. Specific environmental, resource management and safety obligations are set out in the Regulations listed.
Protection of the Sea (Powers of Intervention) Act 1981	This Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction.
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* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 95 - Marine pollution prevention—garbage* • *Marine order 96 - Marine pollution prevention—sewage*	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. Under this Act, discharge of oil or other harmful substances from ships into the sea is an offence. There is also a requirement to keep records of the ships dealing with such substances. The Act applies to all Australian ships, regardless of their location. It applies to foreign ships operating between 3 nautical miles (nm) off the coast out to the end of the Australian Exclusive Economic Zone (200 nm). It also applies within the 3 nm of the coast where the State/Northern Territory does not have complementary legislation. All the Marine Orders listed, except for Marine Order 95, are enacted under both the *Navigation Act 2012* and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This Act is an amendment to the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This amended Act provides the protection of the sea from pollution by oil and other harmful substances discharged from ships.
Protection of the Sea (Harmful Antifouling Systems) Act 2006 *Marine order 98—(Marine pollution prevention—anti-fouling systems)*	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the application or reapplication of harmful anti-fouling compounds on Australian ships or foreign ships that are in an Australian shipping facility.
Underwater Cultural Heritage Act 2018	This Act relates to the protection and management of underwater cultural heritage in Australia, including historic shipwrecks, sunken aircraft and other underwater cultural heritage sites.

APPENDIX C: EPBC ACT PROTECTED MATTERS SEARCH

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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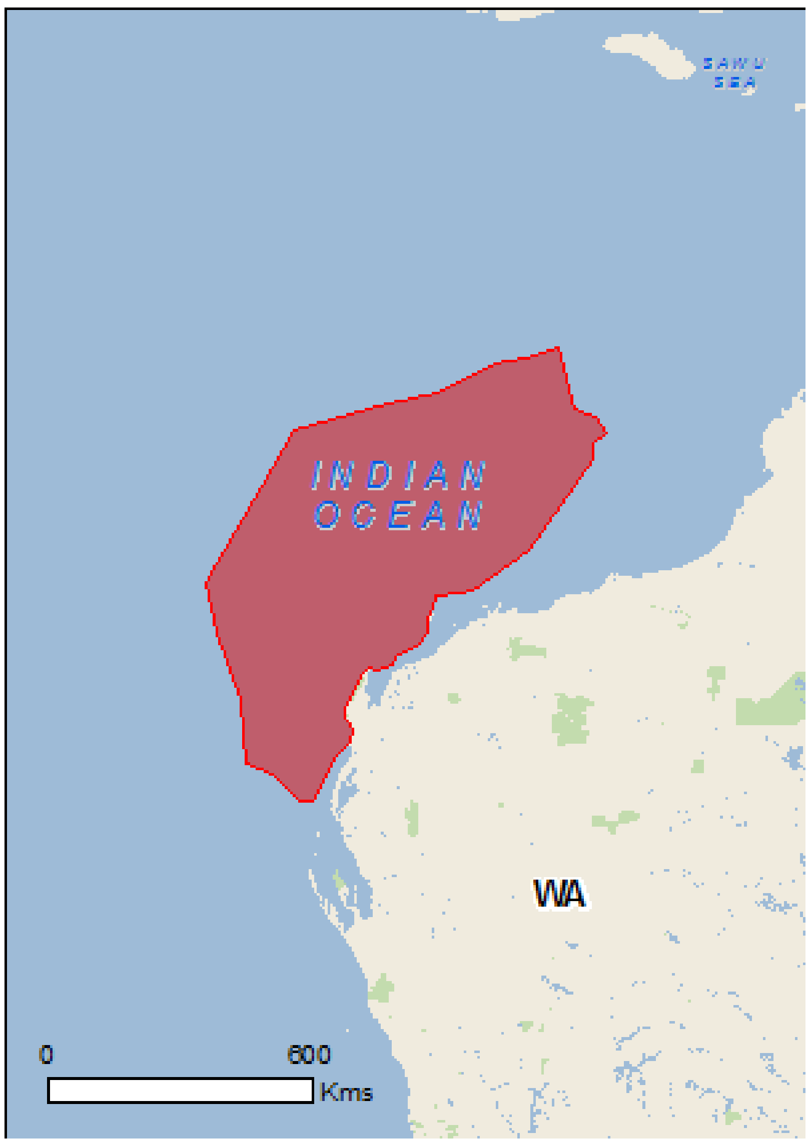

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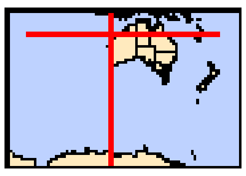

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	42
Listed Migratory Species:	59

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	1
Listed Marine Species:	114
Whales and Other Cetaceans:	31
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	7

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	8
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	6

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
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
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat likely to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
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
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
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	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

Name	Status	Type of Presence
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation 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 lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	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
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to 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

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		

Name	Threatened	Type of Presence
Anous stolidus Common Noddy [825]		Species or species habitat likely 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 likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may 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]		Foraging, feeding or related behaviour likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding 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

Name	Threatened	Type of Presence
		area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to 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
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat 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		
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat 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 may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		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
Pandion haliaetus Osprey [952]		Breeding known to occur

Name	Threatened	Type of Presence
		within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat 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 may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat 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 may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys 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
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
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 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

Name	Threatened	Type of Presence
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 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 penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		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

Name	Threatened	Type of Presence
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
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
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 czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding 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]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common		Species or species

Name	Status	Type of Presence
Dolphin [60]		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 simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
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 chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat 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

Name	Status	Type of Presence
		area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Barrow Island	WA
Boodie, Double Middle Islands	WA
Cape Range	WA
Jurabi Coastal Park	WA
Montebello Islands	WA
Muiron Islands	WA
Serrurier Island	WA
Unnamed WA41080	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Key Ecological Features (Marine)

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west

Caveat
The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates
-16.9029 118.7263,-16.7744 118.3067,-15.5801 117.9955,-15.7501 117.3427,-15.8819 116.6938,-16.4592 115.5659,-16.6397 114.5345,-17.1611 112.6003,-18.2485 111.9382,-20.1114 110.8211,-21.0913 111.0169,-22.3269 111.501,-23.5285 111.6438,-23.7273 112.1558,-24.2156 112.7001,-24.2096 112.9773,-23.3871 113.4715,-23.1602 113.7453,-22.8883 113.7996,-22.7203 113.6772,-22.6564 113.6402,-22.5456 113.6622,-22.2168 113.8237,-21.9019 113.9611,-21.8004 114.0792,-21.7552 114.2107,-21.8035 114.3091,-21.6898 114.6002,-21.5306 114.6999,-21.3026 115.1625,-21.0641 115.3373,-20.8511 115.3035,-20.6585 115.3732,-20.6303 115.4377,-20.368 115.504,-20.2955 116.0268,-20.2412 116.2777,-19.4908 117.4025,-17.7424 118.707,-17.4124 118.69,-17.225 118.9683,-16.9029 118.7263

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
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-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

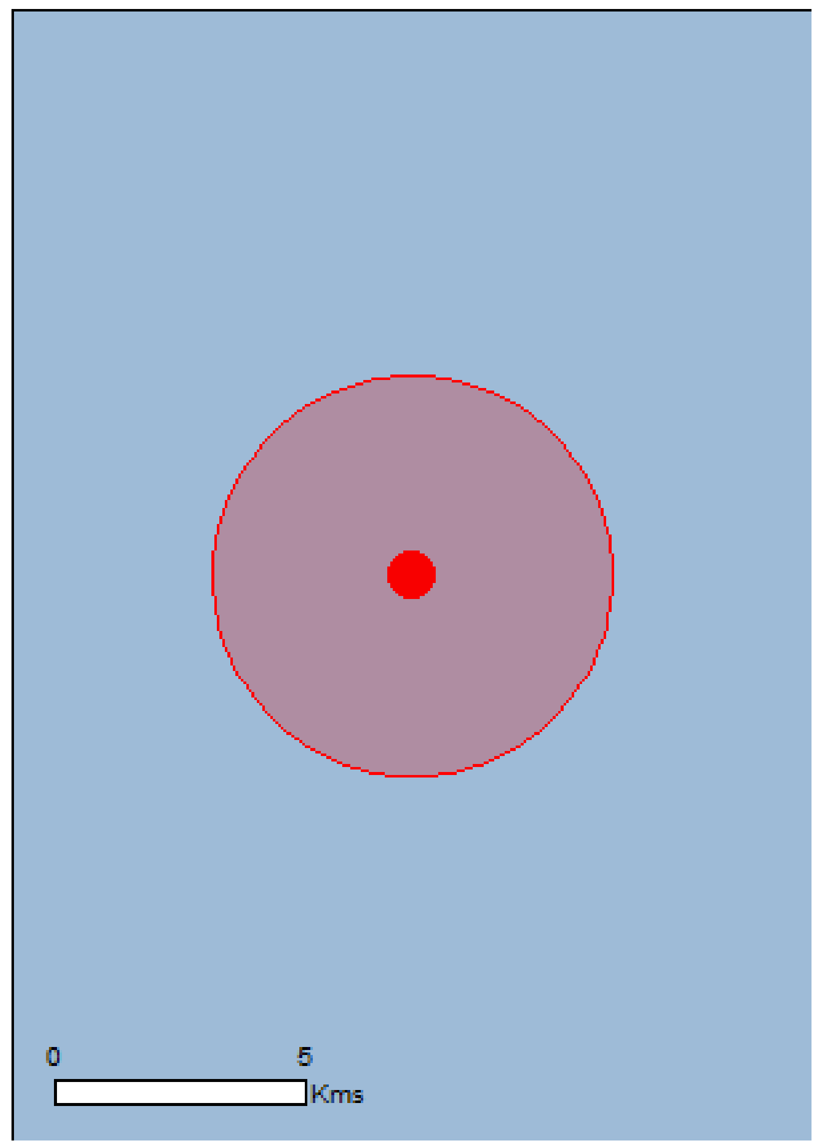
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 28/10/19 14:31:52



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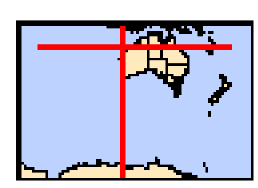
Buffer: 4.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	31

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	62
Whales and Other Cetaceans:	24
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

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 the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	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
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	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
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

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
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 may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may 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	Migration route known to occur within area

Name	Threatened	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to 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	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	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
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation 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 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

Name	Threatened	Type of Presence
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 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
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
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
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 melanotos Pectoral Sandpiper [858]		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 may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	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
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		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
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
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 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 grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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 penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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 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	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat 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
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation 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]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area

Name	Status	Type of Presence
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	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, 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 simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may 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
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

Name	Status	Type of Presence
		habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		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
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Continental Slope Demersal Fish Communities	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

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- some species and ecological communities that have only recently been listed
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The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.0352 115.1091

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
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- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
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- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D: OIL SPILL PREPAREDNESS AND RESPONSE MITIGATION ASSESSMENT

Oil Spill Preparedness and Response Mitigation Assessment for WA-49-L Gemtree Exploration Drilling Environment Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness Unit

February 2020

Revision: 0

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Document to be read in conjunction with Gemtree Exploration Drilling Environment Plan.

FIGURES

TABLES

EXECUTIVE SUMMARY

Woodside Energy (Julimar) Pty Ltd (Woodside) has developed an oil spill preparedness and response position for the WA-49-L Gemtree Exploration Drilling project, hereafter known as the Petroleum Activities Program (PAP).

This document demonstrates that the risks and impacts from an unplanned hydrocarbon release, and the associated response operations, are controlled to As Low As Reasonably Practicable (ALARP) and Acceptable levels. It achieves this by evaluating response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the Environment Plan (EP). This document then outlines Woodside's decisions and techniques for responding to a hydrocarbon release event and the process for determining its level of hydrocarbon spill preparedness.

A summary of the key facts and references to additional detail within this document are presented below.

Table 0-1: Summary of the key details for assessment

Key details of assessment	Summary	Reference to additional detail
Worst Case Credible Scenarios	Scenario 1 (Credible Scenario-01) Hydrocarbon release caused by loss of well containment during drilling of exploration well (open hole to base of reservoir) – Gemtree-A well. 70,956 m^3 release of Julimar Condensate over 61 days comprising a 5-day surface release of 6,240 m^3 followed by a 56-day subsurface release of 64,716 m^3. 0.4% residual component of 284 m^3.	Section 2.2
	Scenario 4 (Credible Scenario-04) Hydrocarbon release caused by loss of well containment during drilling of exploration well (open hole 30 m into reservoir) – Gemtree-A well. 90,114 m^3 release of Julimar Condensate over 61 days comprising a 5-day surface release of 8,035 m^3 followed by a 56-day subsurface release of 82,079 m^3. 0.4% residual component of 360 m^3.	
Hydrocarbon Properties	**Julimar Condensate** (API 47.9) contains a low proportion (0.4% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.248 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 48.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 21.3% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 29.5% should evaporate over several days (265 °C < BP < 380 °C). **Marine Diesel (API 37.2)** In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent (50 m^3). Under calm conditions the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will	Section 2.2.1 Section 6.7 of the EP Appendix A of the First Strike Plan

	then be subject to more gradual decay through biological and photochemical processes.	
Modelling Results	**Stochastic modelling** A quantitative, stochastic assessment has been undertaken for credible spill scenarios Credible Scenario-01 and Credible Scenario-04 (Table 2-1) to help assess the environmental risk of a hydrocarbon spill. A total of 100 replicate simulations were completed for the scenarios to test for trends and variations in the trajectory and weathering of the spilled oil, with an even number of replicates completed using samples of metocean data that commenced within each calendar quarter (25 simulations per quarter). The stochastic modelling used to understand the consequences of the marine diesel scenario (Credible Scenario-05) has been taken from the library of diesel spill models Woodside has accumulated over the years of undertaking similar activities to those within this PAP. The model used is considered representative of this PAP scenario due to their close proximity to one another, the selected model being closer to shore and of greater magnitude (double the scenario for this PAP), similar outputs and the same thresholds being used. The selected modelling was undertaken by the same contractor and within the recent past. In addition, the predictions of extent, severity, and duration of diesel released are also within the assumptions and case made in Reference Case 2018:1003 – Consequence analysis of an accidental release of diesel (National Energy Resources Australia (NERA), 2018). For the selected spill model, a total of 50 replicate simulations, of 42 days' duration for each of four quarterly periods, were completed for the scenario to test for trends and variations in the trajectory and weathering of the spilled oil. The modelled outputs were subsequently annualised.	Section 2.3
	Deterministic modelling Deterministic modelling was then undertaken for scenarios Credible Scenario-01 and Credible Scenario-04 (Table 2-1) as the worst-case credible scenarios (WCCS) to establish the following for response planning purposes. Deterministic modelling was not undertaken for Credible Scenario-05 but the stochastic results have been included here to further inform response planning: • Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2) • Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2) • Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2) Results as follows:	

	Credible Scenario-01: Hydrocarbon release caused by loss of well containment (70,956 m^3 of Julimar Condensate over 61 days)	**Credible Scenario-04: Hydrocarbon release caused by loss of well containment** (90,114 m^3 of Julimar Condensate over 61 days)	**Credible Scenario-05: Hydrocarbon release due to vessel collision** (instantaneous release of 275 m^3 of marine diesel)
Minimum time to shoreline contact (above 100 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*

	Largest volume ashore at any single Response Priority Area (RPA) (above 100 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*	
	Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m^2 accumulation concentration)	2.38 m^3 at Barrow Island (38 days) Model 7, Q2	3.78 m^3 at Barrow Island (37 days) Model 7, Q2	<1 m^3 at Ningaloo Coast Middle WHA (15 days)	
Net Environmental Benefit Assessment	Monitor and evaluate, source control (capping stack)*, source control (relief well drilling), source control (vessel), protection and deflection, shoreline clean-up, and oiled wildlife response are all identified as potentially having a net environmental benefit (dependent on the actual spill scenario) and carried forward for further assessment.				Section 4
ALARP evaluation of selected response techniques	The evaluation of the selected response techniques shows the proposed controls reduced the risk to an ALARP and Acceptable level for the risks and impacts presented in Section 2 and Section 3, including the implementation of considered additional, alternative or improved control measures.				Section 5 Section 6

**NB This option would only viable for a loss of well containment where the plume radius is ~25 m or less.*

1 INTRODUCTION

1.1 Overview

This document outlines Woodside's decisions and techniques for responding to a hydrocarbon loss of containment event and the process for determining its level of hydrocarbon spill preparedness.

1.2 Purpose

This document, together with the documents listed below, meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Environment Regulations) relating to hydrocarbon spill response arrangements:

- the WA-49-L Gemtree Exploration Drilling EP
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- the WA-49-L Gemtree Exploration Drilling Oil Pollution Emergency Plan (OPEP) including:
  - First Strike Plan (FSP)
  - relevant Operations Plans
  - relevant Tactical Response Plans (TRPs)
  - relevant Supporting Plans
  - Data Directory.

1.3 Scope

This document evaluates response options to address the potential environmental risks and impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the EP. It then outlines Woodside's decisions and techniques for responding to a hydrocarbon release event and the process for determining its level of hydrocarbon spill preparedness. It should be read in conjunction with the documents listed in Table 1-1. The location of the PAP is shown in Figure 3.2 of the EP.

1.4 Oil spill response document overview

The documents outlined in Table 1-1 and Figure 1-1 are collectively used to manage the preparedness and response for a hydrocarbon release.

ANNEX A contains a pre-operational Net Environmental Benefit Analysis (NEBA) summary, outlining the selected response techniques for this PAP. Relevant Operational Plans to be initiated for associated response techniques are identified in the FSP and relevant forms to initiate a response are appended to the FSP.

The process to develop an Incident Action Plan (IAP) begins once the FSP is underway. The IAP includes inputs from the monitor and evaluate operations and the operational NEBA (Section 4). Planning, coordination and resource management are initiated by the Incident Management Team (IMT). In some instances, technical specialists may be utilised to provide expert advice. The planning may also involve liaison officers from supporting government agencies.

During each operational period, field reports are continually reviewed to evaluate the effectiveness of response operations. In addition, the operational NEBA is continually reviewed and updated to ensure the response techniques implemented continue to result in a net environmental benefit (see Section 4). The response will continue as described in Section 5 until the response termination criteria have been met as set out in ANNEX B: Operational Monitoring Activation and Termination Criteria.

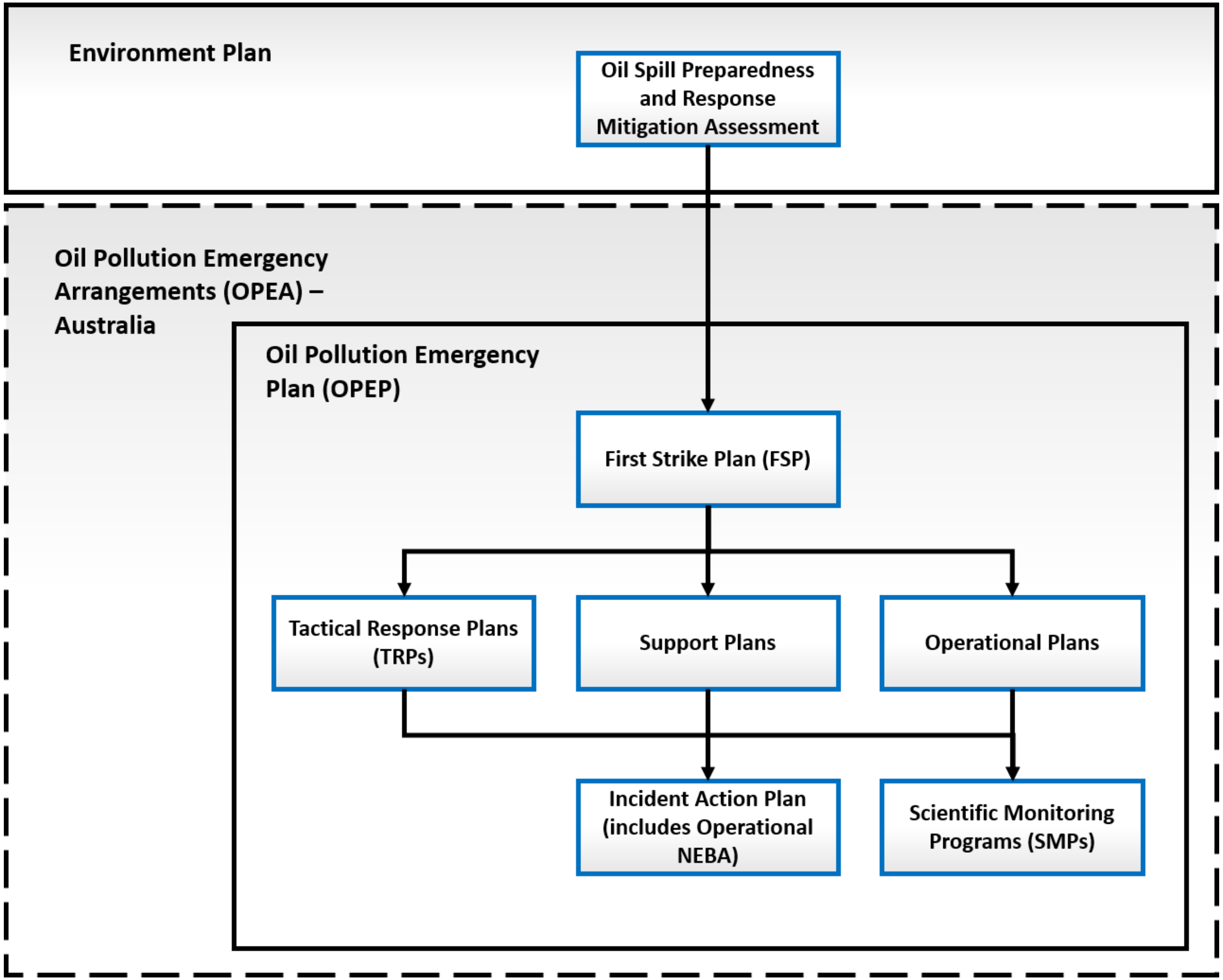

Figure 1-1: Woodside hydrocarbon spill document structure

Table 1-1: Hydrocarbon spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
WA-49-L Gemtree Exploration Drilling EP	Demonstrates that potential adverse impacts on the environment associated with the WA-49-L Gemtree Exploration Drilling (during both routine and non-routine operations) are mitigated and managed to ALARP and will be of an acceptable level.	NOPSEMA General public Woodside internal	EP Section 6 (Environmental Risk Assessment, Performance Outcomes, Standards and Measurement Criteria). EP Section 7 (Implementation strategy – including emergency preparedness and response). EP Section 7 (Reporting and compliance).	
OPEA Australia	Describes the arrangements and processes adopted by Woodside when responding to a hydrocarbon spill from a petroleum activity.	Regulatory agencies Woodside internal	All sections	
Oil Spill Preparedness and Response Mitigation Assessment for the WA-49-L Gemtree Exploration Drilling (this document)	Evaluates response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the EP.	Regulatory agencies Corporate Incident Control Centre (CICC): Control function in an ongoing spill response for activity-specific response information.	All performance outcomes, standards and measurement criteria related to hydrocarbon spill preparedness and response are included in this document.	
WA-49-L Gemtree Exploration Drilling Oil Pollution FSP	Facility specific document providing details and tasks required to mobilise a first strike response. Primarily applied to the first 24 hours of a response until a full incident action plan (IAP) specific to the event is developed. Oil Pollution FSPs are intended to be the first document used to provide immediate guidance to the responding IMT.	Site-based IMT for initial response, activation and notification. CICC for initial response, activation and notification. CICC: Control function in an ongoing spill response for	Initial notifications and reporting required within the first 24 hours of a spill event. Relevant spill response options that could be initiated for mobilisation in the event of a spill. Recommended pre-planned tactics. Details and forms for use in immediate response. Activation process for oil spill trajectory	

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
		activity-specific response information.	modelling, aerial surveillance and oil spill tracking buoy details.	
Operational Plans	Lists the actions required to activate, mobilise and deploy personnel and resources to commence response operations. Includes details on access to equipment and personnel (available immediately) and steps to mobilise additional resources depending on the nature and scale of a release. Relevant operational plans will be initially selected based on the Oil Pollution First Strike Plan; additional operational plans will be activated depending on the nature and scale of the release.	CICC: Operations and Logistics functions for first strike activities. CICC: Planning Function to help inform the IAP on resources available.	Locations from where resources may be mobilised. How resources will be mobilised. Details of where resources may be mobilised to and what facilities are required once the resources arrive. Details on how to implement resources to undertake a response.	Operational Monitoring Plan Source Control and Well Intervention Protection and Deflection Shoreline Clean-up Oiled Wildlife Scientific Monitoring
Tactical Response Plans	Provides options for response techniques in selected Response Protection Areas (RPAs). Provides site, access and deployment information to support a response at the location.	CICC: Planning Function to help develop IAPs, and Logistics function to assist with determining resources required.	Indicative response techniques. Access requirements and/or permissions. Relevant information for undertaking a response at that site. Where applicable, may include equipment deployment locations and site layouts.	Mangrove Bay Turquoise Bay Yardie Creek Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek Barrow and Lowendal Islands Montebello Island – Stephenson Channel Nth TRP Montebello Island – Champagne Bay and Chippendale channel TRP Montebello Island – Claret Bay TRP Montebello Island – Hermite/Delta Island Channel TRP Montebello Island – Hock Bay TRP Montebello Island – North and Kelvin Channel TRP

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
				Montebello Island – Sherry Lagoon Entrance TRP Pilbara Islands - Southern Island Group Rankin Bank & Glomar Shoals Muiron Islands Exmouth OWRP
Support Plans	Support Plans detail Woodside's approach to resourcing and the provision of services during a hydrocarbon spill response.	CICC: Operations, Logistics and Planning functions.	Strategy for mobilising and managing additional resources outside of Woodside's immediate preparedness arrangements.	Marine Logistics People and Global Capability Surge Labour Requirement Plan Health and Safety Aviation IT (First Strike Response) IT (Extended Response) Communications (First Strike Response) Communications (Extended Response) Stakeholder Engagement Accommodation and Catering Waste Management Guidance for Oil Spill Claims Management (Land based) Security Support Plan Hydrocarbon Spill Responder Health Monitoring Guideline

2 RESPONSE PLANNING PROCESS

This document details Woodside's process for identifying potential response options for the hydrocarbon release scenarios, identified in the EP. Figure 2-1 outlines the interaction between Woodside's response, planning/preparedness and selection process.

This structure has been used because it shows how the planning and preparedness activities inform a response and provides indicative guidance on what activities would be undertaken, in sequential order, if a real event were to occur. The process also evaluates alternative, additional and/or improved control measures specific to the PAP.

The WA-49-L Gemtree Exploration Drilling FSP then summarises the outcome of the response planning process and provides initial response guidance and a summary of ongoing response activities, if an incident were to occur.

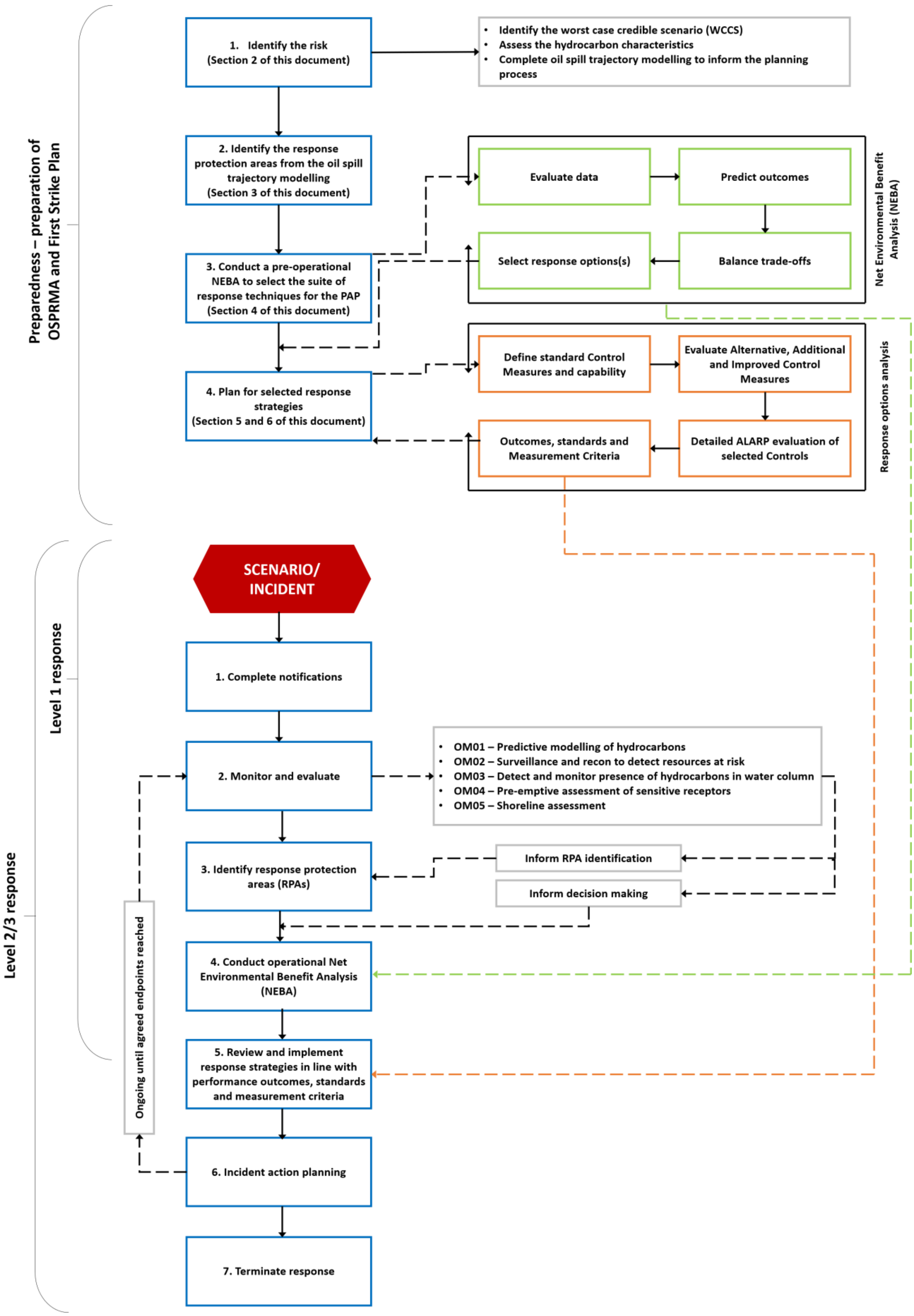

Figure 2-1: Response planning and selection process

2.1 Response planning process outline

This document is expanded below to provide additional context on the key steps in determining capability, evaluating ALARP and hydrocarbon spill response requirements.

Section 1. INTRODUCTION

Section 2. RESPONSE PLANNING PROCESS

- identification of worst-case credible scenario(s) (WCCS)
- spill modelling for WCCS

Section 3. IDENTIFY RESPONSE PROTECTION AREAS (RPAs)

- areas predicted to be contacted at concentrations of >100 g/m^2.

Section 4. NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

- pre-operational NEBA (during planning/ALARP evaluation): this must be reviewed during the initial response to an incident to ensure its accuracy
- selected response techniques prioritised and carried forward for ALARP assessment

Section 5. HYDROCARBON SPILL ALARP PROCESS

- determines the response need based on predicted consequence parameters.
- details the environmental performance of the selected response options based on the need.
- sets the environmental performance outcomes, environmental performance standards and measurement criteria.

Section 6. ALARP EVALUATION

- evaluates alternative, additional, and improved options for each response technique to demonstrate the risk has been reduced to ALARP.
- provides a detailed ALARP assessment of selected control measure options against:
  - predicted cost associated with implementing the option
  - predicted change to environmental benefit
  - predicted effectiveness / feasibility of the control measure

Section 7. ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

- evaluation of impacts and risks from implementing selected response options

Section 8. ALARP CONCLUSION

Section 9. ACCEPTABILITY CONCLUSION

2.1.1 Response Planning Assumptions – Timing, Resourcing and Effectiveness

Figure 2-2 illustrates the initial steps of a response to an oil spill event and, where available, the indicative timing. For the latter stages, the timing will be specific to the selective response option.

IMT Call-out/ Notification	Contract Activation	Response Option Mobilisation	Response Option Deployment	Response Option Effectiveness
This is the time taken from call-out to mobilise the IMT to the designated Incident Control Centre	This is the time taken once the IMT has been mobilised to activate specific contracts for resources (SFRT, FWADC, AMOSC, AMSA, OSRL, etc)	This is the time taken to mobilise resources from home location to laydown/staging area (expected to be airport or sea port) close to response area	This is the time taken to deploy resources from laydown/staging area (expected to be airport or sea port) to response area/field	This relates to the performance of equipment/response option as well as required personnel resourcing (Specialists/Supervisors + support personnel)
Approx 2-4 hours	Approx 2-4 hours	Response Technique specific	Field/Location specific	Response Strategy specific

Figure 2-2: Response Planning Assumptions – Timing, Resourcing and Effectiveness

2.2 Environment plan risk assessment (credible spill scenarios)

Potential hydrocarbon release scenarios from the PAP have been identified during the risk assessment process (Section 6 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 6 of the EP. Three unplanned events or credible spill scenarios for the PAP have been selected as representative across types, sources and incident/response levels, up to and including the WCCS. The WCCS for the activity is then used for response planning purposes, as all other scenarios are of a lesser scale and extent. By demonstrating capability to manage the response to the WCCS, Woodside assumes other scenarios that are smaller in nature and scale can also be managed by the same capability. Response performance measures have been defined based on a response to the WCCS.

Table 2-1 presents the credible scenarios for the PAP. Two loss of well containment scenarios (Credible Scenario-01 and Credible Scenario-04) were both deterministically modelled.

Table 2-1: Petroleum Activities Program credible spill scenarios

Credible Scenario No. [1]	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m^3)[1]	Incident Level	Hydrocarbon (HC) type	Residual proportion (%)	Residual volume (liquid m^3)
Credible Scenario-01	Yes	Loss of well control during drilling of development well Gemtree-A. A long-term (61-day) uncontrolled surface/subsurface release of Julimar Condensate from the Gemtree Exploration Well (open hole to base of TR28 reservoir), representing loss of containment after a loss of well control.	Surface: 5-day release of 6,240 m^3 Subsurface: 56-day release of 64,716 m^3 Total: 70,956 m^3 over 61 days 0.4% residual component	3	Julimar condensate	0.4%	284 m^3 (4.66 m^3 per day)
Credible Scenario-04	Yes	Loss of well control during drilling of development well Gemtree-A. A long-term (61-day) uncontrolled surface/subsurface release of Julimar Condensate from the Gemtree Exploration Well (open hole 30 m into TR28 reservoir), representing loss of containment after a loss of well control.	Surface: 5-day release of 8,035 m^3 Subsurface: 56-day release of 82,079 m^3 Total: 90,114 m^3 over 61 days 0.4% residual component	3	Julimar condensate	0.4%	360 m^3 (5.9 m^3 per day)
Credible Scenario-05	Yes	Rupture of the largest single tank inventory of the fuel tanker due to collision with installation vessel.	Surface: instantaneous release of 275 m^3 of marine diesel. 5% residual component	2	Marine diesel	5%	13.75 m^3

[1] A full description of Credible Scenarios used in this document is included in EP Section 6.8.

2.2.1 Hydrocarbon characteristics

More detailed hydrocarbon characteristics, including modelled weathering data and ecotoxicity, are included in Section 6 of the EP.

Julimar Condensate

Julimar Condensate (API 47.9) contains a low proportion (0.4% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.248 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 48.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 21.3% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 29.5% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers.

The whole oil has low asphaltene content (<0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 11.5% by mass of the whole oil, with a significant proportion (7.4%) 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.

Marine Diesel

Marine Diesel Oil is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group I/II oil. Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

It is predicted that 13.75 m^3 of product would remain after weathering from the representative marine diesel scenario.

2.3 Hydrocarbon spill modelling

Oil spill trajectory modelling (OSTM) tools are used for environmental impact assessment and during response planning to understand spatial scale and timeframes for response operations. Woodside recognises that there is a degree of uncertainty related to the use of modelling data and has subsequently utilised conservative approaches to volumes, weathering, spatial areas, timing and response effectiveness to scale capability to need.

The Oil Spill Model and Response System (OILMAP) and Integrated Oil Spill Impact Model System (SIMAP) models are both used for stochastic and deterministic trajectory modelling. They have been developed over three decades of planning, exercises, actual responses, several peer reviews, and validation studies. OILMAP was originally derived from the United States Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA) Type A model (French et al. 1996), for assessing marine transport, biological impact and economic damage that was also used under the United States Oil Pollution Act 1990 Natural Resource Damage Assessment (NRDA) regulations. Notable spills where the model has been used and validated against actual field observations include, Exxon Valdez (French McCay 2004), North Cape Oil Spill (French McCay 2003), along with an assessment of 20 other spills (French McCay and Rowe, 2004). In addition, test spills designed to verify fate, weathering and movement algorithms have been conducted regularly and in a range of climate conditions (French and Rines 1997; French et al. 1997; Payne et al. 2007; French McCay et al. 2007).

Further to this, the algorithms have been updated using the latest findings from the Macondo/Deepwater Horizon well blowout in the Gulf of Mexico and validated according to the Deepwater Horizon (DWH) oil spill in support of the NRDA (Spaulding et al. 2015; French McCay et al. 2015, 2016). Finally, the OILMAP and SIMAP models have been used extensively in Australia to prosecute pollution offences, predict discharge locations and likely spill volumes based on weathering and surveillance observations, and has been used as expert witness evidence in Australian court proceedings, aiding the prosecution to determine spill quantum estimates.

2.3.1 Stochastic modelling

Quantitative, stochastic assessments have been undertaken for credible spill scenarios Credible Scenario-01 and Credible Scenario-04 (Table 2-1) to help assess the environmental consequences of a hydrocarbon spill.

A total of 100 replicate simulations were completed for the scenarios to test for trends and variations in the trajectory and weathering of the spilled oil, with an even number of replicates completed using samples of metocean data that commenced within each calendar quarter (25 simulations per quarter). Further details relating to the assessments for the scenarios can be found in Section 6 of the EP.

The stochastic modelling used to understand the consequences of Credible Scenario-05 has been taken from the library of diesel spill models Woodside has accumulated over the years of undertaking similar activities to those within this PAP. These models are considered representative of the scenario considered in this PAP because:

- The selected spill model scenario volume is 550 m^3 which is double the volume of the worst-case credible marine diesel scenario of 275 m^3 for this PAP.
- The selected spill model scenario is located within 5 NM of the Gemtree operational area thus environmental and metocean conditions are very closely aligned.
- The 550 m^3 release is closer to shorelines than the operational area of this PAP.
- The modelled outputs have comparable outputs and use the same thresholds.
- The model used is relatively recent and utilises the latest and same hydrodynamic assumptions and inputs.
- The model has been carried out by the same contractor using the same predictive software.

Woodside considered commissioning bespoke modelling for this PAP and it was determined that the outputs would not provide a significantly different understanding of the consequences of a diesel spill. In addition, the predictions of extent, severity, and duration of diesel released are also within the assumptions and case made in Reference Case 2018:1003 – Consequence analysis of an accidental release of diesel (National Energy Resources Australia (NERA), 2018).

For the selected spill model, a total of 50 replicate simulations, of 42 days' duration for each of four quarterly periods, were completed for the scenario to test for trends and variations in the trajectory and weathering of the spilled oil. The modelled outputs were subsequently annualised. Further details relating to the assessments for the scenarios can be found in Section 6 of the EP.

2.3.1.1 Environmental impact thresholds – Environment that May Be Affected (EMBA) and hydrocarbon exposure

The outputs of the stochastic spill modelling are used to assess the potential environmental impact from the credible scenarios. The stochastic modelling results are used to delineate areas of the marine and shoreline environment that could be exposed to hydrocarbon levels exceeding environmental impact threshold concentrations. The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the EMBA and is discussed further in Section 6 of the EP. As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is presented for each fate within the EP.

A conservative approach – adopting accepted contact thresholds for impacts on the marine environment – is used to define the EMBA. These hydrocarbon thresholds are presented in Table 2-2 below and described in Section 6 of the EP.

Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine the EMBA and environmental impacts

Floating Oil Concentration (g/m^2)	Shoreline Oil Concentration (g/m^2)	Entrained Oil Concentration (ppb)	Dissolved Aromatic Hydrocarbon Concentration (ppb)
1	10	10	10
10	100	100	50
50	1000	500	400
			500

2.3.2 Deterministic modelling

Woodside uses deterministic modelling results to evaluate risks and impacts and response capability requirements. These results are provided in both shapefile and data table format with each row of the data table representing a 1 km^2 cell. This cell size has been used as it represents the approximate area that a single containment and recovery operation or surface dispersant operation (single sortie or vessel spraying) can effectively treat in one ten (10) hour day. Smaller cell sizes have been considered but would not change the response need as the potential distance between cells would not allow multiple cells to be treated per day by response operations. Additionally, a 1 km^2 cell is expected to allow averaging of threshold concentrations and mass across the spatial extent to represent a conservative approach (patches of oil and windrows) to response planning that simulates operational monitoring feedback in a real event.

Deterministic modelling was carried out on scenarios Credible Scenario-01 and Credible Scenario-04 (both loss of well containment) as they were determined to be WCCS and thus used for response planning purposes. A sample of these deterministic results is provided below as an indication of the data format and content.

- Column A and B provide the latitude and longitude of the cell
- Column C is the elapsed time since the release occurred
- Column D represents the average concentration across the cell in g/m^2
- Column E represents the viscosity of the hydrocarbon in centistokes (cSt) at sea surface temperature
- Column F and G represents the mass of hydrocarbon across the entire cell in kg and tons respectively.

Table 2-3: Example Deterministic modelling data

Latitude A	Longitude B	Time_hour C	Conc_gm^2 D	Visc_cSt E	Mass_kg F	Mass_tons G
-20.045420	115.069062	6	2.149645	34.656543	2150.548637	2.149645
-20.045420	115.078617	6	7.971793	34.718463	7975.135028	7.971793
-20.036388	115.078617	6	6.137017	34.669694	6139.947116	6.137017
-20.045420	115.088172	6	5.193963	34.863617	5196.134239	5.193963
-20.036388	115.088172	6	9.777514	34.846503	9782.170862	9.777514
-20.045420	115.097727	6	5.235050	34.048570	5237.231374	5.235050
-20.036388	115.097727	6	17.654881	33.330116	17663.267493	17.654881

The deterministic modelling data provides an indication of the response need by displaying the potential surface area and volume that may be treated or recovered by response operations. Existing capability is reviewed to approximate the surface area and volumes that can be treated or removed and a range of alternate, improved and additional options to reduce risks and impacts to ALARP are considered.

Woodside recognises that no single response technique will treat all available subsea or surface oil and that a combination of response techniques will be required for the identified scenario. Even with the significant resources available to Woodside through existing capability and third-party resources, the primary offshore response techniques of surface dispersant application and containment and recovery will only treat or recover a minor proportion (<30%) of the available surface hydrocarbons based on previous response experience.

Woodside is committed to a realistic, scalable response capability that is commensurate to the level of risk and able to be practically implemented and feasibly sustained.

2.3.2.1 Response planning thresholds for surface and shoreline hydrocarbon exposure

Thresholds to determine the EMBA are used to predict and assess environmental impacts and inform the Scientific Monitoring Program (SMP), however they do not appropriately represent the thresholds at which an effective response can be implemented. Additional response thresholds are used for response planning and to determine areas where response techniques would be most effective. The deterministic modelling is then used to assess the nature and scale of a response.

In the event of an actual response, existing deterministic modelling would be reviewed for suitability and additional modelling would be conducted using real-time data and field information to inform IMT decisions.

The deterministic spill modelling outputs are presented at response planning thresholds for surface hydrocarbons for the WCCS. Surface spill concentrations are expressed as grams per square metre (g/m^2) (Section 2.2). The thresholds used are derived from oil spill response planning literature and industry guidance and are summarised below.

2.3.2.1.1 Surface hydrocarbon concentrations

Table 2-4: Surface hydrocarbon thresholds for response planning

Surface hydrocarbon threshold (g/m^2)	Description	Bonn Agreement Oil Appearance Code	Mass per area (m^3/km^2)
>10	Predicted minimum threshold for commencing operational monitoring[2]	Code 3 – Dull metallic colours	5 to 50
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [3]	Code 4 – Discontinuous true oil colour	50 to 200
100	Predicted optimum floating oil threshold for containment and recovery and surface dispersant application	Code 5 – Continuous true oil colour	>200
Shoreline hydrocarbon threshold (g/m^2)	**Description**	**National Plan Guidance on Oil Contaminated Foreshores**	**Mass per area (m^3/km^2)**
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations	Stain	>100
250	Predicted minimum threshold for commencing shoreline cleanup operations	Level 3 – Thin Coating	200 to 1000

The surface thickness of oil at which dispersants are typically effective is approximately 100 g/m². However, substantial variations occur in the thickness of the oil within the slick, and most fresh crude oils spread within a few hours, so that overall the average thickness is 0.1 mm (or approx. 100 g/m²) (International Tanker Owners Pollution Federation [ITOPF] 2011). Additionally, the recommended rate of application for surface dispersant is typically 1-part dispersant to 20 or 25 parts of spilled oil. These figures assume a 0.1 mm slick thickness, averaged over the thickest part of the spill, to calculate a litres/hectare application rate from vessels and aircraft. In practice this can be difficult to achieve as it is not possible to accurately assess the thickness of the floating oil.

Some degree of localised over-dosage and under-dosage is inevitable in dispersant response. An average oil layer thickness of 0.1 mm is often assumed, although the actual thickness can vary over a wide range (from less than 0.0001 mm to more than 1 mm) over short distances (International Petroleum Industry Environment Conservation Association [IPIECA] 2015).

Guidance from the Australian Maritime Safety Authority (AMSA, 2015) indicates that spreading of spills of Group II or III products will rapidly decrease slick thickness over the first 24 hours of a spill resulting in the potential requirement of up to a ten (10) fold increase in capability on day 2 to achieve the same level of performance.

Further guidance from the European Maritime Safety Authority (EMSA) states that spraying the 'metallic' looking area of an oil slick (Bonn Agreement Oil Appearance Code [BAOAC] 3, approx. 5 – 50 µm) with dispersant from spraying gear designed to treat an oil layer 0.1 mm (100 µm) thick, will inevitably cause dispersant over-treatment by a factor of 2 to 20 times (EMSA 2012).

Therefore, dispersant application should be concentrated on the thickest areas of an oil slick and Woodside intends on applying surface dispersants to only BAOAC 4 and 5. Spraying areas of oil

[2] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

[3] At 50g/m², containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and containing the spread of surface oil.

designated as BAOAC Code 4 (Discontinuous true oil colour) with dispersant will, on average, deliver approximately the recommended treatment rate of dispersant.

Spraying areas of oil designated as BAOAC Code 5 with dispersant (Continuous true oil colour and more than 0.2 mm thick) will, on average, deliver approximately half the recommended treatment rate of dispersant. Repeated application of these areas of thicker oil, or increased dosage ratios, will be required to achieve the recommended treatment rate of dispersant (EMSA 2012).

Guidance from NOAA in the United States is found in the document: *Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments 2013 (NOAA 2013).* This guide outlines advice for response planning across all common techniques, including surface dispersant spraying and containment and recovery. It states that oil thickness can vary by orders of magnitude within distinct areas of a slick, thus the actual slick thickness and oil distribution of target areas are crucial for determining response method feasibility. Further to this, ITOPF also states that in terms of oil spill response, sheen can be disregarded as it represents a negligible quantity of oil, cannot be recovered or otherwise dealt with to a significant degree by existing response techniques, and is likely to dissipate readily and naturally (ITOPF, 2014).

Figure 2-3 below from AMSA's Identification of Oil on Water – Aerial Observation and Identification Guide (AMSA, 2014) shows expected percent coverage of surface hydrocarbons as a proportion of total surface area. Wind-rows, heavy oil patches and tar balls, for example, must be considered, as they influence oil encounter rates, chemical dosages and ignition potential. Each method has different thickness thresholds for effective response.

From this information and other relevant sources (Allen and Dale, 1996, EMSA, 2012, Spence, 2018) the surface threshold of 50g/m^2 was chosen as an average/equilibrium thickness for offshore response operations (50 g/m^2 is an average of 50% coverage of 0.1mm Bonn Agreement Code 4 – discontinuous true oil colour, or 25% coverage of 0.2mm Bonn Agreement Code 5 – continuous true oil colour which would represent small patches of thick oil or wind-rows).

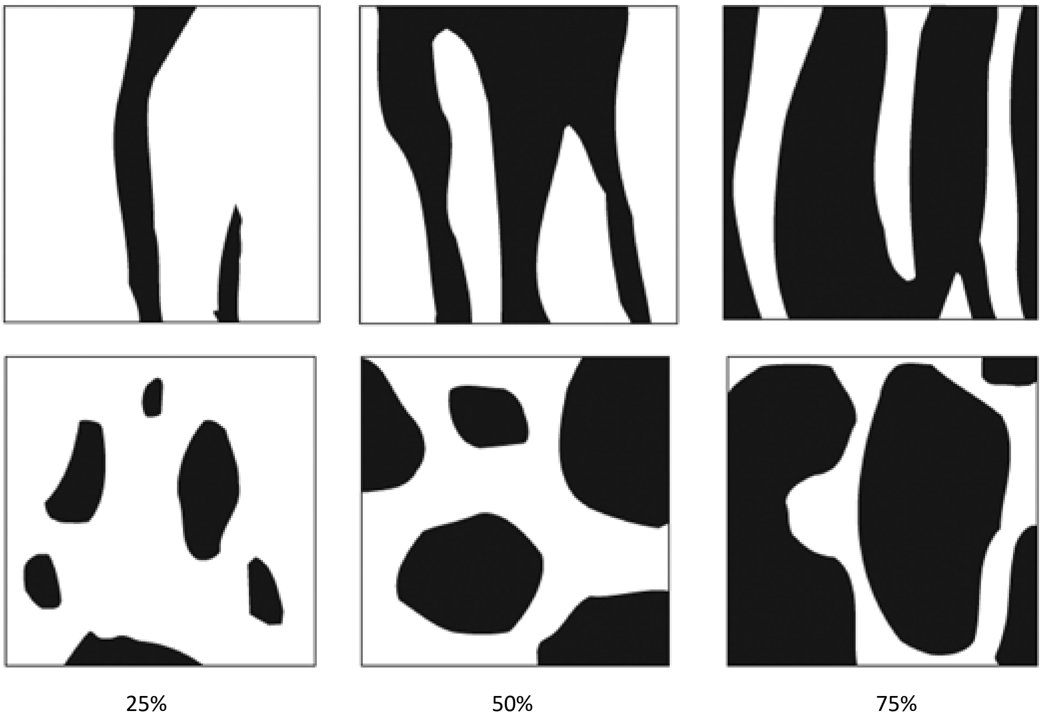

Figure 2-3: Proportion of total area coverage (AMSA, 2014)

Figure 2-4 illustrates the general relationships between on-water response techniques and slick thickness. Wind-rows, heavy oil patches and tar balls, for example, must be considered, as they influence oil encounter rates, chemical dosages and ignition potential. Each method has different thickness thresholds for effective response.

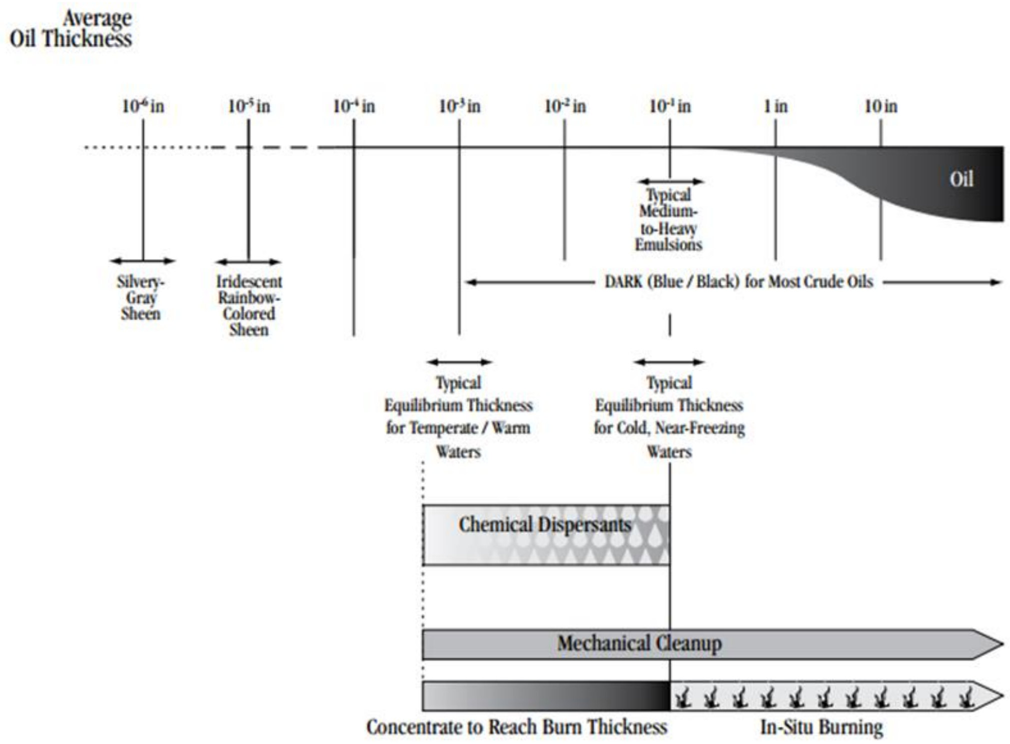

Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and wave influence on the feasibility of response operations are also considered below:

- Mechanical Clean-up: Effectiveness drops significantly because of entrainment and/or splash-over as short period waves develop beyond 2–3 ft. (0.6–0.9m) in height. The ability to contain and recover oil decreases rapidly as the slick thickness becomes less than a thousandth of an inch (0.025 mm) (i.e., very low oil encounter rates). Waves and wind can also be limiting factors for the safe operation of vessels and aircraft.
- Dispersants: Effective dispersion requires a threshold amount of surface mixing energy (typically a few knots of wind and a light chop) to be effective. At higher wind and sea conditions, dispersant evaporation and wind-drift will limit chemical dispersion application effectiveness; and, there is a point (~25-kt winds, 10-ft waves) where natural dispersion forces become greater, particularly for light oils. Because of droplet size versus slick thickness constraints and application dose-rate limitations, dispersants work best on slick thicknesses of a few thousandths (approx. 50 g/m^2) to hundredths of an inch (approx. 250 g/m^2). Improved dispersants, higher dose rates, and multiple-pass techniques may extend the thickness limitation to 0.1 inch (2.5 mm) or more.

As offshore response operations (surface dispersant and containment and recovery) are intended to be undertaken at the thickest part of the slick, 50 g/m^2 and 100 g/m^2 (aligning with the lower limit of BAOAC 4 and midpoint of BAOAC 5) have been utilised by Woodside in deterministic modelling to identify the most likely locations for surface dispersant application and containment and recovery operations.

2.3.2.1.2 Surface hydrocarbon viscosity

Table 2-5: Surface hydrocarbon viscosity thresholds

Surface viscosity threshold (cSt)	Description	European Maritime Safety Authority (EMSA)	Viscosity at sea temperature (cSt)
5,000*	Predicted optimum viscosity for surface dispersant operations	Generally possible to disperse	500-5,000

15,000*	Predicted maximum viscosity for effective surface dispersant operations	Sometimes possible to disperse	5,000-15,000

*Measured at sea surface temperature

Further to the required thickness for surface dispersant application and containment and recovery to be deployed effectively as outlined above, changes to viscosity will also limit the treatment of offshore response techniques. As outlined in the EMSA Manual on the Applicability of Oil Spill Dispersants (EMSA, 2012), guidance around changes to viscosity and likely effectiveness of surface dispersant application is provided.

This includes the following statements; “It has been known for many years that it is more difficult to disperse a high viscosity oil than a low or medium viscosity oil. Laboratory testing had shown that the effectiveness of dispersants is related to oil viscosity, being highest for modern “Concentrate, UK Type 2/3” dispersants at an oil viscosity of about 1,000 or 2,000 mPa (1,000 – 2,000 cSt) and then declining to a low level with an oil viscosity of 15,000 mPa (15,000 cSt). It was considered that some generally applicable viscosity limit, such as 2,000 or 5,000 mPa (2,000 – 5,000 cSt), could be applied to all oils.”

However, modern oil spill dispersants are generally effective up to an oil viscosity of 5,000 mPa (5,000 cSt) or more, and their performance gradually decreases with increasing viscosity; oils with a viscosity of more than 15,000 are in most cases, no longer dispersible. Guidance from CEDRE (EMSA, 2012) also indicates that products with a range of 500 – 5,000 cSt at sea temperature are generally possible to disperse, while 5,000 – 15,000 cSt at sea temperature above pour point are sometimes possible to disperse, with products beyond 15,000 cSt at sea temperature below pour point are generally impossible to disperse.

To support decision making and response planning, a threshold of 15,000 cSt at sea temperature was chosen as a conservative estimate of maximum viscosity for surface dispersant spraying operations.

The thresholds described above are compared with the modelling results for the WCCS (Table 2-6).

2.3.3 Spill modelling results

The selected deterministic runs used to represent the WCCS are based on response thresholds:

- Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2).
- Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2).
- Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor (at a threshold of 100 g/m^2).
- Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors (at a threshold of 100 g/m^2).
- Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb).

The volumes as presented in Table 2-6 are the worst case volumes resulting from the deterministic modelling and have been used to determine appropriate level of response. Scenarios Credible Scenario-01 and Credible Scenario-04 do not have floating oil at any of the assessed thresholds (10 g/m^2 or 25 g/m^2) at any RPA,and no shoreline contact at feasible response threshold concentrations (100 g/m^2 or 250 g/m^2). Deterministic modelling was not undertaken for Credible Scenario-05 but the stochastic results have been included here to ensure complete response planning:

Table 2-6: Worst case credible scenario modelling results

Response parameter	Modelled result		
	Credible Scenario-01: Hydrocarbon release caused by loss of well containment	**Credible Scenario-04: Hydrocarbon release caused by loss of well containment**	**Credible Scenario-05: Hydrocarbon release due to vessel collision**
Maximum continuous liquid hydrocarbon release rate and duration	70,596 m^3 of Julimar Condensate over 61 days	90,114 m^3 of Julimar Condensate over 61 days	Instantaneous release of 275 m^3 of marine diesel
Maximum residual surface hydrocarbon after weathering	0.4% residual component of 284 m^3	0.4% residual component of 360 m^3	5% residual component of 13.75 m^3
Deterministic modelling results			
Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	*No contact at threshold**	*No contact at threshold**	5 hours at Montebello Marine Park
Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact*
Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor (at a threshold of 100 g/m^2).	*No contact at threshold*	*No contact at threshold*	*No contact*
Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m^2 accumulation concentration)	2.38 m^3 at Barrow Island (38 days) Model 7, Q2	3.78 m^3 at Barrow Island (37 days) Model 7, Q2	<1 m^3 at Ningaloo Coast Middle WHA (15 days)
Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb)	17.3 days at Muiron Islands MMA-WHA (790 ppb) Model 21, Q2	16.1 days at Muiron Islands MMA-WHA (1,030 ppb) Model 21, Q2	5 hours at Montebello Marine Park

* As shown in Table 2-6, deterministic modelling does not show floating oil at threshold (>10 g/m^2) at any RPA. Surface hydrocarbons at response threshold (>50 g/m^2) are, however, predicted to be present in open water within 5 km of the well as follows:

- Credible Scenario-04: 1 km^2 (55 m^3) on day 1 and 1 km^2 (60 m^3) on day 2. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.
- Credible Scenario-01: 1 km^2 (53 m^3) on day 30. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.

Due to the volatile nature of Julimar Condensate and very low residue (0.4%), together with no predicted floating oil >10 g/m^2 or shoreline impacts at threshold arriving at any RPA, an offshore response would not be practicable and would not provide a net environmental benefit. Furthermore, on days 1 and 2 atmospheric volatiles are likely to be at unsafe levels for responders to undertake an offshore response. Additional safety considerations that may prevent an offshore response include high winds (>20 knots), waves and/or sea states (>1.5m waves) and high ambient temperatures.

From the above results, model runs 7 (Q2) and 21 (Q2) from the deterministic modelling for both Credible Scenario-01 and Credible Scenario-04 have been used as the basis for response planning and are included in Section 4.2.

3 IDENTIFY RESPONSE PROTECTION AREAS

In a response, operational monitoring programs – including trajectory modelling and vessel/aerial observations – would be used to predict RPAs that may be impacted. For the purposes of planning and appropriately scaling a response, modelling has been used to identify RPAs as outlined below in Figure 3-1.

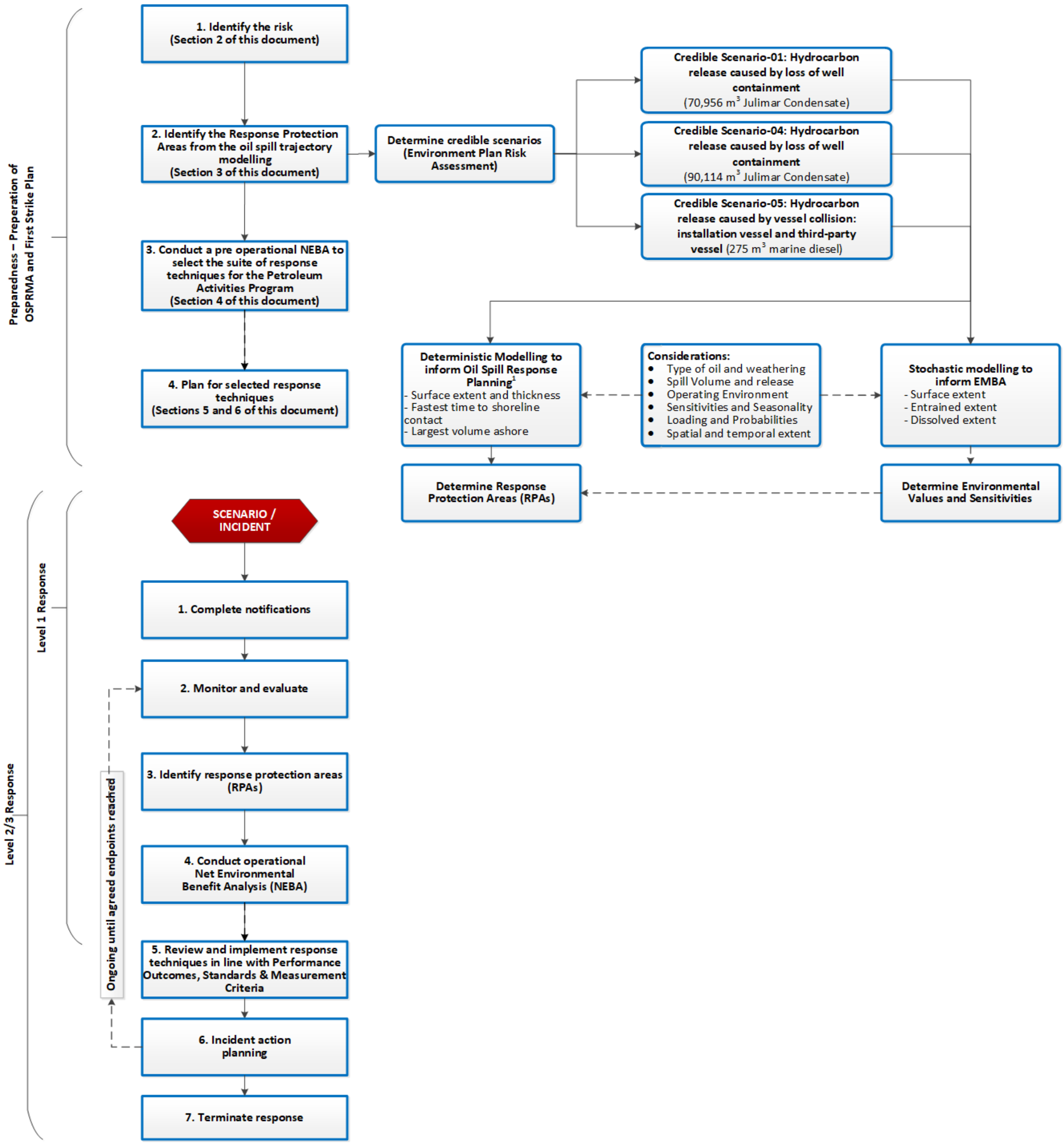

Figure 3-1: Identify Response Protection Areas flowchart

3.1 Identified sensitive receptor locations

Section 4 of the EP includes the list of sensitive receptor locations that have been identified by stochastic modelling as meeting the requirements outlined below:

- Receptors with the potential to incur surface, entrained or shoreline accumulation contact above environmental impact thresholds
- Receptors within the EMBA which meet the following:
  - a number of priority protection criteria/categories
  - International Union for Conservation of Nature (IUCN) marine protected area categories
  - high conservation value habitat and species
  - important socio-economic/heritage value.

3.2 Identify Response Protection Areas

RPAs are selected on the basis of their environmental ecological, social, economic, cultural and heritage values and sensitivities and the ability to conduct a response based on the minimum response thresholds (Section 2.3.2.1).

From the identified sensitive receptors described in Section 4 of the EP, none have accumulations >100 g/m^2 for shoreline assessment and the only RPA contacted with surface slicks >10 g/m^2 for operational monitoring[4] is Montebello Marine Park at 5 hours (Credible Scenario-05). Some floating oil at threshold is also present in open water at the well site as follows:

- Credible Scenario-04: 1 km^2 (55 m^3) on day 1 and 1 km^2 (60 m^3) on day 2. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.
- Credible Scenario-01: 1 km^2 (53 m^3) on day 30. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.

Additional sensitive receptors are presented the existing environment description (Section 4 of the EP) and impact assessment section (Section 6 of the EP) for each respective spill scenario. The pre-operational NEBA (Section 4) considers the results from the stochastic modelling to ensure all feasible response techniques are considered in the planning phase, therefore additional receptors are also included in the pre-operational NEBA.

If operational monitoring identifies RPAs at risk of impact during a real spill event, TRPs for a shoreline response will be drafted in advance for any RPAs with a contact time of <14 days.

[4] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

4 NET ENVIRONMENTAL BENEFIT ANALYSIS

A Net Environmental Benefit Analysis (NEBA) is a structured process to consider which response techniques are likely to provide the greatest net environmental benefit.

The NEBA process typically involves four key steps outlined in Figure 4-1: evaluate data, predict outcomes, balance trade-offs, and select response options. These steps are followed in the planning/preparedness process and would also be followed in a response.

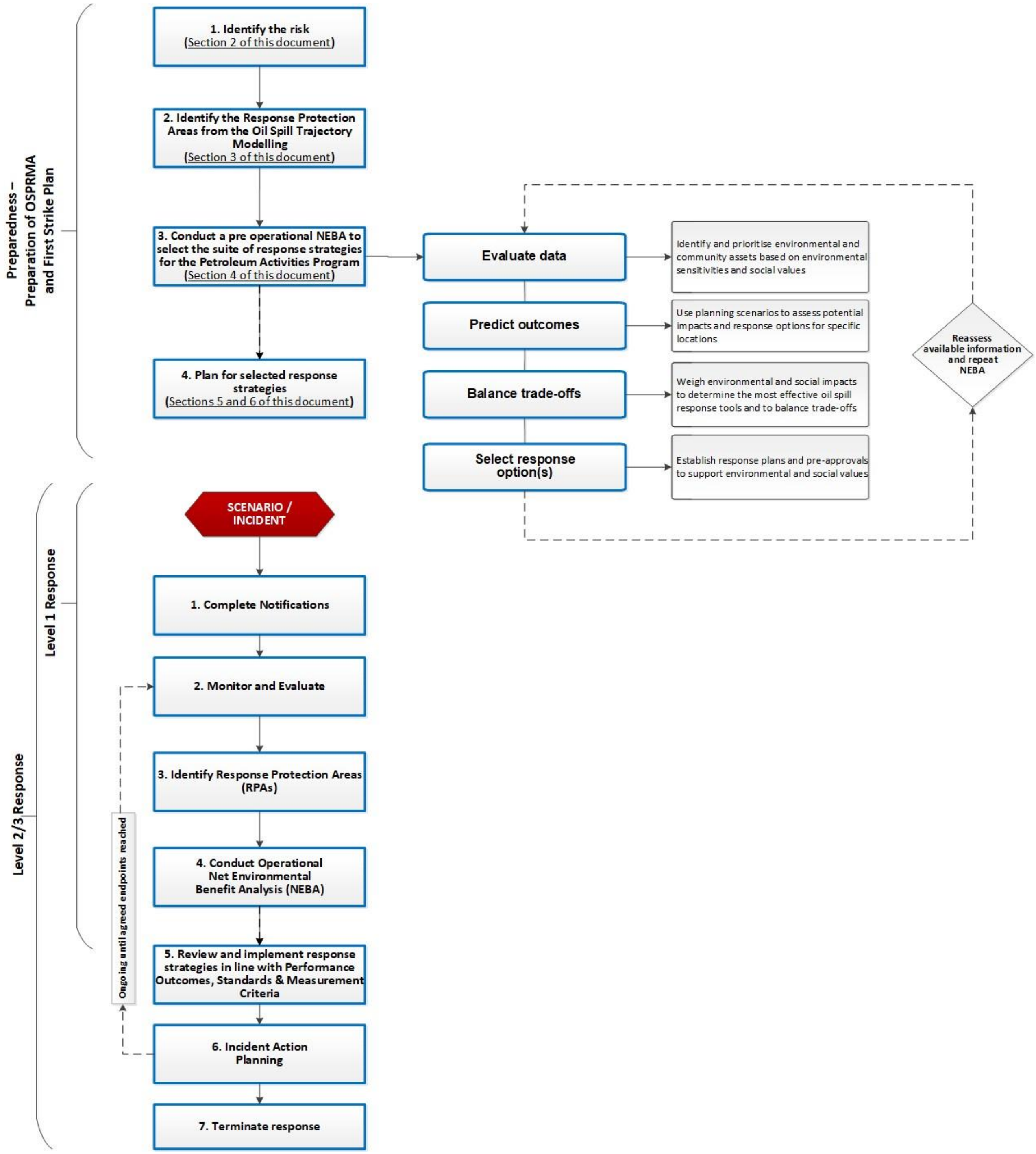

Figure 4-1: Net Environmental Benefit Analysis (NEBA) flowchart

4.1 Pre-operational / Strategic NEBA

The pre-operational NEBA identifies positive and negative impacts to sensitive receptors from implementing the response techniques. Feasibility is considered by assessing the receptors potentially impacted above response thresholds (Section 2.3.2.1) and the surface concentrations (Section 2.3.2.1.1) from the deterministic modelling.

Completing a pre-operational NEBA is a key response planning control that reduces the environmental risks and impacts of implementing the selected response techniques. Comprehensive details of the pre-operational NEBA for this PAP are contained in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

4.2 Stage 1: Evaluate data

Woodside identifies and prioritises environmental and community assets based on environmental sensitivities and social values, informed through the use of trajectory modelling. Interpretation of stochastic oil spill modelling determines the EMBA for the release, which defines the spatial area that may be potentially impacted by the PAP activities.

4.2.1 Define the scenario(s)

Woodside uses scenarios identified from the risk assessment in the EP to assess potential impacts and response options for specific locations. The overall WCCS is then selected for deterministic modelling and is used for this pre-operational NEBA. Outlier locations with potential environmental impacts, selected from the stochastic modelling may also be included for assessment. The worst-case diesel scenario is also analysed to meet regulatory requirements. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness and scale of the response.

Table 4-1: Scenario summary information (WCCS)

Scenario summary information (Credible Scenario-01)	
Scenario	Hydrocarbon release caused by loss of well containment – Gemtree-A well (Credible Scenario-01)
Location	Lat: 20° 02’ 06” S Long: 115° 06’ 32” E
Oil Type	Julimar Condensate
Fate and Weathering	48.8% of the mass should evaporate within the first 12 hours (BP < 180 °C); 21.3% of the mass should evaporate within the first 24 hours (180 °C < BP < 265 °C); 29.5% of the mass should evaporate over several days (265 °C < BP < 380 °C).
Volume and duration of release	70,956 m^3 over 61 days
Scenario summary information (Credible Scenario-04)	
Scenario	Hydrocarbon release caused by loss of well containment – Gemtree-A well (Credible Scenario-04)
Location	Lat: 20° 02’ 06” S Long: 115° 06’ 32” E
Oil Type	Julimar Condensate
Fate and Weathering	48.8% of the mass should evaporate within the first 12 hours (BP < 180 °C); 21.3% of the mass should evaporate within the first 24 hours (180 °C < BP < 265 °C); 29.5% of the mass should evaporate over several days (265 °C < BP < 380 °C).
Volume and duration of release	90,114 m^3 over 61 days
Scenario summary information (Credible Scenario-05)	
Scenario	Hydrocarbon release caused by vessel collision
Location	Lat: 20° 02’ 06” S Long: 115° 06’ 32” E
Oil Type	Marine diesel
Fate and Weathering	6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); 54% should evaporate over several days (265 °C < BP < 380 °C).
Volume and duration of release	275 m^3 (instantaneous)

4.2.1.1 Hydrocarbon characteristics

Julimar Condensate

Julimar Condensate (API 47.9) contains a low proportion (0.4% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.248 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 48.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 21.3% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 29.5% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers.

The whole oil has low asphaltene content (<0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 11.5% by mass of the whole oil, with a significant proportion (7.4%) 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.

Subsea release

The results of the OILMAP simulation predict that the discharge will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface (201 m above the seabed). This outcome was calculated by the model for both scenarios at all discharge rates specified throughout the 9-week blowout period. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of between 10 m/s and 14 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 26 m for both scenarios.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate relatively small oil droplets between 78 μm and 470 μm in diameter for Credible Scenario-01 and between 57 μm and 369 μm in diameter for Credible Scenario-04. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. Therefore, despite reaching the surface due to the lift produced by the rising plume, the droplets will then tend to remain within the wave-mixed layer of the water column (3-10 m deep, depending on the conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Marine diesel

Marine Diesel Oil is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group I/II oil. Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Table 4-2: Oil fate, behaviour and impacts

<table>
<tr><th colspan="7">Modelling results</th></tr>
<tr><th></th><th colspan="2">Credible Scenario-01</th><th colspan="2">Credible Scenario-04</th><th colspan="2">Credible Scenario-05</th></tr>
<tr><td>Surface area of hydrocarbons (>50g/m^2 and <15,000cSt)</td><td colspan="2">Surface hydrocarbons at response threshold (>50 g/m^2 and <15,000 cSt) are predicted to be present in the open water within 5 km of the well as follows:
• 1 km^2 (53 m^3) on day 30
• Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.</td><td colspan="2">Surface hydrocarbons at response threshold (>50 g/m^2 and <15,000 cSt) are predicted to be present in the open water within 5 km of the well as follows:
• 1 km^2 (55 m^3) on day 1
• 1 km^2 (60 m^3) on day 2
• Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.</td><td colspan="2">Deterministic modelling was not undertaken for Credible Scenario-05 thus surface area and volume are not available.
Floating oil at >50 g/m^2 is predicted at Montebello Marine Park after 5 hours.</td></tr>
<tr><td>Minimum time to shoreline contact (>100 g/m^2)</td><td colspan="2">No contact at threshold</td><td colspan="2">No contact at threshold</td><td colspan="2">No contact at threshold</td></tr>
<tr><td>Largest volume ashore at any single RPA (>100g/m^2)</td><td colspan="2">No contact at threshold</td><td colspan="2">No contact at threshold</td><td colspan="2">No contact at threshold</td></tr>
<tr><td>Largest total shoreline accumulation (including those contacted at <100 g/m^2 accumulation concentration)</td><td colspan="2">2.38 m^3 at Barrow Island (38 days)
Model 7, Q2</td><td colspan="2">3.78 m^3 at Barrow Island (37 days)
Model 7, Q2</td><td colspan="2"><1 m^3 at Ningaloo Coast Middle WHA (15 days)</td></tr>
<tr><th colspan="7">Response Protection Areas (RPAs)</th></tr>
<tr><th></th><th colspan="2">Credible Scenario-01</th><th colspan="2">Credible Scenario-04</th><th colspan="2">Credible Scenario-05</th></tr>
<tr><th></th><th>Minimum time to shoreline contact (above 100g/m^2) in days</th><th>Maximum shoreline accumulation (above 100g/m^2) in m^3</th><th>Minimum time to shoreline contact (above 100g/m^2) in days</th><th>Maximum shoreline accumulation (above 100g/m^2) in m^3</th><th>Minimum time to shoreline contact (above 100g/m^2) in days</th><th>Maximum shoreline accumulation (above 100g/m^2) in m^3</th></tr>
<tr><td>All RPAs</td><td colspan="6">No contact at threshold</td></tr>
</table>

4.2.2 Determining potential response options

The available response techniques based on current technology can be summarised under the following headings:

- monitor and evaluate (including operational monitoring)
- source control
  - remotely operated vehicle (ROV) intervention
  - debris clearance and/or removal
  - capping stack
  - relief well drilling
- source control on the vessel
- subsea dispersant injection

- surface dispersant application:
  - aerial dispersant application
  - vessel dispersant application
- mechanical dispersion
- in-situ burning
- containment and recovery
- shoreline protection and deflection:
  - protection
  - deflection
- shoreline clean-up:
  - phase 1 – mechanical clean-up
  - phase 2 – manual clean-up
  - phase 3 – final polishing
- oiled wildlife response.

Support functions may include:

- waste management
- post spill monitoring/scientific monitoring.

An assessment of which response options are feasible for the scenarios is included below in Table 4-3 and Table 4-4: Response technique evaluation – marine diesel release from vessel collision (Credible Scenario-05. These options are evaluated against each scenario's parameters including oil type, volume and characteristics, prevailing weather conditions, logistical support, and resource availability to determine their deployment feasibility.

A shortlist of the feasible response options is then carried forward for the ALARP assessment with a justification for the exclusion of other response techniques included in Section 4.2.3. This assessment will typically result in a range of available options that are deployed at different areas (at-source, offshore, nearshore and onshore) and times through the response. The NEBA process assists in prioritising which options to use where, when and timings throughout the response.

Table 4-3: Response technique evaluation – Julimar Condensate release from loss of well containment (Credible Scenario-01 and Credible Scenario-04)

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Julimar Condensate				
Monitor and evaluate	Will be effective in tracking the location of the spill, informing when it has entered State Waters, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform which RPAs have been impacted.	Monitoring of a Julimar Condensate spill is a feasible response technique and an essential element of all spill response incidents. Outputs will be used to guide decision making on the use of other monitoring/response techniques and providing required information to regulatory agencies including AMSA and WA DoT.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via blowout preventer (BOP) intervention	Controlling a loss of well containment at source via BOP intervention would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	In the event of the worst-case scenario with a loss of well containment during drilling operations, ROV operations to locally operate the BOP would be attempted.	**Yes**	The use of source control intervention via ROV may be feasible (depending on local concentration of atmospheric volatiles) and would reduce quantity of hydrocarbons entering the marine environment.
Source control via debris clearance and capping stack	Controlling a loss of well containment at source via capping stack would be an effective way to limit the quantity of hydrocarbon entering the marine environment.	Woodside commissioned an independent, subsea site-specific plume analysis, landing study and capping stack deployment feasibility assessment for the Julimar Phase 2 Drilling & Subsea Installation project (WWC, 2019) and a gap analysis of the study was then completed for this PAP due to the close proximity and similarities of the projects. The study indicates that shallow water in combination with high absolute open hole flow rates in the event of a worst-case blowout prohibit the safe deployment of a capping stack for the WA-49-L Gemtree Exploration Drilling project. Modelling indicates that likely VOCs are not a risk beyond the exclusion zone for fire hazard posed by the gas cloud. It is expected that the extent of the gas cloud will be independent of SSDI treatment due to the high GOR nature of the expected flow stream (INPEX, 2019). As such the exclusion zone will be governed by the gas boil at the sea surface and resulting gas plume. Various options for safe and effective deployment of a capping stack in these conditions were assessed but due to the complex nature of implementation or inability to implement were deemed as not ALARP. These are detailed in Section 6.2.7.1. Though all capping stack deployment technologies are unproven, in the event of a loss of well containment at less than the WCCS (plume radius is ~25 m), the use of a proven subsea deployment method such as a heavy lift vessel, which is more commonly used in industry, is a more reliable and, in turn, ALARP approach. If environmental conditions permit (wind speed, wave height, current and plume radius), deployment of a capping stack would be attempted with a heavy lift vessel. Woodside maintains several frame agreements with various vessel service providers and maintains the ability to call off services with a capping stack and debris clearance agreement. The location of suitable vessels for capping stack deployment are monitored monthly. The supply arrangements and reliability to achieve the required mobilisation time will be revalidated prior to spud. Consideration to mobilise the capping stack from the supplier on a suitable vessel but then hand over to another vessel to conduct the capping activity will also be made to meet response	**Yes**	Conventional/vertical capping stack deployment with a heavy lift vessel will be attempted if plume radius is ~25 m and environmental conditions permit (wind speed, wave height, current and plume radius).

		time frames. A site-specific landing force analysis through CFD modelling confirms the ability to land the capping stack on either a xmas tree or BOP.		
Source control via relief well drilling	A subsea release of condensate will be over approximately 61 days. Relief well drilling will be the primary option to stop the release.	For a spill from the Gemtree-A well, relief well drilling will be the only feasible means of controlling of well containment event. Relief well drilling is a widely accepted and utilised technique.	**Yes**	Relief well drilling will be the main technique employed to control a loss of well containment event.
Subsea dispersant injection	Application of subsea dispersant may reduce the scale and extent of surface hydrocarbons and reduce the volumes of surface hydrocarbons contacting sensitive areas. It is expected that the extent of the gas cloud will be independent of any subsea dispersant injection (SSDI) treatment, however, due to the high gas-to-oil ratio of the expected flow stream (INPEX, 2019). As such, the exclusion zone for the deployment of other response techniques will be governed by the gas boil at the sea surface and resulting gas plume, thus no safety benefit would be realised through the use of SSDI.	The high discharge velocity and turbulence from the gas plume is predicted to generate very small oil droplets with very low-rise velocities. These droplets will be subject to mixing from plume turbulence, wind and breaking waves. Therefore, at the surface, the droplets will tend to remain within the wave-mixed layer of the water column due to their weak buoyancy. This effectively replicates the action of a chemical dispersant thus rendering the use of SSDI unnecessary.	**No**	Due to the predicted behaviour of the subsea plume, the lack of any safety benefit from its use, and the characteristics of Julimar Condensate, particularly the low residue of 0.4%, the use of subsea dispersant injection would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Surface dispersant application	Application of surface dispersant would likely reduce the volumes of hydrocarbons contacting sensitive receptors. It has the potential to remove large volumes of oil from the surface that could cause secondary contamination of wildlife or shorelines. Dispersant can also enhance biodegradation and may reduce VOCs therefore reducing potential health and safety risk to responders.	Dispersants are not considered a feasible response technique when applied on thin surface films such as condensate as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon. Modelling of a Julimar Condensate spill for the WA-49-L Gemtree Exploration Drilling project predicts that floating oil will be prone to rapid spreading and evaporation and will not reach the required threshold (>50 g/m^2) at any RPA for surface dispersant to be effective. Whilst some floating oil >50 g/m^2 is predicted in open waters within 5 km of the Gemtree-A well (1 km^2 (55 m^3) on day 1 and 1 km^2 (60 m^3) on day 2 for Credible Scenario-04 and 1 km^2 (53 m^3) on day 30 for Credible Scenario-01), due to the aforementioned volatile nature of Julimar Condensate and very low residue (0.4%), together with no predicted floating oil >10 g/m^2 or shoreline impacts at threshold arriving at any RPA, surface dispersant use would not be practicable and would not provide a net environmental benefit. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	Due to the predicted behaviour of a surface spill coupled with characteristics of Julimar Condensate, particularly the low residue of 0.4%, the use of surface dispersant would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, any vessel used for mechanical dispersion activities would be contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.	No	Given the limited benefit of mechanical dispersion over natural wind and wave action, secondary contamination and waste issues, and the associated safety risk of implementing the response for this activity, this strategy is deemed unsuitable.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved and where calm metocean conditions can be ensured. Use of this technique would also cause an increase the release of atmospheric pollutants.	There is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which would be difficult to achieve. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5. It has the potential to reduce the magnitude, probability of, extent of, contact with and accumulation of hydrocarbon on shorelines receptors. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by entrained/ dissolved hydrocarbons.	Modelling of a Julimar Condensate spill from Gemtree-A well predicts that floating oil will rapidly spread and evaporate and does not reach any of the assessed thresholds (10 g/m^2 and 25 g/m^2) at any RPA. The required minimum threshold for containment and recovery to be effective is 50 g/m^2 Whilst some floating oil >50 g/m^2 is predicted in open waters within 5 km of the Gemtree-A well (1 km^2 (55 m^3) on day 1 and 1 km^2 (60 m^3) on day 2 for Credible Scenario-04 and 1 km^2 (53 m^3) on day 30 for Credible Scenario-01), due to the aforementioned volatile nature of Julimar Condensate and very low residue (0.4%), together with no predicted floating oil >10 g/m^2 or shoreline impacts at threshold	**No**	In addition to low effectiveness and potential safety issues from predicted high local concentrations of atmospheric volatiles, the modelling results show that the non-persistent characteristics and fate/trajectory of Julimar Condensate would make containment and recovery an unsuitable response technique.

		arriving at any RPA, mounting an offshore containment and recovery operation would not be practicable. Containment and recovery can have low effectiveness levels with, on average, <10% of available oil contained and recovered. The largest operation ever mounted was during the Deepwater Horizon/Macondo which achieved an effectiveness of approximately 3-5%. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.		
Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of sensitive resources and can be used to corral oil into slicks thick enough to skim effectively.	The modelling undertaken predicts no floating oil at any of the assessed thresholds (10 g/m^2 and 25 g/m^2) and no shoreline impacts at response thresholds (100 g/m^2). The maximum accumulated impact across all shorelines is 3.78 m^3 at Barrow Island on day 37 at a concentration of 10 g/m^2 (Credible Scenario-04). If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate surface hydrocarbons are moving towards shorelines, however, pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills).	**Yes**	If RPAs are deemed to be at risk, based on real-time modelling during a spill event, shoreline protection and deflection techniques will be employed to minimise hydrocarbon contact.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	The modelling undertaken predicts the only shoreline impacts for a spill of Julimar Condensate from Gemtree-A would be at 10 g/m^2 which is significantly lower than the minimum threshold required for effective shoreline clean-up (>100 g/m^2 and, optimally, >250 g/m^2). The maximum accumulated impact across all shorelines is 3.78 m^3 at Barrow Island on day 37 at a concentration of 10 g/m^2 (Credible Scenario-04) If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate hydrocarbons will contact shorelines, however, pre-emptive assessments of sensitive receptors at risk (OM04), shoreline assessments (OM05) and existing TRPs will be utilised, in agreement with WA DoT (for Level 2/3 spills), to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations.	**Yes**	If RPAs are deemed to be at risk, based on real-time modelling during a spill event, shoreline clean-up techniques will be deployed to expedite clean-up of the impacted sites.
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is mostly achieved through hazing to prevent additional wildlife from being contaminated and through rehabilitation of those already subject to contamination.	Due to the likely volatile atmospheric conditions surrounding a Julimar Condensate spill, response options may be limited to hazing to ensure the safety of response personnel. The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. Monitor and evaluate will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. Thus, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists.	**Yes**	The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. However, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken as and where required.

Table 4-4: Response technique evaluation – marine diesel release from vessel collision (Credible Scenario-05)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Marine Diesel				
Monitor and evaluate	Will be effective in tracking the location of the spill, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform if any RPAs have been impacted.	Monitoring of a marine diesel spill is a feasible response technique and outputs will be used to guide decision making on the use of other monitoring/response techniques and providing information to regulatory agencies including AMSA and WA DoT. Practicable techniques that could be used for this scenario include predictive modelling (OM01), surveillance and reconnaissance OM02) and monitoring of hydrocarbon presence in water (OM03). Modelling does not predict impact of any shoreline receptors at threshold, however, pre-emptive assessment of sensitive receptors at risk (OM04) and monitoring of contaminated resources (OM05) would be utilised if any sensitive shoreline receptors are deemed to be at risk of impact.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via vessel SOPEP	Controlling the spill of diesel at source would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	A spill of diesel from a vessel collision will be instantaneous and source control will be limited to what the vessel or facility can safely achieve whilst responding to the incident.	**Yes**	Ability to stop the spill at source will be dependent upon the specific spill circumstances and whether or not it is safe for response personnel to access/isolate the source of the spill.
Surface dispersant application	Dispersants are not considered effective when applied on thin surface films such as marine diesel as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon resulting in the unnecessary addition of chemicals to the marine environment	Marine diesel is prone to rapid spreading and evaporation and is not suitable for surface dispersant application. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon thus this response technique is deemed inappropriate.	**No**	The application of dispersant to marine diesel is unnecessary as the diesel will rapidly evaporate and would thus unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, any vessel used for mechanical dispersion activities would be contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.	**No**	Given the limited benefit of mechanical dispersion over natural wind and wave action, secondary contamination and waste issues, and the associated safety risk of implementing the response for this activity, this strategy is deemed unsuitable.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved.	Use of in-situ burning as a response technique for marine diesel is unfeasible as the minimum slick thickness cannot be attained due to rapid spreading. In addition, there is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which is unlikely to be achieved. Furthermore, entering a volatile environment to undertake this technique would be unsafe for response personnel and its used would unnecessarily cause an increase the release of atmospheric pollutants.	**No**	Diesel characteristics are not appropriate for the use of in-situ burning and would unnecessarily cause an increase the release of atmospheric pollutants.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5 with a 50-100% coverage of 100 g/m^2 to 200 g/m^2.	Marine diesel is prone to rapid spreading and evaporation and is deemed unsuitable for effective containment and recovery operations, particularly with the predicted residue of 13.75 m^3. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon thus this response technique is deemed inappropriate.	**No**	Containment and recovery would be an inappropriate response technique for a spill of marine diesel. In addition to the safety issues, most of the spilled diesel would have been subject to rapid evaporation prior to the commencement of containment and recovery operations.

Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of at-risk areas.	A marine diesel spill would be prone to rapid spreading and evaporation and modelling predicts that no shoreline receptors will be contacted at threshold. The maximum accumulated volume is predicted to be <1 m^3. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time.	**No**	In addition to safety issues and the rapid spreading and evaporation of the diesel, the modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at any of the assessed thresholds.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	A marine diesel spill would be prone to rapid spreading and evaporation and the modelling predicts that no shoreline receptors will be contacted at threshold – any minor contact is significantly below any threshold concentration that would allow a response to be feasible. The maximum accumulated volume is predicted to be <1 m^3. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time.	**No**	In addition to safety issues, the modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at a recoverable threshold and a spill of marine diesel is unlikely to accumulate at concentrations appropriate for shoreline clean-up techniques.
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is mostly achieved through hazing to prevent additional wildlife from being contaminated and through rehabilitation of those already subject to contamination.	Due to the likely volatile atmospheric conditions surrounding a diesel spill, response options may be limited to hazing to ensure the safety of response personnel. The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. Monitor and evaluate will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. Thus, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists.	**Yes**	The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. However, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken as and where required.

4.2.3 Exclusion of response techniques

Response techniques that are not feasible for all scenarios for this PAP are detailed in the subsections below and are excluded from further assessment within this document.

4.2.3.1 Subsea dispersant injection

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate very small oil droplets (<25 μm) that will have very low-rise velocities (<0.01 cm/s). These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. Therefore, despite reaching the surface due to the lift produced by the rising plume, the droplets will then tend to remain within the wave-mixed layer of the water column (3-10 m deep, depending on the conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

Subsea dispersant injection would be unlikely to have any appreciable effect on the simulated behaviour or extent of a rising subsea oil plume, since the initial droplet size distribution of the plume would be very similar to that which would be expected to result post-application of dispersant.

Modelling also indicates it is likely that 11.5% of the hydrocarbon will be volatile and contributing to the flammable hazard at the surface. It is expected that the extent of the gas cloud will be independent of any subsea dispersant injection (SSDI) treatment due to the high gas-to-oil ratio of the expected flow stream (INPEX, 2019). As such, the exclusion zone will be governed by the gas boil at the sea surface and resulting gas plume, thus no safety benefit would be realised through the use of SSDI.

Furthermore, due to the predicted behaviour of a surface spill coupled with characteristics of Julimar Condensate, particularly the low residue of 0.4%, the use of subsea dispersant injection would unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.

4.2.3.2 Surface dispersant application

Modelling results for both scenarios for hydrocarbon releases caused by a loss of well containment of Julimar Condensate (Credible Scenario-01 and Credible Scenario-04) do not show surface hydrocarbons at any RPA above the threshold concentration (>50 g/m^2) required for effective surface dispersant application for the duration of the spill. Below this threshold, dispersant droplets tend to pass through the surface films without binding to the hydrocarbon thus providing no net benefit.

Surface hydrocarbons at response threshold (>50 g/m^2) are, however, predicted to be present in open ocean/ Commonwealth Waters within 5 km of the well as follows:

- Credible Scenario-04: 1 km^2 (55 m^3) on day 1 and 1 km^2 (60 m^3) on day 2. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.
- Credible Scenario-01: 1 km^2 (53 m^3) on day 30. Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.

Due to the volatile nature of Julimar Condensate and very low residue (0.4%), together with no predicted floating oil >10 g/m^2 or shoreline impacts at threshold arriving at any RPA, an offshore response would not be practicable and would not provide a net environmental benefit.

Additionally, there is the potential for the plume to breach the surface which may cause conditions leading to high local concentrations of atmospheric volatiles. This would create a health and safety risk for responders and thus limiting the feasibility of a surface dispersant response to a Julimar Condensate spill.

In relation to Credible Scenario-05, dispersants are not considered effective when applied on thin surface films such as diesel, as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon, making it unsuitable for effective treatment and unnecessarily adding chemicals to the marine environment. A marine diesel spill is also expected to dissipate rapidly on the surface and become entrained due to local metocean conditions.

Surface application of dispersants is therefore considered inappropriate for all scenarios. It could potentially be unsafe and would unnecessarily introduce additional chemical substances to the marine environment increasing the exposure of subsea species and habitats to hydrocarbons.

4.2.3.3 Mechanical dispersion

Mechanical dispersion involves the use of a vessel's propeller wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. This technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages. Additionally, the volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.

Any vessel used for mechanical dispersion activities would become contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.

4.2.3.4 In-situ burning

This technique requires calm sea state conditions as is required for containment and recovery operations, which limits its feasibility in the region. Optimum weather conditions are <20 knot wind speed and waves <1 to 1.5 m with oil collected to a minimum 3 mm thick layer. Due to the conditions in the region it is expected that the ability to contain oil may be limited as the sea state may exceed the optimum conditions. It is preferable that oil is fresh and does not emulsify to maximise burn efficiency and reduce residue thickness.

There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons. It is also suggested that the residue from attempts to burn would sink, thereby posing a risk to the environment. The longer-term effects of burn residues on the marine environment are not fully understood and therefore, no assessment of the potential environmental impact can be determined.

Until further operational and environmental information becomes available, Woodside will not consider this option.

4.2.3.5 Containment and recovery

Modelling results for both scenarios for hydrocarbon releases caused by a loss of well containment of Julimar Condensate (Credible Scenario-01 and Credible Scenario-04) do not show surface hydrocarbons above the threshold concentration (>50 g/m^2) required for effective containment and recovery for the duration of the spill. The spill is predicted to rapidly spread, thin and evaporate which would render containment and recovery operations ineffective.

Additionally, there is the potential for the plume to breach the surface which may cause conditions leading to high local concentrations of atmospheric volatiles. This would create a health and safety risk for responders and thus limiting the feasibility of containment and recovery response to a Julimar Condensate spill.

In relation to Credible Scenario-05, diesel would evaporate and spread too thinly to allow this response technique to be effective. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon.

4.3 Stage 2: Predict outcomes

Woodside uses planning scenarios to assess potential impacts and response options for specific locations. Locations with potential environmental impacts, selected from the stochastic modelling are included for assessment. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness of a response.

4.4 Stage 3: Balance trade-offs

Woodside considers environmental impacts and response effectiveness/feasibility to determine the most effective oil spill response tools and balance trade-offs, using an automated NEBA tool. The tool considers potential benefits and impacts associated with a response at sensitive receptors and then considers the effectiveness/feasibility of the response to select the response techniques carried forward to the ALARP assessment (ANNEX A: Net Environmental Benefit Analysis detailed outcomes).

4.5 Stage 4: Select Best Response Options

To select the response technique, all the other stages in the NEBA process are considered and used to establish response plans and any pre-approvals to support protection of identified environmental and social values.

The response techniques implemented may vary according to a particular spill. The hydrocarbon type released and the sensitivities of the receptors (both ecological and socio-economic) may influence the response. The pre-operational NEBA broadly evaluates each response technique and supports decisions on whether they are feasible and of net environmental benefit. Response techniques that are not feasible or beneficial are rejected at this stage and not progressed to planning.

Further risks and impacts from implementing these selected response options are outlined in Section 7.

Table 4-5: Selection and prioritisation of response techniques

Response planning scenario	Key characteristics for response planning (times are minimum times to contact for first receptor and/or shoreline contacted above response threshold)	Feasibility of response techniques													Outline response technique
		Monitor and evaluate	Debris clearance – for subsea dispersant	Source control – capping stack	Source control on the vessel	Source control – relief well drilling	Subsea dispersant injection	Surface dispersant application	Mechanical dispersion	In-situ burning	Containment and recovery	Shoreline protection and deflection	Shoreline cleanup	Oiled wildlife response	
Hydrocarbon release caused by loss of well containment: Credible Scenario-01 – 70,956 m³ of Julimar Condensate released over 61 days (residual component of 284 m³). Credible Scenario-04 – 90,114 m³ of Julimar Condensate released over 61 days (residual component of 360 m³).	Fastest time to shoreline accumulation >100 g/m²: Credible Scenario-01 – No contact Credible Scenario-04 – No contact Maximum shoreline accumulation: Credible Scenario-01 – 2.38 m³ at Barrow Island (38 days) Credible Scenario-04 – 3.78 m³ at Barrow Island (37 days)	Yes	No	Yes*	N/A	Yes	No	No	No	No	No	Yes	Yes	Yes	Monitor and evaluate. Initiate source control via capping stack if plume radius permits. Initiate relief well drilling. Consider shoreline protection and deflection (in liaison with WA DoT) if there is potential contact predicted. Consider shoreline monitoring and clean-up (in liaison with WA DoT) if potential contact is predicted. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-05: Instantaneous release of up to 275 m³ marine diesel from a vessel collision (residual component of 13.75 m³)	Fastest time to shoreline accumulation >100 g/m² – no contact Maximum shoreline accumulation – <1 m³ at Ningaloo Coast Middle (15 days)	Yes	N/A	N/A	Yes	N/A	N/A	No	No	No	No	No	No	Yes	Monitor and evaluate. Initiate source control if feasible. Plan for oiled wildlife response and implement if oiled wildlife is observed.

**NB This option would only viable for a loss of well containment of a lower magnitude than the worst case credible scenario where the plume radius is ~25 m.*

From the NEBA undertaken on the WCCSs identified (loss of well containment – Credible Scenario-01 and Credible Scenario-04), and marine diesel from a support vessel collision (Credible Scenario-05), the recommended response techniques are;

- Monitor and evaluate (all scenarios)
- Source control (capping stack) if lower magnitude than the worst case credible scenario where the plume radius is ~25 m (Credible Scenario-01 and Credible Scenario-04)
- Source control via relief well drilling (Credible Scenario-01 and Credible Scenario-04)
- Source control on the vessel (Credible Scenario-05)
- Shoreline protection and deflection if any RPAs are identified via operational monitoring (Credible Scenario-01 and Credible Scenario-04).
- Shoreline clean-up if any RPAs impacted (Credible Scenario-01 and Credible Scenario-04).

- Oiled wildlife response (all scenarios)

Support functions include:

- Waste management
- Scientific monitoring programs

5 HYDROCARBON SPILL ALARP PROCESS

Woodside's hydrocarbon spill ALARP process is aligned with guidance provided by NOPSEMA in *Guideline N-04750-GL1687* (2016) and is set out in the 'Woodside Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Guidelines'.

From the identified response planning need and pre-operational NEBA, Woodside conducts a structured, semi-quantitative hydrocarbon spill process which has the following steps:

1. considers the response planning need identified in terms of surface area (km^2) and available surface hydrocarbon volumes (m^3) against existing Woodside capability
2. considers alternative, additional, and improved options for each response technique/control measure by providing an initial and, if required, detailed evaluation of:
    - predicted cost associated with adopting the control measure
    - predicted change/environmental benefit
    - predicted effectiveness/feasibility of the control measure.
3. evaluates the risks and impacts of implementing the proposed response techniques, and any further control measures with associated environmental performance to manage these additional risks and impacts.

Woodside considers the risks and impacts from a hydrocarbon spill to have been reduced to ALARP when:

1. a structured process for identifying and considering alternative, additional, and improved options has been completed for each selected response technique
2. the analysis of alternate, additional, and improved control measures meets one of the following criteria:
    - all identified, reasonably practicable control measures have been adopted
    - no identified reasonably practicable additional, alternative and/or improved control measures would provide further overall increased proportionate environmental benefit; or
    - no reasonably practical additional, alternative, and/or improved control measures have been identified.
3. where an alternative, additional and/or improved control measure is adopted, a measurable level of environmental performance has been assigned
4. higher order impacts/risks have received more comprehensive alternative, additional, and improved control measure evaluations and do not just compare the cost of the adopted control measures to the costs of an extreme or clearly unreasonable control measure
5. cumulative effects have been analysed when considered in combination across the whole activity.

The response technique selection is based on the risk assessment conducted in the EP. The risk assessment identifies the type of oil, volume of release, duration of release, predicted fate, weathering and the EMBA (along with other requirements such as time to impact and predicted volumes ashore). Modelling is then used to inform the NEBA and the prioritisation of suitable response options. The scale of the response techniques selected in the pre-operational NEBA is informed through the assessment of results from deterministic modelling.

For the purpose of the ALARP assessment, the following terms and definitions have been used:

- Response techniques are considered the control measures that reduce consequences from hydrocarbon spill events. The terms 'response technique' and 'control measure' are used interchangeably.
- Cost is defined as the time, effort and/or trouble taken in financial, safety, design/storage/installation, capital/lease, and/or operations/maintenance terms to adopt a control measure.

- Where the predicted change to environmental impact is compared against standard environmental values and sensitivities impacts using positive or negative criteria from the NEBA Impact Ranking Classification Guidance in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

5.1 Monitor and Evaluate (including operational monitoring)

Monitor and evaluate includes the gathering and evaluation of data to inform the oil spill response planning and operations. It includes fate and trajectory modelling, spill tracking, weather updates and field observations. This response option is deployed in some capacity for every event.

The table below provides the operational monitoring plans that support the successful execution of this response technique.

Table 5-1: Description of supporting operational monitoring plans

ID	Title
OM01	Predictive modelling of hydrocarbons to assess resources at risk
OM02	Surveillance and reconnaissance to detect hydrocarbons and resources at risk
OM03	Monitoring of hydrocarbon presence, properties, behaviour and weathering in water
OM04	Pre-emptive assessment of sensitive receptors at risk
OM05	Shoreline assessment

Woodside maintains an *Operational Monitoring Operational Plan*. If shoreline contact is predicted, Response Protection Areas (RPAs) will be identified and assessed before contact. If shorelines are contacted, a shoreline assessment survey will be completed to guide effective shoreline clean-up operations. This plan includes the process for the IMT to mobilise resources depending on the nature and scale of the spill.

The proximity of Exmouth, Onslow and Dampier to the spill event location means that multiple logistical options are available to monitor the spill in relatively short timeframes.

5.1.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Operational monitoring will be undertaken from the outset of a spill. This is needed to assess the nature of the spill and track its location. The data collected from the operational monitoring will inform the need for any additional operational monitoring, deployment of response techniques and may assist post-spill scientific monitoring. It also informs when the spill has entered State Waters and control of the incident passes to WA DoT.
- Surface hydrocarbons at >10 g/m^2 are predicted to be present in open water within 5 km of the well on day 1 and 2 (Credible Scenario-04) and day 30 (Credible Scenario-01). Modelling predicts floating oil at operational monitoring threshold at Montebello Marine Park after 5 hours for Credible Scenario-05.
- Shoreline contact is not predicted for any of the scenarios at response threshold (>100 g/m^2). The maximum accumulated volume ashore during a loss of well containment event is predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) and 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01).
- The shortest time to contact for oil at concentrations of entrained hydrocarbons greater than 500 ppb at shoreline receptors is 5 hours at Montebello Marine Park at 752 ppb (Credible Scenario-05), day 16.1 at Muiron MMA-WHA at 1,030 ppb (Credible Scenario-04) and day 17.3 at Muiron MMA-WHA at 790 ppb (Credible Scenario-01).
- Arrangements for support organisations who provide specialist services or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

- The duration of the spill may be up to 61 days. Although minor shoreline impacts are predicted to continue beyond this day, they are all below thresholds required for feasible shoreline clean-up.
- The location, trajectory and fate of the spill will be verified by real-time spill tracking via modelling, direct observation and remote sensing (OM01, OM02, OM03, OM04 and OM05).

5.1.2 Environmental performance based on need

Table 5-2: Environmental Performance – Monitor and Evaluate

Environmental Performance Outcome		To gather information from multiple sources to establish an accurate common operating picture as soon as possible and predict the fate and behaviour of the spill to validate planning assumptions and adjust response plans as appropriate to the scenario.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
1	Oil spill trajectory modelling	1.1	Initial modelling available within 6 hours using the Rapid Assessment Tool.	1, 3B, 3C, 4
		1.2	Detailed modelling available within 4 hours of APASA receiving information from Woodside.	
		1.3	Detailed modelling service available for the duration of the incident upon contract activation.	
2	Tracking buoy	2.1	Tracking buoy located on facility/vessel and ready for deployment 24/7.	1, 3A, 3C, 4
		2.2	Deploy tracking buoy from facility within 2 hours as per the First Strike Plan.	1, 3A, 3B, 4
		2.3	Contract in place with service provider to allow data from tracking buoy to be received 24/7 and processed.	1, 3B, 3C, 4
		2.4	Data received to be uploaded into Woodside COP daily to improve the accuracy of other monitor and evaluate strategies.	1, 3B, 4
3	Satellite imagery	3.1	Contract in place with 3rd party provider to enable access and analysis of satellite imagery. Imagery source/type requested on activation of service.	1, 3C, 4
		3.2	3rd party provider will confirm availability of an initial acquisition within 2 hours.	1, 3B, 3C, 4
		3.3	First image received with 24 hours of Woodside confirming to 3rd party provider its acceptance of the proposed acquisition plan.	1
		3.4	3rd party provider to submit report to Woodside per image. Report is to include a polygon of any possible or identified slick(s) with metadata.	1
		3.5	Data received to be uploaded into Woodside COP daily to improve accuracy of other monitor and evaluate strategies.	1, 3B, 4
		3.6	Satellite Imagery services available and employed during response.	1, 3C, 4
4	Aerial surveillance	4.1	2 trained aerial observers available to be deployed by day 1 from resource pool.	1, 2, 3B, 3C, 4
		4.2	1 aircraft available for 2 sorties per day, available for the duration of the response from day 1.	1, 3C, 4
		4.3	Observer to compile report during flight as per First Strike plan. Observers report available to the IMT within 2 hours of landing after each sortie.	1, 2, 3B, 4
		4.4	Unmanned Aerial Vehicles/Systems (UAV/UASs) to support Shoreline Clean-up Assessment Technique (SCAT), containment and recovery and surface dispersal and pre-emptive assessments as contingency if required.	1, 2
5	Hydrocarbon detections in water	5.1	Activate 3rd party service provider as per First Strike Plan. Deploy resources within 3 days: • 3 specialists in water quality monitoring • 2 monitoring systems and ancillaries • 1 vessel for deploying the monitoring systems with a dedicated winch, A-frame or Hiab and ancillaries to deploy the equipment.	1, 2, 3C, 3D, 4
		5.2	Water monitoring services available and employed during response.	1, 3C, 4
		5.3	Preliminary results of water sample as per contractor's implementation plan within 7 days of receipt of samples at the accredited lab.	
		5.4	Daily fluorometry reports as per service provider's implementation plan will be provided to IMT to validate modelling and monitor presence/absence of entrained hydrocarbons.	
		5.5	Use of Autonomous Underwater Vehicles (AUVs) for hydrocarbon presence and detection may be used as a contingency if the	1, 2, 3C, 4

			operational SIMA confirms conventional methods are unsafe or not possible.	
6	Pre-emptive assessment of sensitive receptors	6.1	10 days prior to any predicted impact, in agreement with WA DoT (for Level 2/3 incidents), deployment of 2 specialists from resource pool in establishing the status of sensitive receptors.	1, 2, 3B, 3C, 4
		6.2	Daily reports provided to IMT on the status of the receptors to prioritise Response Protection Areas (RPAs) and maximise effective utilisation of resources.	1, 3B, 4
7	Shoreline assessment	7.1	10 days prior to any predicted impact, in agreement with WA DoT (for Level 2/3 incidents), deployment of 1 specialist(s) in SCAT from resource pool for each of the Response Protection Areas (RPAs) with predicted impacts	1, 2, 3B, 3C, 4
		7.2	SCAT reports provided to IMT daily detailing the assessed areas to maximise effective utilisation of resources.	1, 3B, 4
		7.3	Shoreline access routes with the least environmental impact identified will be selected by a specialist in SCAT operations.	1

The control measures and capability of Woodside and its third-party service providers are shown to support Monitor and Evaluate activities up to and including the identified WCCS. This is demonstrated by the following:

- Woodside has a documented, structured and tested capability for Monitor and Evaluate operations including internal trajectory modelling capabilities, tracking buoys located offshore and contracted aerial observation platforms with access to trained observers.
- Woodside and its third-party service providers ensure there is sufficient capability for the duration of the response.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.1.
- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the environmental benefit gained and/or not reasonably practicable for this PAP.

The Monitor and Evaluate capability outlined in this section is part of the response developed to manage potential risks and impacts associated with the scenarios to ALARP, and there are no further additional, alternative and improved control measures other than those implemented that would provide further benefit.

5.2 Source control and well intervention

The worst-case credible scenario for a loss of well containment is considered to be loss of well control during drilling operations. This scenario would result in an uncontrolled flow from the well as outlined in the EP. In the event of a loss of well containment, the primary response would be source control and well intervention.

The Woodside Source Control Response Procedure includes the process for the IMT to mobilise resources for BOP intervention, Subsea First Response Toolkit (SFRT) support, and capping support. This plan has pre-identified vessel specifications and contracts required for SFRT debris clearance work and Woodside monitors the availability and location of these vessels.

Woodside is a signatory to a MoU between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a MODU and drilling a relief well, if a loss of well control incident were to occur. The MoU commits the signatories to share rigs, equipment, personnel and services to assist another operator in need. Dynamically positioned with mooring system, and moored MODUs are suitable for the Gemtree PAP, however, moored MODUs are more readily available thus they have been used as the basis for the analysis within this document.

Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. Circumstances that limit the safe execution of this control measure include lower explosive limit (LEL) concentrations, volatile concentrations of hydrocarbons in the atmosphere, weather window, waves and/or sea states (>1.5m waves) and high ambient temperatures.

5.2.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Prior to any source control activities, Woodside will implement protocols to ensure that the site is safe including subsea ROV surveys and surface air monitoring.
- Hydrocarbons will flow from the well until one of the following interventions can be made:
  - a relief well is drilled and first attempt at well kill within 61 days
  - a capping stack is in place (only feasible for a lower magnitude event with a plume radius of ~25 m).
- Arrangements for support organisations who provide specialist services or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The duration of the spill may be up to 61 days. Although minor shoreline impacts are predicted to continue beyond this day, they are all below thresholds required for feasible shoreline clean-up.

In addition, a number of assumptions are required to estimate the response need for source control. These assumptions have been described in the table below.

Table 5-3: Response Planning Assumptions – Source Control

Response planning assumptions	
Capping stack feasibility	Woodside commissioned an independent study on the feasibility of using a capping stack for the Julimar Phase 2 Drilling & Subsea Installation project (Wild Well Control, 2019) and a gap analysis of this study was then completed for this PAP due to the close proximity and similarities of the projects and endorsed as a suitable analogue. Wild Well Control (WWC) analysed the plume and reported that with the WCCSs (Credible Scenario-01 and Credible Scenario-04) surface gas boil could extend up to 90 m from the well centre and, hence, conventional vertical deployment is not feasible based on safety grounds. The model was based on a current speed of 0.2 m/s and a wind speed of 3.0 m/s to 6.5 m/s to present the worst case scenario. Various options for safe and effective deployment of a capping stack in these conditions were assessed but due to the complex nature of implementation or inability to implement were deemed as not ALARP. These are detailed in Section 6.2.7.1.
Safety considerations	Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site, in accordance with the Woodside Management System (WMS). Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Feasibility considerations	Woodside's primary source control option would be ROV intervention and relief well drilling for the WA-49-L Gemtree Exploration Drilling well. Capping stack may be viable where a loss of well containment of a lower magnitude than the worst case credible scenario occurs with a plume radius is ~25 m. The following approaches outline Woodside's hierarchy for relief well drilling; • Primary relief well – review internal drilling programs and MODU availability to source an appropriate rig operating within Australia with an approved Safety Case; • Alternate relief well – source and contract a MODU through APPEA MOU that is operating within Australia with an approved Safety Case; • Contingency relief well – if required, source and contract a MODU outside Australia with an approved Australian Safety Case

5.2.2 Environmental performance based on need

Table 5-4: Environmental Performance – Source Control

Environmental Performance Outcome		To stop the flow of hydrocarbons into the marine environment.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
8	Subsea First Response Toolkit (SFRT)	8.1	Oceaneering support staff available all year round, via contract, to assist with the mobilisation, deployment, and operation of the SFRT equipment.	1, 3B, 3C
		8.2	Intervention vessel with minimum requirement of a working class ROV and operator.	1, 3C
		8.3	Mobilised to site for deployment within 11 days.	1, 3B, 3C
		8.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
9	Well intervention	9.1	Frame agreements with ROV providers in place to be mobilised upon notification. ROV equipment deployed within 7 days.	1, 3B, 3C
		9.2	Source control vessel will have the following minimum specifications: • Active Heave Compensated crane, rated to at least 120 T • At least 90 m in length. • Deck has water/electricity supply. • Deck capacity to hold at least 110 T of capping stack.	1, 3B, 3C
		9.3	Identify source control vessel availability within 24 hours and begin contracting process. Vessel mobilised to site for deployment within 16 days for conventional capping.	1, 3B, 3C
		9.4	ROV available on MODU ready for deployment within 48 hours to attempt initial BOP well intervention.	1, 3B, 3C
		9.5	Staged deployment of multiple BOP SFRTs in the event the first system deployed fails.	1, 3B, 3C
		9.6	Hot Stab and/or well intervention attempt made using ROV and SFRT within 11 days.	1, 3B, 3C
		9.7	Staged deployment of additional capping and well intervention equipment in the event the first system deployed fails.	1, 3B, 3C
		9.8	Capping stack on suitable vessel mobilised to site within 16 days. Deployment and well intervention attempt will be made once plume size is acceptable and safety and metocean conditions are suitable.	1, 3C
		9.9	Wild Well Control Inc (WWCI) staff available all year round to assist with the mobilisation, deployment, and operation of the capping stack and well intervention equipment.	1, 3B, 3C
		9.10	MODU mobilised to site for relief well drilling within 21 days.	1, 3C
		9.11	First well kill attempt completed within 61 days.	1, 3B, 3C
		9.12	Open communication line(s) to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		9.13	Relief Well Peer review undertaken during well design which includes screening and identification of suitable MODU(s) with in-force Australian safety cases for relief well drilling.	1, 3C
		9.14	Monthly monitoring of the availability of MODUs through existing market intelligence including current Safety Case history, to meet specifications for relief well drilling. Titleholders of suitable MODUs notified.	3C
		9.15	At least two communication methods, one of which will include the capability to communicate with aviation.	1, 3A
		9.16	Prior to entering the reservoir, reconfirm that pre-identified/screened MODU(s) remain available for relief well drilling and engage titleholder.	1, 3C
10	Support vessels	10.1	Monthly monitoring of availability of larger vessels through existing Frame Agreements and market intelligence to meet specifications for source control.	3C

		10.2	Frame agreements for Infield Support Vessels (ISVs) require vessels maintain in-force safety case approvals covering ROV operations and provide support in the event of an emergency.	1, 3B, 3C
		10.3	MODU and vessel contracts include clause outlining requirement for support in the event if an emergency	1, 3C
11	Safety case	11.1	Woodside will prioritise MODU or vessel(s) for intervention work(s) that have an existing safety case.	1, 3C
		11.2	Woodside Planning, Logistics, and Safety Officers (on-roster/ call 24/7) to assist in expediting the safety case assessment process as far as practicable.	1, 3C
		11.3	Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for safety case guidance	1, 3C

The resulting source control capability has been assessed against the WCCS. The range of techniques provide a feasible and viable approach to well intervention and relief well drilling operations to stop the well flowing.

- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the insignificant environmental benefit gained and/or not reasonably practicable for this PAP.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.2.

5.3 Shoreline Protection and Deflection

The placement of containment, protection or deflection booms on and near a shoreline is a response technique to reduce the potential volume of hydrocarbons contacting or spreading along shorelines, which may reduce the scale of shoreline clean-up. Hydrocarbons contained by the booms would be collected where practicable.

Shorelines would be protected where accessible via vessel or shore. Where hydrocarbon contact has already occurred, there may still be value in deploying protection equipment to limit further accumulations and preventing remobilisation of stranded hydrocarbons.

Shoreline protection and deflection equipment would be mobilised to selected locations, where the following conditions were met:

- Sea-states and hydrocarbon characteristics permit safe deployment of protection and deflection measures.
- Oil trajectory has been identified as heading towards identified RPAs.

5.3.1 Response need based on predicted consequence parameters

Modelling conducted predicts that, for the duration of the spill, shoreline impacts will not meet the 100 g/m^2 concentration threshold. As a conservative approach, Woodside has included shoreline protection and deflection as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed.

The following statements identify the key parameters upon which the response need can be based:

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and to identify when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04), to direct any protection and deflection operations. OM04 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- No shoreline contact is predicted for any of the scenarios at response threshold (>100 g/m^2) at any RPA. The maximum accumulated volume ashore during a loss of well containment event is predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) and 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01).
- Following pre-emptive assessments of sensitive receptors at risk, and in agreement of prioritisation with WA DoT (if a Level 2/3 incident and within State Waters), protection and deflection operations would commence until agreed termination criteria are reached.
- The duration of the spill may be up to 61 days. Although minor shoreline impacts are predicted to continue beyond this day, they are all below thresholds required for feasible shoreline clean-up.
- Arrangements for support organisations who provide specialist services (trained personnel, protection and deflection equipment) and/or resources and should be tested regularly.
- TRPs for RPAs along with other relevant plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Shoreline Protection and Deflection. These assumptions have been described in the table below.

Table 5-5: Response Planning Assumptions – Shoreline Protection and Deflection

Response Planning Assumptions	
Safety considerations	Shoreline protection and deflection operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • safe for deployment and conditions within range of vessels • high ambient temperatures.
Shoreline Protection and Deflection	• 1 x Shoreline Protection and Deflection operation may include; – Quantity of shoreline sealing boom (as outlined in TRP) – Quantity of fence or curtain boom (as outlined in TRP) – 1-2 x trained supervisors – 8-10 x personnel / labour hire Specific details of each operation would be tailored to the TRP implemented (where available).

5.3.2 Environmental performance based on need

Table 5-6: Environmental Performance – Shoreline Protection and Deflection

Environmental Performance Outcome		To stop hydrocarbons encountering particularly sensitive areas		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
12	Response teams	12.1	In liaison with WA DoT (for Level 2/3 incidents), relevant Tactical Response Plans (TRPs) will be identified in the First Strike plan for activation 5 days prior to a predicted impact.	1, 3A, 3C, 4
		12.2	In liaison with WA DoT (for Level 2/3 incidents), mobilise teams to RPAs 5 days prior to predicted impact. Teams to contaminated RPAs comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool.	1, 2, 3B, 3C, 4
		12.3	In liaison with WA DoT (for Level 2/3 incidents), 1 operation mobilised 5 days prior to predicted impact for each identified RPA. Expected to be 1 RPAs within 19 days (operation as detailed above).	1, 3A, 3B, 4
		12.4	12 trained personnel available (2 supervisors plus 10 additional personnel) 5 days prior to predicted impact for each identified RPA. Sourced through resource pool.	1, 2, 3A, 3B, 3C, 4
		12.5	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		12.6	The safety of shoreline response operations will be considered and appropriately managed. During shoreline operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel.	1, 3B, 4
13	Response equipment	13.1	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	1, 3A, 3C, 4
		13.2	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		13.3	Supplementary equipment mobilised from 5 days prior to predicted impact.	
		13.4	Woodside maintains integrated fleet of vessels. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3C, 4
14	Management of Environmental Impact of the response risks	14.1	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified.	1
		14.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines.	

The resulting shoreline protection and deflection capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to shoreline protection and deflection at identified RPAs.

Under optimal conditions, during the subsea and surface releases the capability available exceeds the need identified. It indicates that the shoreline protection and deflection capability have the following expected performance:

- Existing capability allows for mobilisation and deployment of shoreline protection operations by day 2 (if required). Given that no shoreline contact is predicted at threshold (>100 g/m^2) at any RPA for any scenario and initial contact at 10 g/m^2 is not predicted until day 19.8 at Muiron Islands MMA-WHA (Credible Scenario-04), the existing capability is considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by the ongoing operational monitoring.

- TRPs have been developed for all identified RPAs that are predicted to be impacted in less than 14 days except in international locations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.3.

5.4 Shoreline Clean-up

Shoreline clean-up may be undertaken using a broad range of techniques when floating hydrocarbons contact shorelines. The timing, location and extent of shoreline clean-up activities can vary from one scenario to another, depending on the hydrocarbon type, sensitivities and values contacted, shoreline type and access, degree of oiling, and area oiled.

Shoreline clean-up is typically undertaken as a three-phase process:

- Phase one (gross contamination removal) involving the collection of bulk oil, either floating against the shoreline or stranded on it.
- Phase two (moderate to heavy contamination removal) involving removal or in-situ treatment of shoreline substrates such as sand or pebble beaches.
- Phase three (final treatment or polishing) involving removal of the remaining residues of oil.

As phase one typically involves recovery of floating and pooled oil, and phase three removes minor volumes, they have not been considered in the assessment of response need for the scenarios identified.

The *Shoreline Cleanup Operational Plan* details the mobilisation and resource requirements for a shoreline cleanup operation including the logistics, support and facility arrangements to manage the movement of personnel and resources. It includes the process for the IMT to mobilise resources depending on the nature and scale of the spill. Woodside would activate and mobilise trained and competent personnel in shoreline assessment before or following shoreline contact at response thresholds.

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove hydrocarbons and contaminated debris from a shoreline; this is to minimise ongoing environmental contamination and impact. The National Plan also provides guidance on shoreline clean-up techniques as outlined in National Plan Guidance *Response, assessment and termination of cleaning for oil contaminated foreshores* (AMSA 2015).

5.4.1 Response need based on predicted consequence parameters

Modelling conducted predicts that, for the duration of the spill, shoreline impacts will not meet the 100 g/m^2 concentration threshold required for a feasible clean-up. As a conservative approach, Woodside has included shoreline clean-up as a potential response technique in the instance that operational monitoring predicts or observes impacts at RPAs.

The following statements identify the key parameters upon which the response need can be based:

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) and, subsequently, shoreline assessments (OM05) to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. OM04 and OM05 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- No shoreline contact is predicted for any of the scenarios at response threshold (>100 g/m^2) at any RPA. The maximum accumulated volume ashore during a loss of well containment event is predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) and 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01).
- Following Shoreline Assessment, and agreement of prioritisation with WA DoT (if a Level 2/3 event), clean-up operations would commence until agreed termination criteria are reached.
- Prior to predicted impact, and in line with the relevant TRP and in agreement with WA DoT (if a Level 2/3 event), rubbish removal and segregation will be undertaken along the shoreline to minimise additional oiled waste volumes.

- The duration of the spill may be up to 61 days. Although minor shoreline impacts are predicted to continue beyond this day, they are all below thresholds required for feasible shoreline clean-up.
- Arrangements for support organisations who provide specialist services (trained personnel, labour hire, shoreline clean-up, and site management equipment) and/or resources and should be tested regularly.
- TRPs for RPAs along with other relevant plans, procedures and support documents should be in developed and in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for shoreline clean-up. These assumptions have been described in the table below.

Table 5-7: Response Planning Assumptions – Shoreline Clean-up

Response planning assumptions: Shoreline cleanup	
Safety considerations	Shoreline clean-up operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • waves and/or sea states, tidal cycle and intertidal zone limits • presence of wildlife • high ambient temperatures.
Manual shoreline clean-up operation (Phase 2)	1 x manual shoreline clean-up operation (Phase 2) may include: • 1–2 x trained supervisor • 8–10 x personnel/labour hire • Supporting equipment for manual clean-up including rakes, shovels, buckets, plastic bags etc.
Physical properties	**Surface Threshold for Response Planning** • Lower – 100 g/m^2 – 100% coverage of 'stain' – cannot be scratched off easily on coarse sediments or bedrock • Optimum – 250 g/m^2 – 25% coverage of 'coat' – can be scratched off with a fingernail on coarse sediments In the event of a real incident, operational monitoring will be undertaken from the outset of a spill whether or not these thresholds have been reached.
Efficiency **(m^3 oil recovered per person per day)**	Manual shoreline clean-up (Phase 2) – approximately 0.25–1 m^3 oil recovered per person per 10 hr day is based on moderate to high coverage of oil (100 g/m^2–1,000 g/m^2) with manual removal using shovels/rakes, etc. from studies of previous response operations and exercises.

Table 5-8: Shoreline Clean-up techniques and recommendations

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Natural recovery	Allowing shoreline to self-clean; no intervention undertaken.	Remote and inaccessible shorelines for personnel, vehicles and machinery. Other clean-up techniques may cause more damage than allowing the shoreline to naturally recover. Natural recovery may be recommended for areas with mangroves and coral reefs due to their sensitivity to disturbance from other shoreline clean-up techniques. High-energy shorelines: where natural removal rates are high, and hydrocarbons will be removed over a short timeframe.	Low-energy shorelines: these areas tend to be where hydrocarbon accumulates and penetrates soil and substrates.	May be employed, if the operational NEBA identifies that other clean-up techniques will have a negligible or negative environmental impact on the shoreline. May also be used for buried or reworked hydrocarbons where other techniques may not recover these.
Manual recovery	Use of manpower to collect hydrocarbons from the shoreline. Use of this form of clean-up is based on type of shoreline.	Areas where shorelines may not be accessible by vehicles or machinery and personnel can recover hydrocarbons manually. Where hydrocarbons have formed semi-solid to solid masses that can be picked up manually. Areas where nesting and breeding fauna cannot or should not be disturbed.	Coral reef or other sensitive intertidal habitats, as the presence of a response may cause more environmental damage then allowing them to recover naturally. For some high-energy shorelines such as cliffs and sea walls, manual recovery may not be recommended as it may pose a safety threat to responders.	May be used for sandy shorelines. Buried hydrocarbons may be recovered using shovels into small carry waste bags, but where possible the shoreline should be left to naturally recover to prevent any further burying of hydrocarbons (from general clean-up activities).

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Sorbents	Sorbent boom or pads used to recover fluid or sticky hydrocarbons. Can also be used after manual clean-up to remove any residues from crevices or from vegetation.	When hydrocarbons are free-floating close to shore or stranded onshore. As a secondary treatment method after hydrocarbon removal and in sensitive areas where access is restricted.	Access for deploying and retrieving sorbents should not be through soft or sensitive habitats or affect wildlife.	Used for rocky shorelines. Sorbent boom will allow for deployment from small shallow draught vessels, which will allow deployment close to shore where water is sheltered and to aid recovery. Sorbents will create more solid waste compared with manual clean-up, so will be limited to clean rocky shorelines.
Vacuum recovery, flushing, washing	The use of high volumes of low-pressure water, pumping and/or vacuuming to remove floating hydrocarbons accumulated at shorelines.	Suited to rocky or pebble shores where flushing can remobilise hydrocarbons (to be broken up) and aid natural recovery. Any accessible shoreline type from land or water. May be mounted on barges for water-based operations, on trucks driven to the recovery area, or hand-carried to remote sites. Flushing and vacuum may be useful for rocky substrate. Medium- to high-energy shorelines where natural removal rates are moderate to high. Where flushed hydrocarbons can be recovered to prevent further oiling of shorelines.	Areas of pooled light, fresh hydrocarbons may not be recoverable via vacuum due to fire and explosion risks. Shorelines with limited access. Flushing and washing not recommended for loose sediments. High-energy shorelines where access is restricted.	High volume low pressure (HVLP) flushing and washing into a sorbent boom could be used for rocky substrate, if protection booming has been unsuccessful in deflecting hydrocarbons from these areas.

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Sediment reworking	Movement of sediment to surf to allow hydrocarbons to be removed from the sediment and move sand via heavy machinery.	When hydrocarbons have penetrated below the surface. Recommended for pebble/cobble shoreline types. Medium- to high-energy shorelines where natural removal rates are moderate to high.	Low-energy shorelines as the movement of substrate will not accelerate the natural cleaning process. Areas used by fauna which could potentially be affected by remobilised hydrocarbons.	Use of wave action to clean sediment: appropriate for sandy beaches where light machinery is accessible.
Vegetation cutting	Cutting vegetation to prevent oiling and reduce volume of waste and debris.	Vegetation cutting may be recommended to reduce the potential for wildlife being oiled. Where oiling is restricted to fringing vegetation.	Access in bird-nesting areas should be restricted during nesting seasons. Areas of slow-growing vegetation.	May be used on shorelines where vegetation can be safely cleared to reduce oiling.
Cleaning agents (National Plan registered Oil Spill Cleaning Agent – 'OSCA')	Application of chemicals such as dispersants to remove hydrocarbons.	May be used for manmade structures and where public safety may be a concern.	Natural substrates and in low-energy environments where sufficient mixing energy is not present.	Not recommended for shorelines. Could be used for manmade structures such as boat ramps.

5.4.2 Environmental performance based on need

Table 5-9: Environmental Performance – Shoreline Clean-up

Environmental Performance Outcome		To remove bulk and stranded hydrocarbons from shorelines and facilitate shoreline amenity habitat recovery.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
15	Shoreline responders	15.1	In liaison with WA DoT (for Level 2/3 incidents), deployment of 1 shoreline clean-up team to each contaminated RPA comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool 5 days prior to predicted impact upon request from the IMT.	1, 2, 3A, 3B, 3C, 4
		15.2	Relevant TRPs will be identified in the first strike plan for activation 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		15.3	Relevant TRPs available for shoreline contacted 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		15.4	Clean-up operations for shorelines in line with results and recommendations from SCAT outputs.	1, 3A, 3B
		15.5	All shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates.	
		15.6	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy 1 shoreline clean-up operation to each site where operational monitoring predicts an accumulation 5 days prior to impact.	1, 2, 3A, 3C, 4
		15.7	The safety of shoreline response operations will be considered and appropriately managed. During shoreline clean-up operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel	1, 3B, 4
		15.8	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
16	Waste Management	16.1	Contract with waste management services for transport, removal, treatment and disposal of waste.	1, 3A, 3B, 3C, 4
		16.2	Access to 38 m^3 waste storage capacity by Week 5.	
		16.3	Waste management services available and employed during response.	
17	Shoreline clean-up equipment	17.1	Contract in place with 3rd party providers to access equipment.	1, 3A, 3C, 4
		17.2	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	
		17.3	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		17.4	Supplementary equipment mobilised from OSRL 5 days prior to predicted impact.	
18	Management of Environmental Impact of the	18.1	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to	1

	response risks		nearshore benthic environments with a preference for areas of sandy seabed where they can be identified.	
		18.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines.	
		18.3	Vehicular access will be restricted on dunes, turtle nesting beaches an in mangroves.	
		18.4	Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations.	
		18.5	Removal of vegetation will be limited to moderately or heavily oiled vegetation.	
		18.6	Oversight by trained personnel who are aware of the risks.	
		18.7	Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline.	

The resulting shoreline clean-up capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to shoreline clean-up at identified RPAs. Woodside's capability can cover all required shoreline clean-up operations for the PAP and thus meets the need identified for this activity. The shoreline clean-up capability has the following expected performance (if required during a response):

- Existing capability allows for mobilisation and deployment of shoreline clean-up operations by Day 2 (if required). Given that no shoreline contact is predicted at threshold (>100 g/m^2) at any RPA for any scenario and initial contact at 10 g/m^2 is not predicted until Day 19.8 at Muiron Islands MMA-WHA (Credible Scenario-04), the existing capability is considered sufficient to mobilise and deploy shoreline clean-up operations, if required, guided by the ongoing operational monitoring.
- Woodside has the capacity to mobilise and deploy up to 105-140 shoreline clean-up teams (approx. 1,260-1,680 responders in total) by Week 3 using existing labour hire contracts with Woodside, AMOSC, Core Group, AMSA, WA DoT and OSRL team leads.
- Assessment of response capability indicates that for a worst-case scenario the actual teams required would meet the available capability and the response would be completed by end month 3.
- Woodside has considered deployment of additional personnel to undertake shoreline clean-up operations but is satisfied that the identified level of resource is balanced between cost, time and effectiveness. The most significant constraint on expanding the scale of response operations is accommodation and transport of personnel in the Exmouth to Port Hedland region and management of response generated waste. From previous assessment of accommodation in this region, Woodside estimates that current accommodation can cater for a range of 500-700 personnel per day for an ongoing operation.
- TRPs have been developed for all identified RPAs excepting international locations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.4.

5.5 Oiled wildlife response

Woodside would implement a response in accordance with the *Oiled Wildlife Operational Plan*. This plan includes the process for the IMT to mobilise resources depending on the nature and scale of the spill. Oiled wildlife operations would be implemented with advice and assistance from the Oiled Wildlife Advisor from the Department of Biodivseristy, Conservation and Attractions (DBCA).

Oiled wildlife response is undertaken in accordance with the Western Australian Oiled Wildlife Response Plan to ensure it is conducted in accordance with legislative requirements under the *Animal Welfare Act 2002*.

If there is a net environmental benefit, oiled wildlife operations will be conducted 24 hours per day to reduce the time for rehabilitation and release of oiled wildlife. Hazing and pre-emptive capture techniques to keep non-oiled animals away from contaminated habitat in instances where it is deemed appropriate will be conducted in accordance with the Western Australian Oiled Wildlife Response Plan, specifically vessels used in hazing/pre-emptive capture will approach wildlife at slow speeds to ensure animals are not directed towards the oil and deterrence/hazing and pre-emptive capture will only be conducted if Woodside has licensed authority from DBCA and approval from the Incident Controller.

Shoreline access will be considered as part of the operational NEBA. Vehicular access would be restricted on dunes, turtle nesting beaches and in mangroves. Woodside retains specialist personnel to support and manage oiled wildlife operations, including trained and competent responders in Exmouth and Dampier. Additional personnel would be sourced through Woodside's arrangements to support an oiled wildlife response as required.

5.5.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- No shoreline contact is predicted for any of the scenarios at response threshold (>100 g/m^2) at any RPA. The maximum accumulated volume ashore during a loss of well containment event is predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) and 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01).
- The offshore location of the release site is expected to initially result in low numbers of at-risk or impacted wildlife.
- As the surface oil approaches shorelines, potential for oiled wildlife impacts are likely to increase.
- It is estimated that an oiled wildlife response would be between Level 1 and 2, as defined in the WA OWRP (Table 5-12).

Table 5-10: Key at-risk species potentially in Priority Protection Areas and open ocean

Species	Argo-Rowley Terrace CMR	Barrow Island	Gascoyne Marine Park	Glomar Shoals	Lowendal Islands	Montebello Islands and State Marine Park	Muiron Islands WHA & SMP	Ningaloo Coast	Rankin Bank	Open ocean
Marine turtles	✓	✓	✓		✓	✓	✓	✓	✓	✓
Whale sharks			✓		✓		✓	✓		✓
Seabirds and/or migratory shorebirds	✓	✓	✓		✓	✓	✓	✓		✓
Cetaceans – migratory whales	✓		✓		✓		✓	✓		✓
Cetaceans – dolphins and porpoises	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dugongs		✓			✓	✓	✓	✓		✓
Sharks and rays	✓		✓	✓	✓		✓	✓	✓	✓

The oiled wildlife response technique targets key wildlife populations at risk within Commonwealth open waters and the nearshore waters as described in Section 4 of the EP. Responding to oiled wildlife consists of eight key stages, as described in Table 5-11 below.

Table 5-11: Oiled wildlife response stages

Stage	Description
Stage 1: Wildlife first strike response	Gather situational awareness including potential wildlife assets at risk.
Stage 2: Mobilisation of wildlife resources	Resources include personnel, equipment and facilities.
Stage 3: Wildlife reconnaissance	Reconnaissance to identify potentially affected animals.
Stage 4: IAP wildlife sub-plan development	The IAP includes the appropriate response options for oiled wildlife, including wildlife priorities for protection from oiling; deterrence measures (see below); and recovery and treatment of oiled wildlife; resourcing of equipment and personnel. It includes consideration of deterrence practices such as ‘hazing’ to prevent wildlife from entering areas potentially contaminated by spilled hydrocarbons, as well as dispersing, displacing or relocating wildlife to minimise/prevent contact and provide time for clean-up.
Stage 5: Wildlife rescue and staging	This includes the different roles of finding oiled wildlife, capturing wildlife, and holding and/or transportation of wildlife to oiled wildlife facilities.
Stage 6: Establishment of an oiled wildlife facility	Treatment facilities would be required for the first-aid, cleaning and rehabilitation of affected animals. A vessel-based ‘on-water’ facility would likely need to be established to enable stabilisation of oiled wildlife before transport to a suitable treatment facility. Suitable staging sites in the Dampier and Exmouth have been identified in the draft Regional OWROP, should a land-based site be required.
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping and success tracking.
Stage 8: Oiled wildlife response termination	Once a decision has been made to terminate operations, the Incident Controller will stand down individual participating and supporting agencies.

Reconnaissance and primary response would be done during operational monitoring and surveillance activities. Where marine wildlife are observed on water or transiting near or within the spill area, observations would be recorded through surveillance records. The shoreline assessments would be done in accordance with OM05, which would be used as a further tool to identify wildlife and habitats contacted by hydrocarbons.

Staging sites would be established as forward bases for shoreline- or vessel-based field teams. Once recovered to a staging site, wildlife would be transported to the designated oiled wildlife facility or a temporary holding centre (before being transported to the oiled wildlife facility). Temporary holding centres are required when there is significant distance between a staging site and the oiled wildlife facility, to enable stabilisation of oiled animals. The oiled wildlife facility is the primary location where animals would be housed and treated. Sites proposed for staging a regional oiled wildlife response in Dampier and Exmouth have been identified.

To deploy a response that is appropriate to the nature and scale of the event, as well as scalable over time, Woodside would implement an oiled wildlife response in consultation with DBAC and use the capability outlined in the WA OWRP, with additional capability if required (e.g. volunteers) accessible through Woodside's *People & Global Capability Surge Labour Requirement Plan*.

The WA OWRP provides indicative oiled wildlife response levels (Table 5-12) and the resources likely to be needed at each increasing level of response.

Table 5-12: Indicative oiled wildlife response level (adapted from the WA OWRP, 2014)

Oiled wildlife response Level	Indicative personnel numbers	Indicative duration	Indicative number of birds (non-threatened species)	Indicative number of birds (threatened species)	Turtles (hatchlings, juveniles, adults)	Cetaceans	Pinnipeds	Dugongs
Level 1	6	<3 days	1–2/day <5 total	No complex birds	None	None	None	None
Level 2	26	4–14 days	1–5/day <20 total	No complex birds	<20 hatchlings No juv/adults	None	None	None
Level 3	59	4–14 days	5–10/day <50 total	1–5/day <10 total	<5 juv/adults <50 hatchlings	None	<5	None
Level 4	77	>14 days	5–10/day <200 total	5–10/day	<20 juv/adults <500 hatchlings	<5, or known habitats affected	5–50	Habitat affected only
Level 5	116	>14 days	10–100/ day >200 total	10–50/day	>20 juv/adults >500 hatchlings	>5 dolphins	>50	Dugongs oiled
Level 6	122	>14 days	>100/day	10–50/day	>20 juv/adults >500 hatchlings	>5 dolphins	>50	Dugongs oiled

5.5.2 Environmental performance based on need

Table 5-13: Environmental Performance – Oiled Wildlife Response

Environmental Performance Outcome		Oiled Wildlife Response is conducted in accordance with the Western Australian Oiled Wildlife Response Plan (WAOWRP) to ensure it is conducted in accordance with legislative requirements to house, release or euthanise wildlife under the Animal Welfare Act 2002.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
19	Wildlife response equipment	19.1	Contracted capability to treat 100 individual wildlife for immediate mobilisation to Response Priority Areas (RPAs).	1, 3A, 3B, 3C, 4
		19.2	Contracted capability to treat up to an additional 250 individual wildlife within a 5 day period.	
		19.3	National plan access to additional resources under the guidance of the WA DoT (up to a Level 5 oiled wildlife response as specified in the OWRP), with the ability to treat about 600 individual wildlife by the time hydrocarbons contact the shoreline.	1, 3C, 4
		19.4	Vessels used in hazing/pre-emptive capture will approach wildlife at slow speeds to ensure animals are not directed towards the hydrocarbons.	1, 3A, 3B, 4
		19.5	Facilities for the rehabilitation of oiled wildlife are operational 24/7 as per WAOWRP.	1, 3A, 4
20	Wildlife responders	20.1	2 wildlife divisional commanders to lead the oiled wildlife operations who have completed an Oiled Wildlife Response Management course.	1, 2, 3B
		20.2	Wildlife responders to be accessed through resource pool and additional agreements with specialist providers.	1, 2, 3A, 3B, 3C, 4
		20.3	Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA, and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan.	1
		20.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B

The resulting wildlife response capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to response at identified RPAs.

Under optimal conditions, during the subsea or surface release, the capability available meets the need identified. It indicates that, the wildlife response capability has the following expected performance:

- Mobilisation and deployment of 1 wildlife collection team to each impacted RPA as directed by operational monitoring.
- Mobilisation and deployment of up to 2 central wildlife treatment and rehabilitation locations at Exmouth and Dampier in accordance with WA OWRP, if required.
- The waste storage capacity is sufficient to meet the need (circa 1 m^3 waste generated per wildlife unit cleaned).

Woodside would establish a wildlife collection point at the RPA for identified oiled wildlife collection and sorting. From these locations, recovered wildlife would be transported to a central treatment location at Dampier or Exmouth.

5.6 Waste Management

Waste management is considered a support technique to shoreline clean-up and wildlife response. Waste generated and collected during the response that will require handling, management and disposal may consist of:

- Liquids (hydrocarbons and contaminated liquids) collected during shoreline clean-up and wildlife response, and/or
- Solids/semi-solids (oily solids, garbage, contaminated materials) and debris (e.g. seaweed, sand, woods, and plastics) collected during shoreline clean-up and wildlife response.

Expected waste volumes during an event are likely to vary depending on oil type, volume released, response techniques employed and how weathering of hydrocarbons. Waste management, handling and capacity should be scalable to ensure continuous response operations can be maintained.

All waste management activities will follow the *Environment Protection (Controlled Waste) Regulations 2004* and the waste will be managed to minimise final disposal volumes. Waste treatment techniques will consider contaminated solids treatment to allow disposal to landfill and solids with high concentrations of hydrocarbon will be treated and recycled where possible or used in clean fill if suitable.

The waste products would be transported from response locations to the nearest suitable staging area/waste transfer station for treatment, disposal or recycling. Waste will be transferred with appropriately licensed vehicles. Containers will be available for temporary waste storage and will be:

- Labelled with the waste type
- Provided with appropriate lids to prevent waste being blown overboard
- Bunded if storing liquid wastes.
- Processes will be in place for transfers of bulk liquid wastes and include:
  - Inspection of transfer hose undertaken prior to transfer
  - Watchman equipped with radio visually monitors loading hose during transfer
  - Tank gauges monitored throughout operation to prevent overflow.

The *Oil Spill Preparedness Waste Management Support Plan* details the procedures, capability and capacity in place between Woodside and its primary waste services contractor (Veolia Waste Management) to manage waste volumes generated from response activities.

Modelling predicts no floating oil at concentrations suitable for offshore response and no shoreline impact at response thresholds (>100 g/m^2) thus waste volumes will be minimal and result primarily from any oiled wildlife response undertaken. Shoreline clean-up has been included in Table 5-14 in the event that operational monitoring detects any impacts at RPAs and thus shoreline clean-up operations are deployed.

5.6.1 Response need based on predicted consequence parameters

Table 5-14: Response Planning Assumptions – Waste Management

Response planning assumptions: Waste management	
Waste loading per m^3 oil recovered (multiplier)	Shoreline clean-up (manual) – approx. 5-10x multiplier for oily solid and liquid wastes generated by manual clean-up.
	Oiled wildlife response – approx. 1m^3 of oily liquid waste generated for each wildlife unit cleaned.

Document to be read in conjunction with Gemtree Exploration Drilling Environment Plan.

5.6.2 Environmental performance based on need

Table 5-15: Environmental performance – waste management

<table>
<tr><th colspan="2">Environmental Performance Outcome</th><td colspan="3">To minimise further impacts, waste will be managed, tracked and disposed of in accordance with laws and regulations.</td></tr>
<tr><th colspan="2">Control measure</th><th colspan="2">Performance Standard</th><th>Measurement Criteria (Section 5.9)</th></tr>
<tr><td rowspan="9">21</td><td rowspan="9">Waste Management</td><td>21.1</td><td>Contract with waste management services for transport, removal, treatment and disposal of waste.</td><td rowspan="6">1, 3A, 3B, 3C, 4</td></tr>
<tr><td>21.2</td><td>Access to at least 675 m^3 of solid and liquid waste storage available within 5 days upon activation of 3rd party contract, if required.</td></tr>
<tr><td>21.3</td><td>Access to 38 m^3 waste storage capacity by Week 5.</td></tr>
<tr><td>21.4</td><td>Recovered hydrocarbons and wastes will be transferred to licensed treatment facility for reprocessing or disposal.</td></tr>
<tr><td>21.5</td><td>Teams will segregate liquid and solid wastes at the earliest opportunity.</td></tr>
<tr><td>21.6</td><td>Waste management provider support staff available year-round to assist in the event of an incident with waste management as detailed in contract.</td></tr>
<tr><td>21.7</td><td>Open communication line to be maintained between IMT and waste management services to ensure the reliable flow of accurate information between parties.</td><td>1, 3A, 3B</td></tr>
<tr><td>21.8</td><td>Waste management to be conducted in accordance with Australian laws and regulations.</td><td rowspan="2">1, 3A, 3B, 3C, 4</td></tr>
<tr><td>21.9</td><td>Waste management services available and employed during response.</td></tr>
</table>

The resulting waste management capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to waste management at identified RPAs.

Given the maximum shoreline accumulation is predicted during Week 5 at a maximum volume of 3.78 m^3, 38 m^3 of waste is expected across all shoreline clean-up operations, and the capability available exceeds the need identified.

It indicates that the waste management capability has the following expected performance:

- Shoreline operations may generate up to 38 m^3 waste over 5 weeks of operations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.5.
- Veolia has the capacity to treat up to 120,000 m^3 overall waste volumes. The waste management requirements are within Woodside's and its service providers existing capacity.

5.7 Scientific monitoring

A scientific monitoring program (SMP) would be activated following a Level two or three unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socio-economic) for the entire predicted Environment that Maybe Affected (EMBA) and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities (refer to Table 2-1: PAP credible spill scenarios).

The outputs of the stochastic hydrocarbon spill modelling were used to assess the environmental risk of the hydrocarbon affected area as delineated by the ecological impact EMBA and social-cultural EMBA based on exceedance of environmental and social-cultural hydrocarbon threshold concentrations (refer to Table 2-2, Section 2.3.1.1 and see Section 4 and 6 of the EP for further information on applicable thresholds and the EMBAs). The Petroleum Activities Program worst-case credible spill Credible Scenario-01, Credible Scenario-04 and Credible Scenario-05 define the EMBAs and are the basis of the SMP approach presented in this section

It should be noted that the resulting SMP receptor locations differ from the Response Protection Areas (RPAs) presented and discussed in Section 3 of this document due to the applicability of different hydrocarbon threshold levels. The SMP would be informed by the data collected via the operational monitoring program (OMP) studies, however, it differs from the OMP in being a long-term program independent of, and not directing, the operational oil spill response or monitoring of impacts from response activities (refer to Section 5.1) for operational monitoring overview).

Key objectives of the Woodside oil spill SMP are:

- Assess the extent, severity and persistence of the environmental impacts from the spill event; and
- Monitor subsequent recovery of impacted key species, habitats and ecosystems.

The SMP comprises ten targeted environmental monitoring programs to assess the condition of a range of physico-chemical (water and sediment) and biological (species and habitats) receptors including EPBC Act listed species, environmental values associated with protected areas and socio-economic values, such as fisheries. The ten SMPs are as follows:

- SM01 - Assessment of the presence, quantity and character of hydrocarbons in marine waters (linked to OM01 to OM03)
- SM02 - Assessment of the presence, quantity and character of hydrocarbons in marine sediments (linked to OM01 and OM05)
- SM03 – Assessment of impacts and recovery of subtidal and intertidal benthos
- SM04 - Assessment of impacts and recovery of mangroves/saltmarsh habitat
- SM05 - Assessment of impacts and recovery of seabird and shorebird populations
- SM06 - Assessment of impacts and recovery of nesting marine turtle populations
- SM07 - Assessment of impacts to pinniped colonies including haul-out site populations
- SM08 - Desktop assessment of impacts to other non-avian marine megafauna
- SM09 - Assessment of impacts and recovery of marine fish (linked to SM03)
- SM10 - Assessment of physiological impacts to important fish and shellfish species (fish health and seafood quality/safety) and recovery.

These SMPs have been designed to cover all key tropical and temperate habitats and species within Australian waters and broader, if required. A planning area for scientific monitoring is also identified to acknowledge potential hydrocarbon contact below the environmental threshold concentrations and beyond the EMBA. This planning area has been set with reference to the entrained low exposure value of 10 ppb detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019), as shown in Figure 5-1.

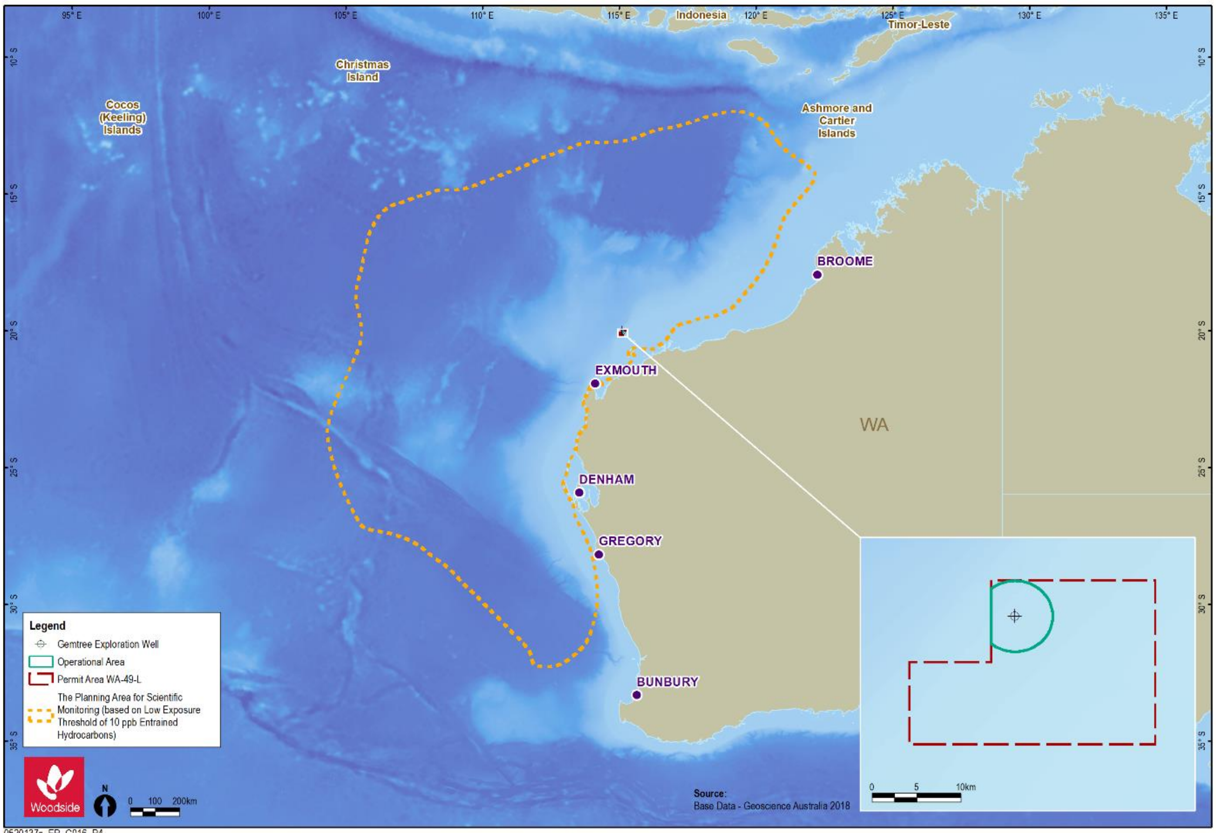

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Figure 5-1: The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (Credible Scenario-04). Please note that Figure 5-1 represents the overall combined extent of the oil spill model outputs based on a total of 100 replicate simulations over an annual period for Credible Scenario-04 and therefore represents the largest spatial boundaries of 100 Credible Scenario-04 oil spill combinations, not the spatial extent of a single Credible Scenario-04 spill.

Document to be read in conjunction with Gemtree Exploration Drilling Environment Plan.

5.7.1 Scientific Monitoring Deployment Considerations

Table 5-16: Scientific monitoring deployment considerations

Scientific Monitoring Deployment Considerations	
Existing baseline studies for sensitive receptor locations predicted to be affected by a spill	PBAs of the following two categories: • PBAs within the predicted <10-day hydrocarbon contact time prediction: The approach is to conduct a desktop review of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted within 10 days of a spill and look to conduct baseline data collection to address data gaps and demonstrate spill response preparedness. Planning for baseline data acquisition is typically commenced pre-PAP and execution of studies undertaken with consideration of weather, receptor type, seasonality and temporal assessment requirements. • PBAs >10 days' time to predicted hydrocarbon contact in the event of an unplanned hydrocarbon release (from the facility operational activities). SMP activation (as per the WA-49-L Gemtree Exploration Drilling FSP) directs the SMP team to follow the steps outlined in the SMP Operational Plan. The steps include: checking the availability and type of existing baseline data, with particular reference to any PBAs identified as >10 days to hydrocarbon contact. Such information is used to identify response phase PBAs and plan for the activation of SMPs for pre-emptive (i.e. pre-hydrocarbon contact) baseline assessment.
Pre-emptive Baseline in the event of a spill	Activation of SMPs in order to collect baseline data at sensitive receptor locations with predicted hydrocarbon contact time >10 days (as documented in ANNEX C).
Survey platform suitability and availability	In the event of the SMP activation, suitable survey platforms are available and can support the range of equipment and data collection methodologies to be implemented in nearshore and offshore marine environments.
Trained personnel to implement SMPs suitable and available.	Access to trained personnel and the sampling equipment contracted for scientific monitoring via a dedicated scientific monitoring program standby contract.
Met-ocean conditions	The following met-ocean conditions have been identified to implement SMPs: • Waves <one m for nearshore systems • Waves <1.5 m for offshore systems • Winds <20 knots • Daylight operations only SMP implementation will be planned and managed according to HSE risk reviews and the met-ocean conditions on a day to day basis by SMP operations.

5.7.2 Response planning assumptions

Table 5-17: Scientific monitoring response planning assumptions

Response Planning Assumptions	
PBAs	PBAs identified through the application of defined hydrocarbon impact thresholds during the Quantitative Spill Risk Assessment process and a consideration of the minimum time to contact at receptor locations fall into two categories: • PBAs for which baseline data are planned for and data collection may commence pre-PAP (≤ 10 days minimum time to contact), where identified as a gap. • PBAs (> 10 days minimum time to contact) for which baseline data may be collected in the event of an unplanned hydrocarbon release. Response phase PBAs are prioritised for SMP activities due to vulnerability (i.e. time to contact and environmental sensitivity) to potential impacts from hydrocarbon contact and an identified need to acquire baseline data.

	Time to hydrocarbon contact of >10 days has been identified as a minimum timeframe within which it is feasible to plan and mobilise applicable SMPs and commence collection of baseline (pre-hydrocarbon contact) data, in the event of an unplanned hydrocarbon release from WA-49-L Gemtree Exploration Drilling. PBAs for WA-49-L-Gemtree Exploration Drilling are identified and listed in ANNEX D, Table D-1. The PBAs together with the situational awareness (from the operational monitoring) are the basis for the response phase SMP planning and implementation.
Pre-Spill	A review of existing baseline data for receptor locations with potential to be contacted by floating or entrained hydrocarbons at environmental thresholds within ≤10 days has identified the following: • Rankin Bank [5] For example, adequate baseline data are available for Rankin Bank as last surveyed (benthic communities and fish assemblages) in November 2018 (Currey-Randall et al., 2019). Australian Marine Parks (AMPs) potentially affected includes: • Montebello AMP • Gascoyne AMP All the Australian Marine Parks (AMPs) are located in offshore waters where hydrocarbon exposure is possible on surface waters (floating hydrocarbons) and in the water column (entrained hydrocarbons).
In the Event of a Spill	Locations with >10 days to hydrocarbon contact, as well as the wider area, will be investigated and identified by the SMP team (in the Environment Unit of the Incident Control Centre (ICC)) as the spill event unfolds and as the situational awareness provided by the OMPs permits delineation of the spill affected area (for example, updates to the spill trajectory tracking). The full list is presented in ANNEX D, based on the PAP worst-case credible spill scenario(s) (Table 2-1). To address the initial focus in a response phase SMP planning situation, receptor locations predicted to be contacted between >10 days and 20 days have been identified as follows: • Ningaloo Coast, north[6] • Ningaloo AMP • Muiron Islands[6] • Montebello State Marine Park In the event key receptors within geographic locations that are potentially impacted after 10 days following a spill event or commencement of the spill and where adequate and appropriate baseline data are not available, there will be a response phase effort to collect baseline data for the following purposes: i. Priority will be given to the collection of baseline data for receptors predicted to be within the spill affected area prior to hydrocarbon contact. The process is initiated with the investigation of available baseline and time to hydrocarbon contact (>10 days which is sufficient time to mobilise SMP teams and acquire data before hydrocarbon contact). With reference to the WA-49-L-Gemtree Exploration project, priority would be focused on Ningaloo Coast, north and Muiron Islands. ii. Highly sensitive and/or valued habitats and communities in coastal waters will be prioritised for pre-emptive baseline surveys over open water areas of AMPs e.g. Ningaloo AMP.

[5] Only entrained hydrocarbon contact is predicted at Rankin Bank ≤10 days. A precautionary approach for this SMP has been adopted by including Rankin Bank.
[6] Ningaloo Coast and Muiron Islands includes the WHA, State Marine Park and Marine Management Area.

	iii. Collect baseline data for receptors predicted to be outside the spill affected area so reference datasets for comparative analysis with impacted receptor types can be assessed post-spill.
Baseline Data	A summary of the spill affected area and receptor locations as defined by the EMBAs for the PAP worst case credible spill Credible Scenario-01 and Credible Scenario-04, is presented in the WA-49-L-Gemtree Exploration EP (Section 6). The key receptors at risk by location and corresponding SMPs based on the EMBAs for the PAP are presented in ANNEX D, as per the PAP credible spill Credible Scenario-01 and Credible Scenario-04. This matrix maps the receptors at risk with their location and the applicable SMPs that may be triggered in the event of a Level two or three hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. Receptor locations and applicable SMPs are colour coded to highlight possible time to contact based on receptor locations identified as PBAs. The status of baseline studies relevant to the PAP are tracked by Woodside through the maintenance of a Corporate Environment Environmental Baseline Database (managed by the Woodside Environmental Science team), as well as accessing external databases such as IGEM (Industry-Government Environmental Metadata database) (refer to ANNEX C).

5.7.3 Summary – scientific monitoring

The resulting scientific monitoring capability has been assessed against the PAP worst case credible spill scenarios. The range of strategies provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts. All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be moderate and the overall delivery effectiveness determined to be medium. The SMP's main objectives can be met, with no additional, alternative or improved control measures providing further benefit.

5.7.4 Response planning: need, capability and gap – scientific monitoring

The receptor locations identified in ANNEX D provide the basis of the SMPs likely to be selected and activated. Once the Woodside SMP Delivery team and Standby SMP contractor have been stood up and the exact nature and scale of the spill becomes known, the SMPs to be activated will be confirmed as per the process set out in the SMP Operational Plan.

<u>Scope of SMP Operations in the event of a hydrocarbon spill:</u>

Receptor locations of interest for the SMP during the response phase are:

- Ningaloo Coast, north[6]
- Ningaloo AMP
- Muiron Islands
- Montebello State Marine Park

Documented baseline studies are available for certain sensitive receptor locations including the Rankin Bank and Montebello AMP (ANNEX D, Table D-2). The SMP approach in the response phase would still deploy SMP teams to maximise the opportunity to collect pre-emptive baseline data at sensitive receptor locations, i.e., the sections of the Ningaloo Coast not immediately exposed to hydrocarbons. As the exact locations where hydrocarbon contact occurs may be unpredictable, SM01 would be mobilised as a priority to be able to detect hydrocarbons and track the leading edge of the spill to verify where hydrocarbon contact occurs which will assist with where SMP resources are a priority need to obtain pre-emptive baseline data.

The option analysis in Section 6.7considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.7.5 Environmental performance based on need

Table 5-18: Environment Performance – Scientific Monitoring

Environmental Performance Outcome		Woodside can demonstrate preparedness to stand up the SMP to quantitatively assess and report on the extent, severity, persistence and recovery of sensitive receptors impacted from the spill event.		
Control measure		**Performance Standard**		**Measurement Criteria**
14	• Woodside has an established and dedicated SMP team comprising the Environmental Science Team and additional Environment Advisers within the Health Safety Environment and Quality (HSEQ) Function.	14.1	SMP team comprises a pool of competent Environment Advisers (stand up personnel) who receive training regarding the SMP, SMP activation and implementation of the SMP on an annual basis.	• Training materials. • Training attendance registers. Process that maps minimum qualification and experience with key SMP role competency and a tracker to manage availability of competent people for the SMP team including redundancy and rostering.
15	• Woodside have contracted SMP service provider to provide scientific personnel to resource a base capability of one team per SMP (SM01-SM10, see ANNEX C Table C-2) as detailed in Woodside's SMP standby contractor Implementation Plan, to implement the oil spill scientific monitoring programs. The availability of relevant personnel is reported to Woodside on a monthly basis via a simple report on the base-loading availability of people for each of the SMPs comprising field work for data collection (SMP resourcing report register). • In the event of a spill and the SMP is activated, the base-loading availability of scientific personnel will be provided by SMP standby contractor for the individual SMPs and where gaps in resources are identified, SMP standby contractor/Woodside will seek additional personnel (if needed) from other sources including Woodside's Environmental Services Panel.	15.1	Woodside maintains the capability to mobilise personnel required to conduct scientific monitoring programs SM01 – SM10 (except desktop based SM08): • Personnel are sourced through the existing standby contract with SMP standby contractor, as detailed within the SMP Implementation Plan. • Scientific Monitoring Program Implementation Plan describes the process for standing up and implementing the scientific monitoring programs. SMP team stand up personnel receive training regarding the	• OSPU Internal Control Environment tracks the quarterly review of the Oil Spill Contracts Master. • SMP resource report of personnel availability provided by SMP contractor on monthly basis (SMP resourcing report register. • Training materials. • Training attendance registers. • Competency criteria for SMP roles. SMP annual arrangement testing and reporting.

			stand up, activation and implementation of the SMP on an annual basis.	
16	• Roles and responsibilities for SMP implementation are captured in Table C-1 (ANNEX C) and the SMP team (as per the organisational structure of the ICC) is outlined in SMP Operational Plan. Woodside has a defined Crisis and Incident Management structure including Source Control, Operations, Planning and Logistics functions to manage a loss of well control response. • SMP Team structure, interface with SMP standby contractor and linkage to the ICC is presented in Figure C-1, ANNEX C. • Woodside has a defined Command, Control and Coordination structure for Incident and Emergency Management that is based on the AIIMS framework utilised in Australia. • Woodside utilises an online Incident Management Information System (IMIS) to coordinate and track key incident management functions. This includes specialist modelling programs, geographic information systems (GIS), as well as communication flows within the Command, Control and Coordination structure. • SMP activated via the FSRP. • Step by step process to activation of individual SMPs provided in the SMP Operational Plan. • All decisions made regarding SMP logged in the online IMIS (SMP team members trained in using Woodside's online Incident Management System). • SMP component input to the ICC IAP as per the identified ICC timed sessions and the SMP IAP logged on the online IMIS. • Woodside Environmental Science Team provide awareness training on the activation and stand-up of the Scientific Monitoring Programme (SMP) for the Environment Advisers in Woodside who are listed on the SMP team on an annual basis. • Woodside Environmental Science Team provide awareness training on the activation and stand-up of the Scientific Monitoring Programme (SMP) for the SMP Standby provider. • Woodside Environmental Science Team co-ordinates an annual SMP arrangement testing exercise which the Standby SMP contractor SMP team participates in since 2016 (report on 2016 SMP simulation: and Standby SMP	16.1	• Woodside have established an SMP organisational structure and processes to stand up and deliver the SMP.	• SMP Oil Spill Scientific Monitoring Operational Plan. • SMP Implementation Plan. • SMP annual arrangement testing and reporting.

	contractor SMP arrangements (people and equipment availability) tested annually since 2016.			
17	• Chartered and mutual aid vessels. • Suitable vessels would be secured from the Woodside support vessels, regional fleet of vessels operated by Woodside and other operators and the regional charter market. • Vessel suitability will be guided by the need to be equipped to operate grab samplers, drop camera systems and water sampling equipment (the individual vessel requirements are outlined in the relevant SMP methodologies (refer to Table C-2, ANNEX C). • Nearshore mainland waters could use the same approach as for open water. Smaller vessels may be used where available and appropriate. Suitable vehicles and machinery for onshore access to nearshore SMP locations would be provided by Woodside's transport services contract and sourced from the wider market. • Dedicated survey equipment requirements for scientific monitoring range from remote towed video and drop camera systems to capture seabed images of benthic communities to intertidal/onshore surveying tools such as quadrats, theodolites and spades/trowels, cameras and binoculars (specific survey equipment requirements are outlined in the relevant SMP methodologies (refer to Table C-2, ANNEX C)). Equipment would be sourced through the existing SMP standby contract with Standby SMP contractor for SMP resources and if additional surge capacity is required this would be available through the other Woodside Environmental Services Panel Contractors and specialist contractors. Standby SMP contractor can also address equipment redundancy through either individual or multiple suppliers. MoUs are in place with marine sampling equipment suppliers and analytical laboratories (SMP resourcing report register). • Availability of SMP equipment for offshore/onshore scientific monitoring team mobilisation is within one week to ten days of the commencement of a hydrocarbon release. This meets the SMP mobilisation lead time that will support meeting the response objective of 'acquire, where practicable, the environmental baseline data prior to	17.1	Woodside maintains standby SMP capability to mobilise equipment required to conduct scientific monitoring programs SM01 – SM10 (except desktop based SM08): • Equipment are sourced through the existing standby contract with Standby SMP standby contractor, as detailed within the SMP Implementation Plan.	• OSPU Internal Control Environment tracks the quarterly review of the Oil Spill Contracts Master. • SMP standby monthly resource reports of equipment availability provided by SMP contractor (SMP resourcing report register). • SMP annual arrangement testing and reporting.

	hydrocarbon contact required to support the post-response SMP.			
18	Woodside's SMP approach addresses the pre-PAP acquisition of baseline data for PBAs with ≤10 days if required following a baseline gap analysis process. Woodside maintains knowledge of Environmental Baseline data through: • Documentation annual reviews of the Woodside Baseline Environmental Studies Database, and specific activity baseline gap analyses. • Industry-Government Environmental Meta-database (IGEM) Baseline Studies Database: http://www.igem.com.au/landing/ (Note – the IGEM password is documented in the SMP Operational Plan).	18.1	• Annual reviews of environmental baseline data. • PAP specific Pre-emptive Baseline Area baseline gap analysis.	• Annual review/update of Woodside Baseline Environmental Studies Database. • Desktop review to assess the environmental baseline study gaps completed prior to EP submission. • Accessing baseline knowledge via the SMP annual arrangement testing.

Environmental Performance Outcome		SMP plan to acquire response phase monitoring targeting pre-emptive data achieved.		
Control measure		**Performance Standard**		**Measurement Criteria**
19	Woodside's SMP approach addresses: • Scientific data acquisition for PBAs >10 days to hydrocarbon contact and activated in the response phase and • Transition into post-response SMP monitoring.	19.1	**<u>PBA baseline data acquisition in the response phase</u>** If baseline data gaps are identified for PBAs that has predicted hydrocarbon contact (contact time >10 days), there will be a response phase effort to collect baseline data with priority in implementing SMPs given to receptors where pre-emptive baseline data can be acquired or improved. SMP team (within the Environment Unit of the ICC) contribute SMP component of the ICC Planning Function in development of the IAP.	• Response SMP plan. • Woodside's online Incident Management System Records. • SMP component of the Incident Action Plan.
		19.2	**<u>Post Spill contact</u>** For the receptors contacted by the spill in where baseline data are available, SMPs programs to assess and monitor receptor	• SMP planning document. • SMP Decision Log. • IAPs.

			condition will be implemented post spill (i.e. after the response phase):	
Environmental Performance Outcome		Implementation of the SMP (response and post-response phases).		
Control measure		**Performance Standard**		**Measurement Criteria**
20	• Scientific monitoring will address quantitative assessment of environmental impacts of a level two or three spill or any release event with the potential to contact sensitive environmental receptors. The SMP comprises ten targeted environmental monitoring programs. • SMP supporting documentation: (1) Oil Spill Scientific Monitoring Operational Plan; (2) SMP Implementation Plan and (3) SMP Process and Methodologies Guideline. • The Oil Spill Scientific Monitoring Operational Plan details the process of SMP selection, input to the IAP to trigger operational logistic support services. Methodology documents for each of the ten SMPs are accessible detailing equipment, data collection techniques and the specifications required for the survey platform support. • The SMP standby contractor holds a Woodside SMP implementation plan detailing activation processes, linkage with the Woodside SMP team and the general principles for the planning and mobilisation of SMPs to deliver the individual SMPs activated. Monthly resourcing report are issued by the SMP standby contractor (SMP resourcing report register). All SMP documents and their status are tracked via SMP document register.	20.1	**Implementation of SM01** SM01 will be implemented to assess the presence, quantity and character of hydrocarbons in marine waters during the spill event in nearshore areas.	Evidence SM01 has been triggered: • Documentation as per requirements of the SMP Operational Plan. • Woodside's online Incident Management System Records. • SMP component of the IAP. • SMP data records from field.
		20.2	**Implementation of SM02-SM10** SM02-SM10 will be implemented in accordance with the objectives and activation triggers as per Table C-2 of ANNEX C.	Evidence SMPs have been triggered: • Documentation as per requirements of the SMP Operational Plan. • Woodside's online Incident Management System Records. • SMP component of the IAP. • SMP Data records from field.
		20.3	**Termination of SMP plans** The Scientific Monitoring Program will be terminated in accordance with termination triggers for the SMP's detailed in Table C-2 of ANNEX C, and the Termination Criteria Decision-tree for	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for specific receptor types.

			Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C).	

5.8 Incident Management System

The Incident Management System is both a control measure and a measurement criteria. As a control measure the IMS function is to prompt, facilitate and record the completion of three key response planning processes detailed below. As a measurement criteria, the IMS records the evidence of the timeliness of all response actions included in the environmental performance standards and the plans used of the PAP.

As the IMS does not directly remove hydrocarbons spilt into the marine environment there is no direct relationship to the response planning need.

5.8.1 Incident action planning

The ICC will be required to collect and interpret information from the scene of the incident to determine support requirements to the site-based IMT, develop an IAP and assist the IMT with the execution of that plan. The site-based IC may request the ICC to complete notifications internally within Woodside, to stakeholders and government agencies as required. Depending on the type and scale of the incident either the ICC Duty Manager (DM) or IC will be responsible for ensuring the development of the IAP. Incident action planning is an ongoing process that involves continual review to ensure techniques to control the incident are appropriate to the situation at the time.

5.8.2 Operational NEBA process

In the event of a response Woodside will confirm that the response techniques adopted at the time of EP/OPEP acceptance remain appropriate to reduce the consequences of the spill. This process verifies that there is a continuing net environmental benefit associated with continuing the response technique through the operational NEBA process. This process manages the environmental risks and impacts of response techniques during the spill response, an operational NEBA will be undertaken throughout the response, for each operational period.

The operational NEBA will consider the risks and benefits of conducting and response activity. For example, if vessels are required for access to nearshore or onshore areas, anchoring locations will be selected to minimise disturbance to benthic habitats. Vessel cleanliness would be commensurate with the receiving environment. The operational NEBA will consider the risks and benefits of conducting other response techniques.

The operational NEBA process is also used to terminate a response. Using data from operational and scientific monitoring activities the response to a hydrocarbon spill will be terminated in accordance with the termination process outlined in the OPEA. In effect the operational NEBA will determine whether there is net environmental benefit to continue response operations.

5.8.3 Stakeholder engagement process

Woodside will ensure stakeholders are engaged during the spill response in accordance with internal standards. This process requires that Woodside will:

- Undertake all required notifications (including government notifications) for stakeholders in the region (identified in the FSP). This includes notification to mariners to communicate navigational hazards introduced through response equipment and personnel.
- Identify and engage with relevant stakeholders and continually assess and review.

5.8.4 Environmental performance based on need

Table 5-19: Environmental Performance – Incident Management System

Environmental Performance Outcome		To support the effectiveness of all other control measures and monitor/record the performance levels achieved.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.9)**
29	Operational SIMA	29.1	Confirm that the response strategies adopted at the time of acceptance remain appropriate to reduce the consequences of the spill within 24 hours.	1, 3A
		29.2	Record the evidence and justification for any deviation from the planned response activities.	
		29.3	Record the information and data from operational and scientific monitoring activities used to inform the SIMA.	
30	Stakeholder engagement	30.1	Prompt and record all notifications (including government notifications) for stakeholders in the region are made.	
		30.2	In the event of a response, identification of relevant stakeholders will be re-assessed throughout the response period.	
		30.3	Undertake communications in accordance with: 1) Woodside Crisis Management Functional Support Team Guideline – Reputation 2) External Communication Operating Standard External Stakeholder Engagement Operating Standard	
31	Personnel required to support any response	31.1	Action planning is an ongoing process that involves continual review to ensure strategies to control the incident are appropriate to the situation at the time.	1, 3B
		31.2	A duty roster of trained and competent people will be maintained to ensure that minimum manning requirements are met all year round.	3C
		31.3	Immediately activate the IMT with personnel filling one or more of the following roles: • Operations Duty Manager; • D&C Duty Manager; • Operations Coordinator; • Deputy Operations Coordinator; • Planning Coordinator; • Logistics (materials, aviation, marine and support positions); • Management Support; • Health and Safety Advisor; • Environment Duty Manager; • People Coordinator; • Public Information Coordinator; • Intelligence Coordinator; and • Finance Coordinator.	1, 2, 3B, 3C, 4
		31.4	Collect and interpret information from the scene of the incident to determine support requirements to the site-based IMT, develop an IAP and assist with the execution of that plan.	
		31.5	S&EM advisors will be integrated into ICC to monitor performance of all functional roles.	
		31.6	Continually communicate the status of the spill and support Woodside to determine the most appropriate response by delivering on the responsibilities of their role.	
		31.7	Follow the OPEA, Operational Plans, FSPs, support plans and the IAPs developed.	1, 2, 3A, 4
		31.8	Contribute to Woodside's response in accordance with the aims and objectives set by the Duty Manager.	1, 2, 3B, 3C, 4

5.9 Measurement criteria for all response techniques

Woodside ensures compliance with environmental performance outcomes and standards through four primary mechanisms. The performance tables aforementioned identify which of these four mechanisms monitors the readiness and records the effectiveness and performance of the control measures adopted.

1. The Incident Management System

The Incident Management System (IMS) supports the implementation of the Emergency & Crisis Management Procedure. The IMS provides a near real-time, single source of information for monitoring and recording an incident and measuring the performance of those control measures.

The Emergency & Crisis Management Procedure defines the management framework, including roles and responsibilities, to be applied to any size incident (including hydrocarbon spills). The organisational structure required to manage an incident is developed in a modular fashion and is based on the specific requirements of each incident. The structure can be scaled up or down.

The IAP process formally documents and communicated the:

- incident objectives;
- status of assets;
- operational period objectives;
- response techniques (defined during response planning); and
- the effectiveness of response techniques.

The information captured in the IMS (including information from personal logs and assigned tasks/close outs) confirms the response techniques implemented remain appropriate to reduce the consequences of the spill. The system also records all information and data that can be used to support the site-based IMT, development and the execution of the IAP.

2. The Security & Emergency Management Competency Dashboard

The Security & Emergency Management (S&EM) competency dashboard records the number of trained and competent responders that are available across Woodside, and some external providers, to participate in a response.

This number varies dependent on expiry of competency certificates, staff attrition, internal rotations, leave and other absences. As such the Dashboard is designed to identify the minimum manning requirements and to identify sufficient redundancy to cater for the variances listed above.

Figure 5-2 shows the minimum manning numbers for the different hydrocarbon spill response roles and the number of qualified persons against those roles.

Woodside's pool of trained responders is composed of but not limited to personnel from the following organisations:

- Woodside internal
- AMOSC core group
- AMOSC
- OSRL
- Marine Spill Response Corporation (MSRC)
- AMSA
- Woodside contracted workforce

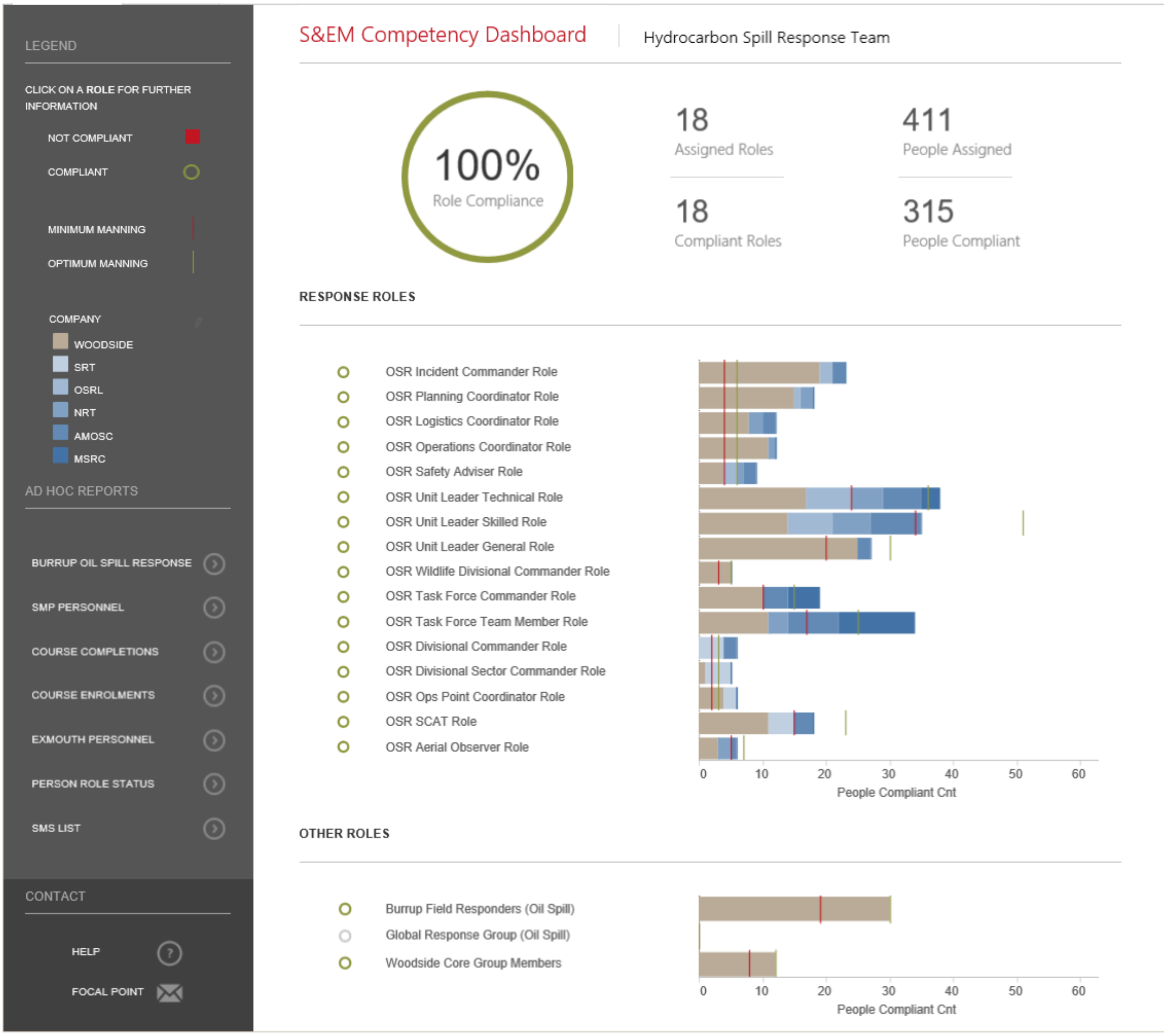
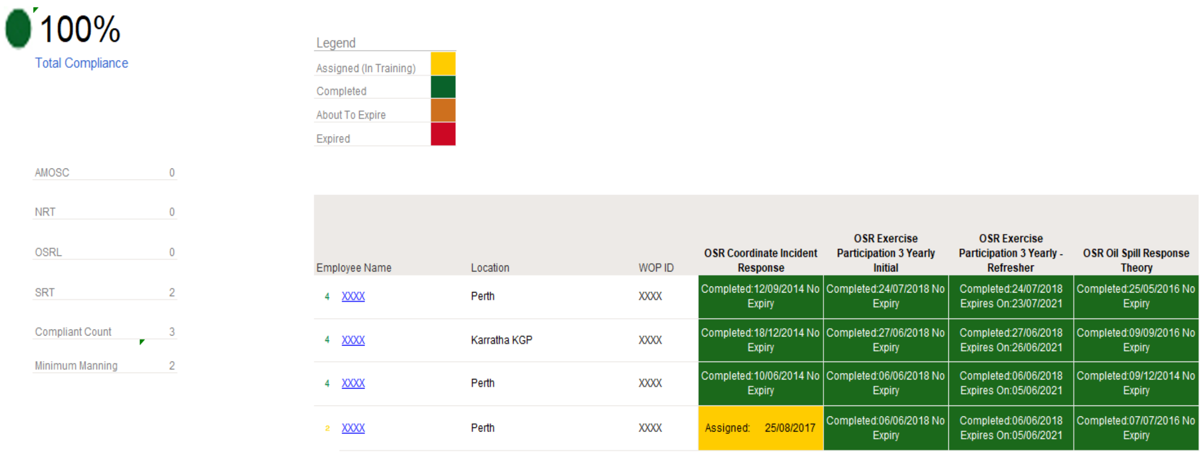


Figure 5-2: Example screen shot of the Hydrocarbon Spill Preparedness competency dashboard

The Dashboard is one of Woodside's key means of monitoring its readiness to respond. It also shows that Woodside can meet the requirements of the environmental performance standard that relate to filling certain response roles.

Figure 5-3 shows deeper dive into the Operations Point Coordinator role and the training modules required to show competence.



	Employee Name	Location	WOP ID	OSR Coordinate Incident Response	OSR Exercise Participation 3 Yearly Initial	OSR Exercise Participation 3 Yearly - Refresher	OSR Oil Spill Response Theory
4	XXXX	Perth	XXXX	Completed:12/09/2014 No Expiry	Completed:24/07/2018 No Expiry	Completed:24/07/2018 Expires On:23/07/2021	Completed:25/05/2016 No Expiry
4	XXXX	Karratha KGP	XXXX	Completed:18/12/2014 No Expiry	Completed:27/06/2018 No Expiry	Completed:27/06/2018 Expires On:26/06/2021	Completed:09/09/2016 No Expiry
4	XXXX	Perth	XXXX	Completed:10/06/2014 No Expiry	Completed:06/06/2018 No Expiry	Completed:06/06/2018 Expires On:05/06/2021	Completed:09/12/2014 No Expiry
2	XXXX	Perth	XXXX	Assigned: 25/08/2017	Completed:06/06/2018 No Expiry	Completed:06/06/2018 Expires On:05/06/2021	Completed:07/07/2016 No Expiry

Figure 5-3: Example screen shot for the Operations Point Coordinator role

3. The Hydrocarbon Spill Preparedness ICE Assurance Process

The Hydrocarbon Spill Response Team has developed a Hydrocarbon Spill Preparedness and Response Internal Control Environment (ICE) process to align and feed into the Woodside Management System Assurance process for hydrocarbon spill. The process tracks compliance over four key control areas:

a) **Plans** – Ensures all plans (including: OPEA, FSPs, operational plans, support plans and TRPs) are current and in line with regulatory and internal requirements.
b) **Competency** – Ensures the competency dashboard is up to date and there are the minimum competency numbers across ICC, CMT and hydrocarbon spill response roles. The hydrocarbon spill training plan and exercise schedule, including testing of arrangements is also tracked. The Testing of Arrangements (TOA) register tracks the testing of all hydrocarbon spill response arrangements, key contracts and agreements in place with internal and external parties to ensure compliance.
c) **Capability** – Tracks and monitors capability that could be required in a hydrocarbon incident, including but not limited to: integrated fleet[7] vessel schedule, dispersant availability, rig/vessels monitoring, equipment stockpiles, tracking buoy locations and the CICC duty roster.
d) **Compliance & Assurance** – Ensures all regulator inspection outcomes are actioned and closed out, the global legislation register is up to date and that the key assurance components are tracked and managed. Assurance activities (including Audits) conducted on memberships with key Oil Spill Response Organisations (OSROs) including AMOSC and OSRL are also tracked and recorded in the ICE.

The ICE assurance process records how each commitment listed in the performance tables above is managed to ensure ongoing compliance monitoring. The level of compliance can be reviewed in real time and is reported on a monthly basis through the S&EM Function.

The completion of the assurance checks (over and above the ICE process) is also applied via the Woodside Integrated Risk & Compliance System (WiRCs) and subject to the requirements of Woodside's Provide Assurance Procedure.

4. The Hydrocarbon Spill Preparedness and Response Procedure

[7] The Integrated fleet consists of vessels from multiple operators that have been contracted to Woodside to undertake a number of duties including hydrocarbon spill response

This procedure sets out how to plan and prepare for a liquid hydrocarbon spill to the marine environment. (Note, this procedure does not apply to scenarios relating to gas releases in the marine environment).

This procedure details the:

- Requirement for an OPEP to be developed, maintained, reviewed, and approved by appropriate regulators (where applicable) including:
  - Defining how spill scenarios are developed on an activity specific basis;
  - Developing and maintaining all hydrocarbon spill related plans;
  - Ensuring the ongoing maintenance of training and competency for personnel;
  - Developing the testing of spill response arrangements; and
  - Maintaining access to identified equipment and personnel.
- Planning for hydrocarbon spill response preparedness
- Accountabilities for hydrocarbon spill response preparedness
- Spill training requirements
- Requirements for spill exercising / testing of spill response arrangements
- Spill equipment and services requirements.

The procedure also details the roles and responsibilities of the dedicated Woodside Hydrocarbon Spill Preparedness team. This team is responsible for:

- Assuring that Woodside hydrocarbon spill responders meet competency requirements.
- Establishing the competency requirements, annual training schedule and a training register of trained personnel.
- Establishing and maintaining the total numbers of trained personnel required to provide an effective response to any hydrocarbon spill incident.
- Ensuring equipment and services contracts are maintained
- Establishing OPEPs
- Establishing OPEAs
- Priority response receptor determination
- ALARP determination
- Ensuring compliance and assurance is undertaken in accordance with external and internal requirements.

6 ALARP EVALUATION

This Section should be read in conjunction with Section 5 which is the capability planned for this activity.

6.1 Monitor and Evaluate – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.1.1 Monitor and Evaluate – Control Measure Options Analysis

6.1.1.1 Alternative Control Measures

Alternative Control Measures considered
Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Aerostat (or similar inflatable observation platform) for localised aerial surveillance.	Lead time to Aerostat surveillance is disproportionate to the environmental benefit. The system also provides a very limited field of visibility around the vessel it is deployed from.	Long lead time to access (>10 days). Each system would require an operator to interpret data and direct vessels accordingly. Requires multiple systems for shoreline use.	Purchase cost per system approx. A$300,000.	This option is not adopted as the minimal environmental benefit gained is disproportionate to the cost and complexity of its implementation.	No

6.1.1.2 Additional Control Measures

Additional Control Measures considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Additional personnel trained to use systems.	Current arrangement provides an environmental benefit in the availability of trained personnel facilitating access to monitoring data used to inform all other response techniques. No improvement required.	No improvement can be made, all personnel in technical roles e.g. intelligence unit are trained and competent on the software systems. Personnel are trained and exercised regularly. Use of the software and systems forms part of regular work assignments and projects.	Cost for training in-house staff would be approx. A$25,000.	This option is not adopted as the current capability meets the need.	No
Additional satellite tracking buoys to enable greater area coverage.	Increased capability does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	Tracking buoy on location at manned facility, additional needs are met from Woodside owned stocks in King Bay Support Base (KBSB) and Exmouth or can be provided by service provider.	Cost for an additional satellite tracking buoy would be A$200 per day or A$6,000 to purchase.	This option is not adopted as the current capability meets the need, but additional units are available if required.	No
Additional trained aerial observers.	Woodside has access to a pool of trained, competent observers at strategic locations to ensure timely and sustainable response. Additional observers are available through current contracts with AMOSC and OSRL.	Aviation standards and guidelines ensure all aircraft crews are competent for their roles. Woodside maintains a pool of trained and competent aerial observers with various home base locations to be called upon at the time of an incident. Regular audits of oil spill response organisations ensure training and competency is maintained.	Cost for additional trained aerial observers would be $2,000 per person per day.	This option is not adopted as the current capability meets the need, but additional observers are available via response contractors if required.	No

6.1.1.3 Improved Control Measures

Additional Control Measures considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Faster turnaround time from modelling contractor.	Improved control measure does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	External contractor on ICC roster to be called as soon as required. However initial information needs to be gathered by ICC team to request an accurate model. External contractor has person on call to respond from their own location.	Modelling service with a faster activation time would be achieved via membership of an alternative modelling service at an annual cost of $50,000 for 24hr access plus an initial $5,000 per modelling run.	This option is not adopted as the minimal environmental benefit gained is disproportionate to the cost and complexity of its implementation.	No

Night time aerial surveillance.	The risk of undertaking the aerial observations at night is disproportionate to the limited environmental benefit. The images would be of low quality and as such the variable is not adopted.	Flights will only occur when deemed safe by the pilot. The risk of night operations is disproportionate to the benefit gained, as images from sensors (IR, UV, etc). will be low quality. Flight time limitations will be adhered to.	No improvement can be made without risk to personnel health and safety and breaching Woodside's Golden Rules.	This option is not adopted as the safety considerations outweigh any environmental benefit gained.	No
Faster mobilisation time (for water quality monitoring).	Due to the restriction on accessing the spill location on Day one there is no environmental benefit in having vessels available from day one. The cost of having dedicated equipment and personnel is disproportionate to the environmental benefit. The availability of vessels and personnel meets the response need. Shortening the timeframes for vessel availability would require dedicated response vessels on standby in KBSB. The cost and organisational complexity of employing two dedicated response vessels (approximately $15M/year per vessel) is considered disproportionate to the potential environmental benefit to be realised by adopting this delivery options.	Operations are not feasible on day 1 as the hydrocarbon will take time to surface, and volatility has potential to cause health concerns within the first 24 hours of the response.	Cost for purchase of equipment approx. $200,000. Ongoing costs per annum for cost of hire and pre-positioning for life of asset/activity would be larger than the purchase cost. Dedicated equipment and personnel, living locally and on short notice to mobilise. The cost would be approx. $1M per annum, which is disproportionate to the incremental benefit this would provide, assets are already available on day 1. 2 integrated fleet vessels are available from day 1, however these could be tasked with other operations.	This option is not adopted as the area could not be accessed earlier due to safety considerations. Additionally, the cost and complexity of implementation outweighs the benefits.	No

6.1.2 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.2 Source Control – ALARP Assessment

Woodside has based its response planning on the worst-case credible scenario (as described in Section 2.2). This includes the following selection of primary source control and well intervention techniques which would be conducted concurrently;

- ROV intervention
- debris clearance and/or removal
- capping stack (only viable for a loss of well containment of a lower magnitude than the worst case credible scenario where the plume radius is ~25 m)
- relief well drilling.

6.2.1 ROV Intervention

Following confirmation of an emergency event, Woodside would mobilise inspection class ROVs in an attempt to manually activate the BOP either through hydraulic pressure supplied from the ROV or through a subsea accumulator. The ROV available on the MODU can be deployed within 48 hours. Should the ROV on the MODU be unavailable, work class ROVs for well intervention are also available through the existing frame agreements and are available for deployment within seven days (Table 6-1). Following this, a hydraulic accumulator contained as part of the SFRT can be mobilised and deployed with well intervention attempted within 11 days.

As Woodside holds Frame Agreements for vessels along with contracts for ROV providers and pilots, inspection activities using ROVs are expected to commence within seven days.

Table 6-1: ROV timings

	Estimate ROV inspection duration for WA-49-L Gemtree Exploration Drilling (days)
Source and mobilise vessel with work class ROV	2 days
Liaise with Regulator regarding risks and impacts*	4 days
Undertake ROV Inspection	1 day
TOTAL	**7 days***

** Based on timings from the Report into the Montara Commission of Enquiry, submission and discussion of revised documentation for limited activities inside the Petroleum Safety Zone (water deluge operations) to manage personnel risks and impacts was up to 20 days.*

6.2.1.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1161), confirming that vessels conducting subsea intervention operations are not classified as an “associated offshore place” but as a facility and therefore require the appropriate Safety Case arrangements to be in place. In the event of an emergency, Woodside has access to suitable vessels (ISVs) for well intervention through existing frame agreements. The frame agreements for ISV vessels require the vessels to maintain in-force safety case approval covering a range of subsea activities. This would cover the requirement for intervention operations such as subsea manifold installation, maintenance and repair, commissioning, cargo transfer (including bulk liquids) and ROV operations. With frame agreements in place, the credible Safety Case Scenario from those presented in Figure 6-3 for implementing this response would be “no safety case revision required”. Timeframes for well intervention are detailed in Figure 6-2 and would be implemented concurrently to the actions required by the “no Safety Case” revision scenario detailed in Figure 6-3, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.2.2 Debris clearance and/or removal

The Woodside Source Control Response Procedure details the mobilisation and resource requirements for implementing this strategy. Debris clearance may be required as a prerequisite to deployment of the capping stack. The AMOSC SFRT would be mobilised from Fremantle. The mobilisation of the SFRT would take place in parallel with mobilisation of the capping stack to ensure initial ROV surveys and debris clearance have commenced before the arrival of the capping stack. The SFRT comprises ROV-deployed cutters and tools that are used to remove damaged or redundant items from the wellhead and allow improved access to the well. The SFRT can be mobilised and deployed with well intervention attempted within 11 days.

6.2.2.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1161) and can confirm that vessels conducting debris clearance and removal operations are not classified as an “associated offshore place” but as a facility and therefore require the appropriate Safety Case arrangements in place. In the event of an emergency, Woodside has access to suitable ISVs for these operations through existing frame agreements. The frame agreements for ISVs require the vessels to maintain in-force safety case approval covering a range of subsea activities. This would cover the requirement for debris clearance and removal operations such as subsea manifold installation, commissioning, cargo transfer (including bulk liquids) and ROV operations. With frame agreements in place, the credible Safety Case Scenario, from those presented in Figure 6-3 for implementing this response would be “no safety case revision required”. Timeframes for debris clearance and removal equipment deployment are detailed in Figure 6-2 and would be implemented concurrently to the actions required by the “No Safety Case” revision scenario detailed in Figure 6-3, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.2.3 Capping stack

The Woodside Source Control Response Procedure details the mobilisation and resource requirements for implementing this strategy. A capping stack is designed to be installed on a subsea well and provides a temporary means of sealing the well, until a permanent well kill can be performed through either a relief well or well re-entry.

Woodside commissioned an independent, subsea site-specific plume analysis, landing study and capping stack deployment feasibility assessment for the Julimar Phase 2 Drilling & Subsea Installation project (WWC, 2019) and a gap analysis of the study was then completed for this PAP due to the close proximity and similarities of the projects. The study indicates that shallow water in combination with high absolute open hole flow rates in the event of a worst-case blowout prohibit the safe deployment of a capping stack for the WA-49-L Gemtree Exploration Drilling project.

It is expected that the extent of the gas cloud will be independent of any SSDI treatment due to the high gas-to-oil ratio of the expected flow stream (INPEX, 2019). As such, the exclusion zone will be governed by the gas boil at the sea surface and resulting gas plume.

Various alternative options for safe and effective deployment of a capping stack in these conditions (plume of 90 m radius) were assessed but due to their complex nature or inability to implement under those conditions, these have been deemed as not ALARP (see Section 6.2.7).

Though all capping stack deployment technologies are unproven for high rate gas wells, in the event of a loss of well containment at less than the WCCS (plume radius is ~25 m), the use of a subsea deployment method such as a heavy lift vessel, which is more commonly used in industry, is a more reliable and, in turn, ALARP approach. If environmental conditions permit (wind speed, wave height, current and plume radius is ~25 m), deployment of a capping stack with a heavy lift vessel with a 120 T crane capacity, as recommended in the WWC study, could be feasible.

Woodside assumes that sourcing conventional capping stack deployment vessels would be per the Source Control Response Procedure. This plan has pre-identified vessel specifications for the capping stack deployment and Woodside monitors the availability and location of these vessels on a monthly basis. Woodside maintain several frame agreements with various vessel service providers and maintains the ability to call off services with a capping stack and debris clearance agreement. The location of suitable vessels for capping stack deployment are monitored monthly. The supply arrangements and reliability to achieve the required mobilisation time will be revalidated prior to spud.

Consideration to mobilise the capping stack from the supplier on a suitable vessel but then hand over to another vessel to conduct the capping activity will also be made to meet response time frames.

A capping stack will be mobilised to site within 16 days. Woodside will monitor the conditions around the wellsite and deployment for well intervention attempt will be undertaken once plume size is acceptable (~25 m radius) and safety and metocean conditions are suitable.

6.2.3.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1161) and can confirm that vessels conducting capping stack are not classified as an “associated offshore place” but as a facility and therefore require the appropriate Safety Case arrangements in place.

The 16-day timeframe to mobilise the vessel is based on the following assumptions:

- Existing frame agreement vessel, located outside the region with approved Australian Safety Case.
- A safety case revision and scope of validation is required.
- Vessel has an active heave compensated crane, rated to at least 120 T and at least 90 m in length and a deck capacity to hold at least 110T of capping stack.

Timeframes for capping stack deployment detailed in Figure 6-2 would be implemented concurrently with the actions required for the Safety Case revision development scenarios detailed in Figure 6-3 and Table 6-3. To reduce uncertainty in regulatory approval timeframe, Woodside is collaborating with The Drilling Industry Steering Committee (DISC) and a contracted ISV Vessel Operator to develop a generic Safety Case Revision that contemplates a capping stack deployment. This Safety Case Revision will be used to reduce uncertainty in permissioning timeframes in the event a capping stack deployment is required. Woodside will execute the capping stack response in the fastest possible timeframe, provided the required safety and metocean conditions allow. Woodside has considered a broad range of alternate, additional, and improved options as outlined later in Section 6.2.5.

6.2.4 Relief Well drilling

The options analysis detailed in this section considers options to source, contract and mobilise a MODU and ensure necessary regulatory approvals are in place to meet timelines for relief well drilling. The screening for relief well drilling MODUs is based on the following and the process used for Gemtree is illustrated in Figure 6-1:

- Primary – review internal Woodside drilling programs and MODU availability to source an appropriate rig operating within Australia with an approved Safety Case.
- Alternate – source and contract a MODU through APPEA MOU that is operating within Australia with an approved Safety Case.
- Contingency – if required, source and contract a MODU outside Australia with an approved Australian Safety Case. This option is not required for Gemtree due to the high certainty of rig availability.

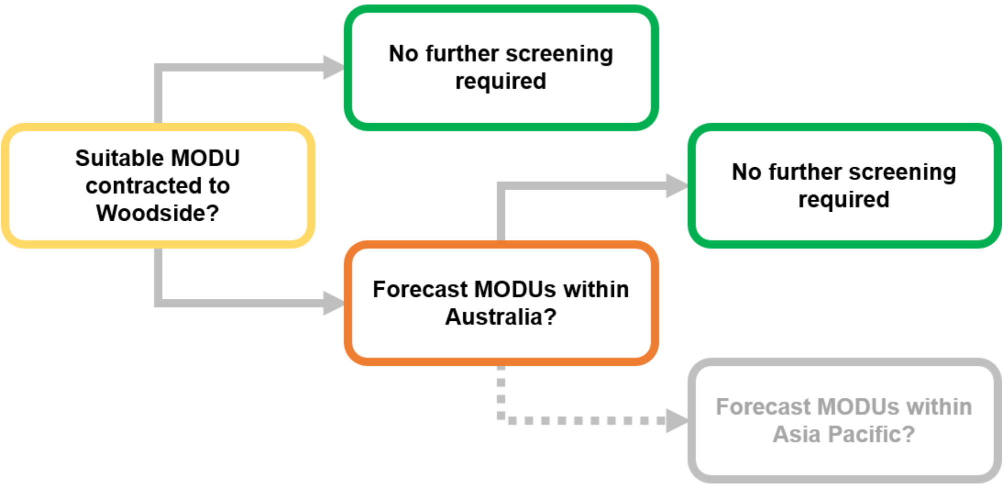


Figure 6-1: Gemtree process for sourcing relief well MODU

Woodside has not assessed the timeframe for obtaining a relief well MODU through international supply for this project as the certainty of supply has been confirmed through local supply. Screening of a relief well MODU from international waters is undertaken only if required, i.e. there is low confidence in local (Australian) availability. The screening of relief well MODUs is undertaken and presented at a well design stage peer assessment. The capability, location and Australian Safety Case status is assessed for each Woodside contracted MODU. In the event the Woodside contracted MODUs are unsuitable, screening is extended to all MODUs operating in Australian Waters. The suitability and location of pre-identified relief well MODUs is tested again prior to the operation. Though the APPEA MoU will serve as the instrument to facilitate the transfer of drilling units and well site services between operators in the event of an emergency, Woodside will engage each of the identified titleholders in advance to maintain confidence in MODU suitability and availability.

Based on the detail provided, the Primary and Alternate approaches are expected to be achieved within the 61-day period.

The detail of these arrangements demonstrates that the risks have been reduced to ALARP and Acceptable levels through the control measures and performance standards outlined in Section 5.2.

6.2.4.1 Relief Well drilling timings

The duration of a blowout (from initiation to a successful kill) is assessed as 61 days for the WA-49-L Gemtree Exploration Drilling project. Relief wells for other wells within the field are expected to be similar duration.

Details on the steps and time required to drill a relief well is shown in Table 6-2 below. Dynamically positioned with mooring system and moored MODUs are suitable for the Gemtree PAP, however, moored MODUs are more readily available thus they have been used as the basis for the analysis within this document.

On a monthly basis, Woodside tracks and assesses the suitability of available MODUs internally and externally, plus MODU activities of registered operators and MODUs with approved safety cases. MODUs expected to be stationed in Australia for the duration of the project are identified as part of the Relief Well Peer review conducted during the planning phase and immediately prior to spud.

The ability to meet MODU mobilisation of 21 days is screened based on where the pre-identified MODUs will be stationed. For this project, suitable MODUs based in Australia have been identified by Woodside and thus there is a high level of confidence that the stated 21-day timeframe can be met.

To validate the effectiveness of the relief MODU supply arrangements through the APPEA MoU, the 21-day mobilisation period was tested in April 2019 in an exercise facilitated by an external party. This exercise included suspension of the assisting operator's activities, contracting the MODU, vessel safety case revision and transit to location. The testing of mobilisation arrangements has been incorporated into Woodside's Hydrocarbon Spill Arrangements Testing Schedule.

Table 6-2: Relief well drilling timings

	Estimate Relief Well duration for the WA-49-L Gemtree Exploration Drilling project (days)
Source and contract MODU comprising the following stages:	**21 days total:**
Activate MOU.	*8 days*
Secure and suspend well.	
Complete relief well design.	
Secure relief well materials.	
Transit to location based on mobilisation from Northwest shelf region.	*2 days*
Backload and loadout bulks and equipment.	*2 days*
Complete internal assurance of relief well design.	
Contingency for unforeseen event e.g. longer transit from another area of Australia, problems in securing well, cyclone event.	*9 days*
Pre-spud survey	**Already included – concurrent with MODU mobilisation above**
Mooring Spread Installation *NB Occurs in parallel with the 21 days to mobilise the rig, so the timing included here is the difference.*	**3 days**
Drilling, casing and test BOP estimate	**23 days**
Intersection & well kill comprising the following stages:	**14 days total:**
Drill out shoe, conduct formation integrity test and drill towards intersection point.	*1.5 days*
Execute well-specific ranging plan to intersect blowout wellbore in minimum timeframe, with highest possible accuracy.	*9.5 days*
Pump kill weight drilling fluid per the relief well plan. Confirm the well is static with no further flow.	*0.5 days*
Contingency for unforeseen technical issues (e.g.: more ranging runs required to make intersect, additional mud circulations required to execute kill).	*2.5 days*
	61 days

The following conditions and assumptions are applicable:

- The 21-day mobilisation time assumes a local MODU is available in Australia with another titleholder.
- Woodside has considered a broad range of alternate, additional, and improved options as outlined in Section 6.2.5.
- Intersect and kill duration is estimated at 14 days. This is a moderately conservative estimate. During the intersect process, the relief well will be incrementally drilled and logged to accurately approach and locate the existing well bore. This will result in the highest probability of intersecting the well on the first attempt and thus will reduce the overall time to kill the well. During the Montara incident, it took five attempts to achieve a successful intersect.

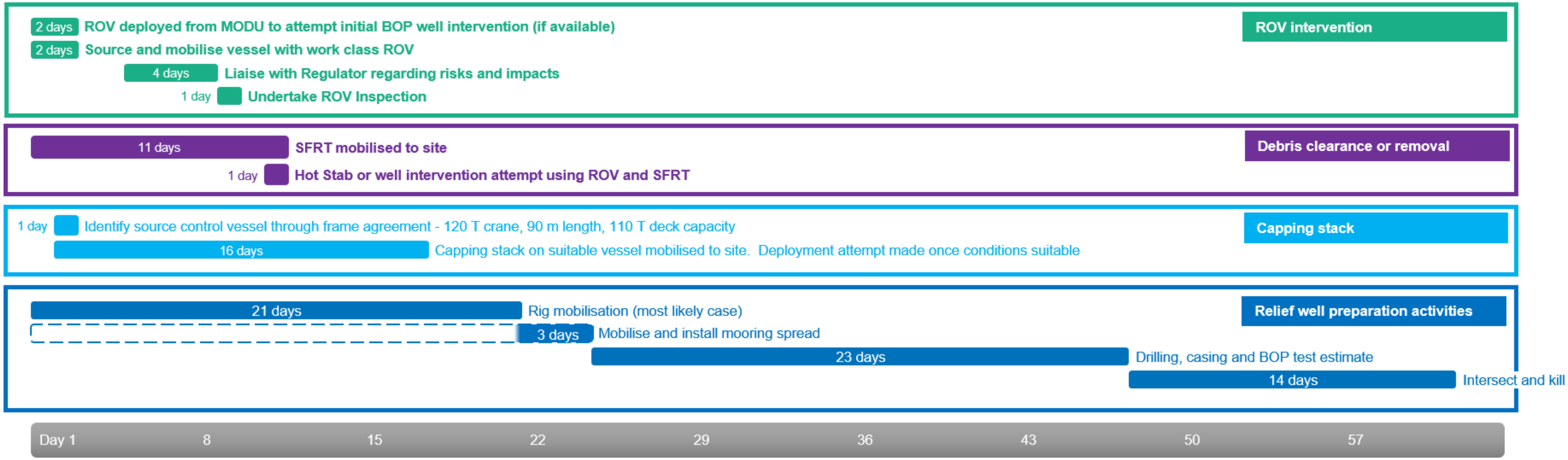


Figure 6-2: Source control and well intervention response strategy deployment timeframes

6.2.4.2 Safety Case considerations

Woodside recognises that it will not be the Operator or holder of the Safety Case for the MODU and/or vessels involved in relief well activities. In the event that a revision to the Operator's Safety Case is required for relief well drilling, Woodside has identified measures to ensure timely response and optimise preparedness as far as practicable that can be undertaken to expedite a straightforward Safety Case revision for a MODU/ vessel to commence drilling a relief well. Performance standards associated with these measures have been included in Section 5.2.

These include;

- Access to Safety and Risk discipline personnel with specialist knowledge.
- Monitoring internal and external rigs and vessel availability in region and extended area through contracted arrangements on a monthly basis.
- Prioritisation of rigs/vessels with current or historical contracting arrangements. Woodside maintains records of previous contracting arrangements and companies. All current contracts for vessels and rigs are required to support Woodside in the event of an emergency.
- Leverage mutual aid arrangements such as the APPEA MOU for vessel and rig support.
- Woodside Planning and Logistics, and Safety Officers (on-Roster/Call 24/7) which can articulate need for, and deliver Woodside support, in key delivery tasks including sitting with potential outside operators.
- Ongoing strategic industry engagement and collaboration with NOPSEMA to work toward time reductions in regulatory approvals for emergency events.

Woodside has identified three safety case revision development and submission scenarios for a MODU and plotted these alongside the relief well preparation activities in Figure 6-3. The assumptions for each of the cases are detailed in subsequent Table 6-3.

The MODUs screened for contingency relief well drilling all operate under an Accepted base Safety Case. A relief well Safety Case Revision would leverage the previously accepted Safety Case Revision for the WA-49-L Gemtree Exploration Drilling, including the associated site-specific well hazards. As such, there is less new detail for the regulator to review and should present a short review timeframe with no impact expected to the commencement of relief well drilling activities.

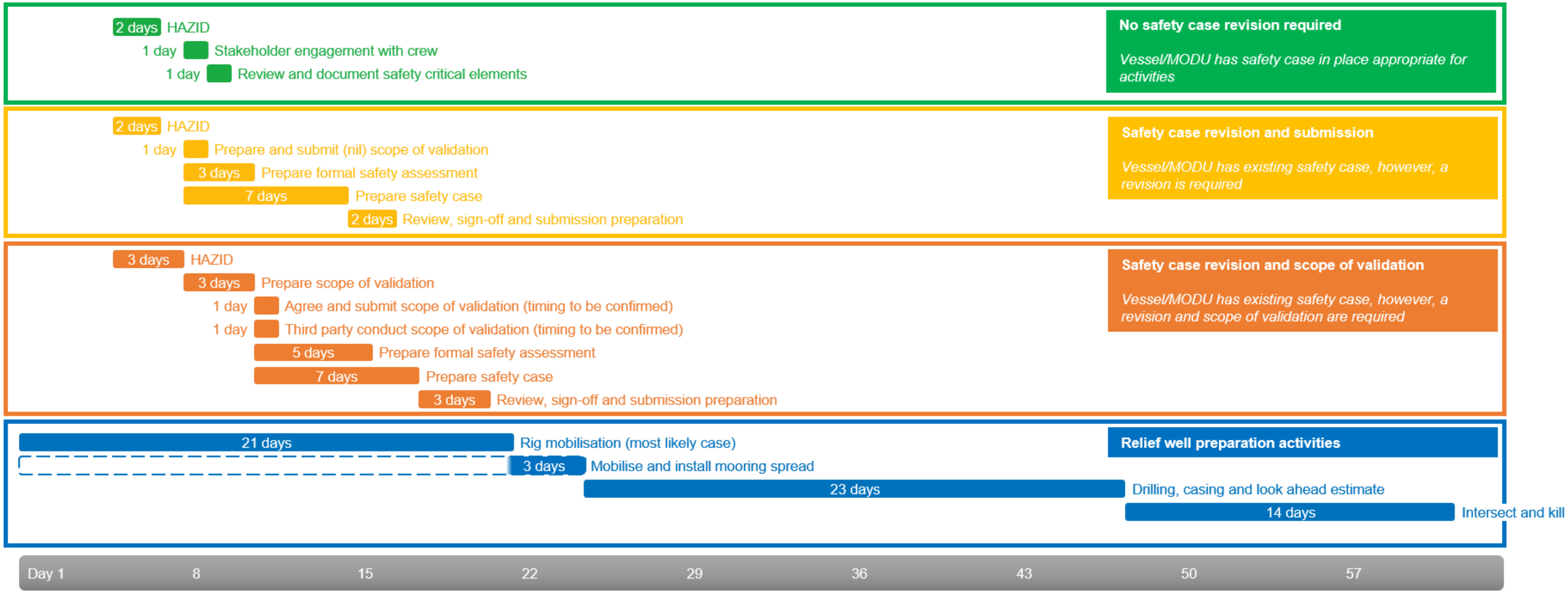


Figure 6-3: Timeline showing safety case revision timings alongside other relief well preparation activity timings

Table 6-3: Safety case revision conditions and assumptions

Case	No safety case revision required	Safety case revision and submission	Safety case revision and scope of validation
Description	Vessel/MODU has a safety case in place appropriate for activities.	Vessel/MODU has an existing safety case, however, a revision is required.	Vessel/MODU has an existing safety case, however, a revision is required plus scope of validation.
Conditions/ assumptions	• Assumes that existing vessel/MODU safety case covers working under the same conditions or the loss of containment is not severe enough to result in any risk on the sea surface.	• Safety case timing assumes vessel/MODU selected and crew and available for workshops and safety case studies.	• Safety case timing assumes vessel/ MODU selected and crew and available for workshops and safety case studies.
		• Assumes nil scope of validation. This assumes that the vessel for SSDI allows for working in a hydrocarbon environment and control measures are already in place in the existing safety case. For MODU, it assumes that the relief well equipment is already part of the MODU facility and MODU safety case.	• Validation will be required for new facilities only. The time needed for the validator to complete the review (from the last document received) and prepare validation statement is undetermined. This is not accounted for here as the safety case submission is not dependent on the validation statement, however the safety case acceptance is.
		• Assumes safety case preparation is undertaken 24/7.	• Assumes safety case preparation is undertaken 24/7.

6.2.5 Source Control – Control Measure Options Analysis

The assessments described in Sections 6.2.1, 6.2.2, 6.2.3 and 6.2.4 outline the primary and alternate approaches that Woodside would implement for source control. Woodside has outlined the options considered against the activation/mobilisation (alternative, additional and improved options), deployment additional and improved options) process described in Section 2.1.1 that provides an evaluation of:

- predicted cost associated with adopting the option
- predicted change/environmental benefit
- predicted effectiveness/feasibility of the option.

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical.

- Alternative options, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control.
- Additional control measures are evaluated in terms of their ability to reduce an impact or risk when added to the existing suite of control measures.
- Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility.

Options where there is not a clear justification for their inclusion or exclusion may be subject to a detailed assessment.

6.2.5.1 Activation/Mobilisation Options considered

Alternative

- Standby MODU shared for all Woodside activities
- Standby MODU shared across APPEA MOU Titleholders

Additional

- Implement and maintain minimum standards for Safety Case development

Improved

- Monitor internal drilling programs for rig availability
- Monitor external activity for rig availability
- Monitor status of Registered Operators/ Approved Safety cases for rigs

6.2.5.2 Deployment Options considered

Additional

- Offset capping alternative to conventional capping stack deployment
- Dual vessel capping stack deployment
- Subsea containment system alternative to capping stack deployment
- Pre-drilling top-holes
- Purchase and maintain mooring system
- Contract in place with WWCI and Oceaneering

Improved

- Maintaining relief well drilling supplies (mud, casing, etc).

6.2.6 Activation/Mobilisation – Control Measure Options Analysis

This section details the assessment of alternative, additional or improved control measures that were considered to ensure the selected level of performance in Section 5.2 reduces the risk to ALARP. The Alternative, Additional and Improved control measures that have been assessed and selected are highlighted in green and the relevant performance of the selected control is cross referenced. Items highlighted in red have been considered and rejected on the basis that they are not feasible or the costs are clearly grossly disproportionate compared to the environmental benefit.

6.2.6.1 Alternative control measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Feasibility**	**Environmental benefits/impacts**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Standby MODU shared for all Woodside activities	A standby MODU shared across all Woodside activities is likely to provide a moderate environmental benefit as it may reduce the 21-day sourcing, contracting and mobilisation time by up to 10 days (to 11 days). This would reduce the volume and duration of release and may reduce impacts on receptors and sensitivities.	This option is not considered feasible for all Woodside activities as there are a large range of well depths, complexities, geologies and geophysical properties across all Woodside's operations. The large geographic area of Woodside activities also means that the MODU is unlikely to be in the correct location at the right time when required.	Even with costs shared across Woodside operations, the costs (approximately A$219 m per annum, A$1.95 b over the five years) of maintaining a shared MODU are considered disproportionate to the environmental benefit potentially achieved by reducing mobilisation times by up to 10 days.	The costs and complexity of having a MODU and maintaining this arrangement for the duration of the Petroleum Activities Program are disproportionate to the environmental benefit gained above finding a MODU through the MOU agreement for all spill scenarios.	No
Standby MODU shared across APPEA MOU Titleholders	A standby MODU shared across all titleholders who are signatories to the APPEA MOU is likely to provide a minor environmental benefit as it may reduce the 21-day sourcing, contracting and mobilisation time by up to seven days (to 14 days). This would reduce the volume and duration of release and may reduce impacts on receptors and sensitivities.	This option is not considered feasible for a number of Titleholders due to the remote distances in Australia as well as a substantial range of well depths, types, complexities, geologies and geophysical properties across a range of Titleholders	As the environmental benefit is only considered minor and the reduction in timing would only be for the mobilisation period (reduction from 21 days to 14 days) the costs are considered disproportionate to the minor benefit gained.	The costs and complexity of having a MODU and maintaining a shared arrangement for the duration of the Petroleum Activities Program are disproportionate to the environmental benefit gained above finding a MODU through the MOU agreement for all spill scenarios.	No

6.2.6.2 Additional control measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Feasibility**	**Environmental benefits/impacts**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Implement and maintain minimum standards for Safety Case development	Woodside's contingency planning consideration would be to source a rig from outside Australia with an existing Safety Case. This would require development and approval of a safety case revision for the rig and activities prior to commencing well kill operations.	This option is considered feasible and would require Woodside to develop minimum standards for safe operations for relevant Safety Case input along with maintaining key resources to support review of Safety Cases. Woodside would not be the operator for relief well drilling and would therefore not develop or submit the Safety Case revision. Woodside's role as Titleholder would be to provide minimum standard for safe operations that MODU operators would be required to meet and/or exceed.	Woodside has outlined control measures and performance standards regarding template Safety Case documentation and maintenance of resources and capability for expedited Safety Case review.	This option has been selected based on its feasibility, low cost and the potential environmental benefits it would provide.	Yes

6.2.6.3 Improved control measures

Improved control measures Considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Feasibility**	**Environmental benefits/impacts**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Monitor internal drilling programs for MODU availability	Woodside may be conducting other campaigns that overlap with the Petroleum Activities Program, potentially providing availability of a relief well drilling rig within Woodside. The environmental benefit of monitoring other drilling programs internally is for Woodside to understand what other rigs may be rapidly available for relief well operations if required, potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	Woodside monitors vessel and MODU availability through market intelligence services for location. Woodside will continually monitor other drilling and exploration activities within Australia and as available throughout the region to track rigs and explore rig availability during well intervention operations.	Associated cost of implementation is minimal to the environmental benefit gained. Woodside has outlined control measures and performance standards.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes
Monitor external activity for MODU availability	The environmental benefit achieved by monitoring drilling programs and rig movements across industry provides the potential for increased availability of suitable rigs for relief well drilling. Additional discussions with other Petroleum Titleholders may be undertaken to potentially gain faster access to a rig and reduce the time taken to kill the well and therefore volume of hydrocarbons released.	Woodside will source a relief well drilling rig in accordance with the APPEA MOU on rig sharing in the unlikely event this is required. Commercial and operational provisions do not allow Woodside to discuss current and potential drilling programs in detail with other Petroleum Titleholders.	Associated cost of implementation is moderate to the environmental benefit gained. Woodside will continually engage with other Titleholders and Operators regarding activities within Australia and as available throughout the region to track rigs and explore rig availability during well intervention operations.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes
Monitor status of Registered Operators / Approved Safety cases for MODUs	Woodside can monitor the status of Registered Operators for rigs operating within Australia (and therefore safety case status) on a monthly basis. This allows for a prioritised selection of rigs in the event of a response with priority given to those with an existing safety case.	The environmental benefit of monitoring rigs is for Woodside to understand what other rigs may be rapidly available for relief well operations if required, potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The cost is minimal.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes

6.2.7 Deployment – Control Measure Options Analysis

6.2.7.1 Additional Control Measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Offset capping alternative to conventional capping stack deployment	While the use of an offset capping system could reduce the quantity of hydrocarbon entering the marine environment, the feasibility issues surrounding an offset capping deployment in the water depths at the Gemtree well (201 m), together with mobilisation lead times for both a cap and required vessels/ support equipment, would minimise any environmental benefit gained.	Technical feasibility: • The base case considerations for OIE requires a coordinated response by 4 to 7 vessels working simultaneously outside of the 500m exclusion zone. In the event of a worst-case shallow water gas discharge, the 10% LEL modelled radius extends beyond the area of activity required for the OIE deployment thereby introducing health and safety risk to any vessels required for the initial deployment of the carrier and subsequent operations with ROV during capping operations. Though manageable for single vessels, it is prohibitive for operations requiring SIMOPs with numerous vessels working at 180 degrees from one another. • Water depth is also a key consideration as buoyancy modules have not been proven for use in these depths or with the expected worst-case gas blowout rates. Other factors: • Due to the OIE's size and scale, fabrication of equipment, e.g. mooring anchors, outside of the contractor's scope of supply is likely to require engagement of international suppliers, further increasing complexity and uncertainty in associated time frames. • Screening indicates that mobilising some components of the OIE, based in Italy, can only be done so by sea and is likely to erode any time savings realised through killing the well via a relief well. • The March 2019 OSRL exercise in Europe tested deployment of the OIE and highlighted that it will require a 600+MT crane vessel for deployment to ensure there is useable hook height for the crane to conduct the lift of the carrier. Vessels with such capability and a current Australian vessel safety case are not locally or readily available.	Due to risks, uncertainty and complexity of this option, and the inability to realise any environmental gains, any cost would be disproportionate to the benefits gained.	The titleholder has confidence in availability of suitable relief well MODUs across the required drilling time frame thus the OIE would provide no advantage. Implementation of OIE has been assessed as a complex and unfeasible SIMOPs operation, precluded by a combination of the site-specific metocean and worst-case discharge conditions at the Gemtree location. Implementation of a novel technology such as OIE culminates in low certainty of success while at the same time increasing associated health and safety risks. As such the primary source control response and ALARP position remains drilling a relief well.	No
Dual vessel capping stack deployment	While the use of dual vessel to deploy the capping system could reduce the quantity of hydrocarbon entering the marine environment, this is an unproven technology. Additionally, the feasibility issues surrounding a dual vessel capping deployment in the water depths at the Gemtree-A well (201 m), together with mobilisation lead times for both a cap and required vessels and support equipment, would minimise any environmental benefit.	A dual vessel deployment is somewhat feasible provided a large enough deck barge can be located. Deck barges of 120 m are not, however, very common and will present a logistical challenge to identify and relocate to the region. Further, the longer length barges may need mooring assist to remain centred over the well. The capping stack would be handed off from a crane vessel to the anchor handler vessel (AHV) work wire outside of the exclusion zone. The AHV would then manoeuvre the barge into the plume to get the capping stack over the well. In this method, the barge would be in the plume, but the AHV and all personnel would be able to maintain a safe position outside of the gas zone. The capping stack would actually be lowered on the AHV work wire so a crane would not be required on the barge.	Due to there being minimal environmental benefits gained by the prolonged lead times needed to execute this technique, plus a potential increase in safety issues, any cost would be disproportionate to the benefits gained.	Given there is minimal environmental benefit and an increase in safety issues surrounding SIMOPS and deployment in shallow waters, this option would not provide an environmental or safety benefit.	No
Subsea containment system alternative to capping stack deployment	While the use of a subsea containment system could reduce the quantity of hydrocarbon entering the marine environment, this is an unproven technology. Additionally, the system is unlikely to be feasibly deployed and activated for at least 90 days following a blowout due to equipment requirements and logistics. No environmental benefit is therefore predicted given the release duration is 61 days before drilling of a relief well under the adopted control measure.	The timing for mobilisation, deployment and activation of the subsea containment system is likely to be longer (>90 days), than the expected 61 day relief well drilling operations based on the location, size and scale of the equipment required, including seabed piles that can only be transported by vessel.	Woodside has investigated the logistics of reducing this timeframe by pre-positioning equipment but the costs of purchasing dedicated equipment by Woodside for this Petroleum Activities Program is not considered reasonably practical and are considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit.	No

Pre-drilling top-holes	This option represents additional environmental impacts associated with discharge of additional drill cuttings and fluids along with benthic habitat disturbance. It is also not expected to result in a significant decrease in relief well timings	This option is not considered feasible due to the uncertainties related to the location and trajectory of the intervention well, which may vary according to the actual conditions at the time the loss of containment event occurs. Additionally, there is only expected to be a minor reduction in timing for this option of 1-2 days based on the drilling schedule. Duration to drill and kill may be reduced by 1-2 days, but top-hole may have to be relocated, due to location being unsafe or unsuitable and further works will be required each year to maintain the top holes.	Utilising an existing MODU and pre-drilling top-hole for relief well commencement would significantly increase costs associated the Petroleum Activities Program. Estimated cost over the program's life is approx. A$555,000 per day over the PAP based on 2-4 days of top-hole drilling (plus standby time) for the well as the worst-case scenario.	This option would not provide an environmental benefit due to the additional environmental impacts coupled with a lack of improved relief well timings.	No
Purchase and maintain mooring system	Purchasing and maintaining a mooring system could provide a moderate environmental benefit as it may reduce equipment sourcing time. However, due to the continued need for specialists to install the equipment plus sourcing a suitable vessel, the timeframe reduction would be minimal.	Woodside is not a specialist in installing and maintaining moorings so would require specialists to come in to install the moorings and would also require specialist vessels to be sourced to undertake the work.	The cost of purchasing, storing and maintaining pre-lay mooring systems with anchors, chains, buoys and ancillary equipment is considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit as timeframe reductions would be minimal.	No
Contract in place with WWCI and Oceaneering	Woodside has an agreement in place with WWCI and Oceaneering to provide trained personnel in the event of an incident. This will ensure that competent personnel are available in the shortest possible timeframe.	Having contracts in place to access trained, competent personnel in the event of an incident would reduce mobilization times. This option is considered reasonably practicable.	Minimal cost implications – Woodside has standing contract in place to provide assistance across all activities.	This control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

6.2.7.2 Improved Control Measures

Improved Control Measures considered
Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Maintaining relief well drilling supplies	There is not predicted to be any reduction in relief well timing or spill duration from Woodside maintaining stocks of drilling supplies (mud, casing, cement, etc.)	It would be feasible to source some relief well drilling supplies such as casing but the actual composition of the cement and mud required will need to be specific to the well. This option is also not deemed necessary as the lead time for sourcing and mobilising these supplies is included in the 21 days for sourcing and mobilising a rig.	The capital cost of Woodside purchasing relevant drilling supplies is expected to be approximately A$600,000 with additional costs for storage and ongoing costs for replenishment. These costs are considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit.	No

6.2.8 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Implement and maintain minimum standards for Safety Case development
  - Contract in place with WWCI and Oceaneering to supply trained, competent personnel
- Improved
  - Monitor internal drilling programs for MODU availability
  - Monitor external activity for MODU availability
  - Monitor status of Registered Operators / Approved Safety cases for MODUs

6.3 Shoreline Protection & Deflection – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.3.1 Existing Capability – Shoreline Protection and Deflection

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.3.2 Response Planning: WA-49-L Gemtree Exploration Drilling project – Shoreline Protection and Deflection

Planning for shoreline protection is based upon identification of RPAs from deterministic modelling and the logistics associated with deploying protection at these locations. The response planning scenarios indicate that this would require effective mobilisation to priority shorelines and maintenance of protection until operational monitoring confirms that the locations were no longer at risk. Modelling conducted predicts that, for the duration of the spill, shoreline impacts will not meet the 100 g/m^2 concentration threshold at any RPA. As a conservative approach, Woodside has included shoreline protection and deflection as a potential response technique in the instance that operational monitoring observes sufficient surface oil concentrations for it to be deployed.

The control measures selected provide capability to mobilise shoreline protection equipment by Day 2 (if required). As noted previously, no shoreline contact is predicted for any of the scenarios at response threshold (>100 g/m^2). The maximum accumulated volumes ashore at any threshold are, however, predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) or 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01). The shorter, larger impact has been included in Table 6-4 below. The existing capability is, therefore, considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) employed from the outset of a spill to track the oil and assess receptors at risk. This will then trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) if required. OM04 would only be undertaken in liaison with WA DoT.

Tactical response plans exist for many of the RPAs identified. In the event that an impact is predicted, to allow for the best use of available shoreline protection and deflection resources, operational monitoring (OM01, OM02 and OM03) will inform the response, targeting RPAs where contact is predicted (Table 6-4).

Table 6-4 below outlines the capability required (number of RPAs predicted to be impacted) against the capability available (number of shoreline protection and deflection operations that can be mobilised and deployed). As can be seen from the table below. Woodside's capability exceeds the response planning need identified for shoreline protection and deflection operations.

Table 6-4: Response Planning – Shoreline Protection and Deflection

	Shoreline Protection & Deflection	Day	Day	Day	Day	Day	Day	Day	Week	Week	Week	Month	Month	Month
		1	2	3	4	5	6	7	2	3	4	2	3	4
	Oil on shoreline (from deterministic modelling) m^3	0	0	0	0	0	0	0	0	0	0	3.78	0	0
A	Capability Required													
A1	RPAs impacted by maximum accumulated volume – WA-49-L Gemtree Exploration Drilling LOWC (Credible Scenario-04)	0	0	0	0	0	0	0	0	0	0	1	0	0
B	Capability Available (operations per day)													
B1	SPD operations available – per day (lower)	0	1	1	2	2	4	6	70	70	70	330	330	0
B2	SPD operations available – per day (upper)	1	2	3	4	6	8	10	84	84	84	336	336	0
C	Capability Gap (operations per day)													
C1	SPD operations gap – per day (lower)	0	0	0	0	0	0	0	0	0	0	0	0	0
C2	SPD operations gap – per day (upper)	0	0	0	0	0	0	0	0	0	0	0	0	0

A1 – the number of Response Protection Areas contacted at the maximum accumulated volume.

B1 and B2 – the upper and lower number of shoreline protection and deflection operations available (based on response planning assumptions in Section 5.3).

C1 and C2 – the gap between the upper and lower number of shoreline protection and deflection operations required in A1 compared to the operations available in B1 and B2

Pre-emptive mobilisation of equipment and personnel would commence as soon as practicable prior to oil contact. Additional resources would be mobilised depending on the scale of the event to increase the length or number of shorelines being protected.

A shoreline protection and deflection response would be launched and additional TRPs drafted only when operational monitoring (OM02 and OM03) and modelling (OM01) indicate that contact could occur at RPA(s) within 14 days. The outputs from the monitoring will inform the need for and/or direct any additional response techniques and, additionally, if/when the spill enters State Waters and control of the incident passes to WA DoT.

6.3.3 Shoreline Protection and Deflection – Control Measure Options Analysis

6.3.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-position equipment at Response Protection Areas (RPAs)	Additional environmental benefit of having equipment prepositioned is considered minor. Equipment is currently available to protect RPAs and additional shorelines, within estimated minimum times until shoreline contact at RPAs, enabling mobilisation of the selected delivery options.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost to preposition protection/ deflection packages at each site of potential impact would be approx. A$6100 per package per day.	This option is not adopted as the existing capability meets the need.	No

6.3.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Supplemented stockpiles of equipment in Exmouth to protect additional shorelines	Additional equipment would increase the number of receptor areas that could be protected from hydrocarbon contact. However, current availability of personnel and equipment is capable of protecting up to 30 km of shoreline, commensurate with the scale and progressive nature of shoreline impact. Additional stocks would be made available from international sources if long term up scaling were necessary. A reduction in environmental consequence from a ‘B’ rating (serious long-term impacts) is unlikely to be realised as a result of having more equipment available locally.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost for purchase supplemental protection and deflection equipment would be approx. A$455,000 per package.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel	The level of training and competency of the response personnel ensures the shoreline protection and deflection operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSRO’s (OSRL/AMOSC) to manage other responders. Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.3.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict floating or shoreline impacts at threshold throughout the spill, and a maximum shoreline accumulation of 3.78 m^3 on day 37 at Barrow Island, Woodside considers that there is sufficient time for deployment of protection and deflection operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48 hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are not predicted to strand at threshold and that the maximum shoreline accumulation of 3.78 m^3 will be on day 37 at Barrow Island therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new mitigation equipment (including protection and deflection boom) closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.3.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.4 Shoreline Clean-up – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.4.1 Existing Capability – Shoreline Clean-up

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.4.2 Response planning – WA-49-L Gemtree Exploration Drilling – Shoreline Clean-up

Woodside has assessed existing capability against the WCCS and has identified that the range of techniques provide an ongoing approach to shoreline clean-up at identified RPAs. Woodside's capability can cover all required shoreline clean-up operations for the PAP.

Modelling conducted predicts that, for the duration of the spill, shoreline impacts will not meet the 100 g/m^2 concentration threshold at any RPA. As a conservative approach, Woodside has included shoreline clean-up as a potential response technique in the instance that operational monitoring predicts or observes impacts at RPAs. Woodside is satisfied that the current capability is managing risks and impacts to ALARP.

As noted, no shoreline contact is predicted for any of the scenarios at response threshold (>100 g/m^2). The maximum accumulated volumes ashore at any threshold are, however, predicted to be 37 days at Barrow Island (3.78 m^3) (Credible Scenario-04) or 38 days at Barrow Island (2.38 m^3) (Credible Scenario-01). The shorter, larger impact has been included in Table 6-5 below. The control measures selected provide capability to mobilise shoreline protection equipment by Day 2 (if required).

In the unlikely event of a real spill, predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) will be employed from the outset of a spill to track the oil real-time and assess receptors at risk of impact. This will then trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) and shoreline assessments (OM05) to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. OM04 and OM05 would only be undertaken in liaison with WA DoT.

These figures have been combined into a single response planning need scenario that provides a worst-case scenario for planning purposes as outlined below. Given all other shoreline contact scenarios identified from deterministic modelling are longer time frames and lesser volumes, demonstration of capability against this need will ensure Woodside can meet requirements for any other outcome.

Woodside has identified several options which could be mobilised to achieve defined response objectives. Evaluation considers the benefit in terms of the time to respond and the scale of response made possible by each option. The evaluation of possible control measures is summarised in Section 6.4.3.

Table 6-5: Response planning – shoreline clean-up

	Shoreline Clean-up (Phase 2)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3	Month 4
	Oil on shoreline (from deterministic modelling) m^3													
	Shoreline accumulation (above 100 g/m^2) - m^3	0	0	0	0	0	0	0	0	0	0	3.78	0	0
	Oil remaining following response operations - m^3	0	0	0	0	0	0	0	0	0	0	0	0	0
A	**Capability Required (number of operations)**													
A1	**Shoreline clean-up operations required (lower)**	0	0	0	0	0	0	0	0	0	0	1	0	0
A2	**Shoreline clean-up operations required (upper)**	0	0	0	0	0	0	0	0	0	0	1	0	0
B	**Capability Available (number of operations)**													
B1	**Shoreline clean-up operations available - Stage 2 - Manual (lower)**	0	1	3	5	8	12	15	105	105	105	560	560	560
B2	**Shoreline clean-up operations available - Stage 2 - Manual (upper)**	0	2	5	8	10	15	20	140	140	140	560	560	560
C	**Capability Gap**													
C1	**Shoreline clean-up operations gap (lower)**	0	0	0	0	0	0	0	0	0	0	0	0	0
C2	**Shoreline clean-up operations gap (upper)**	0	0	0	0	0	0	0	0	0	0	0	0	0

A1 and A2 – the number of shoreline clean-up operations required based on the hydrocarbon volumes ashore above 100 g/m^2.

B1 and B2 – the upper and lower number of shoreline clean-up operations available (based on response planning assumptions in Section 5.4).

C1 and C2 – the gap between the upper and lower number of shoreline clean-up operations required in A1 and A2 compared to the operations available in B1 and B2.

6.4.3 Shoreline Clean-up – Control measure options analysis

6.4.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.4.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional trained personnel available	The level of training and competency of the response personnel ensures the shoreline clean-up operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSRO's (OSRL/AMOSC) to manage other responders Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel deployed	Maintaining a span of control of 200 competent personnel is deemed manageable and appropriate for this activity. Additional personnel conducting clean-up activities may be able to complete the clean-up in a shorter timeframe, but modelling predicts ongoing stranding of hydrocarbons over a period of weeks. Managing a smaller, targeted response is expected to achieve an environmental benefit through ensuring the shoreline clean-up response is suitable and scalable for the shoreline substrate and sensitivity type. This will ensure there is no increased impact from the shoreline clean-up through the presence of unnecessary personnel and equipment.	The figure of 200 personnel is broken down to include on 1-2 x Trained Supervisors managing 8-10 personnel/labour hire responders. This allows for multiple operational teams to operate along the extended shoreline at different locations. Typically, an additional 30-50% of the tactical workforce is required to support ongoing operations including On-Scene control, logistics, safety/medical/welfare and transport. Personnel on site will include members with the appropriate specialties to ensure an efficient shoreline clean-up. Additional personnel are available through existing contracts with oil spill response organisations, labour hire organisations and environmental panel contractors	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.4.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict floating or shoreline impacts at threshold throughout the spill, and a maximum shoreline accumulation of 3.78 m^3 on day 37 at Barrow Island, Woodside considers that there is sufficient time for deployment of shoreline clean-up operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are not predicted to strand at threshold and that the maximum shoreline accumulation of 3.78 m^3 will be on day 37 at Barrow Island therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new shoreline clean-up equipment closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.4.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.5 Oiled Wildlife Response – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.5.1 Existing Capability – Wildlife Response

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.5.2 Oiled Wildlife Response – Control Measure Options Analysis

6.5.2.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Direct contracts with service providers	This option duplicates the capability accessed through AMOSC and OSRL and would compete for the same resources. Does not provide a significant increase in environmental benefit.	These delivery options provide increased effectiveness through more direct communication and control of specialists. However, no significant net benefit is anticipated.	Duplication of capability – already subscribed to through contracts with AMOSC and OSRL	This option is not adopted as the existing capability meets the need.	No

6.5.2.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional wildlife treatment systems	The selected delivery options provide access to call-off contracts with selected specialist providers. The agreements ensure that these resources can be mobilised to meet the required response objectives, commensurate with the progressive nature of environmental impact and the time available to monitor hydrocarbon plume trajectories. Provides response equipment and personnel by Day 3. The additional cost in having a dedicated oiled wildlife response (equipment and personnel) in place is disproportionate to environmental benefit. These selected delivery options provide capacity to carry out an oiled wildlife response if contact is predicted; and to scale up the response if required to treat widespread contamination. Current capability meets the needs required and there is no additional environmental benefit in adopting the improvements.	Although hydrocarbon contact above threshold concentrations with offshore waters is expected on Day 1 (Credible Scenario-05), given the low likelihood of such an event occurring and the low environmental benefit of an offshore response, the cost of implementing measures to reduce the mobilisation time is considered disproportionate to the benefit. Additionally, the remote offshore location of the release site, with maximum accumulations at shoreline receptors predicted on Day 37, provides sufficient opportunity for the ongoing monitoring and surveillance operations to inform the scale of the response. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. Oiled wildlife response capacity would be addressed for open Commonwealth waters through the AMOSC arrangements, as informed by operational monitoring. The cost and organisational complexity of this approach is moderate, and the overall delivery effectiveness is high.	Additional wildlife response resources could total A$1700 per operational site per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained wildlife responders	Current numbers meet the needs required and additional personnel are available through existing contracts with oil spill response organisations and environmental panel contractors. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. The potential environmental benefit of training additional personnel is expected to be low.	The capability provides the capacity to treat approximately 600 wildlife units (primarily avian wildlife) by Day 6, with additional capacity available from OSRL. Additional equipment and facilities would be required to support ongoing response, depending on the scale of the event and the impact to wildlife. Materials for holding facilities, portable pools, enclosures and rehabilitation areas would be sourced as required.	Additional wildlife response personnel cost A$2000 per person per day	This option is not adopted as the existing capability meets the need.	No

6.5.2.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster mobilisation time for wildlife response	Response time is limited by specialist personnel mobilisation time. Current timing is sufficient for expected first shoreline contact. This control measure provides increased effectiveness through faster mobilisation of specialists. However, no significant net environmental benefit is expected due to shoreline stranding times.	Pre-positioning vessels or equipment would reduce mobilisation time for oiled wildlife response activities. However, given the effectiveness of an oiled wildlife response is expected to be low, an earlier response would provide a marginal increase in environmental benefit. The selected delivery options provide the capacity to mobilise an oiled wildlife response capable of treating up to 600 wildlife from at least Day 6 and exceeds the estimated Level 1-2 oiled wildlife response thought to be applicable. This delivery option provides the maximum expertise pooled across the participating operators, backed up by the international resources provided by OSRL. The availability of vessels and personnel meets the response need.	Wildlife response packages to preposition at vulnerable sites identified through the deterministic modelling cost A$700 per package per day. The cost of having dedicated equipment and personnel available to respond faster is considered disproportionate to the environmental benefit.	This option is not adopted as the existing capability meets the need.	No

6.5.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.6 Waste Management – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.6.1 Existing Capability – Waste Management

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/restocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.6.2 Waste Management – Control Measure Options Analysis

6.6.2.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.6.2.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Increased waste storage capability	The procurement of waste storage equipment options on the day of the event will allow immediate response and storage of collected waste. The environmental benefit of immediate waste storage is to reduce ecological consequence by safely securing waste, allowing continuous response operations to occur.	Access to Veolia's storage options provides the resources required to store and transport sufficient waste to meet the need. Access to waste contractors existing facilities enables waste to be stockpiled and gradually processed within the regional waste handling facilities. Additional temporary storage equipment is available through existing contract and arrangements with OSRL. Existing arrangements meet identified need for the PAP.	Cost for increased waste disposal capability would be approx. A$1300 per m^3. Cost for increased onshore temporary waste storage capability would be approx. $40 per unit per day.	This option is not adopted as the existing capability meets the need.	No

6.6.2.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response time	The access to Veolia waste storage options provides the resources to store and transport waste, permitting the wastes to be stockpiled and gradually processed within the regional waste handling facilities. Bulk transport to Veolia's licensed waste management facilities would be undertaken via controlled-waste-licensed vehicles and in accordance with Environmental Protection (Controlled Waste) Regulations 2004. The environmental benefit from successful waste storage will reduce pressure on the treatment and disposal facilities reducing ecological consequences by safely securing waste. In addition, waste storage and transport will allow continuous response operations to occur. This delivery option would increase known available storage, eliminating the risk of additional resources not being available at the time of the event. However, the environmental benefit of Woodside procuring additional waste storage is considered minor as the risk of additional storage not being available at the time of the event is considered low and existing arrangements provide adequate storage to support the response.	Woodside already maintains an equipment stockpile in Exmouth to enable shorter response times to incidents. This stockpile includes temporary waste storage equipment. Woodside has access to stockpiles of waste storage and equipment in Dampier and Exmouth through existing contracts and arrangements.	The incremental benefit of having a dedicated local Woodside owned stockpile of waste equipment and transport is considered minor and cost is considered disproportionate to the benefit gained given predicted shoreline contact times.	This option is not adopted as the existing capability meets the need.	No

6.6.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.7 Scientific Monitoring – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.7.1 Existing Capability – Scientific Monitoring

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitations that are beyond Woodside's direct control.

6.7.2 Scientific Monitoring – Control Measure Options Analysis

Table 6-6: Scientific Monitoring - Control Measure Options considered – A. alternative control measures

Evaluate Alternative, Additional and Improved Control Measures					
Alternative Control Measures considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Ref	Control Measure Category	Option considered	Implemented	Environmental Consideration	Feasibility / Cost
SM01	System	Analytical laboratory facilities closer to the likely spill affected area	No	SM01 water quality monitoring requires water samples to be transported to NATA rated laboratories in Perth or interstate. Consider the benefit of laboratory access and transportation times to deliver water samples and complete lab analysis. There is a time lag from collection of water samples to being in receipt of results and confirming hydrocarbon contact to sensitive receptors). The environmental consideration of having access to suitable laboratory facilities in Exmouth or Karratha to carry out the hydrocarbon analysis would provide faster turnaround in reporting of results only by a matter of days (as per the time to transport samples to laboratories).	Laboratory facilities and staff available at locations closer to the spill affected area can reduce reporting times only to a moderate degree (days) with associated high costs of maintaining capability do not improve the environmental benefit.
SM01	System	Dedicated contracted SMP vessel (exclusive to Woodside)	No	Would provide faster mobilisation time of scientific monitoring resources, environmental benefit associated with faster mobilisation time would be minor compared to selected options.	Chartering and equipping additional vessels on standby for scientific monitoring has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated availability of vessels and resources within in the required timeframes. The selected delivery provides capability to meet the scientific monitoring objectives, including collection of pre-emptive data where baseline knowledge gaps are identified for receptor locations where spill predictions of time to contact are >10 days. The effectiveness of this alternative control (weather dependency, availability and survivability) is rated as very low The cost and organisational complexity of employing a dedicated response vessel is considered disproportionate to the potential environmental benefit by adopting these delivery options.

Table 6-7: Scientific Monitoring - Control Measure Options considered – B. Additional control measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Ref	**Control Measure Category**	**Option considered**	**Implemented**	**Environmental Consideration**	**Feasibility / Cost**
SM01	System	Determine baseline data needs and provide implementation plan in the event of an unplanned hydrocarbon release	Yes	Address resourcing needs to collect post spill (pre-contact) baseline data as spill expands in the event of a loss of well control from the PAP activities.	Woodside relies on existing environmental baseline for receptors which have predicted hydrocarbon contact (above environment threshold) <10 days and acquiring pre-emptive data in the event of a loss of well control from the PAP activities based on receptors predicted to have hydrocarbon contact >10 days. Ensure there is appropriate baseline for key receptors for all geographic locations that are potentially impacted <10 days of spill event, where practicable. Address resourcing needs to collect pre-emptive baseline as spill expands in the event of a loss of well control from the PAP activities.

6.7.3 Improved Control Measures

Improved Control Measures considered – No reasonably practicable improved Control Measures identified.

6.7.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Determine baseline data needs and activate SMPs for any identified PBAs in the event of an unplanned hydrocarbon release
- Improved
  - None Selected

6.7.5 Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-8.

Table 6-8: Scientific monitoring program operational plan actions

Responsibility	Action
Activation	
Perth ICC Planning (ICC Planning – Environment Unit)	Mobilise Chief Environmental Scientist/SMP Lead/Manager and SMP Coordinator to the ICC Planning function.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager and SMP Coordinator)	Constantly assess all outputs from OM01, OM02 and OM03 (Section 5 and ANNEX B: Operational Monitoring Activation and Termination Criteria) to determine receptor locations and receptors at risk. Confirm sensitive receptors likely to be exposed to hydrocarbons, timeframes to specific receptor locations and which SMPs are triggered. Review baseline data for receptors at risk.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager and SMP Coordinator)	SMP co-ordinator stand up SMP standby contractor as the SMP contractor. Stands up subject matter experts, if required.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager SMP Coordinator, SMP standby contractor SMP manager)	Establish if, and where, pre-contact baseline data acquisition is required. Determine practicable baseline acquisition program based on predicted timescales to contact and anticipated SMP mobilisation times. Determine scope for preliminary post-contact surveys during the Response Phase. Determine which SMP activities are required at each location based on the identified receptor sensitivities.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP standby contractor SMP manager)	If response phase data acquisition is required, stand up the contractor SMP teams for data acquisition and instruct them to standby awaiting further details for mobilisation from the IMT.

Responsibility	Action
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP standby contactor SMP manager)	SMP contractor, SMP standby contractor to prepare the Field Implementation Plan. Prepare and obtain sign-off of the Response Phase SMP work plan and Field Implementation Plan. Update the IAP.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator SMP standby contactor SMP manager)	Liaise with ICC Logistics, and determine the status and availability of aircraft, vessels and road transportation available to transport survey personnel and equipment to point of departure. Engage with SMP standby contactor SMP Manager and ICC Logistics to establish mobilisation plan, secure logistics resources and establish ongoing logistical support operations, including: • Vessels, vehicles and other logistics resources • Vessel fit-out specifications (as • Detailed in the Scientific Monitoring Program Operational Plan • Equipment storage and pick-up locations • Personnel pick-up/airport departure locations • Ports of departure • Land based operational centres and forward operations bases Accommodation and food requirements.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP standby contactor (SMP manager)	Confirm communications procedures between Woodside SMP team, SMP standby contactor SMP Manager, SMP Team Leads and Operations Point Coordinator.
Mobilisation	
Perth ICC Logistics	Engage vessels and vehicles and arrange fitting out as specified by the mobilisation Plan Confirm vessel departure windows and communicate with the Jacob's SMP Manager. Agree SMP mobilisation timeline and induction procedures with the Division and Sector Command Point(s).
Perth ICC Logistics	Coordinate with SMP standby contactor SMP Manager to mobilise teams and equipment according to the logistics plan and Sector induction procedures.
SMP Survey Team Leads	SMP Survey Team Leader(s) coordinate on-ground/on-vessel mobilisations and support services with the Sector Command point(s).

6.7.6 ALARP and Acceptability Summary

ALARP and Acceptability Summary		
Scientific Monitoring		
ALARP Summary	X	All known reasonably practicable control measures have been adopted
	X	No additional, alternative and improved control measures would provide further benefit
	X	No reasonably practical additional, alternative, and/or improved control measure exists
	The resulting scientific monitoring capability has been assessed against the worst-case credible spill scenarios. The range of strategies provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts. All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be Moderate and the overall delivery effectiveness considered Medium. The SMP's main objectives can be met, with the addition of one alternative control measures to provide further benefit.	
Acceptability Summary	• The control measures selected for implementation manage the potential impacts and risks to ALARP. • In the event of a hydrocarbon spill for the PAP, the control measures selected, meet or exceed the requirements of Woodside Management System and industry best-practice. • Throughout the PAP, relevant Australian standards and codes of practice will be followed to evaluate the impacts from a loss of well control. • The level of impact and risk to the environment has been considered with regard to the principles of Environmentally Sustainable Development (ESD); and risks and impacts from a range of identified scenarios were assessed in detail. The control measures described consider the conservation of biological and ecological diversity, through both the selection of control measures and the management of their performance. The control measures have been developed to account for the worst-case credible case scenarios, and uncertainty has not been used as a reason for postponing control measures.	
On the basis from the impact assessment above and in Section 6 of the EP Woodside considers the adopted controls discussed manage the impacts and risks associated with implementing scientific monitoring activities to a level that is ALARP and acceptable.		

7 ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

The implementation of response techniques may modify the impacts and risks identified in the EP and response activities can introduce additional impacts and risks from response operations themselves. Therefore, it is necessary to complete an assessment to ensure these impacts and risks have been considered and specific measures are put in place to continually review and manage these further impacts and risks to ALARP and Acceptable levels. A simplified assessment process has been used to complete this task which covers the identification, analysis, evaluation and treatment of impacts and risks introduced by responding to the event.

7.1 Identification of impacts and risks from implementing response techniques

Each of the control measures can modify the impacts and risks identified in the EP. These impacts and risks have been previously assessed within the scope of the EP. Refer to the EP for details regarding how these risks are being managed. They are not discussed further in this document.

- atmospheric emissions
- routine and non-routine discharges
- physical presence, proximity to other vessels (shipping and fisheries)
- routine acoustic emissions vessels
- lighting for night work/navigational safety
- invasive marine species
- collision with marine fauna
- disturbance to seabed.

Additional impacts and risks associated with the control measures not included within the scope of the EP include:

- drill cuttings and drilling fluids environmental impact assessment for relief well drilling
- vessel operations and anchoring
- presence of personnel on the shoreline
- additional stress or injury caused to wildlife
- waste generation.

7.2 Analysis of impacts and risks from implementing response techniques

The table below compares the adopted control measures for this activity against the environmental values that can be affected when they are implemented.

Table 7-1: Analysis of risks and impacts

	Environmental value						
	Soil & groundwater	**Marine sediment quality**	**Water quality**	**Air quality**	**Ecosystems/ habitat**	**Species**	**Socio-economic**
Monitor and evaluate		✓	✓		✓	✓	
Source control		✓	✓	✓	✓	✓	✓
Shoreline protection & deflection	✓	✓	✓		✓	✓	✓
Shoreline clean-up	✓	✓	✓		✓	✓	✓
Oiled wildlife response					✓	✓	
Scientific monitoring	✓	✓	✓	✓	✓	✓	✓
Waste management	✓	✓		✓	✓	✓	✓

7.3 Evaluation of impacts and risks from implementing response techniques

Drill cuttings and Drilling Fluids Environmental Impact Assessment for Relief Well Drilling

The identified potential impacts associated with the discharge of drill cuttings and fluids during a relief well drilling activity include a localised reduction in water and seabed sediment quality, and potential localised changes to benthic biota (habitats and communities).

A number of direct and indirect ecological impact pathways are identified for drill cuttings and drilling fluids as follows:

- temporary increase in total suspended solids (TSS) in the water column
- attenuation of light penetration as an indirect consequence of the elevation of TSS and the rate of sedimentation
- sediment deposition to the seabed leading to the alteration of the physio-chemical composition of sediments, and burial and potential smothering effects to sessile benthic biota
- potential contamination and toxicity effects to benthic and in-water biota from drilling fluids.

Potential impacts from the discharge of cuttings range from the complete burial of benthic biota in the immediate vicinity of the well site due to sediment deposition, smothering effects from raised sedimentation concentrations as a result of elevated TSS, changes to the physico-chemical properties of the seabed sediments (particle size distribution and potential for reduction in oxygen levels within the surface sediments due to organic matter degradation by aerobic bacteria) and subsequent changes to the composition of infauna communities to minor sediment loading above background and no associated ecological effects. Predicted impacts are generally confined to within a few hundred metres of the discharge point (International Association of Oil and Gas Producers 2016) (i.e. within the EMBA for a hydrocarbon spill event).

The discharge of drill cuttings and unrecoverable fluids from relief well drilling is expected to increase turbidity and TSS levels in the water column, leading to an increased sedimentation rate above ambient levels associated with the settlement of suspended sediment particles in close proximity to the seabed or below sea surface, depending on location of discharge. Cuttings with retained (unrecoverable) drilling fluids are discharged below the water line at the MODU location, resulting in drill cuttings and drilling fluids rapidly diluting, as they disperse and settle through the water column. The dispersion and fate of the cuttings is determined by particle size and density of the retained (unrecoverable) drilling fluids, therefore, the sediment particles will primarily settle in proximity to the well locations with potential for localised spread downstream (depending on the speed of currents throughout the water column and seabed) (IOGP 2016). The finer particles will remain in suspension and will be transported further before settling on the seabed.

These conclusions were supported by discharge modelling which was undertaken by Woodside in support of the Greater Enfield Development EP. Modelling results indicating that the TSS plume of suspended cuttings will typically disperse to the south-west while oscillating with the tide and diminish rapidly with increasing distance from the well locations. Maximum TSS concentrations predicted for 100 m; 250 m and 1 km distances from the wellsite were 7, 5 and 1 mg/L, respectively. Furthermore, water column concentrations below 10 mg/L remain within 235 m of the discharge location for each modelled well. For all well discharge locations (outside of direct discharge sites), TSS concentration did not exceed 10 mg/l. Nelson et al. (2016) identified <10 mg/L as a no effect or sub-lethal minimal effect concentration.

The low sensitivity of the deep-water benthic communities/habitats within and in the vicinity of relief well locations, combined with the relatively low toxicity of water-based mud (WBM) and non water-based muds (NWBMs), no bulk discharges of NWBM and the highly localised nature and scale of predicted physical impacts to seabed biota indicate that any localised impact would likely be of a slight magnitude (especially when considering the broader consequence of the LOC event a relief well drilling activity would be responding too).

Vessel operations and anchoring

During the implementation of response techniques, where water depths allow, it is possible that response vessels will be required to anchor (e.g. during shoreline surveys). The use of vessel anchoring will be minimal and likely to occur when the impacted shoreline is inaccessible via road. Anchoring in the nearshore environment of sensitive receptor locations will have the potential to impact coral reef, seagrass beds and other benthic communities in these areas. Recovery of benthic communities from anchor damage depends on the size of anchor and frequency of anchoring. Impacts would be highly localised (restricted to the footprint of the vessel anchor and chain) and temporary, with full recovery expected.

Presence of personnel on the shoreline

Presence of personnel on the shoreline during shoreline operations could potentially result in disturbance to wildlife and habitats. During the implementation of response techniques, it is possible that personnel may have minimal, localised impacts on habitats, wildlife and coastlines. The impacts associated with human presence on shorelines during shoreline surveys and response operations may include:

- damage to vegetation/habitat, especially in sensitive locations such as mangroves and turtle nesting beaches, to gain access to areas of shoreline oiling
- damage or disturbance to wildlife during shoreline surveys
- removal of surface layers of intertidal sediments (potential habitat depletion)
- excessive removal of substrate causing erosion and instability of localised areas of the shoreline.

However, any impacts are expected to be localised with full recovery expected.

Additional stress or injury caused to wildlife

Additional stress or injury to wildlife could be caused through the following phases of a response:

- capturing wildlife
- transporting wildlife
- stabilisation of wildlife
- cleaning and rinsing of oiled wildlife
- rehabilitation (e.g. diet, cage size, housing density)
- release of treated wildlife.

Inefficient capture techniques have the potential to cause undue stress, exhaustion or injury to wildlife, additionally pre-emptive capture could cause undue stress and impacts to wildlife when there are uncertainties in the forecast trajectory of the spill. During the transportation and stabilisation phases there is the potential for additional thermoregulation stress on captured wildlife. Additionally, during the cleaning process, it is important personnel undertaking the tasks are familiar with the relevant techniques to ensure that further injury and the removal of water proofing feathers are managed and mitigated. Finally, during the release phase it's important that wildlife is not released back into a contaminated environment.

Waste generation

Implementing the selected response techniques will result in the generation of the following waste streams that will require management and disposal:

- liquids (recovered oil/water mixture), recovered from shoreline clean-up operations
- semi-solids/solids (oily solids), collected during shoreline clean-up operations
- debris (e.g. seaweed, sand, woods, plastics), collected during shoreline clean-up operations and oiled wildlife response.

If not managed and disposed of correctly, wastes generated during the response have the potential for secondary contamination similar to that described above, impacts to wildlife through contact with or ingestion of waste materials and contamination risks if not disposed of correctly onshore.

Cutting back vegetation prior to impact could minimise the amount of contaminated organic material and thus reduce the amount of oiled/hazardous waste to be handled. However, removal of vegetation also allows more extensive penetration of oil into the substrate and may lead to habitat loss. Any impacts are expected to be localised with full recovery expected.

7.4 Treatment of impacts and risks from implementing response techniques

In respect of the impacts and risks assessed the following treatment measures have been adopted. It must be recognised that this environmental assessment is seeking to identify how to maintain the level of impact and risks at levels that are ALARP and of an acceptable level rather than exploring further impact and risk reduction. It is for this reason that the treatment measures identified in this assessment will be captured in Operational Plans, TRPs, and/or the FSP.

Vessel operations and access in the nearshore environment

- Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified (PS 14.1, 18.1).
- Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines (PS 14.2, 18.2).

Presence of personnel on the shoreline

- Oversight by trained personnel who are aware of the risks (PS 18.6).
- Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline (PS 18.7).
- Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations (PS 7.3, 18.4).
- Vehicular access will be restricted on dunes, turtle nesting beaches and in mangroves. (PS 18.3).

Additional stress or injury caused to wildlife

- Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan (PS 20.3).

Waste generation

- All shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates (PS 15.5).
- Limiting vegetation removal to only that vegetation that has been moderately or heavily oiled (PS 18.5).

8 ALARP CONCLUSION

An analysis of alternative, additional and improved control measures has been undertaken to determine their reasonableness and practicability. The tables in Section 6 document the considerations made in this evaluation. Where the costs of an alternative, additional, or improved control measure has been determined to be clearly disproportionate to the environmental benefit gained from its adoption it has been rejected. Where this is not considered to be the case the control measure has been adopted.

The risks from a hydrocarbon spill have been reduced to ALARP because:

- Woodside has a significant hydrocarbon spill response capability to respond to the WCCS through the control measures identified
- new and modified impacts and risks associated with implementing response techniques have been considered and will not increase the risks associated with the activity
- a consideration of alternative, additional, and improved control measures identified any other control measures that delivered proportionate environmental benefit compared to the cost of adoption for this activity ensuring that:
  - all known, reasonably practicable control measures have been adopted
  - no additional, reasonably practicable alternative and/or improved control measures would provide further environmental benefit
  - no reasonably practical additional, alternative, and/or improved control measure exists.
- a structured process for considering alternative, additional, and improved control measures was completed for each control measure
- the evaluation was undertaken based on the outputs of the WCCS so that the capability in place is sufficient for all other scenarios from this activity
- the likelihood of the WCCS spill has been ignored in evaluating what was reasonably practicable.

9 ACCEPTABILITY CONCLUSION

Following the ALARP evaluation process, Woodside deems the hydrocarbon spill risks and impacts to have been reduced to an acceptable level by meeting all of the following criteria:

- Techniques are consistent with Woodside's processes and relevant internal requirements including policies, culture, processes, standards, structures and systems.
- Levels of risk/ impact are deemed acceptable by relevant persons (external stakeholders) and are aligned with the uniqueness of, and/or the level of protection assigned to the environment, its sensitivity to pressures introduced by the activity, and the proximity of activities to sensitive receptors, and have been aligned with Part 3 of the EPBC Act.
- Selected control measures meet requirements of legislation and conventions to which Australia is a signatory (e.g. MARPOL, the World Heritage Convention, the Ramsar Convention, and the Biodiversity Convention etc.). In addition to these, other non-legislative requirements met include:
    - Australian IUCN reserve management principles for Commonwealth marine protected areas and bioregional marine plans
    - National Water Quality Management Strategy and supporting guidelines for marine water quality)
    - conditions of approval set under other legislation
    - national and international requirements for managing pollution from ships
    - national biosecurity requirements.
- Industry standards, best practices and widely adopted standards and other published materials have been used and referenced when defining acceptable levels. Where these are inconsistent with mandatory/ legislative regulations, explanation has been provided for the proposed deviation. Any deviation produces the same or a better level of environmental performance (or outcome).

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11 GLOSSARY & ABBREVIATIONS

11.1 Glossary

Term	Description / Definition
ALARP	Demonstration through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.
Availability	The availability of a control measure is the percentage of time that it is capable of performing its function (operating time plus standby time) divided by the total period (whether in service or not). In other words, it is the probability that the control has not failed or is undergoing a maintenance or repair function when it needs to be used.
Control	The means by which risk from events is eliminated or minimised.
Control effectiveness	A measure of how well the control measures perform their required function.
Control measure (risk control measure)	The features that eliminate, prevent, reduce or mitigate the risk to environment associated with PAP.
Credible spill scenario	A spill considered by Woodside as representative of maximum volume and characteristics of a spill that could occur as part of the PAP.
Dependency	The degree of reliance on other systems in order for the control measure to be able to perform its intended function.
Environment that may be affected	The summary of quantitative modelling where the marine environment could be exposed to hydrocarbons levels exceeding hydrocarbon threshold concentrations.
Incident	An event where a release of energy resulted in or had (with) the potential to cause injury, ill health, damage to the environment, damage to equipment or assets or company reputation.
Major Environment Event	The events with potential environment, reputation, social or cultural consequences of category C or higher (as per Woodside's operational risk matrix) which are evaluated against credible worst-case scenarios which may occur when all controls are absent or have failed.
Performance outcome	A statement of the overall goal or outcome to be achieved by a control measure
Performance standard	The parameters against which [risk] controls are assessed to ensure they reduce risk to ALARP. A statement of the key requirements (indicators) that the control measure has to achieve in order to perform as intended in relation to its functionality, availability, reliability, survivability and dependencies.
Preparedness	Measures taken before an incident in order to improve the effectiveness of a response
Reasonably practicable	... a computation ... made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) [showing whether or not] that there is a gross disproportion between them ... made by the owner at a point of time anterior to the accident. (Judgement: Edwards v National Coal Board [1949])
Receptors at risk	Physical, biological and social resources identified as at risk from hydrocarbon contact using oil spill modelling predictions.
Receptor areas	Geographically referenced areas such as bays, islands, coastlines and/or protected area (WHA, Commonwealth or State marine reserve or park) containing one or more receptor type.

Term	Description / Definition
Receptor Sensitivities	This is a classification scheme to categorise receptor sensitivity to an oil spill. The Environmental Sensitivity Index (ESI) is a numerical classification of the relative sensitivity of a particular environment (particularly different shoreline types) to an oil spill. Refer to the Woodside OPEA for more details.
Regulator	NOPSEMA are the Environment Regulator under the Environment Regulations.
Reliability	The probability that at any point in time a control measure will operate correctly for a further specified length of time.
Response technique	The key priorities and objectives to be achieved by the response plan Measures taken in response to an event to reduce or prevent adverse consequences.
Survivability	Whether or not a control measure is able to survive a potentially damaging event is relevant for all control measures that are required to function after an incident has occurred.
Threshold	Hydrocarbon threshold concentrations applied to the risk assessment to evaluate hydrocarbon spills.
Zone of Application	The zone in which Woodside may elect to apply dispersant. The zone is determined based on a range of considerations, such as hydrocarbon characteristics, weathering and metocean conditions. The zone is a key consideration in the Net Environmental Benefit Analysis for dispersant use.

11.2 Abbreviations

Abbreviation	Meaning
AIIMS	Australasian Inter-Service Incident Management System
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APASA	Asia Pacific Applied Science Associates
BAOAC	Bonn Agreement Oil Appearance Code
BOP	Blowout Preventer
CSt	Centistokes
CICC	Corporate Incident Coordination Centre
DM	Duty Manager
DBCA	Western Australia Department of Biodiversity, Conservation and Attractions (former Western Australian Department of Parks and Wildlife)
EMBA	Environment that May Be Affected
EMSA	European Maritime Safety Agency
EP	Environment Plan
Environment Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
ESI	Environmental Sensitivity Index
ESD	Environmentally Sustainable Development
ESP	Environmental Services Panel
FPSO	Floating Production Storage Offloading
FSP	First Strike Plan
GIS	Geographic Information System
IAP	Incident Action Plan
ICC	Incident Coordination Centre
IMT	Incident Management Team
IPIECA	International Petroleum Industry Environment Conservation Association
ISV	Infield support vessel
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
KBSF	King Bay Support Facility
LEL	Lower explosive limit
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
NEBA	Net Environmental Benefit Analysis
NWBM	Non Water-Based Muds
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment

Abbreviation	Meaning
OILMAP	Oil Spill Model and Response System
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OSCA	Oil Spill Cleaning Agent (registered for use within the National Plan)
OSRL	Oil Spill Response Limited
OSTM	Oil Spill Trajectory Modelling
OWRP	Oiled Wildlife Response Plan
OWROP	Regional Oiled Wildlife Response Operational Plan
PAP	Petroleum Activities Program
PBA	Pre-emptive Baseline Areas
PPB	Parts per billion
PPM	Parts per million
ROV	Remotely Operated Vehicle(s)
RPA	Response Protection Area
S&EM	Security & Emergency Management
SCAT	Shoreline Clean-up Assessment Technique
SDA	Surface Dispersant Application
SIMAP	Integrated Oil Spill Impact Model System
SSDI	Subsea Dispersant Injection
SFRT	Subsea First Response Toolkit
SIMA	Spill Impact Mitigation Assessment
SMP	Scientific monitoring program
TRP	Tactical Response Plan
TSS	Total suspended solids
WA DoT	Western Australia Department of Transport
WBM	Water-Based Mud
WHA	World Heritage Area
Woodside	Woodside Energy Limited
WWCI	Wild Well Control Inc
WCCS	Worst Case Credible Scenario
ZoA	Zone of Application

ANNEX A: NET ENVIRONMENTAL BENEFIT ANALYSIS DETAILED OUTCOMES

A pre-operational NEBA has been conducted to assess the net environmental benefit of different response techniques to selected receptors in the event of an oil spill from the PAP for a loss of well containment of Julimar Condensate from the WA-49-L Gemtree Exploration Drilling project. The complete list of potential receptor locations within the EMBA within the PAP is included in Section 6 of the EP.

With the exception of a surface contact of >50 g/m^2 in Commonwealth Waters (Credible Scenario-01 and Credible Scenario-04) and at Montebello Marine Park (Credible Scenario-05), there were no other impacts predicted at RPAs above the threshold concentrations (surface contact >50 g/m^2 or shoreline accumulation of 100 g/m^2) to undertake most response techniques from the selected spill modelling and thus many of the response techniques would not be feasible. The locations utilised for the NEBA were limited to RPAs identified from stochastic and deterministic modelling but at lesser concentration thresholds.

The detailed NEBA assessment outcomes are shown below. The WA-49-L Gemtree Exploration Drilling project preoperational NEBA contains the full assessments.

Table A-1: NEBA assessment technique recommendations for Julimar Condensate (Credible Scenario-01 and Credible Scenario-04)

Receptor	Monitor and evaluate	Well control	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Barrow Island	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
Gascoyne Marine Park	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
Montebello Marine Park	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
Muiron Islands WHA & SMP	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
Pilbara Islands - Southern Island Group	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
Rankin Bank	Yes	Yes	No	No	No	No	No	No	No	No	No	Yes
Open Ocean	Yes	Yes	No	No	No	No	No	No	No	No	No	Yes

Overall assessment

Sensitive receptor (sites identified in EP)	Monitor and evaluate	Well control	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Is this response Practicable?	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	Yes

Table A-2: NEBA assessment technique recommendations for marine diesel (Credible Scenario-05)

Receptor	Monitor and evaluate	Source Control via Vessel SOPEP	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Argo-Rowley Terrace CMR	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Barrow Island	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Glomar Shoals	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Lowendal Islands	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Montebello Islands and State Marine Park	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Montebello Marine Park	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Muiron Islands WHA & SMP	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Rankin Bank	Yes	Yes	No	No	No	No	No	No	No	No	Yes
Open ocean	Yes	Yes	No	No	No	No	No	No	No	No	Yes

Overall assessment

Sensitive receptor (sites identified in EP)	Monitor and evaluate	Source Control via Vessel SOPEP	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Is this response practicable?	Yes	Yes	No	No	No	No	No	No	No	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	Yes	No	No	No	No	No	No	No	No	Yes

NEBA Impact Ranking Classification Guidance

To reduce variability between assessments, the following ranking descriptions have been devised to guide the workshop process:

			Degree of impact	Potential duration of impact	Equivalent Woodside Corporate Risk Matrix Consequence Level
Positive	**3P**	**Major**	Likely to prevent: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-today business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches) or regulatory designations.	Decrease in duration of impact by >5 years	N/A
	2P	**Moderate**	Likely to prevent: • significant impact to a single phase of reproductive cycle of biological receptors • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors.	Decrease in duration of impact by 1–5 years	N/A
	1P	**Minor**	Likely to prevent impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors such as: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Decrease in duration of impact by several seasons (< 1 year)	N/A
	0	**Non-mitigated spill impact**	**No detectable difference to unmitigated spill scenario.**		
Negative	**1N**	**Minor**	Likely to result in: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-to-day business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches), or regulatory designations. **[Note 1]**	Increase in duration of impact by several seasons (< 1 year)	Increase in risk by one sub-category, without changing category (e.g. Minor (E) to Minor (D))
	2N	**Moderate**	Likely to result in: • significant impact to a single phase of reproductive cycle for biological receptors; or • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors. This level of negative impact is recoverable and unlikely to result in closure of business/industry in the region.	Increase in duration of impact by 1–5 years	Increase in risk by one category (e.g. Minor (D) to Moderate (C or B))
	3N	**Major**	Likely to result in impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors resulting in either: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Increase in duration of impact by >5 years or unrecoverable	Increase in risk by two categories (e.g. Minor (E) to Major (A))

NOTE: the maximum likely impact should be considered; for example, if a spill were to directly impact the behaviour that results in an impact to reproduction and/or the breeding population (such as fish failing to aggregate to spawn), then the score should be a 2 or 3 rather than a 1. Similarly, if a change in behaviour resulted in an increased risk of mortality of a population, then it should be scored as a 2 or 3.

ANNEX B: OPERATIONAL MONITORING ACTIVATION AND TERMINATION CRITERIA

Table B-1: Operational monitoring objectives, triggers and termination criteria

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 1 (OM01) Predictive Modelling of Hydrocarbons to Assess Resources at Risk	OM01 focuses on the conditions that have prevailed since a spill commenced, as well as those that are forecasted in the short term (1–3 days ahead) and longer term. OM01 utilises computer-based forecasting methods to predict hydrocarbon spill movement and guide the management and execution of spill response operations to maximise the protection of environmental resources at risk. The objectives of OM01 are to: • Provide forecasting of the movement and weathering of spilled hydrocarbons • Identify resources that are potentially at risk of contamination • Provide simulations showing the outcome of alternative response options (booming patterns etc.) to inform on-going Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP	OM01 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM01 are: • The hydrocarbon discharge has ceased and no further surface oil is visible • Response activities have ceased • Hydrocarbon spill modelling (as verified by OM02 surveillance observations) predicts no additional natural resources will be impacted

Operational Monitoring <u>Operational Plan</u>	Objectives	Activation triggers	Termination criteria
<u>Operational Monitoring Operational Plan 2 (OM02)</u> Surveillance and reconnaissance to detect hydrocarbons and resources at risk	OM02 aims to provide regular, on-going hydrocarbon spill surveillance throughout a broad region, in the event of a spill. The objectives of OM02 are: • Verify spill modelling results and recalibrate spill trajectory models (OM01). • Understand the behaviour, weathering and fate of surface hydrocarbons. • Identify environmental receptors and locations at risk or contaminated by hydrocarbons. • Inform ongoing Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP. • To aid in the subsequent assessment of the short- to long-term impacts and/or recovery of natural resources (assessed in SMPs) by ensuring that the visible cause and effect relationships between the hydrocarbon spill and its impacts to natural resources have been observed and recorded during the operational phase.	OM02 will be triggered immediately following a level 2/3 hydrocarbon spill.	The termination triggers for the OM02 are: • 72 hours has elapsed since the last confirmed observation of surface hydrocarbons. • Latest hydrocarbon spill modelling results (OM01) do not predict surface exposures at visible levels.
<u>Operational Monitoring Operational Plan 3 (OM03)</u> Monitoring of hydrocarbon presence, properties, behaviour and weathering in water	OM03 will measure surface, entrained and dissolved hydrocarbons in the water column to inform decision-making for spill response activities. The specific objectives of OM03 are as follows: • Detect and monitor for the presence, quantity, properties, behaviour and weathering of surface, entrained and dissolved hydrocarbons. • Verify predictions made by OM01 and observations made by OM02 about the presence and extent of hydrocarbon contamination. Data collected in OM03 will also be used for the purpose of longer-term water quality monitoring during SM01.	OM03 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM03 are as follows: • The hydrocarbon release has ceased. • Response activities have ceased. • Concentrations of hydrocarbons in the water are below available ANZECC/ ARMCANZ (2018) trigger values for 99% species protection.

Operational Monitoring **Operational Plan**	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 4 (OM04) Pre-emptive assessment of sensitive receptors at risk	OM04 aims to undertake a rapid assessment of the presence, extent and current status of shoreline sensitive receptors prior to contact from the hydrocarbon spill, by providing categorical or semi-quantitative information on the characteristics of resources at risk. The primary objective of OM04 is to confirm understanding of the status and characteristics of environmental resources predicted by OM01 and OM02 to be at risk, to further assist in making decisions on the selection of appropriate response actions and prioritisation of resources. Indirectly, qualitative/semi-quantitative pre-contact information collected by OM04 on the status of environmental resources may also aid in the verification of environmental baseline data and provide context for the assessment of environmental impacts, as determined through subsequent SMPs. OM04 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	Triggers for commencing OM04 include: • Contact of a sensitive habitat or shoreline is predicted by OM01, OM02 and/or OM03. • The pre-emptive assessment methods can be implemented before contact from hydrocarbons (once a receptor has been contacted by hydrocarbons it will be assessed under OM05).	The criteria for the termination of OM04 at any given location are: • Locations predicted to be contacted by hydrocarbons have been contacted. • The location has not been contacted by hydrocarbons and is no longer predicted to be contacted by hydrocarbons (resources should be reallocated as appropriate).

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational monitoring operational plan 5 (OM05) Monitoring of contaminated resources	OM05 aims to implement surveys to assess the condition of wildlife and habitats contacted by hydrocarbons at sensitive habitat and shoreline locations. The primary objectives of OM05 are: • Record evidence of oiled wildlife (mortalities, sub-lethal impacts, number, extent, location) and habitats (mortalities, sub-lethal impacts, type, extent of cover, area, hydrocarbon character, thickness, mass and content) throughout the response and clean-up at locations contacted by hydrocarbons to inform and prioritise clean-up efforts and resources, while minimising the potential impacts of these activities. Indirectly, the information collected by OM05 may also support the assessment of environmental impacts, as determined through subsequent SMPs. OM05 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	OM05 will be triggered when a sensitive habitat or shoreline is predicted to be contacted by hydrocarbons by OM01, OM02 and/or OM03.	The criteria for the termination of OM05 at any given location are: • No additional response or clean-up of wildlife or habitats is predicted. • Spill response and clean-up activities have ceased. OM05 survey sites established at sensitive habitat and shoreline locations will continue to be monitored during SM02. The formal transition from OM05 to SM02 will begin on cessation of spill response and clean-up activities.

ANNEX C: OIL SPILL SCIENTIFIC MONITORING PROGRAM

Oil Spill Environmental Monitoring

The following provides some further detail on Woodside's oil spill Scientific Monitoring Program and includes the following:

- the organisation, roles and responsibilities of the woodside oil spill scientific monitoring team and external resourcing
- a summary table of the ten scientific monitoring programs as per the specific focus receptor, objectives, activation triggers and termination criteria
- details on the oil spill environmental monitoring activation and termination decision-making processes
- baseline knowledge and environmental studies knowledge access via geo-spatial metadata databases
- an outline of the reporting requirements for oil spill scientific monitoring programs.

Oil Spill Scientific Monitoring – Delivery Team Roles and Responsibilities

Woodside Oil Spill Scientific Monitoring Delivery Team

The Woodside science team are responsible for the delivery of the oil spill scientific monitoring. The roles and responsibilities of the Woodside scientific monitoring delivery team are presented in Table C-1 and the organisational structure and Incident Control Centre (ICC) linkage provided in Figure C-1.

Woodside Oil Spill Scientific monitoring program - External Resourcing

In the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors, scientific monitoring personnel and scientific equipment to implement the appropriate SMPs will be provided by standby SMP contractor who hold a standby contract for SMP via the Woodside Environmental Services Panel (ESP). In the event, that additional resources are required other consultancy capacity within the Woodside ESP will be utilised (as needed and may extend to specialist contractors such as research agencies engaged in long-term marine monitoring programs). In consultation with the standby SMP contractor and/or specialist contractors, the selection, field sampling and approach of the SMPs will be determined by the nature and scale of the spill.

Table C-1: Woodside and Environmental Service Provider – Oil Spill Scientific Monitoring Program Delivery Team Key Roles and Responsibilities

Role	Location	Responsibility
Woodside Roles		
SMP Lead/Manager	Onshore (Perth)	• Approves activated the SMPs based on operational monitoring data provided by the Planning Function • Provides advice to the ICC in relation to scientific monitoring • Provides technical advice regarding the implementation of scientific monitoring • Approves detailed sampling plans prepared for SMPs • Directs liaison between statutory authorities, advisors and government agencies in relation to SMPs.
SMP Co-ordinator	Onshore (Perth)	• Activates the SMPs based on operational monitoring data provided by the Planning Function • Sits in the Planning function of the ICC. • Liaises with other ICC functions to deliver required logistics, resources and operational support from Woodside to support the Environmental Service Provider in delivering on the SMPs. Acts as the conduit for advice from the Chief Environmental Scientist to the Environmental Service Provider • Manages the Environmental Service Provider's implementation of the SMPs • Liaises with the Environmental Service Provider on delivery of the SMPs • Arranges all contractual matters, on behalf of Woodside, associated with the Environmental Service Provider's delivery of the SMPs.

Role	Location	Responsibility
Environmental Service Provider Roles		
SMP Standby Contractor – SMP Duty Manager/Project Manager	Onshore (Perth)	• Coordinates the delivery of the SMPs • Provides costings, schedule and progress updates for delivery of SMPs • Determines the structure of the Environmental Service Provider's team to necessitate delivery of the SMPs • Verifies that HSE Plans, detailed sampling plans and other relevant deliverables are developed and implemented for delivery of the SMPs • Directs field teams to deliver SMPs • Arranges all contractual matters, on behalf of Environmental Service Provider, associated with the delivery of the SMPs to Woodside • Manages sub-consultant delivery to Woodside • Provides required personnel and equipment to deliver the SMPs.
SMP Field Teams	Offshore – Monitoring Locations	• Delivers the SMPs in the field consistent with the detailed sampling plans and HSE requirements, within time and budget. • Early communication of time, budget, HSE risks associated with delivery of the SMPs to the Environmental Service Provider – Project Manager • Provides start up, progress and termination updates to the Environmental Service Provider – Project Manager (will be led in-field by a party chief).

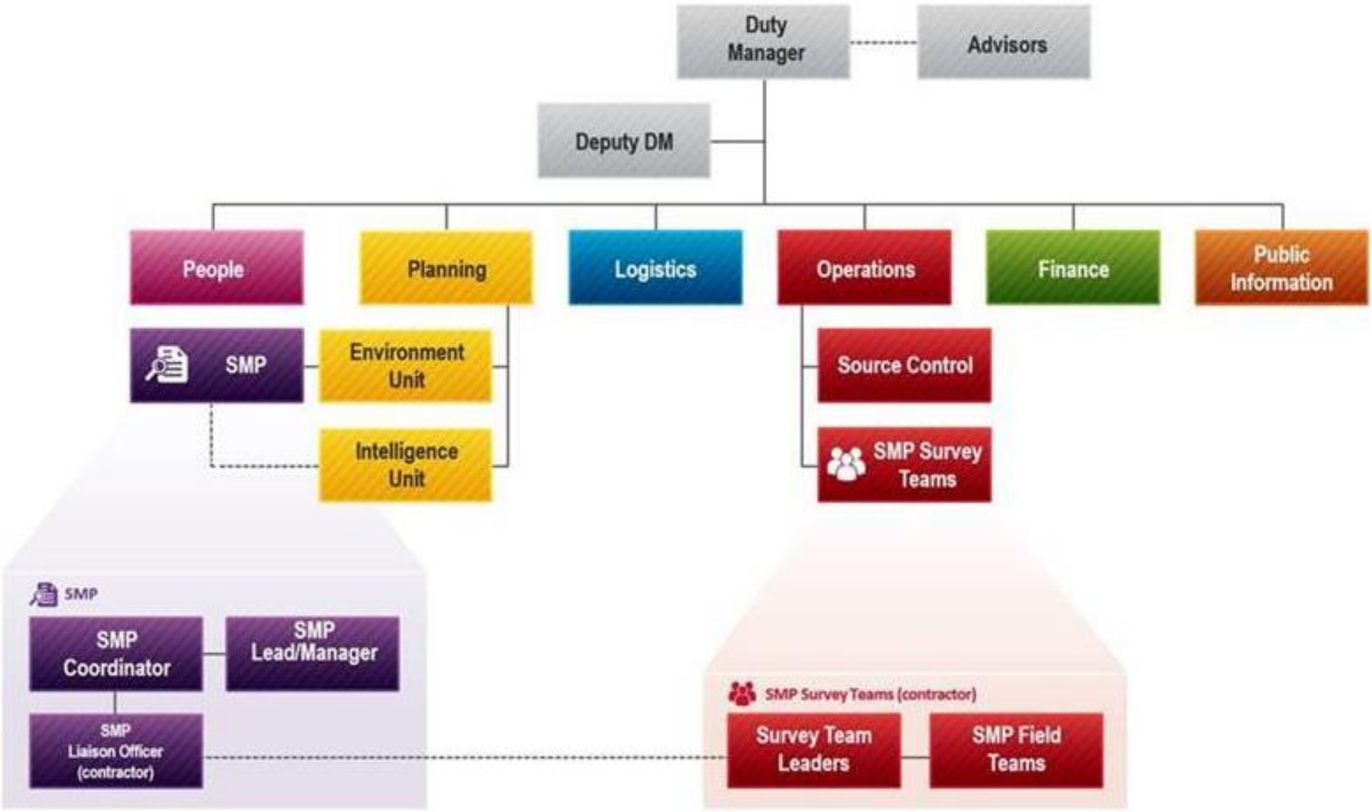

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to Incident Control Centre (ICC) organisational structure.

Table C-2: Oil Spill Environmental Monitoring: Scientific Monitoring Program - Objectives, Activation Triggers and Termination Criteria

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
Scientific monitoring program 1 (SM01) **Assessment of Hydrocarbons in Marine Waters**	SM01 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine waters following the spill and the response. The specific objectives of SM01 are as follows: • Assess and document the extent, severity and persistence of hydrocarbon contamination with reference to observations made during surveillance activities and / or in-water measurements made during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM01 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors	SM01 will be terminated when: • Operational monitoring data relating to observations and / or measurements of hydrocarbons on and in water have been compiled, analysed and reported; and • The report provides details of the extent, severity and persistence of hydrocarbons which can be used for analysis of impacts recorded for sensitive receptors monitored under other SMPs. SMP monitoring of sensitive receptor sites: • Concentrations of hydrocarbons in water samples are below NOPSEMA guidance note (2019[8]) concentrations of 1 g/m2 for floating, 10 ppb for entrained and dissolved; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in water have been documented at sensitive receptor sites monitored under other SMPs.
Scientific monitoring program 2 (SM02) **Assessment of the Presence, Quantity and Character of Hydrocarbons in Marine Sediments**	SM02 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine sediments following the spill and the response. The specific objectives of SM02 are as follows: • Determine the extent, severity and persistence of hydrocarbons in marine sediments across selected sites where hydrocarbons were observed or recorded during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM02 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • Response activities have ceased; and • Operational monitoring results made during the response phase indicate that shoreline, intertidal or sub-tidal sediments have been exposed to surface, entrained or dissolved hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation).	SM02 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Concentrations of hydrocarbons in sediment samples are below ANZECC/ ARMCANZ (2013[9]) sediment quality guideline values (SQGVs) for biological disturbance; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in sediments have been documented.
Scientific monitoring program 3 (SM03) **Assessment of Impacts and Recovery of Subtidal and Intertidal Benthos**	The objectives of SM03 are: • Characterize the status of intertidal and subtidal benthic habitats and quantify any impacts to functional groups, abundance and density that may be a result of the spill; and • Determine the impact of the hydrocarbon spill and subsequent recovery (including impacts associated with the implementation of response options). Categories of intertidal and subtidal habitats that may be monitored include: • Coral reefs • Seagrass • Macro-algae • Filter-feeders SM03 will be supported by sediment contamination records (SM02) and characteristics of the spill derived from OMPs.	SM03 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of PBAs of receptor locations identified by time to hydrocarbon contact >10 days, to target receptors and sites where it is possible to acquire pre-hydrocarbon contact baseline; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for subtidal and intertidal benthic habitat.	SM03 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Overall impacts to benthic habitats from hydrocarbon exposure have been quantified. • Recovery of impacted benthic habitats has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 4 (SM04) **Assessment of Impacts and Recovery of Mangroves / Saltmarsh**	The objectives of SM04 are: • Characterize the status of mangroves (and associated salt marsh habitat) at shorelines exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance and density) and mangrove/saltmarsh community structure; and	SM04 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows:	SM04 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Impacts to mangrove and saltmarsh habitat from hydrocarbon exposure have been quantified.

[8] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf

[9] Simpson SL, Batley GB and Chariton AA (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO and Water Science Report 08/07. Land and Water, pp. 132.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options). SM03 will be supported by sediment sampling undertaken in SM02 and characteristics of the spill derived from OMPs.	• As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for mangrove/saltmarsh habitat.	• Recovery of impacted mangrove/saltmarsh habitat has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 5 (SM05) **Assessment of Impacts and Recovery of Seabird and Shorebird Populations**	The Objectives of SM05 are to: • Collate and quantify impacts to avian wildlife from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population level; and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to seabirds and shorebird populations at targeted breeding colonies / staging sites / important coastal wetlands where hydrocarbon contact was recorded.	SM05 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Operational monitoring predicts shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at important bird colonies / staging sites / important coastal wetland locations; or • Records of dead, oiled or injured bird species made during the hydrocarbon spill or response.	SM05 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to seabird and shorebird populations from hydrocarbon exposure have been quantified. • Recovery of impacted seabird and shorebird populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 6 (SM06) **Assessment of Impacts and Recovery of Nesting Marine Turtle Populations**	The objectives of SM06 are to: • To quantify impacts of hydrocarbon exposure or contact on marine turtle nesting populations (including impacts associated with the implementation of response options); • Collate and quantify impacts to adult and hatchling marine turtles from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels (including impacts associated with the implementation of response options); .and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to nesting marine turtle populations at known rookeries (including impacts associated with the implementation of response options).	SM06 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Predicted shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known marine turtle rookery locations; or • Records of dead, oiled or injured marine turtle species made during the hydrocarbon spill or response.	SM06 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to nesting marine turtle populations from hydrocarbon exposure have been quantified. • Recovery of impacted nesting marine turtle populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 7 (SM07) **Assessment of Impacts to Pinniped Colonies including Haul-out Site Populations**	The objectives of SM07 are to: • Quantify impacts on pinniped colonies and haul-out sites as a result of hydrocarbon exposure/contact. • Collate and quantify impacts to pinniped populations from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels.	SM07 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Identified shoreline contact of hydrocarbons ((at or above 0.5 g/m^2 surface, ≥5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known pinniped colony or haul-out site(s) (i.e. most northern site is the Houtman Abrolhos Islands); or • Records of dead, oiled or injured pinniped species made during the hydrocarbon spill or response.	SM07 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to pinniped populations from hydrocarbon exposure have been quantified. • Recovery of pinniped populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 8 (SM08) **Desk-Based Assessment of Impacts to Other Non-Avian Marine Megafauna**	The objective of SM08 is to provide a desk-based assessment which collates the results of OM02 and OM05 where observations relate to the mortality, stranding or oiling of mobile marine megafauna species not addressed in SM06 or SM07, including: • Cetaceans;	SM08 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring reports	SM08 will be terminated when the results of the post-spill monitoring have quantified impacts to non-avian megafauna.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Dugongs; • Whale sharks and other shark and ray populations; • Sea snakes; and • Crocodiles. The desk-based assessment will include population analysis to infer potential impacts to marine megafauna species populations.	records of dead, oiled or injured non-avian marine megafauna during the spill/ response phase.	• Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 9 (SM09) **Assessment of Impacts and Recovery of Marine Fish associated with SM03 habitats**	The objectives of SM09 are: • Characterise the status of resident fish populations associated with habitats monitored in SM03 exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance, richness and density) and resident fish population structure (representative functional trophic groups); and • Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options).	SM09 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented with SMO3.	SM09 will be undertaken and terminated concurrent with monitoring undertaken for SM03, as per the SMP termination criteria process • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 10 (SM10) **SM10 - Assessment of physiological impacts important fish and shellfish species (fish health and seafood quality/safety) and recovery**	SM10 aims to assess any physiological impacts to important commercial fish and shellfish species (assessment of fish health) and if applicable, seafood quality/safety. Monitoring will be designed to sample key commercial fish and shellfish species and analyse tissues to identify fish health indicators and biomarkers, for example: • Liver Detoxification Enzymes (ethoxyresorufin-O-deethylase (EROD) activity) • PAH Biliary Metabolites • Oxidative DNA Damage • Serum SDH • Other physiological parameters, such as condition factor (CF), liver somatic index (LSI), gonado-somatic index (GSI) and gonad histology, total weight, length, condition, parasites, egg development, testes development, abnormalities. Seafood tainting may be included (where appropriate) using applicable sensory tests to objectively assess targeted finfish and shellfish species for hydrocarbon contamination. Results will be used to make inferences on the health of commercial fisheries and the potential magnitude of impacts to fishing industries.	SM10 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring (OM01, OM02 and OM05) indicates the following: • The hydrocarbon spill will or has intersected with active commercial fisheries or aquaculture activities. • Commercially targeted finfish and/or shellfish mortality has been observed/recorded. • Commercial fishing or aquaculture areas have been exposed to hydrocarbons (≥0.5 g/m^2 surface and ≥5 ppb for entrained/dissolved hydrocarbons); and • Taste, odour or appearance of seafood presenting a potential human health risk is observed.	SM10 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Physiological impacts to important commercial fish and shellfish species from hydrocarbon exposure have been quantified. • Recovery of important commercial fish and shellfish species from hydrocarbon exposure has been evaluated. • Impacts to seafood quality/safety (if applicable) have been assessed and information provided to the relevant stakeholders and regulators for the management of any impacted fisheries. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.

Activation Triggers and Termination Criteria

Scientific monitoring program activation

The Woodside oil spill scientific monitoring team will be stood up immediately with the occurrence of a hydrocarbon spill (actual or suspected) Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors via the First Strike plan for the petroleum activity programme. The presence of any level of hydrocarbons in the marine environment triggers the activation of the oil spill scientific monitoring program (SMP). This is to ensure the full range of eventualities relating to the environmental, socio-economic and health consequences of the spill are considered in the planning and execution of the SMP. The activation process also takes into consideration the management objectives, species recovery plans, conservation advices and conservations plans for any World Heritage Area (WHA), AMPs, State Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act) potentially exposed to hydrocarbons. With the first 24-48 hours of a spill event, such information will be sourced and evaluated as part of the SMP planning process guided by Appendix D (identified receptors vulnerable to hydrocarbon contact), the information presented in the Existing Environment section of the EP as well as other information sources such as the Woodside Baseline Environmental Studies Database.

The starting point for decision-making on which SMPs are activated, and the spatial extent of monitoring activities, will be based on the predictive modelling results (OM01) in the first 24-48 hours until more information is made available from other operational monitoring activities such as aerial surveillance and shoreline surveys. Pre-emptive Baseline Areas (WHA, AMPs and State Marine Parks encompassing key ecological and socio-economic values) are a key focus of the SMP activation decision-making process, particularly, in the early spill event/response phase. As the operational monitoring progresses and further situational awareness information becomes available, it will be possible to understand the nature and scale of the spill. The SMP activation and implementation decision-making will be revisited on a daily basis to account for the updates on spill information. One of the priority focus areas in the early phase of the incident will be to identify and execute pre-emptive SMP assessments at key receptor locations, as required. The SMP activation and implementation decision tree is presented in Figure C-2.

Scientific monitoring program termination

The basis of the termination process for the active SMPs (SMPs 1-10) will include quantification of impacts, evaluation of recovery for the receptor at risk and consultation with relevant authorities, persons and organisations. Termination of each SMP will not be considered until the results (as presented in annual SMP reports for the duration of each program) indicate that the target receptor has returned to pre-spill condition.

Once the SMP results indicate impacted receptor(s) have returned to pre-spill condition (as identified by Woodside) a termination decision-making process will be triggered and a number of steps will be undertaken as follows:

- Woodside will engage expert opinion on whether the receptor has returned to pre-spill condition (based on monitoring data). Subject Matter Expert (SMEs) will be engaged (via the Woodside SME scientific monitoring terms of reference) to review program outcomes, provide expert advice and recommendations for the duration of each SMP.
- Where expert opinion agrees that the receptor has returned to pre-spill condition, findings will then be presented to the relevant authorities, persons and organisations (as defined by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulation 11A). Stakeholder identification, planning and engagement will be managed by Woodside's Reputation Functional Support Team (FST) and follow the stakeholder management FST guidelines. These guidelines outline the FST roles and responsibilities, competencies, stakeholder communications and planning processes. An assessment of the merits of any objection to termination will be documented in the SMP final report.
- Woodside will decide on termination of SMP based on expert opinion and merits of any stakeholder objections. The final report following termination will include: monitoring results, expert opinion and stakeholder consultation including merits of any objections.

- Termination of SMPs will also consider applicable management objectives, species recovery plans, conservation advices and conservations plans for any World Heritage Area (WHA), AMPs, State Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act).

The SMP termination decision-making process will be applied to each active SMP and an iterative process of decision steps continued until each SMP has been terminated (refer to decision-tree diagram for SMP termination criteria, Figure C-3).

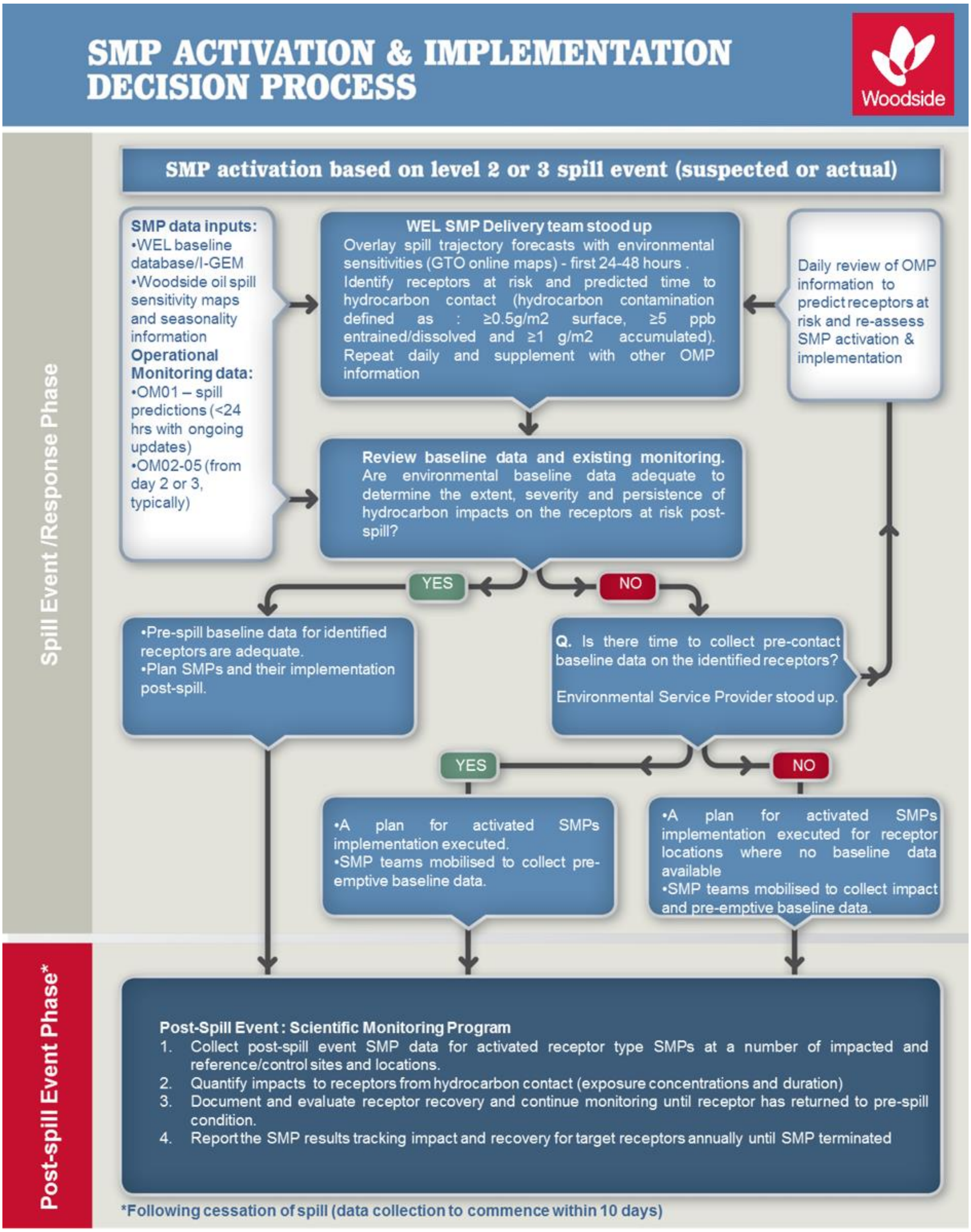

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

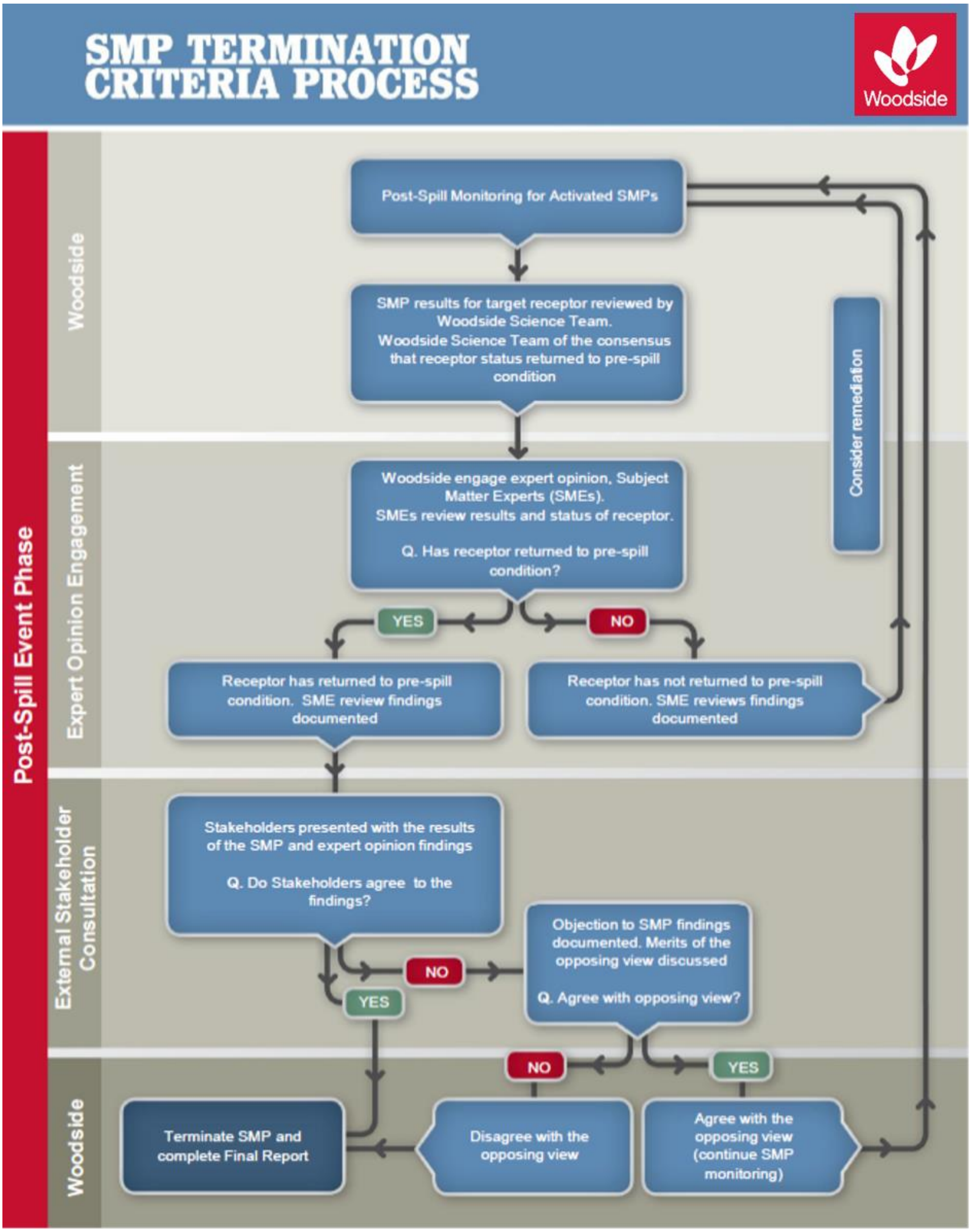

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

Receptors at Risk and Baseline Knowledge

In order to assess the baseline studies available and suitability for oil spill scientific monitoring, Woodside maintains knowledge of environmental baseline studies through the upkeep and use of its Environmental Knowledge Management System.

Woodside's Environmental Knowledge Management System is a centralised platform for scientific information on the existing environment, marine biodiversity, Woodside environmental studies, key environmental impact topics, key literature and web-based resources. The system comprises a number of data directories and an environmental baseline database, as well as folders within the 'Corporate Environment' server space. The environmental baseline database was set up to support Woodside's SMP preparedness and as a SMP resource in the event of an unplanned hydrocarbon spill. The environmental baseline database is subject to updates including annual reviews completed as part of the contracted SMP standby, SMP standby contract. This database is accessed pre-PAP to identify Pre-emptive Baseline Areas (PBAs) where hydrocarbon contact is predicted to occur <10 days.

In addition to Woodside's Environmental Knowledge Management System, it is acknowledged that many relevant baseline datasets are held by other organisations (e.g. other oil and gas operators, government agencies, state and federal research institutions and non-governmental organisations). In order to understand the present status of environmental baseline studies a spatial environmental metadata database for Western Australia (Industry-Government Environmental Metadata, I-GEM) was established. IGEM is a collaboration comprising oil and gas operators (including Woodside), government and research agencies and other organisations. The key objective of IGEM is for participating organisations to have the ability to identify quantitative marine baseline datasets available for species and habitats via a geo-spatially referenced metadata database. It provides members the ability to enter, view and filter metadata records on baseline studies as well as customise and generate report outputs. IGEM aims to provide a foundational baseline framework so industry and government can access the same knowledge base to understand baseline data in the event of an unplanned hydrocarbon release.

In the event of an unplanned hydrocarbon release, Woodside intends to interrogate the information on baseline studies status as held by the various databases (e.g. Woodside Environmental Knowledge Management System, IGEM and other sources of existing baseline data) to identify Pre-emptive Baseline Areas (PBAs), i.e., receptors at risk where hydrocarbon contact is predicted to be >10 days, and baseline data can be collected before hydrocarbon contact.

Reporting

For the scientific monitoring program relevant regulators will be provided with:

- Annual reports summarising the SMPs deployed and active, data collection activities and available findings; and
- Final reports for each SMP summarising the quantitative assessment of environmental impacts and recovery of the receptor once returned to pre-spill condition and termination of the monitoring program.

The reporting requirements of the scientific monitoring program will be specific to the individual SMPs deployed and terms of responsibilities, report templates, schedule, QA/QC and peer-review will be agreed with the contractors engaged to conduct the SMPs. Compliance and auditing mechanisms will be incorporated into the reporting terms.

ANNEX D: SCIENTIFIC MONITORING PROGRAM AND BASELINE STUDIES FOR THE PETROLEUM ACTIVITIES PROGRAM

Table D-1: Oil Spill Environmental Monitoring – scientific monitoring program scope for the Petroleum Activities Program based on Spill EMBA for Credible Scenario-01, Credible Scenario-04 and Credible Scenario-05

Receptors to be Monitored	Applicable SMP	Receptor Areas - Potential Impact and Reference Scientific Monitoring Sites (marked X)																																							
		Kimberley AMP	Agro-Rowley Terrace AMP	Montebello AMP	Dampier AMP	Carnarvon Canyon AMP	Ningaloo AMP	Gascoyne AMP	Shark Bay Open Ocean (including AMP)	Abrolhos AMP	Jurien AMP	Two Rocks AMP	Perth Canyon AMP	Geographe AMP	South-west Corner AMP	Ashmore Reef and AMP	Seringapatam Reef	Scott Reef (North and South)	Mermaid Reef and AMP	Clerke Reef and State Marine Park	Imperieuse Reef and State Marine Park	Rankin Bank	Glomar Shoals	Rowley Shoals (including Sate Maine Park)	Fantome Shoal	Adele Island	Lacepede Islands	Montebello Islands (including State Marine Park)	Lowendal Islands (including State Nature Reserves)	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	Muiron Islands (WHA, Marine Management Area)	Pilbara Islands - Southern Island Group (Serrurier, Thevenard and Bessieres Islands - State Nature Reserves)	Pilbara Islands - Northern Island Group (Sandy Island Passage Islands - State nature reserves)	Abrolhos Islands	Kimberley Coast	Dampier Peninsula	Northern Pilbara Shoreline	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	Shark Bay - Open Ocean Coast	Shark Bay (WHA, State Marine Park)	Ngari Capes State Marine Park
Habitat																																									
Water Quality	SM01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Sediment Quality	SM02	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Coral Reef	SM03	X		X												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	
Seagrass / Macro-Algae	SM03	X									X					X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Deeper Water Filter Feeders	SM03	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X							X			
Mangroves and Saltmarsh	SM04																											X						X	X	X	X	X		X	
Species																																									
Sea Birds and Migratory Shorebirds (significant colonies / staging sites / coastal wetlands)	SM05	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Turtles (significant nesting beaches)	SM06	X	X	X	X		X	X	X							X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pinnipeds (significant colonies / haul-out sites)	SM07									X	X	X			X																										X
Cetaceans - Migratory Whales	SM08	X	X	X	X		X	X	X	X	X	X	X	X	X			X									X	X	X	X	X			X	X	X		X		X	X
Oceanic and Coastal Cetaceans	SM08	X	X	X	X		X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dugongs	SM08	X							X							X												X	X	X	X	X	X		X	X	X	X	X	X	
Sea Snakes	SM08	X		X	X			X	X	X						X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Whale Sharks	SM08			X			X	X										X										X	X	X	X							X			
Other Shark and Ray Populations	SM08, SM09	X	X	X	X		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fish Assemblages	SM09	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Socio-economic																																									
Fisheries - Commercial	SM10		X	X	X	X	X	X	X	X	X	X										X	X	X	X			X	X	X		X	X	X	X	X	X	X	X	X	X
Fisheries - Traditional	SM10															X	X	X									X													X	
Tourism (incl. recreational fishing)	SM10	X		X			X	X	X		X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X

(dark red)	Receptor areas identified as Pre-emptive Baseline Areas (based on criteria of surface contact and/or entrained hydrocarbon contact ≤10 days (Offshore Australian Marine Parks contacted by hydrocarbons in this timeframe also noted)
(light red)	Receptor areas identified as Pre-Emptive Basline Areas in the response phase >10 days (based on criteria of surface contact and/or entrained hydrocarbon contact >10 days)
(white)	Receptor areas that may be identified as impact or reference sites in the event of major hydrocarbon release and would be identified as part of the SMP planning process

(Table 2-1)

Table D-2: Baseline Studies for the SMPs applicable to identified Pre-emptive Baseline Areas for the Petroleum Activities Program

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank	Montebello AMP
Benthic Habitat (Coral Reef)	SM03 Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	Studies:	
		1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	Coral Reefs & Filter Feeders 1. Montebello Marine Park, 2019, Identification and qualitative descriptions of benthic habitat. 2. Montebello Australian Marine Parks – 2019 – Baseline survey on benthic habitats. 3. Pluto Trunkline within Montebello Marine Park – Monitoring marine communities.
		Methods:	
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system.	1.ROV Transects. 2. Benthic habitat mapping, multibeam acoustic swathing. 3. ROV video.
		References and Data:	
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3.Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	1. Advisian 2019 2. Keesing 2019 3. McLean et al. 2019
Benthic Habitat (Seagrass and Macro-algae)		Studies:	
		1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	N/A – see table D – 1

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank	Montebello AMP
	SM03 Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	Methods:	
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system	N/A – see table D – 1
		References and Data:	
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	N/A – see table D – 1
Benthic Habitat (Deeper Water Filter Feeders)	SM03 Quantitative assessment using image capture using towed video. Post analysis into broad groups based on taxonomy and morphology.	Studies:	
		1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	N/A – see table D – 1
		Methods:	
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system	N/A – see table D – 1
		References and Data:	

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank	Montebello AMP
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	N/A – see table D – 1
Mangroves and Saltmarsh	SM04 Aerial photography and satellite imagery will be used in conjunction with field surveys to map the range and distribution of mangrove communities.	Studies:	
		N/A – See Table D-1	N/A – see table D – 1
		Methods:	
		N/A – See Table D-1	N/A – see table D – 1
		References and Data:	
		N/A – See Table D-1	N/A – see table D – 1
Seabirds	SM05 Visual counts of breeding seabirds, nest counts, intertidal bird counts at high tide.	Studies:	
		N/A – See Table D-1	Present, in open water, no breeding habitat.
		Methods:	
		N/A – See Table D-1	N/A
		References and Data:	
		N/A – See Table D-1	N/A
Turtles	SM06 Beach surveys (recording species, nests, and false crawls).	Studies:	
		N/A – See Table D-1	Present, in open water, no nesting habitats.
		Methods:	
		N/A – See Table D-1	N/A
		References/Data:	
		N/A – See Table D-1	N/A
		Studies:	
		1. Glomar Shoals and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoals and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoals, 2018.	1. CSIRO – Fish Diversity. 2. Fish species richness and abundance.
		Methods:	

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank	Montebello AMP
Fish	Baited Remote Underwater Video Stations (BRUVS), Visual Underwater Counts (VUC), Diver Operated Video (DOV).	1. BRUVs. 2. BRUVs. 3. BRUVs. 4. BRUVs.	1. Semi V Wing trawl net or an epibenthic sled. 2. ROV Video.
		References/Data:	
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	1. Keesing 2019. 2. McLean et al. 2019.

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Currey-Randall L, Wakeford M, Colquhoun J, Cappo M, Stowar M, Birt M, Cure K, Vaughan B, Case M, Fisher R and Miller KJ (2019) Temporal trends in benthic communities and demersal fishes at Rankin Bank and Glomar Shoal. Report prepared for Woodside Energy Ltd. Australian Institute of Marine Science, Perth. 59 pp.

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ANNEX E: TACTICAL RESPONSE PLANS

TACTICAL RESPONSE PLANS
Exmouth
Mangrove Bay
Turquoise Bay
Yardie Creek
Muiron Islands
Jurabi to Lighthouse Beaches Exmouth
Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek
Exmouth Gulf
Shark Bay Area 1: Carnarvon to Wooramel
Shark Bay Area 2: Wooramel to Petite Point
Shark Bay Area 3: Petite Point to Dubaut Point
Shark Bay Area 4: Dubaut Point to Herald Bight
Shark Bay Area 5: Herald Bight to Eagle Bluff
Shark Bay Area 6: Eagle Bluff to Useless Loop
Shark Bay Area 7: Useless Loop to Cape Bellefin
Shark Bay Area 8: Cape Bellefin to Steep Point
Shark Bay Area 9: Western Shores of Edel Land
Shark Bay Area 10: Dirk Hartog Island
Shark Bay Area 11: Bernier and Dorre Islands
Abrohlos Islands: Pelseart Group
Abrohlos Islands: Wallabi Group
Abrohlos Islands: Easter Group
Dampier
Rankin Bank & Glomar Shoals
Barrow and Lowendal Islands
Pilbara Islands - Southern Island Group
Montebello Island - Stephenson Channel Nth TRP
Montebello Island - Champagne Bay and Chippendale channel TRP
Montebello Island - Claret Bay TRP
Montebello Island - Hermite/Delta Island Channel TRP
Montebello Island - Hock Bay TRP
Montebello Island - North and Kelvin Channel TRP
Montebello Island - Sherry Lagoon Entrance TRP
Withnell Bay
Holden Bay
King Bay
No Name Bay / No Name Beach
Enderby Is -Dampier
Rosemary Island - Dampier
Legendre Is - Dampier

Karratha Gas Plant
KGP to Whitnell Creek
KGP to Northern Shore
KGP Fire Pond & Estuary
KGP to No Name Creek
Broome
Sahul Shelf Submerged Banks and Shoals
Clerke Reef (Rowley Shoals)
Imperieuse Island (Rowley Shoals)
Mermaid Reef (Rowley Shoals)
Scott Reef
Oiled Wildlife Response
Exmouth
Dampier region
Shark Bay

APPENDIX E: NOPSEMA REPORTING FORMS

NOPSEMA Recordable Environmental Incident monthly Reporting Form
https://www.nopsema.gov.au/assets/Forms/A198750.doc
Report of an accident, dangerous occurrence or environmental incident
https://www.nopsema.gov.au/assets/Forms/N-03000-FM0831-Report-of-an-Accident-Dangerous-Occurrence-or-Environmental-Incident-Rev-8-Jan-2015-MS-Word-2010.docx

APPENDIX F: STAKEHOLDER CONSULTATION

WA-49-L Gemtree-A Exploration Drilling Environment Plan

February 2020
Revision: 0

1. Consultation

1.1 Email sent to relevant stakeholders (23 and 24 October 2019)

Woodside sent the email below and consultation Information Sheet below to:

- *Australian Customs Service (ACS)*
- *Department of Biodiversity, Conservation and Attractions (DBCA)*
- *Department of Industry, Innovation and Science (DIIS)*
- *Department of Mines, Industry Regulation and Safety (DMIRS)*
- *Australian Petroleum Production and Exploration Association (APPEA)*

Dear Stakeholder

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures.

The Information Sheet is also available on our website.

Activity overview

Activity:	• Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	• Barrow sub-basin • 20002' 06.754 S 115006' 32.749 E • The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	• ~200 m
Earliest commencement date:	• Q3, 2020
Estimated duration:	• 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you y have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.2 Woodside Consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION
SHEET

October 2019

GEMTREE-A EXPLORATION WELL ENVIRONMENT PLAN

BARROW SUB-BASIN

Woodside is submitting an Environment Plan for the proposed Gemtree-A exploration well in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

The proposed exploration well is located in the Barrow sub-basin in approximately 200 m of water and will take around 50 days to drill.

The exploration well is location in Production Licence WA-49-L, which is held by Woodside (Operator and 65% interest) and KUFPEC Australia Pty Ltd (35% interest).

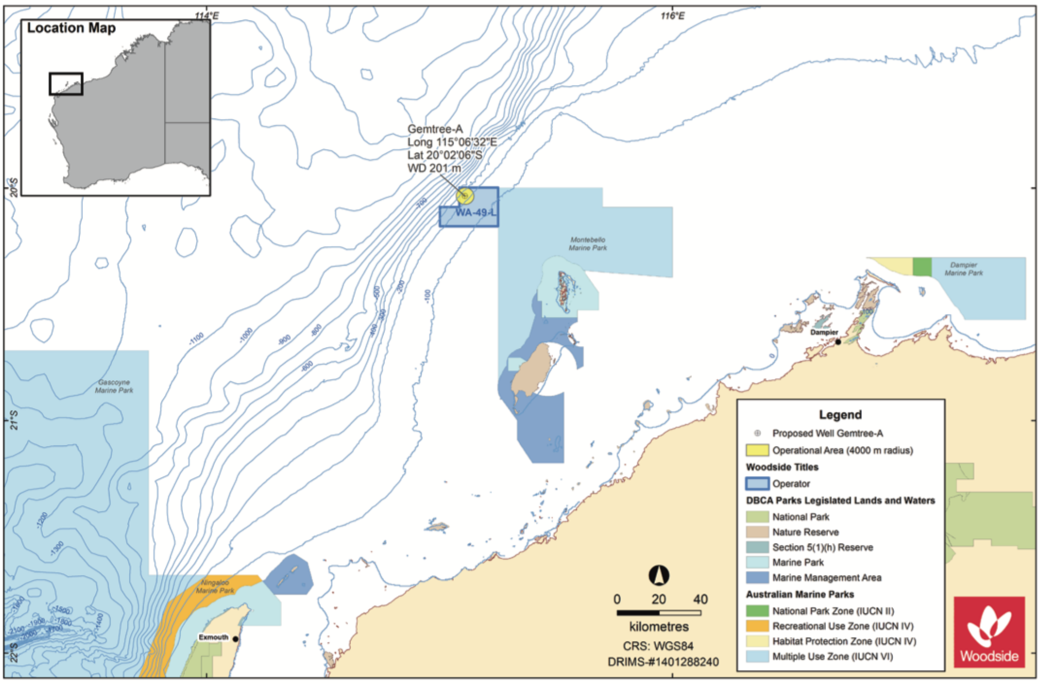


Table 1. Activity summary

Gemtree-A exploration well	
Commencement date	+ Q3, 2020
Location	+ Barrow sub-basin + 20002' 06.754 S 115006' 32.749 E
Approximate estimated duration	+ 50 days
Water depth (well)	+ -200 m
Number of wells	+ One exploration well
Project vessels	+ Semi-submersible mobile offshore drilling unit (MODU) + Activity support vessels, including general supply/support vessels and anchor handling vessel(s) (AHV)
Distance to nearest port	+ 182 km (Dampier Port)
Distance to nearest marine park	+ 47 km (Montebello Island Marine Park)

Proposed Activity

Exploration and appraisal wells are used to explore for and confirm new accumulations of oil and gas. The proposed Gemtree-A Well is located in Permit Area WA-49-L, in Commonwealth waters in the Barrow sub-basin, about 142 km off the Pilbara coast of Western Australia.

The closest landfall to the well location is the Montebello Islands, which are about 55 km southeast (and 47 km to the Montebello Island Marine Park).

The proposed drilling of the exploration well is expected to commence in Q3 of 2020 and take about 50 days to complete.

Key activities related to the well include (referred to as the Petroleum Activities Program):

+ Anchor holding testing
+ Pre-lay of anchors by AHV and contingent suction piling if necessary
+ Mooring activity on arrival of MODU
+ Top-hole section drilling
+ Installation of blow-out preventer (BOP) and marine riser
+ Bottom hole section drilling
+ Formation evaluation, including vertical seismic profiling (VSP)
+ Permanent abandonment of well

Activity Vessels

The Petroleum Activities Program will be drilled by the Ocean Apex MODU or similar. Due to variabilities such as contractual and operational matters, the MODU used may be subject to change.

During the Petroleum Activities Program, the MODU will be supported by other vessels, such as general support vessel(s) and AHV(s).

Support vessels are used to transport equipment and materials between the MODU and port. Support vessels may transit between the Operational Area and north-west Ports including Dampier, Onslow and Exmouth (primarily Dampier).

Support vessels do not anchor within the Operational Area during the activities due to water depth. The support vessels are also available to assist in implementing the Oil Pollution First Strike Plan, should an environmental incident occur (e.g. spills).

Communications with mariners

The Operational Area defines the spatial boundary of the Petroleum Activities Program. The Operational Area encompasses a radius of 4000 m from the well centre.

The 4000 m (radius) Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities. The Operational Area for drilling activities includes a 500 m petroleum safety zone around the MODU to manage vessel movements. The 500 m petroleum safety zone is under the control of the MODU Person in Charge and excludes other vessels from this area.

The Petroleum Activities Program will involve activities running 24 hours per day, seven days per week. Timing and duration of these activities is subject to change due to project schedule requirements, MODU/vessel availability, unforeseen circumstances and weather.

Marine notices will be issued prior to activity commencement to alert vessels which maybe operating in waters nearby.

Implications for stakeholders

Woodside will consult relevant stakeholders whose interests, functions, and activities may be affected by the proposed activities. We will also keep other stakeholders who have identified an interest in the activities informed about our planned activities.

Woodside has undertaken an assessment to identify potential risks to the marine environment and relevant stakeholders, considering timing, duration, location and potential impacts arising from petroleum activities.

A number of mitigation and management measures will be implemented and are summarised in the Table 2. Further details will be provided in the Environment Plan.

Based on previous consultation for activities in the region, Woodside is not aware of any social activities in the vicinity of the proposed activity, such as recreational fishing. Permit Area WA-49-L is also located outside of any established or proposed Commonwealth and State Marine Protected Areas, outside of established shipping fairways and outside the Defence practice area (but marginally within the training area). WA-49-L is also adjacent to other petroleum permits that include pipeline and production infrastructure.

Environmental Context

Water depths at the activity location are approximately 200 m. The benthic habitat is typical of the broader region and is characterised by soft unconsolidated sediment (fine to coarse sands), which supports diverse benthic infauna and sparse epifauna. The Operational Areas for the proposed activities do not overlap any established or proposed marine protected areas.

Woodside will use reasonable endeavours to remove the wellheads following the completion of appraisal and exploration well activities. However, there is a possibility that these structures may not be retrievable, given technical or safety issues. Removing wellheads from the seabed and leaving them in-situ will have minor impacts on other marine users given the small footprint of the structure and approximate 3 m height of the structures above seabed. The structures will be marked on nautical charts and long-term management of the wells will meet regulatory requirements.

A number of mitigation and management measures will be implemented and are summarised in Table 2. Further details will be provided in the revised Environment Plan.

Table 2. Summary of key risks and/or impacts and management measures

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Chemical use	+ Chemical use will be managed in accordance with the Contractors Chemical Selection and Approval Procedure.
Interests of relevant stakeholders including: + **Defence activities** + **Petroleum activities** + **Commercial fishing activities** + **Shipping activities**	+ Consultation with petroleum titleholders, commercial fishers and their representative organisations, and government departments and agencies to inform decision making for the proposed activity and development of the Environment Plan. + Advice to relevant stakeholders prior to the commencement of activities.
Marine fauna interactions	+ Measures will be taken to protect marine fauna and ecosystems from vessel activities and to prevent vessel collisions.
Marine discharges	+ All routine marine discharges will be manged according to legislation and regulatory requirements and Woodside's Environmental Performance Standards where applicable.
Seabed disturbance	+ Well location and site approaisal to identify and address well-specific hazards and drilling contraints. + MODU mooring analysus and anchor deployment in accordance with internal standards. + No anchoring of support and installation vessels during drilling.
Underwater noise	+ Vertical well profiling undertaken in accordance with internal procedure, inlcuding pre-start visual observations and shutdown for whales.
Waste generation	+ Waste generated on the vessels will be manages in accordance with legislation requirements and a Waste Management Plan. + Waste will be managed and disposed of in a safe and environmentally responsible manner that prevents accidental loss to the environment. + Wastes transported onshore will be sent to appropriate recycling or disposal facilities by a licensed waste contractor.
Vessel interaction	+ Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any exclusion zones prior to commencement of the activity. + A 500 m radius safety zone will be in place around the MODU (and potential ISV) for the duration of the drilling activities. + For safety reasons, Woodside requests marine users observe a 4000 m radius precautionary zone around the MODU/ISV while on location. Note, this is not an exclusion zone as vessels may enter, however extra vigilance is requested.
Unplanned	
Hydrocarbon release (including from vessel collision)	+ Appropriate spill response plans, equipment and materials will be in place and maintained. + Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment.
Introduction of invasive marine species	+ All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. + Compliance with Australian biosecurity requirements and guidance.

Providing feedback

Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

If you would like to comment on the proposed activities outlined in this information sheet, or would like additional information, please contact Woodside before **22 November 2019.**

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)*. A copy of this fact sheet will remain available on our website for the duration of public consultation and the Petroleum Activities Program.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Andrew Decet, Corporate Affairs Manager | Exploration
E: Feedback@woodside.com.au | **Toll free:** 1800 442 977

Please note that stakeholder feedback will be communicated to NOPSEMA as required under legislation. Woodside will communicate any material changes to the proposed activity to affected stakeholders as they arise.

www.woodside.com.au

Woodside

1.3 Email sent to DPIRD, WAFIC and PPA (23 October 2019)

Dear [name supplied]

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

An information sheet and a map of State Fisheries (Pilbara Line Fishery and Pilbara Trap) relevant to the proposed activities are attached. The Information Sheet is also available on our website.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods, and water depth.

We are also liaising with WAFIC to confirm which individual licence holders should be advised.

Activity overview

Activity:	• Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	• Barrow sub-basin • 20002’ 06.754 S 115006’ 32.749 E • The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	• ~200 m
Earliest commencement date:	• Q3, 2020
Estimated duration:	• 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Potential risks to commercial fishing and proposed mitigation measures

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence:	• The presence of the project vessels and MODU may result in exclusion of other users.	• Woodside will implement a 500 m radius petroleum safety zone around the MODU whilst in the field for the duration of activities to reduce the likelihood of interactions. • Notification and updates to mariners and marine charts. • Woodside will routinely consult with marine users to ensure they are informed and aware thereby reducing the likelihood of interactions.
Seabed disturbance:	• Disturbance to the seabed from mooring of the MODU and drilling.	• Woodside will seek to minimise seabed disturbance for planned activities through: ○ MODU mooring analysis and anchor deployment in accordance with internal standards. ○ No anchoring of support vessels during drilling.
Underwater noise:	• Noise will be generated by the project vessels and MODU, and helicopters.	• Due to the low acoustic source levels associated with the MODU and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges:	• Discharges from drilling include water-based drill mud and cuttings, brines and cement. • Operational discharges from the project vessels and the MODU, including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process.
Unplanned Risks		

Hydrocarbon release:	• Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting in a tank rupture.	• Procedures for the supply and transfer of fuel. • Design of the wells and barriers within the wells to prevent loss of hydrocarbons. • Well blow-out-preventers, which are large valves or similar mechanical devices used to seal, control and monitor oil and gas wells. • Relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be implemented based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species:	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.4 Email sent to Pilbara Trap and Line Fishery licence holders (19 November 2019)

Dear licence holder

Woodside is planning to undertake petroleum activities in production licence WA-49-L offshore north-west Australia, subject to approvals, vessel availability and weather constraints.

The first of these activities will be anchor holding testing activities, which are expected to take 14 days, starting in Q1 2020. Results from these tests will be used to inform planning for the drilling of the Gemtree-A exploration well, which is planned to be drilled in WA-49-L from Q3 2020.

Both of these activities will have separate Environment Plans and a Consultation Information Sheet for each activity is attached (also available on our website), which provides background on the proposed activities, including summaries of potential key risks and associated management measures.

WAFIC and other stakeholders have been informed of the activities and a State Fisheries map relevant to these activities is also attached.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods and water depth. Individual licence holders or representative fishing organisations who have requested ongoing advice on Woodside's planned activities will also be advised.

Activity overview

Activity purpose:	• To support planning for the Gemtree-A Exploration well, which is planned to be drilled from Q3 2020
Activity:	• Lowering an anchor to the seafloor and then tensioning to determine the anchor's ability to hold, embed and not drag at the Gemtree-A location.
Activity location:	• Approximately 178 km north west of Dampier, Western Australia.
Approximate water depth:	• 200 m
Earliest commencement date:	• Q1 2020

Estimated duration:	• 14 days
Vessels:	• Anchor handling and support vessels
Relevant fisheries consulted for this activity:	• State Fisheries ○ Pilbara Line Fishery ○ Pilbara Trap Fishery
Exclusion zones:	• An Operational Area with a 4000 m radius from the Gemtree-A well centre for the duration of activities

Potential risks to commercial fishing and proposed mitigation measures

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the project vessels may result in exclusion of other users, or interactions between vessels.	• Woodside will implement an Operational Area with a 4000 m radius from the Gemtree-A well centre for the duration of activities. Notification and updates to mariners and marine charts. • Woodside will routinely consult with marine users to ensure they are informed and aware thereby reducing the likelihood of interactions.
Seabed disturbance	• Disturbance to the seabed from anchor holding testing.	• Preliminary mooring analysis
Underwater noise	• Noise will be generated by the project vessels.	• Due to the low acoustic source levels associated with the project vessels, there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	• Operational discharges from the project vessels, including, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process.
Unplanned Risks		

Potential risk	Risk description	Mitigation and/or management measures
Hydrocarbon release	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be implemented based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

Your feedback
Your feedback on the proposed activities and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

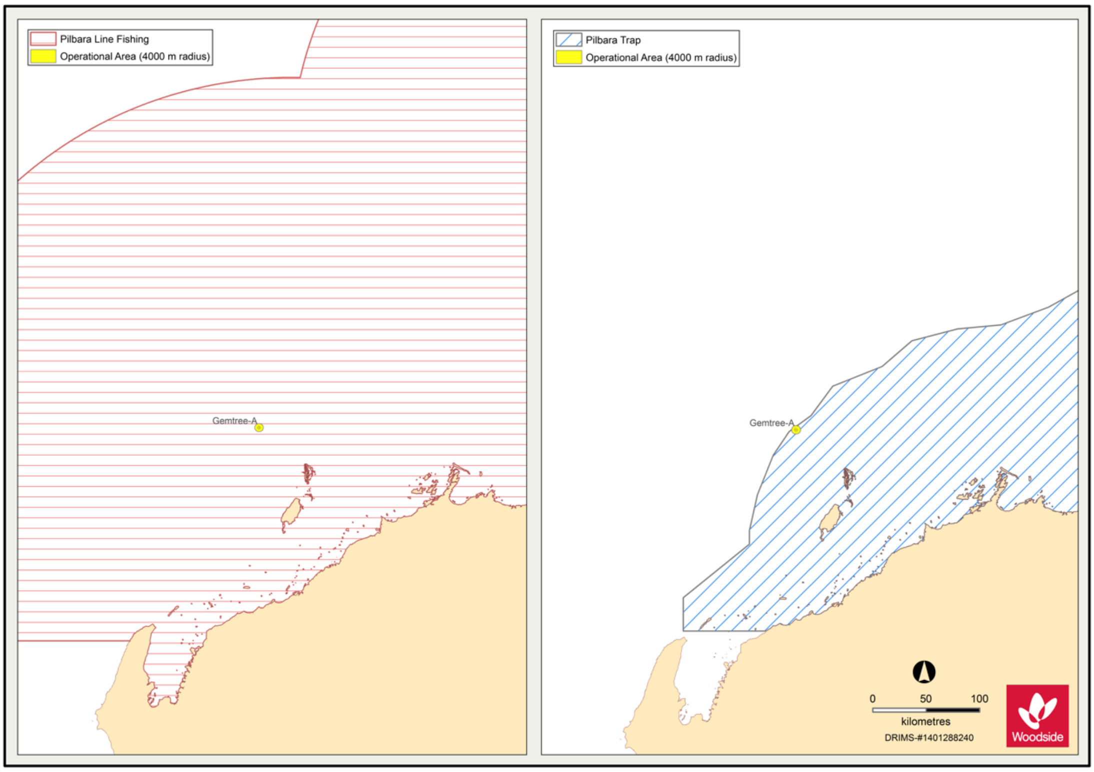
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **18 December 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.5 State Fisheries map sent to DPIRD (23 October 2019), WAFIC (23 October 2019), PPA (23 October 2019) and Pilbara Line and Trap Fishery licence holders (19 November 2019)



1.6 Email to DPIRD (25 November 2019)

Hi **[name supplied]** – thanks for the chat.

We've engaged WAFIC, and relevant individual licence holders (based on Fishcube) for these Environment Plans.

In terms of EP's for comment (I've attached emails sent):

- Gemtree Exploration Well – comment period has closed but appreciate any comments you may have by the end of the week.
- NGA Cessation of Operations - comment period has closed but appreciate any comments you may have by the end of the week.
- Echo Yodel ([name supplied] and [name supplied] participated in the Comparative Assessment Workshop) – comment period closes today but appreciate any comments you may have by the end of the week.
- Gemtree Anchor Hold Testing – comments appreciated by 18 December.

We also have a number of other EP's we will be consulting on shortly, and throughout 2020. Happy to discuss how best we engage with DPIRD.

Thanks

[name supplied]
Senior Corporate Affairs Adviser | Operation

1.7 Email sent to AFMA and CFA (23 October 2019)

Dear Stakeholder

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures.

The Information Sheet is also available on our website.

Activity overview

Activity:	· Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	· Barrow sub-basin · 20002' 06.754 S 115006' 32.749 E · The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	· ~200 m
Earliest commencement date:	· Q3, 2020
Estimated duration:	· 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Commercial fishing
Whilst four Commonwealth Fisheries overlap the proposed Operational Area, it is our assessment that only the North West Slope Trawl Fishery has recent activity just within the Operational Area (see map attached).

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activity, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.8 Email sent to North West Slope Trawl Fishery licence holders (23 October 2019)

Dear licence holder

Woodside is planning to undertake petroleum activities in production licence WA-49-L offshore north-west Australia, subject to approvals, vessel availability and weather constraints.

The first of these activities will be anchor holding testing activities, which are expected to take 14 days, starting in Q1 2020. Results from these tests will be used to inform planning for the drilling of the Gemtree-A exploration well, which is planned to be drilled in WA-49-L from Q3 2020.

Both of these activities will have separate Environment Plans and a Consultation Information Sheet for each activity is attached (also available on our website), which provides background on the proposed activities, including summaries of potential key risks and associated management measures.

AFMA, the CFA and other stakeholders have been informed of the activities and a State Fisheries map relevant to these activities is also attached.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods and water depth. Individual licence holders or representative fishing organisations who have requested ongoing advice on Woodside's planned activities will also be advised.

Activity overview

Activity purpose:	• To support planning for the Gemtree-A Exploration well, which is planned to be drilled from Q3 2020

Activity:	• Lowering an anchor to the seafloor and then tensioning to determine the anchor's ability to hold, embed and not drag at the Gemtree-A location.
Activity location:	• Approximately 178 km north west of Dampier, Western Australia.
Approximate water depth:	• 200 m
Earliest commencement date:	• Q1 2020
Estimated duration:	• 14 days
Vessels:	• Anchor handling and support vessels
Relevant fisheries consulted for this activity:	• State Fisheries ○ Pilbara Line Fishery ○ Pilbara Trap Fishery
Exclusion zones:	• An Operational Area with a 4000 m radius from the Gemtree-A well centre for the duration of activities

Potential risks to commercial fishing and proposed mitigation measures

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	• The presence of the project vessels may result in exclusion of other users, or interactions between vessels.	• Woodside will implement an Operational Area with a 4000 m radius from the Gemtree-A well centre for the duration of activities. Notification and updates to mariners and marine charts. • Woodside will routinely consult with marine users to ensure they are informed and aware thereby reducing the likelihood of interactions.
Seabed disturbance	• Disturbance to the seabed from anchor holding testing.	• Preliminary mooring analysis
Underwater noise	• Noise will be generated by the project vessels.	• Due to the low acoustic source levels associated with the project vessels, there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges	• Operational discharges from the project vessels, including, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine.	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process.

Potential risk	Risk description	Mitigation and/or management measures
	• These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	
Unplanned Risks		
Hydrocarbon release	• Loss of hydrocarbons to the marine environment from a vessel collision resulting in a tank rupture.	• Relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be implemented based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

Your feedback
Your feedback on the proposed activities and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

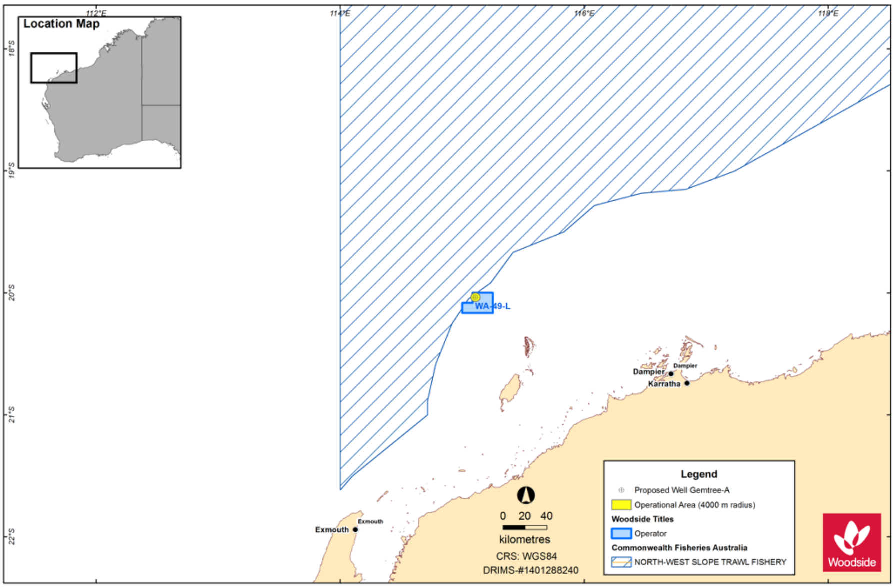
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **18 December 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.9 Commonwealth Fisheries map sent to AFMA (23 October 2019), CFA (23 October 2019) and North West Slope Trawl Fishery licence holders (19 November 2019)



1.10 Email sent to DoD – 23 October 2019

Dear [name supplied]

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of Defence Areas relevant to the proposed activity is also attached.

Activity overview

Activity:	• Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	• Barrow sub-basin • 20002’ 06.754 S 115006’ 32.749 E • The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	• ~200 m
Earliest commencement date:	• Q3, 2020
Estimated duration:	• 50 days

Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activity, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

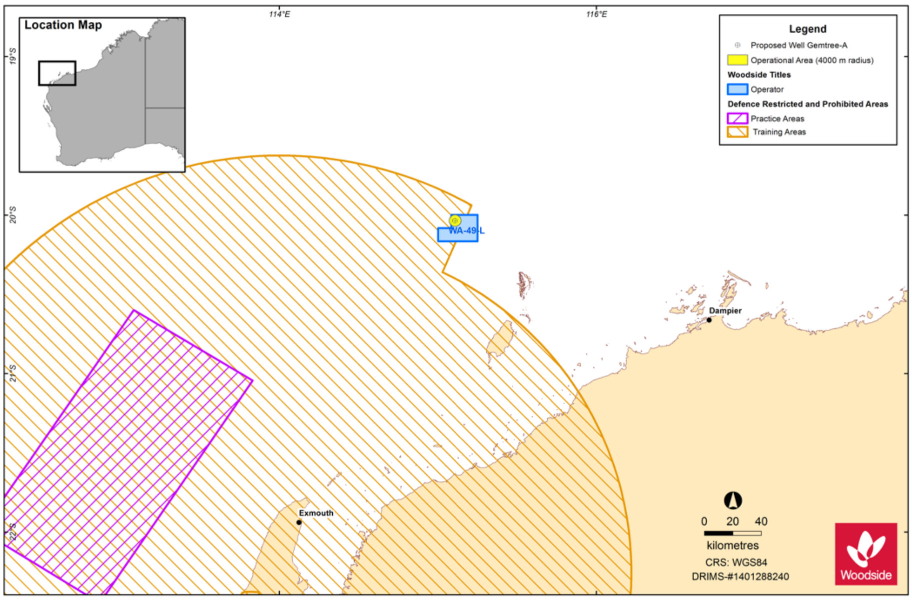
Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.11 Defence map sent to DoD – 23 October 2019



1.12 Email sent to adjacent titleholder – Chevron – 23 October 2019

Dear **[name supplied]**

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures.

The Information Sheet is also available on our website.

A map of adjacent titles relevant to the proposed activity is also attached.

Activity overview

Activity:	· Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	· Barrow sub-basin · 20002' 06.754 S 115006' 32.749 E · The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	· ~200 m
Earliest commencement date:	· Q3, 2020
Estimated duration:	· 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

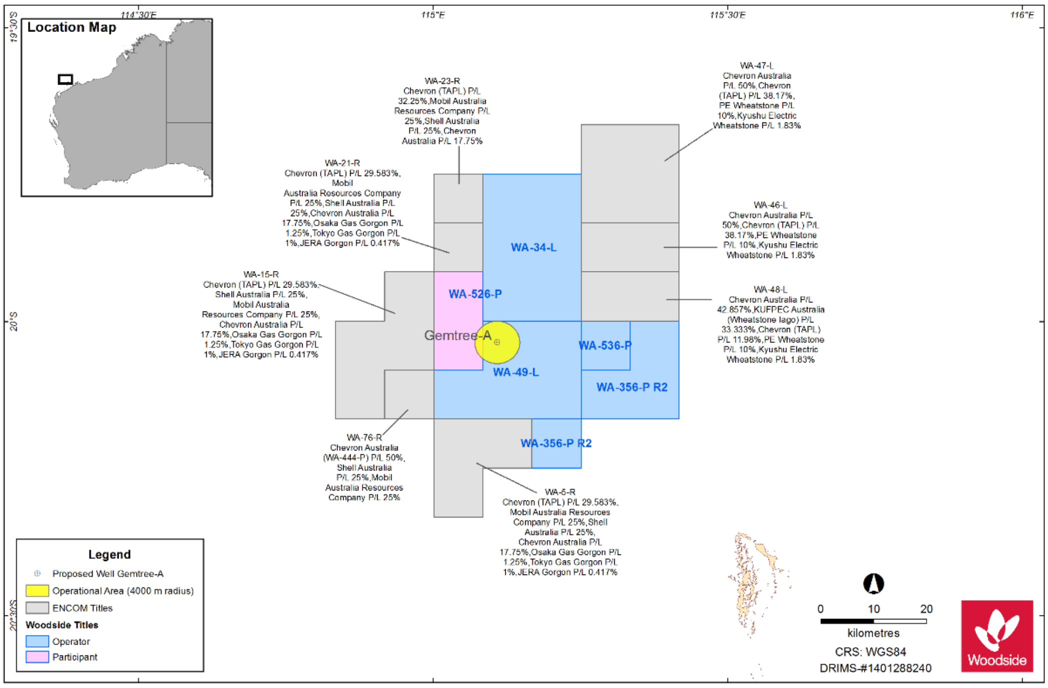
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.13 Titles map sent to adjacent titleholder – Chevron – 23 October 2019



1.14 Email sent to DAWR – 23 October 2019

Dear Department of Agriculture and Water Resources

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity:	· Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A

Activity location:	· Barrow sub-basin · 20002’ 06.754 S 115006’ 32.749 E · The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	· ~200 m
Earliest commencement date:	· Q3, 2020
Estimated duration:	· 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Commercial fishing
Whilst four Commonwealth Fisheries overlap the proposed Operational Area, it is our assessment that only the North West Slope Trawl Fishery has recent activity just within the Operational Area (see map attached).

Biosecurity
With respect to the biosecurity matters, please note the following information below.

Vessels:	• Two types of vessels may be utilised to undertake the activity
	    • MODU
	    • Support vessels, including anchor handling vessels, and support vessels
	• All vessels are required to undergo a Woodside Marine Assurance Inspection to review compliance with marine laws and Woodside safety and environmental requirements.
	• Support vessels may be sourced from the local area (Dampier, Karratha, etc) or from further afield, depending on the type of vessel required and availability

Environment description:	• The exploration well is located on the continental shelf and the seabed around the exploration well is relatively flat and featureless. Seabed relief in areas of bare sediment consisted mainly of ‘small ripples’ less than 0.1 m high, which is consistent with tidally driven bottom currents. • The nearest Marine Park is the Montebello Australian Marine Park, 47 km east of the exploration well location.
Ballast and biofouling management:	• Introduction or translocation and establishment of invasive marine species to the area via vessels or biofouling. • Introducing invasive marine species into the local marine environment will alter the ecosystem, as invasive species have characteristics that make them superior (in a

	survival and/or reproductive sense) to the indigenous species. • Invasive marine species have also proven economically damaging to areas where they have been introduced and established.
IMS risk:	• Compliance with National Ballast Water and Biofouling Management Requirements (as defined under the *Biosecurity Act 2015*). • Requirements are aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments and the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry. • As a minimum, all vessels mobilised from outside of Australia will undertake ballast water exchange > 12 nm from land and > 50 m water depth. • The operator of a vessel must provide a ballast water report if it is intended that the vessel discharge, or the vessel discharges, ballast water in Australian seas.
IMS mitigation:	• Vessels will be assessed and managed to prevent the introduction of invasive marine species in accordance with Woodside's Invasive Marine Species Management Plan. • Woodside's Invasive Marine Species Management Plan includes a risk assessment process that is applied to vessels undertaking Activities. Based on the outcomes of each IMS risk assessment, Management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced. • Vessels are required to comply with the *Australian Biosecurity Act 2015.*

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

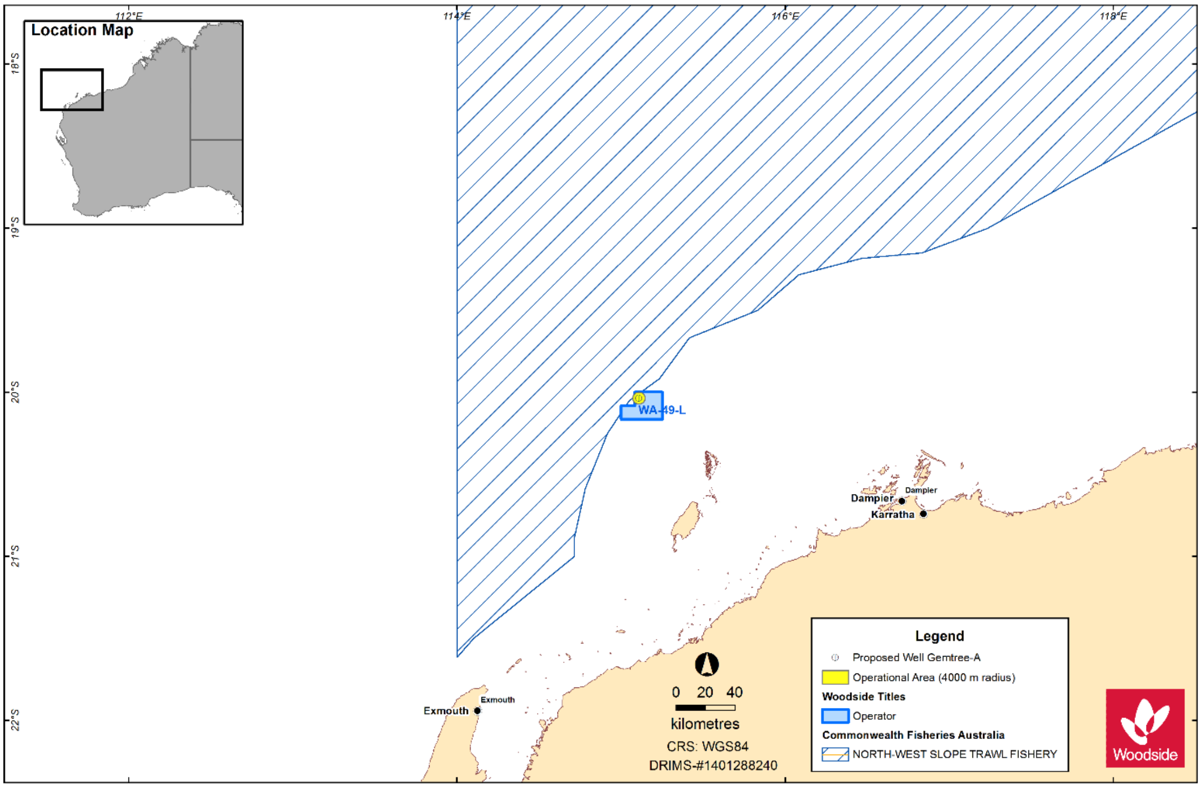
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.15 Commonwealth Fisheries map sent to DAWR – 23 October 2019



1.16 Email sent to AMSA (marine safety) and AHO – 23 October 2019

Dear Stakeholder

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of shipping lanes relevant to the proposed activity is also attached.

Activity overview

Activity:	· Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A

Activity location:	· Barrow sub-basin · 20002’ 06.754 S 115006’ 32.749 E · The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	· ~200 m
Earliest commencement date:	· Q3, 2020
Estimated duration:	· 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

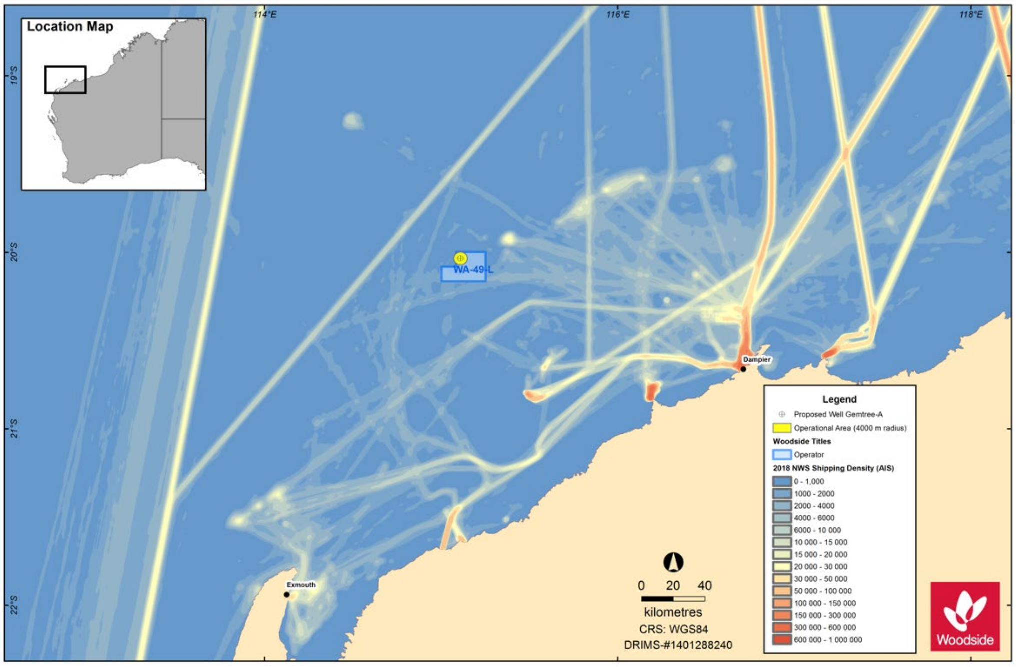
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.17 Shipping fairways map sent to AMSA (marine safety) and AHO – 23 October 2019



1.18 Email sent to AMSA (marine pollution) and DoT – 23 October 2019

Hi [names supplied]

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

A Consultation Information Sheet is attached, which provides background on the proposed activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We will provide a copy of our Oil Pollution First Strike Plan once planning is finalised.

Activity overview

Activity:	• Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	• Barrow sub-basin • 20002’ 06.754 S 115006’ 32.749 E • The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	• ~200 m
Earliest commencement date:	• Q3, 2020
Estimated duration:	• 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)

Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activity, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **22 November 2019** to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.19 Email sent to DNP – 5 November 2019

Dear Director of National Parks

Woodside is planning to undertake petroleum activities (the drilling of one exploration well) in production licence WA-49-L offshore north-west Australia.

We have identified and assessed potential risks and impacts that are relevant to the proposed Operational Area in the development of the proposed Environment Plan for this activity (see summary below).

Activity overview

Activity:	• Drilling and associated activities (such as anchor hole testing, anchor pre-lays and mooring and installation of relevant equipment like blow-out preventers) for one exploration well called Gemtree-A
Activity location:	• Barrow sub-basin • 20002’ 06.754 S 115006’ 32.749 E • The well will be located about 142 km off the Pilbara coast with the closest landfall being the Montebello

	Islands, which are about 55 km southeast. The well is 182 km from the Port of Dampier.
Approximate water depth:	• ~200 m
Earliest commencement date:	• Q3, 2020
Estimated duration:	• 50 days
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Activity support vessels, including general supply/support vessels and anchor handling vessel(s)
Exclusion zones:	• The Operational Areas for the activity is temporary 4000 m radius around the MODU and includes a temporary 500 m radius petroleum safety zone.

Potential risks and proposed mitigation measures

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence:	• The presence of the project vessels and MODU may result in exclusion of other users.	• Woodside will implement a temporary 500 m radius petroleum safety zone around the MODU whilst in the field for the duration of activities to reduce the likelihood of interactions. • Notification and updates to mariners and marine charts. • Woodside will routinely consult with marine users to ensure they are informed and aware thereby reducing the likelihood of interactions.
Seabed disturbance:	• Disturbance to the seabed from mooring of the MODU and drilling.	• Woodside will seek to minimise seabed disturbance for planned activities through: ○ MODU mooring analysis and anchor deployment in accordance with internal standards. ○ No anchoring of support vessels during drilling.
Underwater noise:	• Noise will be generated by the project vessels and	• Due to the low acoustic source levels associated with the MODU and vessel operations there is

	MODU, and helicopters.	not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Marine discharges:	• Discharges from drilling include water-based drill mud and cuttings, brines and cement. • Operational discharges from the project vessels and the MODU, including produced water, sewage, putrescible water, grey water, bilge water, drain water cooling water and brine. • These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	• Discharges are compliant with industry best practice standards. • Implementation of chemical assessment and approval process.
Unplanned Risks		
Hydrocarbon release:	• Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting in a tank rupture.	• Procedures for the supply and transfer of fuel. • Design of the wells and barriers within the well to prevent loss of hydrocarbons. • Well blow-out-preventers, which are large valves or similar mechanical devices used to seal, control and monitor oil and gas wells. • Relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. • Oil spill response strategies will be implemented based on potential impact to identified key receptor locations and sensitivities, which includes fish

		spawning and nursery areas.
Invasive Marine Species:	• Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	• All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

We note Australian Government Guidance on consultation activities with respect to the proposed activities and confirm that:

- The proposed activities are outside the boundaries of proclaimed Australian Marine Parks the nearest being Montebello Marine Park, 47 km to the south east of the Operational Area.
- We have assessed potential risks to Australian Marine Parks in the development of the proposed Environment Plan for this activity and believe that there are no credible risks as part of planned activities that have potential to impact the values of the Marine Parks.
- The worst case credible spill scenario assessed in this EP is the remote likelihood event of a subsea well blow-out. For this consequence to occur, there must be a failure of multiple physical and procedural barriers within the well and related to its operation. Given the controls in place to prevent and control loss of well control events and mitigate their consequences, it is considered that the risk associated with a subsea well blow out is managed to as low as reasonably practical (ALARP).
- In the unlikely event of a loss of well control there is a risk of condensate entering the following Marine Parks:

    - Montebello Marine Park
    - Argo-Rowley Terrace Marine Park
    - Gascoyne Marine Park
    - Ningaloo Marine Park

A Commonwealth Government-approved oil spill response plan will be in place for the duration of the activities, which includes notification to relevant agencies and organisations as to the nature and scale of the event, as soon as practicable following an occurrence. In support of this, the State Department of Transport and Australian Maritime Safety Authority (AMSA) are being engaged on unplanned spill preparedness. The Director of National Parks will be advised if an environmental incident occurs that may impact on the values of the Marine Park.

For information, a Consultation Information Sheet about the planned activity is attached, which provides background on the activity. The Information Sheet is also available on our website.

Your feedback
Our intent is to minimise environmental and social impacts associated with the proposed activity, and we are seeking any interest or comments you may have to inform our decision making.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).*

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Regards

[name supplied]
Corporate Affairs Manager | Exploration
Woodside Energy Ltd

1.20 Email sent to AMSA with first strike plan – 3 December 2019

Good Morning [name supplied],

As part of Woodside's ongoing consultation for its current and planned activities, I would like to advise the Australian Maritime Safety Authority (AMSA) that Woodside are preparing the *WA-49-L Gemtree-A Exploration Well Environment Plan* and would like to offer AMSA the opportunity to review or provide comment on the activity.

Information is presented as follows:

- A Consultation Information Sheet is available on our website here, providing information on the proposed petroleum activities program.
- The WA-49-L *Gemtree A Exploration Well Oil Pollution First Strike Plan* is attached. This will form part of the approval submission in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth). Please note at this stage of drafting some of the links and figures in the document are still being finalised, and as such may show as incomplete.

Woodside propose to submit an EP 28th February 2020 to support these activities.

Should you require additional information or have a comment to make about the proposed activity, please contact myself by close of business 14th January 2020 to allow us sufficient time to inform our activity planning and EP development.

Comments can be made by email, letter or by phone.

Please be aware that your feedback will be communicated to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under legislation.

We look forward to hearing from you, if you have any question, please don't hesitate to get in touch with me.

Kind Regards

[name supplied]
Hydrocarbon Spill Adviser | Security & Emergency Management

1.21 Email sent to DoT with first strike plan – 5 December 2019

Good Morning [names supplied],

As part of Woodside's ongoing consultation for its current and planned activities, I would like to advise WA Department of Transport (DoT) that Woodside are preparing the WA-49 L *Gemtree A Exploration Well Environment Plan* and would like to offer DoT the opportunity to review or provide comment on the activity.

Information is presented as follows:

A Consultation Information Sheet is available on our website here, providing information on the proposed petroleum activities program.

- The WA-49- L *Gemtree A Exploration Oil Pollution First Strike Plan* is attached. This will form part of the approval submission in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

- In the table below, as requested in the *Offshore Petroleum Industry Guidance Note* (September 2018) and from recent engagement activities between DoT-Woodside, responses to the information requirements in a succinct summary and source of information.

Should you require additional information or have a comment to make about the proposed activity, please contact myself by close of business 16th January 2020 to allow us sufficient time to inform our activity planning and EP development.

Comments can be made by email, letter or by phone.

Please be aware that your feedback will be communicated to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under legislation.

We look forward to hearing from you.

Information Requested in the Offshore Petroleum Industry Guidance Note (September 2018)	Information Provided & Reference
Description of activity, including the intended schedule, location (including	Included in the consultation information sheet

coordinates), distance to nearest landfall and map.		
Worst case spill volumes.	Included in Appendix A of the First Strike Plan	
Known or indicative oil type/properties.	Included in Appendix A of the First Strike Plan	
Amenability of oil to dispersants and window of opportunity for dispersant efficacy.	Not Applicable for Diesel and Condensate in this particular scenario	
Description of existing environment and protection priorities.	Included in section 4 of the First Strike Plan	
Details of the environmental risk assessment related to marine oil pollution - describe the process and key outcomes around risk identification, risk analysis, risk evaluation and risk treatment. For further information see the Oil Pollution Risk Management Information Paper (NOPSEMA 2017).	Unplanned loss of containment events from the Petroleum Activities Program have been identified during the risk assessment process (presented in Section 7 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 7 of the EP. Five unplanned events or credible spill scenarios for the Petroleum Activities Program have been selected as representative across types, sources and incident/response levels, up to and including the WCCS. Table 2-1 of the OSPRMA presents the credible scenarios for the Petroleum Activities Program. Two WCCS for the activity are then used for response planning purposes as all other scenarios are of a lesser scale and extent. By demonstrating capability to meet and manage an event of this size, Woodside assumes relevant scenarios that are smaller in nature and scale can also be managed by the same capability. Response performance outcomes have been defined based on a response to the WCCS.	
Outcomes of oil spill trajectory modelling, including predicted times to enter State waters and contact shorelines.	Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m2 accumulation concentration)	MEE-01, Julimar Condensate spill from loss of well containment 38 days at Barrow Island – 2.38 m3 No floating oil >10 g/m2 is predicted in State Waters. No shoreline contact is predicted at 100 g/m2
	Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m2 accumulation concentration)	MEE-04, Julimar Condensate spill from loss of well containment 37 days at Barrow Island – 3.78 m3 No floating oil >10 g/m2 is predicted in State Waters. No shoreline contact is predicted at 100 g/m2

	Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (including those contacted at <100 g/m2 accumulation concentration)	MEE-05, marine diesel spill from vessel collision 15 days at Ningaloo Coast Middle – <1 m3 No shoreline contact is predicted at 100 g/m2 *Please note that the stochastic modelling used to understand the consequences of the marine diesel scenario (MEE-05) was taken from the library of diesel spill models Woodside has accumulated over the years of undertaking similar activities to those within this Petroleum Activity Program (PAP) area. The model used is considered representative of this PAP scenario due to their close proximity to one another, the selected model being closer to shore and of greater magnitude (double the scenario for this PAP), similar outputs and the same thresholds being used. Due to the much larger magnitude, any predicted impacts are likely to be much lesser for the actual PAP scenario.* *Woodside considered commissioning bespoke modelling for this PAP and it was determined that the outputs would not provide a significantly different understanding of the consequences of a diesel spill. In addition, the predictions of extent, severity, and duration of diesel released are also within the assumptions and case made in Reference Case 2018:1003 – Consequence analysis of an accidental release of diesel (National Energy Resources Australia (NERA), 2018).*
Details on initial response actions and key activation timeframes.	Included in Section 2 and 3 of the First Strike Plan	
Potential Incident Control Centre arrangements.	Included in Appendix E and F of the First Strike Plan	

Potential staging areas / Forward Operating Base.	A Forward Operating Base can be established at Exmouth and/ or Dampier.
Details on response strategies.	Included in Section 2 and 3 of the First Strike Plan
Details and diagrams on proposed IMT structure including integration of DoT arrangements as per this IGN.	Included in Appendix E and F of the First Strike Plan
Details on testing of arrangements of OPEP/OSCP.	One oil spill response themed level 1 drill to be conducted within two weeks of commencing drilling The drill will test elements of the recommended response identified in the Gemtree-A Exploration Well Oil Pollution First Strike Plan, in relation to the level of the incident. **Testing of Oil Spill Response Arrangements** There are a number of arrangements which in the event of a spill will underpin Woodside's ability to implement a response across its petroleum activities. In order to ensure each of these arrangements is adequately tested, the Hydrocarbon Spill Preparedness Capability and Competency Coordinator ensures tests are conducted in alignment with the Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092). Woodside's Hydrocarbon Spill Preparedness & Response Testing Schedule aligns with international good practice for spill preparedness & response management; the testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook. The Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092) identifies the type of test which will be conducted annually for each arrangement, and how this type will vary over a five year rolling schedule. Testing methods may include (but are not limited to): audits, drills, field exercises, functional workshops, assurance reporting, assurance monitoring and reviews of key external dependencies. Activity specific Oil Spill Pollution First Strike Plans are developed to meet the response needs of that particular activity's Worst Credible Spill Scenario (WCCS). The ability to implement these plans may rely on specific arrangements or those common to other Woodside activities. Regardless of their commonality each arrangement will be tested in at least one of the methods annually. This ensures that personnel are familiar with spill response procedures, reporting requirements, and roles/ responsibilities.

	At the completion of testing a report is produced to demonstrate the outcomes achieved against the tested objectives. The report will include the lessons learned, any improvement actions and a list of the participants. Alternatively, an assurance report, assurance records, or audit report may be produced. These reports record findings and include any recommendations for improvement. Improvement actions and their close-out are actively recorded and managed. This is over and above the emergency management exercises conducted.
Additional comments	Please note at this stage of drafting some of the links and figures in the document are still being finalised, and as such may show as incomplete or have a reference error in the attached version.

[name supplied]
Hydrocarbon Spill Adviser | Security & Emergency Management

APPENDIX G: DEPARTMENT OF ABORIGINAL AFFAIRS HERITAGE INQUIRY SYSTEM RESULTS

Search Criteria

14 Other Heritage Places in Custom search area - Polygon - 114.160197706265°E, 21.6035353822842°S (GDA94) : 114.154704542202°E, 20.1405074113021°S (GDA94) : 114.187663526577°E, 20.1405074113021°S (GDA94) : 115.429118604702°E, 20.1198769982062°S (GDA94) : 115.497783155484°E, 20.1639758552212°S (GDA94) : 115.497783155483°E, 20.3494987039001°S (GDA94) : 115.440104932827°E, 20.6659178510767°S (GDA94) : 115.437358350796°E, 20.6967529293064°S (GDA94) : 115.415385694546°E, 20.7481307931616°S (GDA94) : 115.37968012814°E, 20.7738131846115°S (GDA94) : 115.341227979702°E, 20.8380000514064°S (GDA94) : 115.330241651577°E, 20.8764990441755°S (GDA94) : 115.110515089077°E, 21.3121280434017°S (GDA94) : 114.731486768765°E, 21.5013535716512°S (GDA94) : 114.63260981564°E, 21.6494936866341°S (GDA94) : 114.467814893765°E, 21.7872807335531°S (GDA94) : 114.286540479702°E, 21.7872807335531°S (GDA94) : 114.160197706265°E, 21.6035353822842°S (GDA94)

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

Status:

- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:

- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact heritageenquiries@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
  - **No Restrictions:** *Anyone* can view the information.
  - **Male Access Only:** Only *males* can view restricted information.

- **Female Access Only:** *Only* females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Basemap Copyright

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
886	BARROW ISLAND 04	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	325227mE 7694610mN Zone 50 [Reliable]	P07294
887	BARROW ISLAND 05	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337603mE 7713680mN Zone 50 [Reliable]	P07295
888	BARROW ISLAND 06 A-F	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337202mE 7710824mN Zone 50 [Unreliable]	P07296
890	BARROW ISLAND 08	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326487mE 7695727mN Zone 50 [Reliable]	P07298
891	BARROW ISLAND 09	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326270mE 7691185mN Zone 50 [Reliable]	P07299
893	BARROW ISLAND 11	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326145mE 7695108mN Zone 50 [Reliable]	P07301
894	BARROW ISLAND 12	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	326347mE 7699332mN Zone 50 [Reliable]	P07302
8951	BARROW ISLAND	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	335137mE 7705156mN Zone 50 [Unreliable]	P03542
22943	Flacourt Bay 01	No	No	No Gender Restrictions	Lodged	Rockshelter	*Registered Knowledge Holder names available from DAA	331540mE 7705613mN Zone 50 [Reliable]	
36199	Boodie Cave	No	No		Lodged	Artefacts / Scatter, Rockshelter	*Registered Knowledge Holder names available from DAA	329709mE 7703887mN Zone 50 [Reliable]	
36261	G-13-S0001	No	No		Lodged	Quarry	*Registered Knowledge Holder names available from DAA	329032mE 7702259mN Zone 50 [Reliable]	
36270	M-03-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	335996mE 7712066mN Zone 50 [Reliable]	

Aboriginal Heritage Inquiry System

List of Other Heritage Places

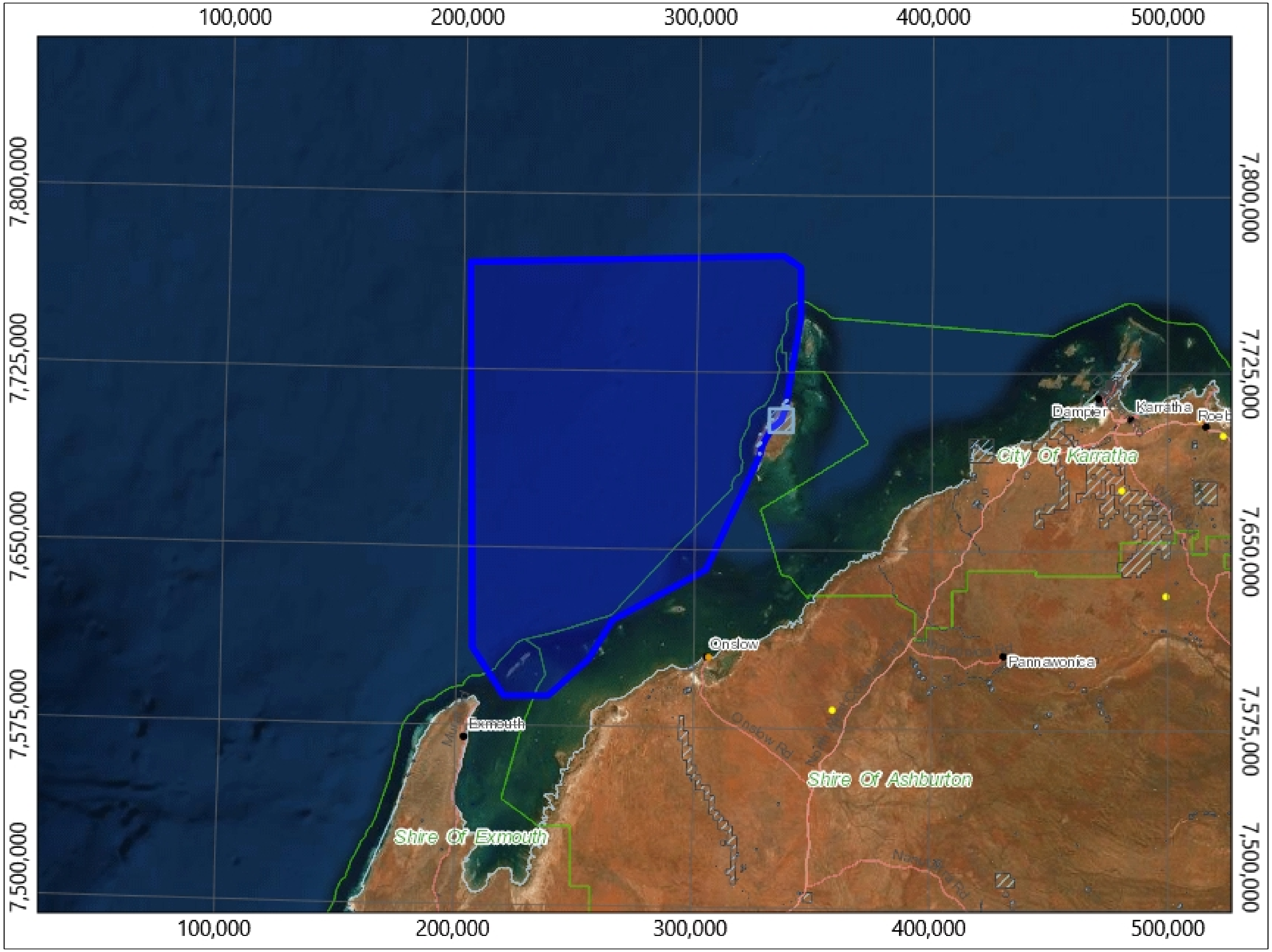
ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
36271	N-02-S0001	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	336855mE 7713004mN Zone 50 [Reliable]	
36272	O-02-S0002	No	No		Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	337100mE 7713272mN Zone 50 [Reliable]	

Department of Planning, Lands and Heritage

Aboriginal Heritage Inquiry System

Map of Other Heritage Places

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



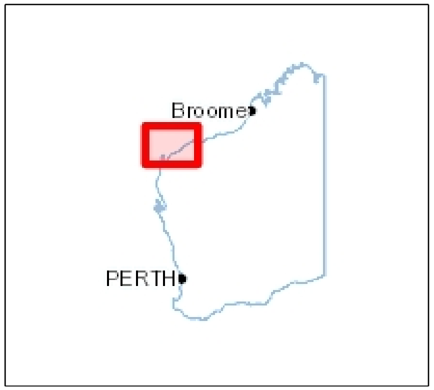
Legend

- Other Heritage Place
- Search Area
- Town
- Road
- River
- Local Government Authority

86.51 kilometres

Map Scale 1 : 2,620,000

MGA Zone 50 (GDA94)



APPENDIX H: FIRST STRIKE PLAN

WA-49-L Gemtree Exploration Drilling – Oil Pollution First Strike Plan

Security and Emergency Management
Hydrocarbon Spill Preparedness Unit

February 2020
Revision: 0

TABLE OF CONTENTS

WA-49-L GEMTREE EXPLORATION DRILLING

OIL POLLUTION FIRST STRIKE PLAN

SPILL FROM FACILITY INCLUDING SUBSEA INFRASTRUCTURE

(Note: Pipe laying and accommodation vessels are considered a "FACILITY" under Australian Regs).

LEVEL 1

CONTROL AGENCY:	WOODSIDE
INCIDENT CONTROLLER:	Person In Charge (PIC) with support from Onshore Team Leader (OTL)

LEVEL 2 and 3

CONTROL AGENCY:	WOODSIDE
INCIDENT CONTROLLER:	Corporate Incident Coordination Centre (CICC) DUTY MANAGER

SPILL FROM FACILITY ENTERING STATE WATERS

LEVEL 1

CONTROL AGENCY:	WOODSIDE
INCIDENT CONTROLLER:	CICC DUTY MANAGER

LEVEL 2 and 3

CONTROL AGENCY:	Department of Transport (DoT)
INCIDENT CONTROLLER:	DoT Incident Controller (IC)

SPILL FROM VESSEL

(Note: SOPEP should be implemented in conjunction with this document)

LEVEL 1

CONTROL AGENCY:	AMSA
INCIDENT CONTROLLER:	VESSEL MASTER (with response assistance from Woodside)

LEVEL 2 and 3

CONTROL AGENCY:	AMSA
INCIDENT CONTROLLER:	AMSA (with response assistance from Woodside)

Guidance to Oil Spill Incident Levels

The most significant characteristic of the below guidance should be considered when determining level or escalation potential.

Characteristic	Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
General Description	Generally able to be resolved within 24-48 hours.	Generally response required beyond 48 hours.	Response may extend beyond weeks.
Woodside Emergency Management (EM)/ Crisis Management Team (CMT) Activation	Onsite Incident Controller (IC) activated. Use of ICC support may be required.	Additional support required from Corporate Incident Coordination Centre (CICC) Duty Manager (DM).	Includes Perth based CMT activation.
Number of Agencies	First-response agency and Incident Management Team (IMT)	Multi-agency response	Agencies from across government and industry.
Environment	Isolated impacts or with natural recovery expected within weeks.	Significant impacts and recovery may take months.	Significant area and recovery may take months. Remediation required.
Economy	Business level disruption (i.e. Woodside).	Business failure or 'Channel' impacts.	Disruption to a sector.
Public Affairs	Local and regional media coverage (Western Australia).	National media coverage.	International media coverage.

For guidance on credible spill scenarios and hydrocarbon characteristics refer to APPENDIX A – credible spill scenarios and hydrocarbon information

For Spills Entering State Waters

In the event of a spill where Woodside is the responsible party and the spill may impact State waters/shorelines, Woodside will notify the Western Australian Department of Transport Maritime Environmental Emergency Response unit (DoT).

If the spill impacts State waters/shorelines and is a Level 1, Woodside will remain the Controlling Agency. If the spill is a Level 2/3 then DoT will become the Control Agency for the response in State waters/shorelines only. DoT will appoint an Incident Controller and form a separate Incident Management Team to manage the State waters/shorelines response only. The coordination structure for a concurrent hydrocarbon spill in both Commonwealth and State waters/shorelines is shown in APPENDIX E – Coordination Structure for a Concurrent Hydrocarbon Spill in Both Commonwealth And State Waters/Shorelines.

Initially Woodside will be required to make available an appropriate number of suitably qualified persons to work in the DoT IMT (see APPENDIX G – Woodside liason officer resources to DoT). DoT's role as the Controlling Agency for Level 2 and 3 spills in State waters/shorelines does not negate the requirement for Woodside to have appropriate plans and resources in place to adequately respond to a Marine Hydrocarbon Spill incident in State waters/shorelines or to commence the initial response actions to a spill prior to DoT establishing incident control in line with DoT Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements (September 2018):

https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_StateHazardPlanMaritimeEnviroEmergMEE.pdf

Woodside's Incident Management Structure for a Hydrocarbon Spill, including Woodside Liaison Officer's command structure within DoT can be seen at APPENDIX F – Woodside incident management structure**.**

Response Process Overview

<table>
<tr><th colspan="3">Use the below to determine actions required and which parts of this plan are relevant to the incident.</th></tr>
<tr><td colspan="3">For guidance on credible scenarios and hydrocarbon characteristics, refer to APPENDIX A – credible spill scenarios and hydrocarbon information</td></tr>
<tr><td rowspan="2">ALL INCIDENTS</td><td colspan="2">Notify the Woodside Communication Centre (WCC) on:
[redacted], +[redacted] / [redacted]
or sat phone: +[redacted]</td></tr>
<tr><td colspan="2">Incident Controller or delegate to make relevant notifications in Table 1-1 of this document.</td></tr>
<tr><td rowspan="3">LEVEL 1</td><td>FACILITY INCIDENT</td><td>VESSEL INCIDENT</td></tr>
<tr><td>Coordinate pre-identified tactics in Table 2-1 of this document.
Remember to download each Operational Plan.</td><td>Upon agreement with AMSA:
Coordinate pre-identified tactics in Table 2-1 of this document.
Remember to download each Operational Plan.</td></tr>
<tr><td colspan="2">If the spill escalates such that the site cannot manage the incident, inform the WCC on: [redacted] +[redacted] /[redacted] or sat phone +[redacted] and escalate to a Level 2/3 incident.</td></tr>
<tr><td rowspan="4">LEVEL 2/3</td><td>FACILITY INCIDENT</td><td>VESSEL INCIDENT</td></tr>
<tr><td>Handover control to CICC for facility spill including from subsea infrastructure.
OR
Handover control to DoT for facility spill which has entered State waters.</td><td>Stand up CICC to assist AMSA.</td></tr>
<tr><td>Undertake quick revalidation of the recommended strategies in Table 3-1 taking into consideration seasonal sensitivities and current situational awareness.

Undertake validated strategies.</td><td>If requested by AMSA:
Undertake quick revalidation of the recommended strategies in Table 3-1 taking into consideration seasonal sensitivities and current situational awareness.

Undertake validated strategies.</td></tr>
<tr><td>Create an Incident Action Plan (IAP) for all ongoing operational periods.

<u>The content of the IAP should reflect the selected response strategies based on current situational awareness.</u>

For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see WA-49-L Gemtree Exploration Drilling Pre-operational NEBA.</td><td>If requested by AMSA:
Create an IAP for all ongoing operational periods.

<u>The content of the IAP should reflect the selected response strategies based on current situational awareness.</u>

For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see WA-49-L Gemtree Exploration Drilling Pre-operational NEBA.</td></tr>
</table>

1. NOTIFICATIONS (ALL LEVELS)

The Incident Controller or delegate must ensure the below notifications Table 1-1 are completed within the designated timeframes.

For other environmental notifications required refer to the *WA-49-L Gemtree Exploration Drilling Environment Plan*.

Table 1-1: Immediate Notifications

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
Notifications to be made for ALL LEVELS of spill *(For spills from a vessel the following notifications must be undertaken by a WEL representative).*							
Immediately	Offshore Installation Manager (OIM) or Vessel Master	Woodside Communication Centre (WCC)	Duty Manager	[redacted] or [redacted] / [redacted] or Satellite phone: [redacted]	Verbally notify WCC of event and estimated volume and hydrocarbon type.	Verbal	
Within 2 hours	OIM or Woodside Site Representative (WSR)	National Offshore Petroleum Safety Environmental Management Authority (NOPSEMA[1])	Incident notification office	+61 1300 674 472	Verbally notify NOPSEMA for spills >80L. Record notification using Initial Verbal Notification Form or equivalent and send to NOPSEMA as soon as practicable (cc to National Offshore Petroleum Titles Administrator (NOPTA) and Department of Mines, Industry Regulation and Safety (DMIRS).	APPENDIX B – Form 1	
Within 3 days	OIM or WSR				Provide a written NOPSEMA Incident Report Form as soon as practicable (no later than 3 days after notification) (cc to NOPTA and DMIRS).	APPENDIX B – Form 2	

[1] Notification to NOPSEMA must be from a Woodside Representative.

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					NOPSEMA: submissions@nopsema.gov.au NOPTA: resources@nopta.gov.au DMIRS: petreps@dmirs.wa.gov.au		
As soon as practicable	OIM or WSR	Woodside	Hydrocarbon Spill Preparedness Manager	[redacted]	Verbally notify Hydrocarbon Spill Preparedness (HSP) Manager of event and estimated volume and hydrocarbon type.	Verbal	
As soon as practicable	CICC DM or Delegate	Woodside	Environment Duty Manager	As per roster	Verbally notify Duty Environment of event and seek advice on relevant performance tandards from EP.	Verbal	
As soon as practicable	CICC DM or Delegate	Department of Environment and Energy	Director of National Parks (Director)	+61 8 6274 2220	The Director is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken.	Verbal	
Additional notifications to be made ONLY if spill is from a vessel							
Without delay as per protection of the Sea Act, part II, section 11(1)	Vessel Master	Australian Maritime Safety Authority (AMSA)	Response Coordination Centre (RCC)	1800 641 792 or +61 2 6230 6811	Verbally notify AMSA RCC of the hydrocarbon spill. Follow up with a written Marine Pollution Report (POLREP) as soon as practicable following verbal notification.	APPENDIX B – Form 3	
ADDITIONAL LEVEL 2/3 NOTIFICATIONS							
As soon as practicable	CICC DM or Delegate	AMOSC	AMOSC Duty Manager	+61 438 379 328	Notify Australian Marine Oil Spill Centre (AMOSC) that a spill has occurred and follow-up with an	APPENDIX B – Form 4	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					email from the IC/CICC DM, CMT Leader or Oil Spill Preparedness Manager to formally activate AMOSC. Determine what resources are required consistent with the AMOSPlan and detail in a Service Contract that will be sent to Woodside from AMOSC upon activation.		
As soon as practicable	CICC DM or Delegate	Oil Spill Response Limited (OSRL)	OSRL Duty Manager	+65 6266 1566	Contact OSRL Duty Manager and request assistance from technical advisor in Perth. Send the notification form to OSRL as soon as practicable. For mobilisation of resources, send the Mobilisation Form to OSRL as soon as practicable.	Notification: APPENDIX B – Form 6a Mobilisation: APPENDIX B – Form 6b	
As soon as practicable or if spill is likely to extend into WA State waters.	CICC DM or Delegate	WA Department of Transport	DOT Duty Manager	08 9480 9924	Marine Duty Manager to verbally notify DoT that a spill has occurred and request use of equipment stored in the Exmouth supply shed at Harold E Holt. Follow up with a written POLREP as soon as practicable following verbal notification. Additionally DoT to be notified if spill is likely to extend into WA State waters. Request DoT to provide Liaison to WEL IMT.	APPENDIX B – Form 5	
As soon as practicable if there is potential for oiled wildlife or	CICC DM or Delegate	WA Department of Biodiversity, Conservation and Attractions (DBCA)	Duty Officer	08 9219 9108	Phone call notification.	Verbal	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
the spill is expected to contact land or waters managed by WA Department of Biodiversity, Conservation and Attractions							
As soon as practicable	CICC DM or Delegate	Marine Spill Response Corporation (MSRC)	MSRC Response Manager	+1-732-417-0175 or +1-703-326-5609	Activate the contract with MSRC (in full) for the provision of up to 30 personnel depending on what skills are required. Please note that provision of these personnel from MSRC are on a best endeavours basis and are not guaranteed.	Verbal	

2. LEVEL 1 RESPONSE

2.1 Mobilisation of Response Techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a ‘Yes’ in Table 2-1. Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 2-1 Operational Plan column.

All response techniques and pre-identified tactics have been identified from the pre-operational NEBA presented in the WA-49-L Gemtree Exploration Drilling Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 2-1: Level 1 Response Summary

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
Monitor and evaluate – tracking buoy (OM02)	Yes	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with APPENDIX D – Tracking buoy deployment instructions.
Please consider instructing the CICC DM to activate or implement any of the following Pre-Identified tactics. The following tactics will assist in answering the '7 Questions of Spill Assessment' identified in Appendix C to increase situational awareness.							
Monitor and evaluate – predictive modelling (OM01)	Yes	Yes	Undertake initial modelling using the Rapid assessment oil spill tool and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of the Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email response@apasa.com.au) and call [redacted]	Intelligence	**DAY 1:** Detailed modelling within four hours of APASA receiving information from Woodside.		
Monitor and evaluate – aerial surveillance (OM02)	Yes	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance	Logistics – Aviation	**DAY 1:** Two trained aerial observers.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
			observer to complete log in APPENDIX B, Form 8		One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		Risk (OM02 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
Monitor and evaluate – satellite tracking (OM02)	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email emergency@ksat.no and call [redacted]	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours. Data received to be uploaded into Woodside Common Operating Picture		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessment access and capability. Daily fluorometry reports will be provided to IMT.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	In agreement with WA DoT, deployment of two specialists for each of the Response Protection Areas (RPA) within 10 days of predicted impacts.		Pre-emptive Assessment of Sensitive Receptors at Risk (OM04 of The Operational Monitoring Operational Plan).
Monitor and evaluate – shoreline assessment (OM05)	Yes	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment	In agreement with WA DoT, deployment of one specialist in SCAT for each of the RPAs within 10 days of predicted impacts.		Monitoring of contaminated resources (OM05 of The Operational Monitoring Operational Plan).

3. LEVEL 2/3 RESPONSE

3.1 Mobilisation of Response Techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a ‘Yes’ in Table 3-1. Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 3-1 Operational Plan column.

All response strategies and pre-identified tactics have been identified from the pre-operational NEBA presented in the WA-49-L Gemtree Exploration Drilling Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 3-1: Level 2/3 Response Summary

Response Techniques	Hydrocarbon Type: Marine Diesel	Hydrocarbon Type: Julimar Condensate	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
Monitor and evaluate – tracking buoy (OM02)	Yes	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with APPENDIX D – Tracking buoy deployment instructions.
Monitor and evaluate – predictive modelling (OM01)	Yes	Yes	Undertake initial modelling using the Rapid assessment oil spill tool and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email response@apasa.com.au) and call [redacted]	Intelligence	**DAY 1:** Detailed modelling within 4 hours of APASA receiving information from Woodside.		
Monitor and evaluate – aerial surveillance (OM02)	Yes	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in APPENDIX B, Form 8	Logistics - Aviation	**DAY 1:** Two trained aerial observers. One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
Monitor and evaluate – satellite	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up Kongsberg Satellite Services (KSAT) to provide satellite imagery of the spill.	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours.		

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
tracking (OM02)					Data received to be uploaded into Woodside Common Operating Picture.		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessment access and capability Daily fluorometry reports will be provided to IMT.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists for each of the Response Protection Areas (RPA) with predicted impacts.		Pre-emptive Assessment of Sensitive Receptors (OM04) of The Operational Monitoring Operational Plan.
Monitor and evaluate – shoreline assessment (OM05)	Yes	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of one specialist in SCAT for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan.
Surface Dispersant	No	No	This technique is not recommended. Dispersants are not considered a feasible response technique for thin surface films such as condensate or diesel as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon. Modelling predicts that for Credible Scenario-01 and Credible Scenario-04 floating oil will not reach dispersant response thresholds at any RPA. For Credible Scenario-05, one RPA meets the dispersant response				

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
			threshold but this technique is not appropriate for use on diesel. Furthermore, high local concentrations of atmospheric volatiles are predicted making a response unsafe.				
Mechanical Dispersion	No	No	This technique is not recommended. Although feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly and lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, vessels used for mechanical dispersion would be contaminated by the hydrocarbon and could cause secondary contamination of unimpacted areas.				
Containment and Recovery	No	No	This technique is not recommended. Modelling predicts that for Credible Scenario-01 and Credible Scenario-04 floating oil will not reach containment and recovery response thresholds at any RPA. For Credible Scenario-05, one RPA meets the containment and recovery response threshold but this technique is not deemed an appropriate technique for diesel. Furthermore, high local concentrations of atmospheric volatiles are predicted potentially making a response unsafe.				
In Situ Burning	No	No	This technique is not recommended.				

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
			It requires calm sea state conditions which limits its feasibility in the region. Furthermore, modelling predicts that floating oil will not reach response thresholds or slick thickness to required for effective in situ burning operations. There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons and the residue from attempts to burn would sink, posing a risk to the environment.				
Shoreline Protection and Deflection	No	Yes	Shoreline protection and deflection may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards shorelines. Undertaken in agreement with WA DoT (for Level 2/3 spills). Woodside will mobilise and begin the shoreline protection and deflection response to reduce the volume of oil at shorelines by deploying protection and deflection equipment at selected RPA shorelines 5 days prior to predicted impact. Equipment from Woodside, AMOSC and AMSA Western Australian Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).	Operations and Planning	In agreement with WA DoT, activate relevant Tactical Response Plans (TRPs) 5 days prior to impact. In agreement with WA DoT, mobilise teams to RPAs 5 days prior to impact. In agreement with WA DoT, equipment mobilised from closest stockpile 5 days prior to impact. Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to impact.		Protection and Deflection Operational Plan *Logistics to download immediately and follow steps* Tactical Response Plans available from: *Oil Spill Portal – Tactical Response Plans* Relevant TRPs: Mangrove Bay Turquoise Bay Yardie Creek Ningaloo Reef – refer to Mangrove/Turquoise Bay and Yardie Creek Barrow and Lowendal Islands Montebello Island – Stephenson Channel Nth TRP Montebello Island Champagne Bay and Chippendale Channel TRP Montebello Island – Claret Bay TRP

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
							Montebello Island – Hermite/Delta Island Channel TRP Montebello Island – Hock Bay TRP Montebello Island – North and Kelvin Channel TRP Montebello Island – Sherry Lagoon Entrance TRP Barrow and Lowendal Islands TRP Pilbara Islands – Southern Island Group TRP Muiron Islands TRP Rankin Bank and Glomar Shoals
			Mobilise security provider as per security support plan.				Land Based Security Support Plan
Shoreline Clean Up	No	Yes	Shoreline clean-up operations may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards shorelines. Undertaken in agreement with WA DoT (for Level 2/3 spills). Equipment from Woodside, AMOSC and AMSA Western Australian Stockpiles and relevant personnel mobilised. Consideration of mobilisation of interstate/international shoreline cleanup equipment and relevant personnel (i.e. OSRL).	Logistics and Planning	One shoreline clean-up team to each contaminated RPA 5 days prior to impact. TRPs available for at risk shorelines 5 days prior to impact. Access to at least 675 m^3 of solid and liquid waste storage available within five days upon activation of third party contract.		Shoreline Clean-up Operational Plan *Logistics to download immediately and follow steps*
			Mobilise security provider as per security support plan.				Land Based Security Support Plan

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
Oiled Wildlife Response	Yes	Yes	If oiled wildlife is a potential impact, request AMOSC to mobilise containerised oiled wildlife first strike kits and relevant personnel. Refer to relevant Tactical Response Plan for potential wildlife at risk. Mobilise AMOSC Oiled Wildlife Containers. Consider whether additional equipment is required from local suppliers.	Logistics and Planning	**DAY 5:** Contracted capability to treat up to an additional 250 individual fauna within a five-day period. Facilities for oiled wildlife rehabilitation are operational 24/7		Oiled Wildlife Response Operational Plan
Scientific Monitoring (Type II)	Yes	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – Operational Plan
For well integrity event the following strategies apply:							
Well Intervention – SFRT	No	Yes	Debris clearance equipment to be mobilised prior to deployment of capping stack.	Operations, Logistics and Drilling and Completions (source control)	**DAY 2:** Remotely Operated Vehicle (ROV) on Mobile Offshore Drilling Unit (MODU) ready for deployment within 48 hours		Source Control and Well Intervention Operational Plan
Subsea Dispersant	No	No	The high discharge velocity and turbulence from the gas plume is predicted to generate very small oil droplets with very low-rise velocities. This effectively replicates the action of a chemical dispersant thus rendering the use of SSDI unnecessary.				
Capping Stack	No	Yes	As per WA-49-L Gemtree Exploration Drilling – Blowout Contingency Plan.	Drilling and Completions (source control)	**DAY 1:** Identify source control vessel availability within 24 hours. Capping stack on suitable vessel mobilised to site within 16 days.		Source Control and Well Intervention Operational Plan

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Julimar Condensate					
Relief Well	No	Yes	As per WA-49-L Gemtree Exploration Drilling – Blowout Contingency Plan.	Operations, Logistics and Drilling and Completions (source control)	**DAY 1:** Identify source control vessel availability within 24 hours. ROV on MODU ready for deployment within 48 hours. MODU mobilised to location		Source Control and Well Intervention Operational Plan

4. PRIORITY RECEPTORS

Note: DoT are the Control Agency to respond to all the sites listed below in a Level 2/3 spill into State waters/shorelines.

Action: Provide DoT with all relevant Tactical Response Plans for these locations.

Based on hydrocarbon spill risk modelling results the sensitive receptors outlined in Table 4-2 are identified as priority protection areas, as they have the potential to be contacted by hydrocarbon at or above impact threshold levels within 48 hours of a spill.

Please note that impact thresholds (10 g/m^2 surface hydrocarbon concentration, 100 g/m^2 shoreline accumulation, and 500 ppb entrained hydrocarbon concentration) used to determine the 'environment that may be affected' (EMBA) identified in the Environment Plan are lower than the response thresholds (Table 4-1).

Table 4-1: Response Thresholds

Surface Hydrocarbon (g/m^2)	Description
>10	Predicted minimum threshold for commencing operational monitoring[2]
50	Predicted minimum floating oil threshold for effective containment and recovery and surface dispersant application [3]
100	Predicted optimum floating oil threshold for effective containment and recovery and surface dispersant application
250	Predicted minimum threshold for effective shoreline clean-up operations

Table 4-2: Receptors for Priority Protection (Credible Scenario-05)

Receptor	Distance and Direction from Gemtree exploration well	Threshold triggered and recommended strategy	Tactical Response Plans (also available within the Data Directory)
Montebello Marine Park	11 km SE	Threshold: >50 g/m^2 within 5 hours. Strategies: Monitor the slick to assess if any shoreline RPAs become at risk of impact. *N.B. No shoreline impact is predicted at response thresholds. Additionally, although this RPA has surface concentrations at the >50 g/m^2 threshold, dispersant and containment and recovery are not feasible for a spill of marine diesel as detailed in Table 3-1*	N/A – offshore receptor.

[2] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

[3] At 50g/m^2 containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and displaying the spread of surface oil.

Hydrocarbon spill modelling results indicate the sensitive receptors listed below have the potential to be contacted by hydrocarbons beyond 48 hours of a spill, although contact is below response thresholds in all cases thus the main technique required will be monitor and evaluate:

- Argo-Rowley Terrace CMR
- Barrow Island
- Gascoyne Marine Park
- Glomar Shoals
- Lowendal Islands
- Montebello Islands and State Marine Park
- Muiron Islands WHA and SMP
- Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)
- Pilbara Islands – Southern Island Group
- Rankin Bank
- Open Ocean

Tactical Response plans for these locations can be accessed via the Oil Spill Portal - Tactical Response Plans. [4]

Oil spill trajectory modelling specific to the spill event will be required to determine the regional sensitive receptors to be contacted beyond 48 hours of a spill.

Figure 4-1 illustrates the location of regional sensitive receptors in relation to the WA-49-L Gemtree Exploration Drilling PAP.

Consideration should be given to other stakeholders (including mariners) in the vicinity of the spill location. Table 4-3 indicates the assets within the vicinity of the WA-49-L Gemtree Exploration Drilling PAP.

Table 4-3: Assets in the vicinity of the WA-49-L Gemtree Exploration Drilling operational area

Asset	Distance and Direction from WA-49-L Gemtree Exploration Drilling well	Operator
Pluto Platform	21 km ENE	Woodside
Wheatstone Platform	28 km NE	Chevron
John Brookes	35 km S	Santos
East Spar	61 km S	Santos
Goodwyn	91 km NE	Woodside
North Rankin	113 km NE	Woodside

[4] The Tactical Response Plans for the RPAs idenitifed contain the details of potential forward operating bases and staging areas. Incident Command Centre: For Level 1 incidents the in-field team and asset operator will lead the response on-scene. For level 2/3 Incident the Incident Command Centre will be located in Perth at Woodside's building. The Woodside CICC is fully equipped with communications equipment and technology to ensure the coordination of response activities for the overall response.

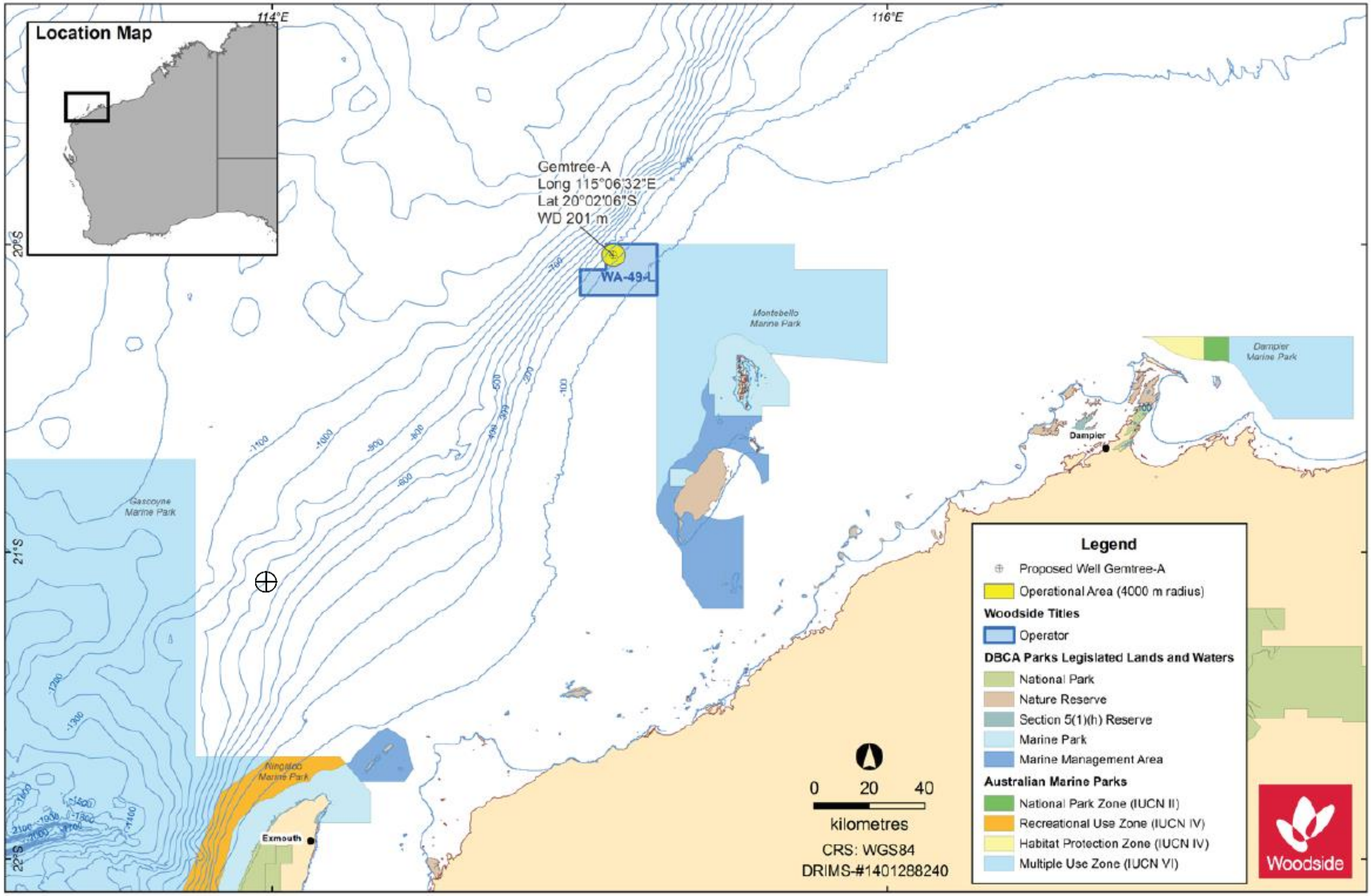


Figure 4-1: Regional sensitive receptors – WA-49-L Gemtree Exploration Drilling operational area

5. DISPERSANT APPLICATION

Dispersant is not considered an appropriate response technique for this activity as described in WA-49-L Gemtree Exploration Drilling Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

APPENDIX A – CREDIBLE SPILL SCENARIOS AND HYDROCARBON INFORMATION

For more detailed hydrocarbon information see the
Hydrocarbon Data Directory

Credible Spill Scenarios

Scenario	Product	Maximum Volumes	Suggested ADIOS2 Analogue*
Credible Scenario-01: Hydrocarbon release caused by loss of well containment	Julimar Condensate (API 47.9°)	70,956 m^3 over 61 days (0.4% residue of 284 m^3)	Julimar 1 (API 47.9°)
Credible Scenario-04: Hydrocarbon release caused by loss of well containment	Julimar Condensate (API 47.9°)	90,114 m^3 over 61 days (0.4% residue of 360 m^3)	Julimar 1 (API 47.9°)
Credible Scenario-05: Hydrocarbon release due to vessel collision (instantaneous surface release)	Marine diesel (API 37.2°)	275 m^3 (5% residue of 13.75 m^3)	Diesel Fuel Oil – Southern USA 1 (API 37.2°)

**Initial screening of possible ADIOS2 analogues was done by considering hydrocarbons with similar APIs. Suggested selection was based on the closest distillation cut to WEL hydrocarbon. Only hydrocarbons with distillation cuts that showed results for >380°C were included in selection process*

Julimar condensate

Julimar Condensate (API 47.9°) contains a low proportion (0.4% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment.

The unweathered mixture has a dynamic viscosity of 1.248 cP. The pour point of the whole oil (-24 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 48.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 21.3% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 29.5% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Although removal of the volatile compounds through evaporation and dissolution will result in an increase in density of the remaining oil, the mixture is unlikely to solidify or sink as it weathers.

The whole oil has low asphaltene content (<0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 11.5% by mass of the whole oil, with a significant proportion (7.4%) 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.

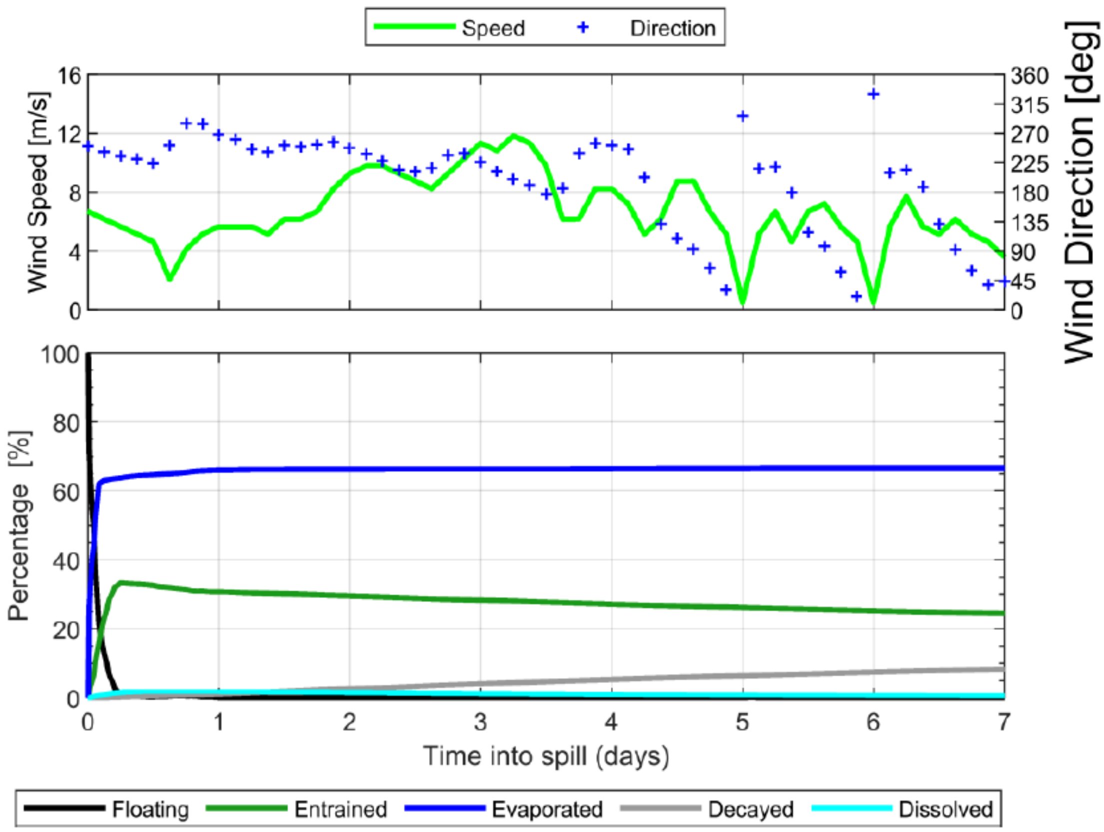


Figure A-1: Proportional mass balance plot representing the weathering of Julimar Condensate spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

The results of the OILMAP simulation predict that the discharge will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface (201 m above the seabed). This outcome was calculated by the model for both scenarios at all discharge rates specified throughout the 9-week blowout period. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of between 10 m/s and 14 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 26 m for both scenarios.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Marine diesel

Marine Diesel Oil is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group I/II oil. Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Under the test, variable-wind case, where the winds are of greater strength, entrainment into the water column is indicated to be significant. Approximately 2 days after the spill, around 45% of the oil mass is forecast to have entrained and a further 45% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface. The residual compounds will tend to entrain beneath the surface under conditions that generate wind waves (> ~6 m/s).

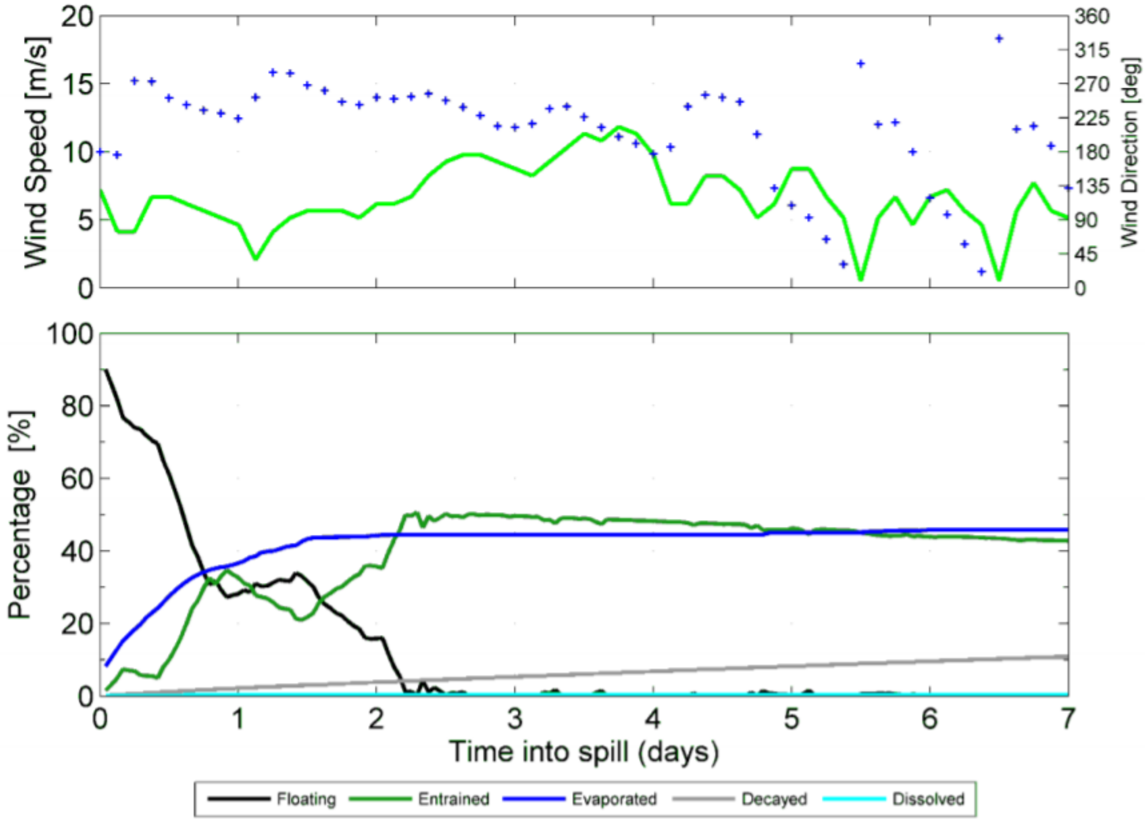


Figure A-2: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

APPENDIX B – FORMS

Form No.	Form Name	Link
1	Record of Initial Verbal Notification to NOPSEMA Template	Link
2	NOPSEMA Incident Report Form	Link
3	Marine Pollution Report (POLREP – AMSA)	Link
4	AMOSC Service Contract Note	Link
5	Marine Pollution Report (POLREP – DoT)	Link
6a	OSRL Initial Notification Form	Link
6b	OSRL Mobilisation Activation Form	Link
7	RPS APASA Oil Spill Trajectory Modelling Request	Link
8	Aerial Surveillance Observer Log	Link

FORM 1

Record of initial verbal notification to NOPSEMA

____

(NOPSEMA ph: (1300 674 472)

Date of call	
Time of call	
Call made by	
Call made to	

Information to be provided to NOPSEMA:

Date and Time of incident/time caller became aware of incident	
Details of incident	1. **Location** ____________ 2. **Title** ____________ 3. **Hydrocarbon source** □ **Platform** ____________ □ **Pipeline** ____________ □ **FPSO** ____________ □ **Exploration drilling** ____________ □ **Well** ____________ □ **Other (please specify)** ____________ 4. **Hydrocarbon type** ____________ 5. **Estimated volume of hydrocarbon** ____________ 6. **Has the discharge ceased?** ____________ 7. **Fire, explosion or collision?** ____________ 8. **Environment Plan(s)** ____________ 9. **Other Details** ____________

Actions taken to avoid or mitigate environmental impacts	
Corrective actions taken or proposed to stop, control or remedy the incident	

After the initial call is made to NOPSEMA, please send this record as soon as practicable to:

1. **NOPSEMA** **submissions@nopsema.gov.au**
2. **NOPTA** **resources@nopta.gov.au**
3. **DMIRS** **petreps@dmirs.wa.gov.au**

FORM 2

[for exploration/development activities]
[insert NOPSEMA Incident Report Form when printing]
Link

FORM 3

[insert Marine Pollution Report (POLREP – AMSA) when printing]

Link

FORM 4

[insert AMOSC Service Contract note when printing]

Link

FORM 5

[insert Marine Pollution Report (POLREP – DoT) when printing]

Link

FORM 6a

[insert OSRL Initial Notification Form when printing]
Link

FORM 6b

[insert OSRL Mobilisation Activation Form when printing]
Link

FORM 7

[insert RPS APASA Oil Spill Trajectory Modelling Request form when printing]

Link

FORM 8

[insert Aerial Surveillance Observer Log when printing]

Link

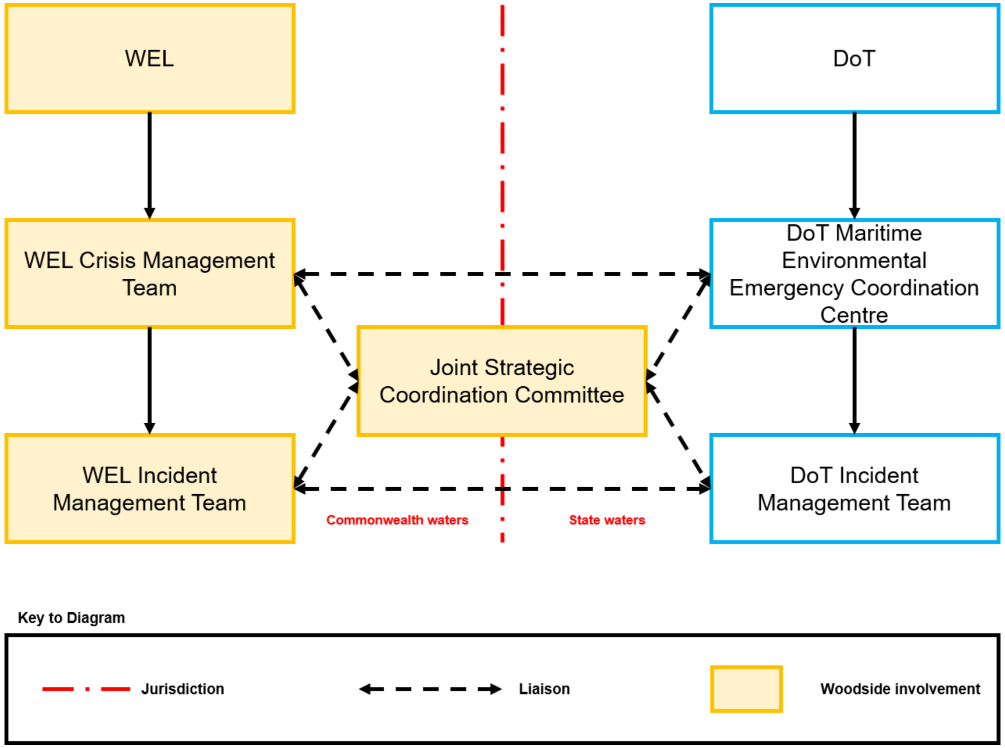
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

WHAT IS IT? **Oil Type/name** **Oil properties** **Specific gravity / viscosity / pour point / asphphaltines / wax content / boiling point**	
WHERE IS IT? Lat/Long Distance and bearing	
HOW BIG IS IT? Area Volume	
WHERE IT IS GOING? Weather conditions Currents and tides	
WHAT IS IN THE WAY? Resources at risk	
WHEN WILL IT GET THERE? Weather conditions Currents and tides	
WHAT'S HAPPENING TO IT? Weathering processes	

APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert Link when printing)

APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH AND STATE WATERS/SHORELINES[5]

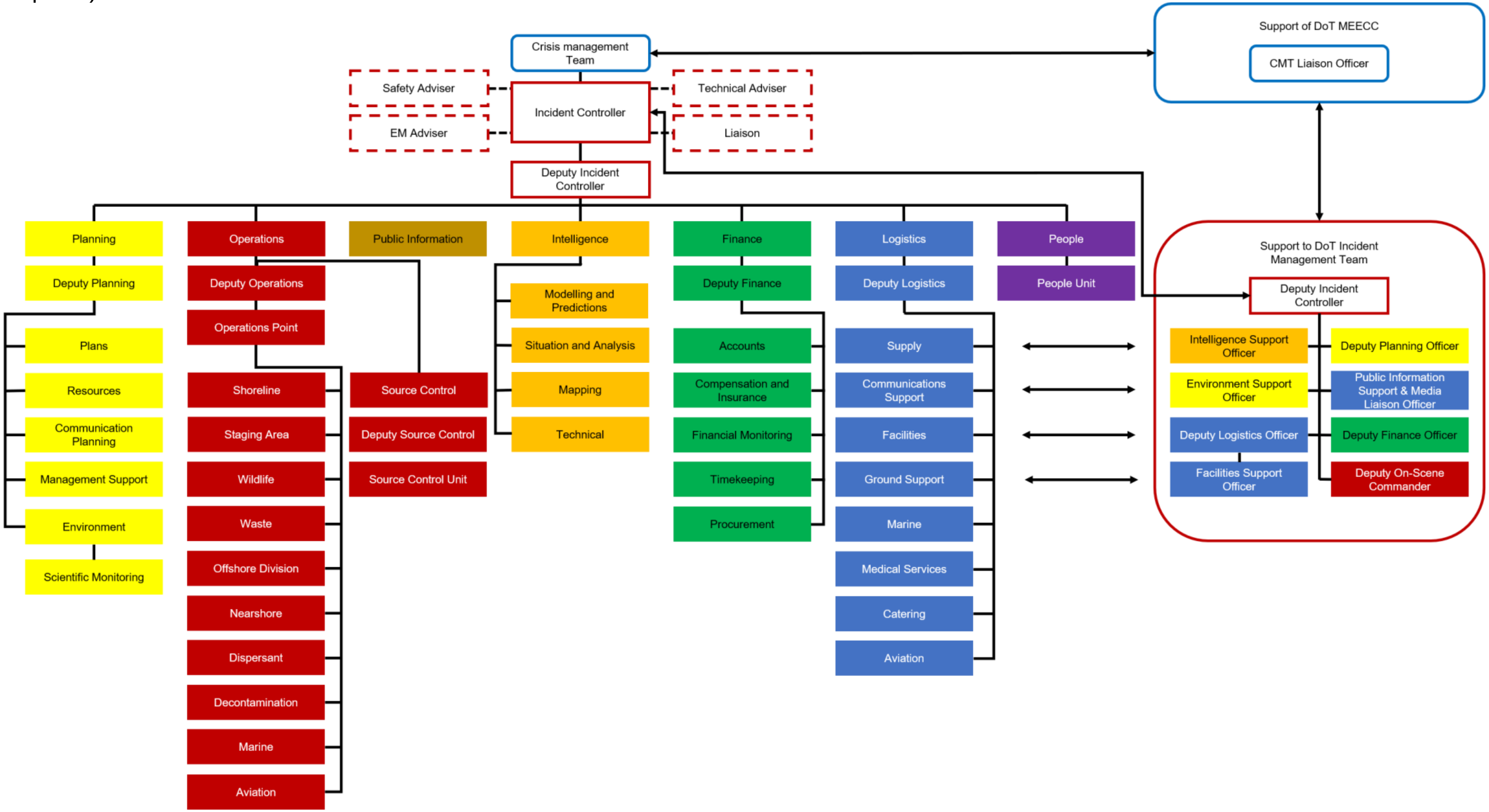


The Control Agency for a hydrocarbon spill in Commonwealth waters/shorelines resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder). The Control Agency for a hydrocarbon spill in State waters/shorelines resulting from an offshore petroleum activity is DoT. DoT will appoint an Incident Controller and form a separate IMT to only manage the spill within State waters/shorelines.

[5] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements September 2018. Note: For full structure up to Commonwealth Cabinet/Minister refer to Marine Oil Pollution: Response and Consultation Arrangements Section 6.5, Figure 4.

APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within DoT IMT if required).



APPENDIX G – WOODSIDE LIASON OFFICER RESOURCES TO DOT

Once DoT activates a State waters/shorelines IMT, Woodside will make available the following roles to DoT.

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
DoT MEECC	CMT Liaison Officer	CMT Duty Managers Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT and State Maritime Environment Emergency Coordinator (MEEC). • Offer advice to SMEEC on matters pertaining to Petroleum Titleholder (PT) crisis management policies and procedures.	1
DoT IMT Incident Control	WEL Deputy Incident Controller	CICC Duty Managers Reserve List Roster	• Provide a direct liaison between the PT IMT and DoT IMT. • Facilitate effective communications and coordination between the PT IC and the DoT IC. • Offer advice to the DoT IC on matters pertaining to PT incident response policies and procedures. • Offer advice to the Safety Coordinator on matters pertaining to PT safety policies and procedures, particularly as they relate to PT employees or contractors operating under the control of the DoT IMT.	1
DoT IMT Planning-Intelligence/ Mapping	Intelligence Support Officer	AMOSC Staff Member or AMOSC Core Group	• Facilitate the provision of relevant modelling and predications from the PT IMT. • Assist in the interpretation of modelling and predictions originating from the PT IMT. • Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the PT IMT. • Facilitate the provision of relevant mapping from the PT IMT. • Assist in the interpretation of mapping originating from the PT IMT. • Facilitate the provision of relevant mapping originating from the DoT IMT to the PT IMT.	1
DoT IMT Planning-Plans/ Resources	Deputy Planning Officer	AMOSC Core Group/CICC Planning Coordinator Reserve List and Planning Group 3	• Facilitate the provision of relevant IAP and sub plans from the PT IMT. • Assist in the interpretation of the PT OPEP from the PT. • Assist in the interpretation of the PT IAP and sub plans from the PT IMT. • Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the PT IMT. • Assist in the interpretation of the PT existing resource plans. • Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the PT IMT.	1
DoT IMT Planning-Environment	Environment Support Officer	CMT Environmental FST Duty Managers Roster	• Assist in the interpretation of the PT OPEP and relevant TRP plans. • Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the PT IMT. • Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the PT IMT.	1

[6] See Combined CICC, KICC, CMT roster and Preparedness Schedule Link / AMOSC Service Contract Link

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
DoT IMT Public Information-Media/ Community Engagement	Public Information Support and Media Liaison Officer	CMT Reputation {Media} FST Duty Manager Roster	• Facilitate effective communications and coordination between the PT 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 DoT Media Coordinator on matters pertaining to PT media policies and procedures. • Facilitate effective communications and coordination between the PT 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 the PT community liaison policies and procedures. • Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the PT IMT.	1
DoT IMT Logistics-Supply	Deputy Logistic Officer	CMT Services FST Logistics Team 2 Roster	• Facilitate the acquisition of appropriate supplies through the PTs existing OSRL, AMOSC and private contract arrangements. • Collects Request Forms from DoT to action via PT IMT.	1
DoT IMT Logistics-Waste	Facilities Support Officer	CMT Services FST Logistics Team 2 and WEL Waste Contractor Roster	• Facilitate the acquisition of appropriate services and supplies through the PTs existing private contract arrangements related to waste management. • Collects Request Forms from DoT to action via PT IMT.	1
DoT IMT Finance-Accounts/ Financial Monitoring	Deputy Finance Officer	CICC Finance Coordinator Roster	• 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 Woodside's existing OSRL, AMOSC and private contract arrangements. • Facilitate the communications of financial monitoring information to Woodside to allow Woodside to track the overall cost of the response. • Assist the finance office in the tracking of financial commitments thought he response, including the supply contracts commissioned directly and to be charged back to Woodside.	1
DoT FOB Operations Command	Deputy On-Scene Commander	AMOSC Core Group	• Provide a direct liaison between the PT FOB and DoT FOB. • Facilitate effective communications and coordination between the PT FOB Operations Commander and the DoT FOB Operations Commander. • Offer advice to the DoT FOB Operations Commander on matters pertaining to PT incident response policies and procedures. • Assist the Senior Safety Officer deployed in the FOB in the performance of their duties, particularly as they relate to PT employees or contractors. • Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to PT safety policies and procedures.	1
Total Woodside Personnel Initial Requirement to DoT IMT				10

DOT LIAISON OFFICER RESOURCES TO WOODSIDE

Once DoT activates a State waters/shorelines IMT, Woodside will request DoT to make available the following roles:

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
WEL CMT	DoT Liaison Officer	DoT	• Provide a direct liaison via CICC HSP Advisor between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and SMEEC. • Offer advice to CMT Leader on matters pertaining to DoT and wider government emergency management policies and procedures. • Provide a direct liaison between the PT IMT and DoT IMT. • Facilitate effective communications and coordination between the PT IC and the DoT IC. • Offer advice to the PT IC on matters pertaining to DoT and wider government incident response policies and procedures. • Facilitate requests for specific tasks from PT IMT related to Aviation and Waste Management.	1
WEL Reputation FST (Media Room)	DoT Media Liaison Officer	DoT	• Provide a direct liaison via Reputation FST Media Team between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT 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 PT Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.	1
			Total DoT Personnel Initial Requirement to Woodside	2