Echo Yodel and Capella Plugging and Echo Yodel Decommissioning Environment Plan

Developments Division
Revision 0
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1 INTRODUCTION

1.1 Overview

Woodside Energy Ltd (Woodside), as Titleholder under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (referred to as the Environment Regulations), proposes to perform the following activities within Permit Areas WA-1-L, WA-23-L and in relation to the pipeline licenced under WA-9-PL:

- Permanently plug for abandonment the Yodel-3 and Yodel-4 production wells, and the Capella-1 exploration well. Permanent plugging will involve removing temporary plugs and installing permanent abandonment barriers in the wells using a Mobile Offshore Drilling Unit (MODU).
- Leave the Echo Yodel subsea infrastructure in-situ permanently to enable the infrastructure to continue to provide hard substrate to maintain the marine growth and habitat that currently supports local ecological functions.

These activities will hereafter be referred to as the Petroleum Activities Program and form the scope of this Environment Plan (EP). A more detailed description of the activities is provided in **Section 3**.

The 'Echo Yodel subsea infrastructure' is defined as two wellheads with X-mas trees (Yodel-3 and Yodel-4), a pipeline, a main electrohydraulic umbilical (EHU), two umbilical termination assemblies (UTAs), an infield umbilical termination basket (IUTB), a pig launcher and two infield jumpers. The Capella-1 exploration well is not considered part of the Echo Yodel subsea infrastructure.

This EP has been prepared to meet the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) for decommissioning. Decommissioning the Echo Yodel subsea infrastructure in-situ provides a better environmental and safety outcome compared to the base case of completely removing it from the permit areas.

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

In accordance with the requirements of Regulation 19 of the Environment Regulations, this EP submission will supersede the management of Echo Yodel subsea infrastructure under the Goodwyn Alpha (GWA) Facility Operations EP (NOPSEMA Document No. A1800RH158693, Revision 8). Capella-1 wellhead infrastructure will continue to be managed under the North Rankin Complex (NRC) Facility Operations EP (NOPSEMA Document No. BA0000AH7558519, Revision 10) after permanent plugging activities, which are proposed to be performed under this EP. A permanent management option for the Capella-1 wellhead infrastructure will be managed under a new, separate EP.

The scope of this EP includes only inspection, maintenance, monitoring and repair (IMMR) activities where they will be performed from a Mobile Offshore Drilling Unit (MODU). Normal IMMR activities performed from an IMMR vessel, including, for example, subsea cleaning and preparation of the subsea X-mas trees, are excluded from the scope of this EP. They are managed under the GWA Facility Operations EP for the Yodel-3 and Yodel-4 wells and under the NRC Facility Operations EP for the Capella-1 well.

1.2 Defining the Petroleum Activity

The Petroleum Activities Program to be performed in Permit Titles WA-1-L, WA-23-L and WA-9-PL comprise permanent plugging and decommissioning, which are both petroleum activities as defined in Regulation 4 of the Environment Regulations. As such, this 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 and risks (planned [routine and non-routine] and unplanned) 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 (EPSs) and measurement criteria (MC). These form the basis for monitoring, auditing and managing the Petroleum Activities Program to be performed 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 1**. The spatial boundary of the Petroleum Activities Program has been described and assessed using two 'areas':

1. Operational Area A, defined as the area in which permanent plugging for abandonment-related petroleum activities will occur
2. Operational Area B, defined as the area in which the impacts and risks from leaving the Echo Yodel subsea infrastructure in-situ permanently will occur.

The combination of the two Operational Areas defines the spatial boundary of the Petroleum Activities Program, as described, risk-assessed and managed by this EP. The Operational Areas are further defined in **Section 3.4**.

This EP addresses potential environmental impacts from planned activities and any potential unplanned risks that originate from within the Operational Areas. Transit to and from the Operational Areas by vessels associated with the Petroleum Activities Program and support vessels, as well as port activities associated with these vessels, are not within the scope of this EP. Vessels supporting the Petroleum Activities Program operating outside the Operational Areas (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

This summary has been prepared based on the material provided in this EP, addressing the items listed in **Table 1-1** as required by Regulation 11(4).

Table 1-1: EP summary

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	**Section 3.3**, starting at page 43
A description of the receiving environment	**Section 4**, starting at page 70
A description of the activity	**Section 3**, starting at page 41
Details of the environmental impacts and risks	**Section 6**, starting at page 209
The control measures for the activity	**Section 7.3**, starting at page 242
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 8.5**, starting at page 401
Response arrangements in the oil pollution emergency plan	**Section 8.9**, starting at page 411 and **Appendix D**
Consultation already performed and plans for ongoing consultation	**Section 5**, starting at page 181
Details of the titleholder's nominated liaison person for the activity	**Section 1.8**, starting at page 18

1.6 Structure of the Environment Plan

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

Table 1-2: EP process phases, applicable regulations and relevant section of EP

Criteria for acceptance	Content requirements/relevant regulations	Elements	Section of EP
Regulation 10A(a): Is appropriate for the nature and scale of the activity	Regulation 13: *Environmental assessment*	The principle of 'nature and scale' is applicable throughout the EP.	**Section 1** **Section 3** **Section 4** **Section 5** **Section 6** **Section 7.9.1**
	Regulation 14: *Implementation strategy for the environment plan*		
	Regulation 16: *Other information in the environment plan*		
Regulation 10A(b): Demonstrates that the environmental impacts and risks of the activity will be reduced to ALARP Regulation 10A(c): Demonstrates that the environmental impacts and risks of the activity will be of an acceptable level	Regulation 13(1)–13(7): *13(1) Description of the activity* *13(2)(3) Description of the environment* *13(4) Requirements* *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*	Set the context (activity and existing environment). Define 'acceptable' (the requirements, the corporate policy, relevant persons). Detail the impacts and risks. Evaluate the nature and scale. Detail the control measures – ALARP and acceptable.	**Section 1** **Section 2** **Section 3** **Section 4** **Section 5** **Section 6** **Section 7.9.1**

Criteria for acceptance	Content requirements/relevant regulations	Elements	Section of EP
Regulation 10A(d): Provides for appropriate EPOs, EPSs and MC	Regulation 13(7): *Environmental performance outcomes and standards*	EPOs. EPSs. MC.	**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 (OPEP) and scientific monitoring • ongoing consultation.	**Section 7.9.1** **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 performed in any part of a declared World Heritage property within the meaning of the EPBC Act	Regulation 13(1)–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, performed in any part of a declared World Heritage property.	**Section 3** **Section 4**
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 performed in the preparation of this EP.	**Section 5**

Criteria for acceptance	Content requirements/relevant regulations	Elements	Section of EP
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 5** **Section 6** **Appendix A** **Appendix B**

1.7 Description of the Titleholder

Woodside Energy Ltd. (Woodside), as Titleholder for this activity, on behalf of the North West Shelf Joint Venture comprising BHP Billiton Petroleum (North West Shelf) Pty. Ltd., BP Developments Australia Pty. Ltd., Chevron Australia Pty. Ltd., CNOOC North West Shelf (NWS) Private Ltd. (joint venture partner for all titles except WA-9-PL), Japan Australia Liquefied Natural Gas (LNG) (MIMI) Pty. Ltd. and Shell Australia 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, it is 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, which is 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 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 it is a partner of choice. More 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 Regulations, details of the titleholder, liaison person and arrangements for notifying of changes are described in the next subsections.

1.8.1 Titleholder

Woodside Energy Limited
11 Mount Street
Perth, Western Australia
Telephone: 08 9348 4000
ACN: 63 005 482 986

1.8.2 Activity Contact

Neil McKay
Project Manager
11 Mount Street
Perth, Western Australia
Telephone: 08 9348 4000
Email: neil.mckay@woodside.com.au

1.8.3 Nominated Liaison Person

Daniel Clery
Corporate Affairs Manager
11 Mount Street
Perth, Western Australia
Telephone: 08 9348 4000
Email: feedback@woodside.com.au

1.8.4 Arrangements for Notifying of Change

Should the titleholder, titleholder's nominated liaison person or the contact details for either change, NOPSEMA will be notified in writing of the change within two weeks or as soon as practicable (ASAP).

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 four elements: Compass and Policies, Expectations, Processes and Procedures, and Guidelines, outlined below (and illustrated in **Figure 1-1**):

- **Compass** and **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 and Procedures:** Processes identify the set of interrelated or interacting activities that transform inputs into outputs, to systematically achieve a purpose or specific objective. Procedures specify what steps, by whom and when to perform an activity or a process.
- **Guidelines:** Provide recommended practice and advice about how to perform the steps defined in Procedures, together with supporting information and associated tools. Guidelines provide advice about how activities or tasks may be performed, information that may be considered, or how to use tools and systems.

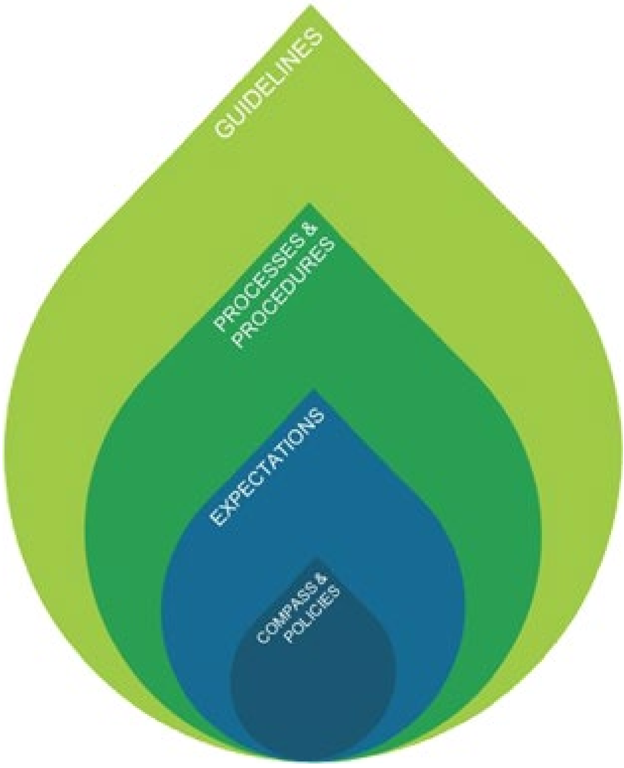

Figure 1-1: The four major elements of the WMS Seed

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.

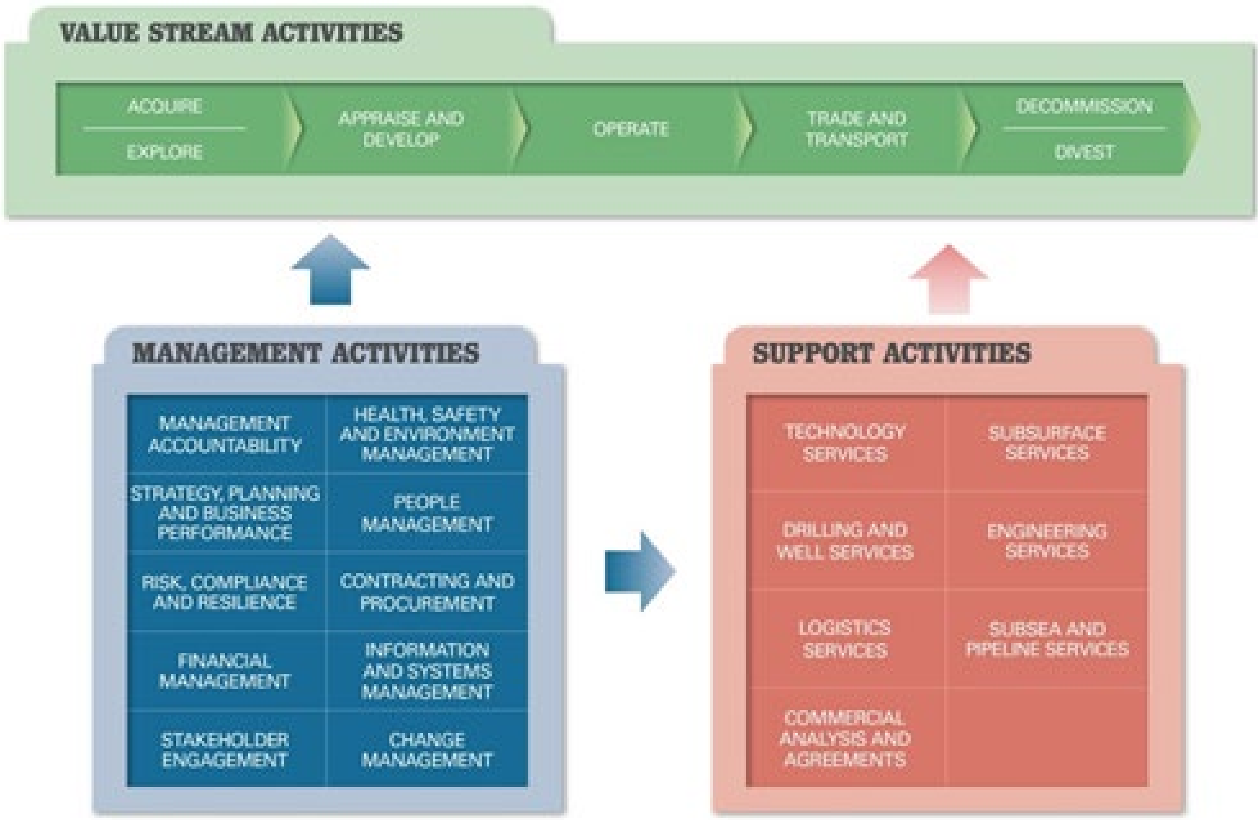

Figure 1-2: The WMS business process hierarchy

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, that apply to the activity and are relevant to managing risks and impacts of the Petroleum Activities Program are detailed in **Appendix B**. This EP will not be assessed under the *WA Environment Protection Act 1986* as the activity does not occur on State land or within State waters.

1.10.1 Applicable Environmental Legislation

1.10.1.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

The Commonwealth OPGGS Act controls exploration and production activities beyond three nautical miles (nm) of the mainland (and islands) to the outer extent of the Australian Exclusive Economic Zone (EEZ) at 200 nm.

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

The objective of the Environment Regulations is to ensure petroleum activities are:

- carried out in a manner consistent with the principles of ecological sustainable development

- carried out in a manner by which the environmental impacts and risks of the activity will be reduced to ALARP
- carried out in a manner by which the environmental impacts and risks of the activity will be of an acceptable level.

Furthermore, section 270(3)(c) of the OPGGS Act states that a licence holder can only surrender its petroleum licence if all property brought into the area by any person engaged or concerned in the operations authorised by the permit holder has been removed, or if alternative arrangements have been made with NOPSEMA.

This EP has been written to meet the requirements of the OPGGS Act by demonstrating that an alternate arrangement provides a better outcome for decommissioning the Echo Yodel subsea infrastructure than complete removal does.

1.10.1.2 Environment Protection (Sea Dumping) Act 1981

The Commonwealth *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) is the legislative instrument that addresses Australia's obligations under the London Protocol. The aims of the London Protocol are to protect and preserve the marine environment from all sources of pollution, and to prevent, reduce and eliminate pollution by controlling the dumping of wastes and other materials at sea.

The Act regulates the dumping at sea of controlled material (including certain wastes and other matter), the incineration at sea of controlled material, loading for the purpose of dumping or incineration, export for the purpose of dumping or incineration, and the placement of artificial reefs. Permits are required for any authorised sea dumping activities.

The Sea Dumping Act and associated sea dumping permits are administered by the Department of Agriculture, Water and Environment (DoAWE) (previously Department of Environment and Energy [DoEE]). Woodside is liaising with DoAWE regarding the requirements under the Sea Dumping Act for the proposed Petroleum Activities Program described in this EP (**Section 5**). Woodside will comply with all requirements under the Act in relation to this EP.

1.10.1.3 Australian Marine Parks

Under the EPBC Act, Australian Marine Parks (AMPs), formally known as Commonwealth Marine Reserves, are recognised for conserving marine habitats and the species that live and rely on these habitats. The Director of National Parks (DNP) is responsible for managing AMPs (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 relating 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 (DNP, 2018a) and the South-west Marine Parks Network Management Plan (DNP, 2018b) describe the requirements for managing the marine parks that are relevant to this EP.

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 through 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.

1.10.2 World Heritage Properties

Australian World Heritage management principles are prescribed in Schedule 5 of the EPBC Regulations 2000. Management principles that are considered relevant to the scope of this EP are provided in **Table 1-3**.

Table 1-3: Relevant management principles under Schedule 5 – Australian World Heritage management principles of the EPBC Act

Number	Principle	Relevant Section of the EP
3	Environmental impact assessment and approval 3.01 This principle applies to the assessment of an action that is likely to have a significant impact on the World Heritage values of a property (whether the action is to occur inside the property or not). 3.02 Before the action is taken, the likely impact of the action on the World Heritage values of the property should be assessed under a statutory environmental impact assessment and approval process. 3.03 The assessment process should: (a) identify the World Heritage values of the property that are likely to be affected by the action; and (b) examine how the World Heritage values of the property might be affected; and (c) provide for adequate opportunity for public consultation. 3.04 An action should not be approved if it would be inconsistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property. 3.05 Approval of the action should be subject to conditions that are necessary to ensure protection, conservation, presentation or transmission to future generations of the World Heritage values of the property. 3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions of the approval.	3.01 and 3.02: Assessment of significant impact on World Heritage values is included in **Section 6**. Principles are met by the submitted EP. 3.03 (a) and (b): World Heritage values are identified in **Section 4** and considered in the assessment of impacts and risks for the Petroleum Activity in **Section 6**. 3.03 (c): Relevant stakeholder consultation and feedback received in relation to impacts and risks to the Ningaloo Coast and Shark Bay World Heritage Properties (which are both within the scope of this EP) are outlined in **Section 5**. 3.04, 3.05 and 3.06: Principles are considered to be met by the acceptance of this EP.

Note that Section 1 – General Principles and 2 – Management Planning of Schedule 5 are not considered relevant to the scope of this EP and, therefore, have not been included.

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**). This includes a description of the comparative assessment process and the environmental risk management methodology that is used to identify, analyse and evaluate risks to meet ALARP and acceptability requirements and to develop EPOs and EPSs. This section also describes Woodside's risk management methodologies applicable to implementation strategies applied during the activity.

To define the decommissioning activity, Section 270(c) of the OPGGS Act states that when a petroleum title is surrendered, all infrastructure that was brought into the lease area by the titleholder must be removed, unless other arrangements are made to the satisfaction of NOPSEMA. To support this section of the Act, the Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science, 2018) clarifies how to determine what is a 'satisfactory arrangement'. These guidelines state that "the titleholder must demonstrate that the alternative decommissioning approach delivers equal or better environmental, safety and well integrity outcomes compared to complete removal". Therefore, to determine the decommissioning option that provides equal or better environmental, safety and well integrity outcomes to complete removal, a comparative assessment was performed. This is described further in **Section 2.2** and **Section 6**.

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 selected Petroleum Activities Program. The objective of the risk assessment process, described in this section, is to identify the risks and associated impacts of an activity so they can be assessed, appropriate control measures applied to eliminate, control or mitigate the impact or risk to ALARP, then 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 include potential emergency and accidental events:

- Planned activities have the potential for inherent environmental impacts.
- Environmental risks are unplanned events 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 impacts termed potential 'consequence'.

The next subsections explain the comparative assessment and the risk assessment processes that form the basis of this EP.

2.2 Comparative Assessment

A comparative assessment was performed to assess various decommissioning options for the Echo Yodel subsea infrastructure. The purpose of this comparative assessment process was to understand the decommissioning options that present the same or better environmental, safety and well integrity outcomes as complete removal of the subsea infrastructure. The comparative assessment process included the steps outlined in **Figure 2-1**. Information that supported the comparative assessment processes included scientific and engineering studies commissioned by Woodside and stakeholder participation. Furthermore, to ensure all options were assessed consistently, a set of criteria was developed and applied throughout the comparative assessment. The comparative assessment process, including the background studies, how options were developed, the basis of the assessment criteria and stakeholder comparative assessment workshop, is explained in **Section 6**. **Section 3** explains the comparative assessment results and summarises how the preferred option provides better or equal environment, safety and well integrity options as full removal of the infrastructure.

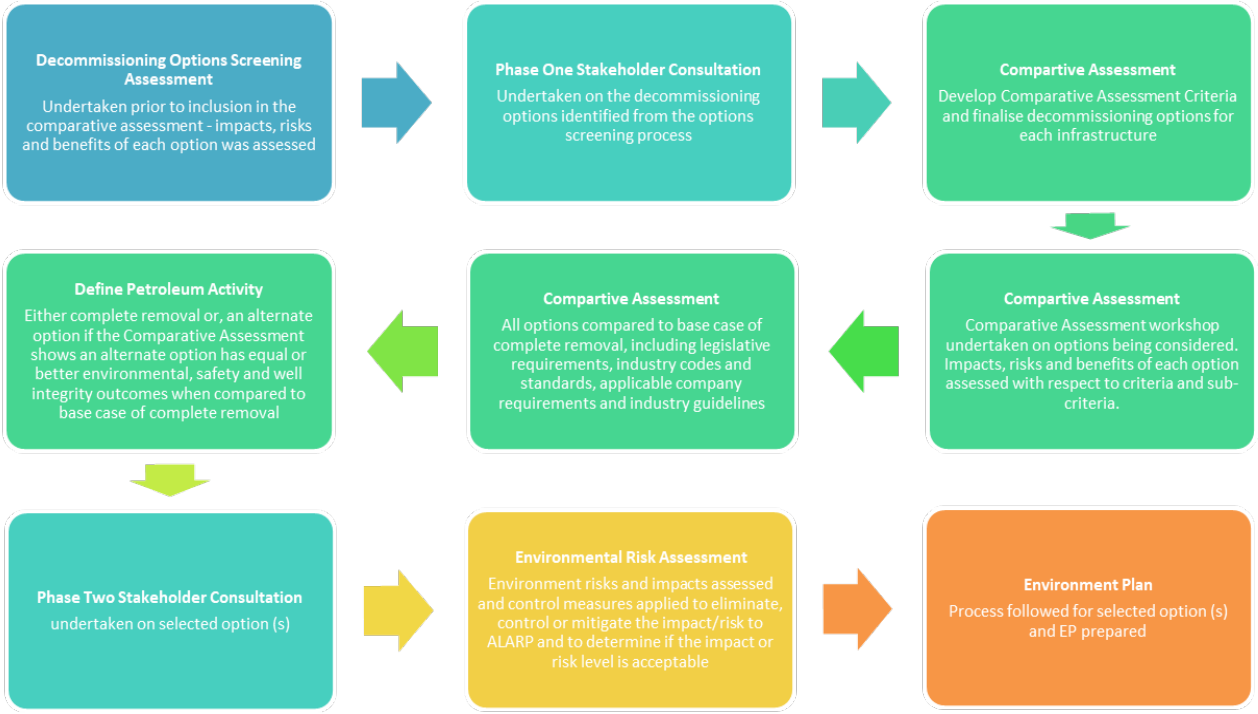

Figure 2-1: Overview of integrated comparative assessment and Environment Plan process

2.3 Environmental Risk Management Methodology

2.3.1 Woodside Risk Management Processes

Woodside recognises that risk is inherent to its business and effectively managing risk 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 its business. Achieving this objective includes ensuring risks consider impacts across the 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 31000:2009. The WMS risk management procedure, guidelines and tools provide guidance on specific techniques for managing risk, tailored for particular areas of risk within certain business processes. Procedures applied for environmental risk management include:

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

The risk management methodology provides a framework to demonstrate that the 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 2-2**. Each step and how it is applied to the scopes of this activity is described in **Sections 2.3** to **2.11**.

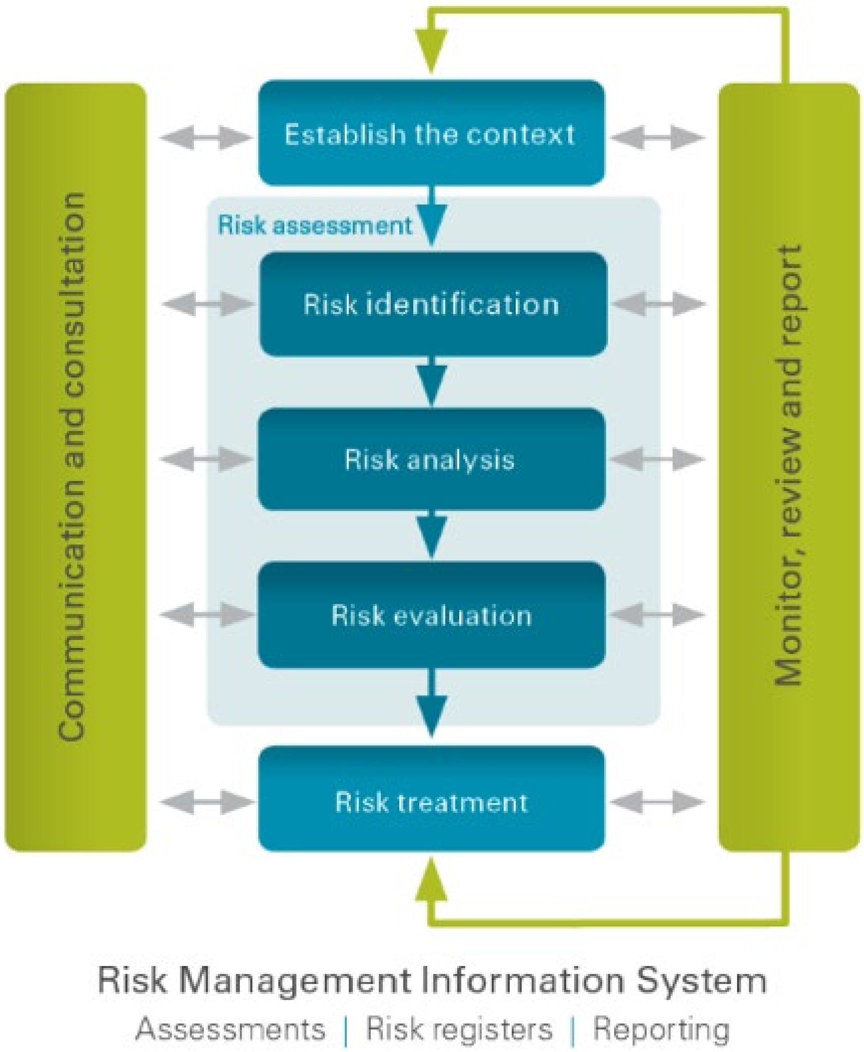

Figure 2-2: Woodside's risk management process

2.3.2 Health, Safety and Environment Management Procedure

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

2.3.3 Impact Assessment Procedure

To support effective environmental risk assessment, Woodside's Impact Assessment Procedure (**Figure 2-3**) provides the steps needed to meet required environment, health and social standards by ensuring impacts are assessed 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.

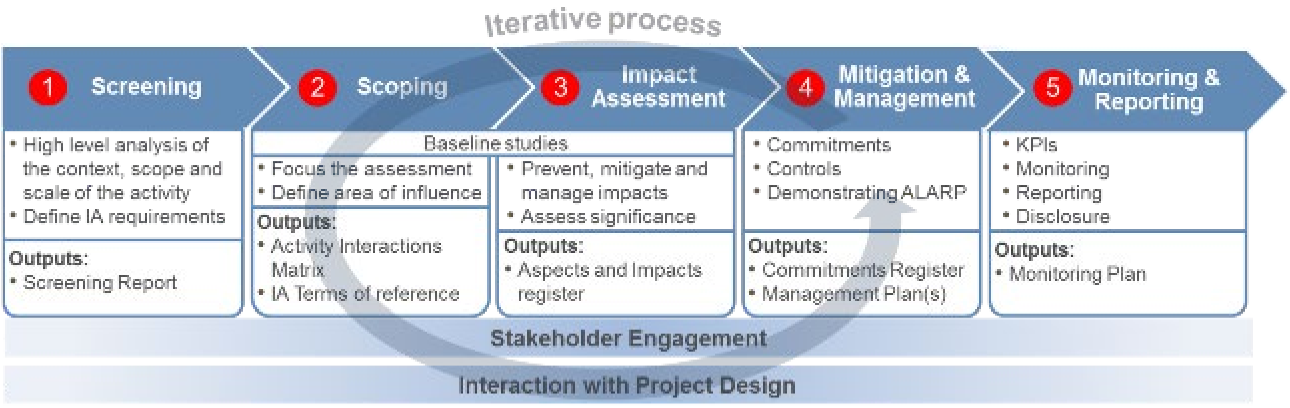

Figure 2-3: Woodside's impact assessment process

2.4 Environment Plan Process

Figure 2-4 illustrates the EP development process. Each element of this process is discussed further in **Sections 2.5** to **2.11**.

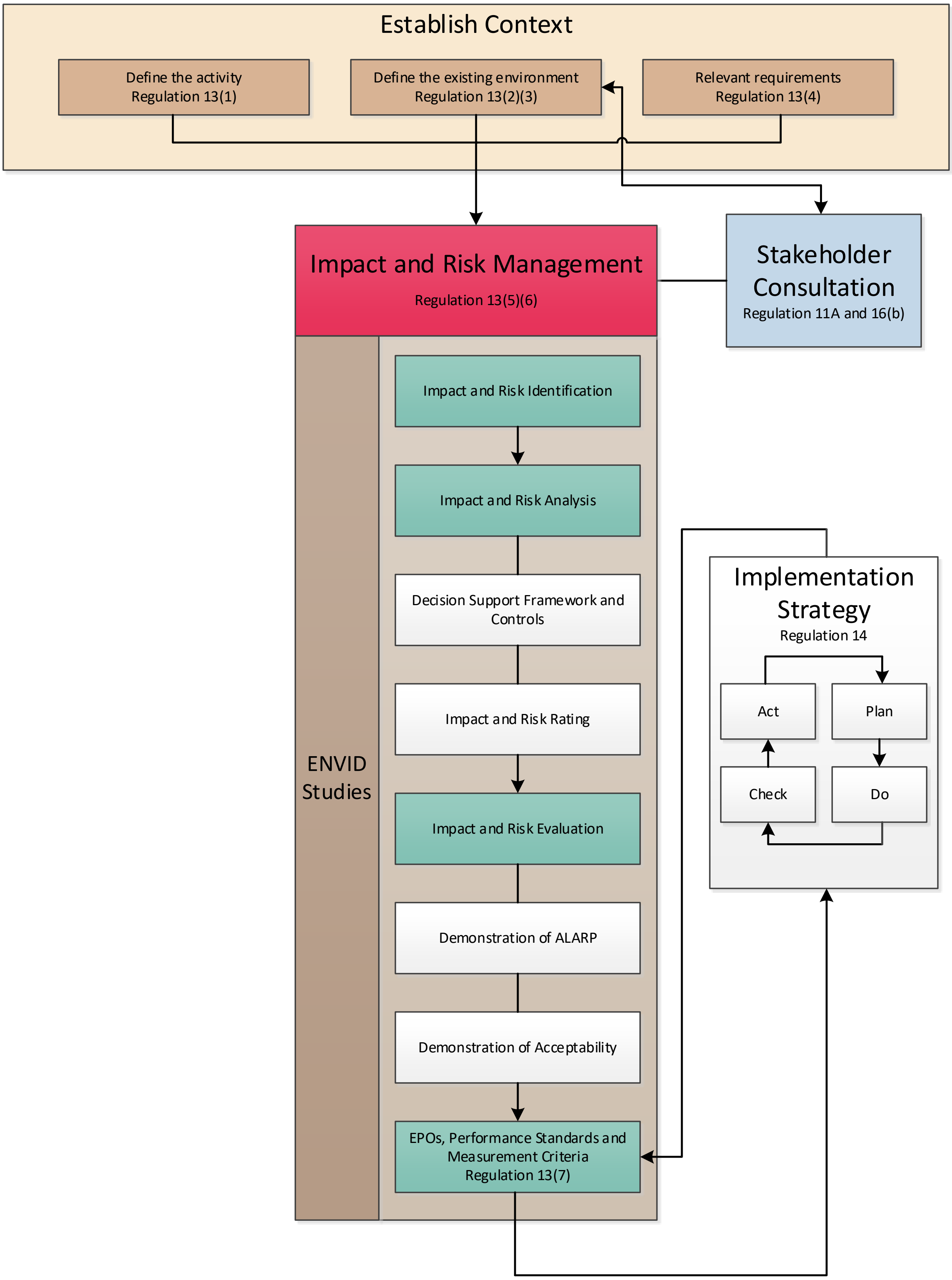

Figure 2-4: Environment Plan development process

2.5 Establish the Context

2.5.1 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 performed
- how it is planned to be performed, 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 and emergency conditions) activities.

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

2.5.2 Defining the Existing Environment

The context of the existing environment is described and determined by considering the nature and scale of the activity (size, type, timing, duration, complexity, and intensity of the activity), as described in **Section 3**. The purpose is to describe the existing environment that may be impacted by the activity, directly or indirectly, by planned or unplanned[2] events.

The existing environment section (**Section 4**) is structured to define 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 environmental, and social and cultural consequences as defined by Woodside (refer to **Table 2-1**), which address key physical and biological attributes, as well as social and cultural values of the existing environment. These consequence definitions are applied to the impact and risk analysis (refer **Section 2.5.2**) and rated for all planned and unplanned activities. Additional detail is provided for evaluating unplanned hydrocarbon spill risk.
- 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 (and associated sources of environmental risk). This considers the Operational Areas and wider environment that may be affected (EMBA), as determined by the hydrocarbon spill risk assessments presented in **Section 7.7**. MNES, as defined within the EPBC Act, are addressed through Woodside's impact and risk assessment (**Section 6**).

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

[2] For each source of risk, the credible worst-case scenario in conjunction with impact thresholds is used to determine the spatial extent of the EMBA. 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.

- Relevant values and sensitivities, which may include world or national Heritage Listed areas, Ramsar wetlands, listed threatened species or ecological communities, listed migratory species, and sensitive values that exist in or in relation to Commonwealth marine area or land.
- In categorising the environmental values potentially impacted by the Petroleum Activities Program (as presented in **Table 2-1**), there is standardisation of information relevant to understanding the receiving environment. Potential impacts to these environmental values are evaluated in the risk analysis (refer **Section 2.7**), 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.

By grouping potentially impacted environmental values by aspect (as presented in **Table 2-1**), the presentation of information about the receiving environment is standardised. This information is then consistently applied to the risk evaluation section to provide a robust approach to the overall environmental risk evaluation and its documentation in the EP.

Table 2-1: Environmental values potentially impacted by the Petroleum Activities Program which are assessed within the EP

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

2.5.3 Relevant Requirements

The relevant requirements in the context of legislation, other environmental approval requirements, conditions and standards that apply to the Petroleum Activities Program have been identified and reviewed. Relevant requirements are presented in **Appendix B** and **Section 1**.

Woodside's Corporate Health, Safety, Environment and Quality Policy is presented in **Appendix A**.

2.6 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 and workshops (e.g. HAZID/Environmental Hazard Identification [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 1**), the existing environment (**Section 3**) 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' hereafter in this EP.

Two ENVID workshops were performed specific to this EP; an ENVID workshop was conducted for the permanent plug and abandon activities on 2 October 2019, and on 7 November 2019 for the Echo Yodel subsea infrastructure that is proposed to be permanently left in-situ. Participants included project environmental advisors, environmental engineers, development coordinator, subsea engineer and drilling engineers. The participants' breadth of knowledge, training and experience was sufficient to reasonably assure that the hazards that may arise in connection with the Petroleum Activities Program in this EP were identified.

Impacts and risks were identified during the ENVID for both planned (routine and non-routine) activities and unplanned (accidents, incidents and emergency conditions) events. During this process, risks that are identified as not applicable (not credible) are removed from the assessment. This is done by defining the activity and identifying that an aspect is not applicable.

The impact and risk information is then 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 MC. 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***					
	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												

2.7 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 a review of the existing environment.

The key steps performed for each risk identified during the risk assessment were:

1. Identify the decision type in accordance with the decision support framework.
2. Identify appropriate control measures (preventative and mitigative) aligned with the decision type.
3. Assess the risk rating or impact.

2.7.1 Decision Support Framework

To support the risk assessment process and Woodside's determination of acceptability (**Section 2.8.2**), 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 and Gas UK, 2014). This concept is 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 ALARP and acceptable (**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 manage risks based on the uncertainty of the risk, the complexity and risk rating (i.e. potential higher order environmental impacts are subject to further evaluation/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 about the uncertainty of the risk, and documented in ENVID output.

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

2.7.1.1 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.

2.7.1.2 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.

2.7.1.3 Decision Type C

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

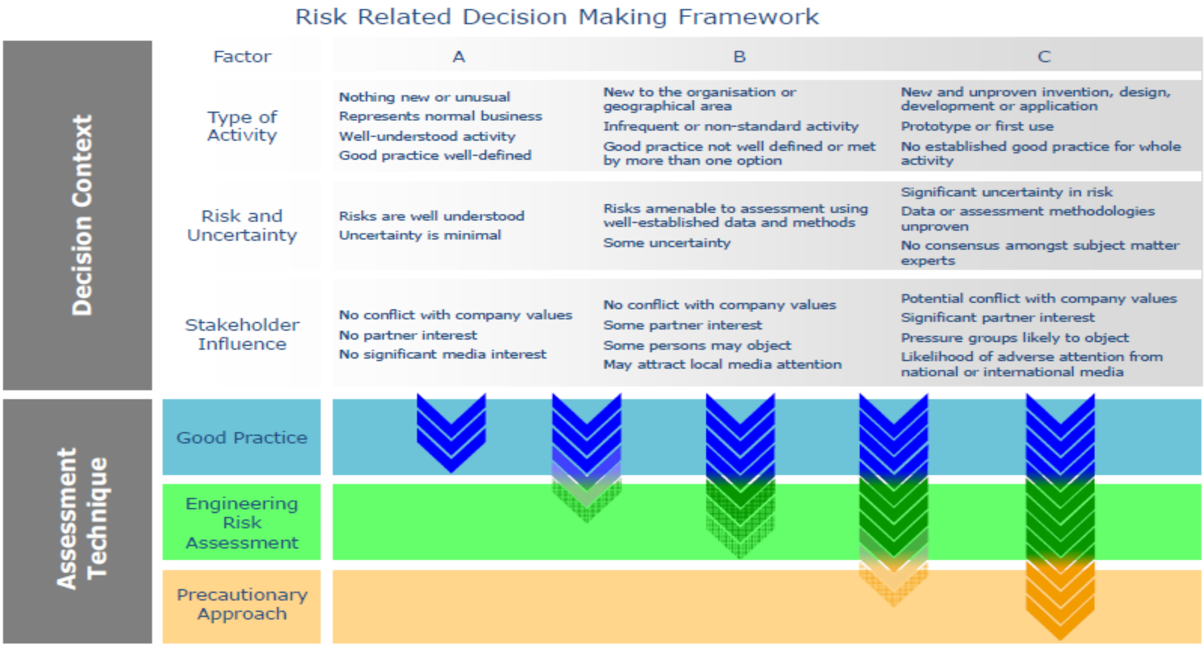

Figure 2-5: Risk related decision-making framework (Oil and Gas UK, 2014)

2.7.2 Decision Support Framework Tools

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

- **Legislation, Codes and Standards (LCS)** – identifies the requirements of legislation, codes and standards which must be complied with for the activity.
- **Good Industry Practice (GP)** – identifies further engineering control standards and guidelines that may be applied by Woodside above those required to meet the LCS.
- **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 identified 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.

2.7.3 Decision Calibration

To determine that alternatives selected and the 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 LCS and/or good industry practice.
- **Peer Review** – independent peer review of PJs, supported by risk-based analysis, where appropriate.
- **Benchmarking** – where appropriate, benchmarking against a similar facility or activity type or situation that has been accepted to represent acceptable risk.
- **Internal Stakeholder Consultation** – consultation performed within Woodside to inform the decision and verify CVs are met.
- **External Stakeholder Consultation** – consultation performed 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.

2.7.4 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, or 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 has occurred.
- **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).

2.7.5 Impact and Risk Classification

Environmental impacts and risks are assessed to determine their potential significance or consequence. The impact significance or consequence considers the magnitude of the impact or risk and the sensitivity of the potentially impacted receptor (represented by **Figure 2-6**).

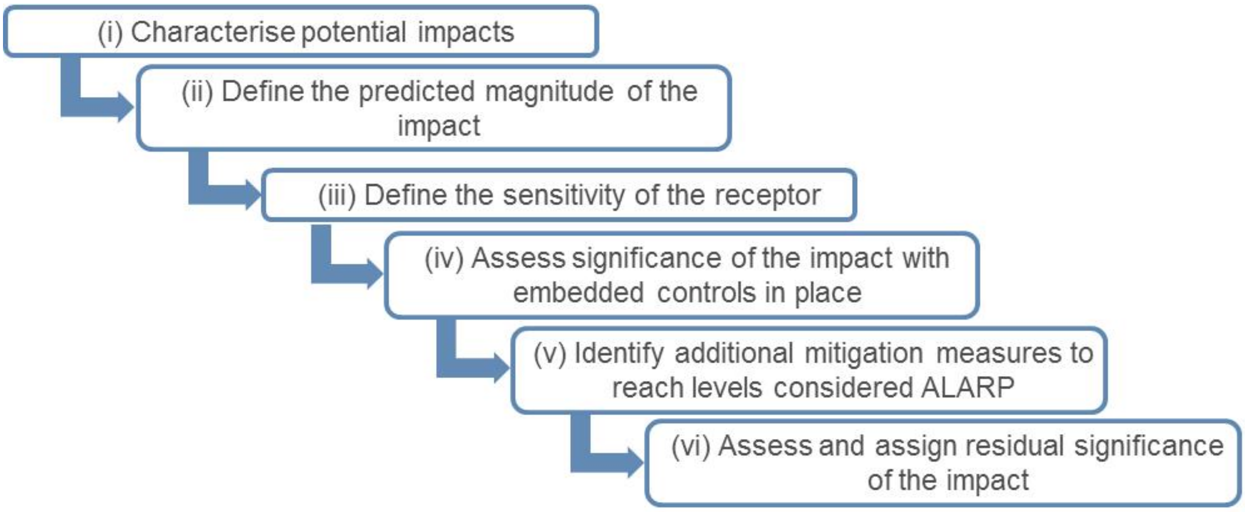

Figure 2-6: Environmental impact and risk analysis

Impacts are classified in accordance with the consequence (**Section 2.4**) outlined in the 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 in **Table 2-2**, evaluated for each planned activity and unplanned event.

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

Environment	Social and Cultural	Consequence Level
Catastrophic, long-term impact (more than 50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	Catastrophic, long-term impact (more than 20 years) to a community, social infrastructure or highly valued areas/items of international cultural significance	***A***
Major, long-term impact (ten to 50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	Major, long-term impact (five to 20 years) to a community, social infrastructure or highly valued areas/items of national cultural significance	***B***
Moderate, medium-term impact (two to ten years) on ecosystems, species, habitat or physical or biological attributes	Moderate, medium term Impact (two to five years) to a community, social infrastructure or highly valued areas/items of national cultural significance	***C***
Minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems function), physical or biological attributes	Minor, short-term impact (one to two years) to a community or highly valued areas/items of cultural significance	***D***
Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes	Slight, short-term impact (less than one year) to a community or areas/items of cultural significance	***E***
No lasting effect (less than one month); localised impact not significant to environmental receptors	No lasting effect (less than one month); localised impact not significant to areas/items of cultural significance	***F***

2.7.6 Risk Rating Process

The risk rating process is performed 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 (**Figure 2-7**).

The risk rating process is performed using the following steps:

2.7.6.1 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, select the highest severity consequence level.

2.7.6.2 Select the Likelihood Level

Determine the description that best fits the chance of the selected consequence occurring, assuming reasonable effectiveness of the preventative and mitigative 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 100–1,000 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**

2.7.6.3 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 2-7**. 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.

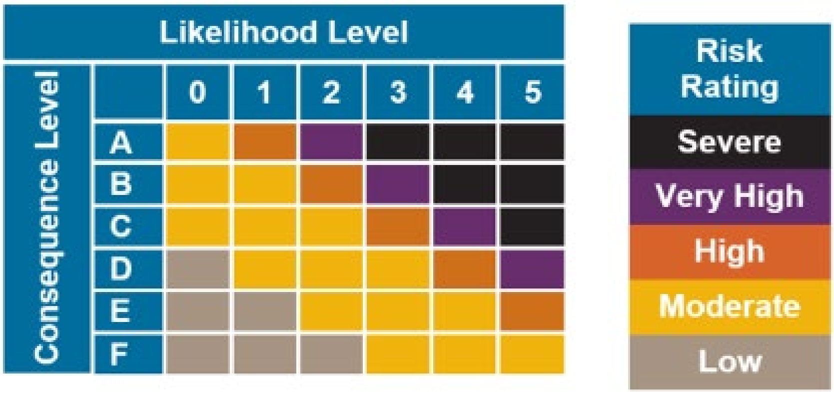

Figure 2-7: Woodside risk matrix – risk level

To support ongoing risk management (a key component of Woodside's Process Safety Management Framework – refer to Implementation Strategy (**Section 8**)), Woodside uses the concept of 'current risk' and applies a current risk rating to indicate the current or 'live' level of risk, considering the controls that are currently in place and regularly effective. Current risk rating 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 the communication and visibility of the risk events, and ensures risk is continually managed to ALARP by identifying risk reduction measures and assessing acceptability.

2.8 Impact and Risk Evaluation

Environmental impacts and risks, cover a wide 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 an impact or risk 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 Ecological Sustainable Development (ESD) 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 Regulations 10A(a), 10A(b), 10A(c) and 13(5)(b) of the Environment Regulations, 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.

2.8.1 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 ALARP demonstration

<table>
<tr><th>Risk</th><th>Impact</th><th>Decision Type</th></tr>
<tr><td>Low and Moderate
(below C level consequences)</td><td>Negligible, Slight, or Minor
(D, E or F)</td><td>A</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>High, Very High or Severe
(C+ consequence risks)</td><td>Moderate and above
(A, B or C)</td><td>B and C</td></tr>
<tr><td colspan="3">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) that:
• 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.</td></tr>
</table>

2.8.2 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.

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

Risk	Impact	Decision Type
Low and Moderate (below C level consequences)	***Negligible, Slight, or Minor (D, E or F)***	***A***
Woodside demonstrates these lower order risks, impacts and decision types are 'Broadly Acceptable' if they meet industry: • legislation, codes and standards • good practice • professional judgement and where 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 (C+ consequence risks)	***Moderate and above (A, B or C)***	***B and C***
Woodside demonstrates these higher order risks, impacts and decision types are 'Acceptable' if it can be demonstrated that the predicted levels of impact and/or residual risk, are: • at or below the defined acceptable level(s) for that impact or risk • managed to ALARP (as described in **Section 2.8.1**). Acceptable levels are defined appropriate to the nature and scale of each impact and risk and in consideration of: • the Principles of ESD 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 – considering the environment consequence (**Section 6)** and stakeholder acceptability (**Section 5**) • other requirements – the proposed controls and consequence/residual risk level are consistent with national and international industry standards, laws and policies, and consideration of applicable plans for management and conservation advices, conventions, and significant impact guidelines (e.g. for MNES). Once acceptable levels have been defined, a statement of acceptability is made to summarise how a given impact/residual risk will be managed to at or below these levels and appropriate EPOs which are linked to these acceptable levels are established. Where there are significant complexities in assessing and managing impacts to different receptors and for demonstrating how these impacts are acceptable (e.g. multiple requirements which are receptor specific, significant stakeholder concern for specific receptors, lack of consensus of appropriate controls or standards), acceptable levels may be defined, and acceptability demonstrated separately for key receptors. This is not applicable for risks, given the consequence of an unplanned risk event occurring may not be acceptable and, therefore, acceptable levels of risk are defined in the context of the residual likelihood of an event occurring.		

2.9 Environmental Performance Objectives/Outcomes, Standards and Measurement Criteria

EPOs, EPSs and MC have been defined to address the potential environmental impacts and risks and are presented in **Section 6**.

2.10 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
- EPOs 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 emergencies or potential emergencies
- arrangements are in place to respond to and monitor impacts from oil pollution emergencies
- environmental reporting requirements, including 'reportable incidents', are met
- appropriate stakeholder consultation is performed throughout the activity.

The implementation strategy is presented in **Section 6**.

2.11 Stakeholder Consultation

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

Each stakeholder response is summarised and assessed 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**. A copy of the full text correspondence with relevant people is provided in **Appendix F**.

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. It includes the location of the activities, general details of the layout of the Echo Yodel subsea infrastructure and Capella-1 well, the operational details of the activity, and additional information relevant to considering environmental risks and impacts. With regard to the decommissioning component of this EP, it must be noted that the activity description is based on implementing the preferred option, identified through the comparative assessment process detailed in **Section 6**. Activities in the field will therefore consist of permanent plugging for abandonment of the wells only and IMMR activities from the MODU where required to support the permanent plugging activities.

3.2 Project Overview

The Echo Yodel field started producing gas in 2001 via two subsea wells tied back to the GWA platform. The field reached the end of its economic life in 2012, Yodel-4 ceased production in 2006, and Yodel-3 continued to produce until the end of the field life in the first half of 2012. At this time, the wells were suspended with temporary plugs. The pipeline was cleaned and hydrocarbon freed in 2015/2016 and put into a state of preservation. The well tie-in spools were also removed from between the pipeline and the wells. A pipeline section was removed from the pipeline in 2018 at the downstream end, just upstream of the Subsea Isolation Valve (SSIV), disconnecting the pipeline from the GWA platform. In addition to the Yodel wells, the Capella-1 is an exploration well that was drilled in 1996, 40 km north-west of the two Yodel wells. The well was suspended with a shallow plug and the wellhead left in place, with the intention of returning to the well to perform a Drill Stem Test.

The Petroleum Activities Program described in this EP includes the following activities:

- permanently plugging to abandon Yodel-3 and Yodel-4 production wells, and Capella-1 exploration well, which will involve installing permanent abandonment barriers in the wells
- leaving the Echo Yodel subsea infrastructure in-situ permanently, to enable the infrastructure to continue providing hard substrate to maintain beneficial marine growth and habitat.

The Echo Yodel subsea infrastructure consists of the Yodel-3 and Yodel-4 wellheads with X-mas trees, a pipeline, an EHU, two UTAs, an IUTB, a pig launcher and two infield jumpers. A generalised schematic of the Echo Yodel subsea infrastructure is presented in **Figure 3-1**. The Capella-1 well is not considered part of the Echo Yodel subsea infrastructure.

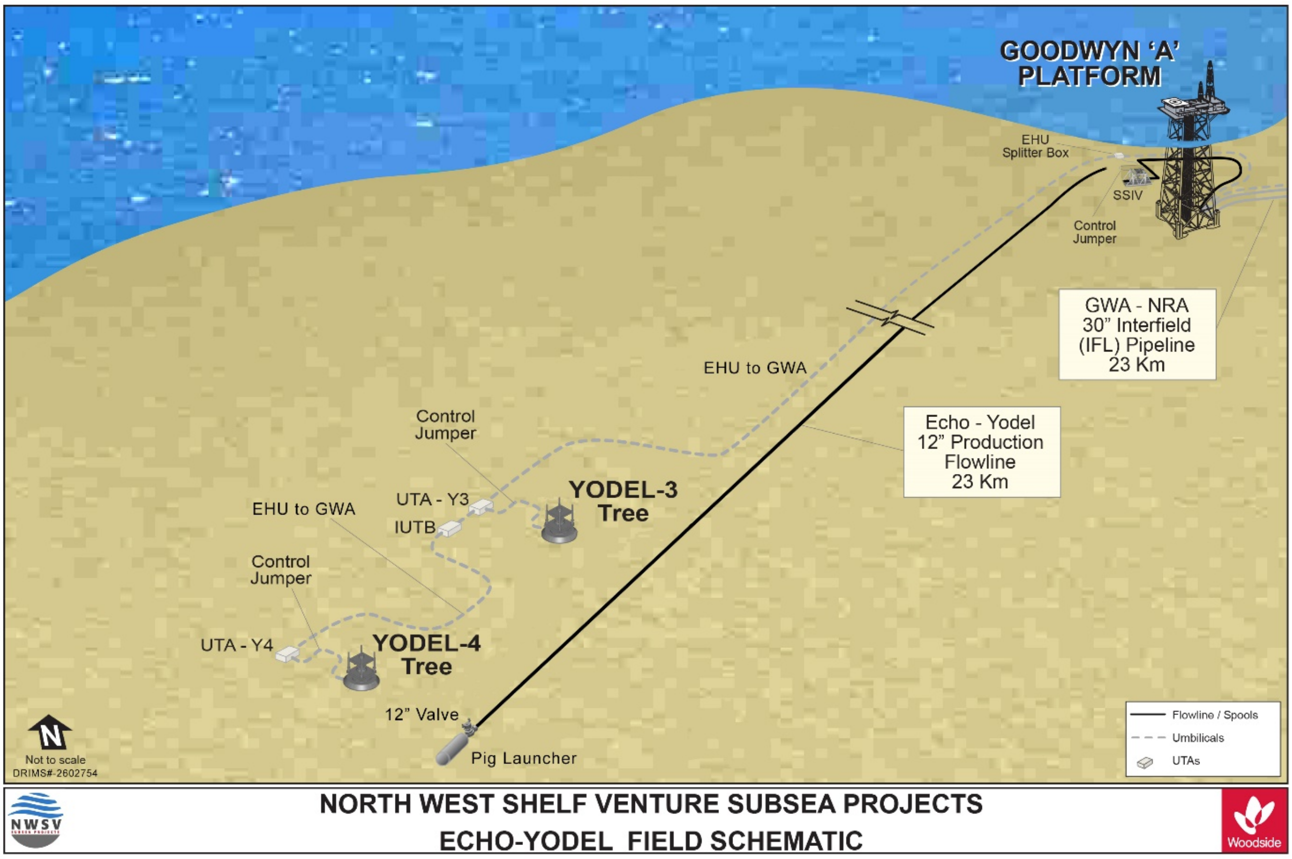

Figure 3-1: Generalised schematic of the Echo Yodel subsea infrastructure

The Petroleum Activities Program includes re-entry of the three wells to permanently plug them for abandonment using a MODU. For the Capella-1 exploration well, this will require drilling out a short section of cement (73 m) installed at the top of the Capella-1 well, to install a deeper-set permanent abandonment barrier to the zones with flow potential.

Capella-1 wellhead will continue to be managed under the NRC Facility Operations EP until a permanent decision has been made for decommissioning.

The remaining Echo Yodel subsea infrastructure (including the pipeline, umbilical and wellhead with X-mas tree structures) will be left in-situ permanently, to enable the infrastructure to continue providing hard substrate to maintain the marine growth and habitat that currently supports local ecological functions, including stocks for commercial fisheries.

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

Table 3-1: Petroleum Activities Program overview

Item	Description
Permit Titles	WA-9-PL (which crosses WA-6-L and WA-5-L), WA-23-L and WA-1-L
Location	NWS Province
Water depth	125 m to 136 m
Number of wells	Two suspended production wells (Yodel-3 and Yodel-4) and one suspended exploration well (Capella-1) to be permanently plugged for abandonment
Pipeline, umbilical and structures	• A 23 km 12-inch diameter polypropylene coated, 13% chromium stainless steel pipeline • A 23 km 5-inch diameter High Density Polyethylene (HDPE) EHU with two UTAs, one IUTB and two infield jumpers • One pig launcher
MODU	Semi-submersible moored MODU
Vessels	• Subsea support vessel(s) including anchor handling vessel(s) (AHV) • Two to three activity support vessels, including general supply vessels
Key activities	• Permanently plug the Yodel-3, Yodel-4 and Capella-1 wells for abandonment using a MODU • Leave Echo Yodel subsea infrastructure in-situ permanently

3.3 Location

The proposed Petroleum Activities Program is located in multiple Permit Titles in Commonwealth waters in the NWS Province, about 140 km north-west of Dampier on the coast of Western Australia (WA) (**Figure 3-2**). The closest landfall to the Permit Titles are the Montebello Islands, which are about 70 km to the south.

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

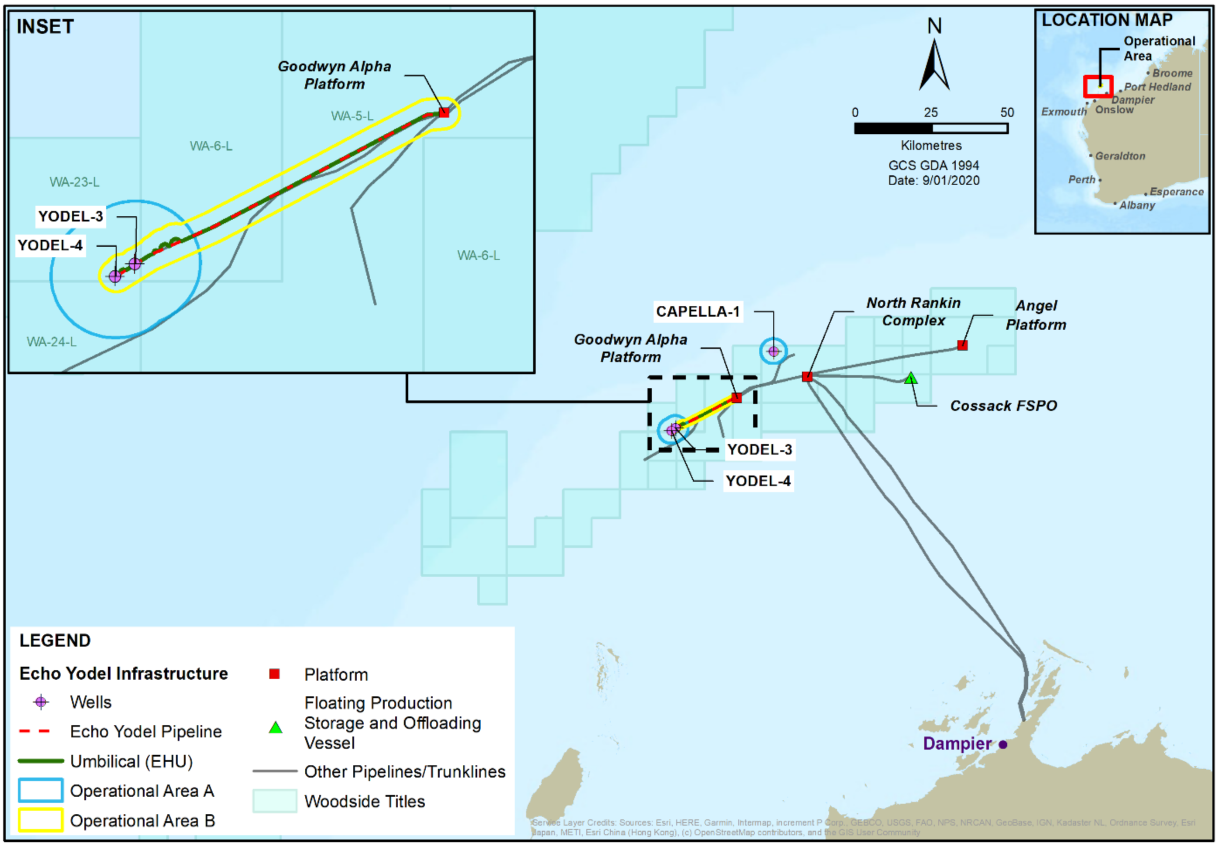

Figure 3-2: Location map of the Petroleum Activities Program

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

Structure	Water Depth (Approx. m LAT)	Latitude	Longitude	Permit Title
Eastern end of pipeline (SSIV)	130	19° 39' 04.585" S	115° 55' 47.881" E	WA-9-PL
Western end of pipeline (pig launcher)	125	19° 44' 44.342" S	115° 44' 12.229" E	WA-9-PL
Yodel-3	136	19° 44' 17.062" S	115° 44' 53.85" E	WA-23-L
Yodel-4	134	19° 44' 43.262" S	115° 44' 11.389" E	WA-23-L
Capella-1	136	19° 30' 52.911" S	116° 02' 17.054" E	WA-1-L

3.4 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].

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

The Operational Area (**Figure 4-1**) is representative of the combined delineated distances from the following:

- Operational Area A (permanent plugging for abandonment activities): A radius of 4000 m around each well (Yodel-3, Yodel-4 and Capella-1). This Operational Area has been defined as the area in which permanent plugging for abandonment activities will occur and be managed under this EP.
- Operational Area B (leaving infrastructure in-situ permanently): A radius of 500 m (1000 m diameter) around the Echo Yodel subsea infrastructure that is to be left in-situ permanently, as well as the water column 20 m above this infrastructure. The Echo Yodel subsea infrastructure includes the Yodel-3 and Yodel-4 X-mas trees, pipeline, umbilical, IUTB, UTAs and pig launcher. This Operational Area has been defined as the area in which the impacts and risks from leaving infrastructure in-situ permanently are addressed by this EP. Upon acceptance of the EP, this Operational Area will cease to exist.

The 4000 m (radius) Operational Area A allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel-related petroleum activities. This Operational Area includes a 500 m petroleum safety zone around the MODU to manage vessel movements.

The 500 m (radius) Operational Area B around subsea infrastructure to be left in-situ permanently allows for considerations of impacts from the infrastructure remaining on the seabed.

Where the assessment in this EP relates to Operational Area A and Operational Area B, they are collectively referred to as the Operational Areas.

3.5 Timing

The proposed Petroleum Activities Program is scheduled to occur between the first quarter of 2021 and the fourth quarter of 2023 (**Table 3-3**).

Permanent plugging activities for the three wells is expected to take about 20 to 60 days per well to complete. If performed as a single campaign, the cumulative duration could be up to 180 days (including mobilisation and demobilisation).

The permanent plugging activities are being planned as a single campaign, but could be performed individually on an opportunistic basis between other drilling campaigns, subject to rig availability.

When underway, activities will be 24 hours per day, seven days per week. There are no planned concurrent 'permanent plugging for abandonment' activities under the EP. As such, no Simultaneous Operations (SIMOPS) have been included in the EP. Any SIMOPS planned to occur on the GWA platform or NRC platform when permanent plugging activities are scheduled to occur under this EP, will be managed by the respective facility operations EP. There are not expected to be any interactions, however, as any GWA platform activities will be 19 km from the nearest permanent plugging activity (Capella-1) and any NRC platform activities will be 13 km from the nearest permanent plugging activities (also Capella-1).

Timing and duration of the permanent plugging activities is subject to change due to project schedule requirements, metocean conditions, vessel availability, unforeseen circumstances and weather.

Note that only IMMR undertaken from a MODU are included in the scope of this EP. Normal IMMR activities performed with an IMMR vessel, including, for example, subsea cleaning and preparation of the subsea X-mas trees, may be undertaken in preparation for the Petroleum Activities Program. These are excluded from the scope of this EP as they are managed under the GWA Facility Operations EP for the Yodel-3 and Yodel-4 wells and under the NRC Facility Operations EP for the Capella-1 well.

Table 3-3: Summary of indicative Petroleum Activities Program

Activity	Approximate timing (and cumulative duration in the field)	Likely Vessel
Leaving all Echo Yodel subsea infrastructure in-situ permanently in relation to WA-9-PL	Commences and is completed upon acceptance of this EP (0 days)	None as no in-field activities required
MODU pre-laid mooring and blow-out preventer (BOP) tether installation (if required)	2 to 4 weeks before planned well plugging activities commence*. One to 12 days per well (up to 36 days)	AHV
Permanent well plugging for abandonment (three wells)	Between first quarter of 2021 and fourth quarter 2023: 20 to 60 days per well (up to 180 days)	MODU and support vessels
Leaving all Echo Yodel subsea infrastructure in-situ permanently in WA-23-L	Commences and is completed once all permanent plugging activities are completed (0 days)	None as no in field activities required

**Will commence no earlier than first quarter 2021.*

This EP has risk-assessed permanent plugging activities throughout the year (all seasons) to provide operational flexibility for requirements and schedule changes, as well as MODU availability. All the above timeframes are subject to change and, as no particular time periods have been nominated for avoidance based on environmental or stakeholder sensitivities, changes to the above will not be interpreted as 'new stages' against Regulation 17(5).

3.6 Infrastructure Overview

This section provides an overview of the infrastructure relevant to the Petroleum Activities Program. An indicative layout of the Echo Yodel subsea infrastructure is presented in **Figure 3-1**. Further details of the infrastructure and field layout are provided in the sections to follow.

3.6.1 Wells

This EP includes permanent plugging for abandoning three subsea wells: Yodel-3, Yodel 4 and Capella-1.

Yodel-3 and Yodel-4 wells were drilled between June and August 2001 and are about 1.9 km from each other. The wells were completed and tied back to the GWA facility in December of that year and began production in 2002. Production ceased in 2012 and the two production wells were suspended in May of that year, with temporary barriers installed which include two tested and verified mechanical barriers between the production tubing and the production tie in spool hub (which has also been blanked off).

Before the two temporary barriers were installed in each well, a remote-operated vehicle (ROV) inspection identified gas bubbles emanating from the valves on the Yodel-3 and Yodel-4 X-mas trees. The barriers had been installed in the wells to prevent ongoing leaks; however, the temporary barriers must be removed before installing permanent barriers, in which case the leaks may return, resulting in a short-duration release of well bore fluids or testing fluids. Once the well is killed using well kill brine (**Section 3.10.3**), there is a potential for release of well kill fluid until the permanent abandonment activities are complete.

Capella-1 is an exploration well that was drilled in 1996 and suspended as a gas discovery well. Capella-1 is about 40 km from the Yodel-3 and Yodel-4 wells and has a mass of about 7.5 mT above the mudline.

3.6.1.1 Yodel-3

The Yodel-3 well was drilled with water-based mud (WBM) and non-water-based mud (NWBM), with the NWBM being circulated out during cementing/completion operations. The surface equipment consists of a wellhead with horizontal X-mas tree and guidebases. On top of the X-mas tree is a non-pressure-containing tree-cap, made of steel, which is the same diameter as the wellhead, about 0.5 m long and weighing about 300 kg. The cap was installed to help prevent marine growth and debris entering the well. The Yodel wells also have internal tree-caps, so for the purposes of this EP, the non-pressure-containing tree-caps are referred to as debris caps and the internal caps are referred to as internal tree-caps.

The well infrastructure also contains small amounts of elastomeric materials such as Teflon used within valve and seal components, as per the project's material specifications.

The X-mas tree is locked on to the wellhead (3.2 m), giving a total height of the well structure as about 7.7 m above the seabed. The X-mas tree is also 3.65 m wide and 3.3 m diameter (**Figure 3-2**).

Figure 3-3: Left – Yodel-3 X-mas tree in 2018 ROV survey. Right – Yodel-4 X-mas tree in 2008 survey compared to ROV for size

3.6.1.2 Yodel-4

The Yodel-4 well was also drilled with WBM and NWBM, with the NWBM circulated out during cementing/completion operations. The surface equipment consists of a wellhead with horizontal X-mas tree and guidebases. On top of the X-mas tree is a debris cap, made of steel, which is the same diameter as the wellhead, about 0.5 m long and weighing about 300 kg. The well infrastructure also contains small amounts of elastomeric materials such as Teflon used within valve and seal components, as per the project's material specifications.

The X-mas tree is locked on to the wellhead (4.4 m), giving a total height of the well structure as about 8.9 m above the seabed. The X-mas tree is also 3.65 m wide and 3.3 m diameter (**Figure 3-3**).

3.6.1.3 Capella-1

Capella-1 is an exploration well that was drilled with NWBM in 1996 and suspended as a gas discovery well. The NWBM was circulated out of the well before cementing.

The Capella-1 wellhead is made of mild steel (AISI 4130), with small amounts of elastomeric materials such as Teflon and Viton used within the seal components. The wellhead with temporary guide-base (TGB) and 30-inch conductor, stands about 2.4 m above the seabed (**Figure 3-4**). The wellhead has a debris cap installed over the well to prevent marine growth from entering the well.

The total weight of the steel material, which consists of the 30-inch conductor plus a low and high pressure wellhead element and a 20-inch extension, is estimated to be 7500 kg.

Figure 3-4: Capella-1 wellhead ROV images from 2018 survey (left) and 2019 (right)

3.6.1.4 Other Wells and Infrastructure in Title Areas

Three exploration and appraisal wells were drilled in WA-23-L: Yodel-1, Yodel-2 and Echo-1. These wells have been permanently plugged and abandoned and the seabed cleared. There is no further work required with these wells. There is no other infrastructure in WA-23-L. All other infrastructure in WA-1-L is described and managed in the North Rankin Complex Operations EP. There is no other infrastructure in WA-9-PL.

3.6.2 Echo Yodel Pipeline

The Echo Yodel pipeline is 23 km long and about 12 inches diameter, comprising of a stainless steel inner pipeline coated by a four-layer polypropylene outer used for protection and insulation.

The pipeline was subject to an extensive pigging campaign in 2016 to clean and hydrocarbon-free the pipeline. A total of five pigs were launched from a subsea pig launcher, with oil in water (OIW) samples taken at regular intervals as the treated seawater arrived at the GWA facility, to determine when hydrocarbon levels in the pipeline stabilised and achieved ALARP. Intertek conducted laboratory analysis of the samples, with the residual hydrocarbon level of the treated seawater within the pipeline being measured at 6 ppm. The seawater was treated with Hydrosure 0-3670R at 1000 ppm. Treated seawater remains in the pipeline with the ends capped.

The pipeline spools connected to the wellheads were disconnected and disposed of onshore during the same campaign, and blind flanges were installed. The pig launcher attached to the end of the pipeline is made of stainless steel and is about 5.1 m long, 1.5 m wide and 0.8 m high and weighs about 2.8 tonnes.

During the operation of the Echo Yodel pipeline, it has been subject to a self-burying process whereby observations of freespans and localised pipeline by Atteris (2019a) found it is lowering into the seabed. This lowering and self-burial is a result of localised scouring of the seabed and is expected to continue until a state of equilibrium of approximately 85% of its overall outside diameter is reached in about 125 years (Atteris, 2019a) (see **Section 3.14.1** for further information).

Pipeline specifications are provided in **Table 3-4**; an image of the pipeline is shown in **Figure 4-7**.

Table 3-4: Echo Yodel pipeline indicative specifications

Component	Material	Specification
Line pipe	13% chromium weldable martensitic stainless steel	Length: 22.89 km Outside diameter: 324 mm Wall thickness: 16.9 mm Total mass: 2925 tonnes
External polymer pipeline coating	Four-layer polypropylene: First Layer – 0.25 mm thick fusion bonded epoxy Second Layer – 0.25 mm thick adhesive Third Layer – 10 mm thick foamed polypropylene Fourth Layer – 3 mm thick solid polypropylene	Total coating wall thickness: 13.5 mm Total coating mass: 247 tonnes
Sacrificial bracelet anodes	Aluminium	Total mass: 12 tonnes
Preservation fluid	Seawater with 1000 ppm of Hydrosure 0-3670R (biocide, oxygen scavenger and corrosion inhibitor mix)	Total volume: 1515 m³

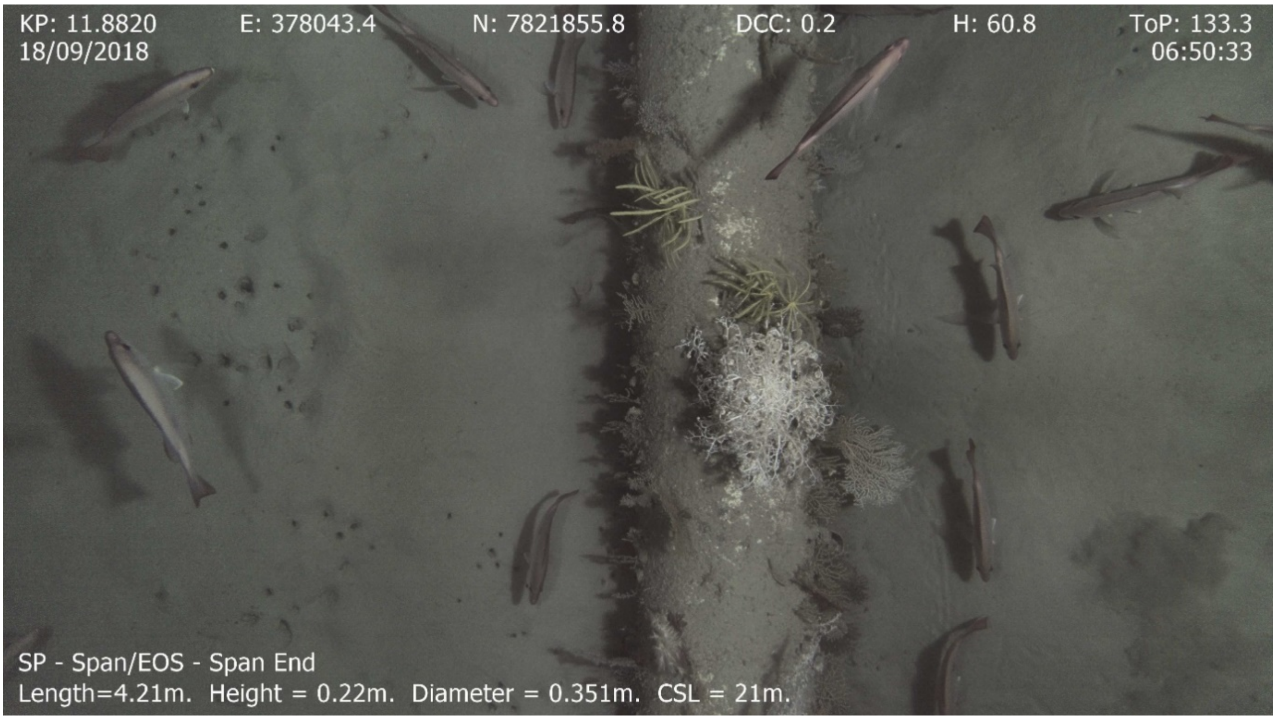

Figure 3-5: Echo Yodel pipeline in-situ

3.6.3 Echo Yodel Umbilical

The Echo Yodel umbilical is comprised of steel, copper and HDPE. It is 132 mm diameter (five inches) with two layers of armour wire, seven hydraulic hose cores and six electrical cores. Indicative specifications for the umbilical are provided in **Table 3-5**. A photo of the umbilical taken by ROV in September 2018 is provided in **Figure 4-8**.

The umbilical contains some operations fluids: about 18 m³ mono-ethylene glycol (MEG) and about 21 m³ hydraulic fluid (water based).

Attached to the umbilical are two UTAs and an IUTB. These two structures are made of steel protected by anodes and they contain about 27 kg of mineral oil (total). Two control jumpers between the two UTAs and the X-mas trees also remain (**Figure 4-8**). These are 50 m and 60 m long respectively and have similar specifications as the EHU.

During operation, the Echo Yodel umbilical has been subject to a self-burying process whereby observations by Atteris (2019b) found it is in the advanced stages of burial. This lowering and self-burial is a result of localised scouring of the seabed and is expected to continue until a state of equilibrium is reached in about 20 to 60 years (Atteris, 2019b). This equilibrium is more than 90% of the umbilicals' length is more than 95% (of its outside diameter) buried (less than 7 mm exposed). See **Section 3.14.2** for more information.

Table 3-5: Echo Yodel umbilical indicative specifications

Component	Material	Specification
Umbilical inner and outer sheath	Thermoplastic HDPE	Length: 23.4 km Outside diameter: 132 mm Total mass of HDPE: 144 tonnes
Armour wire of umbilical	Galvanised carbon steel (BS EN 10025 S355 J2)	Total mass: 513.3 tonnes
Electric cable	Copper conductor	Total mass: 17.6 tonnes
Production fluid (hydrate inhibitor)	MEG	Volume: 18 m³
Hydraulic fluid	Marston Bentley – Type HW443 (water based)	Volume: 21 m³

Figure 3-6: Echo Yodel umbilical in-situ

3.7 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 will be used for permanent plugging for abandonment activities.
- Support vessels including:
  - subsea support vessels such as AHVs may be required to set anchors and support the MODU during operations
  - general support vessels for transporting hardware from port/staging area to Operational Area A, and for general re-supply and support for the other vessels.

Some activities can be completed by multiple different vessels. The appropriate vessel will be determined before execution, depending on detailed activity planning and vessel availability.

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 include 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 standards.

Section 6 includes a description and assessment of general support vessel environmental impacts and risks, credible spill scenarios and environmental sensitivities for the activities within the scope of this EP. Some support vessels may be required ad hoc to support periods of high activity. They 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.

3.7.1 MODU

The Petroleum Activities Program permanent plugging activities will be performed by a moored MODU. The specifications for a typical moored MODU are included in **Table 3-6**. Due to variabilities such as contractual and operational matters, the MODU used may change. If this occurs, a MODU meeting the required technical specifications and with similar specifications as listed in **Table 3-6** will be used.

Table 3-6: Typical moored MODU specifications ranges for the Ocean Apex

Component	Specification Range
Rig type/design/class	Semi-submersible MODU
Accommodation	120 to 200 personnel (maximum persons on board)
Station keeping	Eight- to twelve-point anchor mooring system
Bulk mud and cement storage capacity	283 to 770 m³
Liquid mud storage capacity	576 to 2500 m³
Fuel oil storage capacity	966 to 1400 m³

3.7.2 Subsea Support Vessels

The Petroleum Activities Program will use subsea support vessels, such as an AHV, to perform, including deploying and/or retrieving anchors and/or removing wellheads. An example of this vessel type is the Sapura Constructor, which is 117 m long and equipped with a saturation dive system, two Work Class ROVs, well intervention equipment, a helideck, moon pool and accommodation for 120 persons. AHVs are required to set anchors and support the MODU during operations.

The specifications for a typical subsea support vessel are included in **Table 3-7**. Due to variabilities such as contractual and operational matters, the vessel(s) used may change.

Table 3-7: Typical subsea support vessel specifications for Sapura Constructor

Component	Specification Range
Type	Subsea support vessel
Length overall	117 m
Breadth	22 m
Draft	6.9 m
Dead weight tonnage	About 6500 mt
Accommodation	120 personnel (maximum persons on board)
Fuel (@ 90% capacity)	1006 m^3
Potable water	1253 m^3
Lube oil	35 m^2
Deck area	About 1300 m^2

3.7.3 General Support Vessels

During the Petroleum Activities Program, the MODU and subsea support vessel(s) will be supported by other general support vessels, including cargo vessel(s) and barges.

General support vessels are used to transport equipment and materials between the MODU/subsea support vessel and port. General support vessels may transit between Operational Area A 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 Operational Area A and port for routine, non-routine and emergency operations.

General support vessels will not anchor within Operational Area A during the activities due to water depth; therefore, vessels will use Dynamic Positioning (DP). The general support vessels are also able to assist in implementing the Oil Pollution First Strike Plan (**Appendix H**), should an environmental incident occur (e.g. spills). General support vessels may also have additional capability, such as ROV activities, deployment of subsea equipment, monitoring and inspection.

3.7.4 Vessel Mobilisation

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

3.8 Other Support

3.8.1 Remotely Operated Vehicles

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

- visual inspections/observations
- anchor hold testing
- seabed and hazard survey
- placement of ROV tool baskets and DP transponders on the seabed
- corrosion survey and BOP tether deployment
- marine growth cleaning of the wellhead and removal of the debris cap
- X-mas tree or wellhead connector preparation
- manual valve functioning
- open water tool observation and guidance
- sediment relocation
- BOP land-out and recovery
- BOP well control contingency
- BOP maintenance (including chemical injection)
- wellhead tooling and cutting
- X-mas tree functioning
- post-well seabed survey.

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

3.8.2 Helicopters

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

3.9 Project Vessel Based Activities

3.9.1 Holding Station: Mooring Installation and Anchor Hold Testing/Soil Analysis

Mooring uses a system of chains/ropes and anchors, which may be laid before the MODU arrives at the location, to maintain position when performing the Petroleum Activities Program. 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 MODU, proof tension values, or if using synthetic fibre mooring ropes are required. A pre-laid system can generally withstand higher sea states compared to a system that only uses the MODU's mooring chain/equipment.

As part of mooring preparations, anchor hold may be tested at the well locations. Anchor hold testing would be performed if Woodside determines that further assurance is required to ensure a robust mooring design.

Anchor hold testing may consist of an AHV or similar vessel deploying an anchor at a potential mooring location. The AHV would then tension the anchor to determine its ability to hold, embed and not drag at the location. This may have to be repeated several times at each location. An ROV may also be used to judge how deep the anchor has embedded and independently verify the seabed condition. Anchor hold testing activities would occur before the MODU arrives on location.

Soil analysis may also be necessary to provide data about composition and rock/substrate strength, as input into the mooring or conductor design, and verify seabed conditions for anchor hold. Soil analysis could include taking a physical sample of the seabed using ROV or other tools, or using measuring devices such as a cone penetrometer.

Suction piling may be required as a contingent activity and will be reviewed with the MODU contractor.

3.9.2 Support Activities

Various materials are routinely bulk transferred from support vessels to the MODU, including brine, drilling fluids (e.g. muds) and cements. 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 vessels, for back-loading and disposal on shore.

Loading and back-loading equipment, materials and wastes is one of the most common supporting activities conducted during plugging 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 cooling machinery engines on the MODU. It is subsequently discharged from the MODU to the sea surface at potentially a higher temperature. Alternatively, MODUs may use closed loop cooling systems.

Potable water, primarily for accommodation and associated domestic areas, may be generated on the MODU and support vessels using a reverse osmosis (RO) plant. 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 at appropriate facilities onshore by support vessels.

Support vessels typically transit to and from Operational Area A between two and four trips per week during operations.

3.9.3 Refuelling

The MODU will be refuelled via support vessels about once a month, or as required. This activity will occur within Operational Area A of the well being plugged 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.

3.10 MODU Based Permanent Plugging Activities

3.10.1 Subsea Cleaning and Preparation Activities

3.10.1.1 Typical Marine Growth Removal

Due to the relatively high rate of marine growth on the NWS, excess growth typically needs to be removed before performing permanent plugging activities. An ROV or divers will be used for this activity; **Table 3-8** lists the different techniques used.

Table 3-8: Marine growth removal methods

Activity/Equipment	Description
Water jetting	Uses high-pressure water to remove marine growth
Brush systems	Uses brushes attached to an ROV to physically remove marine growth
Acid (typically sulphamic acid)	Chemically dissolves calcium deposits

3.10.1.2 Sediment Relocation

If sediment builds up around subsea infrastructure and impedes the achievement of permanent plugging for abandonment activities, an ROV-mounted suction pump may be used to move small amounts of sediment in the immediate vicinity of the subsea infrastructure (i.e. within the existing footprint), to allow inspection/intervention works to be performed. Sediment relocation typically results in minor seabed disturbance and some localised turbidity.

3.10.2 Blowout Preventer, Riser and Subsea Test Tree

The Petroleum Activities Program permanent plugging activities commence with installing a control device onto the well. After the MODU arrives and establishes position over the well site, a well control device such as a BOP and a subsea test tree will be installed.

The BOP and the marine riser above it provide a physical connection between the well and MODU. This enables a closed circulation system to be maintained, where fluids can be circulated from the well bore back to the MODU. As the system is closed-circuit, there is no subsea interaction between permanent plugging for abandonment activities and the marine environment.

In addition, the BOP provides a way to seal, control and monitor the well during permanent plugging activities. 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 about every 21 days and a function test about 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 per test is up to 90 L.

Hydraulic fluid used for operating the BOP rams is subject to the chemical assessment process outlined in **Section 3.12**.

Standard operations through the marine riser also include running logging and/or evaluation tools. Depending on requirements, operations such as casing milling, casing perforation and cement circulation behind the casing (collectively referred to as milling) could also be performed during the activity as contingency activities during permanent plugging operations. BOP tether systems may be required, involving deploying a subsea winch and anchor system (see **Section 3.11.3**).

3.10.3 Permanent Plugging Activities for Yodel-3 and Yodel-4 Wells

The permanent plugging for abandonment activities, including designing a permanent well barrier and installing the barriers, will be completed in accordance with the NOPSEMA-accepted Well

Operational Management Plan (WOMP) as required under the *OPPGS (Resource Management and Administration) Regulations 2011*.

Each well plugging sequence will depend on multiple aspects of each well, which include production casing cement quality and quantity, well completion design, and scale levels (if present).

Presented below is a base scope for the Yodel-3 and Yodel-4 wells:

1. position rig over well and anchor or connect to pre-laid anchors
2. clean and prepare wellhead connector using ROV
3. remove debris cap from top of X-mas tree
4. run BOP on riser and connect to X-mas tree and test BOP
5. recover internal tree-cap
6. deploy subsea test tree
7. remove temporary downhole suspension plugs
8. kill, plug and circulate gas from well by flaring/venting as required
9. install deep tubing suspension barriers and test integrity
10. cut and recover production tubing to MODU
11. clean and displace well bore
12. verify downhole casing and cement integrity
13. circulate well annulus to seawater as required
14. punch casing above plug and circulate well annulus fluids back to rig, then flush with seawater as required
15. recover BOP
16. perform as-left survey using ROV
17. retrieve or release anchors to complete plugging activity.

'Downhole plugging for permanent abandonment' activities are to be conducted through the marine riser. This closed-circuit system results in no planned discharges directly to sea, as all fluids, cements and equipment are contained within the well bore and riser and either permanently remain in the well, or are returned to the MODU.

During drilling and construction of the wells, protective steel tubulars (casings and liners) were inserted into the well to maintain the well bore. After the casing/liners were installed into the well bore, these were cemented into place and a central production tubing installed. During production and injection activities, the hydrocarbons, gas or formation water were flowed through the production tubing. To permanently plug a well, some of the inner tubulars, including the production tubing, may have to be removed to allow access to install permanent abandonment cement barriers. These tubulars may have residual contaminants from this previous production. How these tubulars and potential residual contaminants will be managed are described in **Section 3.10.10**.

Temporary suspension plugs will need to be removed through the marine riser to access the reservoir. Internal diameter for subsequent operations will be confirmed or mitigated as required.

Once the temporary suspension plugs are removed, a well kill fluid is pumped into the formation. This is to control the residual pressure from the formation. The well kill fluid will be a weighed brine. The type of brine will be assessed and will comply with the approved chemical assessment process outlined in **Section 3.12**.

If well kill fluid fails to be bullhead-pumped into the well, reservoir fluids may need to be bled off at the MODU through well control equipment (dedicated bleed off/well test spread). In this event, well control equipment will be used to separate the well kill fluids from the hydrocarbons and direct the hydrocarbons to be flared, vented or incinerated, depending on a number of factors including the volume, weather conditions, and safety requirements as documented in relevant procedures for this activity. The well kill fluids will be captured and stored on the MODU and discharged overboard if oil concentration is less than 1% by volume, or returned to shore if discharge requirements cannot be met.

Once the formation pressure is controlled, the tubing is cut and retrieved. Permanent abandonment cement barriers will be installed and verified. If there is any excess cement, it is planned to be discharged after permanent plugging activities. The volume of this cement will be about 5 m^3.

Subject to an ALARP assessment, any materials (e.g. tubulars) recovered from the well may be reinserted into the well rather than retrieved for onshore disposal (see **Section 3.10.10**).

Once the well abandonment cement plug(s) have been set, tested and verified, the marine riser and BOP will be disconnected from the well and returned to the MODU. The mooring anchors may be pulled or released and the MODU will move to the next well or leave Operational Area A. Any released anchors will be retrieved by a subsea support vessel.

3.10.4 Permanent Plugging Activities for Capella-1

Similar to the Yodel-3 and Yodel-4 wells, downhole permanent plugging for abandonment activities on Capella-1 are to be conducted through a marine riser. This closed-circuit system prevents planned subsea discharges, as all fluids, cements or equipment will be contained within the well bore and marine riser and either permanently installed in the well, or returned to the MODU. The Capella-1 well also has several casing strings inside the well bore. It contains a 73 m long cement plug in the top of the well bore. To install additional permanent abandonment barriers in the well bore, the Petroleum Activities Program will include the requirement to drill out this top cement plug from Capella-1. The cement plug will be drilled out using water-based drilling muds which, along with the swarf, drilled cement and residual NWBM from the annulus, will be circulated back to the MODU. The drilling muds that will be used are selected and assessed using Woodside’s chemical selection and assessment procedures, as detailed in **Section 3.12**.

Once the cement plug is drilled out, permanent abandonment plug(s) will be installed and verified.

After this, the marine riser and BOP will be detached and retrieved back to surface. At this point, the anchors may be pulled or released and the MODU will move to the next well (as well permanent plugging order has not yet been determined) or leave Operational Area A. Any released anchors will be retrieved by a subsea support vessel.

3.10.5 Downhole Evaluation

Downhole evaluation is the interpretation of a combination of measurements taken inside a well bore to test and verify the integrity of the well casing and/or cement. It includes wireline logging as well as other down-hole technologies as required. Evaluation tools may be incorporated into the drill string during permanent plugging activities and may include tree running tool, Gamma Ray, Directional Deep resistivity, callipers, density-neutron, Sonic and tools that can measure formation pressures. Some 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.

3.10.6 Well Bore Clean-out

As required throughout activities with the riser connected, wells will be displaced from one fluid system to another (e.g. well kill brine to milling fluid) or cleaned, which may include recovering residual NWBM from the casing annulus for Capella-1. A chemical clean-out pill or fluids train will be circulated between the two fluids.

Clean-out fluids and completion brine will be captured and stored on the MODU and discharged if oil concentration is less than 1% by volume, or returned to shore if discharge requirements cannot be met.

3.10.7 Drilled Cement

The Capella-1 well has a shallow plug that will need to be drilled out to complete the permanent plugging activities. Drilled cement generated from these activities is expected to range from very fine to very coarse (less than 1 cm). Estimated volumes of drilled cement that may be discharged during the base case for the Petroleum Activities Program are 2 m^3.

The cement plug will be drilled out with a marine riser that enables the drilled cement and drilling fluid to be circulated back to the MODU, where the drilled cement will be 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 drilled cement from the drilling mud. After being processed by the shale shakers, the recovered mud from the drilled cement may be directed to centrifuges, which are used to remove fine solids (4.5 to 6 µm). The drilled cement is usually discharged below the water line and the mud is recirculated into the fluid system. Some SCEs (rotating equipment such as cuttings dryers and centrifuges) are not able to be used when swarf is present in the fluids system.

3.10.8 Cement Unit Test

Upon arrival at Operational Area A, the MODU is typically required to perform a cement unit test to test the functionality of the cement unit and the MODU bulk cement delivery system before 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 a length of time (warm-stack or cold-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 cement unit test 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.

Cementing fluids will generally consist of Portland cement with additives (such as inorganic salts, lignins, bentonite, barite, silicates, defoamers and surfactants). Cementing fluids are not routinely discharged to the marine environment, however, volumes of about 5 m^3 per well will be released when surplus fluids require disposal after cementing operations at the surface.

3.10.9 Cement, Barite and Bentonite Discharge

Excess cement, barite and bentonite (dry bulk) after well operations are completed, will either 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 cement, barite and bentonite that does not meet technical requirements during the Petroleum Activities Program may also be bulk discharged to the environment. Bulk discharges of cement may occur as a slurry through the usual cement discharge line, or blown as dry bulk and discharged.

3.10.9.1 Mud Pits

There are typically mud pits (tanks) on the MODU that provide a capacity to mix, maintain and store fluids required for drilling and permanent well plugging activities. The mud pits form part of the fluid circulation system. The mud pits and associated equipment/infrastructure are cleaned out at the completion of operations. Mud pit wash residue is operationally discharged with less than 1% by volume of oil. Mud pit residue over 1% by volume of oil is sent to shore for disposal.

3.10.10 Well Tubulars

Chemicals within the produced fluids such as CO_2, and metal contaminants such as mercury, may interact with the production tubing metal. The production tubing metallurgy may change in response to the chemical reactions and/or chemicals may be precipitated as a solid onto the metals. This may include Naturally Occurring Radioactive Material (NORM) scale. However, tree spools that were connected to the wellheads have already been removed as a separate activity. These were observed as being free of scale and, before disposal, they were tested for contaminants (mercury (Hg) and NORM). The results of this testing indicated there is no Hg within the spools and no NORM was detected in excess of the accepted clearance criteria. Based on this, it is expected that there will not be any NORM scale above accepted clearance criteria on the production tubing.

When the tubing is recovered to surface, it will be assessed for contamination. In the case that contamination is identified, the tubing will be managed as per Woodside procedures appropriate for the contamination type. If uncontaminated, this tubing will be transported onshore for re-use or disposal.

In the case that contamination is identified, the tubing may require special management and treatment during the surface handling, transport and disposal process, depending on the level of contamination. In the case of NORM or mercury contamination, this includes being transported from the MODU to a management and disposal centre using specific processes. All waste will be handled and disposed of in accordance with Federal, State and international requirements.

Alternatively, there may be an option to leave or re-run the production tubing and accessories in the well. This has potential to minimise the environmental and cost footprint of disposal. This decision will be made on an ALARP-assessed basis depending on tubing condition and other operations considerations at the time.

3.10.11 Yodel Wellhead Assembly Left In-situ

The Yodel-3 and Yodel-4 wellhead and subsea X-mas trees are planned to be left in-situ after permanent plugging activities, as an outcome from the comparative assessment (see **Section 6**).

3.11 Additional Potential MODU Based Activities for Permanent Plugging

The next sections present additional potential activities that may be required, if operational or technical issues occur during the Petroleum Activities Program. These additional potential activities have been considered within the relevant impact assessment sections and do not represent significant additional risks or impacts, but may generate additional small volumes of drilling fluids and drilled cement being operationally discharged, which have been assessed as part of the Petroleum Activities Program.

3.11.1 Disposal in Well Bore

During the permanent plugging activities, drilled cement, swarf, casing and tubing may be disposed in the well bore, particularly where NORMs are present. ALARP justification for disposal in the well bore will include environment, health, safety and waste management considerations that will be performed before mobilising the MODU to the location.

3.11.2 Wireline Logging

Wireline activities that may occur for permanent plugging activities include gamma ray and casing collar locator for depth correlation, ultrasonic imaging and cement bond loging to measure cement integrity, formation pressures, density, neutron and resistivity, and punch perforators/cutters suitable for all tubular sizes. Wireline contingency work will be performed with appropriate isolation barriers in place. If wireline work is required to occur where there is a risk of barrier failure, the operation will be performed with full pressure control equipment at the surface.

3.11.3 Blowout Preventer Tether

To manage wellhead fatigue during permanent plugging activities, a BOP tether system may be used to limit BOP movement. A typical BOP tether system uses four to six clump weights, weighing about 25 tonnes; although final number and weight of the clump weights may differ depending on seabed and current conditions. These clump weights are deployed to the seabed about 20 to 40 m away from the wellhead, usually from an AHV. An ROV will then connect tethers between the clump weights and the BOP, which are subsequently tensioned to limit BOP movement. Clump weights used for the activity will be after the activity and may take up to two weeks to remove. Suction piles may be used instead of clump weights, with typically four 16-inch diameter piles used per tether system.

3.11.4 Marine Riser Clean Out

Woodside and industry experience has shown that installations of horizontal X-mas tree systems can be susceptible to rust and other build-up in the marine risers and BOP between wells. This can lead to multiple deployments of subsea test trees or other large diameter pulling tools, as this type of debris, albeit small volumes, can prevent successful land-out of tools. Achieving thorough cleaning of the BOP and marine risers while attached to the horizontal X-mas tree can be difficult and extend the duration of the MODU operations.

To mitigate potential debris issues, the following steps will be performed as required:

1. In between the first and second Echo Yodel wells, the marine riser will be recovered to deck and inspected. Equipment will be available on the MODU to enable cleaning of the riser joints before being redeployed. Cleaning will be done over a bunded area, with fluids returned to tanks on the MODU.
2. The BOP cavities will be cleaned before deployments, using MODU maintenance procedures.
3. To address riser debris while the BOP/marine riser is deployed and connected to the horizontal X-mas tree, large diameter brushes, clean drill pipe and high rate circulation subs will be available to enable riser cleaning/flushing to MODU mud pits.
4. Should debris continue to be a problem after brushing and circulation to the mud pits, then the riser will be disconnected from the X-mas tree and an ROV will be used to flush the remaining debris from around the top of the X-mas tree cap.

3.11.5 X-mas Tree Removal

One or both of the Yodel-3 and Yodel-4 well X-mas trees may need to be removed to allow connection of the BOP directly to the wellheads to perform permanent plugging activities. In this instance, the X-mas tree(s) will be removed and placed on the sea floor next to the wellhead, or temporarily wet parked and reinstalled onto the wellhead after completing permanent plugging abandonment.

If the X-mas tree(s) need to be removed and hydraulic leads are unable to be disconnected, the subsea jumper leads will need to be cut or crimped. If cut, these would release small amounts (less than 5 L) of operations fluids such as MEG, oxygen scavenger and water-based hydraulic fluid.

3.11.6 Milling

Casing or tubing liners may need to be removed either by cutting and pulling or milling, if the cement on the outside of the casing does not meet well barrier requirements. These operations are done through the marine riser with milling debris returned to the MODU and will only be performed if needed.

Milling operations involve removing steel casing, annulus cement and formation to expose fresh formation. The methods used include milling tools that create chips or ribbons of steel (swarf), chips of cement and chips of formation. Milling is typically performed at a controlled rate (1 to 1.5 m/hr), to enable steel swarf to be removed effectively from the milling site to minimise the risk of 'birds nesting' of steel swarf, which may block fluid returns and jam equipment. Milling tools become worn during milling operations and will require tripping for new/redressing about every 30 to 50 m. As a result, the rate of milling is slower than normal drilling operations.

As the steel swarf within the milled fluids is hard and sharp, these fluids from the well will not be processed through drilling muds process equipment such as cuttings driers and centrifuges, because they will damage or excessively wear the equipment. The milling fluids, including up to an additional 2 m³ of swarf, 3 m³ of drilled cement and 3.5 m³ of formation rock, will be discharged overboard per 100 m interval if milling is required, in additional to the 2 m³ cement that is expected to be drilled from each of the three wells. As a result of restricted milling speeds, the rate of swarf and cement will be generated over several days (the rate is expected to be about 50 m per 18 hours).

3.11.7 Gas Venting, Bleed-off and Flaring

During permanent plugging activities, it will be necessary to flare or vent gas from the wells. Gas and any associated condensate will initially be transported from the well to a gas handling package on the deck of the MODU. The hydrocarbons will pass through a pressure reduction arrangement before entering a holding tank. Any liquids collected in the holding tank with more than 1% oil content will be returned to shore for disposal where these are within volatile limits. Any gas will be flared, except where it is required to be vented for health and safety requirements, integrity requirements, or is physically below the lowest volume technically able to be flared by gas handing package. Gas will be flared in accordance with a gas handling procedure. About 1 mMscf of gas may be flared/vented per well.

During well bleed-off activities, residual produced water will be bled from the well and brought back to the MODU. This water will be flared, or discharged to the marine environment after treatment via the well test water treatment package, which cycles the water through a water filtration system consistent with solids and polishing.

3.11.8 Unplanned Contingency Activities

3.11.8.1 Emergency Disconnect Sequence

An Emergency Disconnect Sequence (EDS) may be implemented if the vessel/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 the MODU moves outside of its operating circle (e.g. failure of one or more of the moorings) or moves to avoid a vessel collision (e.g. third-party vessel on collision course with the MODU). The EDS aims to leave the wellhead in a secure condition, but will result in the loss of the fluids in the riser after disconnection.

3.11.8.2 Gas Venting in Event of Well Kick

During permanent plugging of the wells, a kick may occur. A kick is an undesirable influx of formation fluid into the well bore. To maintain well integrity in this situation, a small volume of greenhouse gases is vented to the atmosphere via the degasser.

3.12 Project Fluids

3.12.1 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 plugging and drilling chemicals are included on the Woodside Drilling and Completions – Master Chemical List which is reviewed during a six month chemical review, as per the Chemical Selection and Assessment Environment Guideline.

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 and the Netherlands. It applies the requirements of the Convention for the Protection of the Marine Environment of the North-East Atlantic (Oslo and Paris Commission for 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 managing chemicals.

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 3-7**):

- 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). Used for inorganic substances, hydraulic fluids and pipeline chemicals only.

Hazard Quotient Colour Band	Gold	Silver	White	Blue	Orange	Purple
OCNS Grouping	E	D	C	B	A	
	Lowest Hazard →				Highest Hazard	

Figure 3-7: 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 types of chemicals that need to be assessed further to understand the environmental impacts of discharge into the marine environment are:
  - 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.

3.12.1.1 Further Assessment/ALARP Justification

This includes assessing the ecotoxicity, biodegradation and bioaccumulation of the chemicals in the marine environment in accordance with the United Kingdom Centre for Environment, Fisheries and Aquaculture Science (CEFAS) hazard assessment and the Department of Mines and Petroleum (DMP) (now Department of Mines, Industry Regulation and Safety) Chemical Assessment Guide: *Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.*

3.12.1.2 Ecotoxicity

Chemical ecotoxicity is assessed using the criteria used by CEFAS to group chemicals based on ecotoxicity results (**Table 3-9**). 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 3-9: 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	>100-1,000	>1,000
Result for sediment toxicity data (ppm)	<10	>10-100	>100-1,000	>1,000-10,000	>10,000

Note: Aquatic toxicity refers to the Skeletonema constatum *EC50,* Acartia tonsa *LC50 and* Scophthalmus maximus *(juvenile turbot) LC50 toxicity tests; sediment toxicity refers to Corophium volutator LC50 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 more than 60% biodegradation in 28 days to an OSPAR-harmonised offshore chemical notification format (HOCNF)-accepted ready biodegradation protocol.
- Inherently biodegradable: results more than 20% and less than 60% to an OSPAR HOCNF-accepted ready biodegradation protocol or result of more than 20% by OSPAR-accepted inherent biodegradation study.
- Not biodegradable: results from OSPAR HOCNF accepted biodegradation protocol or inherent biodegradation protocol are less than 20%, or half-life values derived from aquatic simulation test indicate persistence.

Chemicals with more than 60% biodegradation in 28 days to an 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, options to be considered are as follows:

- Environmental data for analogous products can be referred to where chemical ingredients and composition are largely identical.
- Environmental data may be referenced for each separate chemical ingredient (if known) within the product.

Alternatives

If no environmental data is 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, concurrence is required from the relevant environment adviser that the environmental risk as a result of chemical use is ALARP and acceptable.

3.12.2 Drilling Fluid System

3.12.2.1 Water-based Mud System

The base case of the proposed Petroleum Activities Program includes using WBM, well kill brine, drilling fluids and wet cement and will produce well annulus fluids (containing residual NWBM, residual hydrocarbons and residual produced formation water). For Capella-1, the Petroleum Activities Program will also produce solids from small volumes of drilled cement cuttings during plug and abandonment activities. These fluids will be generated during the well bore clean-out, drilling of existing cement barriers, installation of permanent abandonment barriers, circulation of the annulus and washing out of the mud pit. All chemicals selected for use will be assessed under Woodside’s internal guidelines to ensure potential impacts are acceptable, ALARP and meet Woodside’s expectation for environmental performance.

The WBM will either be mixed on the MODU or received pre-mixed, then stored and maintained in a series of pits aboard the MODU. 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.

Potential additional activities that may be required as part of the Petroleum Activities Program include milling, which will produce metal swarf, drilled cement and formation rock. While these additional activities are planned to use WBM, they may require using small volumes of NWBM.

All of the downhole plugging for permanent abandonment activities are conducted through the marine riser. This is a closed system, meaning there are no planned discharges directly to sea during these activities. Planned discharges of the above fluids are only planned to occur after they have been received on the MODU and treated where required.

3.13 New Technologies

Permanent abandonment plug(s) are typically cement pumped into the well bore at specified interval(s) determined through the well barrier design process. There may also be new material technologies that fulfil permanent well plugging for abandonment requirements that may be considered instead of or in combination with cement. These will be assessed using the management of change assessment described in **Section 8.6** and, if required, the chemical selection and assessment process outlined in **Section 3.12**.

3.14 Leave Infrastructure In-situ Permanently Activities

Based on the comparative assessment for Echo Yodel subsea infrastructure (**Section 6**), it is proposed to leave the infrastructure in-situ permanently, to enable the infrastructure to continue providing hard substrate to maintain the marine growth and habitat that currently supports local ecological functions, including commercial fisheries stocks and commercial fishing. This will require no further activities. Studies have been completed to understand the ecosystems associated with the infrastructure and socio-economics (e.g. commercial fish) supported by the infrastructure, as described in **Section 4**. Stakeholder consultation (**Section 5**), including the comparative assessment workshop (**Section 6**) held with external stakeholders, such as the Department of Primary Industries and Regional Development (DPIRD, formerly Department of Fisheries) and commercial fishers, support this as the most preferred option. Engineering studies have also been completed on the predicted burial and degradation of the infrastructure, which also informed the selected option. These are described in the next subsections.

3.14.1 Echo Yodel Pipeline

Woodside commissioned studies to understand the condition timeline for the Echo Yodel pipeline (described in **Section 3.6.2**), should it be left in-situ. These studies were conducted in 2018 and 2019 by Atteris Pty Ltd (Atteris).

The studies found that the Echo Yodel pipeline is self-burying, resulting in it sinking into the seabed to a predicted average of about 85% of its overall outside diameter within about 125 years (Atteris, 2019a). This will result in about 4200 m² of exposed surface area that will continue to provide hard substrate for habitat and support fish and other ecological functions (about 500 years, **Figure 3-8**).

After this, degradation mechanisms will begin to occur. During the degradation process, some material will remain buried (about 69%) and the remainder will be dispersed in the marine environment. As Echo Yodel pipeline consists of stainless steel coated by polymers, degradation of the pipeline will primarily be from degradation of polymers and corrosion of the stainless steel. The degradation of the polymers will predominantly be through material embrittlement/breakdown and biotic degradation, leading to the eventual release of polymer debris (Atteris, 2019a). Corrosion of the stainless steel will primarily be from the exposure to the environment, after the polymer coating loses integrity and becomes an ineffective protective coating (Atteris, 2019b).

It is estimated that the pipeline will take at least 700 years to fully degrade; however, based on the uncertainties around the degradation of the pipeline coating system, this estimate may reasonably be extended to 1700 years (**Figure 3-8**). Degradation products not remaining buried in the seabed will be dispersed very gradually by wave and current activity over this period. Before the coating systems degrade, the pipeline will continue to support the habitat and fish that have established on it (**Figure 3-9**).

Testing for mercury and NORMs has been conducted on the Echo Yodel pipeline. Several tests were completed for radiation and mercury detection on both the spool removed from the downstream end and the pipeline section removed on the upstream end.

Radiation detection for the presence of NORMs was conducted using a hand-held gamma dose rate meter. Radiation readings were within acceptable detection limits above background (surface gamma dose rate – 0.11 μSv/h above background).

Mercury vapour testing was carried out onboard the offshore vessel immediately following the downstream pipeline section removal in 2018. The testing indicated trace levels of mercury vapour. Readings ranged from 0.01 to 0.09 μg/m^3, and peaked 1.3 μg/m^3 levels post packing. The Hg measurements have to be referenced to non-zero background of 0.04 to 0.14 μg/m^3 (mercury is a naturally occurring element that is found in air, water and soil). In addition to vapour testing, high definition x-ray flourescence (HDXRF) testing of the inside of the pipeline surface was also undertaken. Readings were below detection limit (<0.5 μg/m^3). In addition, metal discs (coupons) were temperature-control cut and sent for destructive texting for mercury impregnation. These results came back as below the detection limit of the instruments (<0.05 mg/kg).

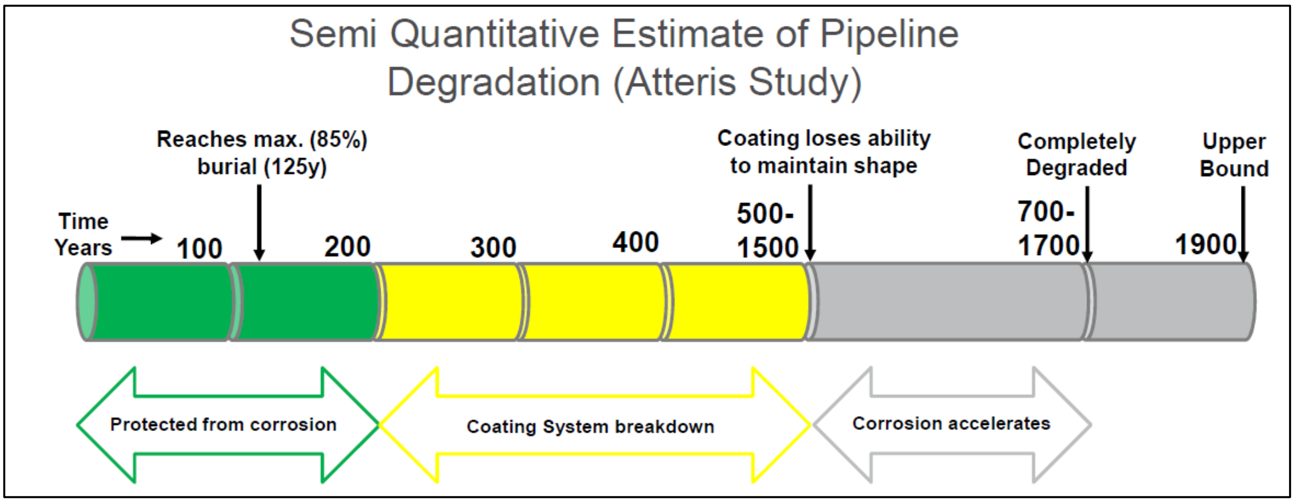

Figure 3-8: Echo Yodel pipeline degradation timeline estimate

Figure 3-9: Echo Yodel pipeline habitat

3.14.2 Echo Yodel Umbilical

Woodside commissioned studies to understand the condition timeline for the Echo Yodel umbilical and umbilical controls systems (described in **Section 3.6.3**), should they be left in-situ. These studies were conducted in 2018 and 2019, also by Atteris.

The studies found that the Echo Yodel umbilical consists of 79% metals (steel and copper) and 21% polymers (high density polyethylene), which are expected to be subject to degradation and corrosion (Atteris, 2019b). These materials are expected to degrade in various ways and produce metal oxides and polymer debris upon final degradation, with about 73% expected to remain in-situ, while the rest is dispersed to the greater environment. The high percentage of degradation materials remaining in-situ is due to the Echo Yodel umbilical self-burying, resulting in it sinking into the seabed, as well as it continuing to self-bury during the degradation process. During the degradation process the umbilical will continue to self bury until more than 90% of the umbilicals' length is more than 95% (of its outside diameter) buried (less than 7 mm exposed). Though exposed in some sections, the top of the umbilical will be significantly below the surface of the surrounding seabed. At current rates, the umbilical is expected to reach a state of burial equilibrum in approximately 40 years (Atteris, 2019b).

The degradation of the umbilical would be initially through material embrittlement/breakdown and biotic degradation of the polymer coating, leading to the eventual release of polymer debris (Atteris, 2019b). Corrosion of the stainless steel would primarily occur after the polymer coating loses integrity and becomes an ineffective protective coating, starting after about 500 years (Atteris, 2019b). Degradation of the umbilical is expected to occur over about 1500 years (**Figure 3-10**). The full volume of the operational fluids (MEG, hydraulic fluid and mineral oil) will seep out once a perforation has been formed (about 500 years). Before the coating systems degrade, the umbilical will continue to support the habitat and fish that have established on it (**Figure 3-11**).

The two UTAs and IUTB are metal, which will result in a relatively quick degradation process of the structures (within 130 years) (Atteris, 2019b). Corrosion of the steel UTAs and the IUTB will commence after about 40 years, taking a further 60 years to corrode to half their original mass, by which time they will likely have collapsed in place and continue to further corrode. The degradation of the structures will have no effect on the degradation of the Echo Yodel umbilical or pipeline.

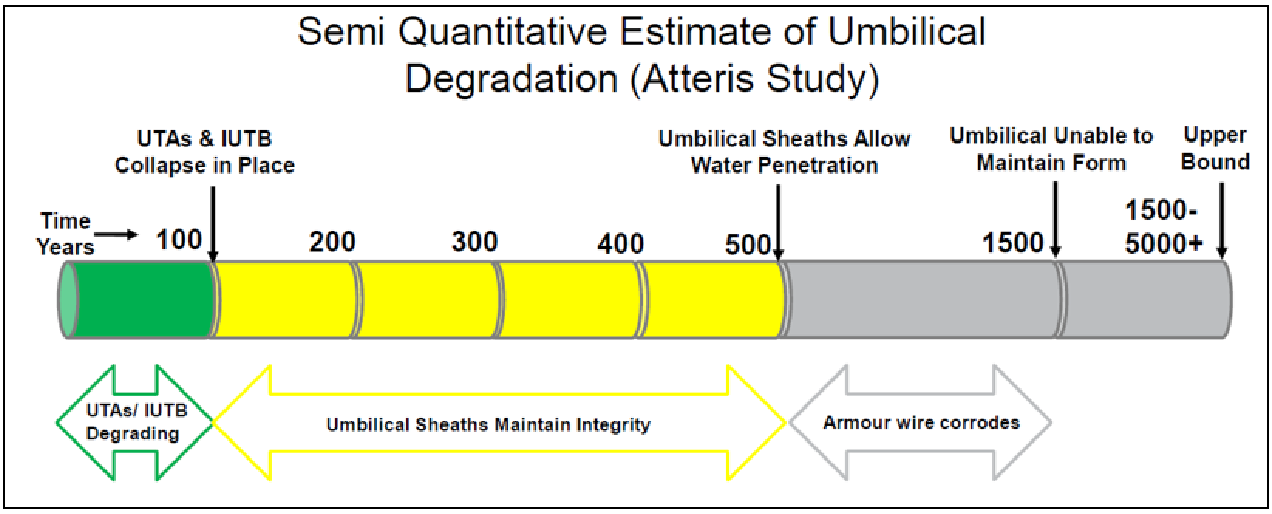

Figure 3-10: Echo Yodel umbilical degradation timeline estimate

Figure 3-11: Echo Yodel umbilical habitat

3.14.3 Yodel-3 and Yodel-4 X-mas Trees and Wellheads

The X-mas tree and wellheads are predominantly made of AISI 4130 steel, with small amounts of elastomeric materials such as Teflon used within valve and seal components. The steel is predominantly iron (around 97%), with additional elements as described in **Table 3-10**.

Table 3-10: Components of the X-mas tree and wellhead steel

Element	Weight Percentage
Carbon	0.28 to 0.33
Manganese	0.04 to 0.06
Phosphorus	0.0035 (maximum)
Sulphur	0.040 (maximum)
Silicon	0.20 to 0.35
Chromium	0.8 to 1.1
Molybdenum	0.15 to 0.25

Corrosion of the X-mas trees and wellheads over time will result in the release of degraded steel (rust) and trace amounts of the other components and elastomeric materials to the water column and surrounding sediments. Marine corrosion studies by Melchers (2005) have shown that for metal structures such as the X-mas trees and wellheads, corrosion is likely to be a relatively slow process, occurring at about 0.2 mm/year (Melchers, 2005). Similar to the umbilical controls systems (UTAs and IUTB), the X-mas trees and wellheads structures are expected to degrade in a similar timeframe (within 130 years).

4. DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulations 13(2) and 13(3) of the Environment Regulations, this section describes the existing environment that may be affected by the activity (planned and unplanned, as described in **Section 7**), including details of the particular relevant values and sensitivities of the environment, which were used for the risk assessment.

The EMBA is the largest spatial extent where unplanned events could have an environmental consequence on the surrounding environment. For this EP, the EMBA is the potential spatial extent of surface and in-water hydrocarbons at concentrations above ecological impact thresholds, in the event of the worst-case credible spill. The ecological impact thresholds used to delineate the EMBA are defined in **Section 7.7.1.1**. The worst-case credible spill scenario for this EP is loss of well integrity. The EMBA also includes any areas that are predicted to experience shoreline contact with hydrocarbons above threshold concentrations.

Woodside recognises that hydrocarbons may be visible beyond the EMBA at lower concentrations than the ecological impact thresholds defined in **Section 7.7.1.1**. These visible hydrocarbons are not expected to cause ecological impacts. In respect of this, an additional socio-cultural EMBA is defined, as the potential spatial extent within which social-cultural impacts may occur from changes to the visual amenity of the marine environment. Receptors relevant to the socio-cultural EMBA include Commonwealth and State marine protected areas, National and Commonwealth Heritage Listed places, areas of tourism and recreation, and commercial and traditional fisheries. For this EP, the socio-cultural EMBA for surface hydrocarbons encompasses an area fully within the boundaries of the EMBA for ecological impacts. The EMBA and socio-economic EMBA are shown in **Figure 4-1**.

It should be noted that each EMBA presented does not represent the predicted coverage of any one hydrocarbon spill or a depiction of a slick or plume at any particular instant in time. Rather, the areas are a composite of a large number of theoretical paths, integrated over the full duration of the simulations under variations in metocean conditions.

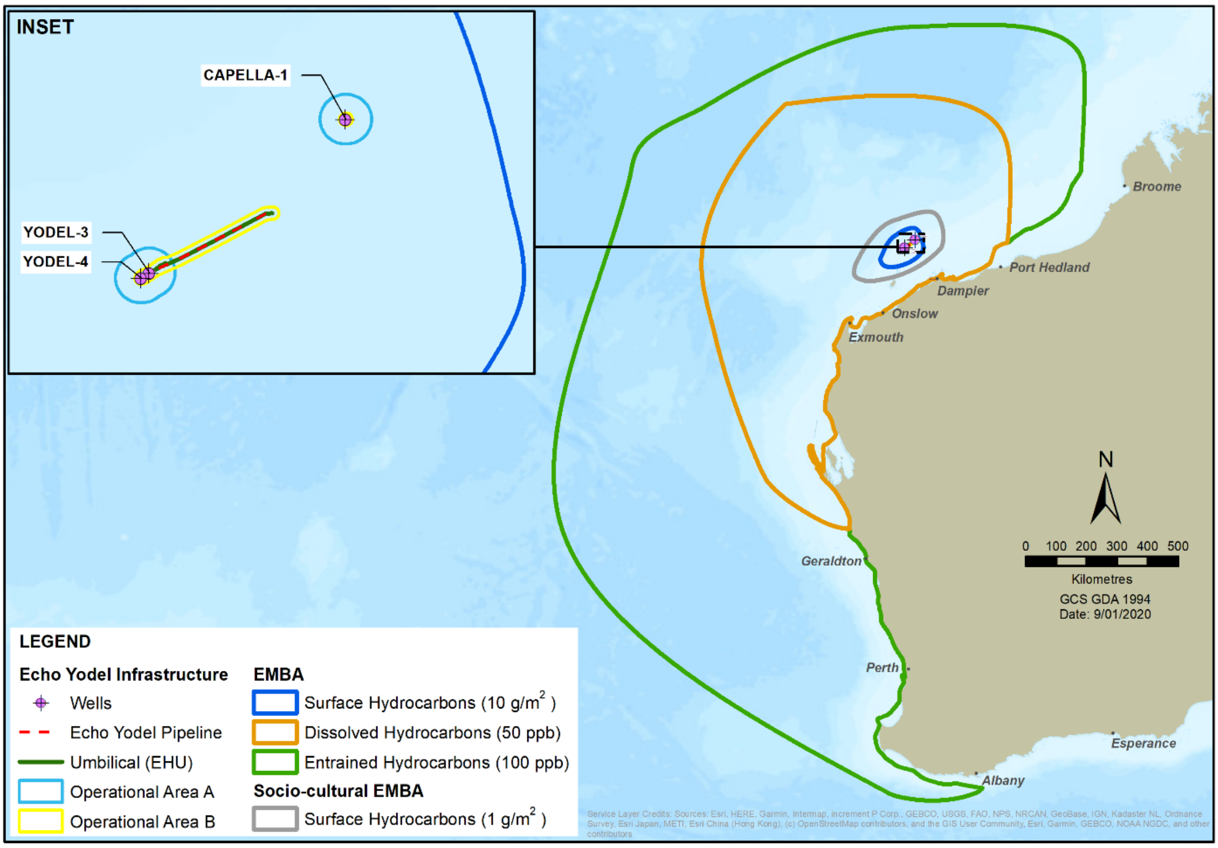

Figure 4-1: Environment that may be affected by the Petroleum Activities Program

4.2 Summary of Key Existing Environment Characteristics

Table 4-1 summarises the key existing environment characteristics, in line with the process of identifying and describing the existing environment in relation to the 'nature and scale' of the activity (refer **Section 2.5.2**). The key existing environment characteristics, in **Table 4-1**, are described in terms of the Operational Areas, Socio-cultural EMBA and the EMBA. The Operational Areas (defined in **Section 3.4**) are located within offshore waters about 140 km north-west of Dampier.

Table 4-1: Summary of key existing environment characteristics for the Operational Areas and EMBA

	Sensitive Receptor	EP Section	Description
Physical Habitats	***Climate and Meteorology***	**4.4.1**	***Operational Areas*** • Dry tropical climate with a hot summer season from October to April and a mild winter season between May and September. • Most rainfall occurs during the wet season (summer), with the highest rains observed during late summer and autumn. • Winds vary seasonally, with a tendency for south-westerly winds characterising summer months and easterly winds characterising winter months. Winds during the transitional period between seasons, typically April and August, are more variable. • Tropical cyclones are a relatively frequent event for the north-west region, occurring between November and April. Cyclones in the region are most frequent during January to March. ***EMBA*** • The EMBA covers a large area with various climates and meteorology. • The portion of the EMBA that is within the North-West Marine Region (NWMR) has climate and meteorology similar to what is described for the Operational Areas. • The portion of the EMBA that is within the South-West Marine Region (SWMR) experiences a Mediterranean style climate and is characterised by cool, wet winters and hot, dry summers.
	Oceanography	**4.4.2**	***Operational Areas*** • Geostrophic flow is characterised by the southward flowing Leeuwin Current, which strengthens in winter and weakens in summer. • Tidal currents influence water movements. • Locally generated wind surface currents are superimposed on geostrophic and tidal currents. • Water quality is expected to reflect the offshore oceanic conditions of the NWS Province and wider region, described as low in nutrient levels and contamination. • 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. • Waves within the region reflect the direction of the synoptic winds and flow predominantly from the south-west in the summer and from the east in winter. Tropical cyclones and storms may generate swells up to 8 m high. ***EMBA*** • The EMBA covers a large area with various oceanography conditions. • The portion of the EMBA that is within the NWMR has oceanography conditions similar to the Operational Areas. • The portion of the EMBA that is within the SWMR is largely driven by the Leeuwin Current, the eastern boundary current. The continental shelf within the SWMR is characterised by high diversity of algal species and benthic communities, due to the low-nutrient environment of the SWMR resulting in clear waters and high levels of light penetration.
	Bathymetry	**4.4.4**	***Operational Areas*** • Located in waters about 125 m to 136 m deep on the outer continental shelf. • Seabed is generally flat and featureless. ***EMBA*** • The bathymetry of the EMBA is varied as the EMBA extends over such a large area. • The EMBA has a number of topographic features including submerged banks, shoals and valleys, including Rankin Bank and Glomar Shoal. • EMBA is characterised by the inner continental shelf, the middle continental shelf, the outer shelf/continental slope and the abyssal plain.
	Marine Sediment	**4.4.4.1**	***Operational Areas*** • Expected to consist of fine carbonate sediments (muds and sands) of high quality (low levels of contaminants). • Nutrients levels (Total Nitrogen and Total Phosphorous) in the Operational Areas are typically low. • Could include areas of hard substrate where the Operational Areas overlap the Ancient Coastline at 125 m Key Ecological Feature (KEF). ***EMBA*** • The marine sediments of the EMBA are varied as the EMBA extends over such a large area. • The portion of the EMBA that is within the NWMR has sediment character which changes with depth and distance from shore, with sediments becoming progressively finer with increasing depth and distance, particularly beyond continental shelf break. • The portion of the EMBA that lies within the SWMR is expected to have marine sediments representative of the entire SWMR. However, it is important to note that the *Marine bioregional plan for the South-west Marine Region* states that the most significant marine sediments within the SWMR are within the Great Australian Bight and, as this area is outside the EMBA, are therefore not relevant to this EP.
	Air Quality	**4.4.5**	Specific air quality information is not available; however, ambient air quality in the Operational Areas, socio-cultural EMBA 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 the Operational Areas.

Sensitive Receptor	EP Section	Description
Marine Primary Producers	**4.5.1.2**	***Operational Areas*** • Given the water depth, benthic primary producers are not expected to occur within the Operational Areas. ***EMBA*** <u>Coral Reefs</u> • There are a number of coral reefs within the EMBA. Those that are known include: Rowley Shoals, Glomar Shoal and waters surrounding the Montebello/Barrow/Lowendal Island Group, Muiron Islands, nearshore waters of the Pilbara coastline, Shark Bay, Rankin Bank and the Houtman Abrolhos Islands. <u>Seagrass Beds/Macroalgae</u> • Seagrass is expected at various areas within the EMBA. In particular, seagrass beds and macroalgae habitats are associated with the Ningaloo Coast, Shark Bay and the Houtman Abrolhos Islands. <u>Mangroves</u> • Broadly distributed in protected coastlines throughout the EMBA, in particular locations such as Ningaloo coast, Shark Bay, the Houtman Abrolhos Islands and the WA mainland shoreline.
Lifecycle Stages 'Critical' Habitats	**4.5.1.3**	Refer to Biologically Important Areas (BIAs) and species descriptions for details of 'critical' habitats for lifecycle stages.
Other Communities/Habitats	**4.5.1.4**	***Operational Areas*** <u>Plankton</u> • Plankton communities in the Operational Areas are likely to reflect the broader NWMR. <u>Pelagic and Demersal Fish Populations</u> • Fish communities in the Operational Areas comprise small and large species of pelagic fish, as well as demersal species. Fish communities have become established in association with complex benthic habitats on Echo Yodel subsea infrastructure. • Small pelagic fish inhabit a range of marine habitats, including inshore and continental shelf waters, feeding on phytoplankton and zooplankton. • Demersal fish biodiversity correlates with habitat complexity, with more complex habitat supporting greater species richness and abundance compared to bare areas. <u>Filter Feeders and Other Benthic Communities</u> • Filter feeders are generally located in areas with strong currents and hard substratum; therefore, it is unlikely the Operational Areas have suitable habitat for significant filter feeder communities as the areas comprise mostly homogenous soft sediments with little or no hard substrate. • The Echo Yodel subsea infrastructure provides substrate for deepwater marine invertebrate species to settle, attach and establish. ***EMBA*** <u>Plankton</u> • Offshore phytoplankton communities are characterised by smaller taxa (e.g. bacteria), while shelf waters are dominated by larger taxa (e.g. diatoms). • Peak primary productivity along the shelf edge of the Ningaloo Reef occurs in late summer/early autumn. • Primary production in the EMBA is linked to mass coral spawning events, peaks in zooplankton and fish larvae abundance. <u>Pelagic and Demersal Fish Populations</u> • Two notable reef systems exist within the EMBA – Rankin Bank and Glomar Shoal – and these areas are identified as supporting high demersal fish richness and abundance. • A number of KEFs also exist within the EMBA, which are also known to support a high biodiversity of demersal fish species. These are all listed in **Section 4.7**, and include the Glomar Shoal KEF and the Continental Slope Demersal Fish Communities KEF. • Within the EMBA, key demersal fish biodiversity areas are likely to occur in association with other complex habitats (Montebello/Barrow/Lowendal islands, Ningaloo Reef and the Houtman Abrolhos Islands). <u>Filter Feeders and Other Benthic Communities</u> • There are various areas within the EMBA that have been identified as a sponge diversity hotspot with a high variety of biodiverse areas. Of particular note are the sponge communities in Dampier Archipelago Nature Reserve and Ningaloo Marine Park. • Filter feeder communities are primarily located in the deeper waters of the Ningaloo Reef system as well as the Muiron Islands, the Cuvier Abyssal Plain and Cape Range Peninsula and nearshore waters of the Pilbara Islands. • Filter feeders at Rankin Bank and Glomar Shoal make up a minor component of the benthic communities in the area. • Deeper (non-phototrophic) habitat areas of the NWMR and SWMR are likely to support filter feeding communities.

	Sensitive Receptor	EP Section	Description
	Habitat Critical to the Survival of a Species	**4.5.2.2**	***Operational Areas*** The Operational Areas do not include any habitat critical to the survival of a species. ***EMBA*** Habitat critical to the survival of green turtles: • Montebello Islands (all with sandy beaches) • Serrurier Island • Thevenard Island. Habitat critical to the survival of loggerhead turtles: • Dirk Hartog Island • Muiron Islands • Gnarraloo Bay • Ningaloo Coast. Habitat critical to the survival of flatback turtles: • Montebello Islands • Barrow Island • Cemetery Beach • Coastal islands from Cape Preston to Locker Island. Habitat critical to the survival of hawksbill turtles: • Dampier Archipelago (including Rosemary Island and Delambre Island) • Shoal Island. Habitat critical to the survival of the Australian Sea Lion: • Abrolhos Islands, Easter Group (Serventy, Suomi, Alexander and Gilbert Island) • Beagle Island • North Fisherman Island • Buller Island.
	Biologically Important Areas	**4.5.2.3**	***Operational Areas*** • Pygmy blue whale migration corridor • Flatback turtle internesting buffer • Whale shark foraging BIA • Wedge-tailed shearwater breeding BIA. ***EMBA*** Large number of BIAs within EMBA, refer to **Section 4.5.2.3** for additional information. • Humpback whale migration BIA • Australian sea lion foraging BIA • Blue whale foraging BIA • Pygmy blue whale foraging BIA • Dugong foraging BIA • Southern right whale calving BIA • Sperm whale foraging BIA • Flatback turtle nesting, internesting buffer, foraging and mating BIA • Green turtle internesting buffer, nesting, migration corridor, mating and foraging BIA • Hawksbill turtle internesting buffer, nesting, foraging, mating and migration corridor BIA • Loggerhead turtle internesting buffer and nesting BIA • Whale shark foraging BIA • Great white shark foraging BIA • Australian lesser noddy foraging BIA • Bridled tern foraging BIA

	Sensitive Receptor	EP Section	Description
			• Brown booby breeding BIA • Caspian tern foraging BIA • Common noddy foraging BIA • Fairy tern breeding and foraging BIA • Flesh-footed shearwater aggregation BIA • Great-winged petrel foraging BIA • Indian yellow-nosed albatross foraging BIA • Lesser crested tern breeding BIA • Lesser frigatebird breeding BIA • Little penguin foraging BIA • Little shearwater foraging BIA • Little tern resting BIA • Pacific gull foraging BIA • Roseate tern breeding and foraging BIA • Soft-plumaged petrel foraging BIA • Sooty tern foraging BIA • Wedge-tailed shearwater foraging and breeding BIA • White-faced storm petrel foraging BIA • White-tailed tropicbird breeding BIA.
Protected Species	***Marine Mammals***	**4.5.2**	***Operational Areas*** • Sei, fin and sperm whales – likely to infrequently occur within proximity to the continental slope section of the Operational Areas during winter months. • Blue whale – migration corridor BIA overlaps the facility section of the Operational Areas; occurrence is expected between about April to January. • Humpback whale – migration corridor BIA overlaps the EMBA; occurrence is expected between May to November. • Bryde's whale – presence in the Operational Areas is likely to be a remote occurrence and limited to a few individuals; may be seasonally present between December to June. • Killer whale, orca – no recognised key localities, expected to rarely occur within the Operational Areas. • Spotted bottlenose dolphin – unlikely to occur within Operational Areas, but may occur in the EMBA. ***EMBA*** • Southern right whale – unlikely to occur within Operational Areas, but may occur in the EMBA. • Australian sea-lion – unlikely to occur within Operational Areas, but may occur in the EMBA. • Pygmy right whale – unlikely to occur within Operational Areas, but may occur in the EMBA. • Dusky dolphin – unlikely to occur within Operational Areas, but may occur in the EMBA. • Antarctic minke whale – unlikely to occur within Operational Areas, but may occur in the EMBA. • Dugongs – unlikely to occur within Operational Areas, but may occur in the EMBA. • Indo-pacific humpback dolphin – unlikely to occur within Operational Areas, but may occur in the EMBA.
	Marine Turtles	**4.5.2**	***Operational Areas*** • There is no foraging habitat for the flatback, green, leatherback, hawksbill and loggerhead turtles within the Operational Areas. • There is no "Habitat critical to the survival of marine turtles" within the Operational Areas. • The Operational Areas contain an internesting BIA for flatback turtles. Presence of the species within the Operational Areas is likely to be limited to the internesting periods. ***EMBA*** • The EMBA contains a number of nesting and internesting habitat critical to the survival of flatback, green, hawksbill and loggerhead turtles. • The EMBA contains a number of internesting BIAs for flatback, green, hawksbill and loggerhead turtles. Leatherback turtles may occur within the EMBA but there are no known nesting beaches in WA. • The EMBA overlaps foraging and mating BIAs for the flatback, green and hawksbill turtle species. • Marine turtles may forage in shallow waters on the continental shelf, including Rankin Bank (25 km from the Operational Areas). • The EMBA overlaps a nesting and migration corridor for the green and hawksbill turtle.

	Sensitive Receptor	EP Section	Description
	Seasnakes	**4.5.2**	***Operational Areas*** • Given the offshore location and deeper water depths of the Operational Areas, seasnake sightings will likely be infrequent and comprise a few individuals. ***EMBA*** • Seasnakes frequent the waters of the continental shelf and around offshore islands. • The short-nosed seasnake (critically endangered) overlaps with the EMBA.
	Fishes and Elasmobranchs	**4.5.2**	***Operational Areas*** • Great white sharks – unlikely to occur within the Operational Areas given absence of preferred prey; known to occur within the EMBA. • Shortfin and longfin mako sharks – potential for infrequent transit of the Operational Areas, known to occur within the EMBA. • Whale sharks – foraging BIA overlaps the Operational Areas (although this may constitute a migration corridor for animals moving to and from annual aggregation off Ningaloo Coast); occurrence is expected between March to July. • Grey nurse sharks – may infrequently transit continental shelf waters overlapping the Operational Areas; are likely to be found in shallow waters of the EMBA. • Giant and reef manta rays – occurrence within the Operational Areas is expected to be infrequent. • Narrow and green sawfish – may infrequently transit continental shelf waters of the Operational Areas; will occur in shallow coastal habitats in the EMBA (near Montebello and Barrow islands). ***EMBA*** • Dwarf and freshwater sawfish will occur in shallow coastal habitats in the EMBA (near Montebello and Barrow islands). • Porbeagle, mackerel shark – unlikely to occur within Operational Areas, but may occur in EMBA. • Southern dogfish, endeavour dogfish, little gulper shark – conservation-dependent species. • School shark, eastern school shark, snapper shark, tope, soupfin shark – conservation-dependent species. • Orange roughy, deep-sea perch, red roughy – conservation-dependent species. • Eastern gemfish – conservation-dependent species. • Scalloped hammerhead – conservation-dependent species. • Southern bluefin tuna – conservation-dependent species.
	Oceanic Seabirds and/or Migratory Shorebirds	**4.5.2**	***Operational Areas*** • Ten species of Threatened and/or Migratory bird species were identified as potentially occurring within the Operational Areas; no EPBC-listed critical habitat associated with these species has been identified within the Operational Areas. • A foraging and breeding BIA for wedge-tailed shearwater, during their breeding season (August to April), overlaps the Operational Areas. ***EMBA*** • Sixty-five species of Threatened and/or Migratory bird species were identified as potentially occurring within the EMBA but outside the Operational Areas. Additionally, 21 BIAs for birds overlap the EMBA.
Socio-economic	***Cultural Heritage***	**4.6.1**	***Operational Areas*** • There are no known sites of Aboriginal or European cultural or heritage significance within or in the vicinity of the Operational Areas. ***Socio-cultural EMBA*** • There are no known sites of Aboriginal or European cultural or heritage significant within or in the vicinity of the Socio-cultural EMBA. ***EMBA*** • Not applicable to environmental EMBA, see Socio-cultural EMBA for details.
	Ramsar Wetlands	**4.6.2**	***Operational Areas*** • No Ramsar wetlands in the Operational Areas. ***EMBA*** • Becher Point wetlands.
	Fisheries – Commercial	**4.6.3**	***Operational Areas*** Woodside is aware of commercial fisheries that target the Echo Yodel subsea infrastructure. This is because the pipeline provides habitat for commercially valuable fish species. Furthermore, there are a number of fisheries that overlap the Operational Areas, as listed below, with the Pilbara Demersal Scalefish Fishery (mainly trap fishing) being the only fishery expected to be active within the Operational Areas. Commonwealth Fisheries • Southern Bluefin Tuna Fishery (SBTF) • Western Skipjack Fishery • Western Tuna and Billfish Fishery.

	Sensitive Receptor	EP Section	Description
			<u>State Fisheries</u> • Pilbara Demersal Scalefish Fishery • Pilbara Crab Managed Fishery • West Coast Deep Sea Crustacean Managed Fishery • Specimen Shell Managed Fishery • Onslow Prawn Managed Fishery • Pearl Oyster Managed Fishery • Marine Aquarium Managed Fishery • West Australian Abalone Fishery • Mackerel Managed Fishery • South West Coast Salmon Managed Fishery. ***EMBA*** <u>Commonwealth Fisheries</u> • Southern Tuna and Billfish Fishery • Small Pelagic Fishery • Southern and Eastern Scalefish and Shark Fishery • Western Deepwater Trawl Fishery (WDTF) • North-West Slope Trawl Fishery (NWSTF). <u>State Fisheries</u> • Abrolhos Islands and Mid-West Trawl Fishery • Broome Prawn Managed Fishery • Exmouth Gulf Prawn Managed Fishery • Gascoyne Demersal Scalefish Managed Fishery Kimberley Crab Managed Fishery • Nickol Bay Prawn Managed Fishery • Northern Demersal Scalefish Managed Fishery • Octopus Fishery • Shark Bay Beach Seine and Mesh Net Managed Fishery • Shark Bay Crab Managed Fishery • Shark Bay Prawn and Scallop Managed Fishery • South Coast Crustacean Managed Fishery • South Coast Purse Seine Managed Fishery • South West Trawl Managed Fishery • South Coast Salmon Managed Fishery • West Coast Beach Bait Managed Fishery • West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery • West Coast Demersal Scalefish Fishery • West Coast Purse Seine Managed Fishery • West Coast Rock Lobster Fishery.
	Fisheries – Traditional	**4.6.4**	There are no traditional or customary fisheries within or adjacent to the offshore Operational Areas. Traditional fisheries are typically restricted to shallow coastal waters and/or areas with structure such as reef. Barrow Island and Montebello Islands and the adjacent foreshores have a known history of fishing, when areas were occupied (as identified from historical records).
	Tourism and Recreation	**4.6.5**	***Operational Areas*** • Given the distance to the nearest access node from the Operational Areas, recreational fishing effort is not expected. ***Socio-cultural EMBA*** • Same as Operational Areas. ***EMBA*** • Same as Operational Areas

	Sensitive Receptor	EP Section	Description
	Shipping	**4.6.6**	***Operational Areas*** • No Australian Maritime Safety Authority (AMSA) shipping fairways pass through the Operational Areas. ***EMBA*** • The coastal and offshore waters of the region support significant commercial shipping activity, most of which is associated with the mining and oil and gas industries. • Major shipping routes are associated with entry to the ports of Exmouth, Onslow, Barrow Island and Dampier.
	Oil and Gas Infrastructure	**4.6.7**	***Operational Areas*** • GWA facility and existing GWA subsea infrastructure including pipelines. ***EMBA*** • There are numerous Petroleum Titles surrounding the Operational Areas and within the EMBA. • The Wheatstone Platform and Pluto Platform lie within 50 km of the Operational Areas.
	Defence	**4.6.8**	***Operational Areas*** • No designated defence practice areas. ***EMBA*** • Designed defence practice areas overlap the EMBA off the Ningaloo coast and the North West Cape.
Values and Sensitivities	***Protected Areas***	**4.7**	***Operational Areas*** • No AMPs or State Marine Parks are within the Operational Areas. ***Socio-cultural EMBA*** • Same as Operational Areas. ***EMBA*** • Montebello AMP (about 25 km from the Operational Areas at their closest point). • Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area (about 60 km, 100 km and 60 km respectively from the Operational Areas at their closest point). • Barrow Island Nature Reserve and Lowendal Island Nature Reserve (about 100 km and 95 km from the Operational Areas respectively at their closest point). • The Ningaloo Coast and Shark Bay World Heritage Areas (WHA) overlap the EMBA (about 270 km from the Operational Areas at their closest point). • The Gascoyne AMP overlaps the EMBA (about 240 km from the Operational Areas at their closest point). • The Ningaloo AMP overlaps the EMBA (about 270 km from the Operational Areas at their closest point). • Montebello Islands Marine Park/Barrow Island Marine Management Area (Jointly managed) (state) (about 70 km from the Operational Areas at their closest point). • Barrow Island Marine Park (state) (about 50 km from the Operational Areas at their closest point). • Bernier and Dorre Islands Nature Reserve (state) (about 600 km from the Operational Areas at their closest point). • Muiron Islands Marine Management Area (state) (about 250 km from the Operational Areas at their closest point). • Ningaloo Marine Park (state) (about 270 km from the Operational Areas at their closest point). • Rowley Shoals Marine Park (state) (about 460 km from the Operational Areas at their closest point). • Jurien Bay Marine Park (state) (more than 1000 km from the Operational Areas at their closest point). • Marmion Marine Park (state) (more than 1000 km from the Operational Areas at their closest point). • Ngari Capes Marine Park (state) (more than 1000 km from the Operational Areas at their closest point). • Shoalwater Islands Marine Park (state) (more than 1000 km from the Operational Areas at their closest point). • Shark Bay Marine Park (state) (more than 1000 km from the Operational Areas at their closest point).

	Sensitive Receptor	EP Section	Description
	Key Ecological Features	**4.7.2**	***Operational Areas*** • Ancient Coastline at 125 m Depth Contour KEF. ***EMBA*** • Continental Slope Demersal Fish Communities (25 km from the Operational Areas). • Glomar Shoal (55 km from the Operational Areas). • Exmouth Plateau (145 km from the Operational Areas). • Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula (221 km from the Operational Areas). • Commonwealth waters adjacent to Ningaloo Reef (268 km from the Operational Areas). • Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals (362 km from the Operational Areas). • Western Demersal Slope and Associated Fish Communities of the Central Western Province (745 km from the Operational Areas). • Wallaby Saddle (791 km from the Operational Areas). • Albany Canyons group and adjacent shelf break (more than 1000 km from the Operational Areas). • Western Rock Lobster (901 km from the Operational Areas). • Perth Canyon and adjacent shelf break (965 km from the Operational Areas). • Ancient coastline at 90 to 120 m depth (918 km from the Operational Areas). • Cape Mentelle upwelling (more than 1000 km from the Operational Areas). • Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break) (951 km from the Operational Areas). • Commonwealth marine environment within and adjacent to the west-coast inshore lagoons (940 km from the Operational Areas).
	Other sensitive areas	**4.7.4**	Rankin Bank lies about 12 km west of the Operational Areas, within the EMBA.

4.3 Regional Context

The Operational Areas are located in Commonwealth waters within the NWS Province, as defined under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA v4.0) (Commonwealth of Australia, 2006), in water depths of about 125 m to 136 m. Within the NWMR, the Operational Areas lie within the NWS Province.

The North West Shelf Province is characterised by the following biophysical features (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012a):

- There are transitional climatic conditions between dry tropics to the south and humid tropics to the north.
- There are strong seasonal winds and moderate offshore tropical cyclone activity.
- 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 deeper, around 120 m depth.
- Surface ocean circulation is strongly influenced by the Indonesian Through Flow (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.
- Internationally significant migratory routes, resident populations, and 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, are all present.
- The region has high species richness, but a relatively low level of endemism compared to other areas of Australian waters. Furthermore, most of the region's species are tropical and are recorded in other areas of the Indian Ocean and Western Pacific Ocean.
- Benthic communities 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).
- 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 to 90% of the sediments in the region are carbonate-derived (Brewer *et al*., 2007). The distribution and re-suspension 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 re-suspension and net downslope deposition of sediments (DSEWPaC, 2012a).

Other marine bioregions within the EMBA include the Northwest Transition, Timor Province, Northwest Province (NWP), Central Western Transition, Central Western Shelf Transition, Central Western Shelf Province, Central Western Province, Southwest Shelf Transition, Southwest Transition, Southwest Shelf Province and Southern Province (**Figure 4-2**).

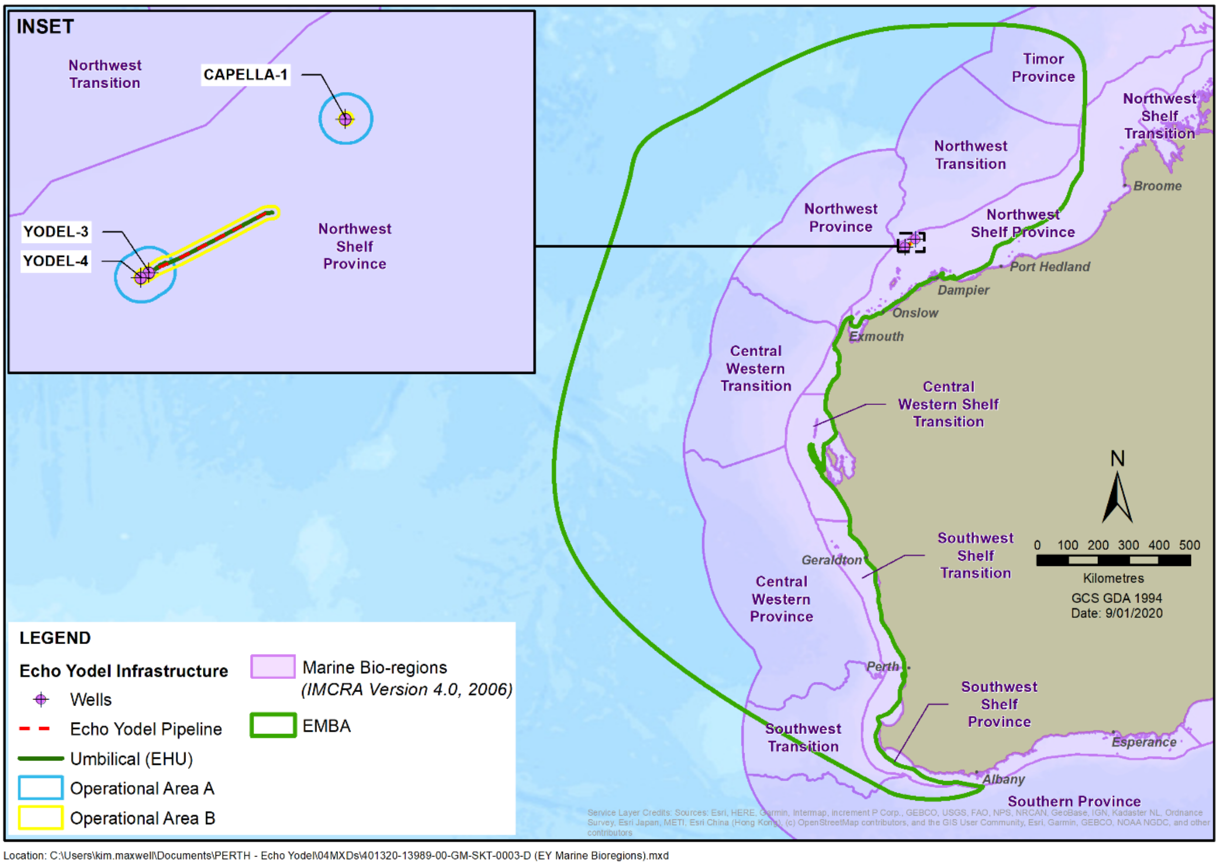

Figure 4-2: Location of the Operational Areas and relevant marine bio-regions

4.4 Physical Environment

Unless specifically stated, the next sections provide information about the physical environment of the Operational Areas and/or immediately surrounding region. The physical environment of the EMBA is only described if relevant to the broader risk assessment.

4.4.1 Climate and Meteorology

4.4.1.1 Seasonal Patterns

The Operational Areas, which lie within the North West Shelf Province, experiences a tropical monsoon climate, with distinct wet (October to April) and dry (May to September) seasons (BoM, 2012). 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 North Rankin A platform (which is about 22.6 km from the closest point of the Operational Areas), indicate maximum average temperatures during summer of 39.5 ºC and minimum temperatures of 15.6 ºC in winter (BoM, 2012; Woodside, 2012).

Rainfall in the region predominantly occurs during the wet season (summer), with highest rains observed during late summer (BoM, 2012), often associated with the passage of tropical low pressure systems and cyclones (Pearce *et al*., 2003). Rainfall outside this period is typically low (**Figure 4-3**).

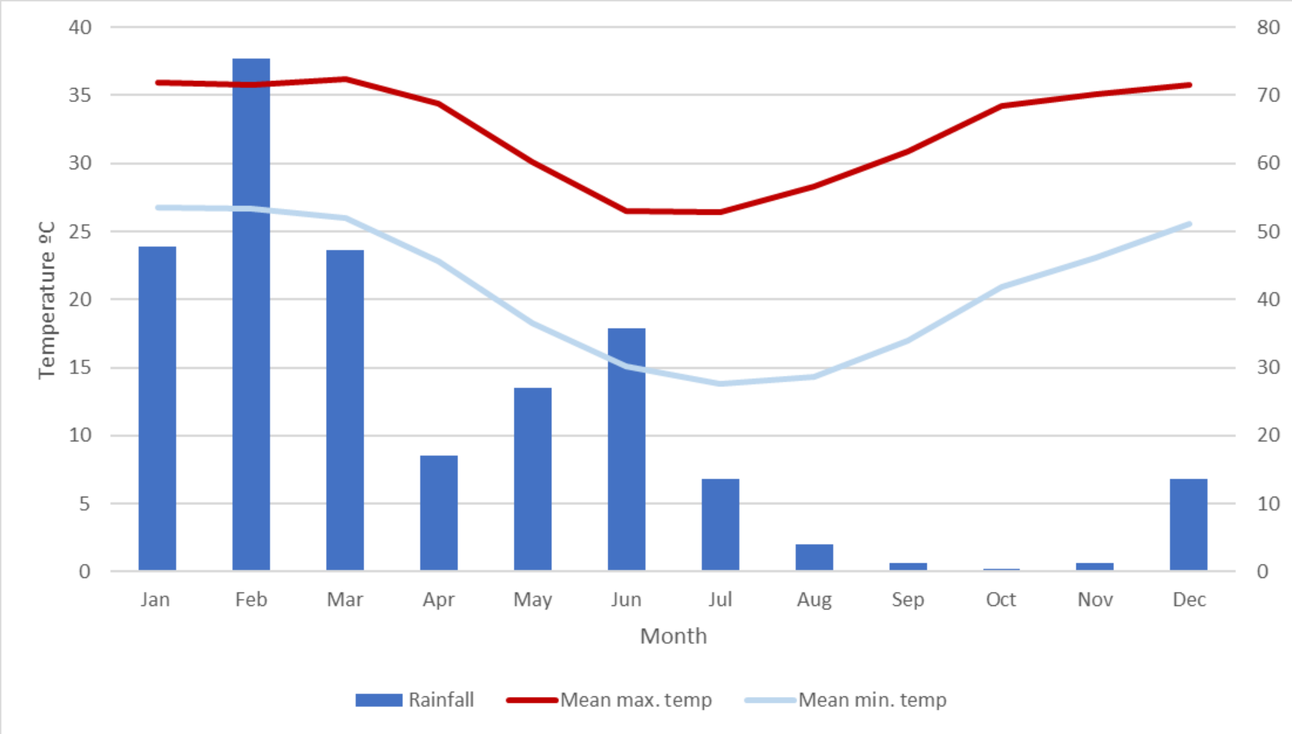

Figure 4-3: Mean monthly maximum temperature, minimum temperature and rainfall from Karratha Aerodrome meteorological station from January 1993 to Dec 2019 (BoM n.d.)

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. 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, typically April and August (**Figure 4-4**).

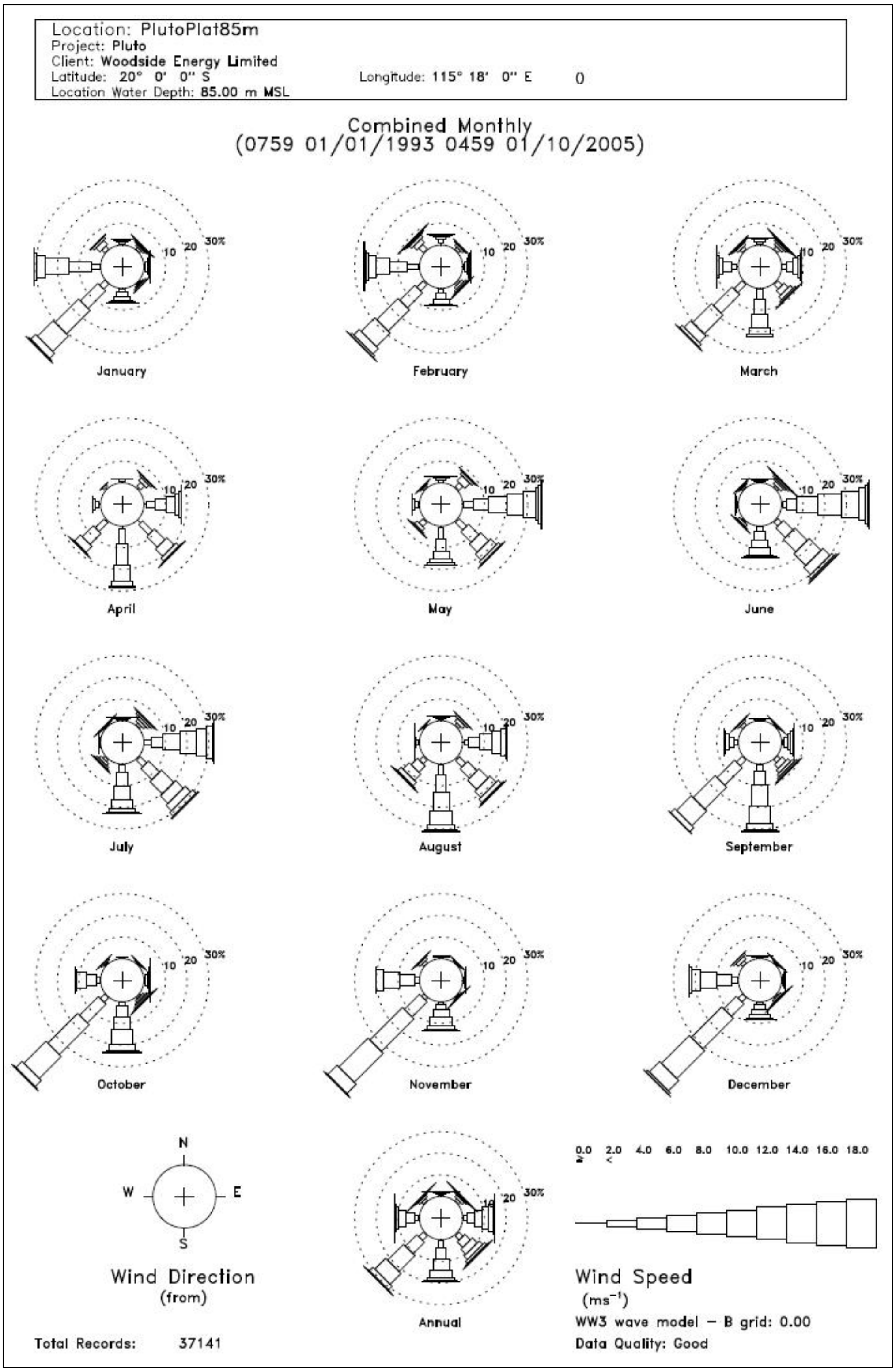

Figure 4-4: Non-cyclonic monthly wind-roses measured at the Pluto Facility from 1993 to 2005

4.4.1.3 Tropical Cyclones

Tropical cyclones are a relatively frequent event in the NWS region (**Figure 4-5**), with the Pilbara coast experiencing more cyclonic activity than any other region of the Australian mainland coast (BoM, 2014). Tropical cyclone activity can occur between November and April and is most frequent in the area during January to March, with an annual average of about one storm per month. Cyclones are less frequent in the area in the months of November, December and April. However, historically, the most severe storms have occurred in April.

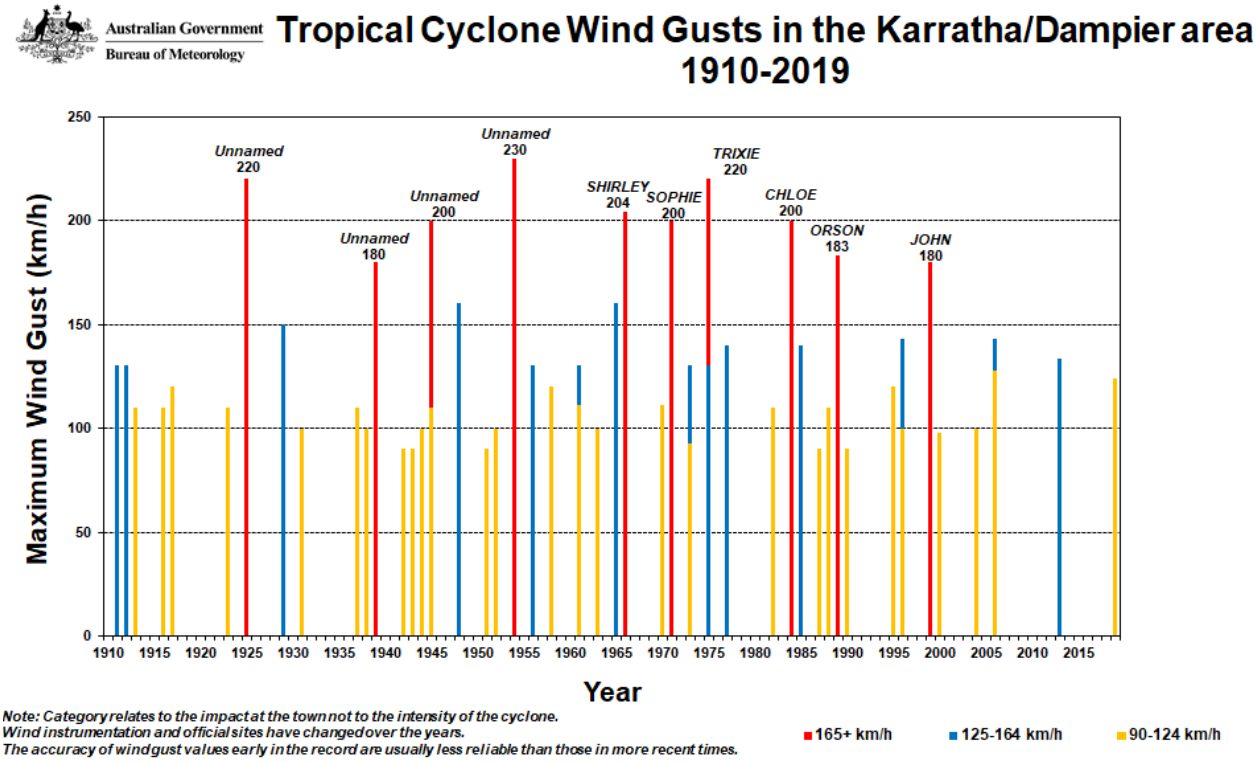

Figure 4-5: Tropical cyclone activity in the Dampier/Karratha region 1910 to 2017 (source: BoM, n.d.)

4.4.2 Oceanography

4.4.2.1 Currents and Tides

Currents in the region are local driven by winds and tides, superimposed on synoptic scale geostrophic currents. Local winds generate stress on the water surface, forcing the surface layer in the general direction of wind movement, but with an offset (15 to 45%) in an anti-clockwise direction (Coriolis Effect). In the open ocean, sustained winds result in wind-forced currents of about 3% of the wind speed (Holloway and Nye, 1985). Thus, a sustained wind of 20 knots may force surface currents of up to 0.6 knots. Wind patterns in the region are described in **Section 4.4.1** and shown in **Figure 4-4**.

The large-scale ocean circulation of the NWS is primarily influenced by the ITF (Meyers *et al*., 1995; Potemra *et al*., 2003), and the Leeuwin Current (Batteen *et al*., 1992; Godfrey and Ridgway, 1985; Holloway and Nye, 1985; James *et al*., 2004; Potemra *et al*., 2003). Both 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 (DSEWPaC, 2012a). The ITF and Leeuwin Current are strongest during late summer and winter (Holloway and 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 (Condie *et al*., 2006; Holloway and Nye, 1985; James *et al*., 2004).

The Leeuwin Current, which originates in the region, flows southward along the edge of the continental shelf and is primarily a surface flow (up to 150 m deep). It is strongest during winter (Woodside, 2002). Eddies formed by the Leeuwin Current transport nutrients and plankton communities offshore (Department of Environment, Water, Heritage and the Arts, 2008). 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). 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 North West Shelf Province (DSEWPaC, 2012a).

In addition to the synoptic-scale current dynamics, tidally driven currents are a significant component of water movement in the NWMR. 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 NWMR (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, 1983; Holloway and Nye, 1985). Internal waves of the NWMR 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 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 NWS exhibits a considerable range in tidal height, from microtidal ranges (less than 2 m) south-west of Barrow Island to macrotidal (more than 6 m) north of Broome (Brewer *et al*., 2007; Holloway, 1983). Storm surges and cyclonic events can also significantly raise sea levels above predicted tidal heights (Pearce *et al*., 2003).

The SWMR has complex oceanography, which is largely driven by the eastern boundary current: the Leeuwin Current. Warm nutrient-depleted water is transported along the shelf break and outer parts of the shelf by the Leeuwin Current, seasonally extending across the entire region during the winter months when it is the strongest (Ridgway and Condie, 2004). Particularly near the Houtman Abrolhos Islands, the Perth Canyon and Cape Naturaliste mesoscale eddies form from interactions with the equatorial-flowing Leeuwin Undercurrent and regional topography (Rennie *et al*., 2007). Two other current systems contribute to the marine region (Middleton and Cirano, 2002):

1. The Cape Current – a seasonal equatorial-flowing current, driven by southerly wind stress along the Western Australian shelf – upwells colder water onto the shelf in summer.
2. The Flinders Current – an upwelling favourable current – transports water from east to west along Australia’s southern shelves.

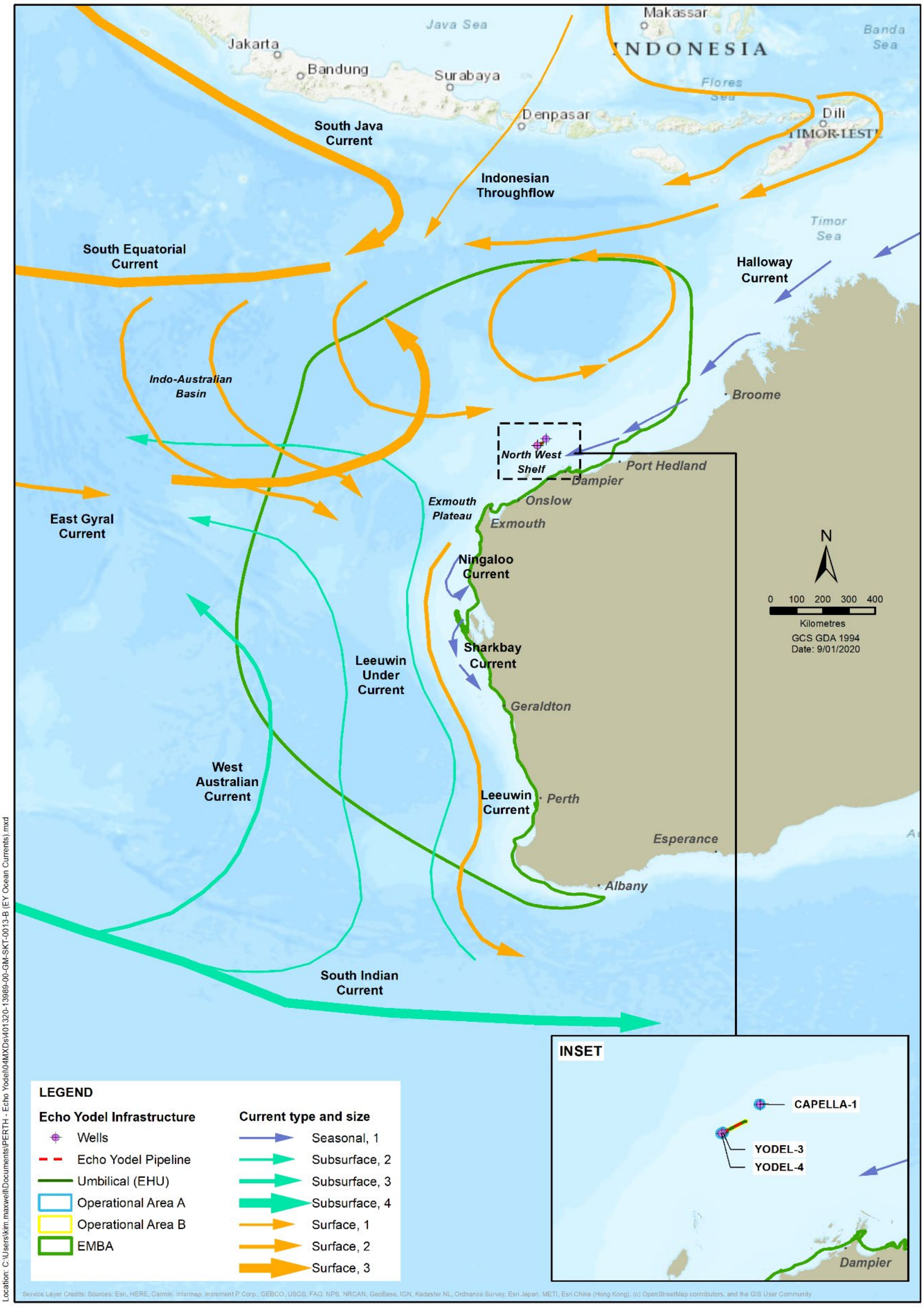

Figure 4-6: Large-scale ocean circulation of the North West Marine Region and South West Marine Region including the location of the Indonesian Throughflow and other currents of significance (Department of Environment, Water, Heritage and the Arts [DEWHA], 2008)

4.4.2.2 Wave Height

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).

4.4.3 Seawater Characteristics

4.4.3.1 Open Water

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. 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 in deeper waters (greater than 120 m water depth) are less variable, with temperatures averaging 22 to 24 °C year-round.

During summer, the water column is thermally stratified due to surface heating, with the thermocline occurring between 30 and 60 m water depth, indicating surface waters are well mixed within the Operational Areas (BMT Oceanica, 2015; James *et al*., 2004). Surface waters are also 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 (DSEWPaC, 2012; James *et al*., 2004).

Seawater temperature records around the Pluto platform (located about 46 km to the south-west of the Operational Areas) 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) (BMT Oceanica, 2015; Woodside Energy Limited, 2006).

Variation in surface salinity across the NWMR 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 (James *et al*., 2004; Pearce *et al*., 2003). 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 transport by oceanic swells and primary productivity (Pearce *et al*., 2003). Upwelling of nutrient-rich waters may increase phytoplankton productivity in the photic zone, which may increase local turbidity (Wilson *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 Operational Areas is expected to reflect the offshore oceanic conditions of the North West Shelf, which are described as low in nutrient levels and contamination (such as metals and hydrocarbons) (Wenziker *et al*., 2007). Furthermore, water quality sampling was conducted in the vicinity of the Operational Areas in 2010 (RPS, 2011). Salinity was about 35 PSU at the surface and remained consistent throughout the water column. Surface water temperature was about 24.5 °C and decreased marginally with depth to the base of the thermocline at about 55 m (RPS, 2011). Turbidity was found to be negligible throughout the water column, indicating pristine and generally very clear waters. Petroleum hydrocarbons (total petroleum hydrocarbons, polyaromatic hydrocarbon (PAH) and benzene, toluene, ethylbenzene and xylene) were not detected (RPS, 2011). Nutrient concentrations within the water column in the proximity of the Operational Areas (including total nitrogen, total phosphorous, ammonia and orthophosphates) were found to reflect typical ranges for tropical offshore, oceanic waters. Higher concentrations of nitrogen were recorded nearer to the seabed, possibly reflecting stratification and non-mixing of deeper waters with the upper surface layers (Condie and Dunn, 2006).

4.4.4 Bathymetry and Seabed Habitats

The Operational Areas are located in waters about 125 m to 136 m deep on the outer continental shelf, consisting of relatively flat and featureless seabed (**Figure 4-7**). Isobaths of the Echo Yodel field show the seabed sloping gently from 125 m in the south to 150 m in the northern parts.

Within the broader NWS region, the NWS Province encompasses more than 60% of the continental shelf in the NWMR (Baker *et al*., 2008). It gradually slopes from the coastline to the shelf break at the edge of the region and includes water depths of 0 m to 200 m. About half of the province is located in water depths of 50 m to 100 m (DEWHA, 2008). The NWS Province includes a number of seafloor features, including 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, 2008). Seabed characteristics identified in the Echo Yodel field during side-scan surveys in 1998 (Svitzer, 1998) include:

- predominant coverage of deep (more than 5 m), fine to silty carbonate sand with very small shell fragments
- shallow depressions or pockmarks
- fine to medium carbonate sands with outcrops and sub-crops of cemented carbonate sediments (calcilutite, calcarenite and calcirudite)
- sediment waves of about 1.5 m in height
- disturbed areas around wellheads
- relic anchor and trawl scars.

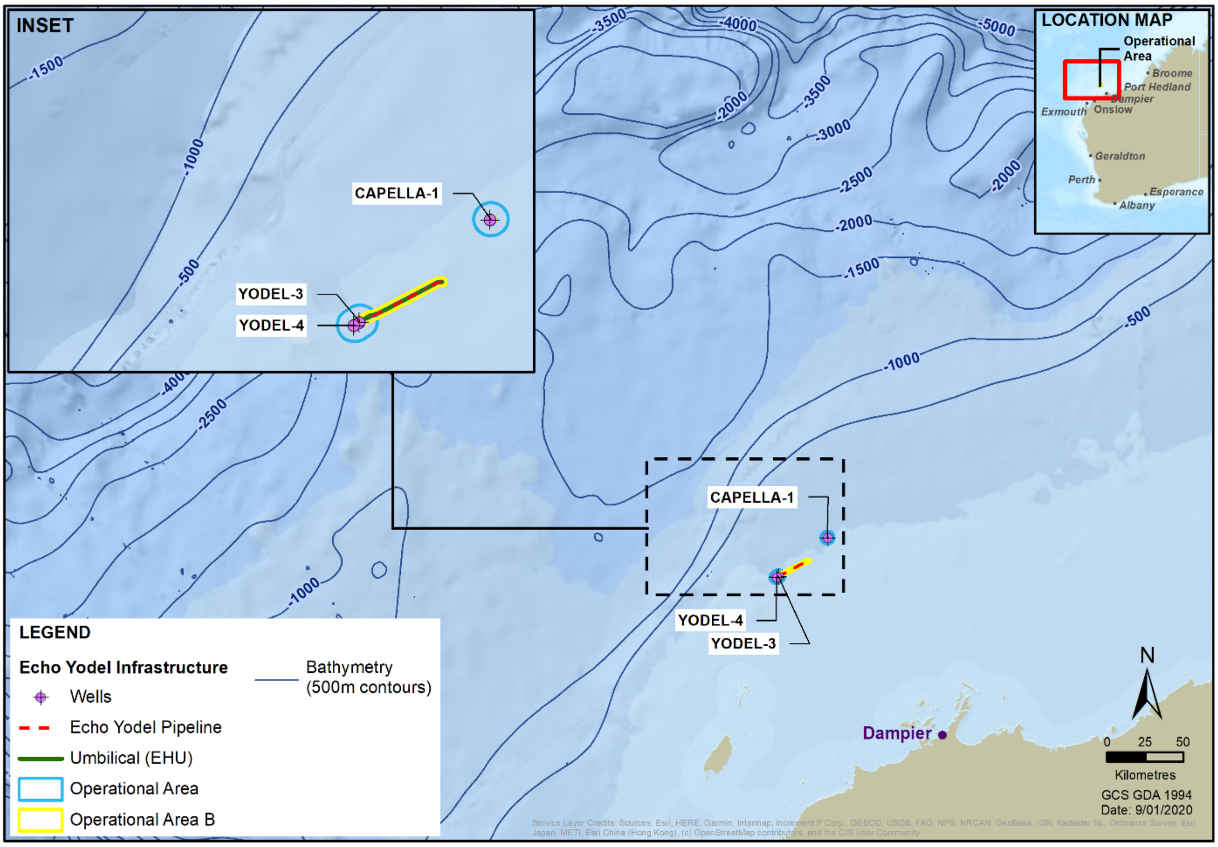

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Figure 4-7: Bathymetry of the Operational Areas

4.4.4.1 Marine Sediment

Sediments in the outer NWS are relatively homogenous and are typically dominated by sands and a small portion of gravel (Baker *et al*., 2008). Fine sediment size classes (e.g. muds) increase with proximity to the shoreline and the shelf break, but are less prominent in the intervening continental shelf (Baker *et al*., 2008). Carbonate sediments typically account for the bulk of sediment composition, with both biogenic and precipitated sediments present on the outer shelf (Dix *et al*., 2005). Beyond the shelf break within the NWMR (200 m depth contour), the proportion of fine sediments increases along the continental slope towards the abyssal plain (Baker *et al*., 2008).

Seabed sediment sampling programs performed in the vicinity of the Operational Areas (SKM, 2006; RPS, 2012a) confirmed sediments comprising coarse sands, silts, fine sands and some gravel. Sediment grain size in the north-east section (close to the GWA facility) is dominated by coarse sand (about 40%), silts (about 25%), fine sand (about 15%) and some gravel (about 12%); whereas sediment in the south-west of the survey area is predominantly fine sand (30%) and silt (25%), and some coarse sand (20%) (RPS, 2012a).

Hard substrates within the region more broadly can host more diverse benthic communities. Hard substrate may be associated with the Ancient Coastline at 125 m Depth Contour KEF. Nutrient levels (total nitrogen and total phosphorous) in the vicinity of the Operational Areas are typically low, and are consistent with other offshore locations within the area that are a considerable distance from typical nutrient sources such as estuaries (RPS, 2012a). Sediment quality in the NWS is generally high, with the exception of areas in proximity to ports (Department of Environment and Conservation [DEC], 2006), where elevated concentrations of metals and hydrocarbons may occur).

4.4.5 Air Quality

There is a lack of air quality data for the offshore NWMR and SWMR air sheds. Studies have been performed 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 performed offshore.

Due to the extent of the open ocean area and the activities that are currently performed, it is considered the ambient air quality across the Operational Areas and wider offshore NWMR and SWMR will be of high quality.

4.5 Biological Environment

4.5.1 Habitats

4.5.1.1 Critical Habitat and Threatened Ecological Communities – EPBC Listed

No marine Critical Habitats or Threatened Ecological Communities (TECs) as listed under the EPBC Act are known to occur within the Operational Areas and EMBA, as indicated by the EPBC Act Protected Matters Report extracted on 1 October 2019 (**Appendix C**).

4.5.1.2 Marine Primary Producers

Sea floor communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or zooxanthellate corals. Given the depth of water for the Operational Areas (between about 126 to 135 m), these benthic primary producer groups will not occur in the Operational Areas, but may occur within the EMBA in shallower waters (typically less than 30 m water depth) near offshore islands, reefs and sedimentary banks.

Coral Reef

Coral reef habitats have a high diversity of corals, associated fish and other species of both commercial and conservation importance. No coral reefs have been identified within the Operational Areas. Coral reef habitats within the EMBA include (approximate distance and direction from Operational Areas in brackets):

- Rankin Bank (12 km west)
- Glomar Shoal (78 km north-east)
- Dampier Archipelago (115 km south-east)
- Rowley Shoals (370 km north-east)
- Ningaloo Coast WHA (268 km south-west)
- Muiron Islands (249 km south-west)
- Barrow Island (103 km south)
- Montebello Islands (61 km south)
- Shark Bay WHA (581 km south-west)
- Houtman Abrolhos Islands (951 km south-west).

Hard corals in the region typically have a distinct spawning season, with most species spawning during autumn (March/April) (Rosser and Gilmour, 2008; Simpson *et al*., 1993).

Seagrass Beds/Macroalgae

Seagrass beds and benthic macroalgae reefs are a main food source for many marine species and also provide key habitats and nursery grounds (Heck Jr. *et al*., 2003; Wilson *et al*., 2010). In the northern half of WA, these habitats are restricted to sheltered and shallow waters due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones. No seagrass beds or macroalgae occur in the Operational Areas, as the seabed depth receives insufficient photosynthetically active radiation to support such communities. However, seagrass beds and macroalgae habitats are widespread in shallow waters in the region. The nearest such areas are the offshore islands of the Montebello/Barrow/Lowendal islands (61 to 95 km south) within the EMBA.

4.5.1.3 Lifecycle Stages 'Critical' Habitats

Spawning, Nursery, Resting and Feeding Areas

Critical habitats for species conservation include spawning, nursery, resting and feeding areas. These critical habitats will vary for each species. No critical habitat for protected species was identified as overlapping the Operational Areas or EMBA from the EPBC Protected Matters search reports (**Appendix C**); however, areas that may be considered habitat critical to the survival of a species (e.g. turtles, Australian Sea Lion) do overlap the EMBA as described in further detail below.

Migration Corridors

Many marine species, including cetaceans, whale sharks and migratory seabirds and shorebirds, migrate seasonally between feeding, breeding and nursery habitats using migration corridors. Any migration corridor for a protected species that passes through the Operational Areas or the EMBA, is outlined in **Section 4.5.2** within BIAs and the relevant species sub-sections.

4.5.1.4 Other Communities/Habitats

Plankton

Phytoplankton within the Operational Areas and EMBA is expected to reflect the conditions of the NWMR and SWMR. Primary productivity of the NWMR appears to be largely driven by offshore influences (as reported by 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 Areas and EMBA 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 and Gilmour, 2008; Simpson *et al*., 1993) and fish larvae abundance (Department of Conservation and Land Management [CALM], 2005) 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 whereas in the southern region of the EMBA, near Geographe Bay, recorded phytoplankton biomass in the surrounding waters has been found to peak during winter and is localised close to the coast. 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 (CALM, 2005) with periodic upwelling throughout the year.

4.5.1.4.1 Pelagic and Demersal Fish Populations

Fish species in the NWMR comprise small and large pelagic and 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.

4.5.1.4.2 Filter Feeders and Other Benthic Communities

Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2008). Filter feeders generally live in areas that have strong currents and hard substratum. They are closely associated with substrate type, with areas of hard substrate typically supporting more diverse epibenthic communities (Heyward *et al*., 2001a). Conversely, higher diversity infauna are mainly associated with soft unconsolidated sediment and infauna communities are considered widespread and well represented along the continental shelf and upper slopes of the NWMR (Brewer *et al*., 2007; Rainer, 1991; SKM, 2006; Woodside Energy Limited, 2006).

A number of targeted surveys investigating epibenthos and infauna within offshore NWS Province shelf and slope environments have been performed by Woodside. Woodside has collected survey data from numerous sampling locations within and surrounding the Operational Areas using ROV/video investigations of benthic habitats and infauna and epifauna sampling using sediment grabs and epibenthic sled (SKM, 2006; Ocean Affinity, 2018). Elsewhere on the North West Shelf Province, surveys have included grab samples of seabed sediments from around North Rankin Complex, Goodwyn A, Angel facilities and their export pipeline routes (SKM, 2006), as well as additional sampling throughout the broader region (SKM, 2007).

The Operational Areas are unlikely to contain suitable habitat for significant filter feeder communities as they comprise mostly homogeneous soft sediments with little or no hard substrate. However, various benthic communities have become established on the Echo Yodel subsea infrastructure, as documented through ROV surveys (**Figure 4-8**). The hard surface of subsea infrastructure provides substrate for deepwater marine invertebrate species to settle, attach and grow on. Analysis of 1318 ROV transects sampled from the Echo Yodel pipeline in 2013 observed complex deepwater epibenthic habitat forming filter-feeders including deepwater corals, crinoids (featherstars), Gorgonocephalidae (basket stars), hydroids, true anemones and sponges (McLean *et al*., 2017). Historically high trawling effort is thought to have extensively removed and modified complex epibenthic habitats in the region. These habitats were considered to be important to commercially target species. The modification or loss of these habitats is thought to have negatively impacted the valuable commercial fisheries in the region. However, McLean *et al*. (2017) demonstrates that modern pipeline structures such as the Echo Yodel pipeline can offer a significant epibenthic habitat and refuge for fish, potentially comparable to the historical habitats lost to trawling.

Bond and Taylor (2019) continued and added to the work completed by McLean *et al*. (2017) who investigated changes in the fish community and habitat on the Echo Yodel pipeline from 2007, 2008 and 2013 using ROV surveys. Changes in habitat coverage on the pipeline continue to show trends described by McLean *et al*. (2017). Additional to increases in sand/rubble/cobble and reduction in the overall area of bare pipe, true anemones continued to reduce in cover while crinoids and gorgonocephalids increased in cover. True anemones found on the pipeline in 2008 are no longer present and those recorded in the 2018 are of a different species.

Filter feeders at Rankin Bank and Glomar Shoal make up minor components of the benthic communities, about 3 % and 4 % of the benthic cover respectively (AIMS, 2014b). Sponges are among the most abundant filter feeders at both locations, and soft corals are more diverse at Glomar Shoal (AIMS, 2014). Benthic communities at these locations are similar to those recorded at other shoals in the NWS region (AIMS, 2014) and other regions of the NWMR (Heyward *et al*., 2011).

Within the EMBA, the NWMR has been identified as a sponge diversity hotspot, with a variety of areas of potentially high and unique sponge biodiversity, particularly in the Commonwealth waters of Ningaloo Marine Park (CALM, 2005; Rees *et al*., 2004).

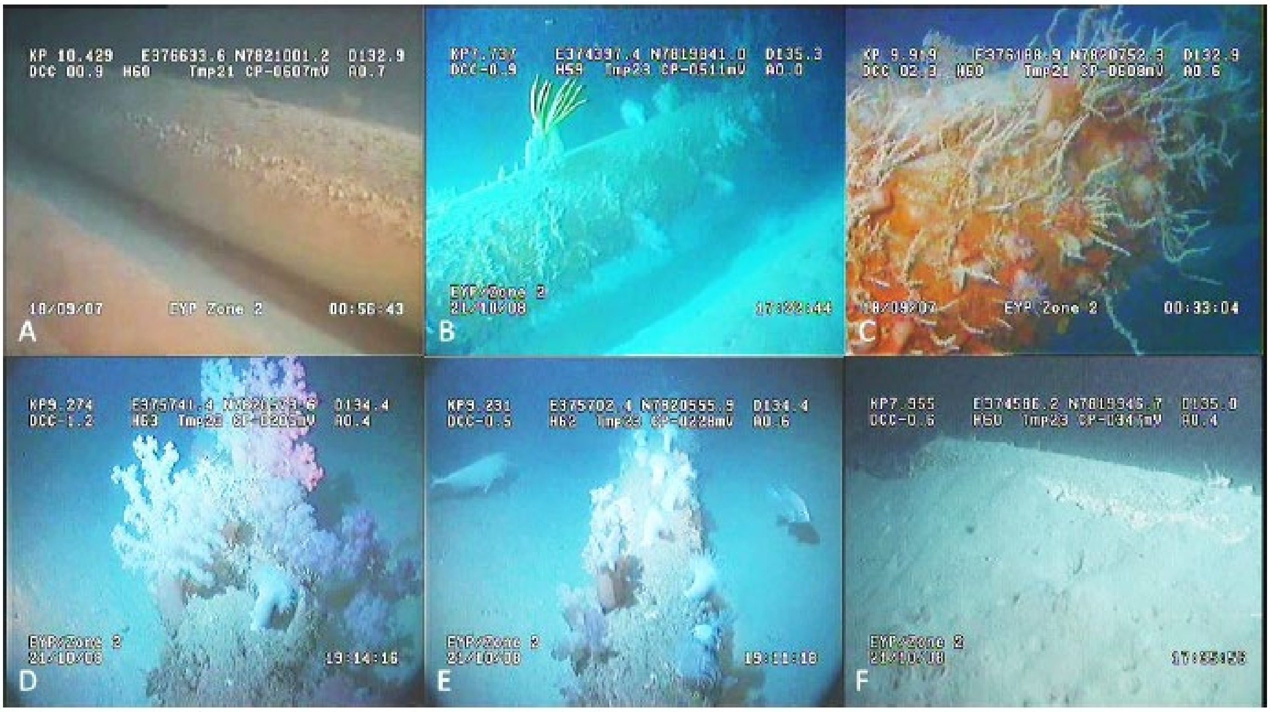

Figure 4-8: Habitats documented along the Echo Yodel Pipeline through ROV surveys

4.5.1.4.3 Artificially Created Habitats

There is an increasing body of scientific literature overseas and in Australia looking at the ecosystem value of oil and gas subsea infrastructure. This knowledge is required and used to understand impacts and benefits of the offshore industry on the marine environment and inform decommissioning decisions. In Australia these have largely focused on the North West Shelf, where the Echo Yodel subsea infrastructure is located (McLean *et al*., 2017, 2018; Bond *et al*., 2017, 2018a, b; Bond and Taylor, 2019). These studies are summarised below:

- Bond and Taylor (2019) continued and added to the work completed by McLean *et al*. (2017) who investigated changes in the fish community and habitat on the Echo Yodel pipeline from 2007, 2008 and 2013 using ROV surveys. They looked at pipeline changes over time and differences between the pipeline and umbilical. Their conclusions include:
  - A total of 1069 fish comprised of 18 known species were recorded during this study. The five most abundant and ubiquitous fish on the pipeline included pearl perch (*G. buergeri*), saddletail snapper (*L. malabaricus*), five-lined snapper (*L. quinquelineatus*), mangrove jack (*L. argentimaculatus*) and Moses' snapper (*L. russellii*). Four of these species were also the most abundant and ubiquitous on the umbilical, with mangrove jack being replaced by Australian striped velvetchin (*H. dampieriensis)*.
  - The 2018 survey recorded the highest percentage of sand/rubble/cobble and lowest percentage of bare pipe, indicating the pipeline has more sand covering its top 50%. These results suggest more pipeline is becoming buried but large spans are still being maintained. These results and information provided by McLean *et al*. (2017) and Bond *et al*. (2018a) suggest abundance of key species such as pearl perch (*G. buergeri*), five-lined snapper (*L. quinquelineatus*) and Moses' snapper (*L. russellii*) will continue to reduce if burial of the pipeline continues.
  - Decreases in total abundance and species richness of fish has occurred since 2008. The latest 2018 survey recorded the lowest abundance and species richness among all years. However, without simultaneous surveys in adjacent natural habitats, it is not possible to determine if these observed changes are isolated to the pipeline or they represent a much larger change in fish assemblage across a region. With this in mind, changes in total abundance and species richness of fish may be due to several reasons including a change in habitat, pipeline burial and thus a reduction in available habitat and spans, commercial fishing events, or a change in survey method. It is also understood that the area was substantially fished before the survey occurred, although this point does not form the conclusions of the study. Woodside understands this could be another contributing factor to the lower abundance recorded during this survey.
  - Free-spanning and 'pockmarks' have been recorded on the pipeline previously and identified by McLean *et al*. (2017) and Bond *et al*. (2018a) to be an important variable in predicting species richness and abundance of a variety of species.
  - The pipeline has more fish and species relative to the umbilical, most likely due to the physical characteristics of each: the umbilical has a smaller diameter and is heavier, contributing to it burying more easily. This burial has resulted in less spanning and marine growth, both important determinants in the abundance and diversity of fish, however despite these differences, the umbilical is still providing ecologically important habitat. Furthermore, the community of fish and marine growth on the pipeline and umbilical continues to evolve. As the pipeline continues to bury, spans decrease in size and the amount of hard structure that marine growth has to grow on is reduced. In turn, fish associated with these spans and marine growth decline in abundance. It is unknown how continued burial will impact marine growth on the pipeline. Tall species of invertebrates may persist once the pipeline is completely covered, or some may secede and migrate to soft sediments nearby. Others will be smothered. In any case, it is important to note that the pipeline and umbilical will not be complete, and burial of the umbilical is not expected to be completed for another 20 to 60 years, nor is the pipeline expected to be up to 85% buried for another 125 years;

therefore, the pipeline and umbilical are expected to continue to provide habitat in the short to medium term, and beyond.

- Species richness was, on average, 25% higher on the Echo Yodel pipeline than off, while relative abundance of fish was nearly double on the pipeline than in adjacent natural habitats. The pipeline was characterised by large, commercially important species known to associate with complex epibenthic habitat and, as such, possessed a biomass of commercial fish 7.5 times higher and catch value 8.6 times higher than in adjacent natural habitats (Bond *et al*., 2018a).
- A study of the Griffin pipeline, which runs from shallow depths near Onslow offshore to depths of 140 m (i.e. very similar water depths to Echo Yodel subsea infrastructure), showed that, in depths beyond 80 m, the predominant habitat off-pipeline was sand and differences between fish assemblages on and off-pipeline were pronounced. The pipeline was characterised by higher biomass and abundances of larger-bodied, commercially important species, such as goldband snapper (*Pristipomoides multidens),* saddletail snapper (*Lutjanus malabaricus)* and Moses' snapper (*Lutjanus russellii)* among others, and possessed a catch value two to three times higher than that of fish observed off-pipeline. Adjacent natural seabed habitats possessed higher abundances of yellowtail scad (*Atule mate)*, threadfin bream (*Nemipterus* spp.) and crescent grunter (*Terapon jarbua)*, species of no or low commercial value (Bond *et al*., 2018b).
- McLean *et al*. (2017) assessed the fish diversity and abundance along two pipelines in the north-west of Australia, one of which was the Echo Yodel pipeline. A total of 5962 individual fish from 92 species and 42 families were observed in ROV footage taken during routine inspection and maintenance activities along the two pipelines. The findings included the presence of larval fish, juveniles, sub-adults and adults, which indicates the populations around the pipelines may be increasing. It was also found that both pipelines, including the Echo Yodel pipeline, provided habitat that supported a high abundance of commercially important fish including snappers (*Lutjanidae)* and groupers (*Epinephelidae)*.
- McLean *et al*. (2018) assessed the fish assemblages and habitats formed by colonising invertebrates on 25 oil and gas wellheads and associated infrastructure in depths of 78 to 825 m on the north west shelf of WA. This study included the Echo Yodel X-mas trees/wellheads. Commercially important snapper (*lutjanid)* and grouper (*epinephelid)* species were common and most abundant on well infrastructure to depths of 135 m, but were absent in depths more than 350 m. An as yet unidentified species of roughy, recorded as *Gephyroberyx* sp., was the most common fish species observed on well infrastructure in depths more than 350 m. Two speckled swellsharks (*Cephaloscyllium speccum*), believed to be endemic to north-west Australia, were observed for the first time in-situ. Numerous fish species were observed at depths beyond their known limits and two IUCN vulnerable species were recorded: the grey nurse shark (*Carcharias taurus*; 135 m depth) and the round ribbon tail ray (*Taeniura meyeni*; 78 m depth). Fish assemblages and colonising invertebrate habitats present on wellheads and associated infrastructure were strongly influenced by depth, age and height of the structures. Older, taller wellheads in depths less than 135 m, such as the Yodel/Capella wells, possessed greater abundances of groupers, snappers, site-attached reef species and transient pelagic fish species. Beyond 350 m depth, the number of species and total fish abundance declined markedly, as did the per cent cover of ascidians, black/octocorals, sponges and gorgonocephalidae (basket stars) observed growing on the infrastructure. Deeper structures were characterised by an abundance of *Gephyroberyx* sp. and, while these structures had less colonising invertebrate coverage in general, crinoids (490 to 550 m) and crustacea (barnacles; 350 to 395 m) were dominant at these depths.

In conclusion, the Echo Yodel subsea infrastructure has been found to create habitat for a number of species, including commercially valuable species that are in low abundance across the region. Although species abundance is declining as the infrastructure self-buries, burying is not expected to be completed for another 125 years. Therefore, there is still a substantial period of time where the environment will benefit from the artificially created habitat that has been formed by the Echo Yodel subsea infrastructure.

4.5.2 Protected Species

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

A total of 34 EPBC Act listed species considered to be MNES were identified as potentially occurring within the Operational Areas (**Appendix C**). Of those listed, 18 are considered threatened marine species (MNES) and 31 migratory species under the EPBC Act.

A total of 112 EPBC Act listed marine species were identified as potentially occurring within the EMBA (**Appendix C**). Of those listed, 54 species within the EMBA are considered threatened marine species (MNES) and 95 migratory species under the EPBC Act.

Two conservation-dependent species have also been identified with a potential to occur within the Operational Areas and EMBA.

Table 4-2: Threatened and migratory marine species under the EPBC Act potentially occurring with the Operational Areas or within the EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	*EMBA*
Mammals					
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	✓	✓
Balaenoptera musculus intermedia	Blue Whale	Endangered	Migratory	✓	✓
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	✓	✓
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	✓	✓
Balaenoptera edeni	Bryde’s Whale	N/A	Migratory	✓	✓
Physeter macrocephalus	Sperm Whale	N/A	Migratory	✓	✓
Orcinus orca	Killer Whale, Orca	N/A	Migratory	✓	✓
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	N/A	Migratory	✓	✓
Eubalaena australis	Southern Right Whale	Endangered	Migratory	X	✓
Neophoca cinereal	Australian Sea-lion	Vulnerable	N/A	X	✓
Balaenoptera bonaerensis	Antarctic Minke Whale, Dark-shoulder Minke Whale	N/A	Migratory	X	✓
Caperea marginate	Pygmy Right Whale	N/A	Migratory	X	✓
Lagenorhynchus obscurus	Dusky Dolphin	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, Leathery Turtle, Luth	Endangered	Migratory	✓	✓
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	Migratory	✓	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	*EMBA*
Natator depressus	Flatback Turtle	Vulnerable	Migratory	✓	✓
Lepidochelys olivacea	Olive Ridley Turtle	Endangered	Migratory	X	✓
Aipysurus apraefrontalis	Short-nosed Seasnake	Critically endangered	N/A	X	✓
Fish					
Carcharodon carcharias	White Shark, Great White Shark	Vulnerable	Migratory	✓	✓
Isurus oxyrinchus	Shortfin Mako, Mako Shark	N/A	Migratory	✓	✓
Isurus paucus	Longfin Mako	N/A	Migratory	✓	✓
Rhincodon typus	Whale Shark	Vulnerable	Migratory	✓	✓
Carcharias taurus	Grey Nurse Shark (west coast population)	Vulnerable	N/A	✓	✓
Manta birostris (recently revised taxonomy Mobula birostris (White et al., 2017))	Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray	N/A	Migratory	✓	✓
Manta alfredi (recently revised taxonomy Mobula alfredi (White et al., 2017))	Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray	N/A	Migratory	✓	✓
Anoxypristis cuspidata	Narrow Sawfish, Knifetooth Sawfish	N/A	Migratory	✓	✓
Pristis zijsron	Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Migratory	✓	✓
Sphyrna lewini	Scalloped Hammerhead	Conservation Dependent	N/A	✓	✓
Thunnus maccoyii	Southern Bluefin Tuna	Conservation Dependent	N/A	✓	✓
Pristis clavata	Dwarf Sawfish, Queensland Sawfish	Vulnerable	Migratory	X	✓
Pristis pristis	Freshwater Sawfish	Vulnerable	Migratory	X	✓
Lamna nasus	Porbeagle, Mackerel Shark	N/A	Migratory	X	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	EMBA
Avifauna					
Calidris canutus	Red Knot, Knot	Endangered	Migratory	✓	✓
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically endangered	Migratory	✓	✓
Actitis hypoleucos	Common Sandpiper	N/A	Migratory	✓	✓
Anous stolidus	Common Noddy	N/A	Migratory	✓	✓
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory	✓	✓
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory	✓	✓
Fregata ariel	Lesser Frigatebird, Least Frigatebird	N/A	Migratory	✓	✓
Calonectris leucomelas	Streaked Shearwater	N/A	Migratory	✓	✓
Sternula nereis	Australian Fairy Tern	Vulnerable	Migratory	✓	✓
Fregata minor	Great Frigatebird, Greater Frigatebird	N/A	Migratory	✓	✓
Calidris tenuirostris	Great Knot	Critically endangered	Migratory	X	✓
Calidris ferruginea	Curlew Sandpiper	Critically endangered	Migratory	X	✓
Macronectes giganteus	Southern Giant-Petrel, Southern Giant Petrel	Endangered	Migratory	X	✓
Anous tenuirostris melanops	Australian Lesser Noddy	Vulnerable	N/A	X	✓
Pachyptila turtur subantarctica	Fairy Prion (southern)	Vulnerable	N/A	X	✓
Botaurus poiciloptilus	Australasian Bittern	Endangered	N/A	X	✓
Pandion haliaetus	Osprey	N/A	Migratory	X	✓
Charadrius leschenaultia	Greater Sand Plover	Vulnerable	Migratory	X	✓
Charadrius mongolus	Lesser Sand Plover	Endangered	Migratory	X	✓
Diomedea amsterdamensis	Amsterdam Albatross	Endangered	Migratory	X	✓
Diomedea antipodensis	Antipodean Albatross	Vulnerable	Migratory	X	✓
Diomedea dabbenena	Tristan Albatross	Endangered	Migratory	X	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	*EMBA*
Diomedea epomophora	Southern Royal Albatross	Vulnerable	Migratory	X	✓
Diomedea exulans	Wandering Albatross	Vulnerable	Migratory	X	✓
Diomedea sanfordi	Northern Royal Albatross	Endangered	Migratory	X	✓
Limosa lapponica bauera	Bar-tailed Godwit	Vulnerable	Migratory	X	✓
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	Critically endangered	Migratory	X	✓
Macronectes halli	Northern Giant Petrel	Vulnerable	Migratory	X	✓
Halobaena caerulea	Blue Petrel	Vulnerable	N/A	X	✓
Malurus leucopterus edouardi	White-winged Fairy-wren (Barrow Island)	Vulnerable	N/A	X	✓
Malurus leucopterus leucopterus	White-winged Fairy-wren (Dirk Hartog Island)	Vulnerable	N/A	X	✓
Papasula abbotti	Abbott's Booby	Critically endangered	N/A	X	✓
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	N/A	X	✓
Rostratula australis	Australian Painted Snipe	Endangered	N/A	X	✓
Thalassarche carteri	Indian Yellow-nosed Albatross	Vulnerable	Migratory	X	✓
Phoebetria fusca	Sooty Albatross	Vulnerable	Migratory	X	✓
Thalassarche cauta cauta	Shy Albatross	Vulnerable	N/A	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	✓
Apus pacificus	Fork-tailed Swift	N/A	Migratory	X	✓
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory	X	✓
Ardenna grisea	Sooty Shearwater	N/A	Migratory	X	✓
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory	X	✓
Hydroprogne caspia	Caspian Tern	N/A	Migratory	X	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	*EMBA*
Onychoprion anaethetus	Bridled Tern	N/A	Migratory	X	✓
Phaethon lepturus	White-tailed Tropicbird	N/A	Migratory	X	✓
Phaethon rubricauda	Red-tailed Tropicbird	N/A	Migratory	X	✓
Sterna dougallii	Roseate Tern	N/A	Migratory	X	✓
Sternula albifrons	Little Tern	N/A	Migratory	X	✓
Sula dactylatra	Masked Booby	N/A	Migratory	X	✓
Sula leucogaster	Brown Booby	N/A	Migratory	X	✓
Thalassarche cauta	Tasmanian Shy Albatross	N/A	Migratory	X	✓
Arenaria interpres	Ruddy Turnstone	N/A	Migratory	X	✓
Calidris alba	Sanderling	N/A	Migratory	X	✓
Calidris ruficollis	Red-necked Stint	N/A	Migratory	X	✓
Charadrius bicinctus	Double-banded Plover	N/A	Migratory	X	✓
Charadrius veredus	Oriental Plover	N/A	Migratory	X	✓
Gallinago megala	Swinhoe’s Snipe	N/A	Migratory	X	✓
Gallinago stenura	Pin-tailed Snipe	N/A	Migratory	X	✓
Glareola maldivarum	Oriental Pratincole	N/A	Migratory	X	✓
Limicola falcinellus	Broad-billed Sandpiper	N/A	Migratory	X	✓
Limosa limosa	Black-tailed Godwit	N/A	Migratory	X	✓
Numenius minutus	Little Curlew, Little Whimbrel	N/A	Migratory	X	✓
Numenius phaeopus	Whimbrel	N/A	Migratory	X	✓
Phalaropus lobatus	Red-necked Phalarope	N/A	Migratory	X	✓
Pluvialis fulva	Pacific Golden Plover	N/A	Migratory	X	✓
Pluvialis squatarola	Grey Plover	N/A	Migratory	X	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Areas/EMBA	
				Operational Areas	***EMBA***
Thalasseus bergii	Crested Tern	N/A	Migratory	X	✓
Tringa brevipes	Grey-tailed Tattler	N/A	Migratory	X	✓
Tringa glareola	Wood Sandpiper	N/A	Migratory	X	✓
Tringa nebularia	Common Greenshank	N/A	Migratory	X	✓
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	N/A	Migratory	X	✓
Tringa totanus	Common Redshank	N/A	Migratory	X	✓
Xenus cinereus	Terek Sandpiper	N/A	Migratory	X	✓

A full list of species identified from the Protected Matters Search is provided in the EPBC Act Protected Matters Search Report (**Appendix C**).

4.5.2.1 Listed Threatened Species Recovery Plans and Conservation Advice

The requirements of the species recovery plans and conservation advice will be considered to identify any requirements that may be applicable 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 4-3 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 Areas and EMBA, and summarises the key threats to those species, as described in relevant recovery plans and conservation advices.

Table 4-3: Conservation advice for EPBC Act listed species considered during environmental risk assessment and their relevance to the Operational Areas and EMBA

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions/advice	Relevant EP section
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.	**7.6.5**
Marine Mammals				
Sei whale	Conservation advice *Balaenoptera borealis* (sei whale) (Threatened Species Scientific Committee, 2015a)	Noise interference	Assess and manage acoustic disturbance.	**7.7.2**
		Vessel disturbance	Assess and manage physical disturbance and decommissioning activities.	**7.6.2**
Blue whale	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015-2025 (Commonwealth of Australia, 2015a)	Noise interference	Assessing the effect of anthropogenic noise on blue whale behaviour Anthropogenic noise in BIAs should be managed such that any blue whale continues to utilise the area without injury, and is not displaced from a foraging area.	**7.7.2**
		Vessel disturbance	Ensure the risk of vessel strikes on blue whales is considered when assessment actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	**7.6.2**
Fin whale	Approved conservation advice for *Balaenoptera physalus* (fin whale) (Threatened Species Scientific Committee, 2015b)	Noise interference	Assess and address anthropogenic noise.	**7.7.2**
		Vessel disturbance	Minimise vessel collisions.	**7.6.2**
Humpback whale	Approved conservation advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee, 2015c)	Noise interference	Assess and address anthropogenic noise.	**7.7.2**
		Vessel disturbance	Minimise vessel collisions.	**7.6.2**
		Noise interference	Assess and address anthropogenic noise.	**7.7.2**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions/advice	Relevant EP section
Southern right whale and pygmy 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)	Vessel disturbance	Address vessel collisions.	**7.6.2**
Reptiles				
All marine turtle species (loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle, flatback turtle)	Recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017)	Marine debris	Reduce the impacts from marine debris.	**7.6.5**
		Chemical discharge	Minimise chemical discharge.	**7.6.4, 7.6.5, 7.6.6**
		Light pollution	Minimise light pollution.	**7.6.8**
		Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat.	**7.6.2**
		Noise interference	No explicit relevant management actions; vessel strikes identified as a threat.	**7.7.2**
Leatherback turtle	Approved conservation advice on *Dermochelys coriacea* (Threatened Species Scientific Committee, 2008a)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat.	**7.6.2**
Short-nosed seasnake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (DSEWPaC, 2011)	Habitat degradation/modification	None applicable.	N/A
Sharks and Rays				
Grey nurse shark (west coast population)	Recovery plan for the grey nurse shark (*Carcharias taurus*) (Department of the Environment, 2014)	No additional threats identified (ex. Marine debris)	None applicable.	N/A
White shark, great white shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013)	No additional threats identified (ex. Marine debris)	None applicable.	N/A
All sawfish (green sawfish, dwarf sawfish)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia [CoA], 2015b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat.	**7.6.2**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions/advice	Relevant EP section
Green sawfish, Dindagubba, narrow snout sawfish	Approved conservation advice for green sawfish (Threatened Species Scientific Committee, 2008b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat.	**7.6.2**
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (DEWHA, 2009a)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat.	**7.6.2**
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	Approved conservation advice for *Pristis pristis* (largetooth sawfish) (DoE, 2014)	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	**7.6.2**
		Marine debris	Partner with marine debris organisations to support initiatives that reduce marine debris likely to impact on largetooth sawfish.	**7.6.5**
Whale shark	Approved Conservation Advice for *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.	**7.7.8**
		Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat.	**7.6.2**
Seabirds				
Migratory shorebird species (red knot, bar-tailed godwit, pectoral sandpiper, oriental plover, oriental pratincole, osprey, common greenshank)	Wildlife conservation plan for migratory shorebirds (CoA, 2015c)	Habitat degradation/ modification	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes.	**7.6.2, 7.6.8**
Red knot, knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (Threatened Species Scientific Committee, 2016)	Habitat degradation/ modification	No explicit relevant management actions; oil pollution identified as a threat.	**7.6.2, 7.6.8**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions/advice	Relevant EP section
Eastern curlew, far eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (Threatened Species Scientific Committee, 2015e)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil pollution identified as a threat.	**7.6.2, 7.6.8**
Southern giant-petrel, Amsterdam Albatross, wandering albatross, northern giant petrel, Indian yellow-nosed albatross, Tasmanian shy albatross, white-capped albatross, Campbell albatross, black-browed albatross	National recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2011)	No additional threats identified (ex. marine debris)	No explicit relevant management actions; pollution identified as a threat.	**N/A**
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee, 2015f)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil pollution identified as a threat.	**7.6.2, 7.6.8, 7.7.2 to 7.7.5**
Soft-plumaged petrel	Conservation advice *Pterodroma mollis* soft-plumage petrel (Threatened Species Scientific Committee, 2015g)	Habitat degradation and modifications	No explicit relevant management actions.	**7.6.2**
Australian lesser noddy	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015h)	Habitat degradation and modifications	No explicit relevant management actions.	**7.6.2**
Australian fairy tern	Conservation advice for *Sterna nereis 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.	**7.6.2, 7.6.8, 7.7.2 to 7.7.5**
Common sandpiper, red knot, pectoral sandpiper, sharp-tailed sandpiper, bar-tailed godwit, oriental pratincole, oriental plover, common greenshank	Wildlife conservation plan for migratory shorebirds (CoA, 2015b)	Habitat degradation/ modification (oil pollution)	No explicit relevant management actions; oil spills recognised as a threat.	**7.6.2, 7.6.8, 7.7.2 to 7.7.5**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant conservation actions/advice	Relevant EP section
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.	**7.6.2, 7.6.8, 7.7.2 to 7.7.5**
White-winged fairy-wren (Barrow Island)	Approved conservation advice for *Malurus leucopterus* edouardi (White-winged Fairy-wren (Barrow Island)) (DEWHA, 2008c)	No additional threats identified	No explicit relevant management actions.	**N/A**
White-winged fairy-wren (Dirk Hartog Island)	Advice for Malurus *leucopterus leucopterus* (White-winged Fairy-wren (Barrow Island)) (DEWHA, 2008d)	No additional threats identified	No explicit relevant management actions.	**N/A**
Abbott's booby	Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee, 2015i)	Habitat degradation/ modification	No explicit relevant management actions.	**7.6.2**

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 identified 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 (CoA, 2017). The Operational Areas do not overlap with any habitat critical to the survival of a species; however, habitat critical to the survival of green, loggerhead, hawksbill and flatback turtles (i.e. nesting and internesting buffer) and habitat critical to the survival of Australian sea lions (breeding areas) do overlap the EMBA (as described in **Table 4-4**).

Table 4-4: Nesting and internesting areas identified as habitat critical to the survival of marine turtles for each stock that overlaps the EMBA

Species	Habitat Critical to the Survival of the Species	Distance from Operational Area
Green turtle	Barrow Island	About 90 km
	Montebello Islands (all with sandy beaches)	About 50 km
	Serrurier Island	About 220 km
	Thevenard Island	About 180 km
	Northwest Cape	About 260 km
	Ningaloo Coast	About 360 km
Loggerhead turtle	Dirk Hartog Island	About 700 km
	Muiron Islands	About 230 km
	Gnarraloo Bay	About 480 km
	Ningaloo Coast	About 360 km
Flatback turtle	Montebello Islands (all with sandy beaches)	About 15 km
	Barrow Island	About 50 km
	Coastal islands from Cape Preston to Locker Island	About 440 km
Hawksbill turtle	Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)	About 50 km
	Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island)	About 80 km
Australian sea lion	Abrolhos Islands, Easter Group (Serventy, Suomi, Alexander and Gilbert Island)	About 980 km
	Beagle Island	More than 1000 km
	North Fisherman Island	More than 1000 km
	Buller Island	More than 1000 km

4.5.2.3 Biologically Important Areas

A review of the DoAWE National Conservation Values Atlas identified that the following BIAs overlap spatially with the Operational Areas:

- whale shark foraging northward from Ningaloo Marine Park along the 200-metre isobath (July to November)
- flatback turtle internesting area during the breeding season (November to March)

- wedge-tailed shearwater breeding area (foraging buffer) during its breeding season (August to April).

BIAs not within the Operational Areas but within the EMBA are listed in **Table 4-5**. In some instances, the BIAs are also identified as 'habitat critical to the survival of a species' which are detailed in **Table 4-4**.

Table 4-5: BIAs beyond the Operational Areas but within the EMBA

Species	BIA type	Approximate distance from Operational Areas (km)
Mammals		
Humpback whale	Migration (North and South)	26
Australian sea lion	Foraging (male) (Houtman Abrolhos Islands)	970
	Foraging (male and female) (mid-west coast)	More than 1000
Blue whale	Foraging (on migration) (outer continental shelf from Cape Naturaliste to south of Jurien Bay)	More than 1000
Pygmy blue whale	Migration (North and South)	Overlaps
	Known foraging area	958
	Possible foraging (Ningaloo)	305
	Foraging area (annual high use area)	More than 1000
Dugong	Foraging (high density seagrass beds), breeding, nursing, calving (Exmouth and Ningaloo Reef)	251
Southern right whale	Seasonal calving habitat, calving buffer (West coat of WA)	More than 1000
Sperm whale	Foraging (abundant food source) (western end of Perth canyon and Albany Canyons)	More than 1000
Reptiles		
Flatback turtle	Nesting (Montebello Islands)	64
	Internesting buffer (Montebello Islands)	Overlaps
	Foraging (Montebello Islands)	64
	Mating (Montebello Islands)	64
Green turtle	Internesting buffer (Montebello Islands)	60
	Nesting (Montebello Islands)	60
	Foraging (Montebello Islands)	60
	Migration corridor (Dampier Archipelago)	119
	Mating (Montebello Islands)	60
	Foraging (string of islands between Cape Preston and Onslow)	119
Hawksbill turtle	Internesting buffer (Montebello Islands)	44
	Nesting (Montebello Islands)	64
	Foraging (Montebello Islands)	64
	Mating (Montebello Islands)	64
	Migration corridor (Dampier Archipelago)	118

Species	BIA type	Approximate distance from Operational Areas (km)
Loggerhead turtle	Internesting buffer (Montebello Islands)	53
	Nesting (Rosemary Island)	117
Shark, Fish and Rays		
Whale shark	Foraging	Overlaps
	Foraging (high density prey) (Ningaloo Marine Park and adjacent Commonwealth waters)	294
Great white shark	Foraging (Houtman Abrolhos Islands)	981
Oceanic Seabirds and/or Migratory Shorebirds		
Australian lesser noddy	Foraging (provisioning young) (Houtman Abrolhos Islands)	977
Bridled tern	Foraging (in high numbers) (west coast of WA)	745
Brown booby	Breeding (Ashmore Reef)	283
Caspian tern	Foraging (provisioning young) (Houtman Abrolhos Islands)	900
Common noddy	Foraging (provisioning young) (Houtman Abrolhos Islands)	957
Fairy tern	Breeding (Montebello Islands)	60
	Foraging (in high numbers) (Houtman Abrolhos Islands)	946
Flesh-footed shearwater	Aggregation (Cape Naturaliste to Eyre)	More than 1000
Great-winged petrel (macroptera race)	Foraging (provisioning young)	More than 1000
Indian yellow-nosed albatross	Foraging (in high numbers)	More than 1000
Lesser crested tern	Breeding (Montebello Islands)	65
Lesser frigatebird	Breeding (Kimberley and Pilbara coast)	224
Little penguin	Foraging (provisioning young) (Perth to Bunbury)	More than 1000
Little shearwater	Foraging (in high numbers) (Kalbarri to Eucla)	860
Little tern	Resting (Kimberley, Pilbara and Gascoyne coast)	367
Pacific gull	Foraging (in high numbers) (west coast)	899
	Foraging (provisioning young) (Houtman Abrolhos Islands)	968
Roseate tern	Breeding (Montebello Islands)	60
	Foraging (provisioning young) (Houtman Abrolhos Islands)	946
Soft-plumaged petrel	Foraging (in high numbers)	More than 1000
Sooty tern	Foraging (Abrolhos Islands)	771
Wedge-tailed shearwater	Foraging (in high numbers)	745
	Breeding (foraging buffer)	Overlaps
White-faced storm petrel	Foraging (in high numbers) (Houtman Abrolhos Islands)	872
White-tailed tropicbird	Breeding (Argo-Rowley Terrace)	271

4.5.2.4 Seasonal Sensitivities of Protected Species

Periods of the year coinciding with key environmental sensitivities for the Operational Areas and the EMBA, including EPBC Act listed threatened and/or migratory species potentially occurring within the Operational Areas, are presented in **Table 4-6**. These relate to breeding, foraging or migration of the indicated fauna.

The following species were listed in the EPBC Act Protected Matters Search but have been excluded from **Table 4-6**:

- Antarctic minke whale, Bryde's whale and sperm whales may occasionally transit the area. However, information is not available to support a definitive seasonality in the North West Shelf Province.
- The leatherback turtle is not confirmed as a nesting species within WA (Limpus, 2008; DoEE, 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 Areas.

Table 4-6: 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
Operational Area												
Blue whale – northern migration (North West Cape, Montebello)[1]												
Blue whale – southern migration (North West Cape, Montebello)[2]												
Humpback whale – northern migration (Jurien Bay to Montebello)[3]												
Humpback whale – southern migration (Montebello to Jurien Bay)[4]												
Bryde's whale – foraging (Shark Bay)[5]												
Killer whale – foraging (Shark Bay)[5]												
Whale shark* – foraging/aggregation near Ningaloo[6]												
Green turtle – various nesting areas[8]												
Flatback turtle – various nesting [8]												

Species	January	February	March	April	May	June	July	August	September	October	November	December
Loggerhead turtle – various nesting areas [8]	Peak	Present	Present	Present	Present						Present	Peak
Hawksbill turtles – various nesting areas [9]	Present	Present								Present	Present	Present
Manta rays – presence, aggregation, breeding (Ningaloo)[10]			Present	Present	Present	Present	Present	Present				
Fairy tern – breeding (Ningaloo)[11]			Present	Present	Present	Present	Present					
EMBA												
Osprey – breeding (Ningaloo)[12]				Present	Present	Present	Present	Present	Present	Present		
Roseate tern – breeding (Ningaloo)[12]	Present	Present	Peak	Peak	Peak	Peak	Peak	Present	Present	Present	Present	Present
Caspian tern – breeding (Ningaloo)[13]						Present	Present	Present	Present	Present	Present	
Crested tern – breeding (Ningaloo)[13]			Present	Present	Present	Present	Present	Present				
Wedgetailed shearwater – various breeding sites[13]	Present	Present	Present	Present				Present	Present	Present	Present	Present

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

References for species seasonal sensitivities:

1. DSEWPaC, 2012a, b; McCauley and Jenner, 2010; McCauley, 2011
2. DSEWPaC, 2012a, b; McCauley and Jenner, 2010
3. CALM, 2005; Environment Australia, 2002; Jenner *et al.*, 2001a; McCauley and Jenner, 2001
4. McCauley and Jenner, 2001; Threatened Species Scientific Committee, 2015c
5. McCauley, 2011
6. CALM, 2005; DSEWPaC, 2012a; Environment Australia, 2002; Sleeman *et al.*, 2010
7. CALM, 2005; Department of Environmental Protection, 2001; DSEWPaC, 2012b; Environment Australia, 2002
8. Chevron Australia Pty Ltd, 2015; CALM, 2005; DSEWPaC, 2012a
9. Chevron Australia Pty Ltd, 2015; DSEWPaC, 2012a
10. Environment Australia, 2002
11. CALM, 2005; Environment Australia, 2002
12. Higgins and Davies, 1996
13. DSEWPaC, 2012x; Environment Australia, 2002.

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

4.5.2.5 Marine Mammals

Cetaceans – Whales

Sei Whale

The sei whale is a baleen whale that, 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 perform seasonal migrations 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 in Australian waters. The species prefers deep waters, and typically occurs in oceanic basins and continental slopes (Prieto *et al*., 2012); records of the species occurring on the continental shelf (less than 200 m water depth) are uncommon in Australian waters (Bannister *et al*., 1996).

Occurrence within the Operational Areas is likely to be restricted to one or few individuals infrequently transiting the area, with a higher likelihood of occurrence during winter months. Sei whales may also occur in the EMBA, in oceanic waters beyond the continental shelf during winter months when the species moves away from Antarctic feeding areas.

Blue Whale

There are two recognised subspecies of blue whale in the Southern Hemisphere, both of which are recorded in Australian waters. These are the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda*) (CoA, 2015a). 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) (CoA, 2015a). 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, nearly all blue whales sighted in the NWMR and SWMR within the EMBA are likely to be 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 defines areas relating to breeding, migration, known high use foraging, known foraging, possible foraging areas, and areas known and likely to occur. In addition, the National Conservation Values Atlas spatially defines a number of BIAs for the pygmy blue whale. 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 migrates annually 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 and Jenner, 2010; McCauley and Duncan, 2011; McCauley *et al*., 2018; Jolliffe *et al*., 2019; Gavrilov *et al*., 2018) (**Figure 4-9**). Satellite tagging (2009 to 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 4-9**). 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, this data suggests individuals transit the deeper waters to the west of the Operational Areas 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), about 200 km south of the Operational Areas 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 4-9**). As such, it is possible that pygmy blue whales feed opportunistically while transiting the region.

Since the Operational Areas overlap with the defined migration corridor (BIA) and the known distribution of the pygmy blue whale, it is possible that individuals may transit the Operational Areas during their northbound or southbound migration. However, satellite tracks and noise logging data (described above) suggest the Operational Areas may overlap with the main corridor transited by East Indian Ocean pygmy blue whales. Therefore, presence within the Operational Areas is considered likely.

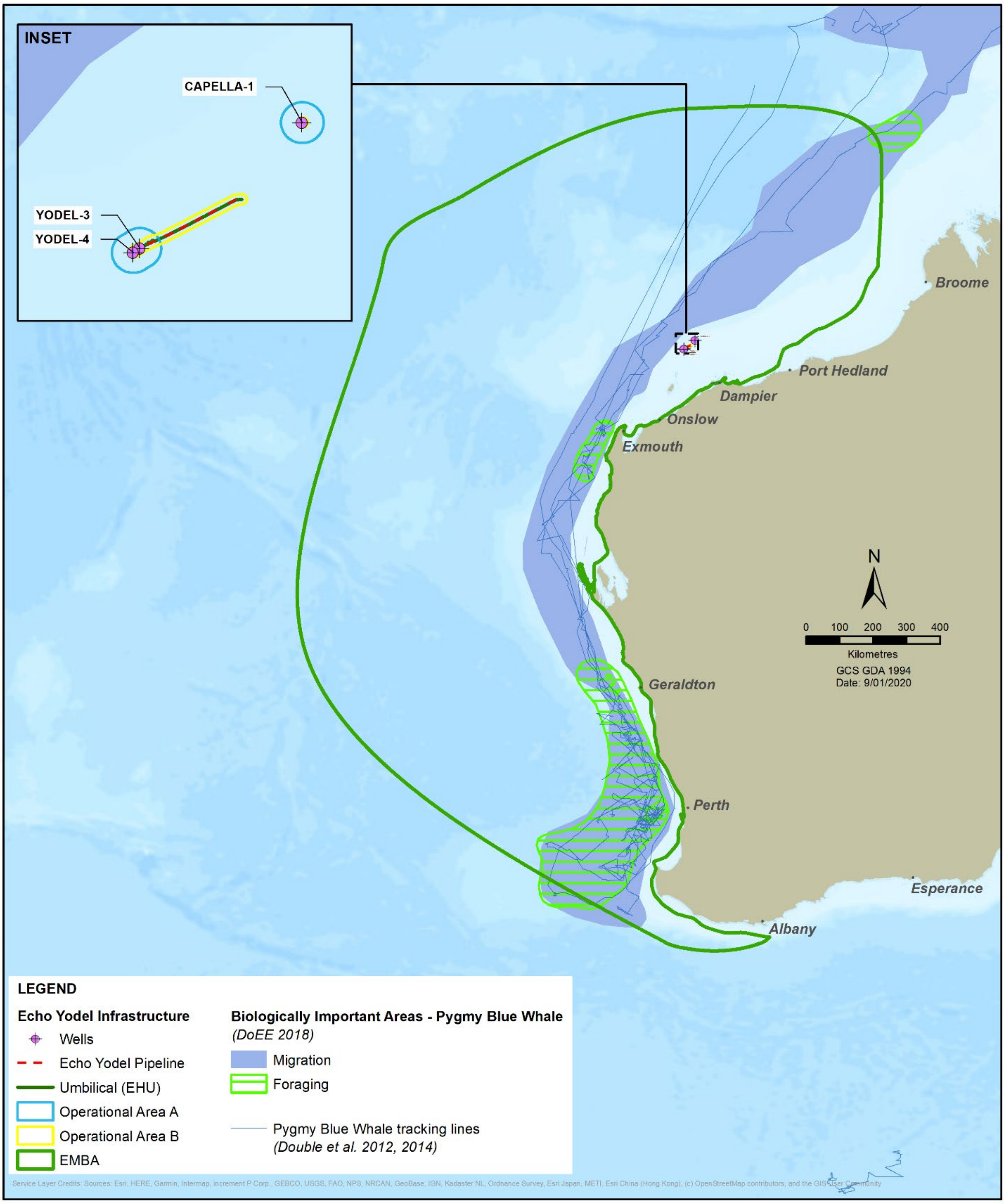

Figure 4-9: Operational Areas and pygmy blue whale satellite tracks and BIAs (after Double *et al.*, 2012b, 2014)

Fin Whale

The fin whale is a large baleen whale with a cosmopolitan distribution in all ocean basins between 20°S and 75°S (Department of the Environment and Heritage, 2005a). 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 also no known BIAs for fin whales in the NWMR or SWMR. Fin whales are likely to infrequently occur within the Operational Areas. Occurrence within this area and offshore areas of the EMBA are likely to be restricted to a few individuals occasionally transiting the area, mainly during winter months when the species may move away from Antarctic feeding areas.

Humpback Whale

Humpback whales occur throughout Australian waters, as two genetically distinct, east and west populations; both populations' distributions are influenced by migratory pathways and aggregation areas for resting, breeding and calving. In the west, humpback whales migrate north to breeding grounds in Camden Sound of the west Kimberley, between May and August, after feeding in Antarctic waters during the summer months (Jenner *et al*., 2001). Calving typically occurs between mid-August and early September, within nearer shelf waters of the Camden Sound (outside the EMBA; more than 1000 km away from the Operational Areas). The whales' southern migration runs between August and November, with females and calves being the last to leave the breeding grounds. 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 mainly 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. The humpback migration BIA is 26 km from the Operational Areas within the EMBA. Exmouth Gulf and Shark Bay are known resting/aggregation areas for southbound humpback whales. In particular, Exmouth Gulf is where cow/calf pairs may stay for up to two weeks. The Exmouth Gulf and Shark Bay humpback whale BIAs are located within the EMBA, about 253 km and 588 km respectively from the Operational Areas. Noise logger deployment conducted near the Goodwyn Facility (which is adjacent to the Operational Areas) detected humpback whales present at the end of September, likely migrating south, and from June to mid-August in deeper water, nearer to the continental shelf, likely migrating north (RPS Environment and Planning, 2011). The southbound migration of cow/calf pairs is slightly later during October (extending into November and December). During the southbound migration, it is likely that most individuals, particularly cow/calf pairs, stay closer to the coast than the northern migratory path. During these migration periods, low numbers of humpback whales may occur within the Operational Areas.

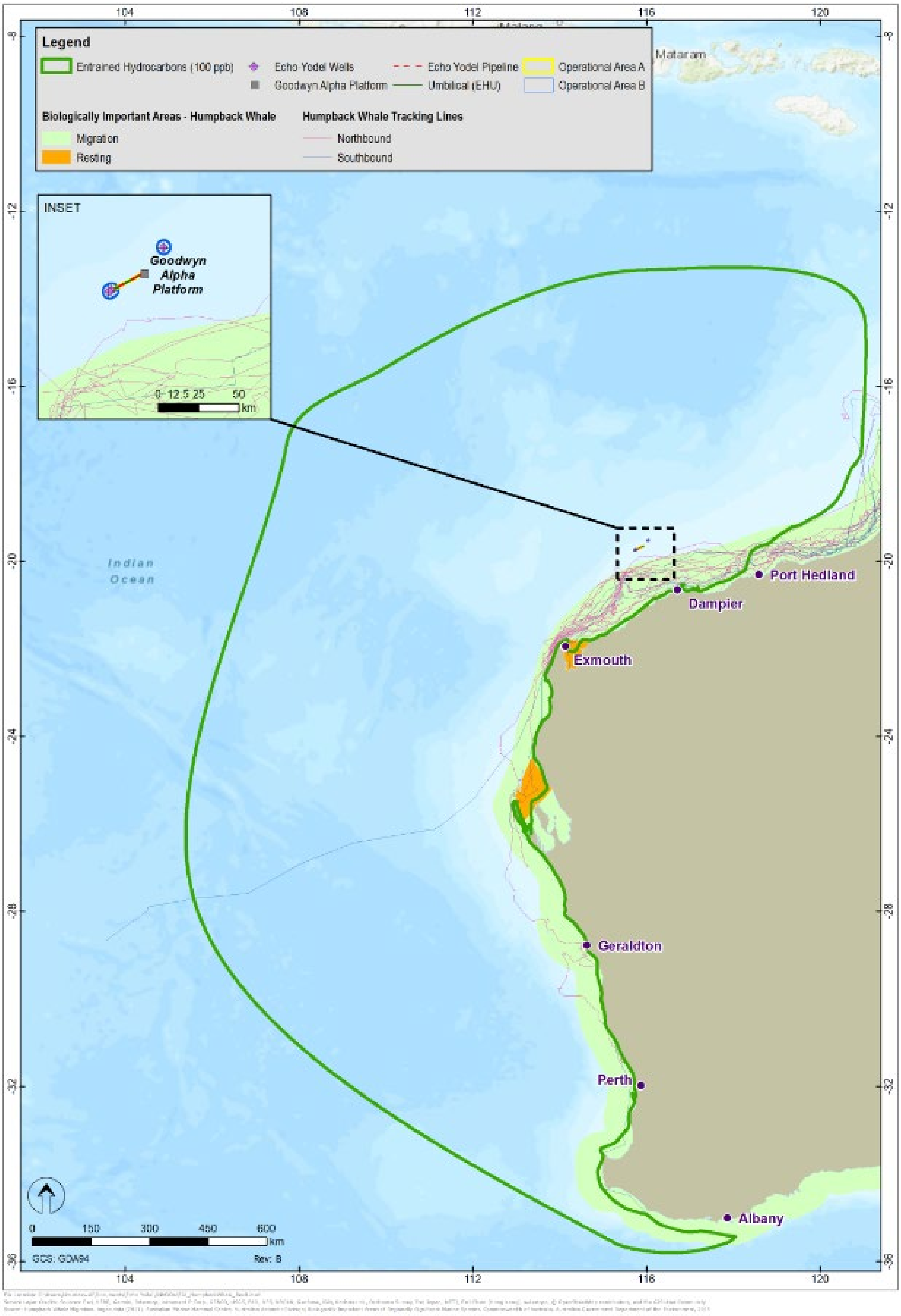

Figure 4-10: Operational Areas and humpback whale satellite tracks and BIA (Double *et al*., 2010, after 2012a)

Bryde's Whale

Bryde's whales are distributed widely throughout tropical and sub-tropical waters (DoAWE, 2015). Bryde's whales have been identified as occurring 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 movement behaviours are recognised for Bryde's whales: inshore (largely sedentary) and offshore (may perform migrations). Data suggests offshore whales may migrate seasonally, heading towards warmer tropical waters during the winter; however, information about migration is not well known (McCauley and Duncan, 2011). There is some taxonomic confusion, with Bryde's whales bearing similarity to, and historically confused with, the sei whale (Bannister *et al*., 1996), particularly in whaling catch statistics (Slijper *et al*., 1964).

Bryde's whales may occur through a broad area of the continental shelf in the NWMR and SWMR regions, including the Operational Areas and EMBA (McCauley and Duncan, 2011; RPS Environment and Planning, 2011). This species has been detected within the NWMR and SWMR from mid-December to mid-June, peaking in late February to mid-April (RPS Environment and Planning, 2011). There are no known BIAs for Bryde's whales in the NWMR or SWMR. The presence of Bryde's whales in the Operational Areas is likely to be a remote occurrence and limited to a few individuals. In the EMBA, occurrence is also likely to be limited.

Sperm Whale

Sperm whales are the largest of the toothed whales and are distributed worldwide in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges (Bannister *et al*., 1996). Sperm whales have been recorded in all Australian State waters and are known to migrate northward in winter and southwards in summer (Bannister *et al*., 1996). In WA, sperm whales have two BIAs recognised for foraging activities. These two areas are located west of Rottnest Island (within the EMBA) and along the southern coastline between Cape Leeuwin and Esperance (outside the EMBA). In deep water off the North West Cape, sperm whales have been sighted in pod sizes up to six animals between February and April from two separate surveys, in 2010 and 2017 (EPI Group, 2017; RPS Environment and Planning, 2010).

There is limited information about sperm whale distribution in Australian waters; however, they are usually found in deep offshore waters, with more dense populations close to continental shelves and canyons (DoEE, 2019). The species may occur in severely fragmented populations. Key localities in Australia include: the southern coastline between Cape Leeuwin and Esperance, WA (Bannister *et al*., 1996); south-west of Kangaroo Island, SA; deep waters off the Tasmanian west and south coasts; southern New South Wales; and deep waters off Stradbroke Island, Queensland (Ceccarelli *et al*., 2011). There are no known BIAs for sperm whales in the Operational Areas or EMBA. 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, 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.

Sperm whales are likely to only infrequently occur within proximity to the Operational Areas and in far offshore waters of the EMBA. Their presence is likely to be a rare occurrence and limited to a few individuals infrequently transiting the area, particularly during winter months.

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, particularly near seal colonies, as well as in shallow coastal areas of WA (Bannister *et al*., 1996; Thiele, D. and Gill, P.C., 1999).

Anecdotal evidence suggests killer whales may feed on dugongs in Shark Bay (within the EMBA), between June and August (Department of Environmental Protection, 2001), but there are no recognised key localities or important habitats for killer whales within the Operational Areas or EMBA. The presence of killer whales is likely to be a rare occurrence and limited to few individuals infrequently transiting the EMBA.

Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)

There are four known subpopulations of spotted bottlenose dolphins, of which the Arafura/Timor Seas population was identified as potentially occurring within the Operational Areas and the EMBA. The species occurs in open coastal waters, primarily within the continental shelf, and within the coastal waters of oceanic islands from Shark Bay to the western edge of the Gulf of Carpentaria. The species forages in a wider range of habitats and within deeper waters than most dolphin species, but is generally restricted to water depths of less than 200 m (DSEWPaC, 2012a).

The Arafura/Timor Sea spotted bottlenose dolphin population is considered migratory; however, their movement patterns are considered highly variable, with some individuals displaying year-round residency to a small area and others performing long-range movements and migrations (DoEE, 2017). The species is likely to occur only infrequently in the Operational Areas. Within the EMBA, the species is likely to transit across the continental shelf waters of the NWMR.

Marine Turtles

Five of the six marine turtle species recorded for the NWMR have the potential to occur within the Operational Areas (**Appendix C**): the loggerhead, green, leatherback, hawksbill and flatback turtles. The Olive Ridley turtle has the potential to occur within the EMBA.

There is no emergent habitat within the Operational Areas; therefore, nesting aggregations of marine turtles are unlikely to occur in the vicinity of the Operational Areas. Flatback turtle internesting BIAs, extending from nesting locations at the Montebello Islands and Dampier Archipelago, overlap the EMBA. The BIAs are considered very conservative, as it is 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. It is also possible that marine turtles forage at Rankin Bank, the nearest submerged shoal containing biota that turtles eat (e.g. sponges and macroalgae – see **Section 4.5.1.2**).

The 60 km internesting buffer for flatback turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), defined as habitat critical to the survival of a species, 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). There is no evidence to date to indicate flatback turtles swim out into deep offshore waters during the internesting period.

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. The Whittock *et al*. (2016) study developed a habitat suitability map to identify areas where internesting flatback turtles may be present within the EMBA based on data compiled for a suite of environmental variables and satellite tracks of 47 internesting flatback turtles from five different mainland and island rookeries tracked over 1289 days. Whittock *et al*. (2016) defined suitable internesting habitat as water 0 to 16 m deep and within 5 to 10 km of the coastline, while unsuitable internesting flatback habitat was defined as waters more than 25 m deep and more than 27 km from the coastline. The primary environmental variables that influenced flatback internesting movement were bathymetry, distance from coastline and sea surface temperature. Suitable areas of internesting habitat were located close to many known flatback turtle rookeries across the region (Whittock *et al*., 2016). This modelling study clearly demonstrates that all of the internesting buffer BIA and habitat critical to the survival of flatback turtles overlapped by the EMBA, do not represent suitable habitat for flatback turtles during internesting periods. Hence, it is highly unlikely that significant numbers of flatback turtles will be in the offshore, deep waters of the Operational Area. The evidence, that suitable internesting habitat for flatback turtles is likely to be limited to relatively shallow waters within close proximity of the coastline, is further supported by data from satellite telemetry of 11 flatback turtles after nesting on the Lacepede Islands (Thums *et al*., 2017). This study found that “During the inter-nesting phase, flatback turtles remained at an average distance of 15.75 ± 12.25 km from West Lacepede Island, in water depths of 16 ± 3 m…” (Thums *et al*., 2017).

Four of the turtle species (green, loggerhead, flatback and hawksbill) have significant nesting rookeries on beaches along the mainland coast and islands off the coast, including the Montebello/Barrow Islands and Dampier Archipelago, all of which are within the EMBA (64 km and 119 km from the Operational Areas respectively) (CoA, 2017; Limpus, 2007, 2008a,b, 2009a,b). **Table 4-7** provides additional details of the marine turtle species identified, including breeding and nesting seasons, diet and key habitats (including BIAs).

Table 4-7: Key information on marine turtles in the EMBA

Turtle species	Key seasons within the NWMR	Diet	Key habitats
Green turtle	**Breeding**: Approximately September to March. **Nesting**: November to April. 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**: Montebello Islands, Barrow Island, Muiron Islands and North West Cape. **Internesting habitat**: Generally within 10 km of nesting beaches (Waayers *et al*., 2011). **Nearest BIA**: Internesting, foraging, mating and nesting on the Montebello Islands during summer, with a 20 km internesting buffer. Foraging on the string of islands between Cape Preston and Onslow. A migration corridor also occurs along the Dampier Archipelago. These BIAs overlap the EMBA. **Nearest habitat critical for the survival of green turtles:** The Operational Areas are about 10 km from the nearest internesting buffer around Montebello Islands.
Loggerhead turtle	**Breeding**: Approximately September to March. **Nesting**: Late October to late 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 Gnarraloo 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 about Australian loggerhead turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (CoA, 2017). **Nearest BIA**: Internesting buffer around the Montebello Islands (peak late December to early January) with a 20 km internesting buffer and nesting on the Rosemary Island. These BIAs overlap the EMBA. **Nearest habitat critical for the survival of green turtles:** The Operational Areas are about 10 km from the nearest internesting buffer around Montebello Islands.
Leatherback turtle	No confirmed nesting activity in WA.	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 NWMR, but noted that there are no known nesting sites within the NWMR.

Turtle species	Key seasons within the NWMR	Diet	Key habitats
Hawksbill turtle	**Breeding**: Approximately October to January. **Nesting**: All year round with peak in September to 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 Island in the Lowendal group, some islands in the Montebello group and along the Ningaloo Coast (Limpus, 2009). **Internesting habitat**: Limited data about Australian hawksbill turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (CoA, 2017). **Nearest habitat critical for the survival of green turtles:** The operational area is about 10 km from the nearest internesting buffer around Montebello Islands. **Nearest BIA**: Internesting buffer around the Montebello Islands in spring and early summer (peak October) with a 20 km internesting buffer. Montebello also has BIAs for nesting, foraging and mating. A migration corridor overlaps the EMBA by the Dampier Archipelago. These BIAs overlap the EMBA. **Nearest habitat critical for the survival of green turtles:** The Operational Areas are about 10 km from the nearest internesting buffer around Montebello Islands.
Flatback turtle	**Breeding**: Peak between December and February. **Nesting**: November 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; Whittock *et al*., 2014). 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. **Nearest BIA**: Internesting buffer around Montebello Islands in summer with an 80 km internesting buffer, which overlaps the Operational Areas. The Montebello Islands also have BIAs for nesting, foraging and mating. These BIAs overlap the EMBA. **Nearest habitat critical for the survival of green turtles:** The Operational Areas are about 10 km from the nearest internesting buffer around Montebello Islands.

Post-nesting migratory routes for green, hawksbill and flatback turtles recorded for the NWMR (Barrow Island and mainland sites) (Chevron Australia Pty Ltd, 2015) indicated no overlap with the Operational Areas. 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 Australia Pty Ltd, 2015). Tracking data indicates the three marine turtle species recorded for the NWMR, which travel and forage in coastal waters that are relatively shallow (Chevron Australia Pty Ltd, 2015), are:

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

Fishes

Great White Shark

The great white shark was identified as potentially occurring within the Operational Areas. The species typically occurs in temperate coastal waters between the shore and the 100 m depth contour; however, adults and juveniles have been recorded diving to depths of 1000 m (Bruce *et al*., 2006; Bruce, 2008). They are also known to make open ocean excursions of several hundred kilometres and can cross ocean basins (Weng *et al*., 2007a, b). Although great white sharks are not known to form and defend territories, they are known to return on a seasonal/regular basis to regions with high prey density, such as pinniped colonies (Bruce, 2008).

Given the migratory nature of the species, its low abundance, broad distribution in temperate waters across southern Australia and absence of preferred prey (pinnipeds), great white sharks are unlikely to occur within the Operational Areas but may occur in the southern waters of the EMBA.

Shortfin Mako

The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al*., 2000), and was identified as potentially occurring within the Operational Areas. The shortfin mako is commonly found in water with temperatures greater than 16 °C and can grow to almost 4 m. Tagging studies indicate shortfin makos spend most of their time in water less than 50 m deep but with occasional dives up to 880 m (Abascal *et al*., 2011; Stevens *et al*., 2010). Little is known about the population size and distribution of shortfin mako sharks in WA; however, it is possible they may transit the Operational Areas and EMBA.

Longfin Mako

The longfin mako is a widely distributed, but rarely encountered, oceanic shark species. The longfin mako was identified as potentially occurring within the Operational Areas. The species can grow to just over 4 m long and is found in northern Australian waters, from Geraldton in WA to at least Port Stephens in New South Wales, and is uncommon in Australian waters relative to the shortfin mako (Bruce, 2013; DEWHA, 2010). There is very little information about these sharks in Australia, with no available population estimates or distribution trends. Longfin mako sharks may occur in the Operational Areas and EMBA.

Whale Shark

The DoAWE 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 4-11**). This area extends northward from the Ningaloo aggregation area and partially overlaps with the south-east portion of the Operational Areas. 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 Ningaloo Reef. However, the numbers of individual whale sharks that transit through the Operational Areas 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 294 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 to 50 m deep (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. Satellite tracking has shown that the sharks may follow three migration routes from Ningaloo (Meekan and Radford, 2010; Wilson *et al*., 2006):

1. north-west, into the Indian Ocean
2. directly north, towards Sumatra and Java
3. north-east, passing through the North West Shelf Province traveling along the shelf break and continental slope.

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 performing opportunistic foraging. Given the BIA for whale sharks spatially overlaps the Operational Areas, it is expected that whale sharks may traverse the vicinity of the Operational Areas 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).

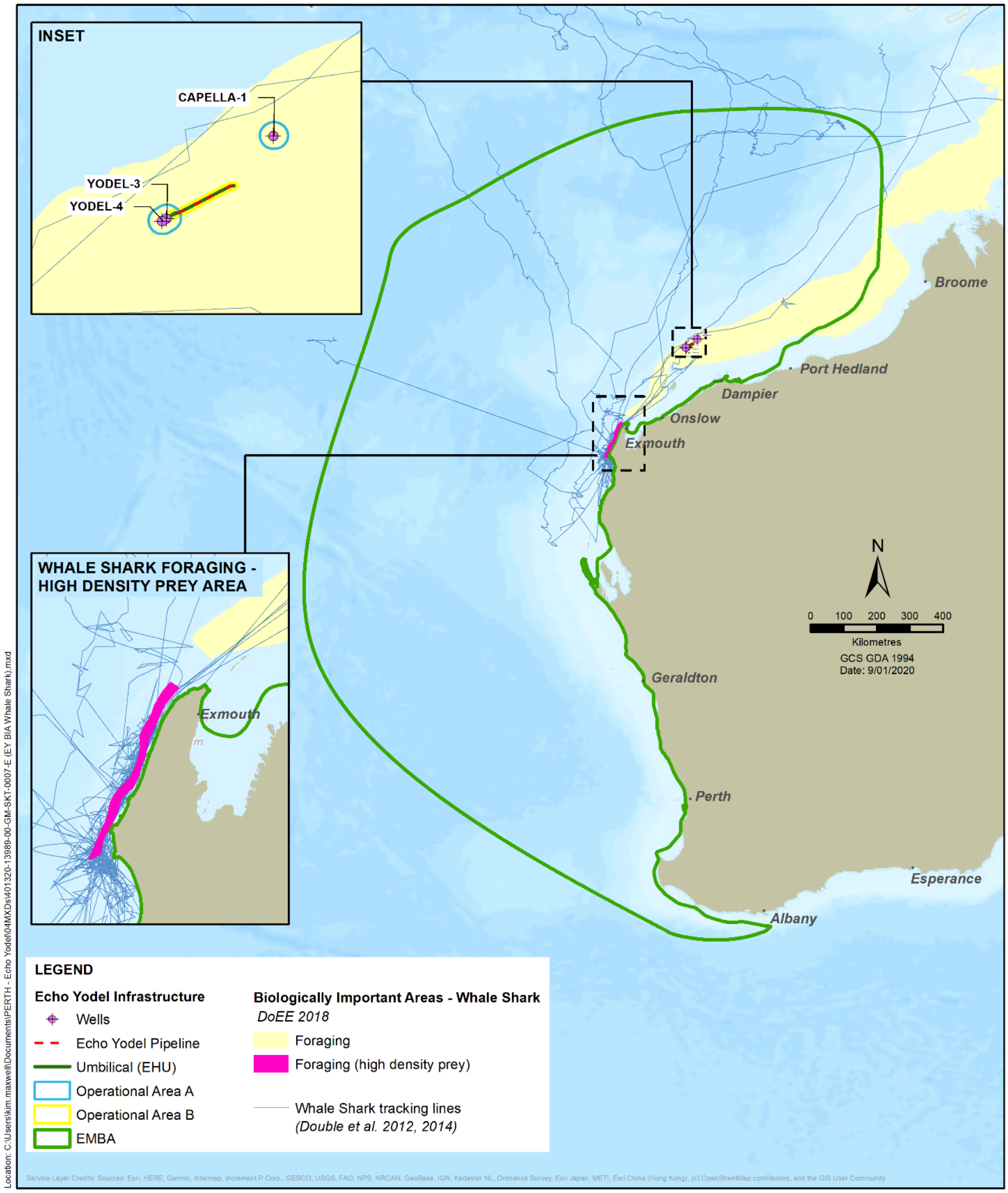

Figure 4-11: Whale shark BIAs within the EMBA and satellite tracks of whale sharks tagged between 2005 and 2008 (Double *et al*. 2012, 2014)

Grey Nurse Shark (West Coast population)

The grey nurse shark has a broad distribution in inner continental shelf waters, primarily in sub-tropical to cool temperate waters. Off WA, the grey nurse shark occurs primarily in south-west coastal waters between 20 and 40 m depth (Chidlow *et al*., 2006). Grey nurse sharks have been documented as aggregating in specific areas (typically reefs); however, no clear aggregation sites have been identified off WA (Chidlow *et al.*, 2006). Grey nurse sharks may occur within continental shelf areas of the Operational Areas. Their occurrence is likely to be infrequent and restricted to individuals transiting the area. Within the EMBA, grey nurse sharks are likely to occur across shallow continental shelf waters and may be more prevalent around reefs.

Giant Manta Ray

The giant manta ray is broadly distributed in tropical waters of Australia and was identified as potentially occurring within the Operational Areas. The species primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall *et al.*, 2011). The Operational Areas are not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). However, the Ningaloo Coast, about 268 km south-west of the Operational Areas and 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 Areas and EMBA is likely to be infrequent, and restricted to individuals transiting the area.

Reef Manta Ray

The reef manta ray is commonly sighted inshore, within a few kilometres of land, but is also found around offshore coral reefs, rocky reefs and seamounts (Marshall *et al.*, 2009). In contrast to the giant manta ray, long-term sighting records of the reef manta ray at established aggregation sites suggest that this species is more resident in tropical waters and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Deakos *et al.*, 2011; Marshall *et al.*, 2009). A resident population of reef manta rays has been recorded at Ningaloo Reef (about 268 km from the Operational Areas and within the EMBA), and the species has been shown to have both resident and migratory tendencies in eastern Australia (Couturier *et al.*, 2011). The reef manta ray may infrequently occur in continental shelf waters of the Operational Areas while transiting between suitable habitats 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 bycatch, and constituted over half of sawfish bycatch in the Northern Prawn Fishery in 2013 (Morgan *et al.*, 2010a) (this fishery does not overlap the EMBA). The species was identified as potentially occurring within the Operational Areas and EMBA. Given their water depth and habitat preference, narrow sawfish are unlikely to occur within the Operational Areas and would be infrequently encountered only within the shallower waters of the EMBA.

Green Sawfish

The green sawfish was once widely distributed in coastal waters along the northern Indian Ocean, although it is believed that northern Australia may be the last region where significant populations exist (Stevens *et al.*, 2005). Within Australia, green sawfish are currently distributed from about the Whitsundays in Queensland, across northern Australian waters to Shark Bay in WA (CoA, 2015b). Preferred habitat for green sawfish includes shallow coastal waters and tidal creeks (Chevron Australia Pty Ltd, 2014). Despite records of the species in deeper offshore waters, green sawfish typically occur in the inshore fringe with a strong association with mangroves and adjacent mudflat habitats (CoA, 2015b; Stevens *et al.*, 2005). Movements within these preferred habitats are correlated with tidal movements (Stevens *et al.*, 2008).

The Multi-species Recovery Plan for Sawfish and River Sharks (CoA, 2015b) indicates 'known to occur' distribution includes offshore waters of the North West Shelf, with 'known' pupping areas in coastal waters north of Port Hedland to Roebuck Bay and pupping 'likely to occur' south of Port Hedland, Exmouth Gulf and North West Cape. The species was identified as potentially occurring within the Operational Areas and the EMBA; however, given the habitat preferences of the green sawfish, they are unlikely to be present in the Operational Areas or deeper waters of the EMBA, but may occur in coastal areas of the EMBA.

Scalloped Hammerhead

The scalloped hammerhead has a circum-global distribution in tropical and sub-tropical waters. As the scalloped hammerhead rarely ventures into or across deep ocean waters, the species shows strong genetic population structuring across ocean basins, but ranges quite widely over shallow coastal shelf waters (Threatened Species Scientific Committee, 2018). Consequently, there is very little structuring from the eastern to western extents within Australia and it is likely to be a shared stock with Indonesia (Chin *et al*., 2017).

Within Western Australian waters, the scalloped hammerhead extends around the north of the continent and then south to about Geographe Bay, though it is rarely recorded south of the Houtman Abrolhos Islands (Threatened Species Scientific Committee, 2018). Scalloped hammerheads are mobile animals that range widely over shallow coastal shelf waters, but rarely venture into or across deep ocean waters.

The species was identified as potentially occurring within the Operational Areas and the EMBA; however, given the habitat preferences of the scalloped hammerhead, it is unlikely to be present in the Operational Areas or deeper waters of the EMBA, but may occur in shallow coastal shelf waters of the EMBA.

Southern Bluefin Tuna

Adult southern bluefin tuna in Australian waters range widely from northern WA to the southern region of the continent (Caton, 1991; CCSBT, 2009; Honda *et al*., 2010). Juveniles of one to two years of age inhabit inshore waters in WA and South Australia (Honda *et al*., 2010). The southern bluefin tuna is highly migratory, occurring globally in waters between 30 to 50ºS, though the species is mainly found in the Eastern Indian Ocean and in the south-west Pacific Ocean.

When moving to spawning grounds, southern bluefin tuna are recorded as favouring temperatures between 19 to 21 ºC, and adjusting their depth of swimming to the vertical temperature distribution. Distinct diurnal diving patterns were observed with adjustment of water depth to maintain constant ambient light levels over a 24-hour period. During this migration, individuals may spend up to 84% of their time within the Australian Fishing Zone (AFZ) (Patterson *et al*., 2008). The species was identified as potentially occurring within the Operational Areas and the EMBA.

4.5.2.6 Birds

Seabirds and/or Migratory Shorebirds

The Operational Areas may be occasionally visited by migratory and oceanic birds, but do not contain any emergent land that could be used as roosting or nesting habitat. The closest emergent facility is the Goodwyn platform, located about 19 km from the Operational Areas. One BIA, a breeding area for wedge-tailed shearwaters, overlaps the Operational Areas and is discussed further in the relevant species section below. The NWMR lies within the East Asian-Australasian flyway for migratory birds; species migrating between East Asia and Australia may be present between late spring and early autumn. Ten species of birds considered to be MNES were identified as potentially occurring within the Operational Areas, including:

- red knot (*Calidris canutus*) – Endangered
- eastern curlew *(Numenius madagascariensis)* – Critically endangered
- common sandpiper *(Actitis hypoleucos)* – Migratory
- common noddy (*Anous stolidus)* – Migratory
- sharp-tailed sandpiper *(Calidris acuminata)* – Migratory
- pectoral sandpiper *(Calidris melanotos)* – Migratory
- lesser frigatebird *(Fregata ariel)* – Migratory
- great frigatebird *(Fregata minor)* – Migratory
- streaked shearwater *(Calonectris leucomelas)* – Migratory
- Australian fairy tern *(Stemula nereis)* – Vulnerable.

Based on the results of two survey cruises and other unpublished records, Dunlop *et al. (1988)* recorded the occurrence of 18 species of seabirds over the North West 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 (Bamford *et al*., 2008; CoA, 2015c). The EMBA includes shoreline habitats, the Ningaloo Coast hosts seabird and migratory shorebird habitat. Note that no Ramsar wetlands were identified within the Operational Areas. One Ramsar wetland overlaps the EMBA; the Becher Point wetlands is located more than 1400 km south of the Operational Areas and within the EMBA.

Red Knot

The red knot migrates long distances 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, such as those within the EMBA. The species is unlikely to occur in the Operational Areas, 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 a long-haul flyer. The eastern curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back in Australia in August to feed on crabs and molluscs in intertidal mud flats (Bamford *et al*., 2008). No critical habitats for the eastern curlew have been identified in the Operational Areas or EMBA and their presence is likely to be restricted to them transiting through the area during their seasonal migration periods.

Common Sandpiper

The common sandpiper is a small, migratory sandpiper with a very large range through which it performs annual migrations between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford *et al*., 2008). In Australia, 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 presence of the common sandpiper within the Operational Areas and EMBA is likely to be restricted to when they transit through during seasonal migration periods.

Common Noddy

The common noddy is the largest species of noddy found in Australian waters. 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 long 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 (Burbidge and Fuller, 1989) (within the EMBA; 951 km from the Operational Areas). The common noddy is thought to perform seasonal movements, with some nesting sites abandoned during the non-breeding season (which is protracted between spring and autumn). A foraging BIA (provisioning young) overlaps the EMBA at the Houtman Abrolhos Islands, 957 km south of the Operational Areas. The species may occur within the Operational Areas as they fly through the area.

Sharp-tailed Sandpiper

Like other species of sandpiper, the sharp-tailed sandpiper is a migratory wading shorebird and performs long distance seasonal migrations between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford *et al*., 2008). The species may occur in Australia between spring and autumn. The species is unlikely to occur within the Operational Areas and only infrequently in the EMBA as it transits through the areas, particularly near offshore islands.

Pectoral Sandpiper

Similar to other species of sandpiper, the pectoral sandpiper breeds in the northern hemisphere during the boreal summer, before performing 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 which occur along the coastal sections within the EMBA, notably Dampier and Carnarvon to Coral Bay. It is unlikely to occur in the Operational Areas.

Lesser Frigatebird

The lesser frigatebird is usually seen in tropical or warmer waters around the coast of north WA, the Northern Territory, Queensland and northern New South Wales (DSEWPaC, 2012d). Within the NWMR, the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Islands (outside the EMBA) (DSEWPaC, 2012d). The lesser frigatebird feeds mostly on fish and sometimes cephalopods. All food is taken while the bird is in flight. Lesser frigate birds generally forage close to breeding colonies. A breeding BIA lies on the border of the EMBA, about 224 km east of the Operational Areas. The species is unlikely to be found within the Operational Areas and only infrequently at the boundary of the EMBA.

Streaked Shearwater

The streaked shearwater is a migratory seabird with a broad distribution in the western Pacific Ocean. The species nests on offshore islands in temperate East Asia, including Japan and the Korean peninsula. During winter months, the species migrates south, as far as northern Australia, where it occurs around islands and inshore waters. The species may occur in the Operational Areas and EMBA during winter months.

Australian Fairy Tern

The Australian fairy tern is a small fish-eating bird, about 22 to 27 cm long. Within Australia, the fairy tern occurs along the coasts of Victoria, Tasmania, South Australia and WA; occurring as far north as the Dampier Archipelago near Karratha. The fairy tern nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The bird roosts on beaches at night (Higgins and Davies, 1996). The species is unlikely to occur in the Operational Areas but may occur in the EMBA.

Great Frigatebird

The great frigatebird has been identified as a conservation value in the NWMR. No BIAs for this species overlaps the Operational Areas or EMBA. The species is unlikely to occur in the Operational Areas but may occur in the EMBA.

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 European cultural heritage significance overlapping the Operational Areas or EMBA. Although there may be shoreline contact, in the event of a hydrocarbon spill this is not predicted to be above shoreline accumulation thresholds and are therefore not considered within the EMBA.

4.6.1.2 Indigenous Sites of Significance

Within the EMBA, Ningaloo Reef, Exmouth, Barrow Island, Montebello Islands and the Dampier Peninsula 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 Department of Aboriginal Affairs (DAA) Heritage Inquiry System was searched from Cape Cuvier to the North West Cape, on to the Pilbara Island Group and Montebello/Barrow islands (**Appendix G**). The search indicated numerous registered sites, including middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites (**Appendix G**). 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 DAA 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*. No known shipwrecks have been recorded within the Operational Areas, based on a review of the National Shipwreck Database; however, there are multiple wrecks listed in the Australian National Shipwrecks Database that are recorded as being located within proximity. Most of these are listed as having an unreliable generic location. As the subsea infrastructure associated with the Operational Areas was mostly commissioned before 2012 when production commenced, and no shipwrecks were identified during or since this time in the area, it is reasonable to assume these shipwrecks are outside the Operational Areas. **Table 4-8** summarises listed shipwrecks within 50 km from the Operational Areas.

Table 4-8: Recorded historical shipwrecks within 50 km of the Operational Areas (DoEE, 2019).

Vessel name	Year wrecked	Wreck location	Latitude	Longitude	Distance from closest point of the Operational Areas (km)
McCormack	1989	N.E. tip of Eaglehawk Island West of Dampier, Dampier Archipelago	20.14ºS	115.953ºE	45

4.6.1.4 National and Commonwealth Heritage Listed Places

There are no Heritage Listed sites within or immediately adjacent to the Operational Areas.

Within the wider region of the EMBA, the Barrow Island and Montebello-Barrow Islands Marine Conservation Reserves are the closest National Heritage Listed place, and are about 60 km from the nearest point of the Operational Areas.

Other National Heritage Listed places that occur within the EMBA are:

- Dampier Archipelago (including Burrup Peninsula) – about 115 km from the Operational Areas
- Ningaloo Coast (includes Ningaloo Marine Park – Commonwealth and State waters and Muiron Islands Marine Management Area) – about 240 km from the Operational Areas
- Shark Bay – about 600 km from the Operational Areas[4]
- HMAS Sydney II and the HSK Kormoran Shipwreck Sites (290 km west south-west of Carnarvon), about 850 km from the Operational Areas (also included on the Commonwealth Heritage List)
- Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos – more than 1000 km south of the Operational Areas.

There are four additional places within the EMBA that are on the Commonwealth Heritage List, being:

1. Mermaid Reef – Rowley Shoals, about 490 km from the Operational Areas
2. Garden Island – more than 1000 km south of the Operational Areas
3. Lancelin Defence Training Area – more than 1000 km south of the Operational Areas
4. Ningaloo Marine Area – Commonwealth Waters, about 260 km from the Operational Areas.

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

The Shark Bay and Ningaloo Coast are listed as both a National Heritage Property and WHA.

4.6.2 Ramsar Wetlands

No Ramsar wetlands overlap the Operational Areas. Becher Point Wetlands (within Ramsar site), about 1400 km south of the Operational Areas, encompass an area of 708 hectares. The Becher Point Wetlands site is located in the City of Rockingham in the Perth Basin. Comprised of seasonal marshes, shrub swamps and sedge lands, it is one of the youngest wetland systems along the Swan Coastal Plain, having formed at different times during the last 5000 years, and is a unique wetland system in WA. Wetlands of this type in such good condition are extremely rare globally. The Ramsar site, about 19 hectares, contains an ecological community of 'Sedge lands in Holocene dune swales of the southern Swan Coastal Plain', listed as threatened under the Australian Government EPBC Act, and is extremely "important for the demonstration of continuous depositional history of sediment during the last 3000 years" (Jaensch, 2014).

4.6.3 Fisheries – Commercial

4.6.3.1 Commonwealth and State Fisheries

A number of Commonwealth and State fisheries are located within the Operational Areas, Socio-cultural EMBA and EMBA. **Table 4-9** provides further detail on the fisheries that have been

[4] The Shark Bay and Ningaloo Coast are listed as both a National Heritage Property and a World Heritage Area

identified through desk-based assessment and consultation (**Section 5**). **Table 4-9** provides the designated fisheries management areas in relation to the Operational Areas.

Table 4-9: Commonwealth and State fisheries of relevance to the Petroleum Activities Program

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Commonwealth Managed Fisheries				
Southern Bluefin Tuna Fishery	✓	✓	×	**Description:** The SBTF boundary overlaps the Operational Areas and EMBA, but effort within the fishery is confined to southern Australia, with the vast majority of effort occurring in the Great Australian Bight (Australian Fisheries Management Authority, 2010; Patterson *et al*., 2016). Southern bluefin tuna are known to spawn in the north-eastern Indian Ocean (Davis *et al*., 1990; Matsuura *et al*., 1997). The species has been heavily exploited by commercial fisheries worldwide. The fishery employs both longlining and purse seine net fishing methods. Given the current distribution of fishing effort and fishing methods used by the industry, fishing for bluefin tuna is unlikely to occur in the Operational Areas, Socio-cultural EMBA or EMBA. The fishery has not been active in the Operational Areas within the last five years (Australian Bureau of Agricultural and Resource Economics and Sciences [ABARES], 2019); therefore, no fishing is expected within the Operational Area. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Six purse seine vessels, 18 longline vessels (Patterson *et al*., 2018).
Western Skipjack Tuna Fishery	✓	✓	×	**Description:** The combined western and eastern skipjack tuna (*Katsuwonus pelamis*) fisheries encompass the entire Australian EEZ, including the Operational Areas, Socio-cultural EMBA and EMBA. The target species has historically been used for canning and, with the closure of canneries at Eden and Port Lincoln, effort in the fishery has declined and there have been no active vessels operating since 2009 (Patterson *et al*., 2018). Data shows fishing effort is concentrated offshore of the 200 m isobath off southern WA, with some effort also recorded off the central and Pilbara coasts of WA (Patterson and Stephan, 2014; Williams *et al*. 2016). The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019); therefore, no fishing is expected within the Operational Area. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** No vessels are active in the Western Skipjack Tuna Fishery.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Western Tuna and Billfish Fishery	✓	✓	×	**Description:** The Western Tuna and Billfish Fishery extends to the Australian EEZ boundary in the Indian Ocean, overlapping the Operational Areas, Socio-cultural EMBA and EMBA. The fishery targets four pelagic species, which are all highly mobile: broadbill swordfish (*Xiphias gladius*), bigeye tuna (*Thunnus obesus*). yellowfin tuna (*T. albacares*) and albacore tuna (*T. alalunga*). Data shows fishing effort is concentrated offshore of the 200 m isobath off southern WA, with some effort also recorded off the central and Pilbara coasts off WA (Patterson and Stephan, 2014; Williams *et al*., 2016). The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019); therefore, no fishing is expected within the Operational Areas. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Three pelagic longline vessels and one minor longline vessel (Patterson and Bath, 2018).
Small Pelagic Fishery	×	✓	×	**Description:** The Small Pelagic Fishery extends from the Queensland/New South Wales border, typically 3 nm, around southern Australia to a line at latitude 31° south (near Lancelin, north of Perth). The fishery is divided into two sub areas, east and west of latitude 146°30', due to evidence of separate stocks both east and west of Tasmania for jack mackerel, blue mackerel and redbait. The Small Pelagic Fishery is managed by limiting the catch, restricting how many boats can fish and regulating what gear they can use. To fish in this fishery, operators must hold statutory fishing rights that allow them to catch the fish species which are under a quota. The quota limits the amount of fish that boats can take in the fishery. **Fishery boundary distance from Operational Areas:** Located 1249 km south-east of the Operational Areas at its closest point; within the EMBA. **Licences/vessels:** Three vessels active in the 2015–16 season (Moore and Mobsby, 2017).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Southern and Eastern Scalefish and Shark Fishery	×	✓	×	**Description:** The Southern and Eastern Scalefish and Shark Fishery stretches south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern WA. The Southern and Eastern Scalefish and Shark Fishery is a multi-sector, multi-species fishery that covers almost half of the AFZ. Australian Fisheries Management Authority (AFMA) manages this fishery by limiting the catch, restricting how many boats can fish and regulating what gear they can use. The fishing season is 12 months, beginning on 1 May. Thirty-four different species/species groups are managed under the quota system in this fishery. **Fishery boundary distance from Operational Areas:** Located 1695 km south of the Operational Areas at its closest point; within the EMBA. **Licences/vessels:** Thirty-four in the Commonwealth trawl and scalefish hook sector, none in the east coast deepwater trawl sector, five in the Great Australian Bight trawl sector, and 62 in the shark gillnet and shark hook sectors active in 2016–2017 (Helidoniotis *et al*. 2017).
Western Deepwater Trawl Fishery	×	✓	×	**Description:** The WDTF is located in deep water off WA, from the line approximating the 200 m isobath to the edge of the AFZ. This fishery targets a number of deepwater, demersal finfish and crustacean species. The nominated fishing grounds are extensive; however, the fishing effort is to the south, offshore of the North West Cape, with areas of medium and high density fishing activity located to the south of Ningaloo Reef and west of Shark Bay, beyond the 200 m isobath. Fishing effort in recent years has been low after a peak in the early 2000s (Woodhams and Bath, 2016b). The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019); therefore, no fishing is expected within the Operational Areas. **Fishing boundary distance from the Operational Areas:** The WDTF management boundary is located about 188 km west of the Operational Areas. **Licences/vessels:** One vessel (ABARES, 2018).
North-West Slope Trawl Fishery	×	✓	×	**Description**: The NWSTF extends, from 114 °E to 125 °E, from the 200 m isobath to the outer limit of the AFZ (200 nm from the coastline, which is the boundary of the Australian EEZ). The fishery traditionally targets scampi and deepwater prawns. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350 to 600 m using demersal trawl gear on the continental slope (Woodhams and Bath, 2017a) focused in the waters to the north-east of the Operational Areas, Socio-cultural EMBA and EMBA. Activity in the fishery started in 1985, peaking at 21 active vessels in 1986–87. Activity has declined since then, to stabilise at one to two active vessels since 2008–09 operating from Point Samson (Woodhams and Bath, 2016a, 2017a). Effort in the fishery is closely related to vessel activity

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				(Woodhams and Bath, 2016a). The fishery has not been active in the Operational Areas within the last five years (DPIRD, 2019); therefore, no fishing is expected within the Operational Area. **Fishery boundary distance from Operational Areas:** Located 12 km north of the Operational Areas at its closest point, within the EMBA. **Licences/vessels:** Two vessels (Patterson and Bath, 2018).
State Managed Fisheries				
Pilbara Demersal Scalefish Fishery (fish trawl, trap and line)	✓	✓	✓	**Description:** The State-regulated Pilbara Demersal Scalefish Fishery is managed as part of the North Coast Demersal Scalefish Fisheries (NCDSF). The NCDSF comprises several management units in the Pilbara and Kimberley regions, targeting a range of low and high value finfish species. The Pilbara demersal scalefish fishery is managed through area closures, gear restrictions and the use of individual effort allocations (Newman *et al.,* 2018). Gear used in the Pilbara Demersal Scalefish Fishery includes trawl, trap and line fishing, with trawl fishing accounting for the bulk of landings. In 2016, 71% (1,529 t) of the total commercial catches of demersal scalefish in the Pilbara (2150 t) were landed by the trawl sector, with 23% (495 t) taken by the trap sector and 6% (126 t) taken by the line sector. (Gaughan and Santoro, 2018). The Pilbara Demersal Scalefish managed fishery boundary overlaps the Operational Areas, Socio-cultural EMBA and EMBA. The Pilbara Trawl Fishery is of high intensity and is divided into two zones and an area governed by Schedule 5 (prohibited to trawling). In addition to the Prohibited Trawl Fishing area, no fish trawl units are allocated for use in Zone 1 or Areas 3 and 6 of Zone 2 (which comprises six management areas) (Newman *et al*., 2015b). The Operational Areas span the Schedule 5 Prohibited Trawl Fishing area (Echo Yodel subsea infrastructure) and Area 6 of Zone 2 (Capella-1 wellhead). No fish trawl units have been allocated for use in Area 6 of Zone 2 since the management plan commenced operation in 1998; however, fish trawl units may be allocated for use in this area in the future. The Pilbara Trap Fishery covers the area from Exmouth northwards and eastwards to the 120° line of longitude, and offshore as far as the 200 m isobath. Like the trawl fishery, the trap fishery is also managed using input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel management system. The fishery includes six licences allocated to three vessels, operating principally from Onslow. Traps are limited in number, with the greatest effort in waters less than 50 m depth. This fishery targets high-value species such as red emperor and goldband snapper (Newman *et al*., 2015b). The Operational Areas are in water depths less than 200 m; hence, trap fishing may occur within the Operational Areas.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				The Pilbara Line Fishery encompasses all of the 'Pilbara waters' targeting tropical demersal scalefish and is the smallest scale fishery in terms of monetary value. There are no stated depth limits and the western extent of the fishery is the boundary of the AFZ (200 nm from the coastline which is the limit of the Australian EEZ) (Newman *et al.*, 2015b). The Line Fishery is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order 2006, with the exemption of nine fishing vessels for any nominated five-month period within the year. In 2014 line fishers operated for 195 days, compared to the 358 days operated in 2013 (Newman *et al.*, 2015b). Line fishing has the potential to occur within the Operational Areas. The fish trap and line catches are dominated by valuable species such as red emperor and goldband snapper, and the demersal scalefish catch from these sectors was estimated to have an economic value of $1 million to $5 million. They also have social amenity value. For the line fishery, the economic value is less than $1 million and social amenity is low because there is little recreational fishing for these offshore species and no specific broader community interests (Gaughan and Santoro, 2018). **Fishery boundary distance from Operational Areas:** The Schedule 5 Prohibited Trawl Fishing area and Area 6 of Zone 2 (no allocated fish trawl units) overlap the Operational Areas. Trawl fishing is not permitted in these. Trap and line fishing both overlap the Operational Areas. **Licences/vessels:** Ten active in 2016 (two trawl (outside Operational Areas), three trap and five line fishery vessels) (Gaughan and Santoro, 2018). Current FishCube data indicates trap, trawl and line fishing regularly occurs within the Pilbara Demersal Scalefish Fishery in waters surrounding the Operational Areas, and trap and line fishing may occur within the Operational Areas.
Mackerel Managed Fishery	✓	✓	×	**Description:** The Mackerel Managed Fishery targets Spanish mackerel (*Scomberomorus commerson*) using near-surface trawling gear from small vessels in coastal areas around reefs, shoals and headlands. Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), with other species from the genera *Scomberomorus* (Molony *et al.,* 2015). The commercial fishery extends from Geraldton to the Northern Territory border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West Coast (Area 3). Most of the catch is taken from waters off the Kimberley coasts (Lewis and Jones, 2018), reflecting the tropical distribution of mackerel species (Molony *et al.,* 2015). Most fishing activity occurs around the coastal reefs of the Dampier Archipelago (within the EMBA) and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development before spawning (Mackie *et al*., 2003). Spanish mackerel spawn between October and January when inhabiting coastal reef areas of the NWS, with females exhibiting serial spawning behaviour (spawning every one to three days) over

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
				the spawning period. Outside the main fishing season, it is unclear where the mackerel populations inhabit. However, there is anecdotal evidence to suggest populations move into deeper offshore waters (Mackie *et al*., 2003). Eleven boats operated during the 2014 commercial season, achieving a catch of 322 tonnes of Spanish mackerel, 3.4 tonnes of grey mackerel and 1.1 tonnes of other mackerel (Molony *et al*., 2015). The estimated commercial value of this fishery is not currently available for the 2014 period. Current FishCube data indicates the Mackerel Managed Fishery has fished in the waters surrounding the Operational Areas. However, interactions with participants in the fishery during the Petroleum Activities Program permanent plugging activities is not anticipated based on consultation (**Section 5**). Due to the methods used (near-surface trawling gear), no interaction with this fishery from leaving the infrastructure in-situ on the sea floor is expected. The estimated value (to fishers) of the Spanish mackerel annual catch, in 2016, was about $2.5 million (Lewis and Jones, 2018). **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Not stated for 2016 although 33 people were directly employed in the Mackerel Managed Fishery during the mackerel fishing season, primarily from May to November (Lewis and Jones, 2018); 11 vessels in 2014 (Molony *et al*., 2015).
Marine Aquarium Managed Fishery	✓	✓	×	**Description:** The Marine Aquarium Managed Fishery can operate in all State waters, with effort typically concentrated around the Capes region, Perth, Geraldton, Exmouth and Dampier (Newman *et al.,* 2018). The fishery is diver-based, which typically restricts effort to safe diving depths (less than 30 m); therefore, interaction with participants is not expected during the Petroleum Activities Program. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Eleven licences were active in 2016 (Newman *et al.,* 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Onslow Prawn Managed Fishery	✓	✓	×	**Description:** The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara. The fishery targets a range of penaeids (primarily king prawns) which typically inhabit soft sediments in less than 45 m water depth. Fishing is performed using trawl gear over unconsolidated sediments (sand and mud). Total prawn catches in 2016 were about three tonnes, considerably lower than other prawn fisheries (total north coast prawn landings in 2016 were 175 tonnes) (Kangas *et al.,* 2018). Considering fishing effort would concentrate in depths less than 45 m, interaction between participants in the fishery during the Petroleum Activities Program are unlikely. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** One vessel (Kangas *et al.,* 2018).
Pearl Oyster Managed Fishery	✓	✓	×	**Description**: The Western Australian Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. Pearl oysters (*Pinctada maxima*) are collected by divers in shallow coastal waters (more than 23 m) along the North West Shelf and Kimberley, which are mainly used to culture pearls (Hart *et al.,* 2018). The fishery is separated into four zones. The Operational Areas overlaps Zone 1. Fishing recently recommenced in Zone 1 after a hiatus of several years (Hart *et al.,* 2018). The portion of the total catch in Zone 1 was minor in 2017 (less than 1%) (Hart *et al.,* 2018). Given the fishery is diver-based (i.e. restricted to safe diving depths), interaction with fishery participants during the Petroleum Activities Program is very unlikely. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels**: 19,699 diver hours (Hart *et al*., 2018).
Pilbara Crab Managed Fishery	✓	✓	×	**Description:** The Pilbara Crab Managed Fishery Management Plan came in to effect on 1 November 2018. The Pilbara Crab Managed Fishery comprises Western Australian waters off the north-western coast of WA north of 23° 34′ south latitude and west of 120° 00′ east longitude. The fishery uses traps to take crab of the Family *Portunidae*, excluding crab of the genus *Scylla*. The capacity of the fishery is 600 traps. Areas of the fishery north and east of Exmouth and nearshore are currently closed. The Operational Areas are within Area A of the fishery. Interactions with participants in the fishery during the Petroleum Activities Program are unlikely due to the limited capacity and significant spatial extent of the fishery. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** No information available at this time.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
South West Coast Salmon Managed Fishery	✓	✓	×	**Description:** The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. This fishery uses beach seine nets to take western Australian salmon (*Arripis truttaceus*). No fishing occurs north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/Northern Territory border). No interactions with participants in the fishery will occur during the Petroleum Activities Program. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Not applicable (shore-based).
Specimen Shell Managed Fishery	✓	✓	×	**Description:** The Specimen Shell Managed Fishery can operate in WA State waters within the Operational Areas and EMBA. The Specimen Shell Managed Fishery targets the collection of specimen shells for display, collection, cataloguing and sale. Collection is predominantly by hand when diving or wading in shallow, coastal waters, though a deeper water collection aspect to the fishery has been initiated with the employment of ROVs operating at depths up to 300 m (Hart *et al*., 2018). The fishery encompasses the entire WA coastline but effort is concentrated in area adjacent to the largest population centres, such as Broome, Karratha, Shark Bay, Mandurah, Exmouth, Capes area, Albany and Perth (Hart *et al*., 2018). **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Thirty-one authorisation holders in this fishery with about seven licences recording consistent activity, the number of people employed regularly in the fishery is likely to be about 11 (Hart *et al*., 2018).
West Australian Abalone Fishery	✓	✓	×	**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. The fishery is concentrated on the south coast (greenlip and brownlip abalone) and the west coast (Roe's abalone). Abalone are harvested by divers, limiting the fishery to shallow waters (typically less than 30 m). No commercial fishing for abalone north of Moore River (Zone 8 of the managed fishery) has occurred since 2011–2012 (Strain *et al*., 2018); interactions with participants in the fishery will not occur during the Petroleum Activities Program. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** 22 vessels active in Roe's abalone fishery (Strain *et al*., 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	×	**Description:** The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the WA/Norther Territory border in water depths greater than 150 m within the AFZ, including the Operational Areas. The fishery targets deepwater crustaceans, with the vast majority (more than 99%) of the catch landed in 2016 comprised of crystal crabs (How and Yerman, 2018). Two vessels operated in the fishery in 2016, using baited pots operated in a longline formation in the shelf edge waters, mostly in depths between 500 and 800 m (How and Yerman, 2018). Fishing effort was concentrated between Fremantle and Carnarvon. Given fishing effort is concentrated beyond the Operational Areas and EMBA, interaction between participants in the fishery during the Petroleum Activities Program is unlikely. **Fishery boundary distance from Operational Areas:** Overlaps Operational Areas. **Licences/vessels:** Two active in 2016 (How and Yerman, 2018).
Abrolhos Islands and Mid-West Trawl Fishery	×	✓	×	**Description:** The Abrolhos Islands and Mid-West Trawl Fishery operates outside of the Operational Areas but within the EMBA. The fishery is the second largest scallop fishery in WA, targeting saucer scallops (*Amusium balloti*). Between 2011 and 2015, the fishery experienced low stock due to the marine heatwave in 2010/2011 and subsequent poor spawning stock (Kangas *et al*. 2018b). The fishery remained closed between 2011 and 2016. **Fishing boundary distance from the Operational Areas:** Located 916 km south of the Operational Areas, within the EMBA. **Licences/vessels:** Information about licences or vessels is not available but the Department of Primary Industry and Regional Development reported 774 t of catch from this fishery in the 2018 annual report (DPIRD, 2018).
Broome Prawn Managed Fishery	×	✓	×	**Description:** The Broome Prawn Managed Fishery operates outside of the Operational Areas but within the EMBA and forms part of the North Coast Prawn Fishery. The fishery operates off Broome and targets western king prawns (*Penaeus latisulcatus*) and coral prawns. In 2016, extremely low fishing occurred, as only trial fishing was performed by one boat to investigate whether commercial fishing was warranted (Kangas *et al*., 2018a). **Fishing boundary distance from the Operational Areas:** Located 436 km east of the Operational Areas, within the EMBA. **Licences/vessels:** One vessel operated in 2016 (Gaughan and Santoro, 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Exmouth Gulf Prawn Managed Fishery	×	✓	×	**Description:** The Exmouth Gulf Prawn Managed Fishery is a limited entry fishery, comprising about 16 vessels operating outside of the Operational Areas 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 2016 season, a fishing effort of about 23,000 hours resulted in a catch of 822 t. **Fishing boundary distance from the Operational Areas:** Located 233 km south west of the Operational Areas, within the EMBA. **Licences/vessels:** The precise number of vessels is unreported. Eighteen people were said to be employed in this fishery in 2018 (Gaughan and Santoro, 2018); however, in 2013 it was reported that 18 skippers as well as other crew and support staff were employed (Western Australia Fishing Industry Council [WAFIC], 2019).
Gascoyne Demersal Scalefish Managed Fishery	×	✓	×	**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 and Santoro, 2014), operating outside of the Operational Areas 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 licenced charter and private (Fletcher and 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 to 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 Areas:** Located 429 km south west of the Operational Areas, within EMBA. **Licences/vessels:** Seventeen vessels (Gaughan and Santoro, 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Kimberley Developing Mud Crab Fishery	×	✓	×	**Description:** The Kimberley Developing Mud Crab Fishery is one of two small trap-based crab fisheries that exist in the North Coast Bioregion between Cambridge Gulf and Broome (Gaughan and Santoro, 2018). The other, being the Pilbara Developing Crab Fishery, is outside of the EMBA. The main species targeted are the brown mud crab (*Scylla olivacea*) and green mud crab (*Scylla serrata*). The catch landed represents all commercially caught mud crabs landed in WA for 2017. The catch was significantly higher than 2016 due to increased effort. The catch rate for 2017 was 1 kg per traplift. **Fishing boundary distance from the Operational Areas:** Located 436 km east of the Operational Areas, within the EMBA. **Licences/vessels:** One vessel operated in 2016 (Gaughan and Santoro, 2018).
Nickol Bay Prawn Managed Fishery	×	✓	×	**Description:** The Nickol Bay Prawn Managed Fishery operates in nearshore and offshore waters of the Pilbara region along the NWS, outside of the Operational Areas but within the EMBA region (**Figure 4-13**). 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 and Santoro, 2014). **Fishing boundary distance from the Operational Areas:** Located 75 km east of the Operational Areas, within the EMBA. **Licences/vessels:** The precise number of vessels is unreported, though low effort produced a catch of 17 t in 2016 (Kangas *et al*., 2018a).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Northern Demersal Scalefish Managed Fishery	×	✓	×	**Description:** The Northern Demersal Scalefish Managed Fishery operates outside of the Operational Areas but within the EMBA, targeting demersal scale fish (red emperor, goldband snapper, cod species). The fishery operates all year round. The fishery is divided into two fishing areas: an inshore sector (Area 1) and an offshore sector (Area 2) (Newman *et al*., 2018). Area 1 permits line fishing only, between the high water mark and the 30 m isobath. Area 2 permits handline, dropline and fish trap fishing methods and is further divided into zones. Zone A is an inshore area, Zone B comprises the area with most historical fishing activity, and Zone C is an offshore deep slope area representing waters deeper than 200 m (Fletcher *et al*., 2017). In 2016, the fishery reported a total catch of 1173 t. Most of the catch is landed from Zone B, with a catch of 965 t in 2016 (Newman *et al*., 2018). The fishery currently employs about 24 people based on the seven fishery licenses in operation (WAFIC, 2019). **Fishing boundary distance from the Operational Areas:** Located 436 km east of the Operational Areas, within the EMBA. **Licences/vessels:** Seven vessels (Gaughan and Santoro, 2018).
Octopus Fishery	×	✓	×	**Description:** The octopus fishery in WA operates outside of the Operational Areas but within the EMBA, primarily targeting *Octopus* cf. *tetricus*, with occasional bycatch of *O. ornatus* and *O. cyanea* in the northern parts of the fishery, and *O. maorum* in the southern and deeper sectors. The developing Octopus Fishery operates from Kalbarri Cliffs in the north to Esperance in the south, and uses both passive shelter pots and active traps. In 2016 the fishery had an estimated value of $2.1 million (Hart *et al*., 2018d). In 2016, about 200 vessels reported a total catch of 252 t (Hart *et al*., 2018d). **Fishing boundary distance from the Operational Areas:** Located 791 km south-west of the Operational Areas, within the EMBA. **Licences/vessels:** About 20 vessels fish within the octopus specific fisheries, and about 200 vessels from the West Coast Rock Lobster Fishery catch octopus as bycatch (Gaughan and Santoro, 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Shark Bay Beach Seine and Mesh Net Managed Fishery	×	✓	×	**Description:** The Shark Bay Beach Seine and Mesh Net Managed Fishery operates outside of the Operational Areas but within the EMBA, targeting snapper, whiting, sea mullet, tailor and yellowfin bream. The fishery operates from Denham and uses a combination of beach seine and mesh net gears. The fishery currently employs about 16 fishers based on the seven fishery licenses in operation (WAFIC, 2019). In 2016, the fishery reported a total catch of 178 t (Jackson *et al*., 2018). **Fishing boundary distance from the Operational Areas:** Located 686 km south-west of the Operational Areas, within EMBA. **Licences/vessels:** Seven vessels (Gaughan and Santoro, 2018).
Shark Bay Crab Managed Fishery	×	✓	×	**Description:** The blue swimmer crab (*Portunus armatus*) resource in Shark Bay is harvested commercially by the Shark Bay crab trap and Shark Bay prawn trawl fisheries, both of which operate outside of the Operational Areas but within the EMBA. Commercial fishing for blue swimmer crabs in Shark Bay was voluntarily halted by industry in April 2012 to facilitate stock rebuilding. The stock is still in a recovery phase; however, the fishery has resumed and reported a total commercial catch of 372 t in the 2015/16 season (Chandrapavan *et al*., 2017). **Fishing boundary distance from the Operational Areas:** Located 477 km south-west of the Operational Areas, within the EMBA. **Licences/vessels:** The precise number of vessels in the Shark Bay Blue Swimmer Crab Fishery is unreported; however, about 110 people are employed in this fishery (Gaughan and Santoro, 2018).

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
Shark Bay Prawn and Scallop Managed Fisheries	×	✓	×	**Description:** The Shark Bay Prawn Managed Fishery is the highest producing Western Australian fishery for prawns. It targets the western king prawn (*Penaeus latisulcatus*) and brown tiger prawn (*Penaeus esculentus*) and takes a variety of smaller prawn species, including endeavour prawns (*Metapenaeus* spp.) and coral prawns (various species). In 2017, the value of the fishery was $24 million. The Shark Bay Scallop Managed Fishery targets the saucer scallop (*Amusium balloti*) and is usually WA's most productive scallop fishery, but is currently in a recovery phase due to the results from the pre-season survey of stock abundance (Fletcher and Santoro, 2014; Kangas *et al*., 2018a). They are limited entry and both use low-opening otter trawls as the fishing method and incorporate in-season real time management to ensure sustainability and maximise economic efficiency. The Shark Bay Prawn Managed Fishery reported a catch of 1529 t, and the Shark Bay Scallop Managed Fishery reported a catch of 192 t (meat weight). **Fishing boundary distance from the Operational Areas:** Located 477 km south-west of the Operational Areas, within the EMBA. **Licences/vessels:** The precise number of vessels in the Shark Bay Prawn Managed Fishery is unreported; however, about 100 people are employed in this fishery (Gaughan and Santoro, 2018). About 20 skippers and crew are employed in scallop fishing in the Shark Bay and South Coast fisheries across 18 vessels in 2015 (Sporer *et al*. 2015b).
South Coast Crustacean Managed Fishery	×	✓	×	**Description:** The South Coast Crustacean Managed Fishery comprises four fisheries: the Windy Harbour/Augusta Rock Lobster Managed Fishery, the Esperance Rock Lobster Managed Fishery, the Southern Rock Lobster Pot Regulation Fishery and the South Coast Deep-Sea Crab Fishery. The South Coast Crustacean Managed Fishery is a multiple crustacean species, pot-based fishery. Its targets are the southern rock lobster (*Jasus edwardsii*), western rock lobster (*Panulirus cygnus*), giant crab (*Pseudocarcinus gigas*), crystal crab (*Chaceon albus*) and champagne crab (*Hypothalassia acerba*), depending on the area. The South Coast Crustacean Managed Fishery reported a total catch of 108.5 t in 2017 and the value of the fishery for 2016/2017 was about $6.2 million (Gaughan and Santoro, 2018). **Fishery boundary distance from Operational Areas:** Located more than 1000 km south of the Operational Areas, within the EMBA and extending beyond the EMBA. **Licences/vessels:** The number of vessels is unknown; however, a total of 1977 pots are licensed to be used.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
South Coast Purse Seine Managed Fishery	×	✓	×	**Description**: The South Coast Purse Seine Managed Fishery targets small pelagic finfish such as pilchards and yellowtail scad using purse seine nets from vessels. The fishery is active in coastal waters between Cape Leeuwin and the South Australia border (Norriss and Baudains, 2017b). Landings are primarily at Albany, Bremer Bay and Esperance. **Fishery boundary distance from Operational Areas:** Located more than 1000 km south of the Operational Areas, within the EMBA. **Licences/vessels:** Eleven active vessels in 2017 (Gaughan and Santoro, 2018).
South West Trawl Managed Fishery	×	✓	×	**Description**: The South West Trawl Managed Fishery is a multi-species fishery and includes two of the state's smaller scallop fishing grounds at Fremantle and north of Geographe Bay. Effort in the fishery is highly variable and typically fluctuates in response to recruitment variability in saucer scallops and prawns (Kangas *et al*., 2017b). The fishery was not active in 2015 or 2016. **Fishery boundary distance from Operational Areas:** Located more than 1000 km south from the Operational Areas, within the EMBA. **Licences/vessels:** Only one boat operated in 2017 for a total of 41 boat days (Gaughan and Santoro, 2018).
The South Coast Salmon Managed Fishery	×	✓	×	**Description:** The South Coast Salmon Managed Fishery is one of two fisheries operating in the South Coast Bioregion that target nearshore and estuarine finfish. The South Coast Estuarine Managed Fishery is the other. The South Coast Salmon Managed Fishery targets the nearshore fish species of: Western Australian salmon (*Arripis truttaceus*), southern school whiting (*Sillago bassensis*), Australian herring (*Arripis georgianus*) and King George whiting (*Sillaginodes punctatus*). Estuarine species targeted are sea mullet (*Mugil cephalus*), estuary cobbler (*Cnidoglanis macrocephalus*) and black bream (*Acanthopagrus butcheri*) (Gaughan and Santoro, 2018). The total catch for 2017 was 231 t. **Fishery boundary distance from Operational Areas:** Located more than 1000 km south of the Operational Areas, within the EMBA. **Licences/vessels:** Number of vessels is unknown; however, 12 commercial fishers were employed in 2017.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
West Coast Beach Bait Managed Fishery	×	✓	×	**Description**: The West Coast Beach Bait Managed Fishery targets whitebait. The fishery historically operates using beach-based haul nets. In recent years the fishery is primarily active in the Bunbury area. Total catch of whitebait in 2015 was 95 tonnes (Smith and Holtz, 2017). **Fishery boundary distance from Operational Areas:** Located more than 1000 km south of the Operational Areas, within the EMBA. **Licences/vessels:** Number of vessels is unknown; however, only one license was issued (DPIRD, 2019).
West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery	×	✓	×	**Description:** The West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery operates within the EMBA. It targets predominantly the gummy (*Mustelus antarcticus*), dusky (*Carcharhinus obscurus*), whiskery (*Furgaleus macki*) and sandbar (*C. plumbeus*) shark species. Catch estimated annual value of the fishery was $0.2 million for 2016 to 2017. **Fishery boundary distance from Operational Areas:** Located 741 km south of the Operational Areas, within the EMBA. **Licences/vessels:** Vessel numbers are unknown; however, 17 interim managed fishery permits were held in 2019 (DPIRD, 2019) and between 18 and 21 skippers and crew were employed between 2016 and 2017.
West Coast Demersal Scalefish Fishery	×	✓	×	**Description:** These fisheries target a suite of inshore (20 to 250 m water depth) and offshore (more than 250 m water depth) demersal scalefish species operating outside of the Operational Areas but within the EMBA. These fisheries include the West Coast Demersal Scalefish (Interim) Managed Fishery (51 boats), the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery and the temperate Demersal Gillnet and Demersal Longline Fisheries. The West Coast Demersal Scalefish Managed Fishery is the main commercial fishery that targets demersal species in the West Coast Bioregion. It encompasses the waters from just south of Shark Bay down to just east of Augusta and extends seaward to the 200 nm boundary. The fishery is divided into four inshore management areas and one offshore management area. In 2016, the West Coast Demersal Scalefish (interim) Managed Fishery reported a total catch of 256 t. **Fishing boundary distance from the Operational Areas:** Located 791 km south of the Operational Areas, within the EMBA. **Licences/vessels:** The precise number of vessels in the West Coast Demersal Scalefish Fisheries is unreported; however, it is restricted to 60 interim managed fishery permit holders.

Fishery	Operational Areas	Within EMBA (incl. the Socio-cultural EMBA)	Potential for interaction within Operational Areas	Description
West Coast Purse Seine Managed Fishery	×	✓	×	**Description**: The West Coast Purse Seine Fishery is quota-based and targets small pelagic finfish such as scaly mackerel, pilchards and yellowtail scad. Fishing is by purse seine nets from boats. Most of the catch is sold for pet and aquaculture feed (Norriss and Baudains, 2017a). **Fishery boundary distance from Operational Areas:** Located more than 1000 km from Operational Areas, within the EMBA. **Licences/vessels:** Seven vessels in 2017 (Gaughan and Santoro, 2018).
West Coast Rock Lobster Managed Fishery	×	✓	×	**Description:** The West Coast Rock Lobster Fishery operates outside of the Operational Areas 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 2016, 226 vessels reported a total catch of 6086 t (Gaughan and Santoro, 2018). **Fishing boundary distance from the Operational Areas:** Located 238 km south-west of the Operational Areas, within the EMBA. **Licences/vessels:** Two hundred and thirty-four vessels operated in 2017 (Gaughan and Santoro, 2018).

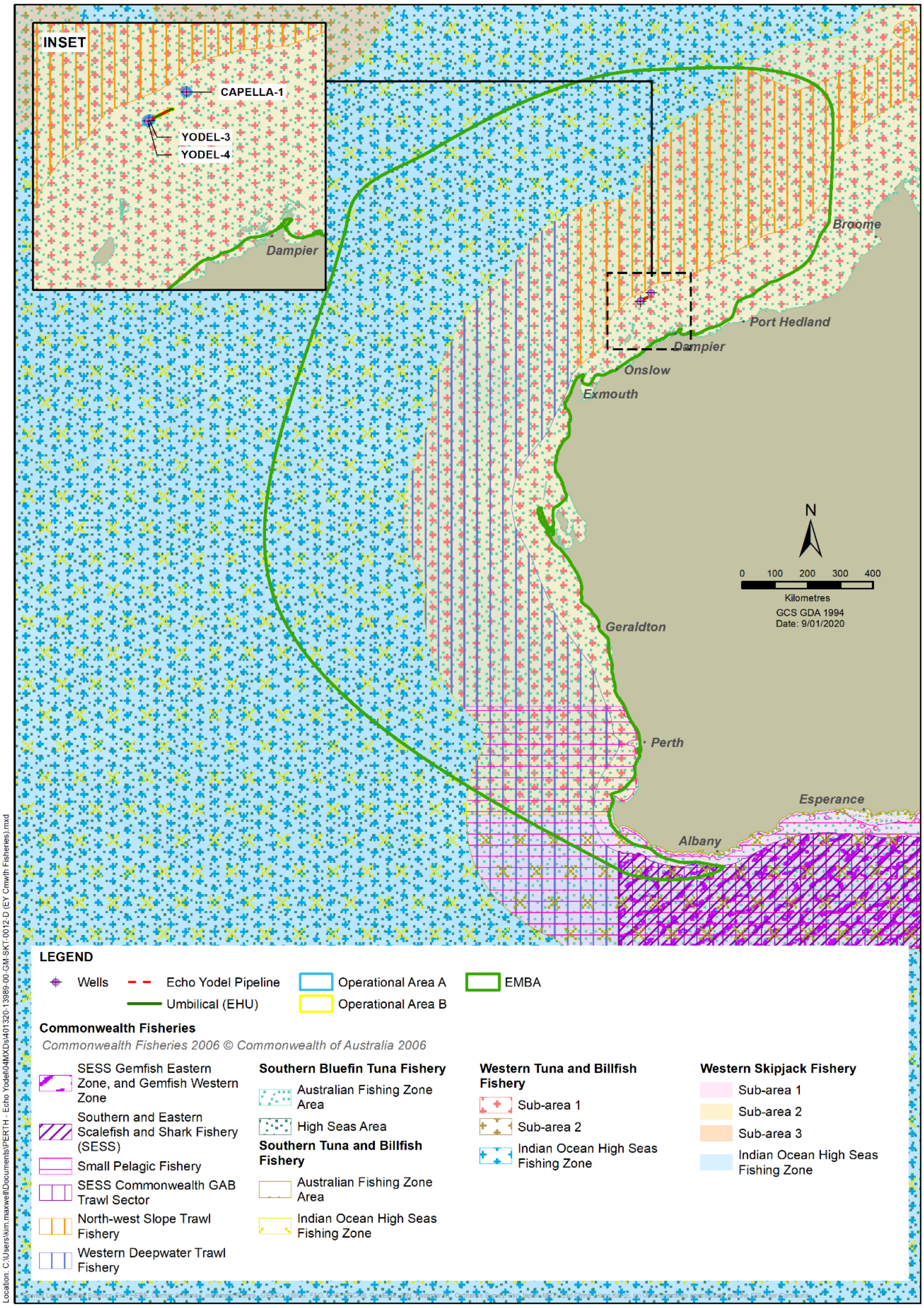

Figure 4-12: Location of Commonwealth fisheries in relation to the Operational Areas

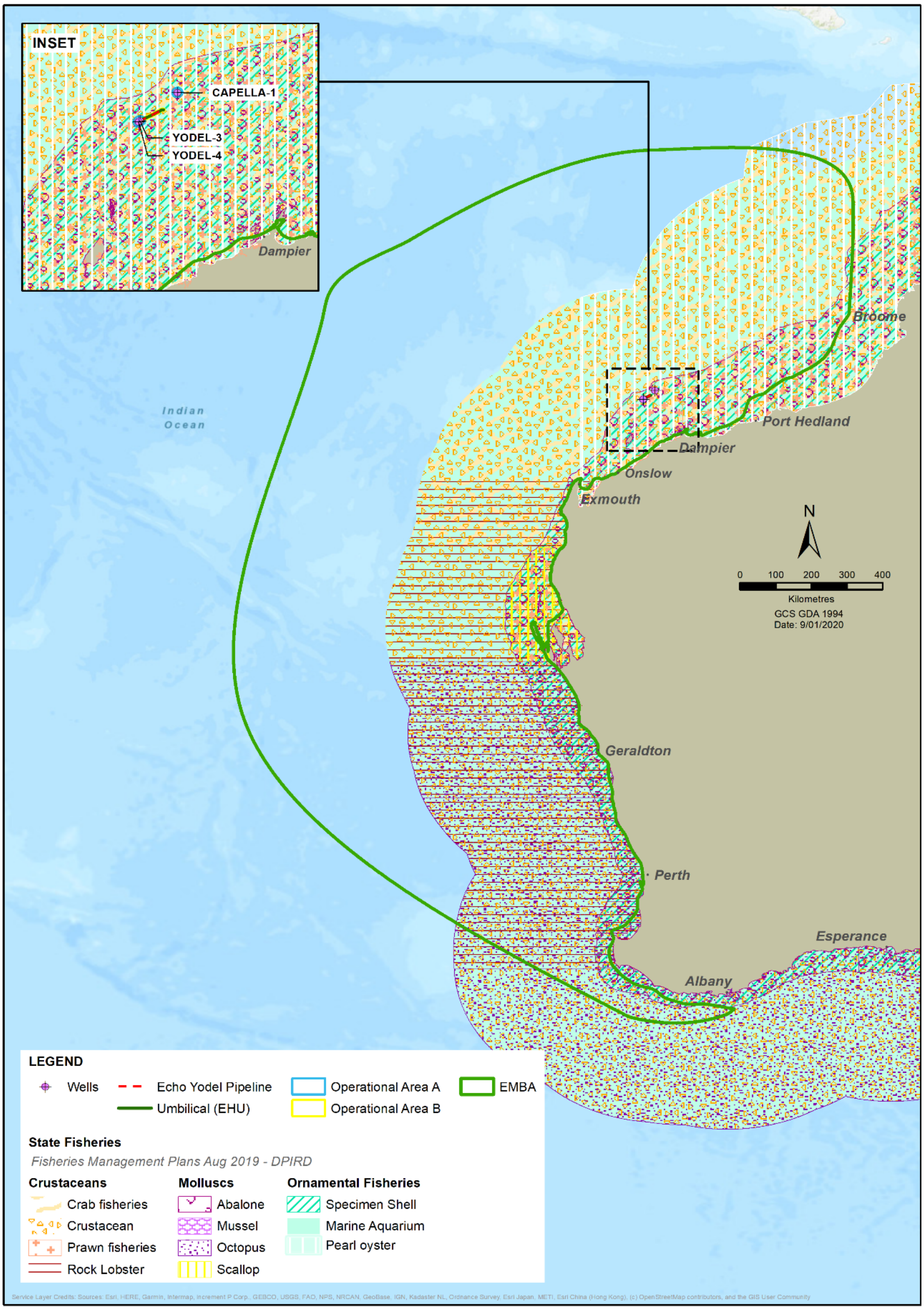

Figure 4-13: Location of State fisheries in relation to the Operational Areas (1 of 2)

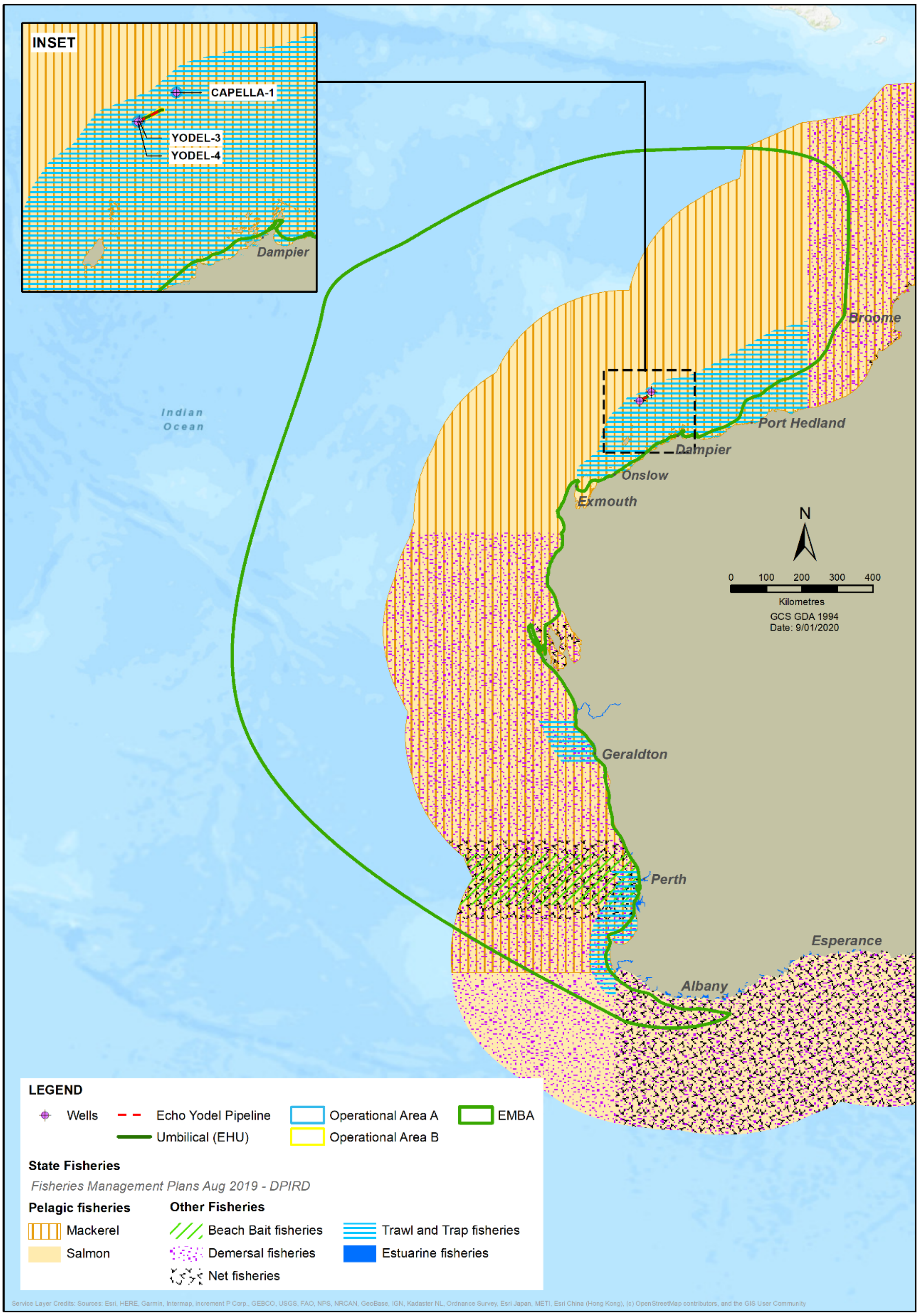

Figure 4-14: Location of State fisheries in relation to the Operational Areas (2 of 2)

4.6.3.2 Aquaculture

There are no aquaculture operations within the Operational Areas as these operations are typically restricted to shallow coastal waters. Aquaculture in the region consists primarily of culturing hatchery reared and wild caught oysters (*Pinctada maxima*) for pearl production, which is primarily centred around Broome and the Dampier Peninsula (outside the EMBA). Leases typically occur in shallow coastal waters at depths of less than 20 m (Fletcher *et al*., 2006). There are existing pearl aquaculture leases at the Montebello Islands, within the Flying Foam Passage in the Dampier Archipelago and within Exmouth Gulf (Fletcher *et al*., 2017), all outside the EMBA.

Other types of aquaculture leases are also found near the Montebello Islands, Dampier Archipelago, the Exmouth Gulf and near Onslow, all within the EMBA.

Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Fletcher *et al*., 2006).

4.6.4 Fisheries – Traditional

There are no traditional or customary fisheries within the Operational Areas, as these are typically restricted to shallow coastal waters and/or areas with structure such as reef. However, it is recognised that Barrow Island and Montebello Islands, the closest islands to the Operational Areas, have a known history of fishing when areas were occupied (as from historical records) (Department of Conservation and Land Management, 2005; Department of Environment and Conservation, 2007).

4.6.5 Tourism and Recreation

No tourist activities occur specifically within the Operational Areas and, given the distance to the nearest access node from the Operational Areas (more than 140 km to the Dampier boat ramp on the Burrup Peninsula, outside the EMBA), recreational fishing effort is not expected. However, it is acknowledged that there are growing tourism and recreational sectors in WA and these sectors have expanded over the last couple of decades. Growth and the potential for further expansion in tourism and recreational activities is recognised for the Pilbara and Gascoyne regions, with the development of regional centres and a workforce associated with the resources sector (SGS Economics and Planning, 2012).

Outside the petroleum industry, tourism is the largest revenue earner of all the major industries of the Gascoyne region. It contributes significantly to the local economy in terms of both income and employment. In 2016 there was an average of 341,000 visitors with a visitor spend of $304 million (Gascoyne Development Commission, 2018). The main marine nature-based tourist activities are concentrated around and within the Ningaloo WHA (about 268 km south-west of the Operational Areas). Activities performed include recreational fishing, game fishing, snorkelling and scuba diving and wildlife watching and encounters (including whale sharks, manta rays, humpback whales and turtles) (Schianetz *et al*., 2009).

The Montebello Islands State Marine Park (about 61 km from the Operational Areas and within the EMBA) is the closest location for tourism, with some charter boat operators taking visitors to these islands (DEC, 2007). Recreational fishing in the Pilbara and Gascoyne regions is mainly concentrated around the coastal waters and islands and has grown considerably with the expanding regional centres, seasonal tourism and increasing residential and fly in/fly out workforce, particularly in the Pilbara region (Fletcher *et al*., 2017). Some recreational fishing has historically occurred at Rankin Bank (about 12 km west of the Operational Areas).

4.6.6 Shipping

The NWMR supports significant commercial shipping activity, most of which is associated with the mining and oil and gas industries.

AMSA has introduced a network of marine fairways across the NWMR 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. A shipping fairway intersects between the Yodel-4 and Capella-1 wellheads, overlapping Operational Area A.

Ports in the region are nodes of increased vessel activities; active ports in the vicinity of the Operational Areas include:

- Dampier (about 140 km south-east)
- Barrow Island (about 100 km south)
- Port Walcott (about 170 km south-east)
- Onslow (about 220 km south)
- Port Hedland (about 250 km south-east).

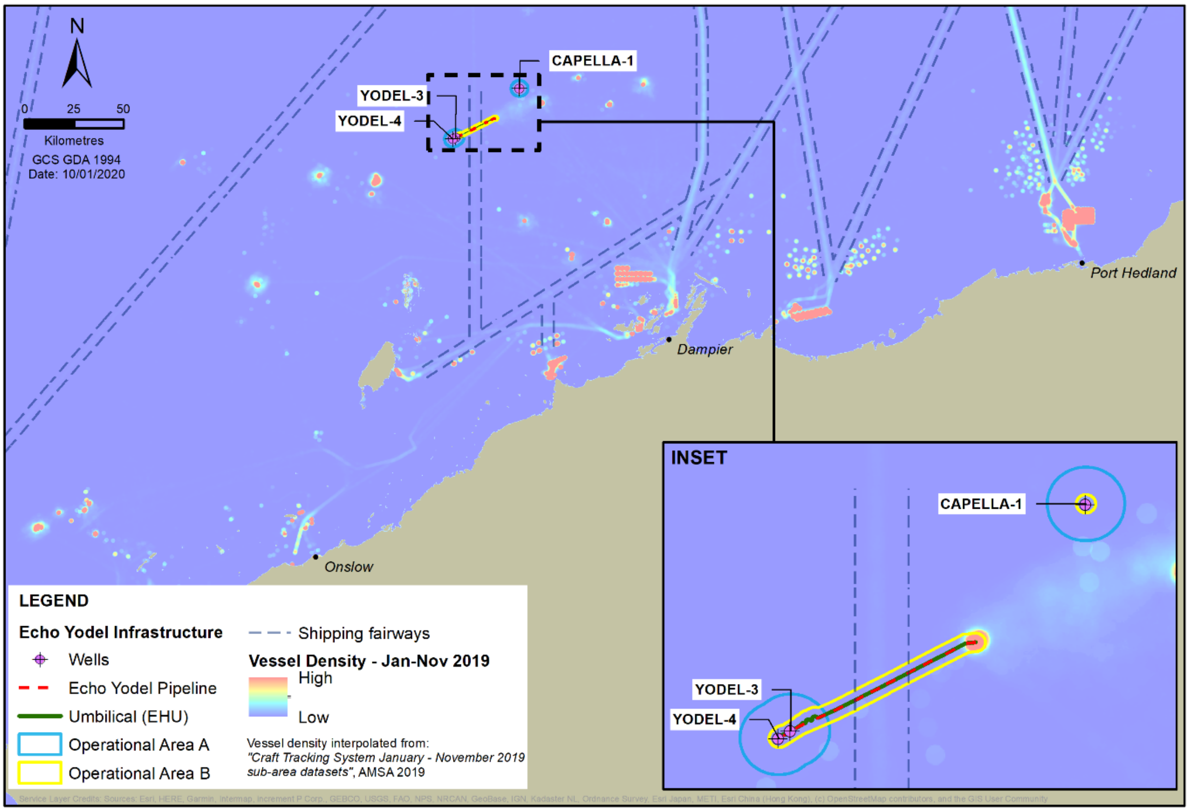

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Figure 4-15: Vessel density map for the Operational Areas from 2019, derived from AMSA satellite tracking system data

4.6.7 Oil and Gas Infrastructure

The Operational Areas are located within an area of established oil and gas operations in the broader NWMR. **Table 4-10** lists other facilities located in proximity to the Operational Areas. Several facilities (platforms and floating production, storage and offloading vessels (FPSOs) and platforms) are currently in operation in the vicinity of the Operational Areas (**Table 4-10**).Two pipelines are also associated with the GWA facility and run parallel to the Echo Yodel pipeline. These are the Greater Western Flank 1 (GWF-1) and Greater Western Flank 2 (GWF-2) pipelines.

Table 4-10: Other oil and gas facilities in the vicinity of the Operational Areas

Facility name and operator	Approximate distance from Operational Areas (km)	Direction
GWA Facility (Woodside)	0.1	North-east
NRC Platforms (Woodside)	22	North-east
Wheatstone Platform (Chevron)	40	South-west
Pluto Platform (Woodside)	46	South-west
Okha FPSO (Woodside)	54	East north-east
Angel Platform (Woodside)	72	East north-east

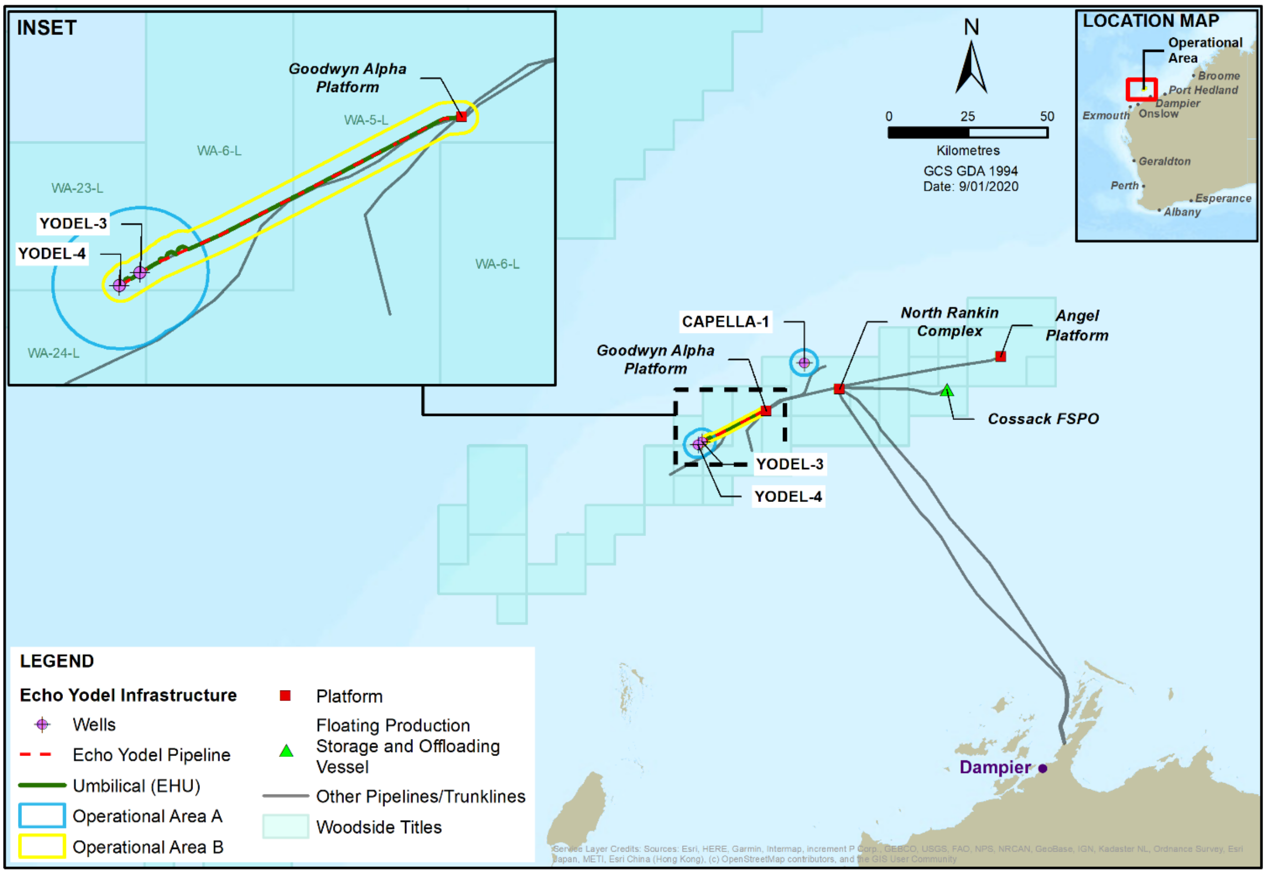

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Figure 4-16: Oil and gas Infrastructure with reference to the location of the Operational Areas

4.6.8 Defence

There are designated Department of Defence (DoD) practice areas in the offshore marine waters off Ningaloo and the North West Cape. This area is associated with the Royal Australian Air Force base located at Learmonth, on North West Cape. However, it does not overlap the Operational Areas (**Figure 4-17**).

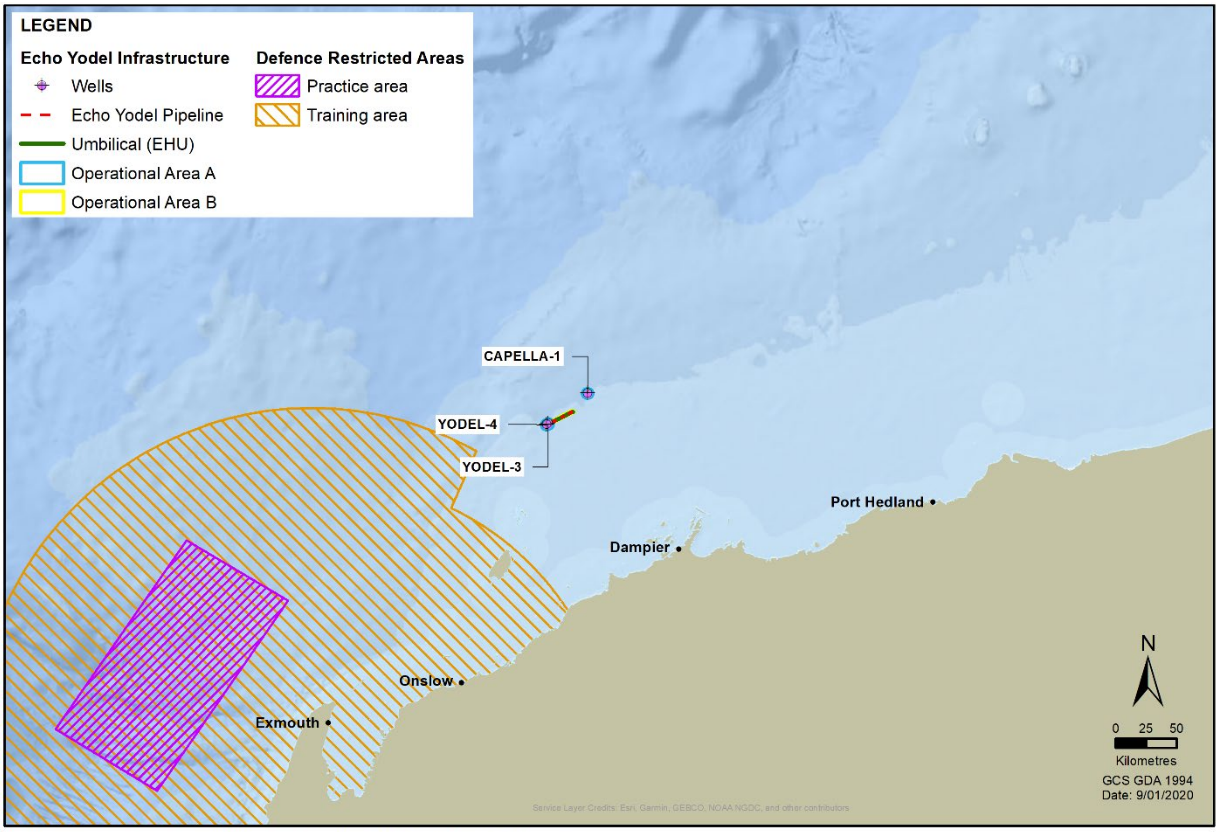

Figure 4-17: DoD Demarcated Marine Offshore Areas for military and defence practice with reference to the location of the Operational Areas

4.7 Values and Sensitivities

The values and sensitivities of the Operational Areas and EMBA are presented in this sub-section. The offshore environment of the NWMR contains environmental assets (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 Islands and the Ningaloo WHA, and the associated resident, temporary or migratory marine life, including species such as marine mammals, turtles and birds.

Many sensitive receptor locations are protected as part of Commonwealth and State managed areas. They have been allocated conservation objectives (IUCN Protected Area Category) based on the Australian IUCN reserve management principles in Schedule 8 of the *EPBC Regulations 2000*.

Particularly, the North-West Marine Parks Network Management Plan 2018 (DNP, 2018) provides for managing the network of AMPs in the North-West Network. The plan states that detailed implementation plans will be developed in the future to set out management actions and identify performance indicators for the North-west Network. However, the plan assigns an IUCN category to each marine park of the North-west Network, divides some marine parks into zones with their own category, and sets out the objectives for each zone. Zoning considers the purposes for which the marine parks were declared, the objectives of the plan, the values of the marine park, and the requirements of the EPBC Act and EPBC Regulations. The management approach applied to activities within these zones are also described in the plan. While the Operational Areas do not overlap any AMPs, 16 do overlap the EMBA. The plan states that actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act, may be conducted in all zones without an authorisation issued by the Director, provided that the actions are taken in accordance with an environment plan that has been accepted by NOPSEMA, and 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, before response action being taken.

The next section outlines the values and sensitivities of the established and proposed Marine Protected Areas (MPAs) and other sensitive areas in the EMBA (listed in **Table 4-11**). These areas are also considered in the environmental risk evaluation of planned and unplanned activities associated with the Petroleum Activities Program.

Table 4-11: Summary of established and proposed MPAs and other sensitive locations in the Operational Areas and EMBA

	Distance from Operational Areas to Values/Sensitivity boundaries (km)	IUCN Protected Area Category** Or Relevant Park Zone
Nearest Habitats of Significant Conservation Value		
Ancient Coastline at 125 m depth contour KEF	Overlaps	N/A
Rankin Bank (50 m bathymetric contour)	12	N/A
Montebello AMP	24	VI – Multiple Use Zone
Continental Slope Demersal Fish Communities KEF	25	N/A
Glomar Shoal	55	N/A
AMPs		
Montebello AMP	24	VI – Multiple Use Zone
Dampier AMP	120	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone
Argo – Rowley Terrace AMP	196	II – Marine National Park Zone VI – Multiple Use Zone VI – Special Purpose Zone
Gascoyne AMP	241	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone
Ningaloo AMP and Ningaloo Coast WHA	268	II – Marine National Park Zone
Eighty Mile Beach AMP	314	VI – Multiple Use Zone
Mermaid Reef AMP	461	II – Marine National Park Zone
Shark Bay AMP and WHA	581	VI – Multiple Use Zone
Carnarvon Canyon AMP	621	IV – Habitat Protection Zone
Kimberley AMP	740	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone
Abrolhos AMP	777	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone VI – Special Purpose Zone
Geographe AMP	More than 1000	IV – Habitat Protection Zone VI – Multiple Use Zone VI – Special Purpose Zone
Jurien Bay AMP	More than 1000	II – Marine National Park Zone VI – Special Purpose Zone
Perth Canyon AMP	More than 1000	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone

	Distance from Operational Areas to Values/Sensitivity boundaries (km)	IUCN Protected Area Category** Or Relevant Park Zone
South-west Corner AMP	More than 1000	II – Marine National Park Zone IV – Habitat Protection Zone VI – Multiple Use Zone VI – Special Purpose Zone
Two Rocks AMP	More than 1000	II – Marine National Park Zone VI – Multiple Use Zone
State Marine Parks and Reserves		
Montebello Islands Marine Park/Barrow Island Marine Management Area (jointly managed)	61	Sanctuary Zone Recreation Zone General Use Zone Special Purpose Zone
Barrow Island Marine Park	103	Sanctuary Zone
Muiron Islands Marine Management Area*	249	Conservation Area Unzoned Area
Ningaloo Marine Park*	269	Sanctuary Zone Recreation Zone General Use Zone Special Purpose Zone
Rowley Shoals Marine Park	370	Sanctuary Zone Recreation Zone General Use Zone
Shark Bay Marine Park	619	Sanctuary Zone Recreation Zone General Use Zone Special Purpose Zone
Bernier and Dorre Islands Nature Reserve	622	Class A Nature Reserve
Jurien Bay Marine Park	More than 1000	Sanctuary Zone General Use Zone Special Purpose Zone
Marmion Marine Park	More than 1000	Sanctuary Zone General Use Zone
Ngari Capes Marine Park	More than 1000	Sanctuary Zone Recreation Zone General Use Zone Special Purpose Zone
Shoalwater Islands Marine Park	More than 1000	Sanctuary Zone General Use Zone Special Purpose Zone
World Heritage Areas		
The Ningaloo Coast	268	N/A
Shark Bay	619	N/A

	Distance from Operational Areas to Values/Sensitivity boundaries (km)	IUCN Protected Area Category** Or Relevant Park Zone
Australian Convict Sites (Fremantle Prison Buffer Zone)	More than 1000	N/A
KEFs		
Ancient coastline at 125 m depth contour	Overlaps	N/A
Continental Slope demersal fish communities	25	N/A
Glomar Shoal	55	N/A
Exmouth Plateau	145	N/A
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	221	N/A
Commonwealth waters adjacent to Ningaloo Reef	268	N/A
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	362	N/A
Canyons linking the Argo Abyssal Plain with the Scott Plateau	700	N/A
Western Demersal Slope and associated fish communities of the Central Western Province	745	N/A
Wallaby saddle	791	N/A
Western rock lobster	901	N/A
Ancient coastline at 90 to 120 m depth	918	N/A
Commonwealth marine environment within and adjacent to the west-coast inshore lagoons	940	N/A
Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break)	951	N/A
Perth Canyon and adjacent shelf break and other west-coast canyons	965	N/A
Albany Canyons group and adjacent shelf break	More than 1000	N/A
Cape Mentelle upwelling	More than 1000	N/A
Naturaliste Plateau	More than 1000	N/A
Other sensitivities		
Rankin Bank	12	N/A

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: national Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

*** IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North-west Marine Parks Network Management Plan 2018 and South-west Marine Parks Network Management Plan 2018.*

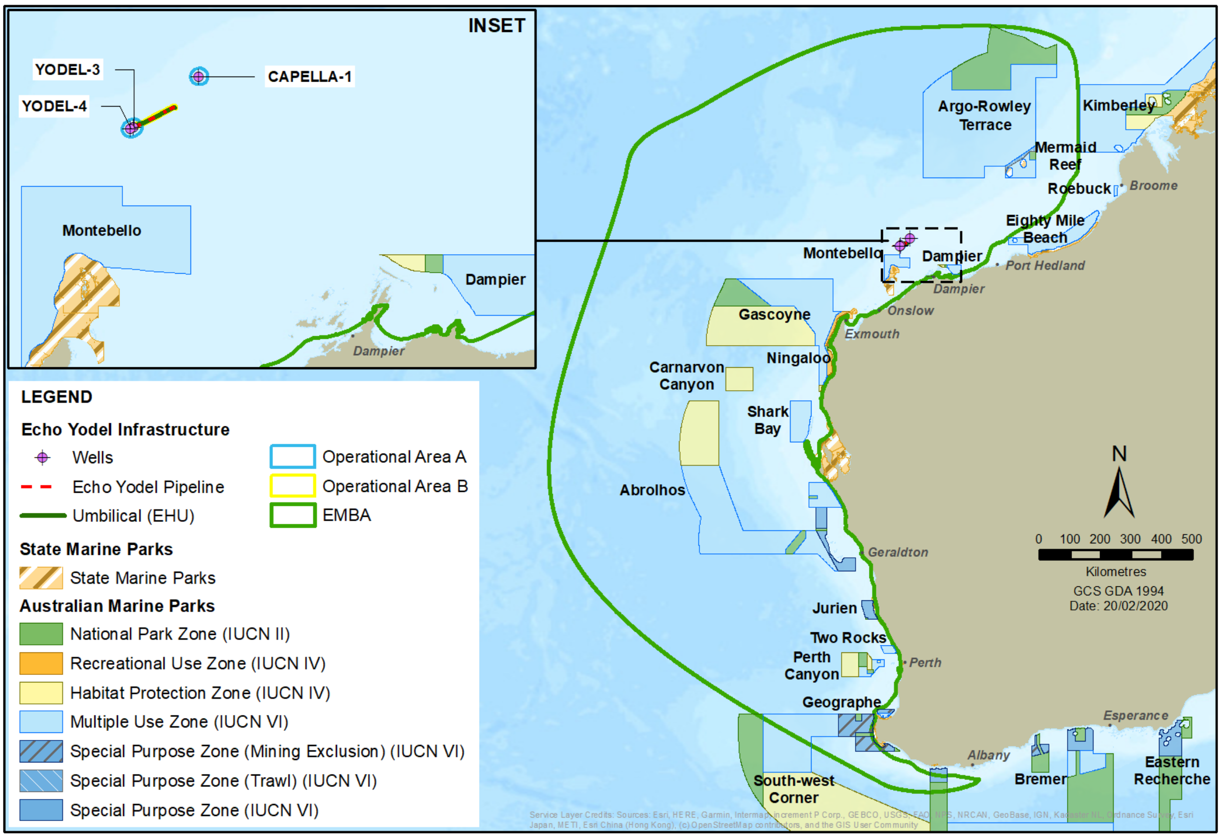

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Figure 4-18: Established and proposed Commonwealth and State Marine Protected Areas in relation to the Operational Areas

4.7.1 Australian Marine Parks

There are no AMPs within the Operational Areas; however, there are a number of AMPs within the EMBA as listed in **Table 4-11**.

Due to the large number of AMPs within the EMBA, only those where there is a 1% or more probability of contact at the oil spill modelling thresholds have been described in detail.

Table 4-12: Australian Marine Parks

Australian Marine Parks within the EMBA	1% or more probability of contact at oil spill modelling thresholds
Argo-Rowley Terrace	✓
Kimberley	×
Rowley Shoals – Mermaid Reef	✓
Eighty Mile Beach	×
Dampier	✓
Montebello	✓
Gascoyne	✓
Ningaloo	✓
Shark Bay	✓
Carnarvon Canyon	✓
Abrolhos Island	✓
Jurien	✓
Two Rocks	✓
Perth Canyon	✓
Geographe	×
South-west Corner	×

4.7.1.1 Montebello Australian Marine Park

The Montebello AMP is adjacent to the Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area, providing a contiguous marine park covering both State and Commonwealth waters. The entire Montebello AMP, an area of 341,300 ha, is designated a multiple use zone (IUCN Category VI), allowing for long-term protection and maintenance of the AMP in conjunction with sustainable use, including oil and gas exploration activities. It is located within 24 km of the Operational Areas.

Major natural values within the Montebello AMP include (DoEE, n.d.; Director of National Parks, 2018):

- habitats, species and ecological communities associated with the North West Shelf Province
- BIAs for a range of MNES
- two historic shipwrecks: the Trial and the Tanami
- diverse social values including tourism, fishing, mining and recreation
- foraging areas adjacent to important nesting sites for marine turtles
- part of the migratory pathway of the protected humpback whale
- examples of the seafloor habitats and communities of the NWMR as well as the Pilbara (offshore) mesoscale bioregion (Heap *et al*., 2005)
- one KEF for the region: the Ancient Coastline at 125 m Depth Contour
- shallow shelf environments with depths ranging from 15 to 150 m and protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features. This includes Tryal Rocks which can emerge from the water.

4.7.1.2 Rowley Shoals – Mermaid Reef Marine Park

The Mermaid Reef Australian Marine Park encompasses Mermaid Reef and covers 540 km²: it is classified as an IUCN protected area category 1a, Sanctuary Zone (Strict Nature Reserve). Mermaid Reef is one of the best geological examples of a shelf-edge reef in Australian waters (one of three oceanic reefs that form the Rowley Shoals). It is the only reef of the Rowley Shoals located entirely in Commonwealth waters. Mermaid Reef is an oval reef formation that extends from depths greater than 500 m, is surrounded by oceanic waters, and contains a variety of marine habitats that include outer reef slopes, reef flats, reef crest (emergent at low tide), enclosed lagoon with narrow channels linking to the surrounding ocean, and submerged sand banks.

Mermaid Reef supports rich coral communities (216 species of hard coral, 12 genera of soft corals) and a high diversity of associated sessile and mobile invertebrates (echinoderms, molluscs and crustaceans), more than 390 reef and pelagic fish species, and a variety of sharks that frequent the reef habitats. EPBC Act species frequent the area, including migratory seabirds (19 species), marine reptiles and cetaceans.

Mermaid Reef has very good water quality due to the remote offshore location and absence of terrigenous and anthropogenic influences (such as land runoff). The reef is influenced by the ITF, with surrounding oceanic waters being warm, nutrient poor, of low salinity and dynamic (wave action, currents and tidal regime).

The Mermaid Reef AMP also included the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF. Values of the KEF include:

- Fauna and flora exhibit a strong affinity to the Indonesian region as compared with WA’s coastal areas.
- Mermaid Reef is considered to be a site of enhanced biological productivity, due to the breaking of internal waves (generated by internal tides) which leads to re-suspension of nutrients into the photic zone, triggering primary productivity.

The natural values of the Mermaid Reef AMP include (Director of National Parks, 2018a):

- The marine park supports a range of species.
- Biologically important areas are within the AMP, including breeding habitat for seabirds and migratory routes for pygmy blue whale.
- Ecosystems are associated with emergent reef flat, deep reef flat, lagoon and submerged sand habitats.

4.7.1.3 Argo-Rowley Terrace Marine Park

The Argo-Rowley Terrace AMP covers 146,099 km² of the AMP 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 to 6000 m.

The natural values of the Argo-Rowley Terrace AMP include (Director of National Parks, 2018a):

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

4.7.1.4 Shark Bay Marine Park

The Shark Bay AMP covers about 7443 km² and includes waters in the depth range of about 15 to 220 m (DoEE, n.d.). The marine park encompasses offshore waters that buffer the State waters of Shark Bay and the barrier islands of Dirk Hartog, Dorre and Bernier. The marine park contains a number of natural values (as listed below) and social values relating to marine nature-based tourism and recreation (water-sports and fishing), including:

- A foraging area is adjacent to important breeding areas for several species of migratory birds.
- It includes part of the migratory pathway of protected humpback whales.
- It is adjacent to the largest nesting area for loggerhead turtles (the largest in Australia).
- It provides protection to shelf and slope habitats as well as terrace features.
- It contains examples of shallower ecosystems of the Central Western Shelf Province and Central Western Transition provincial bioregions including the Zutydorp Meso-Scale bioregions.
- It provides connectivity between inshore waters of the Shark Bay WHA and deeper waters offshore.
- The Shark Bay Marine Park was gazetted in 1990 as a Class A Marine Park Reserve and encompasses an area of 7487 km². The values of the Marine Park are consistent with those of the WHA, as described in **Sections 4.7.1.1** to **4.7.1.12**.
- Stromatolites, in the hypersaline Hamelin Pool, represent the oldest form of life on earth and are comparable to living fossils.
- It is one of the few marine areas in the world dominated by carbonates not associated with reef-building corals.
- One of the largest seagrass meadows in the world is there, covering 103,000 ha, with the most seagrass species recorded in one area.
- Marine fauna such as dugong, dolphins, sharks, rays, turtles, fish and migratory seabirds occur in great numbers.
- The hydrologic structure of Shark Bay, altered by the formation of the Faure Sill and a high evaporation, has produced a basin where marine waters are hypersaline (almost twice that of seawater) and contributed to extensive beaches consisting entirely of shells.
- The Wooramel Seagrass Bank is also of great geological interest due to the extensive deposit of limestone sands associated with the bank, formed by the precipitation of calcium carbonate from hypersaline waters.
- Shark Bay provides outstanding examples of processes of biological and geomorphic evolution occurring in a largely unmodified environment.
- One of the exceptional features of Shark Bay is the steep gradient in salinities, creating three biotic zones that have a marked effect on the distribution and abundance of marine organisms.
- Shark Bay is a refuge for many globally threatened species of plants and animals.
- The property contains either the only or major populations of five globally threatened mammals, including the burrowing bettong (now classified as Near Threatened), Rufous hare wallaby, banded hare wallaby, the Shark Bay mouse and the western barred bandicoot.
- Significant population of dugongs, considered to represent up to 10% of the global population, use seagrass habitats for foraging and nursing year-round and breed during the summer months.

- It represents breeding habitat for 14 species of seabirds, and more than 50 other seabirds pass through the area.
- A major loggerhead turtle nesting site on Dirk Hartog Island.
- A minor nesting area is on the islands for green turtles.
- It contains habitat for whale sharks and manta rays.
- It has important staging and socialising locations for humpback whales during their annual migration.
- There is a large population of resident Indo-Pacific bottlenose dolphins, estimated to number between 2000 and 3000 individuals (Preen *et al*., 1997).

4.7.1.5 Abrolhos Islands Marine Park

Abrolhos Marine Park is located in the Commonwealth waters adjacent to the Houtman Abrolhos Islands, about 27 km south-west of Geraldton. The Abrolhos Marine Park covers an area of about 88,060 km² with water depths between 15 to 6000 m. The Abrolhos Islands Marine Park is one of Australia's most important seabird breeding areas, with more than one million known breeding pairs on the Houtman Abrolhos Islands and foraging in the park's waters, relying on the marine life there to raise their young. The islands support Australia's only known breeding population of lesser noddies.

This marine park hosts a unique community of tropical and temperate species owing to the mixing of the warm tropical waters of the Leeuwin Current and colder waters more typical of lower latitudes. The northernmost breeding colony of sea lions can be found sharing habitat with an abundance of reef sharks, and coral reefs are interspersed with benthic algae.

The natural values of the Abrolhos Islands AMP are as follows (Director of National Parks, 2018b):

- The AMP contains examples of ecosystems representative of the central western province, central western shelf province, central western transition and south-west shelf transition.
- There are seven KEFs within the AMP.
- The AMP supports a range of species, including those that are listed under the EPBC Act, and their biologically important areas for activities such as foraging and migration.

4.7.1.6 Carnarvon Canyon Marine Park

The Carnarvon Canyon AMP covers an area of about 6177 km², including waters between 1500 and 6000 m approximate depth. The entire AMP is zoned as a Habitat Protection Zone (IUCN Category IV).

Major natural values include (Director of National Parks, 2018a):

- It contains the whole of the Carnarvon Canyon – a single channel canyon – along with representations of slope, continental rise and deep hole and valleys.
- The Carnarvon Canyon ranges in depth from 1500 m to more than 5000 m and hence provides a wide range of habitats for benthic and demersal species.
- Examples of the ecosystems of the Central Western Transition provincial bioregion, the reserve lies in a biogeographic faunal transition between tropical and temperate species.

4.7.1.7 Dampier Marine Park

Dampier Marine Park is located 40 km from Dampier and about 10 km north-east of Cape Lambert, WA. Dampier Marine Park provides protection for offshore shelf habitats adjacent to the Dampier Archipelago, and includes several submerged coral reefs and shoals, including Delambre Reef and

Tessa Shoals. It is also important internesting habitat for flatback, hawksbill, loggerhead and green turtles.

The Ngarluma, Yindjibarndi, Yaburara and Mardudhunera people have responsibilities for sea country in the marine park. It covers 1252 km², with depths from less than 15 to 70 m. It has a National Park, Habitat Protection and Multiple Use Zones.

Important activities in this area include:

- shipping and port operations
- commercial fishing
- recreational fishing.

4.7.1.8 Gascoyne Marine Park

The Gascoyne AMP covers about 81,766 km² and includes waters from less than 15 m depth to 6000 m depth. Conservation values identified within the reserve include (DoEE n.d.):

- It contains foraging areas for migratory seabirds (including the wedge-tailed shearwater), hawksbill and flatback turtles and whale sharks.
- It is a continuous connectivity corridor from 15 to over 5000 m.
- Seafloor features include canyon, terrace, ridge, knolls, deep hole/valley and continental rise.
- Sponge gardens are in the south of the reserve, adjacent to Western Australian coastal waters.
- It contains examples of the ecosystems of the Central Western Shelf Transition, the Central Western Transition and the NWP provincial bioregions, as well as the Ningaloo mesoscale bioregion.
- The reserve contains three key conservation values for the region:
  - canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula (associated enhanced productivity, aggregations of marine life and unique sea-floor feature)
  - Exmouth Plateau (unique seafloor feature associated with internal wave generation)
  - 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).
- The reserve boundary is adjacent to the existing Commonwealth portion of the Ningaloo marine protected area.

4.7.1.9 Ningaloo Marine Park

The Ningaloo Australian Marine Park covers 2435 km² and is about 10 km north of Exmouth. It is contiguous with the Western Australian Ningaloo Marine Park. The Ningaloo Australian Marine Park is located about 200 km south-west of the Operational Areas but within the EMBA. The Ningaloo Australian Marine Park 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 ecosystems.

4.7.1.10 Jurien Bay Marine Park

The Jurien Bay Marine Park lies within State waters and encompasses an area of 823 km², of which 31 km² are sanctuary zones, 14 km² are aquaculture/special purpose zones, and 778 km² are general use zones. Values within the Jurien Bay Marine Park include:

- ecological values:
  - geomorphology, such as intertidal reef platforms
  - water and sediment quality
  - seagrass meadows and macroalgal communities
  - fauna such as seabirds, invertebrate communities, finfish, sea lions, cetaceans and turtles.
- social values:
  - Aboriginal heritage and maritime heritage
  - commercial fishing, recreational fishing and aquaculture
  - coastal use
  - seascapes
  - marine nature-based tourism and water sports
  - petroleum drilling and mineral development
  - scientific research and education.

4.7.1.11 Perth Canyon Marine Park

The Perth Canyon AMP covers about 7409 km², with water depths ranging from less than 120 to 5000 m. The main natural values of the reserve include:

- important seasonal feeding aggregation for the threatened blue whale
- important foraging areas for the threatened soft-plumaged petrel, migratory sperm whale and migratory wedge-tailed shearwater
- important migratory areas for protected humpback whale.

4.7.1.12 Two Rocks Marine Park

The Two Rocks AMP covers about 882 km², of which 7 km² is zoned as marine national park and 875 km² is zoned as multiple use. The depth range of the reserve covers 15 to 120 m, and includes representative marine habitats of the continental shelf in the region. Environmental values within the Two Rocks AMP include important foraging areas for the:

- threatened soft-plumaged petrel
- threatened Australian sea lion
- migratory roseate tern, bridled tern, Caspian tern, wedge-tailed shearwater and common noddy

- important migratory areas for protected humpback whales
- examples of the ecosystem of the southernmost parts of the South-west Shelf Transition (including the Central West Coast meso-scale bioregion).

4.7.2 State Marine Parks and Reserves

There are no State Marine Parks or Reserves within the Operational Areas; however, there are a number of these within the EMBA as listed in **Table 4-11**.

Due to the large number of State Marine Parks and Reserves within the EMBA, only those where there is a 1% or more probability of contact at the oil spill modelling thresholds have been described in detail.

Table 4-13: State Marine Parks and Reserves

State Marine Parks and Reserves within the EMBA	1% or more probability of contact at oil spill modelling thresholds
Montebello Islands Marine Park/Barrow Island Marine Management Area (jointly managed)	✓
Barrow Island Marine Park	✓
Bernier and Dorre Islands Nature Reserve	The islands within the Shark Bay area (refer to **Section 4.7.1.4** for description of values)
Muiron Islands Marine Management Area	✓
Ningaloo Marine Park	✓
Rowley Shoals Marine Park	✓
Jurien Bay Marine Park	✓
Marmion Marine Park	
Ngari Capes Marine Park	✓
Shoalwater Islands Marine Park	
Shark Bay Marine Park	State component of the Shark Bay WHA with values similar to Shark Bay AMP (refer to **Section 4.7.1.4** for description of values)

4.7.2.1 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 located 61 km, 103 km and 61 km respectively from the Operational Areas at their closest point and, with the Montebello AMP and Rankin Bank, are some of the closest sensitive environments to the Operational Areas and within the EMBA. The marine parks and management area are jointly managed and cover a combined area of 1770 km². A sanctuary zone covers the entire 41 km² Barrow Island Marine Park. The Barrow Island Marine Management Area covers 1145 km² 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
- historical culture of the pearl oyster (*Pinctada maxima*) in the reserves, producing some of the highest quality pearls in the world.

These islands support significant colonies of wedge-tailed shearwaters and bridled terns. The Montebello Islands support the biggest breeding population of roseate terns in WA. 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 NWMR, 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 AMP. The intertidal habitats of the Montebello/Barrow/Lowendal islands group are influenced by the passage of tropical cyclones that shape sandy beaches (RPS Bowman Bishaw Gorham, 2007). 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 Bowman Bishaw Gorham, 2007).

4.7.2.2 Barrow Island Nature Reserve

The Barrow Island Nature Reserve is a Class A Nature Reserve covering about 235 km² and extends to the low water mark adjacent to the Montebello Islands/Barrow Island Marine Parks. It is located about 103 km from the Operational Areas. The islands surrounding Barrow Island including Boodie, Double and Middle islands make up the Boodie, Double and Middle Islands Nature Reserve, covering 587 ha (Department of Parks and Wildlife, 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. Key conservation values within the reserves include (DPaW, 2015):

- the second largest island off the WA coast
- important biological refuge site because of isolation from certain threatening processes on the mainland
- flora that are restricted in distribution and at or near the limit of their range
- high number of fauna species with high conservation value
- extensive hydrogeological karst system that supports a subterranean community of high conservation significance
- regionally and nationally significant rookeries for green and flatback turtles

- important habitat for migratory shorebirds and also used by these species as a staging and destination terminus
- significant habitat values, such as intertidal mudflats, rock platforms, mangroves, rock piles and cliffs, clay pans and caves
- a significant fossil record that indicates local historical biodiversity and evolution
- a history of Aboriginal and other Australian use including 13 registered Aboriginal cultural heritage sites.

4.7.2.3 Lowendal Islands Nature Reserve

The Barrow Island Marine Management Area includes the waters around the Lowendal Islands, which covers 1145 km². The Lowendal Islands Nature Reserve incorporates the islands of the Lowendal Archipelago, about 15 km south of Montebello Islands and 95 km from the Operational Areas.

The Lowendal Island group is made up of 34 islands and islets, with the largest being Varanus Island at 0.83 km². The islands are limestone rocks that extend a few metres above the sea level and have sparse vegetation (DSEWPaC, 2012b).

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, 2012b) and an 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.

4.7.2.4 Rowley Shoals – Imperieuse Reef State Marine Park and Clerke Reef State Marine Park

The Rowley Shoals Marine Park comprises two reefs of the Rowley Shoals reef system, namely Clerke and Imperieuse reefs. This marine park is characterised by complex intertidal and subtidal reefs, diverse marine fauna and high water quality. Key conservation values associated with the park include (MPRA, 2007):

- intertidal and subtidal coral communities
- high water quality
- diverse non-coral invertebrate communities
- diverse fish fauna
- breeding habitat for seabirds
- foraging and resting habitat for migratory seabirds.

The marine park is located in the headwaters of the Leeuwin Current and is thought to provide a source of invertebrate and fish recruitment for reefs further south. This is considered regionally important (MPRA, 2007). Marine turtles are known to visit Mermaid Reef, and isolated instances of turtles nesting in the Rowley Shoals Marine Park have been recorded.

The Rowley Shoals are also identified as breeding grounds for red-tailed tropicbirds, white-tailed tropicbirds and little terns; however, numbers are generally low. For example, only a single pair of white-tailed tropic birds nest on Bedwell Island on Clerke Reef.

4.7.2.5 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 Muiron Islands Marine Management Area (MMA) is managed under the same management plan as the Ningaloo State Marine Park (CALM, 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 (CALM, 2005). The ecological and conservation values include:

- The 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) are 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 important primary producers providing habitat for vertebrate and invertebrate fauna.
- Mangrove communities occur only in the northern part of the Ningaloo Marine Park, are important for reef fish communities (Cassata and 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 being 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.
- 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 n.d.).

- There is annual mass coral spawning 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 (Rosser and Gilmour, 2008; Taylor and Pearce, 1999).
- 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. 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 (CALM, 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).
- It contains nesting and foraging habitat 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 Marine Park has a number of social values including cultural heritage and marine based tourism and recreation (water-sports and fishing). The Ningaloo Marine Park (State waters) is contiguous with the Ningaloo Commonwealth Marine Reserve.

The Management Plan for the Ningaloo Marine Park and Muiron Islands MMA outlines objectives for retaining the values of this protected area and any potential or existing threats that could impact these values.

4.7.2.6 Jurien Bay Marine Park

The Jurien Bay Marine Park is located on the central west coast of Western Australia and covers an area of 82,375 ha. The values of the marine park include:

- Geomorphology: It contains a complex seabed and coastal topography consisting of islands, sub-tidal and inter-tidal limestone reefs, protected inshore lagoons and deeper basins, beaches and headlands.
- Intertidal reef platforms: A diverse range of intertidal reef platforms occur in the marine park, ranging from highly protected reefs to reefs fully exposed to the action of swell waves.
- Water and sediment quality: The waters and sediments of the marine park are largely pristine and are essential to the maintenance of a healthy marine ecosystem.
- Seagrass meadows: Extensive and diverse perennial seagrass meadows are an important habitat and nursery area for marine life and are important primary producers.
- Macroalgal communities: Extensive subtidal macroalgal communities with high floral diversity occur in the marine park. These communities are important primary producers and refuge areas for diverse fish and invertebrate assemblages.
- Seabirds: Islands within the marine park are nesting areas for at least 15 species of seabirds, which are a major feature of the coastal environment of the Central West Coast region.
- Invertebrate communities: It has diverse marine invertebrate community, which includes a number of endemic species.

- Finfish: A rich amount of finfish fauna is there, which includes an interesting mix of tropical, sub-tropical and temperate species.

4.7.2.7 Ngari Capes Marine Park

The Ngari Capes Marine Park is located off the southwest coast of Western Australia, covering about 123,790 hectares.

The ecological values of the marine park include:

- Water quality (key performance indicator [KPI]): The clear waters of the marine park provide for a healthy marine ecosystem.
- Seagrass communities (KPI): Seagrasses in the marine park are highly diverse and include endemic and rare deepwater species. Seagrass is an important primary producer and provides spawning and nursery habitat for a wide range of finfish and invertebrates.
- Intertidal reef communities (KPI): Intertidal reef communities consist of a diverse range of reef-dependent plants and animals that are adapted to live within shallow, high-energy environments.
- Shallow subtidal reef communities (KPI): Shallow subtidal reef communities consist of a diverse range of reef-dependent plants and animals that are adapted to live within relatively shallow, high-energy environments that may be influenced by strong currents.
- Deep reef communities (KPI): Deep reef communities in the marine park consist of a diverse range of reef-dependent plants and animals that are adapted to live within deep, low and high-energy environments that may be light limited and influenced by strong currents.
- Coral communities: The coral communities consist of both tropical and temperate species. Their presence is influenced by substrate, depth, availability of food and interaction of the Capes and Leeuwin currents.
- Invertebrate communities (excluding corals) (KPI): The invertebrate communities consist of both tropical and temperate species. Their presence is influenced by substrate, depth, availability of food and the interaction of the Capes and Leeuwin currents. Species exhibit high levels of endemism.
- Finfish (KPI): The finfish fauna of the marine park consists of tropical and temperate species whose presence is influenced by habitat type, depth, availability of food and the influences of the Capes and Leeuwin currents.
- Cetaceans and pinnipeds: Cetaceans (whales and dolphins) and pinnipeds (seals and sea lions) are resident in or transient through the marine park.
- Seabirds and shorebirds: The diverse range of seabirds and shorebirds of the marine park include resident, transient and migratory species whose presence is influenced by the availability of prey and of habitat for breeding, nesting and roosting.

4.7.3 Key Ecological Features

KEFs are the parts of the marine ecosystem that are considered to be important for a marine region's biodiversity or ecosystem function and integrity. KEFs have been identified by the Australian Government based on advice from scientists about the ecological processes and characteristics of the area.

KEFs meet one or more of the following criteria:

- a species, group of species, or a community with a regionally important ecological role (e.g. a predator, prey that affects a large biomass or number of other marine species)

- a species, group of species or a community that is nationally or regionally important for biodiversity
- an area or habitat that is nationally or regionally important for:
  - enhanced or high productivity (such as predictable upwellings – an upwelling occurs when cold nutrient-rich waters from the bottom of the ocean rise to the surface)
  - aggregations of marine life (such as feeding, resting, breeding or nursery areas), or
  - biodiversity and endemism (species which only occur in a specific area).
- a unique seafloor feature, with known or presumed ecological properties of regional significance.

KEFs were identified in the Operational Areas and EMBA using the EPBC PMST (**Appendix C**). **Figure 4-19** shows these features in relation to the Operational Areas.

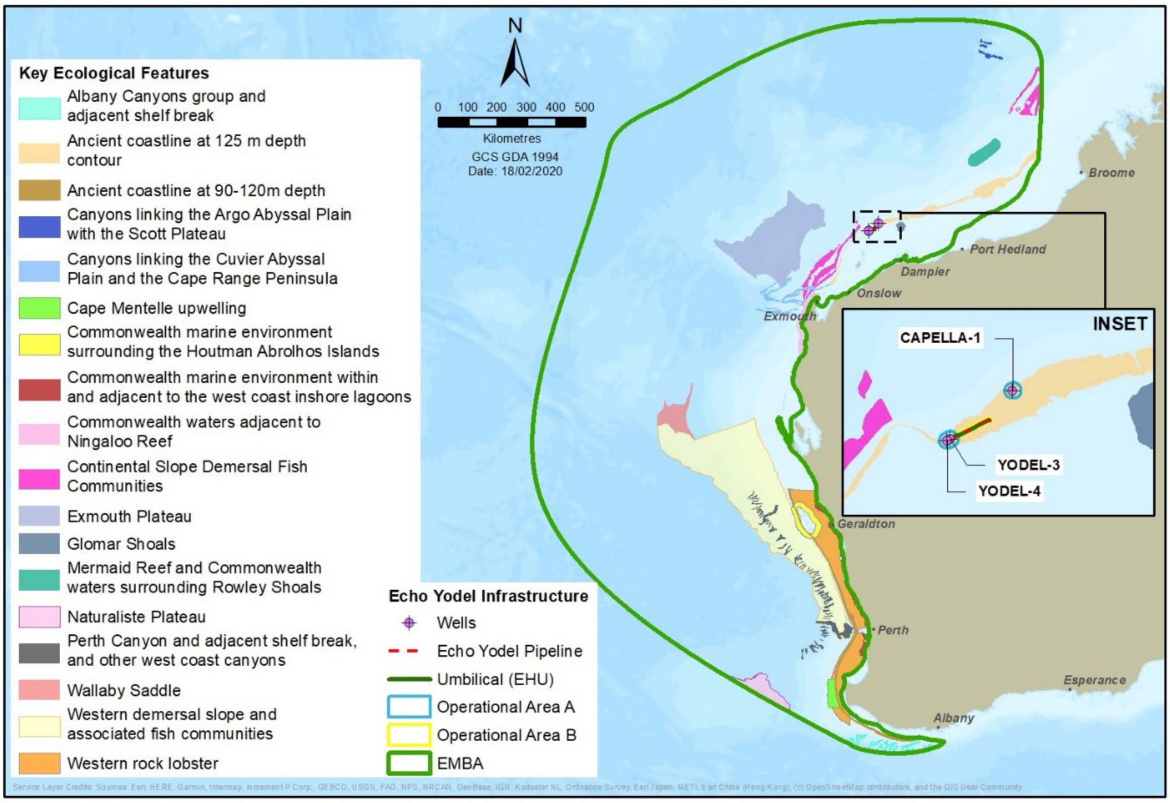

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Figure 4-19: KEFs in relation to the Operational Areas

4.7.3.1 Ancient Coastline at 125 m Depth Contour

The ‘Ancient Coastline at 125 m Depth Contour’ overlaps the Operational Areas and is defined as the depth range 115 to 135 m in the North West Shelf Province and NWS Transition provincial bioregions (**Figure 4-19**). Several steps and terraces as a result of Holocene sea level changes occur in the region, with the most prominent of these features occurring as an escarpment along the NWMR and Sahul Shelf at a water depth of 125 m, which forms the Ancient Coastline at 125 m depth contour KEF (the Ancient Coastline). The Ancient Coastline KEF passes directly below the Operational Areas, both wellheads and the pipeline, extending along a line approximated by the 125 m isobath (**Figure 4-19**). The Ancient Coastline is not continuous throughout the NWMR, and coincides with a well-documented eustatic still stand at about 130 m worldwide (Falkner *et al.*, 2009).

Where the Ancient Coastline provides areas of hard substrate, it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat (Falkner *et al.*, 2009). 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. Although the Ancient Coastline adds additional habitat types to a representative system, the habitat types are not unique to the coastline as they are widespread on the upper shelf (Falkner *et al*., 2009).

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.

4.7.3.2 Continental Slope Demersal Fish Communities

The Continental Slope Demersal Fish Communities in the region have been identified as a KEF of the NWMR (DSEWPaC, 2012d), and lies within the EMBA about 25 km from the Operational Areas. 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 more than 508 fish species and the highest number of endemic species (76) of any Australian slope habitat (DEWHA, 2008). Additional features relating to the fish populations of this area are as follows:

- Continental slope demersal fish communities have been identified as a KEF of the NWMR, due to the notable diversity of the demersal fish assemblages and high levels of endemism (DSEWPaC, 2012d).
- The North West Cape 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 region, 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 and 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 (Department of Conservation and Land Management, 2005). The offshore sediment habitats of the Operational Areas are expected to support lower fish species richness than other shallower, more complex habitats in the coastal areas of the region.

4.7.3.3 Glomar Shoal

The Glomar Shoal is about 55 km east of the Operational Areas but within the EMBA. The submerged shoals that comprise Glomar Shoal are large (768 km²), complex bathymetrical features on the outer western shelf of the West Pilbara. The largest 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 shoals are relatively shallow, with water depths reaching 22 to 28 m at their 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).

The 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, the Glomar Shoal is also known to be an important area for a number of commercial and recreational fish species (DSEWPaC, 2012a).

The Glomar Shoal was surveyed by the 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 Baited Remote Underwater Video System (BRUVS) sampling of the fish assemblages (AIMS, 2014).

The shoals have 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). 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.

4.7.3.4 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 Areas with its closest point about 145 km west of the Operational Areas. 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 (TGS, 2011).

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 (TGS, 2011). 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 (TGS, 2011). 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 (TGS, 2011). Pelagic species are likely to include nekton, small pelagic fish and large predators such as billfish, sharks and dolphins (TGS, 2011). Protected and migratory species are also known to pass through the region, including whale sharks, cetaceans and marine turtles.

4.7.3.5 Canyons Linking the Cuvier Abyssal Plain and 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, more than 221 km south-west of the Operational Areas but within the EMBA. The canyons are believed to support the productivity and species richness of Ningaloo Reef (CoA, 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).

4.7.3.6 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 4.7.2** for more information about the values and sensitivities associated with this KEF. This KEF lies 268 km south-west of the Operational Areas from its closest point.

4.7.3.7 Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals

Mermaid Reef and Commonwealth waters surrounding Rowley Shoals are regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done *et al*., 1994). The Rowley Shoals contain 214 coral species and about 530 species of fish (Gilmour *et al*., 2007), 264 species of molluscs and 82 species of echinoderms (Done *et al*., 1994; Gilmour *et al*., 2007). The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the north-west. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward-flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done *et al*., 1994). The Mermaid Reef and Commonwealth waters surrounding Rowley Shoals is located 362 km north-east of the Operational Areas from its closest point, within the EMBA.

4.7.3.8 Wallaby Saddle

The Wallaby Saddle is located 791 km from the Operational Areas, within the EMBA, covering an area of 7880 km², and includes depths between 4000 to 4700 m. The KEF connects the margin of the Carnarvon Terrace on the upper continental slope to the north-west margin of the Wallaby Plateau. The KEF has been defined for its high productivity and aggregations of marine life. The Wallaby Saddle is thought to be a unique habitat that may have been associated with historical aggregations of sperm whales.

4.7.3.9 Western Demersal Slope and Associated Fish Communities of the Central Western Province

The western continental slope provides important habitat for demersal fish communities. Particularly, the continental slope of the Central Western provincial bioregions supports demersal fish communities characterised by high diversity compared with other, more intensively sampled oceanic regions of the world. Its diversity is attributed to the overlap of ancient and extensive Indo-west Pacific and temperate Australasian fauna (Williams *et al*., 2001). Scientists have described 480 species of demersal fish that inhabit the slope of this bioregion, with 31 of these considered endemic to the bioregion. The Demersal slope and associated fish communities of the Central Western Province are recognised as a KEF for their high levels of biodiversity and endemism. It is located 745 km south-west from the closest point of the Operational Areas, within the EMBA.

4.7.3.10 Albany Canyons Group and Adjacent Shelf Break

In contrast to other canyon systems in the region, the Albany canyon group is immediately adjacent to, and interacts with, a large section of continental shelf break. The area is thought to be associated with small, periodic subsurface upwelling events (Pattiaratchi, 2007) that may drive localised regions of high productivity, contributing to the ecological functioning and integrity of this area. The canyons are known to be a feeding area for the sperm whale (Bannister *et al*., 1996) and sites of orange roughly aggregations (Caton and McLoughlin, 2004). Anecdotal evidence also indicates that this area supports fish aggregations that attract large predatory fish, sharks and toothed, deep-diving whales such as sperm whale. The Albany Canyon group extends 700 km from Cape Leeuwin to east of Esperance, WA, and is located more than 1000 km from the Operational Areas at its closest point, but within the EMBA.

4.7.3.11 Western Rock Lobster

Western rock lobster is the dominant large benthic invertebrate in this bioregion. It is also an important part of the food web on the inner shelf, particularly as a juvenile, when it is preyed upon. Western rock lobsters are also particularly vulnerable to predation during seasonal moults in November to December and, to a lesser extent, during April to May. The high biomass of western rock lobsters and their vulnerability to predation suggest they are an important trophic pathway for a range of inshore species that prey upon juvenile lobsters. Located within the SWMR, western rock lobsters can be found north of Cape Leeuwin to a depth of 150 m. As an abundant and wide-ranging consumer, the western rock lobster is likely to play an important role in ecosystem processes on the shelf waters in the region (MacArthur *et al*., 2007). It is located about 901 km south-west from the nearest point of the Operational Areas, within the EMBA.

4.7.3.12 Perth Canyon and Adjacent Shelf Break and Other West-Coast Canyons

The Perth Canyon is the largest canyon on the Australian margin and, together with numerous smaller submarine canyons that incise the continental slope of southern Western Australia (Potter *et al*., 2006), is expected to have high biodiversity values. The KEF is located about 965 km south-west from the closest point of the Operational Areas.

4.7.3.13 Ancient Coastline at 90 to 120 m Depth

The Ancient Coastline at 90 and 120 m Depth is defined as a KEF for its potential high productivity and aggregations of marine life, biodiversity and endemism. Both benthic habitats and associated demersal communities are of conservation value. The continental shelf of the SWMR contains several terraces and steps, reflecting the gradual increase in sea level across the shelf that occurred during the Holocene. A prominent escarpment occurs close to the middle of the continental shelf off the Great Australian Bight at a depth of about 90 to 120 m. It is located about 918 km south-west from the closest point of the Operational Areas.

4.7.3.14 Cape Mentelle Upwelling

The Cape Mentelle upwelling occurs during summer months between Cape Leeuwin and Cape Naturaliste in the south-west corner of Australia; it is the most intense upwelling contributing to the Capes Current (Pattiaratchi, 2007 and references therein). It is located more than 1000 km south of the closest point to the Operational Areas. The Cape Mentelle upwelling is caused by prevailing southerly winds in the region, that counteract the Leeuwin Current’s driving force, drawing relatively nutrient-rich water from beneath the Leeuwin Current (where nutrient levels are higher), up the continental slope and onto the inner continental shelf (at depths of less than 50 m) (Pattiaratchi, 2007).

4.7.3.15 Commonwealth Marine Environment Surrounding the Houtman Abrolhos Islands (and adjacent shelf break)

The Houtman Abrolhos Islands are a complex of 122 islands and reefs located at the edge of the continental shelf between 28°15’ S to 29° S, about 60 km offshore from the mid-west coast of WA. The Houtman Abrolhos waters and reefs have been relatively well studied and are noted for their high biodiversity and mix of temperate and tropical species, resulting from the southward transport of species by the Leeuwin Current over thousands of years. It is located about 951 km south-west of the nearest point to the Operational Areas, within the EMBA.

4.7.3.16 Commonwealth Marine Environment within and Adjacent to the West-coast Inshore Lagoons

A chain of inshore lagoons extends along the Western Australian coast from south of Mandurah to Kalbarri. The lagoons are formed by distinct ridges of north-south orientated limestone reef with extensive beds of macroalgae, and extend to a depth of 30 m. These inshore lagoons extend in places into the Commonwealth marine environment of the SWMR. It is located about 940 km south-west of the closest point to the Operational Areas, within the EMBA.

4.7.3.17 Canyons linking the Argo Abyssal Plain with Scott Plateau

The Bowers and Oates canyons are the largest canyons connecting the Scott Plateau with the Argo Abyssal Plain. They are situated in the Timor Province, west of Scott Reef. The canyons cut deeply into the south-west margin of the Scott Plateau at a depth of about 2000 to 3000 metres, and act as conduits for transporting sediments to depths of more than 5500 metres on the Argo Abyssal Plain. Benthic communities at these depths are likely to depend on particulate matter falling from the pelagic zone to the sea floor. The ocean above the canyons may be an area of moderately enhanced productivity, attracting aggregations of fish and higher-order consumers such as large predatory fish, sharks, toothed whales and dolphins. The canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations. They are located about 700 km north-west of the closest point to the Operational Areas, within the EMBA.

4.7.3.18 Naturaliste Plateau

The Naturaliste Plateau lies west of Cape Leeuwin and Cape Naturaliste, and is Australia’s deepest temperate marginal plateau. It extends about 400 km east-west and 250 km north-south, covering about 90,000 km² of deepwater habitat (depths of 2000 to 5000 m). The Naturaliste Plateau is Australia’s deepest temperate marginal plateau. Although very little is known about the marine life of this plateau, the combination of its structural complexity, mixed-water dynamics and relative isolation indicate that it supports deepwater communities with high species diversity and endemism. The plateau acts as an underwater ‘biogeographical island’ on the edge of the abyssal plain, providing habitat for fauna unique to these depths. The plateau is also within a deep eddy field that is thought to be associated with high productivity and aggregations of marine life. Proximity to the nearby subtropical convergence front is thought to have a significant influence on the biodiversity of the plateau. It is located more than 1000 km south-west of the closest point to the Operational Areas, within the EMBA.

4.7.4 Other Sensitive Areas

4.7.4.1 Rankin Bank

Rankin Bank is on the continental shelf, about 12 km from the Operational Areas at its closest point. While not a KEF, Rankin Bank, along with the Glomar Shoal KEF, 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 to 30.5 m (AIMS, 2014).

Rankin Bank represents a diverse marine environment, predominantly composed of consolidated reef and algae habitat (about 55% cover), followed by hard corals (about 25% cover), unconsolidated sand/silt habitat (about 16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (about 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*., 2012).

A recent study involving multibeam and towed video surveys at Rankin Bank and Glomar Shoal found coral cover at Rankin Bank comparable to that of other shallow reefs. It reported that the benthic communities at Rankin Bank (hard corals, sponges and sand) influence fish communities in the area, resulting in higher abundance and diversity of fish species associated with shallow hard coral habitats (Wahab *et al*., 2018). Wahab *et al.* (2018) also reported that across depths, benthic taxa cover was up to 30 times greater at Rankin Bank than at Glomar Shoal, a defined KEF, and that fish communities were twice as abundant and 1.5 times as diverse than at Glomar Shoal (Heyward *et al*., 2012).

Rankin Bank has been shown to support a diverse fish assemblage (AIMS, 2014). This is consistent with studies showing a strong correlation between habitat diversity and fish assemblage species richness (Gratwicke and Speight, 2005; Last *et al*., 2005). The habitat surrounding Rankin Bank (less than 50 m) was mapped by AIMS on behalf of Woodside (AIMS, 2014) and hosts filter-feeding communities in areas of consolidated substrate interspersed by sand.

5. STAKEHOLDER CONSULTATION

5.1 Summary

Woodside is committed to consulting relevant stakeholders to ensure stakeholder feedback informs decision-making and planning for proposed petroleum activities.

Consultation activities conducted for the proposed activity build upon Woodside's extensive and ongoing stakeholder consultation for its offshore petroleum activities in the region. Stakeholder consultation for the proposed activity has been performed in three phases to progressively seek stakeholder input into decommissioning planning, these phases being:

- Phase 1 – consultation activities over a 12-month period from mid-2017 seeking stakeholder views on decommissioning options, as well as the long-term management implications of those options
- Phase 2 – an independently-facilitated comparative assessment workshop held in May 2019 to identify stakeholders' most preferred decommissioning option
- Phase 3 – consultation activities to obtain stakeholder feedback and comment on Woodside's preferred in-situ decommissioning option as well as inform the planning of the permanent plugging for abandonment activities.

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 performed under the EP, or the revision of the EP, may be relevant
- each Department or agency of a State or the Northern Territory Government to which the activities to be performed under the EP, or the revision of the EP, may be relevant
- the Department of the responsible State Minister, or the responsible Northern Territory Minister
- a person or organisation whose functions, interests or activities may be affected by the activities to be performed under the EP, or the revision of the EP
- any other person or organisation that the Titleholder considers relevant.

Woodside has assessed stakeholders as being relevant to each phase of consultation, based on feedback required to support each phase of decision-making and planning for decommissioning and permanent plugging activities. Woodside's assessment of stakeholders relevant to its preferred in-situ decommissioning option and permanent plugging for abandonment activities 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 to stakeholders, communications material that is relevant to their interests and information needs
- incorporate stakeholder feedback into managing the proposed activity where practicable
- provide feedback to stakeholders about Woodside's assessment of their feedback and record 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.

Australian Government

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

Australian Fisheries Management Authority

Petroleum industry consultation with the commercial fishing industry.

Department of Agriculture and Water Resources (now the Department of Agriculture, , Water and the Environment)

Fisheries and the Environment – Offshore Petroleum and Greenhouse Gas Act 2006.

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 before or during the proposed activity. These stakeholders will be contacted, provided information relevant 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.

Table 5-1: Assessment of relevant stakeholders for the proposed activity (phases 1 and 2)

Stakeholder	Relevant to activity	Reasoning
Australian Government department or agency		
Australian Customs Service – Border Protection Command (ACS)	Yes	Responsible for coordinating maritime security.

Stakeholder	Relevant to activity	Reasoning
AFMA	No	Responsible for managing Commonwealth fisheries. There has been no fishing in the Operational Areas in the last five years by licence holders in Commonwealth-managed fisheries.
Australian Hydrographic Office (AHO)	Yes	Maritime safety and responsible for Notice to Mariners (NTM).
AMSA (marine safety)	Yes	Statutory agency for vessel safety and navigation in Commonwealth waters.
AMSA (marine pollution)	Yes	Legislated responsibility for oil pollution response in Commonwealth waters.
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 to impact DAWR's interests in preventing introduced marine species. The proposed activity is not expected to impact DAWR's interests in Commonwealth fishery management.
DoD	No	Proposed Operational Areas overlap defence activity areas.
DoAWE	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.
Department of Industry, Innovation and Science (DIIS)	Yes	Department of relevant Commonwealth Minister and is required to be consulted under the Regulations.
DNP	No	Responsible for managing Commonwealth parks and conservation zones. While planned activities do not affect the functions, interests or activities of the DNP, Woodside has chosen to provide information about arrangements for unplanned events, such as an oil spill, which have potential to impact the values within a Commonwealth marine park.
Western Australian Government department or agency or advisory body		
Department of Biodiversity, Conservation and Attractions (DBCA), Parks and Wildlife Service	No	Responsible for managing 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.
DPIRD	Yes	Responsible for managing State fisheries.
Department of Transport (DoT)	Yes	Legislated responsibility for oil pollution response in State waters.
Commonwealth fisheries*		
Southern Bluefin Tuna Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years (ABARES Fishery Status Reports).
Western Skipjack Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years (ABARES Fishery Status Reports).
Western Tuna and Billfish Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years (ABARES Fishery Status Reports).

Stakeholder	Relevant to activity	Reasoning
State fisheries*		
Marine Aquarium Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD FishCube data indicates there is no fishing effort in the Operational Areas. Based on previous WAFIC engagement, this is a dive and wade fishery with activities generally restricted to less than 30 m water
Onslow Prawn Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD FishCube data indicates there is no fishing effort in the Operational Areas.
Pearl Oyster Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD FishCube data indicates there is no fishing effort in the Operational Areas.
Pilbara Demersal Scalefish Fishery (fish trawl, trap and line) • Pilbara Trawl Fishery	No	The Operational Areas falls within Schedule 5 – permanently closed to trawling area (Echo Yodel subsea infrastructure) and Area 6 of Zone 2 (Capella-1 well) of the Pilbara Trawl Fishery, which are both closed to trawling.
• Pilbara Trap Fishery	Yes	The fishery overlaps the Operational Areas and current DPIRD FishCube data indicates there may be fishing effort in the Operational Areas.
• Pilbara Line Fishery	Yes	The fishery overlaps the Operational Areas and current DPIRD FishCube data indicates there may be fishing effort in the Operational Areas.
South West Coast Salmon Managed Fishery	No	While the fishery overlaps the Operational Areas, no fishing occurs north of the Perth metropolitan area, and net fishing from the shore (as per previous WAFIC engagement and *State of the Fisheries Report (DPIRD, 2018))*.
Specimen Shell Managed Fishery	No	While the fishery overlaps the Operational Areas, current DPIRD FishCube data indicates there is no fishing effort in the Operational Areas. Based on previous WAFIC engagement, this is a dive and wade fishery with activities generally restricted to less than 30 m water
West Australian Abalone Fishery	No	While the fishery overlaps the Operational Areas, this is a shore based fishery.
West Australian Mackerel Managed Fishery (Area 2)	No	While the fishery overlaps the Operational Areas, fishing typically is in water depths of up to 70 m.
West Coast Deep Sea Crustacean Managed Fishery	No	While the fishery overlaps the Operational Areas, in recent years fishing has only been performed along the continental shelf edge and in waters south of Exmouth *(*DPIRD, 2018*).*
Industry		
BP Developments	Yes	Adjacent titleholder.
Mobil Australia	Yes	Adjacent titleholder.
Industry representative organisation		
Australian Petroleum Production and Exploration Association (APPEA)	Yes	Represents the interests of oil and gas explorers and producers in Australia.
Commonwealth Fisheries Association (CFA)	No	Represents the interests of commercial fishers with licences in Commonwealth waters. Commonwealth fisheries have not been active in the Operational Areas within the last five years (ABARES Fishery Status Reports).
Pearl Producers Association (PPA)	No	Represents the interests of the Australian South Sea Pearling industry. While proposed activities are not expected to impact the pearling industry, the PPA has previously asked to be kept informed about Woodside's planned petroleum activities.

Stakeholder	Relevant to activity	Reasoning
Recfishwest	Yes	Represents the interests of recreational fishers in Western Australia. Activities have the potential to impact recreational fishers.
WAFIC	Yes	Represents the interests of commercial fishers with licences in State waters. Potential for interaction with licence holders in the Pilbara Line Fishery and Pilbara Trap Fishery.
Other stakeholders		
King Bay Game Fishing Club (KBGFC)	Yes	KBGFC was identified in Phase 1 consultation as a potentially relevant stakeholder and asked to be kept informed about decommissioning planning.
Nickol Bay Sport Fishing Club (NBSFC)	Yes	NBSFC was identified in Phase 1 consultation as a potentially relevant stakeholder and asked to be kept informed about decommissioning planning.

** Fisheries have been identified as being relevant based on fishing licence overlap with the proposed Operational Areas as well as consideration of fishing effort data, fishing methods and water depth.* ***Table 4-9*** *provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Areas.*

Following the initial consultation phases, and introduction of new transparency regulations a further assessment of relevant stakeholders was undertaken to ensure consultation remained relevant and targeted.

Table 5-2: Assessment of relevant stakeholders for the proposed activity (phase 3)

Stakeholder	Relevant to activity	Reasoning
Australian Government department or agency		
ACS Border Protection Command	Yes	Responsible for coordinating maritime security.
AFMA	No	Responsible for managing Commonwealth fisheries.
AHO	Yes	Maritime safety and responsible for NTM.
AMSA	Yes	Statutory agency for vessel safety and navigation in Commonwealth waters.
AMSA	Yes	Legislated responsibility for oil pollution response in Commonwealth waters.
DAWR	Yes	Responsible for implementing Commonwealth policies and programmes to support the agriculture, fisheries, food and forestry industries. The proposed activity has the potential to impact DAWR's interests in preventing introduced marine species. The proposed activity is not expected to impact DAWR's interests in Commonwealth fishery management.
DoD	No	Proposed Operational Areas overlap defence activity areas.
DAWE (Previously DoEE)	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.
DIIS	Yes	Department of relevant Commonwealth Minister and is required to be consulted under the Regulations.
DNP	No	Responsible for managing Commonwealth parks and conservation zones. While planned activities do not affect the functions, interests or activities of the DNP, Woodside has chosen to provide information about arrangements for unplanned events, such as an oil spill, which have potential to impact the values within a Commonwealth marine park.

Stakeholder	Relevant to activity	Reasoning
Western Australian Government department or agency or advisory body		
DBCA	No	Responsible for managing WA's parks, forests and reserves. Planned activities do not impact DBCA's functions, interests or activities.
DMIRS	Yes	Department of relevant State Minister and is required to be consulted under the Regulations.
DPIRD	Yes	Responsible for management of State fisheries.
DoT	Yes	Legislated responsibility for oil pollution response in State waters.
Commonwealth fisheries*		
Southern Bluefin Tuna Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years.
Western Skipjack Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years.
Western Tuna and Billfish Fishery	No	While the fishery overlaps the Operational Areas, the fishery has not been active in the Operational Areas within the last five years.
State fisheries*		
Marine Aquarium Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is beyond the Operational Areas.
Onslow Prawn Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is beyond the Operational Areas.
Pearl Oyster Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is beyond the Operational Areas.
Pilbara Demersal Scalefish Fishery (fish trawl, trap and line)		
• Pilbara Trawl Fishery	No	The Operational Areas fall within Zone 1 and Area 6 of Zone 2 of the Pilbara Trawl Fishery, which are closed to trawling.
• Pilbara Trap Fishery	Yes	The fishery overlaps the Operational Areas and DPIRD data indicates the potential for interaction with licence holders in the fishery.
• Pilbara Line Fishery	Yes	The fishery overlaps the Operational Areas and DPIRD data indicates the potential for interaction with licence holders in the fishery.
South West Coast Salmon Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is concentrated beyond the Operational Areas.
Specimen Shell Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is concentrated beyond the Operational Areas.
West Australian Abalone Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is concentrated beyond the Operational Areas.
West Australian Mackerel Managed Fishery	No	The fishery overlaps the Operational Areas, however, WAFIC have advised the local is too deep for Mackerel fishers.
West Coast Deep Sea Crustacean Managed Fishery	No	While the fishery overlaps the Operational Areas, DPIRD data indicates fishing effort is concentrated beyond the Operational Areas.
Industry		
BP Developments	Yes	Adjacent titleholder.

Stakeholder	Relevant to activity	Reasoning
Mobil Australia	Yes	Adjacent titleholder.
Industry representative organisation		
APPEA	Yes	Represents the interests of oil and gas explorers and producers in Australia.
CFA	No	Represents the interests of commercial fishers with licences in Commonwealth waters. Activities are not expected to impact commercial fishers.
PPA	No	Represents the interests of the Australian South Sea Pearling industry. While proposed activities are not expected to impact the pearling industry, the PPA has previously asked to be kept informed about Woodside's planned petroleum activities.
Recfishwest	Yes	Represents the interested of recreational fishers in WA. While proposed activities are not expected to impact recreational fishers, Woodside has chosen to provided information to Recfishwest.
WAFIC	Yes	Represents the interests of commercial fishers with licences in State waters. Potential for interaction with licence holders in the Pilbara Line Fishery.
Other stakeholders		
KBGFC	Yes	KBGFC was identified in Phase 1 consultation as a potentially relevant stakeholder and asked to be kept informed about decommissioning planning.
NBSFC	Yes	NBSFC was identified in Phase 1 consultation as a potentially relevant stakeholder and asked to be kept informed about decommissioning planning.

Fisheries have been identified as being relevant based on fishing licence overlap with the proposed Operational Areas as well as consideration of fishing effort data, fishing methods and water depth. **Section 4.6.3 provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Areas.*

5.5 Consultation Engagement

Woodside has also drawn on feedback provided by stakeholders for previous consultation activities to help identify relevant stakeholders, as well as potential impacts from leaving the wellheads in situ. Previous feedback relevant to the proposed activity is outlined in **Table 5-6**.

Table 5-3, **Table 5-4** and **Table 5-5** outline the three phases of consultation performed:

- Phase 1 – Preliminary consultation seeking stakeholder views on decommissioning options (**Table 5-3**)
- Phase 2 – Comparative assessment workshop to identify stakeholders' most preferred decommissioning option (**Table 5-4**)
- Phase 3 – Consultation based on the preferred in-situ decommissioning option (**Table 5-5**).

Table 5-3: Phase 1 stakeholder consultation activities

Stakeholder	Information provided	Stakeholder response	Woodside response
Australian Government department or agency			
AFMA	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No response to Woodside email.	Woodside will continue to engage AFMA to inform planning for decommissioning.
	On 18 December 2017, a teleconference was held to provide AFMA with an overview of decommissioning options for Echo Yodel. Woodside's presentation for the teleconference can be found at **Appendix F**, ref 1.2.	AFMA asked a series of questions during the teleconference regarding the activity and asked if this would be the first decommissioning EP that NOPSEMA would need to approve. AFMA advised it would circulate the Echo Yodel presentation and meeting information around the agency for feedback in early 2018. AFMA advised there may be a potential issue to trawl fishery with Echo Yodel being in shallow water but assume it is a closed trawl fishery zone.	Woodside advised that decommissioning around the globe differs, with the North Sea requiring removal and the Gulf of Mexico encouraging 'rigs to reef'. In Australia, the Regulator assesses each activity on its individual merits. Woodside advised that there was no platform attached to the pipeline and marine growth has built up each year, and now there is an increase in the diversity and abundance of fish. Woodside confirmed the umbilicals were flushed once disconnected. Advice that there is hydraulic fluid and other cables inside the six-inch pipe was provided. Woodside advised that it planned to use the first phase of consultation to inform an internal options paper to select a final decommissioning option. Advice was provided that wellhead removal was not uncommon. There was no risk of a blowout potential by cutting a wellhead. There was a risk to safety of people and a minimal risk to the environment. Woodside advised that Echo Yodel decommissioning would be one of the first EPs and Woodside would be the first Operator to go through in recent times.

Stakeholder	Information provided	Stakeholder response	Woodside response
AHO	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	On 14 June 2017, AHO emailed Woodside, acknowledging receipt of its advice and asked to be kept informed to allow any appropriate Notice to Mariners action to occur.	Woodside will continue to engage AHO to inform planning for decommissioning.
AMSA (marine safety)	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	On 15 June 2017, AMSA emailed Woodside, advising of its availability for a teleconference to discuss decommissioning options for Echo Yodel.	Woodside coordinated a teleconference for 22 June 2017.
	On 22 June 2017, a teleconference was held providing an overview of Woodside's proposed decommissioning approach for Echo Yodel, including facility background, location, supporting studies and research, and options for decommissioning the Echo Yodel infrastructure. Woodside's presentation for the teleconference can be found at (**Appendix F**, ref 1.2).	AMSA sought feedback at the teleconference on a number of items, including: • feedback provided through engagement with WAMSI in relation to habitats on subsea infrastructure, stability of infrastructure and potential for contaminants • the lateral distance between the pipeline and umbilical • the height of the X-mas trees • would an exclusion zone be requested from NOPSEMA if X-mas trees were left in-situ • which vessels would be used for partial or full removal of infrastructure • timeframe for pipeline removal • timing for consultation after selecting the preferred decommissioning option.	Woodside discussed the issues raised by AMSA and committed to ongoing consultation. Points raised were: • Woodside confirmed the latteral distance between the pipeline and umbilical as 30 to 40 m. • Woodside confirmed the height of the X-mas trees as 6 m and the width as 3 m. • Woodside confirmed three to six months, with assistance from AMSA, to mitigate risk with the pipeline running across a shipping fairway. • Woodside's expectation for consultation was from late July 2017.

Stakeholder	Information provided	Stakeholder response	Woodside response
		On 23 June 2017, AMSA emailed Woodside that it had discussed the Echo Yodel decommissioning options with its Environmental Standards team. AMSA advised it assessed minimal navigational concerns for the umbilical and pipeline if left in-situ. AMSA advised if the infrastructure is partially removed, then it would provide comment during the second phase of stakeholder consultation. AMSA advised that its preference for wellheads was to at least remove the tree from above the wellhead if left in-situ to minimise navigational safety aspects of the remaining infrastructure.	On 26 June 2019, Woodside acknowledged by email AMSA's advice that it considered there to be minimal navigational safety concerns with Woodside's current, proposed approach to leave the umbilical and pipeline in-situ. Woodside advised it would consider AMSA's preference to have trees removed from the Echo Yodel wellheads, if left in-situ. Woodside will continue to engage AMSA to inform planning for decommissioning.
Western Australian Government department or agency or advisory body			
DPIRD	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	On 19 June 2017, DPIRD emailed Woodside, requesting relevant information about the proposed details and how this differed from the accepted decommissioning plan. DPIRD asked for a reasonable timeframe to review this information before a potential meeting.	Woodside confirmed by email on 20 June 2017 that it did not have an accepted decommissioning plan for Echo Yodel and that it was in the process of developing an EP. Woodside advised that it planned to perform stakeholder consultation in two phases. Woodside confirmed that in the first phase, it planned to discuss its research and a broad range of decommissioning options before landing its final approach for decommissioning. Woodside advised in the second phase, stakeholders would have an opportunity to provide feedback about Woodside's chosen position for the environment plan before it is submitted to NOPSEMA.
		On 23 June 2017, DPIRD emailed Woodside, welcoming Woodside's consultation approach and suggested Woodside present ideas about how it wished to proceed for decommissioning options.	Woodside confirmed by email on 26 June 2017 that it would consider decommissioning options. Woodside advised it would collate additional background information for DPIRD.

Stakeholder	Information provided	Stakeholder response	Woodside response
		DPIRD requested additional background information to review before a meeting.	
		On 27 June 2017, DPIRD acknowledged Woodside's email of 26 June 2017.	No response required.
		On 25 August 2017, DPIRD emailed Woodside requesting an update about decommissioning planning.	Woodside advised by email on 5 September 2017 that project timing had been revised and was still planning to perform consultation.
		On 8 September 2017, DPIRD acknowledged Woodside's email of 5 September 2017.	No response required.
	On 1 February 2018, a meeting was held to provide DPIRD with an overview of decommissioning options for Echo Yodel. Woodside's presentation for the meeting can be found at **Appendix F**, ref 1.2.	On 1 February 2018 at the meeting, DPIRD enquired if reconfiguring the pipeline (i.e. pull it up and put all the pieces into a single location to concentrate the environmental benefit as a benthic habitat) has been investigated. DPIRD advised that oil and gas operators must acknowledge that leaving something in-situ permanently, even if it is in deeper water, leaves a legacy, which may exclude other users in the future.	Woodside confirmed this option was being explored. Woodside acknowledged DPIRD's feedback, confirming it is being considered as part of the overall decommissioning planning.
		On 1 February 2018, DPIRD emailed Woodside requesting a copy of the Echo Yodel presentation and information about studies that supported leaving infrastructure in-situ.	On 7 February 2018, Woodside emailed advice to DPIRD that Echo Yodel decommissioning work started before any Australian guidelines and there is no precedent set. Woodside requested feedback from DPIRD about decommissioning and committed to having ongoing engagement about Echo Yodel. Woodside provided a range of information, including decommissioning data from the North Sea, APPEA guidelines and abstracts from research manuscripts. Contact details for University of Western Australia were also provided to DPIRD to make contact directly about Woodside's research.

Stakeholder	Information provided	Stakeholder response	Woodside response
			Woodside confirmed the Department advised that it was aware of another titleholder who had researched snag-free caps for wellheads. Woodside advised it would contact this titleholder for more information and asked the Department to share any data with Woodside about over-trawl structures. The Department advised that snagging of fishing nets was not well documented by commercial fisheries.
		On 1 March 2018, DPIRD emailed Woodside, advising that it encouraged titleholders to abandon wells and infrastructure sites in conditions that will allow for future fishing operations. DPIRD provided a list of ways that these options could be facilitated, including removing all infrastructure that does not provide environmental benefit, cutting infrastructure that cannot be removed at or below seabed to prevent snagging, and removing any safety zones. DPIRD advised that it trusted the Regulator to evaluate case-by-case decommissioning proposals when the removal of infrastructure may not result in net environmental benefits. DPIRD advised that it expected the Regulator to assess a titleholder's rationale and consideration of options to ensure environmental benefits are maximised. DPIRD acknowledged there would be some environmental benefits for leaving the Echo Yodel pipeline in-situ, including the establishment of benthic communities, offering refuge in high current areas and acting as a conduit for fish that move offshore.	Woodside notes DPIRD's feedback and will continue to consult DPIRD when considering decommissioning options. Woodside will continue to engage WAFIC, Recfishwest and, where relevant, other representative organisations and licence holders.

Stakeholder	Information provided	Stakeholder response	Woodside response
		DPIRD commented that 'biological stocks' that may be a benefit are likely to be minor scale but could still be considered for evaluating decommissioning options. DPIRD outlined that augmentation considerations should be a standard element for environmental assessment approval. DPIRD provided a list of stakeholders it expects Woodside to maintain consultation with and advised that it expected to be re-engaged once Woodside's finalises the Echo Yodel decommissioning plan.	
	On 29 June 2018, a meeting was held to provide DPIRD with an overview of decommissioning options for Echo Yodel.	DPIRD acknowledged at the meeting that feedback provided to date about decommissioning had been mostly of a general nature, and nothing yet existed at a policy level due to decommissioning being a relatively new area in Australia. DPIRD asked if WAFIC had been consulted. DPIRD asked if Woodside could provide a summary of feedback received so far to avoid doubling up with common stakeholders.	Woodside confirmed that WAFIC had been consulted, along with other relevant stakeholders. Woodside confirmed it could send a high-level summary of relevant feedback received to date about Echo Yodel (names and organisations withheld) to help DPIRD understand different viewpoints. Woodside committed to following up with specific questions from DPIRD which could be assessed and answered after consultation with more senior DPIRD staff.
	On 4 July 2018 Woodside emailed DPIRD seeking advice about a range of topics, including guidance about the potential option of in-situ decommissioning of the Echo Yodel pipeline and umbilical. A copy of a State fisheries map and the presentation from the meeting of 29 June 2018 was also provided (**Appendix F**, ref 1.1).	On 6 July 2018, DPIRD emailed Woodside, advising it would need to consult internally before responding.	On 6 July 2018, Woodside emailed DPIRD acknowledging its response.

Stakeholder	Information provided	Stakeholder response	Woodside response
DoT	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No response to Woodside email.	Woodside will continue to engage DoT to inform planning for decommissioning.
State Fisheries			
Pilbara Trap Fishery licence holder	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No response to Woodside email.	Woodside will continue to engage the licence holder and other Pilbara Trap Fishery licence holders to inform planning for decommissioning.
	On 25 July 2017, a meeting was held to provide the licence holder with an overview of decommissioning options for Echo Yodel. Woodside's presentation for the meeting can be found at **Appendix F**, ref 1.2.	The licence holder advised it strongly supported leaving all subsea infrastructure in-situ including pipeline, umbilical and wellheads (including X-mas trees). The licence holder was interested and supportive of further enhancement of infrastructure left on seafloor if there were any opportunities. The licence holder indicated it saw no snagging risk associated with trap fishing around oil and gas infrastructure, including wellheads with trees left in place. The licence holder provided a contact at DPIRD to speak with regarding the history and current status of NWS demersal fish stocks, including benefit of subsea infrastructure. The licence holder supported recent findings of University of Western Australia and it would provide fish samples from Echo Yodel pipeline, although due to financial drivers could not provide advice about when the area is targeted.	Woodside will consider the licence holder's feedback in decommissioning planning and will continue to engage fishing licence holders to inform planning for decommissioning.

Stakeholder	Information provided	Stakeholder response	Woodside response
		The licence holder offered to speak informally to trawl fishing licence holders to gauge their interest in in-situ decommissioning of Echo Yodel infrastructure. The licence holder advised that subsea pipelines provide important hard substrate/habitat to support his trap fishing business. The licence holder also reaffirmed WAFIC's stance around there being no justification for exclusion zones. The licence holder expressed his interest in new pipeline developments, such as Browse. Preference is for pipelines to be in 100 to 60 m and is interested in seeing pipelines augmented to improve ecological value where feasible. The licence holder acknowledged that plastics in subsea infrastructure (i.e. pipeline) may garner negative attention from other stakeholders and hence believed strong position around value of fish/biodiversity may be needed to balance the argument.	
Pilbara Trawl Fishery licence holder	On 12 June 2018, a meeting was held to provide WAFIC with an overview of decommissioning options for Echo Yodel. Woodside's presentation for the meeting can be found at **Appendix F**, ref 1.2.	The licence holder provided an overview of licences within the Pilbara Trawl Fishery. There are 11 licences held by four companies, only two of which were currently active. These two companies lease the remaining licences from the two inactive companies. The licence holder advised that trawlers target pipelines and navigation and sensors are capable of doing so safely. The licence holder was not opposed to leaving the Echo Yodel pipeline in-situ as it lies within a State fishery no-trawl zone.	Woodside will consider the licence holder's feedback in decommissioning planning, acknowledging that Pilbara Trawl Fishery licence holders will not be impacted by decommissioning activities.

Stakeholder	Information provided	Stakeholder response	Woodside response
Industry representative organisations			
CFA	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No feedback from stakeholder.	Woodside will continue to engage CFA to inform planning for decommissioning.
Recfishwest	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No feedback from stakeholder.	Woodside will continue to engage Recfishwest to inform planning for decommissioning.
	On 14 May 2018, a meeting was held to provide Recfishwest with an overview of decommissioning options for Echo Yodel. Woodside's presentation for the meeting can be found at **Appendix F**, ref 1.2.	Recfishwest advised that it had a keen interest in decommissioning due to potential habitat enhancement for fishing. Recfishwest confirmed that although recreational fishers target pipelines, Echo Yodel was too far away for most to reach but would be keen for Woodside to leave the pipeline in-situ as it would be good for supporting fish stocks.	Woodside will consider Recfishwest's feedback in decommissioning planning and will continue to engage recreational fishers to inform planning for decommissioning.
WAFIC	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	No feedback from stakeholder.	Woodside will continue to engage WAFIC to inform planning for decommissioning.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 18 July 2017, a meeting was held to provide WAFIC with an overview of decommissioning options for Echo Yodel. Woodside advised it was seeking feedback from stakeholders in a phased approach, with the first phase introducing stakeholders to the various decommissioning options. Woodside advised that the second phase of consultation would be performed once a decommissioning approach for Echo Yodel was finalised. Woodside's presentation for the meeting can be found at **Appendix F**, ref 1.2.	WAFIC advised that Woodside would need to present a significant environmental case for leaving infrastructure in-situ. WAFIC advised that Woodside would need to demonstrate how the site had 'potential for future use'. WAFIC strongly urged that exclusion zones are not put in place and that snagging risks fall to fishery licence holders, commenting that line and anchor snag can occur over natural habitat. WAFIC advised that every fishery that overlaps petroleum titles for Echo Yodel should be consulted.	Woodside will consider WAFIC's feedback in decommissioning planning and will continue to engage WAFIC to inform planning for decommissioning.
Other stakeholders			
KBGFC	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	On 23 August 2017, the KBGFC acknowledged receipt of Woodside's advice and expressed interest in being kept informed about decommissioning planning.	Woodside will continue to engage the KBGFC to inform planning for decommissioning.
NBSFC	On 13 June 2017, Woodside advised by email that it had commenced planning for decommissioning the Echo Yodel infrastructure, with an invitation to meet to discuss proposed activities and seek feedback about the stakeholder's preferred decommissioning option (**Appendix F**, ref 1.1).	On 10 July 2017, the NBSFC acknowledged receipt of Woodside's advice and expressed interest in being kept informed about decommissioning planning.	Woodside will continue to engage the NBSFC to inform planning for decommissioning.

Table 5-4: Phase 2 stakeholder consultation activities

Stakeholders	Information provided	Stakeholder response	Woodside response
DPIRD	On 5 April 2019, Woodside called DPIRD to discuss decommissioning planning for Echo Yodel and invited DPIRD to participate in a comparative assessment workshop.	On 14 May 2019, DPIRD confirmed it would attend the workshop.	Woodside to follow up with information about the infrastructure, and dates for a comparative assessment workshop.
	On 5 April 2019, Woodside emailed DPIRD (**Appendix F**, ref 2.1), inviting DPIRD to attend a comparative assessment workshop in May 2019.	No response.	Woodside to confirm workshop details and provide workshop pre-read material.
	On 7 May 2019, Woodside emailed DPIRD (**Appendix F**, ref 2.6) an agenda (**Appendix F**, ref 2.7) and pre-read material (**Appendix F**, ref 2.8) for the Echo Yodel comparative assessment workshop on 15 May 2019.	DPIRD agreed to attend the workshop.	Woodside to seek DPIRD's ongoing input at the workshop.
	On 15 May 2019, Woodside held an independently facilitated Comparative Assessment Workshop to identify the most preferred decommissioning option for the infrastructure. Criteria for the assessment included socio-economic, environmental, health and safety, technical feasibility and economic factors. Woodside's presentation for the workshop can be found at **Appendix F**, ref 2.9.	Feedback from stakeholders at the workshop was unanimous for a decommissioning option that would permanently leave Echo Yodel subsea infrastructure in situ.	Woodside acknowledged the views of the stakeholders and subsequently endorsed the option.
	On 5 July 2019, Woodside emailed DPIRD (**Appendix F**, ref 2.10), advising that it had endorsed the decommissioning option preferred by stakeholders at the comparative assessment workshop. It also advised that the option will be considered in an EP and would be subject to further consultation. A workshop report was provided (**Appendix F**, ref 2.11).	No response.	Woodside to provide additional details as part of Phase 3 consultation activities.
Pilbara Trawl Fishery licence holder	On 8 April 2019, Woodside emailed a Pilbara Trawl Fishery licence holder (**Appendix F**, ref 2.2), inviting them to attend a comparative assessment workshop in May 2018.	No response.	Woodside to confirm workshop details and provide workshop pre-read material.

Stakeholders	Information provided	Stakeholder response	Woodside response
WAFIC	On 8 April 2019, Woodside emailed WAFIC (**Appendix F**, ref 2.3), inviting them to attend a comparative assessment workshop in May 2019.	On 8 April 2019, WAFIC emailed seeking clarity about: • Woodside's approach to engaging licence holders in Pilbara Line and Pilbara Trap with information (clear and not over technical) about what the Echo Yodel decommissioning involves specific to commercial fishing. • The need for advance information to determine whether a workshop was an efficient use of stakeholder time, as quality email communication may be sufficient. • A workshop may not be well attended as line fishers are primarily based in the North West, but there will be an opportunity to meet with Line fishers in Exmouth during the whale shark festival; and the Pilbara Trap Fishery has two main operators. • Pilbara Trawl fishers should also be consulted as the trawl zone, while closed in the Echo Yodel area, is a legal part of their fishery.	Woodside confirmed it had invited DPIRD and Pilbara Line, Pilbara Trap and Pilbara Trawl fishers to the workshop. It also confirmed that once a decommissioning option was selected, broader consultation would be performed with all relevant stakeholders to inform planning and decision-making for an EP, which will be submitted to NOPSEMA for consideration and acceptance.
	On 7 May 2019, Woodside emailed WAFIC (**Appendix F**, ref 2.7) an agenda and pre-read material (**Appendix F**, ref 2.8) for the Echo Yodel Comparative Assessment Workshop on 15 May 2019.	On 7 May 2019 WAFIC, contacted Woodside advising it was not willing to attend given the length of the workshop and its current workload.	Woodside will continue to engage the WAFIC to inform planning for decommissioning.
	On 5 July 2019, Woodside emailed WAFIC (**Appendix F**, ref 2.12), advising that it had endorsed the decommissioning option preferred by stakeholders at the comparative assessment workshop. It also advised that the option will be considered in an EP and would be subject to further consultation. A workshop summary report was provided (**Appendix F**, ref 2.13).	No response.	Woodside to provide additional details as part of Phase 3 consultation activities.

Stakeholders	Information provided	Stakeholder response	Woodside response
Licence holders in the Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries	On 5 and 7 May 2019, Woodside emailed licence holders (**Appendix F**, ref 2.5 and 2.6) an agenda (**Appendix F**, ref 2.7) and pre-read material (**Appendix F**, ref 2.8) for the Echo Yodel comparative assessment workshop on 15 May 2019.	No response.	Woodside to provide workshop outcomes.
	On 5 July 2019, Woodside emailed licence holders (**Appendix F**, ref 2.12), advising that it had endorsed the decommissioning option preferred by stakeholders at the comparative assessment workshop. It also advised that the option will be considered in an EP and would be subject to further consultation. A workshop summary report was provided (**Appendix F**, ref 2.13).	No response.	Woodside to provide additional details as part of Phase 3 consultation activities.
Pilbara Trap Fishery licence holder (attendee at the Comparative Assessment Workshop)	On 15 May 2019, Woodside held an independently facilitated comparative assessment workshop to identify the most preferred decommissioning option for the infrastructure. Criteria for the assessment included socio-economic, environmental, health and safety, technical feasibility and economic factors. Woodside's presentation for the workshop can be found at **Appendix F**, ref 2.9.	Feedback from stakeholders at the workshop was unanimous for a decommissioning option that would permanently leave Echo Yodel subsea infrastructure in situ.	Woodside acknowledged the views of the stakeholders and subsequently endorsed the option.
	On 5 July 2019, Woodside emailed the licence holder (**Appendix F**, ref 2.10), advising that it had endorsed the decommissioning option preferred by stakeholders at the comparative assessment workshop. It also advised that the option will be considered in an EP and would be subject to further consultation. A workshop report was provided (**Appendix F**, ref 2.11).	No response.	Woodside to provide additional details as part of Phase 3 consultation activities.

Table 5-5: Phase 3 stakeholder consultation plan activities

Stakeholder	Information provided	Stakeholder response	Woodside response
Australian Government department or agency			
ACS	On 25 October 2019, Woodside emailed ACS, advising of the proposed activity (**Appendix F**, ref 3.1) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Woodside has addressed maritime security-related issues in **Section 7** of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
AHO	On 25 October 2019, Woodside emailed AHO, advising of the proposed activity (**Appendix F**, ref 3.6) and providing a shipping fairways map (**Appendix F**, ref 3.7) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Based on feedback from AMSA, Woodside will notify AHO no less than four working weeks before operations commence.
AMSA (marine safety)	On 25 October 2019, Woodside emailed AMSA, advising of the proposed activity (**Appendix F**, ref 3.7) and providing a shipping fairways map (**Appendix F**, ref 3.8) and consultation Information Sheet (**Appendix F**, ref 3.2).	On 30 October 2019, AMSA emailed Woodside, requesting the Master to email AMSA's Joint Rescue Coordination Centre at least 24 to 48 hours before operations commence and providing details of information required by the Centre in that communication.	Woodside will notify AMSA's Joint Rescue Coordination Centre at least 24 to 48 hours before operations commence.
		AMSA asked that the Australian Hydrographic Service (AHS) be contacted through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners.	Woodside will notify AHO no less than four working weeks before operations commence.
		AMSA provided advice about obtaining vessel traffic plots, including digital datasets and maps.	Woodside notes AMSA's advice about vessel traffic information.
AMSA (marine pollution)	On 25 October 2019, Woodside emailed AMSA, advising of the proposed activity (**Appendix F**, ref 3.7) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	No response required.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 4 December 2019, Woodside emailed AMSA and provided a copy of the Oil Pollution First Strike Plan (**Appendix F**, ref 3.16).	No feedback received.	Email, consultation Information Sheet and first strike plan provided (**Appendix H**). Woodside considers the level of consultation to be adequate.
DAWR	On 28 October 2019, Woodside emailed DAWR, advising of the proposed activity and providing information about invasive marine species (IMS) (**Appendix F**, ref 3.11), a Commonwealth fisheries map (**Appendix F**, ref 3.12) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Woodside has addressed maritime biosecurity and Commonwealth fishing related issues in **Section 7** of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
DIIS	On 25 October 2019, Woodside emailed DIIS, advising of the proposed activity (**Appendix F**, ref 3.1) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
DNP	On 20 December 2019, Woodside emailed DNP, advising of the proposed activity (**Appendix F**, ref 3.19), considering marine park values, and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	On 26 March 2020, DNP advised that planned activities do not overlap any Australian Marine Parks. It advised it does not require any further notification unless the activity changes and results in an overlap with or new impact to a marine park, or for emergency responses.	Woodside notes the DNP feedback and will consult it should the activity change and impact Australian Marine Parks, or for emergency responses.
Western Australian Government department or agency or advisory body			
DMIRS	On 25 October 2019, Woodside emailed DMIRS, advising of the proposed activity (**Appendix F**, ref 3.1) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
DPIRD	On 25 October 2019, Woodside emailed DPIRD, advising of the proposed activity (**Appendix F**, ref 3.3) and providing a State fisheries map relevant to proposed activity (**Appendix F**, ref 3.6) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Woodside to perform follow-up consultation.
	On 12 November 2019, Woodside called DPIRD to discuss the Echo Yodel proposed decommissioning and left a voicemail.	No feedback received.	Woodside to perform follow-up consultation.

Stakeholder	Information provided	Stakeholder response	Woodside response
	On 25 November 2019, Woodside called DPIRD and advised about the proposed decommissioning of Echo Yodel.	DPIRD thanked Woodside for the update and advised it would consider the information.	On 25 November 2019, Woodside re-sent the initial consultation materials to DPIRD.
		On 25 November 2019, DPIRD emailed, thanking Woodside for the information provided.	Woodside considers the level of consultation to be adequate.
DoT	On 25 October 2019, Woodside emailed DoT, advising of the proposed activity (**Appendix F**, ref 3.17) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	On 25 October 2019, DoT emailed Woodside, advising it had received Woodside's advice and would be actioned as soon as possible by the relevant officer.	No further action ahead of sending DoT a copy of the Oil Pollution First Strike Plan (**Appendix H**).
		On 19 November 2019, DoT emailed Woodside, acknowledging receipt of its advice and seeking to be consulted if there was a risk of a spill impacting State waters, as per the DoT Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (September 2018).	Woodside will provide a copy of the Oil Pollution First Strike Plan for the activity for review and comment (**Appendix H**).
	On 13 December 2019, Woodside emailed DoT and provided a copy of the Oil Pollution First Strike Plan (**Appendix F**, ref 3.18).	On 10 January 2020, DoT emailed Woodside, seeking additional information about sensitive receptors and shoreline impacts.	On 10 January 2020, Woodside emailed DoT, advising that the First Strike Plan had been updated to reflect modelling which indicated that no sensitive receptors would be contacted beyond 48 hours of a spill.
		On 13 January 2020, DoT emailed Woodside, advising that it had no further queries but requesting a copy of the First Strike Plan once complete.	On 13 January 2020, Woodside emailed DoT, advising it would send DoT a copy of the First Strike Plan (**Appendix H**) once accepted by NOPSEMA.
State Fisheries			
Pilbara Line Fishery	On 14 November 2019, Woodside emailed licence holders, advising of the proposed activity (**Appendix F**, ref 3.4) and providing a State fisheries map relevant to the proposed activity (**Appendix F**, ref 3.6) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, consultation Information Sheet and State fisheries map provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
Pilbara Trap Fishery	On 14 November 2019, Woodside emailed licence holders, advising of the proposed activity (**Appendix F**, ref 3.14) and providing a State fisheries map relevant to the proposed activity (**Appendix F**, ref 3.6) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, consultation Information Sheet and State fisheries map provided. Woodside considers the level of consultation to be adequate.
Mackerel Fishery (Area 2)	On 14 November 2019, Woodside, sent a letter to licence holders, advising of the proposed activity (**Appendix F**, ref 3.5) and providing a State fisheries map relevant to the proposed activity (**Appendix F**, ref 3.6) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Letter, consultation Information Sheet and State fisheries map provided. Woodside considers the level of consultation to be adequate.
Industry			
BP Developments Australia	On 25 October 2019, Woodside emailed adjacent titleholders, advising of the proposed activity (**Appendix F**, ref 3.9) and providing a titles map relevant to the proposed activity (**Appendix F**, ref 3.10) and a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, titles map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Mobil Australia	On 25 October 2019, Woodside emailed adjacent titleholders, advising of the proposed activity (**Appendix F**, ref 3.9) and providing a titles map relevant to the proposed activity (**Appendix F**, ref 3.10) and a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, titles map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Industry representative organisations			
APPEA	On 25 October 2019 Woodside emailed APPEA, advising of the proposed activity (**Appendix F**, ref 3.1) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
PPA	On 25 October 2019, Woodside emailed PPA, advising of the proposed activity (**Appendix F**, ref 3.3) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, State fisheries map and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
Recfishwest	On 25 October 2019, Woodside emailed Recfishwest, advising of the proposed activity (**Appendix F**, ref 3.1) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
WAFIC	On 25 October, Woodside emailed WAFIC, advising of the proposed activity (**Appendix F**, ref 3.3) and providing a State fisheries map relevant to the proposed activity (**Appendix F**, ref 3.6) and consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email, State fisheries map and consultation Information Sheet provided. Woodside will follow up consultation with WAFIC.
	On 15 November 2019, Woodside called WAFIC to discuss the proposed decommissioning and seek any feedback.	WAFIC advised the activity will be too deep for Mackerel Fishers and that it would respond to Woodside's initial email.	Woodside noted the water depth is too deep for mackerel fishers and it would await WAFIC's further advice.
		On 3 December 2019, WAFIC emailed Woodside, advising it views decommissioning activities positively and seeking clarification about exclusion and cautionary zones in future EPs.	Woodside will update future information clarifying exclusion and cautionary zones.
Other stakeholders			
KBGFC	On 25 October 2019, Woodside emailed KBGFC, advising of the proposed activity (**Appendix F**, ref 3.13) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.
NBSFC	On 25 October 2019, Woodside emailed NBSFC, advising of the proposed activity (**Appendix F**, ref 3.13) and providing a consultation Information Sheet (**Appendix F**, ref 3.2).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Table 5-6: Stakeholder feedback from previous consultation activities relevant to the proposed activity

Environment Plan	Stakeholder	Stakeholder feedback
WA-34-L Exploration Wellheads EP, accepted by NOPSEMA on 29 March 2018	AFMA	AFMA advised at a teleconference on 18 December 2017 that it had no particular concerns with the proposed activity and that it would share the consultation information within its organisation for assessment.
	AMSA	AFMA confirmed at a teleconference on 22 June 2017 that it had no concerns from a navigational safety perspective. It also advised that it would work with Woodside to mitigate risk for marine users, given the pipeline crossed a shipping fairway.
		AMSA advised in an email on 23 June 2017 that it discussed the Echo Yodel decommissioning options with its Environmental Standards team and that navigational concerns for the umbilical and pipeline if left in-situ had been assessed as minimal.

Environment Plan	Stakeholder	Stakeholder feedback
		AMSA also advised that its preference for wellheads is to at least remove the tree from above the wellhead if left in-situ to minimise navigational safety aspects of the remaining infrastructure.
	DPIRD	DPIRD advised in an email on 1 December 2017 that it had no concerns with leaving the Pluto-3 and Pluto-6 wellheads in-situ, based on water depth. DPIRD advised that the Xeres-1A wellhead is in 190 m of water within a WA-managed trawl licence area and encouraged Woodside to remove the unused infrastructure from the seabed; cut the infrastructure at or below the seabed if it cannot be removed to avoid snagging of trawling equipment; and/or remove any safety zones that are in place.
		DPIRD advised in an email on 7 February 2018 that the permanent fish trawl closure zone over the Xeres-1A wellhead (in water depth of 190 m) is highly unlikely to be changed to a trawling zone in the future.
		DPIRD advised in an email on 1 March 2018 that it encourages titleholders to abandon wells and infrastructure sites in conditions that will allow for future fishing operations.
	WAFIC	WAFIC advised at a meeting on 18 July 2018 that a significant environmental case for leaving infrastructure in-situ would need to be presented. WAFIC also advised that Woodside will need to demonstrate how the site has 'potential for future use'. WAFIC requested that exclusion zones are not put in place and that snagging risks fall to fishery licence holders, not oil and gas operators.
WA-404-P Exploration Wellheads EP, accepted by NOPSEMA on 3 July 2018.	AMSA	AMSA advised in an email on 26 March 2018 that from a safety of navigation perspective, it has no preferred decommissioning method. AMSA requested that, regardless of the final method approved by NOPSEMA, any remaining infrastructure that sits proud of the seafloor is notified to AHO for incorporation into nautical charts.
	DPIRD	DPIRD advised in an email on 6 April 2018 that it generally encourages titleholders to ensure abandoned sites are stripped of unused infrastructure; however, understood that in some cases the removal of all infrastructure may not result in a net environmental benefit and trusts the Regulator to evaluate and regulate such decommissioning proposals. With respect to the wellheads that are in waters deeper than 200 m, DPIRD deemed the risk of a significant impact on WA aquatic resources and fisheries associated with the proposed well abandonments to be low.
		DPIRD advised in an email on 30 May 2018 that it had no further comment to add, given that Woodside had performed a comparative assessment that considered options for removal and, on balance, decided to leave the wellheads and well casing in situ.
	WAFIC	WAFIC advised in an email on 4 April 2018 that with regard to the commercial fishing sector, there was little to no interest with activities in the water depths concerned with WA-404-P. The only overlap with the industry may be with transiting vessels.

Environment Plan	Stakeholder	Stakeholder feedback
Interpretation of the *Sea Dumping Act*	DoEE	On 16 April 2018, Woodside engaged DoEE, seeking clarity about interpretation of the Sea Dumping Act to help inform planning and decision-making for decommissioning oil and gas infrastructure.
		On 27 July 2018, DoEE advised by email that it had reviewed the Sea Dumping Act in relation to disposing or abandoning structures or components associated with offshore oil and gas platforms. DoEE advised there were circumstances where abandoning structures or components associated with oil and gas platforms will not constitute dumping for the purposes of the Sea Dumping Act. In determining whether abandoning such structures or components falls outside of the definition of dumping, DoEE advised that the following criteria must be met: 1. The component or structure must be associated with a platform (i.e. a principal or overarching platform facility) or other man-made structure. 2. The component or structure must not constitute a platform or other principal structure itself. 3. The component or structure must have been placed in the particular position where it will be left for a purpose other than disposal. DoEE provided examples where abandoning structures or components associated with an offshore oil and gas platform potentially may not constitute dumping, including abandoning in-situ wellheads, subsea manifolds, gravity bases and mattresses, piles and skirts, fixed anchor or mooring blocks, pipelines and associated stabilisers, flowlines, power cables and umbilicals, etc, that were associated with a platform. DoEE confirmed it would remain Woodside's responsibility to consider, in the particular circumstances of each case, whether abandoning a structure or component associated with an oil and gas platform constitutes 'dumping' under the Act. It advised that due regard should be given to whether the action will minimise pollution of the environment to the fullest possible extent under the United Nations Convention on the Law of the Sea (UNCLOS), as well as any relevant regulatory approvals required under the OPGGS regime. On 31 July 2018, Woodside thanked DoEE for its advice and sought additional guidance about how the Sea Dumping Act applied to wellheads that were not connected to a platform (i.e. exploration wellheads). On 24 May 2019, DoEE advised by email that, depending on the particular circumstances, wells placed on the seabed for the purpose of operating a platform or other principal man-made structure (including drill rigs) would likely fall under the scope of article 1.4.2.3, regardless of whether it remains connected to the platform once exploration, appraisal or production has ceased. In this circumstance, a permit under the Sea Dumping Act would not be required. It also advised that over-trawl structures placed over infrastructure would not constitute abandonment under the Sea Dumping Act, as long as the primary purpose of the placement was for protection. A permit under the Sea Dumping Act would be required if the primary purpose of placement was to create an artificial reef. On 22 January 2020, Woodside emailed DoEE to confirm the validity of the Department's advice for the current preparation of EPs for submission to NOPSEMA that involve plugged and abandoned wellheads. On 12 February 2020, DoEE phoned Woodside to advise that assessment will need to be made on a case by case basis in discussion with DoEE, given recent IMO guidance and other factors.

Environment Plan	Stakeholder	Stakeholder feedback
		On 1 April 2020, Woodside emailed DoEE and requested a teleconference to discuss sea dumping permit assessments for some of Woodside's projects. On 2 April 2020, DoEE advised by email that proposed a teleconference on the afternoon of either 22 April or 23 April 2020. On 3 April 2020, Woodside sent a teleconference invite for Wednesday 22 April to discuss sea dumping for Woodside projects.

5.6 Ongoing Stakeholder Consultation

Woodside is committed to the engagements listed in **Table 5-7** based on stakeholder feedback.

Table 5-7: Ongoing stakeholder consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSA's Joint Rescue Coordination Centre 24-48 hours before operations commence.
	Woodside will notify the AHO no less than four working weeks before operations commence.
DoT	Woodside to provide accepted versions of its oil pollution documentation as well as tactical plans for the activity.

6. COMPARATIVE ASSESSMENT OF OPTIONS FOR PERMANENT MANAGEMENT OF ECHO YODEL SUBSEA INFRASTRUCTURE

6.1 Overview

Woodside has considered various decommissioning options for the Echo Yodel subsea infrastructure, including the base case of complete removal. To understand how the different options compare to each other and to the base case, a comparative assessment process was followed. This comparative assessment process was based on best practice, as described in the Oil and Gas UK Guidelines for Comparative Assessment in Decommissioning Programmes (Oil and Gas UK, 2015), and was implemented with the purpose of understanding which decommissioning option was most preferred and if that preferred decommissioning option delivered equal or better environmental, safety and well integrity outcomes when compared to the base case.

The comparative assessment process intended to actively involve stakeholders in identifying the most preferred decommissioning option, to support Woodside's decision-making about the preferred decommissioning option in accordance with Section 270(3) and Section 572(3) of the OPPGS Act.

As outlined in **Section 6**, the comparative assessment process included:

- early work to understand the existing environment and how the Echo Yodel subsea infrastructure may interact in the marine environment if left in-situ; this included commissioning a number of engineering and scientific studies
- development of assessment criteria, in consultation with external stakeholders
- assessment of the decommissioning options against the assessment criteria, in consultation with external stakeholders in a workshop
- sensitivity analysis and assessment of cumulative results.

The next sections describe the comparative assessment process in more detail and provide an overview of the results. These results provide Woodside with an understanding of the most preferred decommissioning option based on how it ranks against the assessment criteria and stakeholder feedback.

This preferred option has then been compared to the base case, which is defined in the OPGGS Act as complete removal of all infrastructure from the petroleum title area once it is no longer used (Section 572(3)). The comparison against the base case focuses on whether the most preferred option delivers equal or better environmental, safety and well integrity outcomes, with the intention of providing NOPSEMA with assurance that the most preferred option aligns with the Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science, 2018).

6.2 Early Work

To inform the comparative assessment for the Echo Yodel subsea infrastructure, Woodside commissioned a number of scientific and engineering studies between 2016 and 2018. These studies provided information about the existing environment in the vicinity of the Echo Yodel subsea infrastructure and how leaving the Echo Yodel subsea infrastructure would interact with the marine environment over time. These studies provided a robust basis for understanding the potential environmental impacts and benefits associated with various decommissioning options and informed the comparative assessment process. These studies are listed in **Table 6-1**.

Table 6-1: Background studies completed and/or used for the comparative assessment process

Subject matter	Study(s) Title	Findings
Degradation of material	Echo Yodel Pipeline Decommissioning Semi Quantitative Degradation Study (Atteris, 2018). Echo Yodel Umbilical Decommissioning Semi Quantitative Degradation Study (Atteris, 2019).	Assessed the long-term degradation, rate of degradation, burial status and how the burial status may change over time for the Echo Yodel pipeline and umbilical. These reports found that the umbilical and pipeline are self-burying and will continue to do so for up to another 125 years. After this time, they will have reached an equilibrium and will be mostly buried. Although they will also break down over time (about 1700 years), releasing material to the marine environment, the self-burying means most of the material will remain buried. The findings are discussed further in **Section 3.14**.
Mercury and NORMs	Managing the long-term impacts of contaminants associated with decommissioning of the Echo Yodel pipeline (Apte and Gissi, 2017).	Assessed the contaminants that may be present in the Echo Yodel pipeline (mercury and NORMs) and how those contaminants may affect the subsea marine environment in the long term. This report found that there was no contamination.
Mercury	Echo Yodel Subsea Spool Hg Testing Summary (Woodside, 2019).	Sampled, tested and assessed mercury content of a section of the Echo Yodel subsea pipeline. This report found that there was no contamination.
Greenhouse gas emissions	Decommissioning Steel Recycling Greenhouse Gas (GHG) Assessment Report (Energetics, 2016).	This report assessed the GHG emissions resulting from decommissioning subsea pipelines associated with the Goodwyn Alpha platform in the North West Shelf and recycling the recovered steel. The report found that when a lift and cut decommissioning method is used, the GHG emissions from the activity are greater than the benefits from recycling the steel and there is no benefit over leaving the steel in-situ.
Biodiversity and fisheries value	Using industry ROV videos to assess fish associations with subsea pipelines. (McLean *et al.,* 2017). The Value of Subsea Pipelines to Marine Biodiversity (Bond *et al.,* 2018a). Understanding the Global Scientific Value of Industry ROV Data, to Quantify Marine Ecology and Guide Offshore Decommissioning Strategies (McLean *et al.,* 2018). Diel shifts and habitat associations of fish assemblages on a subsea pipeline (Bond *et al.*, 2018b). Fish associated with a subsea pipeline and adjacent seafloor of the north-west shelf of Western Australia (Bond *et al.,* in press) A comparison of pipeline fish assemblages surveyed by ROV and stereo-BRUVS (Bond *et al.,* in press).	These studies describe the diversity and abundance of fish and the composition and complexity of habitats created by colonising invertebrates on subsea infrastructure, including Echo Yodel subsea infrastructure. These studies found that the species around the Echo Yodel subsea infrastructure were significantly different to the species in the sand areas surrounding the Echo Yodel subsea infrastructure. They also found that species richness was on average 25% higher on the Echo Yodel pipeline than off. They also further supported other studies that suggested habitat was provided by the Echo Yodel subsea infrastructure and that habitat was attracting an abundance of species. Results are further discussed in **Section 4.5.1.4.3**.

Subject matter	Study(s) Title	Findings
	Determination of optimal transect length to sample fish and habitats on pipelines from industry ROV footage (Bond *et al.,* in press). Comparing industry ROV and BRUVS for surveys of fish along a subsea pipeline (Bond *et al.,* in press).	
	Fish assemblages and biological habitats of wellheads and associated infrastructure on the North-West Shelf of Western Australia (McLean *et al.*, 2018a). Fish-habitat associations on exploration and production wellheads, North-West Shelf (McLean *et al.*, 2018b).	These studies describes the diversity and abundance of fish and the composition and complexity of habitats create by colonising invertebrates on 25 production wells on the NWS including Yodel-3 and Yodel-4 wells and five exploration wellheads. These studies found that the populations of fish species around Echo Yodel subsea infrastructure is increasing and further supported that there is a high abundance of commercially important fish species including snappers and groupers. Results are further discussed in **Section 4.5.1.4.3**.

6.3 Comparative Assessment Workshops

The comparative assessment process relies on active participation from all relevant stakeholders, both internally from Woodside and external stakeholders, collaboratively in a workshop. To achieve the appropriate level of engagement, a series of workshops were held with internal and external stakeholders. The objectives of these workshops were to:

- develop criteria and sub-criteria
- score the options
- weight the criteria and sub-criteria

The outcome of the workshops was to support Woodside's decision-making for the final decommissioning option for the Echo Yodel subsea infrastructure. To do this, the objectives of the workshop were to:

- ensure stakeholders understand the comparative assessment process and the part it plays in the decommissioning decision-making
- actively involve stakeholders in the comparative assessment multi-criteria decision analysis (MCDA) process (i.e. evaluating the MCDA model in the workshop)
- identify the 'in principle' preferred decommissioning option in the workshop, which considers all the different stakeholders' perspectives.

The outcomes of these workshops have been described where relevant in the next sub-sections of this chapter. **Section 5** contains further details about stakeholder engagement that was performed.

6.4 Decommissioning Options

To develop decommissioning options and progress the comparative assessment process, the Echo Yodel subsea infrastructure was assessed as three separate components:

1. Echo Yodel pipeline
2. Echo Yodel umbilical (including the UTAs and IUTB)
3. Echo Yodel X-mas trees/wellheads (comprising the Yodel-3 and Yodel-4 wellheads).

This was because each component of the Echo Yodel subsea infrastructure has unique characteristics that may have different considerations during the comparative assessment process, such as different vessel types for removal, or different options considered.

To develop the decommissioning options, all possible options were initially considered. These were:

- complete removal (OPGGS Act base case)
- partial removal
- leave in-situ with augmentation
- leave in-situ without augmentation.

These options were then screened to confirm they were warranted. ‘Partial removal’ and ‘leave in-situ with augmentation’ were not considered warranted for the following reasons:

- Partial removal was not considered warranted because the level of effort and cost associated with this option is comparable to the complete removal option. As such, complete removal would be favoured over partial removal, and this option was removed to limit the effort and time expended in assessing the option.
- Leave in-situ with augmentation was not considered warranted, given the benefits it currently provides without augmentation due to its size and length (especially compared to, for example, a single wellhead).

Based on this, the two options that were progressed into the comparative assessment process were:

- complete removal (OPGGS Act base case)
- leave in-situ without augmentation (referred to as ‘leave in-situ’ hereafter).

These are described further in **Table 6-2**.

Table 6-2: Decommissioning options considered in the comparative assessment

<table>
<tr><th>Option</th><th colspan="2">Description</th></tr>
<tr><td colspan="3">Pipeline</td></tr>
<tr><td>Complete removal</td><td>Remove full pipeline via reverse reel, using a dedicated pipe-lay vessel. The length of pipeline that can be recovered would be limited by the size and capacity of the reel (assume to be a vessel capable of about 250 m/hr recovery rate).

It is expected that two separate trips would be required and that the pipeline would be taken to Asia for recycling/disposal, given there are no capable facilities in Australia. The option requires an onshore site for spooling and handling of the pipe.</td><td>
<table>
<tr><th>Activity</th><th>Duration (days)</th><th>People on Board (POB)</th><th>Man Days</th></tr>
<tr><td>Reel lay vessel mob + transit (from Singapore)</td><td>14</td><td>45</td><td>630</td></tr>
<tr><td>Reel lay vessel crew mob</td><td>2</td><td>120</td><td>240</td></tr>
<tr><td>Pipeline removal (in field)</td><td>4</td><td>120</td><td>480</td></tr>
<tr><td>Interim mob (to Malaysia)</td><td>20</td><td>45</td><td>900</td></tr>
<tr><td>Offload pipe to onshore base (Malaysia)</td><td>2</td><td>120</td><td>240</td></tr>
<tr><td>Reel lay vessel demob</td><td>8</td><td>45</td><td>360</td></tr>
<tr><td>Onshore site setup</td><td>20</td><td>8</td><td>160</td></tr>
<tr><td>Onshore site process for transport</td><td>20.5</td><td>15</td><td>308</td></tr>
<tr><td>Recycle / disposal operations</td><td>5</td><td>15</td><td>75</td></tr>
<tr><td>Total Operations</td><td>95.5</td><td></td><td>3,393</td></tr>
</table>
</td></tr>
<tr><td>Leave in-situ</td><td colspan="2">Pipeline to be left in-situ on the sea floor.
No further activities are required.</td></tr>
<tr><td colspan="3">Umbilical</td></tr>
<tr><td>Complete removal</td><td>Mobilise an Installation Support Vessel with tensioner recovery system and three to four reels installed.

Recover umbilical through loading onto reels (about 7.8 km). It is expected that two separate trips would be required and that the umbilical would be taken to Asia for recycling, given there are no capable facilities in Australia.

Recover the UTAs, IUTB, etc, at the same time.</td><td>
<table>
<tr><th>Activity Description</th><th>Duration (days)</th><th>POB</th><th>Man Days</th></tr>
<tr><td>ISV vessel mob + transit (from Singapore)</td><td>15</td><td>45</td><td>675</td></tr>
<tr><td>ISV crew mob</td><td>2</td><td>120</td><td>240</td></tr>
<tr><td>ISV recovery operations (in field)</td><td>5</td><td>120</td><td>600</td></tr>
<tr><td>ISV offload EHU reels to onshore base</td><td>2</td><td>120</td><td>240</td></tr>
<tr><td>ISV demob</td><td>15</td><td>45</td><td>675</td></tr>
<tr><td>Onshore Site Setup</td><td>2</td><td>8</td><td>16</td></tr>
<tr><td>Onshore site process for transport</td><td>7</td><td>15</td><td>105</td></tr>
<tr><td>Recycle/ Disposal Operations</td><td>5</td><td>10</td><td>50</td></tr>
<tr><td>Total</td><td>53</td><td></td><td>2601</td></tr>
</table>
</td></tr>
<tr><td>Leave in-situ</td><td colspan="2">Umbilical, UTAs, IUTB and jumpers/flying leads to be left in-situ on the sea floor.
No further activities are required.</td></tr>
<tr><td colspan="3">Wellheads</td></tr>
<tr><td>Complete removal</td><td>Cut and remove wellhead and X-mas trees using an IMMR vessel after permanent plugging activities are completed.

Vessel will then lift X-mas trees to surface.

Cut well casing about 5 m below seabed and remove the wellhead.

Assume vessel is in Australia.</td><td>
<table>
<tr><th>Activity Description</th><th>Duration (days)</th><th>POB</th><th>Man Days</th></tr>
<tr><td>IMR vessel mob</td><td>2</td><td>45</td><td>90</td></tr>
<tr><td>IMR vessel crew mob</td><td>2</td><td>80</td><td>160</td></tr>
<tr><td>XT and wellhead recovery operations - field</td><td>4</td><td>80</td><td>320</td></tr>
<tr><td>IMR vessel offload XTs, wellheads to onshore base</td><td>2</td><td>80</td><td>160</td></tr>
<tr><td>IMR vessel demob</td><td>2</td><td>45</td><td>90</td></tr>
<tr><td>Onshore site setup</td><td>2</td><td>8</td><td>16</td></tr>
<tr><td>Onshore site process for transport</td><td>5</td><td>15</td><td>75</td></tr>
<tr><td>Recycle / disposal operations</td><td>5</td><td>10</td><td>50</td></tr>
<tr><td>Total</td><td>24</td><td></td><td>961</td></tr>
</table>
</td></tr>
<tr><td>Leave in-situ</td><td colspan="2">X-mas trees and wellheads to be left in-situ.
No further activities are required.</td></tr>
</table>

The key health and safety hazards for comparing the two options, which were presented in the workshops, are summarised in **Table 6-3**.

Table 6-3: Health and safety hazards comparison between complete removal and leave in-situ

Completely Remove	Leave In-situ
Offshore: 1. Vessel collision with the Goodwyn Alpha Platform and subsequent hydrocarbon release due to proximity of vessel to the platform during pipeline/umbilical removal. 2. Dropped object onto GWF subsea infrastructure and subsequent hydrocarbon release during pipeline/umbilical removal. 3. Crash during helicopter transfer of personnel to offshore resulting in fatalities. 4. Dropped objects and/or failure of lines under tension (pipeline/umbilical removal) on deck resulting in injury to personnel or fatalities. 5. Injury due to use of cutting tools.	**Offshore:** 1. Pipeline/infrastructure shifts and impacts other infrastructure resulting in hydrocarbon release. This has been assessed as non-credible due to the pipeline being in a permanent no-trawl zone, inherently stable and self-burying over time. 2. Snagging of equipment during trawling and subsequent injury on deck or fatalities due to foundering of vessels. The pipeline and infrastructure are in a no trawling zone and, as such, this hazard should not eventuate.
Onshore: 1. Working on lines under tension for offloading umbilical/pipeline to quayside. 2. Injury due to repeated use of cutting tools and lifting (about 2000 m × 12 m long sections) of pipe into sections for transport. Dropped object hazards present potential for injury to personnel or fatalities. 3. Road transport and collision. 4. Personnel exposure to low levels of hazardous substances (dust, smoke, fumes) during the cutting/recycling process.	**Onshore:** None.

6.5 Comparative Assessment Criteria

The decommissioning options were assessed against 18 criteria, grouped under five main criteria:

1. socioeconomic
2. environmental
3. health and safety
4. technical
5. economic.

The 18 criteria (also termed ‘sub-criteria’ where they sit under a main criteria) were developed in accordance with the ‘Guidelines for Comparative Assessment in Decommissioning Programmes’ (Oil and Gas UK, 2015).

To differentiate between the benefits and risks that may be presented by the two decommissioning options over time, the criteria were developed with reference to the three timeframes, being:

1. ‘during decommissioning operations’ – the period of performing the decommissioning operations themselves
2. ‘medium-term’ – the period after decommissioning operations up until the point at which the infrastructure degrades or becomes completely buried

3. 'long-term' – the period after the 'medium-term', beyond which the infrastructure has reached a 'steady state', such as being completely buried or completely degraded.

Table 6-4 outlines the criteria and sub-criteria developed for the comparative assessment. This table also outlines general guidance that was used during the comparative assessment workshops to assist participants with consistently understanding and applying the criteria (Catalyze, 2019).

Table 6-4: Echo Yodel comparative assessment criteria details

No.	Sub-criteria	Description	Guidance
Socio-economic			
1.	Socio-economic impact (during decommissioning operations)	The extent to which the option economically impacts commercial (and other) fishing and other activities in the short term, during decommissioning operations	Does the option close the area to fishers, exclude fishing vessels, etc. This does not include safety risks to fishers as these are covered in 'other marine users' risk' (no. 15).
2.	Socio-economic benefit (medium term)	The extent to which the option supports or enhances commercial (e.g. commercial fishing) and social (e.g. recreational fishing) activities after decommissioning over the medium term horizons	Does the option support or enhance presence of commercially fished species, recreationally fished species, etc.
3.	Commercial risk (medium term)	The extent to which the option risks commercial impacts following decommissioning over the medium term	Does the option present risk of net damage from snagging, vessel collisions, downtime due to repair, etc.
Environmental			
4.	Spill risk (during decommissioning operations)	The risk of spill events into the marine environment	Consider whether there is spill risk from decommissioning vessel fuel (e.g. from collision), resulting in a fuel spill, etc.
5.	Waste (during decommissioning operations)	The extent to which the option generates waste and impacts end-points (e.g. landfill, recycle)	Consider whether there is waste from decommissioning vessels, scrap, etc.
6.	Emissions (during decommissioning operations)	The extent to which the option produces emissions	Consider whether there are emissions as a result of decommissioning operations. Incudes impacts from operations vessels, waste processing, manufacture of structures, CO_2 emissions, etc.
7.	Water/sediment quality (during decommissioning operations)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) during the decommissioning operation	Consider whether there is creation of physical impacts, e.g. seabed disturbance, water turbidity, release of chemicals, etc.
8.	Other environmental impacts (during decommissioning operations)	The extent to which the option has other environmental impacts in the short term, during the decommissioning operation	Consider whether there is destruction of marine life attached to infrastructure as a result of removing or moving the infrastructure. This only considers impacts at the time of the decommissioning operation; other impacts (such as loss of habitat) are captured under the 'ongoing' environmental criteria.
9.	Water/sediment quality (medium term)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the medium term after completing decommissioning	Consider whether there are contaminants on in-situ equipment (including potential NORMs, mercury, plastics), etc., in the medium term.

No.	Sub-criteria	Description	Guidance
10.	Environmental benefit (medium term)	The extent to which the option provides overall environmental benefit over the medium term after decommissioning	Consider whether the option supports or enhances marine life and habitats (it is assumed that more habitat is positive for environmental benefit). This excludes the benefit from commercial fishing, recreational fishing, etc.
11.	Water/sediment quality (long term)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the long term	Consider whether there are contaminants on in-situ equipment (including potential NORMs, mercury, plastics), etc., over the long term.
12.	Environmental benefit (long term)	The extent to which the option provides overall environmental benefit over the long term	Consider whether the option supports or enhances marine life and habitats (it is assumed that more habitat is positive for environmental benefit). This excludes the benefit from commercial fishing, recreational fishing, etc.
Health and safety			
13.	Onshore personnel risk (during decommissioning operations)	The extent to which the option risks harm to onshore personnel (decommissioning team) during decommissioning operations	Consider whether there is onshore work required (e.g. scrap handling, transporting, cutting up, disposal), etc.
14.	Offshore personnel risk (during decommissioning operations)	The extent to which the option risks harm to offshore personnel (decommissioning team) during decommissioning operations	Consider what is the duration of operations, complexity of operations, number and size of lifts, etc.
15.	Other marine users' risk (during decommissioning operations)	The extent to which the option risks harm to other marine users (e.g. vessel collision with commercial fishing, shipping, etc.) during decommissioning operations	Consider whether there is a risk to others from collision with decommissioning vessels, etc.
16.	Other marine users' risk (medium term)	The extent to which the option risks harm to other marine users (e.g. commercial fishing, shipping, etc.) after decommissioning operations over the medium term	Consider whether there could be vessel foundering/sinking, etc, due to snag or collision with remaining infrastructure (note this criterion only considers the risk of harm, not financial risk from equipment loss, etc).
Technical			
17.	Technical feasibility	The technical feasibility (likelihood of success) of completing the decommissioning option, including gaining any specific licenses and approvals (in addition to an accepted EP)	Consider whether there is the ability to recover from unplanned excursions and complete the planned decommissioning option. Includes the extent to which the option requires using proven technology.
Economic			
18.	Total project cost	The total cost of the decommissioning activity	Consider the total estimated capital expenditure.

These criteria are able to be represented visually in the structure shown in **Figure 6-1**.

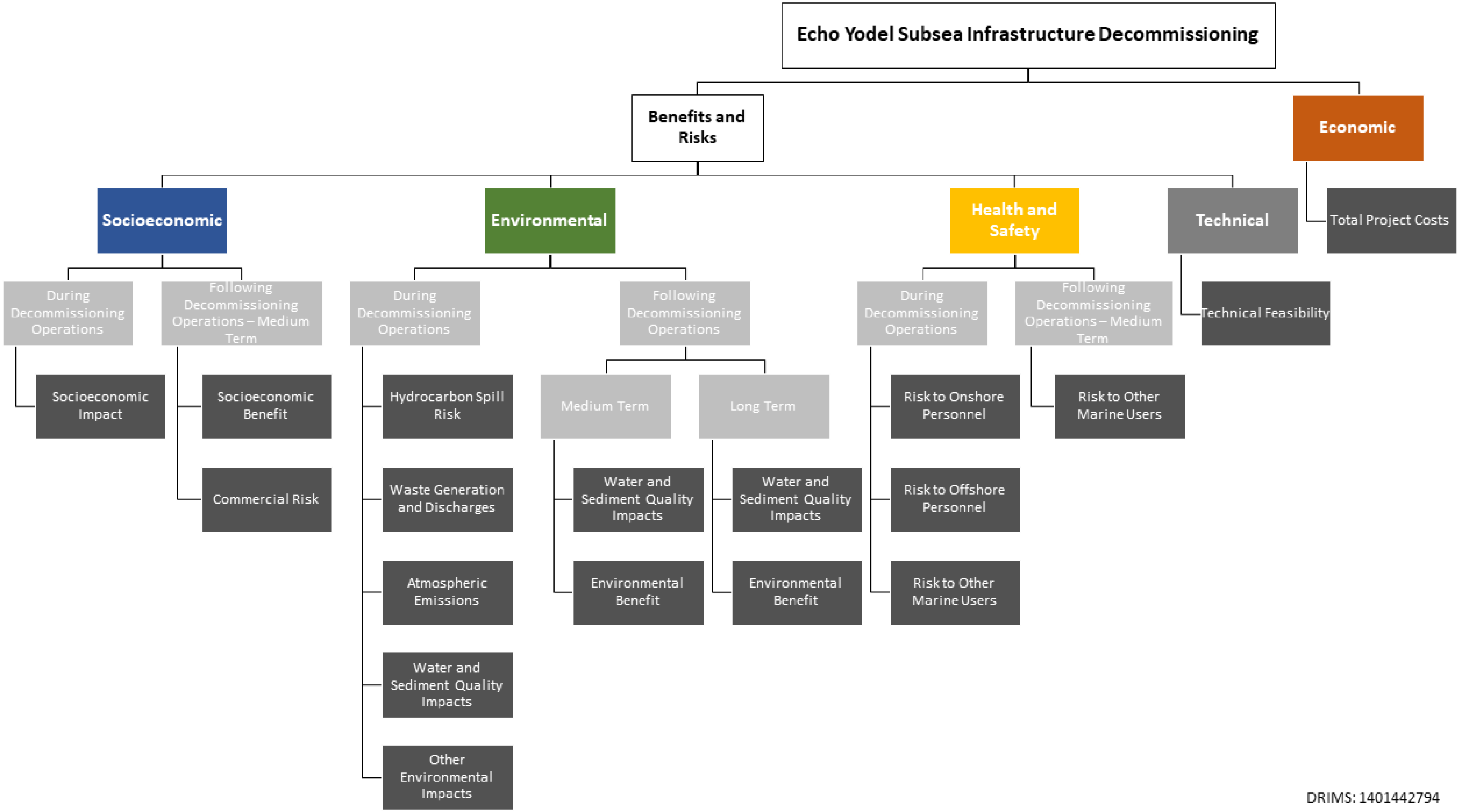

Figure 6-1: Echo Yodel comparative assessment criteria structure

6.6 Scoring and Weighting System

To understand the preferred option, the decommissioning options were scored in a workshop forum with stakeholders against the agreed criteria (**Table 6-4**). This was done using a standard MCDA approach (Catalyze, 2019). This involves numerical analysis performed in two stages: scoring and weighting (Catalyze, 2019).

Scoring involves assigning a numerical score based on the expected consequences (or benefits) of each option, using a strength of relative preference scale for each option for each criterion. Options that are less preferred score lower on the scale, while more preferred options score higher. All options considered in the MCDA would then fall between 0 and 100, with 100 being the ‘most’ preferred and 0 being the ‘least preferred’. This is called a ‘scale of relative preference’ (Catalyze, 2019).

Scoring for the Echo Yodel subsea infrastructure was performed one criterion at a time. Given there were two decommissioning options that were progressed after the options screening (**Section 6.4**), the options were scored as ‘most preferred’ and ‘least preferred’, with ‘most preferred’ being assigned a score of ‘100’ and ‘least preferred’ being assigned a score of ‘0’. Typically, as described above, any other options would be scored relative to those on the scale; however, for the Echo Yodel subsea infrastructure, only two options were being considered for each infrastructure group so the most-preferred scored 100 and the least-preferred scored 0 (Catalyze, 2019).

After scoring, weighting is performed. Weighting involves allocating numerical weights to define, for each criterion, the relative value between the top and bottom of the chosen scale, compared to the other criteria. This is known as a ‘swing weighting’ process. This requires the stakeholders to consider the difference in risk, cost or benefit between the least-preferred (‘scale bottom’) and the most-preferred (‘scale top’) option for a given criterion.

This difference is the ‘swing’ in that criterion, and it represents how much ‘benefit gain’ or ‘risk reduction’ or ‘cost saving’ is represented by that criterion. The stakeholders then compare these ‘swings’ (i.e. the benefit, risk or cost) between different criteria and agree a weight which represents their relative preference for that swing (be it benefit, risk or cost) (Catalyze, 2019).

The weighting enables a correct representation of the level of cost, risk, opportunity and/or benefit provided by each option. Weighting was done in three parts from the bottom up:

1. For each of the five main criteria, weight the sub-criteria against each other.
2. Weight the benefits criteria against each other.
3. Weight the highest-level criteria against each other.

The scoring and weighting from the workshop are presented in **Table 6-5**. The ‘scaled weights’ shown are the final relative swing weights for each criterion once the scaling was applied after the ‘bottom-up’ weighting process (Catalyze, 2019).

The notes summarise the rationale behind the stakeholders’ scoring and weighting and generally refer to the scale of difference between the ‘most preferred’ and ‘least preferred’ options.

The most-preferred scored option of the two considered in the comparative assessment (scored ‘100’) are highlighted green.

The criteria weighted the highest are also highlighted in green.

Table 6-5: Scoring and weighting from the Echo Yodel comparative assessment workshop

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
Pipeline scores and weights								
Socio-economic	During decom. operations	1	Socio-economic impact (during decommissioning operations)	100	0	Leave in-situ preferred as there are no in-field activities and therefore has no socio-economic impacts during decommissioning operations when compared to complete removal, which would have a socio-economic impact. As such, leave in-situ was the most preferred.	**1**	Allocated low scale weight to reflect the small difference the criteria makes on the overall decision, due to the relatively short durations of complete removal activity and infrequency of fishing in these areas (discussed in workshop that the pipeline is only targeted by fishers once or twice a year).
	Ongoing (medium term)	2	Socio-economic benefit (medium term)	100	0	Leave in-situ preferred as the pipeline would continue to provide hard substrate for habitat that supports commercial fish that fishers target. If completely removed, this would be eliminated.	**80**	Allocated a high scale weight due to the large difference it is considered to make in the overall decision, due to the size of the pipeline (about 4200 m² of habitat even when buried in 125 years) and concentration of commercial fish that has been recorded to support.
		3	Commercial risk (medium term)	0	0	No preference as there is no commercial risk due to the pipeline being in an area permanently closed to trawling (i.e. no risk of snagging of commercial fishers' nets leading to loss of nets or damage to equipment). No risk to other fishers' equipment.	**0**	Allocated a zero as this criterion provides no difference to the overall decision.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
Environmental	During decom. operations	4	Spill risk (during decommissioning operations)	100	0	Leave in-situ preferred as there is no spill risk, as there would be no vessels required.	**0**	Allocated a very low scale weight due to the likelihood of a spill being very low if complete removal activities were undertaken, and therefore reflecting the very small difference the criteria makes on the overall decision.
		5	Waste (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no waste generated if the pipeline is left in-situ (either from the vessel(s) or the pipeline itself). If completely removed, the vessel would generate waste and the pipeline would become waste.	**2**	Allocated a low scale weight to reflect the small difference the criteria makes on the overall decision due to relatively short durations of operations (and therefore waste generation) and very high proportion of pipeline able to be recycled.
		6	Emissions (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no emissions generated if the pipeline was left in-situ. If completely removed, there would be a large amount of emissions generated, both in removal and transport to Asia and in recycling; however, there was found to be an emissions reduction through steel recycling (as opposed to emissions generated through making same quantity of steel from raw materials).	**1**	Allocated a low scale weight to reflect the small difference the criteria makes to the overall decision because, despite the relatively large difference in emissions due to the need to take waste to Asia to recycle, the difference is mitigated by opportunity for carbon offset from recycled steel.
		7	Water quality/sediment (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct short-term impacts to water quality or sediment if the pipeline was left in-situ. If completely removed, there would be short-term impacts to both.	**0**	Allocated a negligible scale weight to reflect the very low physical impact and therefore small difference the criteria makes to the overall decision. (Note, impact on life covered under 'other environmental impacts').

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		8	Other environmental impacts (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct impacts on marine life through removal of the habitat that has formed on the pipeline, if left in-situ. If removed, the marine habitats supported by the pipeline would be permanently removed and the marine fauna supported by the pipeline would be dispersed.	**10**	Allocated a scale weight that reflects that this criterion makes the greatest difference of all the environmental sub-criteria during decommissioning operations, due to high levels of life on the pipeline as a result of 18 years of growth.
	Ongoing (medium term)	9	Water quality/sediment (medium term)	0	0	No preference as there is negligible negative impacts to water quality or sediment from the pipeline being left in-situ for the next 500 years (before it starts to break down). If removed, there would be no negative impacts medium-term either.	**0**	Allocated a zero as this criterion provides no difference to the overall decision, due to the assumption that infrastructure will not cause any disturbance.
		10	Environmental benefit (medium term)	100	0	Leave in-situ is the preferred option as the pipeline will continue to provide ecological services over the medium term. If removed, there would be no environmental benefit.	**100**	Allocated a high scale weight to reflect that this criterion makes a large difference to the decision, due to large size of the pipeline and location in an area of little natural hard substrate.
	Ongoing (long term)	11	Water quality/sediment (long term)	0	100	Complete removal is the preferred option as this would eliminate the water quality and sediment impacts in the long-term as the pipeline degrades and breaks down, if left in-situ.	**10**	Allocated a relatively low scale weight to reflect the relatively small difference this criterion makes to the decision, due to all steel dissipating as rust and most polymer coating remaining buried, and remainder breaking down immeasurably slowly, starting off in large chunks then into smaller fragments over time, which will have very little measurable impact on water quality or sediment quality.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		12	Environmental benefit (long term)	100	0	Leave in-situ is preferred because even as the pipeline degrades, it will still provide some level of hard substrate for a very long time (at least 700 years). If removed, there would be no environmental benefit.	**30**	Allocated a medium scale weight to reflect the large difference this criterion makes to the decision, due to the value of it as hard substrate in an area of little natural hard substrate. Even when the pipeline is mostly buried or degrading, it provides environmental benefit over a very long period of time.
Health and Safety	During decom. operations	13	Onshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to onshore personnel during decommissioning operations. If removed, there would be about two months of onshore work to dismantle the pipeline.	**72**	Allocated a relatively high score weight to reflect the relatively high risk and exposure (many man days) to onshore personnel due to challenges of handling 23 km pipeline onshore for recycling.
		14	Offshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to offshore personnel during decommissioning operations. If removed, there would be about 40 days of offshore work, of which six days are high risk due to pipe removal and offloading activities.	**90**	Allocated a high score weight to reflect the high risk and exposure (many man days) due to high loads for lifting and working in proximity to live operational infrastructure (Goodwyn Alpha platform).
		15	Other marine users' risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to other marine users during decommissioning options by not having any vessels in the area to complete the work. If removed, there would be a dedicated pipe lay vessel in the area that other marine users would need to avoid.	**0**	Allocated a negligible score weight to reflect the relatively low risk of injury to other marine users due to ease of avoidance of operational vessels and exclusion procedures.
	Ongoing (medium term)	16	Other marine users' risk (medium term)	0	0	No preference as there is no risk to other marine users in the medium-term, as the area is permanently closed to trawling, so there is no snag hazard. No risk identified to other marine users.	**0**	Allocated a zero as this criterion provides no difference to the decision because there is no trawling in the area and therefore no snag hazard, and no other hazard to other marine users.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
Technical feasibility		17	Technical feasibility	100	0	Leave in-situ preferred as it is the easiest option to execute, with no technical feasibility risk. Although complete removal is a standard methodology, it still provides some technical challenges.	**2**	Allocated a negligible score weight to reflect the small difference to the decision due to tried-and-tested approaches for decommissioning pipelines.
Economic		18	Total project cost	100	0	Leave in-situ preferred as it would provide a significant cost saving (about $50 million to $100 million).	**270**	Allocated a very high weight to reflect the very high difference this cost makes to the decision. The total project cost/investment is approximately equivalent to total benefit/risk reduction across all other highest weighted sub-criteria (270 = 80 + 100 + 90) when considering the significance of cost on the preferred option. However, this criterion was subject to a sensitivity analysis where its weighting was reduced to zero; refer to **Section 6.7**).
Umbilical scores and weights								
Socio-economic	During decom. operations	1	Socio-economic impact (during decommissioning operations)	100	0	Leave in-situ preferred as there are no in-field activities and therefore has no socio-economic impacts during decommissioning operations when compared to complete removal, which would have a socio-economic impact. As such, leave in-situ was the most preferred.	**1**	Allocated a low scale weight to reflect the small difference the criteria makes on the overall decision, due to the relatively short durations of complete removal activity and infrequency of fishing in these areas.
	Ongoing (medium term)	2	Socio-economic benefit (medium term)	100	0	Leave in-situ preferred as the umbilical would continue to provide hard substrate for habitat that supports commercial fish that fishers target. If completely removed, this would be eliminated.	**80**	Allocated a high scale weight due to the large difference it is considered to make in the overall decision, due to size of the umbilical and concentration of commercial fish recorded on it.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		3	Commercial risk (medium term)	0	0	No preference as there is no commercial risk due to the umbilical being in an area permanently closed to trawling (i.e. no risk of snagging of commercial fishers' nets leading to loss of nets or damage to equipment). No risk to other fishers' equipment.	**0**	Allocated a zero as this criterion provides no difference to the overall decision.
Environmental	During decom. operations	4	Spill risk (during decommissioning operations)	100	0	Leave in-situ preferred as there is no spill risk, as there would be no vessels required.	**1**	Allocated a very low scale weight due to the likelihood of a spill being a very low, if complete removal activities were undertaken, and therefore reflecting the very small difference the criteria makes on the overall decision.
		5	Waste (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no waste generated if the umbilical is left in-situ (either from the vessel(s) or the umbilical itself). If completely removed, the vessel would generate waste and the umbilical, UTAs, IUTB, etc, would become waste.	**4**	Allocated a low scale weight to reflect the small difference the criteria makes on the overall decision, due to relatively short durations of operations (and therefore waste generation), and very high proportion of umbilical able to be recycled.
		6	Emissions (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no emissions generated if the umbilical was left in-situ. If completely removed, there would be a large amount of emissions generated, both in removal and transport to Asia and in recycling. Only small emissions reduction through steel recycling (as the umbilical has a much smaller amount than the pipeline).	**8**	Allocated a low scale weight (but higher than the pipeline) to reflect the small difference the criteria makes to the overall decision because of the need to take the waste to Asia to recycle (and is lower carbon offset than pipeline).
		7	Water quality/sediment (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct short-term impacts to water quality or sediment if the umbilical was left in-situ. If completely removed, there would be short-term impacts.	**0**	Allocated a negligible scale weight to reflect the very low physical impact and therefore small difference the criteria makes to the overall decision. (Note,

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
								impact on life covered under 'other environmental impacts').
		8	Other environmental impacts (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct impacts on marine life through removal of the habitat that has formed on the umbilical, if left in-situ. If removed, the marine habitats supported by the umbilical would be permanently removed and the marine fauna supported by the umbilical would be dispersed.	**20**	Allocated a scale weight that reflects that this criterion makes the greatest difference of all the environmental sub-criteria during decommissioning operations, due to high levels of life on the umbilical as a result of 18 years of growth.
	Ongoing (medium term)	9	Water quality/sediment (medium term)	0	0	No preference as there is negligible negative impacts to water quality or sediment from the umbilical being left in-situ for the next 500 years (before it starts to break down). If removed, there would be no negative impacts medium-term either.	**0**	Allocated a zero as this criterion provides no difference to the overall decision due to the assumption that infrastructure will not cause any disturbance.
		10	Environmental benefit (medium term)	100	0	Leave in-situ is the preferred option as the umbilical will continue to provide ecological services over the medium term. If removed, there would be no environmental benefit.	**100**	Allocated a high scale weight to reflect that this criterion makes a large difference to the decision, due to large size of the umbilical and location in an area of little natural hard substrate.
	Ongoing (long term)	11	Water quality/sediment (long term)	0	100	Complete removal is the preferred option as this would eliminate the water quality and sediment impacts in the long term, as the umbilical degrades and breaks down, including slow release of production chemicals, if left in-situ.	**10**	Allocated a relatively low scale weight to reflect the relatively small difference this criterion makes to the decision, due to all steel and copper dissipating as rust and most polymer coating remaining buried, and remainder breaking down immeasurably slowly, starting off in large chunks then into smaller fragments over time, which will have very little measurable impact on water quality or sediment quality.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		12	Environmental benefit (long term)	100	0	Leave in-situ is preferred because even as the umbilical degrades, it will still provide some level of hard substrate for a very long time (at least 500 years). If removed, there would be no environmental benefit.	**30**	Allocated a medium scale weight to reflect the large difference this criterion makes to the decision, due to the value of it as hard substrate in an area of little natural hard substrate; even when the pipeline is mostly buried or degrading, it provides environmental benefit over a very long period of time.
Health and Safety	During decom. operations	13	Onshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to onshore personnel during decommissioning operations. If removed, there would be about two weeks of onshore work to dismantle and recycle/dispose of the umbilical.	**72**	Allocated a relatively high score weight to reflect the relatively high risk and exposure (many man days) to onshore personnel due to challenges of handling 23 km umbilical onshore for recycling.
		14	Offshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to offshore personnel during decommissioning operations. If removed, there would be about 39 days of offshore work, of which seven days are high risk due to umbilical removal and offloading activities.	**90**	Allocated a high score weight to reflect the high risk and exposure (many man days), due to high loads for lifting and working in proximity to live operational infrastructure (Goodwyn Alpha platform).
		15	Other marine users' risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to other marine users during decommissioning options by not having any vessels in the area to complete the work. If removed, there would be a dedicated installation support vessel in the area that other marine users would need to avoid.	**0**	Allocated a negligible score weight to reflect the relatively low risk of injury to other marine users due to ease of avoidance of operational vessels and exclusion procedures.
	Ongoing (medium term)	16	Other marine users' risk (medium term)	0	0	No preference as there is no risk to other marine users in the medium term, as the area is permanently closed to trawling, so there is no snag hazard. No risk identified to other marine users.	**0**	Allocated a zero as this criterion provides no difference to the decision because there is no trawling in the area and therefore no snag hazard, and no other hazard to other marine users.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
Technical feasibility		17	Technical feasibility	100	0	Leave in-situ is preferred as it is the easiest option to execute, with no technical feasibility risk. Although complete removal is a standard methodology, it still provides some technical challenges.	**2**	Allocated a negligible score weight to reflect the small difference to the decision, due to tried-and-tested approaches for decommissioning umbilicals.
Economic		18	Total project cost	100	0	Leave in-situ preferred as it would provide a significant cost saving (about $10 million to $50 million).	**80**	Allocated a high weight to reflect the high cost, but is different from pipeline due to much lower cost for removal of the umbilical compared to the pipeline. This criterion was also subject to a sensitivity analysis where its weighting was reduced to zero; refer to **Section 6.7**.
Wellheads and X-mas tree scores and weights								
Socio-economic	During decom. operations	1	Socio-economic impact (during decommissioning operations)	100	0	Leave in-situ preferred as there are no in field activities and therefore has no socio-economic impacts during decommissioning operations when compared to complete removal which would have a socio-economic impact. As such, leave in-situ was the most preferred.	**0**	Allocated a negligible scale weight to reflect the very small difference the criteria makes on the overall decision, due to the short durations of complete removal activity and infrequency of fishing in these areas.
Socio-economic	Ongoing (medium term)	2	Socio-economic benefit (medium term)	100	0	Leave in-situ preferred as the X-mas trees would continue to provide hard substrate for habitat that supports commercial fish that fishers target. If completely removed, this would be eliminated.	**10**	Allocated a low scale weight due to the small difference it is considered to make in the overall decision, due to the small size of the wellheads with X-mas trees and there are only two; therefore, limited commercial fishing value when considered in isolation.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		3	Commercial risk (medium term)	0	0	No preference as there is no commercial risk due to the wellheads with X-mas trees being in an area permanently closed to trawling (i.e. no risk of snagging of commercial fishers' nets leading to loss of nets or damage to equipment). No risk to other fishers' equipment.	**0**	Allocated a zero as this criterion provides no difference to the overall decision.
Environmental	During decom. operations	4	Spill risk (during decommissioning operations)	100	0	Leave in-situ preferred as there is no spill risk as there would be no vessels required.	**6**	Allocated a very low scale weight due to the likelihood of a spill being a very low if complete removal activities were undertaken, and therefore reflecting the very small difference the criteria makes on the overall decision.
		5	Waste (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no waste generated if the wellheads and X-mas trees were left in-situ (either from the vessel(s) or the wellheads and X-mas trees structures). If completely removed, the vessel would generate waste and the structures. would become waste.	**10**	Allocated a low scale weight to reflect the small difference the criteria makes on the overall decision, due to relatively short durations of operations (and therefore waste generation) and very high proportion of wellhead and X-mas trees able to be recycled.
		6	Emissions (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no emissions generated if the wellheads and X-mas trees were left in-situ. If completely removed, there would be a large amount of emissions generated, both in removal and transport to Asia and in recycling. Only small emissions reduction through steel recycling (as the structures are a smaller volume than the pipeline).	**13**	Allocated a low scale weight (but higher than the pipeline) to reflect the bigger difference the criteria makes to the overall decision because the structures still need to be transported to Asia and are a much smaller volume of steel, thus providing much lower carbon offset.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
		7	Water quality/sediment (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct short-term impacts to water quality or sediment if the umbilical was left in-situ. If completely removed, there would be short-term impacts.	**0**	Allocated a negligible scale weight to reflect the very low physical impact and therefore small difference the criteria makes to the overall decision. (Note, impact on life covered under 'other environmental impacts').
		8	Other environmental impacts (during decommissioning operations)	100	0	Leave in-situ is preferred as there would be no direct impacts on marine life through removal of the habitat that has formed on the X-mas trees, if left in-situ. If removed, the marine habitats supported by the X-mas trees would be permanently removed, and the marine fauna supported by the complex structures would be dispersed.	**20**	Allocated a scale weight that reflects that this criterion makes the greatest difference of all the environmental sub-criteria during decommissioning operations, due to high levels of life on the umbilical as a result of 18 years of growth and attractiveness as a different type of habitat (rising up into the water column).
	Ongoing (medium term)	9	Water quality/sediment (medium-term)	0	0	No preference as there are negligible negative impacts to water quality or sediment from the wellheads and X-mas trees being left in-situ for the next 130 years (before they break down). If removed, there would be no negative impacts medium-term either.	**0**	Allocated a zero as this criterion provides no difference to the overall decision, due to the assumption that infrastructure will not cause any disturbance.
		10	Environmental benefit (medium-term)	100	0	Leave in-situ is the preferred option as the wellheads and X-mas trees will continue to provide ecological services over the medium term. If removed, there would be no environmental benefit.	**100**	Allocated a high scale weight to reflect that this criterion makes a large difference to the decision, due to height and shape of the X-mas trees and location in an area of little natural hard substrate.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
	Ongoing (long term)	11	Water quality/sediment (long-term)	0	100	Complete removal is the preferred option as this would eliminate the water quality and sediment impacts in the long-term as the wellheads and X-mas trees degrade and break down, if left in-situ.	**1**	Allocated a very low scale weight to reflect the small difference this criterion makes to the decision, due to all steel dissipating as rust which will have very little measurable impact on water quality or sediment quality.
		12	Environmental benefit (long-term)	100	0	Leave in-situ is preferred because even as the wellheads and X-mas trees degrade, they will still to provide some level of hard substrate for a long time (about 130 years). If removed, there would be no environmental benefit.	**40**	Allocated a medium scale weight to reflect the difference this criterion makes to the decision, due to the value of it as hard substrate in an area of little natural hard substrate; even when the structures degrade, they will provide environmental benefit over a long period of time.
Health and Safety	During decom. operations	13	Onshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to onshore personnel during decommissioning operations. If removed, there would be about two weeks of onshore work to dismantle and recycle/dispose of the wellheads and X-mas trees.	**36**	Allocated a relatively medium score weight to reflect the risk and exposure to onshore personnel of handling the structures onshore for recycling.
		14	Offshore personnel risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to offshore personnel during decommissioning operations. If removed, there would be about 12 days of offshore work, of which six days are high risk due to wellhead and X-mas tree removal and offloading activities.	**60**	Allocated a medium score weight to reflect the high risk but limited exposure (man days) due to high loads for lifting. Note this is not working in proximity to live operational infrastructure (Goodwyn Alpha platform is about 20 km away from the wells).
		15	Other marine users' risk (during decommissioning operations)	100	0	Leave in-situ is preferred as this option eliminates the health and safety risks to other marine users during decommissioning options by not having any vessels in the area to complete the work. If removed, there would be a dedicated IMR vessel	**0**	Allocated a negligible score weight to reflect the relatively low risk of injury to other marine users due to ease of avoidance of operational vessels and exclusion procedures.

Criteria		No	Sub-criteria	Preference Scores: Leave in-situ	Preference Scores: Complete removal	Notes from Leave in-situ versus Complete removal preference scores	Scaled weights	Notes on weighting from the workshops
						in the area that other marine users would need to avoid.		
	Ongoing (medium term)	16	Other marine users' risk (medium-term)	0	0	No preference as there is no risk to other marine users in the medium-term, as the area is permanently closed to trawling, so there is no snag hazard. No risk identified to other marine users.	**0**	Allocated a zero as this criterion provides no difference to the decision because there is no trawling in the area and therefore no snag hazard, and no other hazard to other marine users.
Technical feasibility		17	Technical feasibility	100	0	Leave in-situ preferred as it is the easiest option to execute, with no technical feasibility risk. Although complete removal is a standard methodology, it still provides some technical challenges.	**2**	Allocated a negligible score weight to reflect the small difference to the decision due to tried-and-tested approaches for decommissioning wellheads and X-mas trees at this water depth.
Economic		18	Total project cost	100	0	Leave in-situ preferred as it would provide a significant cost savings (less than $10 million).	**4**	Allocated a low weight to reflect the low relative cost, which is quite different from pipeline and umbilical due to the much lower cost for removal of the wellheads and X-mas trees. This criterion was also subject to a sensitivity analysis where its weighting was reduced to zero; refer to **Section 6.7**).

6.7 Comparative Assessment Results

6.7.1 Result Summary

To complete the workshops, the final scores and weightings were compiled to understand the preferred option. These weighted scores (known as 'weighted preference values') were scaled into a 0 to 100 scale automatically using the MCDA comparative assessment software. These results were presented at the end of the workshop and are depicted in **Figure 6-2**.

The results show a very clear preference for 'leave in situ' for all infrastructure types. This makes sense, given 'leave in situ' was scored higher than 'complete removal' on every criterion except 'Water quality/sediment impacts (long-term)' (Catalyze, 2019). The results also were considered intuitive by the stakeholders in the workshop, particularly noting:

- the Echo Yodel subsea infrastructure is in an area permanently closed to trawling, so there is no snag risk to commercial trawlers
- the size of the infrastructure and the level of marine life present after 18 years provides both significant medium-term environmental benefit, and significant environmental impact from removal, particularly given it provides hard substrate for marine habitat in a hard habitat limited environment.

Sensitivity analysis was also conducted, which did not change the preferred option (**Section 6.7.3**) and highlights that cost considerations make no material difference (Catalyze, 2019).

It should be noted that the purpose of a comparative assessment is to identify the order of preference of the options, and indicate why, and to what extent, an option is preferred over another. When performing a comparative assessment on only two options, there is no indication of the 'absolute' value of the least-preferred option.

Figure 6-2: Comparative Assessment results summary

Legend	Pipeline – Cumulative Weight	Umbilical – Cumulative Weight	Wellheads/XT – Cumulative Weight
Socio impact	0.1	0.2	0.0
Socio benefit	12.0	16.1	3.3
Comm risk	0.0	0.0	0.0
Spill risk	0.0	0.2	2.0
Waste	0.3	0.8	3.3
Emissions	0.1	1.6	4.3
Water qual/sed dur	0.0	0.0	0.0
Other env impact d	1.5	4.0	6.6
Water qual/sed med	0.0	0.0	0.0
Env benefit med	15.0	20.1	33.1
Water qual/sed long	1.5	2.0	0.3
Env benefit long	4.5	6.0	13.2
Onshore per risk	10.8	14.5	11.9
Offshore per risk	13.5	18.1	19.9
Oth mar usr rsk dur	0.0	0.0	0.0
Oth mar usr rsk med	0.0	0.0	0.0
Tech feasi	0.3	0.4	0.7
Tot Proj Costs	40.4	16.1	1.3
Total	100.0	100.0	100.0

Option	Pipeline	Umbilical	Wellheads/XT
Leave in situ	99	98	100
Complete removal	1	2	0

6.7.2 Description of the Results

This section describes the results of the comparative assessment in the context of the OPGGS Act. As described in **Section 1.10.1.1**, the base case set by the OPGGS Act is for the permit holder to completely remove infrastructure after it has ceased using it (Section 572(3)) and before it surrenders its petroleum licence (Section 270(3)). **Figure 6-2** shows that the comparative assessment found the ‘leave in situ’ option is preferred, while **Table 6-5** demonstrates how the preferred option presents better or equal environmental and safety outcomes. It is noted that the Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science, 2018) also requires the preferred option to have better or equal well integrity outcomes; however, well integrity is not relevant to the options being compared. I.e. well integrity outcomes remain the same, irrelevant of the option selected.

6.7.3 Sensitivity Analysis

Once the results of the comparative assessment were understood, they were tested to confirm that they accurately reflect the whole-of-field considerations and that the project cost was not the defining consideration.

Brief overviews of the sensitivity analysis are provided below:

- **Project cost:** During the workshops there was concern that the high cost of the ‘complete removal’ option might be affecting the results, so sensitivity analysis was performed. The cost (‘economic’) criterion was weighted zero to understand how the result would differ if cost was not considered at all. The result was no material change in the preferred option.
- **Whole field consideration:** Because the comparative assessment was conducted looking at the Echo Yodel subsea infrastructure as three separate assessments for each of the three key infrastructure types, it was then assessed as one whole field. This assessment concluded that for the ‘whole field’ option, the outcome of the comparative assessment did not change. Leave in-situ was still the preferred option because:
  - There would be no reduction in cost if the operations are performed by a single vessel. Removal of the umbilical and pipeline both require two full vessel loads. Additionally, a specific vessel is required for the pipeline removal, and cheaper options for the wellheads/X-mas trees and umbilical exist, so there were no options for cost reduction by completing the activities together.
  - The relatively large size of the Echo Yodel pipeline and umbilical mean they provide significant environmental and socio-economic value in their own right. The benefit of the pipeline and/or umbilical alone would not be ‘magnified’ by leaving the wellheads with X-mas trees in-situ, given the large size difference; however, they are of value by providing a different habitat type.
  - Considering the wellheads and X-mas trees alone, the environmental and socio-economic value of also leaving the pipeline and umbilical in-situ would be a significant gain compared to leaving the wellheads and X-mas trees alone, reinforcing the value of also leaving the pipeline and umbilical in-situ if the wellheads and X-mas trees are left in-situ.

6.8 Conclusion

The results of the comparative assessment show a very clear preference for ‘leave in-situ’ for the Echo Yodel subsea infrastructure.

The alternative option to complete removal meets the requirements of Section 572(3) and Section 270(3)(c) of the OPGGS Act, which allows for considering alternatives when compared to complete removal if those alternatives deliver equal or better environmental, safety and well integrity outcomes. As such, Woodside proposes to leave in-situ permanently the Echo Yodel subsea infrastructure. As such, cumulative impacts are not expected to occur. Furthermore, no SIMOPS are planned to occur on the GWA platform, or NRC platform, when permanent plugging activities are scheduled to occur under this EP. Therefore, there is unlikely going to be activities occurring alongside each other causing similar impacts and having a combined impact greater than what has been assessed in this EP.

Cumulative impacts associated with SIMOPS and the potential for subsea activities to be occurring at the same time as MODU activities has been included in the risk and impact assessments where relevant.

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

7.1 Overview

This section presents the impact and risk analysis, evaluation and EPOs, EPSs and MC for the Petroleum Activities Program, using the methodology described in **Section 2** of this EP.

7.2 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 Areas.

The impacts and risks identified during the ENVID workshops (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:

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

Within these categories, impact and risk assessment groupings are based on environmental aspects[5] such as emissions and physical presence. 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 7-1**.

The impact and risk analysis and evaluation for the Petroleum Activities Program indicate that all current environmental risks and impacts associated with the individual activities are reduced to ALARP and are of an acceptable level, as discussed further in **Sections 7.6** and **7.7**.

7.2.1 Cumulative Impacts

Existing subsea infrastructure within the Operational Areas are described in **Section 3.4**; the closest 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 that could realistically result in overlapping temporal and spatial extents. Woodside is not aware of any other petroleum activities[6] within the Operational Areas during the proposed time of the Petroleum Activities Program.

Woodside is not aware of any other petroleum activities within Permit Areas WA-9-PL and WA-1-L within the proposed time of the Petroleum Activities Program. While Woodside may be undertaking drilling activities in WA-23-L over the lifetime of this EP, there will be no temporal (activities will not occur concurrently) and spatial overlap with permanent plugging activities and, therefore, no cumulative impacts are predicted. Additionally, concurrent plugging activities are not planned under this EP.

Any GWA platform activities will be 19 km from the nearest permanent plugging activity (Capella-1) and 13 km away from any NRC platform activities. As such, cumulative impacts are not expected to

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

[6] Cumulative impacts from the Petroleum Activities Program is addressed under each relevant impact in **Section 7.6.**

occur. Furthermore, no SIMOPS are planned to occur on the GWA platform, or NRC platform, when permanent plugging activities are scheduled to occur under this EP. Therefore, there are unlikely to be activities occurring alongside each other causing similar impacts and having a combined impact greater than what has been assessed in this EP.

Cumulative impacts associated with SIMOPS and the potential for subsea activities to occur at the same time as MODU activities have been included in the risk and impact assessments, where relevant.

Table 7-1: Environmental risk analysis and summary

Aspect	EP Section	Risk Rating				Acceptability of Impact/Risk
		Impact/Consequence	Potential Impact/Consequence Level	Likelihood	Current Risk Rating	
Permanent Plugging Activities						
Planned Activities (Routine and Non-routine)						
Physical presence: Disturbance to other users from permanent plugging activities	**7.6.1**	F	Social and Cultural – no lasting effect (less than one month), localised impact not significant to areas/items of cultural significance.	-	-	Broadly acceptable
Physical presence: Disturbance to benthic habitat from MODU anchoring, permanent plugging activities and ROV operations	**7.6.2**	E	Environment – Slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine acoustic emissions: Generation of noise from project vessels, MODU, positioning equipment, piling activities, and helicopter operations	**7.6.3**	E	Environment – Slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine and non-routine discharges: MODU and project vessels	**7.6.4**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	-	-	Broadly acceptable
Routine and non-routine discharges: Drilled cement and drilling fluids (WBM and NWBM)	**7.6.5**	E	Environment – Slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine and non-routine discharges: Cement, cementing fluids, grout, subsea well fluids, unused bulk products	**7.6.6**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	-	-	Broadly acceptable
Routine atmospheric emissions: Fuel combustion, flaring, incineration and venting	**7.6.7**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. air quality).	-	-	Broadly acceptable

Aspect	EP Section	Risk Rating				Acceptability of Impact/Risk
		Impact/Consequence	Potential Impact/Consequence Level	Likelihood	Current Risk Rating	
Routine light emissions: External lighting on MODU and project vessels	**7.6.8**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. species).	-	-	Broadly acceptable
Unplanned Activities (Accidents, Incidents, Emergency Situations)						
Accidental hydrocarbon release: Loss of well integrity	**7.7.2**	B	Environment – Major, long term impact (ten to 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 (five to 20 years) to reputation and brand. Venture and/or asset operations restricted.	1	M	Broadly acceptable
Accidental hydrocarbon release: Vessel collision	**7.7.3**	D	Environment – Minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Broadly acceptable
Accidental hydrocarbon release: Bunkering	**7.7.4**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	2	M	Broadly acceptable
Unplanned discharges: Drilling fluids	**7.7.5**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Unplanned discharges: Deck and subsea spills	**7.7.6**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	2	M	Broadly acceptable
Unplanned discharges: Release of solid hazardous and non-hazardous wastes	**7.7.7**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly acceptable

Aspect	EP Section	Risk Rating				Acceptability of Impact/Risk
		Impact/Consequence	Potential Impact/Consequence Level	Likelihood	Current Risk Rating	
Physical presence: Vessel collision with marine fauna	**7.7.8**	E	Environment – Slight, short term local impact (less than one 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	**7.7.9**	E	Environment – Slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Physical presence: Dropped object resulting in seabed disturbance	**7.7.10**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. benthic habitats).	2	L	Broadly acceptable
Physical presence: Accidental introduction and establishment of invasive marine species	**7.7.11**	E	Environment – No credible risk identified. Reputation and Brand – Minor, short-term impact (one to two years) to reputation and brand. Close scrutiny of asset level operations or future proposals.	0	L	Broadly acceptable
Leaving Infrastructure In-situ						
Planned Activities (Routine and Non-routine)						
Physical presence: Disturbance to other users from Echo Yodel subsea infrastructure being left in-situ permanently	**7.8.1**	E	Social and Cultural – Slight impact to a community or areas/items of cultural significance.	-	-	Broadly acceptable
Physical presence: Disturbance to benthic habitat from Echo Yodel subsea infrastructure being left in-situ permanently	**7.8.2**	E	Environment – Slight, local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine and non-routine discharges: Echo Yodel subsea infrastructure being left in-situ	**7.8.3**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	-	-	Broadly acceptable

Aspect	EP Section	Risk Rating				Acceptability of Impact/Risk
		Impact/Consequence	Potential Impact/Consequence Level	Likelihood	Current Risk Rating	
Unplanned Activities (Accidents, Incidents, Emergency Situations)						
Unplanned Discharges: Instantaneous release of fluids from infrastructure damage	**7.9.1**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	1	L	Broadly acceptable
Physical Presence: Accidental future impacts to commercial trawling	**7.9.2**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	1	L	Broadly acceptable

7.3 Environmental Performance Outcomes, Standards and Measurement Criteria

Regulation 13(7) of the Environment Regulations requires that an EP includes EPOs, EPSs and MC that address legislative and other controls to manage the environmental risks of the activity to ALARP and acceptable levels.

EPOs, EPSs and MC 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 EPOs and standards have been met.

The EPOs, EPSs and MC 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 1.10.1.3**, as part of the acceptability and ALARP justification process.

The EPOs, EPSs and MC are presented throughout this section and in **Appendix D** (Oil Spill Preparedness and Response). A breach of these EPOs or standards constitutes a 'Recordable Incident' under the Environment Regulations (refer to **Section 8.8.4**).

7.4 Presentation

The environmental impact and risk analysis and evaluation (ALARP and acceptability), EPOs, standards and MC are presented in the following tabular form throughout this section. Italicised 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/Risks Evaluation Summary – *Summary of ENVID outcomes*														
Source of Impact/Risk *Regulation 13(1)*	***Environmental Value Potentially Impacted*** *Regulations 13(2)(3)*							***Evaluation*** ***Section 2.7** and **Section 2.8***						
	Soil and Groundwater	***Marine Sediment***	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-economic***	***Decision Type***	***Impact/Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Summary of source of risk/impact														
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/Risk Assessment														
Discussion and assessment of the potential impacts/risks to the identified environment value(s). Regulation 13(5)(6). *Potential impacts/risks 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)***[7]	***Benefit in Impact/Risk Reduction***[8]	***Proportionality***	***Control Adopted***
ALARP Tool Used – Section 2.7.2 and Section 2.8.1				
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).*	*Qualitative commentary of impact or risk that could be averted or environmental benefit gained if the cost/ sacrifice is made and the control is adopted.*	*Proportionality of cost/sacrifice versus 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 based on the environmental risk assessment outcomes, use of the relevant tools appropriate to the decision type (**Section 2.7** and **Figure 2-5**) and a proportionality assessment. Regulation 10A(b).*				

Demonstration of Acceptability
Acceptability Statement: *Made based on applying the process described in **Section 2.8.2**, 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 is measured.* M: *Performance against the outcome is measured by measuring implementation of the controls via the MC.* 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 is relevant to the source of risk and the potentially impacted environmental value.* T: *The outcome states 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)*

[7] Qualitative measure.

[8] Measured in terms of reduction of likelihood, consequence and current risk rating.

7.5 Potential Environment Risks Not Included Within the Scope of this Environment Plan

The ENVID identified environmental risks that were assessed as not being applicable (refer to **Section 2.6**) within or outside the Operational Areas as a result of the Petroleum Activities Program, and therefore were determined to not form part of this EP. These are described in the next subsections for information only.

7.5.1 Shallow/Near-shore Activities

The Petroleum Activities Program is located in water depths greater than 100 m and at a distance about 75 km from the nearest landfall (Montebello Islands). Consequently, risks associated with shallow/near-shore activities such as vessel anchoring and risks of grounding were assessed as not credible.

7.5.2 Loss of Containment from Existing Subsea Pipelines

A subsea loss of containment from a rupture of live flowlines/pipelines within or close to the Operational Areas could occur, should loss of station keeping of the MODU from mooring failure result in anchor drag across a pipeline/flowline. The GWA, GWF-1 and GWF-2 flowlines occur close to Operational Area A and could credibly be ruptured, resulting in loss of inventory as described in the next subsections.

7.5.2.1 GWA Production Flowline/Export Pipeline

Worst case credible hydrocarbon release scenarios have been defined in the GWA Facility Operations EP as the rupture of a subsea well with highest flow rate, a well blowout at surface (platform wellhead release), and a flowlines (GWF-1/GWF-2) subsea release outboard of an SSIV. This could result in a release to the environment of up to 185,141 m^3, 245,000 m^3 or 237 m^3 of GWA condensate respectively.

Under Regulation 31(1) of the Environment Regulations, the accepted GWA Facility Operations EP provides a full description and assessment of impacts and risks. Management controls and response capabilities are also detailed in that EP. Additional controls for operating the MODU are provided in the next sections.

7.6 Planned Activities (Routine and Non-routine) for Permanent Plugging Activities

7.6.1 Physical Presence: Disturbance to Other Users from Permanent Plugging Activities

Context		
MODU and project vessels – **Section 3.7**	Socio-economic environment – **Section 4.6**	Stakeholder consultation – **Section 5**

Impacts Evaluation Summary

Source of Impact	***Context***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Interference with other users – proximity of MODU and project vessels causing interference with or displacement to third party vessels (commercial fishing and commercial shipping)						X	A	F	-	-	GP PJ	Broadly Acceptable	EPO 1

Description of Source of Impact

Presence of MODU and Vessels and Subsea Infrastructure

The Petroleum Activities Program will require a number of vessels and a MODU to be present in Operational Area A during activities associated with permanently plugging the Yodel-3, Yodel-4 and Capella-1 wells for abandonment.

To permanently plug the Yodel-3, Yodel-4 and Capella-1 wells, a MODU and/or subsea support vessel(s) will be present in Operational Area A. Permanent plugging activities are expected to take about 20 to 60 days per well as outlined in **Section 3.5** or **Table 3-3**. If required, one general support vessel will be present in Operational Area A on standby while the other(s) may transit in and out of Operational Area A for emergency and routine operations (e.g. supply and personnel transfers). The presence of these vessels/MODU in Operational Area A presents an opportunity for interaction with third-party marine users.

Impact Assessment

Potential Impacts to Socio-Economic Environment

Displacement or Interference with Commercial Fishing Activities

Operational Area A overlaps three Commonwealth and ten State managed fisheries. However, only the Pilbara Demersal Scalefish Managed Fisheries (Pilbara Trawl, Trap and Line) are considered to be active in the vicinity of Operational Area A. Operational Area A is located in water depths ranging from about 125 to 136 m, the shallower extent of which is within the depth range where typical fishing effort occurs for the Pilbara Line Fishery. However, Operational Area A is prohibited to trawling, so there is no risk of permanent plugging activities impacting trawling.

During plug and abandon activities, vessels in Operational Area A may restrict the use of the area by the two fisheries, and any other commercial fisheries that have been identified as having potential (but unlikely) to use Operational Area A. Use will particularly be restricted by the 500 m petroleum safety zone that will be established around the MODU. However, because vessels will be in the area for short periods over a defined amount of time, and because the fisheries' areas extend beyond Operational Area A, impacts during decommissioning activities will be temporary and short term.

In observance of good seamanship, all support vessels will avoid any close and/or disruptive engagement with any commercial fishing activity.

Displacement of Recreational Fishing

Recreational fishing is unlikely to occur in Operational Area A due to its depth and distance from shore. Stakeholder consultation did not identify any recreational activities that could be impacted by the activity.

Recreational fishing in the region is concentrated around the coastal waters and islands of the NWMR, such as the Montebello Islands (about 75 km from Operational Area A). Due to the distance offshore and water depths, recreational fishing is unlikely to occur in Operational Area A. If recreational fishing effort occurred within Operational Area A while activities are being performed, displacement as a result of the Petroleum Activities Program would be minimal and relate only to the petroleum safety zones (500 m radius) that would be in place around the MODU. Additionally, fishing activity may be excluded from the immediate area around the subsea locations during permanent plugging for abandonment activities (if required). Therefore, the potential impact is considered to be slight and would be limited to only short-term impacts.

Displacement to Commercial Shipping

The presence of the MODU and/or subsea support vessels could potentially cause temporary disruption to commercial shipping. Shipping in the area is mainly related to the resources industry. The potential impacts associated with this Petroleum Activities Program may include displacement of vessels as they make slight course alterations to avoid the MODU and/or subsea support vessel(s).

Interference with Existing Oil and Gas Infrastructure

Interactions with operators of other nearby facilities have the potential to occur, particularly with the GWA facility. This would mainly be as a result of project-based vessel movements to and from Operational Area A not covered within this EP. However, no SIMOPS are planned to occur on the GWA platform, or NRC platform, when permanent plugging activities are scheduled to occur under this EP.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that physical presence of the MODU and/or subsea support vessel(s) and general support vessels' interference with other marine users will be localised, with no lasting impact to shipping and commercial/recreational fishing interests (i.e. Social and Cultural Impacts – F).

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
AHS of activities and movements no less than four 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 NTM [including AUSCOAST warnings where relevant]).	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes **C 1.1**
Notify DPIRD (WA) (formerly the WA Department of Fisheries [DoF]) of activities within three months of permanent plugging activities.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interference with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes **C 1.2**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Notify AMSA Joint Rescue Coordination Centre (JRCC) of activities and movements 24 to 48 hours before operations commence.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interference 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.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interference with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes **C.1.4**
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				

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; **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the impacts of the physical presence of the MODU, subsea support vessel(s) and general support vessels during permanent plugging activities.

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

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, the physical presence of the MODU, subsea support vessel(s) and general support vessels during permanent plugging activities may result in localised impacts with no lasting effect (<1 month) to commercial fishing, recreational fishing, shipping and defence.

The adopted controls are considered consistent with industry good practice and professional judgement and meet the requirements and expectations of Australian Marine Orders, AMSA, DPIRD, and AHS identified during impact assessment and stakeholder consultation. Therefore, Woodside considers the adopted controls appropriate to manage the impact 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 (MSIN and NTM [including AUSCOAST warnings where relevant]).	**MC 1.1.1** Consultation records demonstrate that AHS has been notified prior to commencement of an activity to allow generation of navigation warnings (MSIN and NTM [including AUSCOAST warnings where relevant]).
	C 1.2 Notify DPIRD (WA) (formerly the WA DoF) of activities within three months of permanent plugging activities.	**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 commencement of permanent plugging activities.
	C 1.3 Notify AMSA JRCC of activities and movements 24 to 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), 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 prior to commencement of 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** In order To prevent activities interfering with other marine users, relevant to stakeholders consulted no less than four working weeks prior to scheduled activity commencement date.	**MC 1.4.1** Consultation records demonstrate relevant stakeholders have been consulted.

7.6.2 Physical Presence: Disturbance to Benthic Habitat from MODU Anchoring, Permanent Plugging Activities and ROV Operations

Context	
Project vessel-based activities **– Section 3.9** MODU based plugging activities -**Section 3.10**	Biological environment – **Section 4.5** Values and sensitivities – **Section 4.7**

Impacts Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Disturbance to seabed from MODU station keeping (MODU mooring, including anchor hold testing and soil analysis for mooring design)				X			A	E	-	-	GP PJ	Broadly Acceptable	EPO 2
Disturbance to seabed from the BOP tethering system				X		X	A	F	-	-			
Disturbance to seabed from subsea cleaning and preparation for permanent plugging activities				X		X	A	F	-	-			

Description of Source of Impact

MODU Anchoring and Anchor hold Testing

Seabed disturbance will result from anchor hold testing and MODU anchor mooring system, including placement of anchors and chain/wire on the seabed, potential dragging during tensioning and recovery of anchors. Overall, the subsea soil testing, mooring of the MODU and anchor hold testing activities will result in localised, small-scale seabed disturbance. Mooring may require an eight to 12 point pre-laid mooring system at each well location, depending on the time of year; however, for permanent plugging activities outside of cyclone season, a standard eight point system is more likely. There are three well locations for the Petroleum Activities Program, equating to the need for up to 36 anchor installations, assuming all implement the 12 point mooring system.

Soil sampling for mooring design may be taken or measured by deploying specific equipment (e.g. cone penetration tests). These will be short-term activities before installing mooring and any impacts would be small and highly localised.

Anchor hold testing may result in short-term, localised anchor drag on the seabed. Anchor hold testing is planned to occur after anchor installation and may occur at each anchor point.

The planned anchoring activities will be within the parameters defined in the *Anchoring of Vessels and Floating Facilities EP Reference Case* (Department of Industry, Innovation and Science, undated) for all anchoring activities performed by vessels and floating facilities (excluding FPSOs and Floating LNG vessels) during the Petroleum Activities Program, including:

- 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
- locations of water depth greater than 70 m. This boundary is set to exclude areas of sensitive primary producer habitats (e.g. corals, seagrass) that occur in shallower waters.

BOP Tethering System

A BOP tether system may be used to manage wellhead fatigue during the plug and abandonment activities. This system is planned to consist of clump weights weighing about 25 tonnes each, although the use of suction pilling may be considered instead of clump weights. There would be around four to six clump weights used, though this may change once seabed and current conditions are better understood. The clump weights would be placed about 20 to 40 m from the wellhead, then the tether would be connected and tensioned using an ROV. It is also possible that suction piles may be used instead of clump weights and, in this instance, it is currently understood that four 16-inch piles would be needed per tether system. This would amount to 12 piling activities, considering three wells. The BOP tether system will result in localised seabed disturbance.

Subsea Cleaning and Preparation

Subsea cleaning and preparation activities include removing marine growth from infrastructure such as the X-mas trees and relocating sediment that has built up around subsea infrastructure.

Removing marine growth may be done in various ways. Those that have the potential to impact the seabed include use of high-pressure water and/or brushes on ROVs.

Relocating sediment involves using an ROV-mounted suction pump/dredging unit to remove sediment that has built up around the subsea infrastructure. The sediment would be relocated nearby and will result in localised disturbance where it has been removed from and at the site to which it is relocated.

ROV

The use of the ROV during the Petroleum Activities Program 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.

An ROV may be used to relocate sediment material around the well location to allow inspection/intervention works to be performed. This will cause localised and temporary impacts to water quality from increased turbidity and may cause localised and temporary impacts to benthic habitats. They may also be used to place and retrieve transponders for DP of vessels. The transponders would have a small overall footprint.

Impact Assessment

Potential Impacts to Ecosystems/Habitats

Deepwater Benthic Habitats

MODU station keeping (including activities associated with mooring design and anchor hold testing), BOP tethering system, subsea cleaning and preparation, and leaving Echo Yodel subsea infrastructure in-situ, are likely to result in localised, physical modification to the seabed and localised disturbance to soft sediments.

Operational Area A overlaps a section of the Ancient Coastline at 125 m Depth Contour KEF. Operational Area A is expected to consist primarily of fine carbonate sediments, which are typical of the broader NWMR but may have areas of hard substrate which is typical of the Ancient Coastline at 125 m Depth Contour KEF. Benthic communities of Operational Area A associated with this substrate show typical low diversity representative of the wider region.

Physical impacts from the Petroleum Activities Program are expected to be for the most part confined to sediment-burrowing infauna and surface epifauna invertebrates, particularly filter feeders, inhabiting the seabed directly around the subsea infrastructure locations and on the infrastructure. Activities at the wellhead locations may therefore temporarily disturb these artificial habitats and associated fauna. These impacts are expected to be localised and mainly restricted to the footprint of the infrastructure and small areas around it. Although, due to the widespread representation of the infauna communities within Operational Area A and the broader NWMR, significant impacts to these communities are not expected. Impacts associated with anchoring, mooring and BOP tethering will occur beyond the footprint of the existing infrastructure, but the area disturbed will also be limited in area, and impacts to infauna will not be significant. Project-specific Mooring Design Analysis would also help avoid any direct physical impacts to natural hard substrate that may occur in Operational Area A.

ROV activities near the seafloor and associated sediment relocation activities may result in slight and short-term impacts to deepwater biota, 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 localised, short-term and temporary, and is therefore not expected to have any significant impact to environment receptors, particularly given the low densities of benthic organisms at the water depths of Operational Area A.

Based on the above assessment, seabed disturbance is unlikely to impact on the ecological value of Operational Area A and surrounding environment, including the Ancient Coastline at 125 m Depth Contour KEF.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, seabed disturbance from the Petroleum Activities Program will result in no greater than localised, slight and short-term impacts to benthic habitat and communities (i.e. Environment Impact – F to E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Project-specific Mooring Design Analysis.	F: Yes. CS: Additional costs associated with upgraded MODU mooring design.	The mooring design analysis determines the number and spread of anchors required based on sediment type and seabed topography, reducing the likelihood of anchor drag leading to seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes **C 2.1**
Long baseline (LBL) or ultra-short baseline (USBL) positioning technology used.	F: Yes. CS: Minimal cost. Standard practice.	Use of positioning technology to position equipment on the seabed with accuracy will reduce seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes **C 2.2**
Environmental monitoring of the seabed prior to and following 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 Areas, 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 about the seabed above what is provided by the Woodside Well Location and Site Appraisal Data Sheet and mooring design analysis. 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 adoption of 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

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Only use DP MODU (no anchoring required).	F: No. CS: No. It is not feasible to use a DP MODU as the Operational Areas are too shallow. 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 plug and abandon activities. 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, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the impacts of benthic habitat disturbance from MODU station keeping (including activities associated with mooring design and anchor hold testing), BOP tethering system, subsea cleaning and preparation. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, disturbance to benthic habitats from MODU anchoring, permanent plugging activities and ROV operations may result in slight and short-term effects (<1 year) to habitat (but not affecting ecosystems function), physical and biological attributes of deepwater benthic habitats.

The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the impact to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 No impact to benthic habitats greater than a consequence level of E to F[9] inside the Operational Areas during the Petroleum Activities Program.	**C 2.1** Project-specific Mooring Design Analysis.	**PS 2.1** Seabed disturbance from MODU mooring limited to that required to ensure adequate MODU station keeping capacity.	**MC 2.1.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
	C 2.2 LBL or USBL positioning technology used.	**PS 2.2** Infrastructure will be positioned in the planned location where impacts have been assessed.	**MC 2.2.1** Records confirm LBL transponders or USBL in place and functioning correctly.

[9] Defined as 'F - No lasting effect (less than one month). Localised impact not significant to areas or items of cultural significance)' and 'E - Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

7.6.3 Routine Acoustic Emissions: Generation of Noise from Project Vessels, MODU, Positioning Equipment, Piling Activities, and Helicopter Operations

Context	
Project vessel based activities **– Section 3.9** MODU based activities – **Section 3.10**	Biological environment – **Section 4.5**

Impacts Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*						*Evaluation*						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Generation of acoustic signals from MODU (plug and abandon operations) and project vessels during normal operations					X		A	E	-	-	GP PJ	Broadly Acceptable	EPO 3
Generation of acoustic signals from DP systems on project vessels during normal operations					X	X	A	F	-	-	GP PJ		
Generation of acoustic signals from instillation of MODU mooring piles					X		A	E	-	-	GP PJ		
Generation of atmospheric noise from helicopter transfers					X		A	F	-	-	GP PJ		
Underwater noise from flaring					X		A	F	-	-	GP PJ		

Description of Source of Impact

The MODU and subsea support vessels will generate noise both in the air and underwater, due to the operation of thrusters' engines, subsea activities, etc. These noises will contribute to and can exceed ambient noise levels which range from about 90 dB re 1 µPa (root square mean sound pressure level (RMS SPL)) under very calm, low wind conditions, to 120 dB re 1 µPa (RMS SPL) under windy conditions (McCauley, 2005).

Noise Generated during Plug and Abandon Activities

Noise associated with plug and abandon activities include drill pipe operations and other machinery onboard the MODU. A range of broadband values (59 to 185 dB re 1 µPa at 1 m (RMS SPL)) have been quoted for various MODUs (Simmonds *et al*., 2004), where noise is likely to be between 100 to 190 dB re 1 µPa at 1 m (RMS SPL) during drilling and between 85 to 135 dB re 1 µPa at 1 m (RMS SPL) when not actively drilling. McCauley (1998) recorded received noise levels about 117 dB re 1 µPa at 1 m (RMS SPL) at 125 m from a moored MODU while actively drilling (with support vessel on anchor).

The MODU is expected to be in Operational Area A for up to 180 days (20 to 60 days per well) to permanently plug the three wells (**Table 3-3**).

Operation of Dynamic Positioning Systems

The main source of noise from a DP vessel relates to using DP thrusters. Subsea support vessels may use DP while the vessel is maintaining position. McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa at 1 m (RMS SPL) from a support vessel holding station in the Timor Sea; it is expected that similar noise levels will be generated by support vessels used for this Petroleum Activities Program.

Suction Piling Noise

Suction piling may be required as a contingent activity for the BOP tether system. Unlike driven piles, suction piles greatly reduce noise generation, which would be minimal due to the noise only being generated from high rate pumps on the ROV.

Generation of Noise from Helicopter Transfers

Helicopter activities may occur in Operational Area A, including 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 operations are the priority.

Noise levels for typical helicopters used in offshore operations (Eurocopter Super Puma AS332) at 150 m separation distance have been measured at up to a maximum of 90.6 dB (BMT Asia Pacific, 2005). 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 three 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 development drilling transponders will be in place for a period of about three months but only active at the commencement of the drilling where positioning is required, while for subsea installation the LBL arrays will be deployed for a total period of about 12 months and be recovered at the end of the installation program.

Generation of Underwater Noise from Flaring

Received levels from airborne propagation modelling were used to ascertain the underwater received levels during flaring activities for the Pyxis EP. Only a very small fraction of the acoustic energy produced from flaring will transmit through the air/water boundary due to the surface of water acting as a reflective plane and a significant component of acoustic energy reflecting back into the air. This is due to the principles of wave propagation between two mediums. When the two mediums have the same density and elasticity, then the ratio of incidental wave (noise from source) to transmitted wave (noise in the secondary medium) is 1:1. This ratio will significantly reduce when the density of the initial medium (air) for the incidental wave (flare noise) is significantly less than the density of the transmitted medium (sea water). Additionally, the angle at which the sound path meets the surface (angle of incidence) influences the transmission of noise energy from the atmosphere through the sea surface; with angles ±>13° from vertical being almost entirely reflected (Richardson *et al*., 1995).

The transmission of sound from air to water was conservatively calculated assuming worst-case vertical incidence. Results indicate the underwater received sound pressure level during flaring is estimated to be 136 dB re 1 µPa at 1 m below the sea surface.

Impact Assessment

Potential Impacts to Protected Species

Receptors

The Operational Area A is located in waters about 125 m to 136 m deep. The fauna associated with this area will be predominantly pelagic species of fish, with migratory species such as turtles, whale sharks and cetaceans potentially present in the area seasonally. The Operational Areas overlaps a small area of the Ancient Coastline at 125 m Depth Contour KEF, which is identified as areas of hard substrate with potential sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates, these communities are recorded as being representative of hard substrate fauna in the North West Shelf Bioregion (DoEE, n.d). The subsea infrastructure also provides habitat for various fish species. The Operational Areas also overlaps BIAs for the pygmy blue whale (migration), flatback turtle (internesting), whale shark (foraging) and wedge-tailed shearwater (breeding). Noise interference is a key threat to a number of migratory and threatened cetaceans and marine turtles identified as occurring within the Operational Area (**Table 4-3**). Relevant conservation actions outlined in conservation management plans and recovery plans for these species are outlined in **Table 4-3**.

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):

1. by causing direct physical effects on hearing or other organs (injury)

2. by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
3. through disturbance leading to behavioural changes or displacement from important areas (e.g. BIAs).

The thresholds that could result in behavioural response for cetaceans is expected to be 120 dB re 1 µPa (SPL) for continuous noise sources, and 160 dB re 1 µPa (SPL) for impulsive noise sources. These thresholds have been adopted by the United States National Oceanic and Atmospheric Administration (NOAA) (National Marine Fisheries Service [NMFS], 2014). More permanent injury would be expected to occur at 230 dB re 1 µPa (peak) (Southall *et al*., 2007). Noise generated by the MODU and subsea support vessels would not exceed that level, so permanent injury to protected species is not anticipated.

Table 7-2: Thresholds where PTS and TTS are expected to be observed

Hearing group	PTS onset thresholds (received level)		TTS onset thresholds (received level)		Behavioural response
	Impulsive	*Non-impulsive*	*Impulsive*	*Non-impulsive*	
Low-frequency cetaceans	L_{pk}, flat: 219 dB L_E, LF, 24h: 183 dB	L_E, LF, 24h: 199 dB	L_{pk}, flat: 213 dB L_E, LF, 24h: 168 dB	L_E, LF, 24h: 179 dB	L_p 160 dB
Mid-frequency cetaceans	L_{pk}, flat: 230 dB L_E, MF, 24h: 185 dB	L_E, MF, 24h: 198 dB	L_{pk}, flat: 224 dB L_E, MF, 24h: 170 dB	L_E, MF, 24h: 178 dB	L_p 160 dB
High-frequency cetaceans	L_{pk}, flat: 202 dB L_E, HF, 24h: 155 dB	L_E, HF, 24h: 173 dB	L_{pk}, flat: 196 dB L_E, HF, 24h: 140 dB	L_E, HF, 24h: 153 dB	L_p 160 dB

Source: NMFS (2014, 2018); Southall et al. (2019).

Listed threatened and listed migratory species that could be potentially impacted by noise and vibration may be present within the Operational Areas and primarily include cetaceans as well as whale sharks, rays and turtles. As mentioned above, the Operational Areas overlap the migration corridor BIA for pygmy blue whales. Pygmy blue whale individuals may occasionally transit the Operational Areas, with a higher likelihood of occurrence during April to August and October to January during their seasonal migrations. While not overlapping any BIA for humpback whales, the Protected Matters Search Tool results identified that humpback whales have the potential to occur in proximity of the Operational Areas, particularly during the migration period (July (northbound) and late August/September (southbound)). Additional cetaceans likely to occur include the sei whale and fin whale. Operational Area A also overlaps with the whale shark foraging BIA, with peak numbers expected March to July, and the flatback turtle internesting buffer BIA around the Montebello Islands and Dampier Archipelago during their summer nesting period. Satellite tracking of flatback turtle nesting populations (Barrow Island and mainland sites) indicates this species travels to the east of Barrow Island between nesting events, within WA mainland coastal waters less than 70 m deep (Chevron Australia Pty Ltd, 2015).

MODU and Support Vessels

Considering the overlap or proximity of the BIAs to the Operational Areas, it is likely there may be increased numbers of individuals of pygmy blue whales (and other whale species such as humpback, sei and fin whales), whale sharks and turtles within the Operational Areas during migratory/foraging periods. However, the potential impacts are considered to be not significant, 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. Note that Operational Area A 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 Areas will be predominantly pelagic species of fish, with migratory species such as whale sharks, rays, marine turtles and other cetacean species transiting through the Operational Areas. Therefore, potential impacts from MODU and vessel noise are likely to be restricted to temporary avoidance behaviour of individuals transiting through the Operational Areas, and are therefore considered localised with no lasting effect. As the wells will not be plugged and abandoned concurrently, there is no potential for cumulative impacts from concurrent plug and abandonment activities.

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. Implementing this control may incidentally reduce the noise generated by vessels in proximity to cetaceans, as vessels will be travelling slower and slower vessel speeds may reduce underwater noise from machinery noise (main engines) and propeller cavitation.

Helicopter Noise

Helicopter engines and rotor blades are recognised as a source of noise emissions, which may result in behavioural disturbance to marine fauna. 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) – most 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 Areas (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance are considered to be not 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 more than 500 m horizontal separation from cetaceans (as per the EPBC Regulations), and the predominantly seasonal presence of whales within the Operational Areas, 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.

While unlikely, turtles may be present in low numbers within the Operational Areas, particularly during internesting periods, 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.

The Operational Areas may be occasionally visited by migratory and oceanic birds but do not contain any emergent land that could be used as roosting or nesting habitat. The closest emergent facility is the GWA platform located about 100 m from the Operational Areas. One BIA, a breeding area for wedge-tailed shearwaters, overlaps the Operational Areas (August to April) and foraging BIAs. However, there are no nesting sites such as islands within or in proximity to the Operational Areas. Seabirds within the Operational Areas may avoid helicopter flights. Given the expected low density of seabirds within the Operational Areas due to a lack of roosting or nesting habitat, the relative infrequency of helicopter flights and lack of lasting effect of potential behavioural responses to helicopter noise, impacts would be unlikely, minor and result in no lasting effect.

Positioning Equipment Noise

Transponders used for positioning have the potential to cause some temporary behavioural disturbance to marine fauna; however, 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 Areas overlap with seasonal BIAs for pygmy blue whales and whale sharks (as described above). Should the short period during which transponders are in use 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 Areas are surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal's ability to avoid the activities.

Underwater Noise from Flaring

Underwater received sound pressure level during flaring is estimated to be 136 dB re 1 µPa at 1 m below the sea surface, and is estimated to attenuate below the marine mammal behavioural response threshold for continuous noise sources of 120 dB re 1 µPa (SPL) within only 7 m from the sea surface. Accordingly, the potential impacts associated with noise produced during flaring are considered highly localised and not expected to result in any significant impacts to marine fauna.

Summary of Potential Impacts to Environmental Value(s)

It is considered that noise generated by the support vessels, MODU activities, helicopters and positioning transponders will result in no greater than localised, slight, short-term impacts to marine fauna (i.e. Environmental Impact – F to E)

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
The use of dedicated Marine Fauna Observers (MFOs) on support vessels for the duration of the Petroleum Activities Program to watch for	F: Yes. However, support vessel bridge crews already maintain a constant watch during operations. CS: Additional cost of MFOs.	Given that subsea support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not further reduce the likelihood of	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No

whales and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.		an individual being within close proximity of the acoustic source during start-up or during operations.		
Professional Judgement – Eliminate				
Remove 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/subsea support vessels. CS: Introduces unacceptable safety risk.	Not considered, control not feasible.	Not considered, control not feasible.	No
Eliminate generation of noise from the MODU, subsea support vessels or survey positioning equipment (if used).	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
Do not flare or vent.	F: No. Flaring may be the only feasible way to safely manage the reservoir fluids and achieve the well objectives. CS: Not considered, control not feasible.	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 deeming the project unviable if activities avoid 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, Woodside considers the potential impacts from routine support vessel, MODU, helicopter and positioning transponder noise emissions to be ALARP in their current risk state. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that the generation of noise from project vessels, MODU, positioning equipment, piling activities, and helicopter operations may result in slight, short-term impacts (<1 year) to species. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice. The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the impact to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 3 Flaring and venting emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity to limit impacts to the environment from noise.	**C 3.1** The bleed-off acceptance criteria that defines the well objectives will be established.	**PS 3.1** Flaring restricted to a duration necessary to achieve the well objectives.	**MC 3.1** Records demonstrate flaring was restricted to a duration necessary to achieve the well objectives.

7.6.4 Routine and Non-routine Discharges: MODU and Project Vessels

Context	
Project vessels **– Section 3.7**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**

Impacts Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***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			X		A	F	-	-	LCS PJ	Broadly Acceptable	EPO 4
Routine discharge of deck and bilge water to marine environment from MODU and support vessels		X			X		A	F	-	-	LCS PJ		
Routine discharge of cooling water or brine to the marine environment from MODU and support vessels		X			X		A	F	-	-	LCS PJ		

Description of Source of Impact

The MODU and support vessels routinely generate/discharge:

- Small volumes of treated sewage, putrescible wastes and grey water to the marine environment (impact assessment based on approximate discharge of 15 m³ per vessel/MODU per day), using an average volume of 75 L/person/day and a maximum of 200 persons on board. However, it is noted that vessels such as 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 the subsea support vessels or MODU. 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. 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 RO to produce potable water onboard the subsea support vessels and MODU.

Environmental risks relating to the unplanned disposal/discharges are addressed in **Section 7.7.7**.

Impact Assessment
Potential Impacts to Water Quality and Marine Fauna
The principal 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 conducted monitoring of 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 50 m, 100 m and 200 m downstream of the platform and at five different water depths confirmed that discharges were rapidly diluted; no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Mixing and dispersion would be further facilitated in deep offshore waters, consistent with the location of Operational Area A, 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 and 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 proximity to Operational Area A, is unlikely. Research also suggests that zooplankton composition and distribution are not affected in areas associated with sewage dumping grounds (McIntyre and 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, deck drainage and cooling water), will be rapidly diluted through the same mechanisms as above. They are expected to be intermittent and 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 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 Operational Area A. Operational Area A 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) 2013. While the Petroleum Activities Program may extend for up to three years, vessels will not be continuously in Operational Area A during this time. Vessels will also be moving (i.e. not in a single location for an extended period of time). Rather, these routine and non-routine discharges are expected to be intermittent in nature for the duration of the Petroleum Activities Program. Therefore, cumulative impacts to water quality within Operational Area A are expected to be localised and short-term with no lasting effect. It is possible that marine fauna transiting the localised area may come into contact with these discharges (e.g. marine turtles, pygmy blue whales, whale sharks, as they traverse Operational Area A, **Section 4.5.2**). However, given the localised extent of cumulative impacts from multiple vessel discharges within Operational Area A, significant impacts to marine fauna are not expected.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that routine or non-routine discharges described will be limited to localised contamination not significant to environmental receptors, with no lasting effect. (i.e. Environment Impact – F). Any localised (non-significant) impacts to marine fish is not expected to impact any commercial fishers in the area.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 95 – Marine pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps are passed through a macerator so that 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 4.1**
Marine Order 96 – Marine pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention (ISPP) Certificate, as required by vessel class • a sewage treatment plant approved by AMSA or an issuing body • a sewage comminution and disinfection 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 (more than four 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 4.2**
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 4.3**
Marine Order 91 – Marine pollution prevention – oil (as relevant to vessel class) requirements, which includes	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 4.4**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
mandatory measures for processing oily water before discharge: • Machinery space bilge/oily water shall have International Maritime Organisation (IMO)-approved oil filtering equipment (oil/water separator) with an online monitoring device to measure OIW content to be less than 15 ppm before 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 less than 15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed of onshore. • Valid International Oil Pollution Prevention (IOPP) Certificate.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Storage, transport and 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 the implementation of this 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)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Not considered, control not feasible.			
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, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the impacts of planned routine discharges from the MODU and project vessels. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, routine and non-routine discharges from the MODU and project vessels may result in localised impacts with no lasting effect (<1 month) to water quality and species. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. However, these species are not expected to be impacted.

The adopted controls are considered consistent with industry legislation, codes and standards, and professional judgement and meet the requirements of Australian Marine Orders. Therefore, Woodside considers the adopted controls appropriate to manage the impact to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 4 No impact to water quality greater than a consequence level of F[10] from discharge of sewage, greywater, putrescible wastes, bilge and deck drainage to the marine environment during the Petroleum Activities Program.	**C 4.1** Marine Order 95 – Marine pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps be passed through a macerator, so they are able to pass through a screen with no opening wider than 25 mm.	**PS 4.1** MODU and project vessels compliant with Marine Order 95 – Marine pollution prevention – garbage.	**MC 4.1.1** Records demonstrate MODU and project vessels are compliant with Marine Order 95.
	C 4.2 Marine Order 96 – Marine pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid ISPP Certificate, as required by vessel class • a sewage treatment plant approved by AMSA or an issuing body • a sewage comminution and disinfection system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water)	**PS 4.2** MODU and project vessels compliant with Marine Order 96 – Marine pollution prevention – sewage (as appropriate to vessel class).	**MC 4.2.1** Records demonstrate MODU and project vessels are compliant with Marine Order 96.

[10] Defined as ‘F - No lasting effect (less than one month). Localised impact not significant to areas or items of cultural significance)’.

	• 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 (more than four knots), to avoid discharges in environmentally sensitive areas.		
	C 4.3 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 4.3** Contaminated drainage contained, treated and/or separated before discharge.	**MC 4.3.1** Records demonstrate MODU has a functioning bilge/oily water management system.
	C 4.4 Marine Order 91 – Marine pollution prevention – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water before discharge: • Machinery space bilge/oily water shall have IMO-approved oil filtering equipment (oil/water separator) with an online monitoring device to measure OIW content to be less than 15 ppm before 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 less than 15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed of onshore. • Valid IOPP Certificate.	**PS 4.4** Discharge of machinery space bilge/oily water will meet oil content standard of less than 15 ppm without dilution.	**MC 4.4.1** Records demonstrate discharge specification met for MODU and project vessels.

7.6.5 Routine and Non-routine Discharges: Drilled Cement, Swarf, Formation Rock, Drilling Fluids (WBM and NWBM), and Well Clean-out Fluids

Context	
MODU based permanent plugging activities **– Section 3.10** Additional potential MODU based activities **– Section 3.11** Project fluids **– Section 3.12**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**

Impacts Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*						*Evaluation*						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine discharge of WBM, and cement cuttings to the marine environment	X	X		X			A	E	-	-	GP PJ	Broadly Acceptable	EPO 5
Non-routine discharge of WBM, swarf, cement cuttings and formation rock	X	X		X		X	A	E	-	-			
Non-routine discharge of NWBM, swarf, cement cuttings and formation rock to the marine environment	X	X		X		X	A	E	-	-			
Non-routine discharge of well clean-out fluids	X	X		X		X	A	E	-	-			

Description of Source of Impact

Permanent Plugging Program

The base case of the proposed Petroleum Activities Program includes the use of WBM and wet cement and will produce well annulus fluids (residual hydrocarbons and residual produced formation water). For Capella-1, dried cement cuttings will also be produced during plug and abandonment activities. These fluids will be generated during the well bore clean-out, drilling of existing cement barriers, installation of permanent abandonment barriers, circulation of the annulus and washing out of the mud pit.

Potential additional activities that may be required as part of the Petroleum Activities Program includes milling, which will produce metal swarf, drilled cement and formation rock.

All of the downhole plugging for permanent abandonment activities are conducted through the marine riser. This is a closed system, meaning there are no planned discharges directly to sea during these activities. Planned discharges of the above fluids are only planned to occur after they have been received on the MODU.

The following describes the source of impact with respect to discharge of drilled cement, drilling fluids and clean-up fluids only (see **Section 7.6.6** for cement, cementing fluids and subsea control fluids).

For the purposes of this impact assessment, the indicative dimensions, discharge locations and approximate volumes are provided in **Table 7-3**.

Table 7-3: Estimated discharges of solids and volumes of drilling fluids used for the Petroleum Activities Program*

Description	Discharge Point	Discharge	Approximate Solids Discharged (m³)	Approximate Fluid Discharged (m³)	Potential Additional Solids (m³)	Potential Additional Fluid Discharge (m³)
Drill out shallow cement plug (Capella-1 only)	Below sea level	WBM and cement cuttings	2	1		
Kill well	Below sea level	Well kill fluid	0	0		
End of well discharge	Below sea level	WBM or brine, mud pit and vessel tank wash fluids	0	600		
Milling (potential activity using WBM)	Below sea level	WBM, swarf, cement and formation rock			2 (swarf) 3 (cement) 3.5 (formation rock)	1600
Milling (potential activity using NWBM)	Below sea level	NWBM, swarf, cement and formation rock			2 (swarf) 3 (cement) 3.5 (formation rock)	5
Total per well			**0 to 2**	**600 to 601**	**2 (swarf)** **3 (cement)** **3.5 (formation rock)**	**5 (NWMB) to 1600 (WBM)**

**Volumes described are approximate and may be subject to change due to well design and operational requirements*
***Seawater with pre-hydrated bentonite sweeps/XC polymer sweeps (seawater volume not included in the estimated "fluid volume"*

Drilled Cement

Indicative drilled cement cuttings generated from drilling out the shallow cement plug in Capella-1 have been estimated to comprise a total of about 2 m³ ranging in size from very fine to very coarse (less than 1 cm) (**Section 3.10**). Indicative volumes of drilled cement for the well are outlined in **Table 7-3**. The shallow cement plug will preferentially be drilled out with WBM. The drilling fluids will pass through shakers to remove the cement cuttings from the drilling fluid before discharging the cement cuttings.

There are no shallow cement barriers in Yodel-3 or Yodel-4.

Well Bore Clean-out Fluids

During plug and abandon activities, wells will generally be displaced from well kill brine to viscosified brine, or cleaned, which may include residual annulus fluid. A chemical clean-out pill or fluids train will be circulated between the two fluids. This will result in a discharge of fluids in accordance with Woodside's internal guidelines to ensure the potential impacts of the chemicals selected are acceptable.

Should there be clean-up brine contaminated with base oil or NWBM, it will be captured and stored on the MODU for discharge if oil concentration is less than 1% by volume, or returned to shore if discharge requirements cannot be met.

WBM, Brine and NWBM

WBM and brines will be operationally discharged to the marine environment at the location of plug and abandon activities during the Petroleum Activities Program under the following scenarios:

1. below sea surface as fluid remaining on drilled cement, after passing through the shakers
2. from the mud pits from a pipe below the sea surface, if the WBM/brine 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.

WBM and brine are contained within the WBM system. Mud pits (tanks) within this system provide capacity for the storage of WBM and brine. The mud pits are cleaned out at the completion of drilling operations. Should NWBM be used, mud pit residue may be discharged to the sea where the residue contains less than 1% oil volume. Where the mud pit residue exceeds 1% oil volume, the residue will be retained and disposed of onshore.

Base oil and chemicals used in WBM and NWBM are assessed in accordance with the Woodside Chemical Selection and Assessment Environment Guideline.

Milling

For plug and abandon activities, there is a potential additional activity where the well casing needs to be milled out (up to 100 m per well). This will produce milled swarf (2 m³ per well), drilled cement cuttings (3 m³ per well) and formation rock (3.5 m³ per well) and will preferentially be completed using WBM. There may be instances where NWBM is required for operational purposes to manage well stability to safe levels. The solids from the WBM or NWBM drilling fluid system (including the swarf, drilled cement cuttings and formation rock) will also pass through the shakers, to separate these solids before discharging them. Given the small volumes of solids and only limited drilling into formation rock, no oil on cuttings (OOC) discharge limits have been applied, as would be the case for a drilling activity. The estimated volume of solids discharged with residual NWBM on them is expected to be about 5 m³ (per 100 m milled interval).

Impact Assessment

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

The identified potential impacts associated with discharging drilled cement, WBM, potential NWBM and brine (collectively referred to as drilling fluids) include a localised and temporary reduction in water and localised change in seabed sediment quality, as well as localised burial of benthic biota (species) and change to habitats and communities.

A number of direct and indirect impact pathways are identified for drilled cement and drilling fluids, including:

- 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 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.

Operational Area A is situated in offshore waters (about 75 km from the nearest shoreline of the Montebello Islands) in water depths of 125 to 136 m. The abiotic habitat in the area is likely comprised of deep, soft, unconsolidated sediment, which is relatively flat and featureless. However, the Ancient Coastline at 125 m Depth Contour KEF overlaps Operational Area A; therefore, there may be areas of hard substrate associated with this KEF.

The plug and abandon activities occur with a riser fitted, creating a closed loop system. Small volumes of cement cuttings and/or formation cuttings with unrecoverable fluids are discharged below the water line at the MODU site, resulting in drilled cement and drilling fluids (WBMs, brine and/or NWBMs) rapidly diluting, which disperse through the water column. The dispersion and fate of the solids are determined by particle size and density of the unrecoverable fluids; the larger solids particles will drop out of suspension and deposit in proximity to the well site (tens of metres) with potential for localised spreading downstream, while the finer fluid particles will remain in suspension and will be transported away from the well site, rapidly diluting and eventually depositing over a larger area (hundreds of metres) downstream of the well site. To understand the extent of the impact, literature about the predicted impacts for bottom hole cuttings are relevant, which state these cuttings are generally confined to a maximum of 500 m from the discharge point (IOGP, 2016), with NWBM cuttings discharges to water less than about 300 to 400 m depth typically deposited in sediments within about 100 to 200 m of the discharge (IOGP, 2016). For the Petroleum Activities Program, because the volumes of cement cuttings are so low, and formation cuttings are only associated with contingency plug and abandonment activities and would also be in low volumes, the extent of the environment impacted is expected to be lower than what is stated in the literature, which is based on drilling new wells with higher volumes of solids.

Potential impacts from the discharge of cement cuttings and formation cuttings can range from 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, elevated metals such as barium sulphate (barite), and potential for reduction 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. Because the volumes of cement cuttings and formation cuttings would be predicted to be so low, the level of impact would also be lower than what is usually expected during the drilling of new wells.

<u>Habitats and Communities (physical impact of cement cuttings and formation cuttings)</u>

Cement cuttings and formation cuttings discharged at the seabed during plug and abandon activities may result in small, localised solids piles on the seabed surrounding the wellhead as discussed above, with a greater spread of solids expected to occur downstream from the well site. The solids pile may vary in particle size distribution from the surrounding sediments. Although the discharge volumes are low, there may be instances where solids piles cover benthic organisms and mobile benthic fauna, such as demersal fish, may be temporarily displaced from areas where solids discharges accumulate.

Ecological impacts to sessile benthic organisms is predicted when sediment deposition is equal to or greater than 6.5 mm (in thickness) (IOGP, 2016). This amount of sediment deposition is expected to be confined to less than 150 m around each well location considering the small volumes that are expected to be discharged. 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 solids 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 any 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.

No hard coral habitat or other light-dependent benthic primary producer communities are expected to be present within Operational Area A, with the closest coral reef being Rankin Bank (12 km away). However, the presence of the Ancient Coastline at the 125 m Depth Contour KEF and the fauna associated with the subsea infrastructure does present the possibility of the presence of hard substrate within Operational Area A and associated encrusting assemblages, such as soft corals and sponges. However, as the KEF is widely represented outside the Operational Areas and the drilled cement is expected to be in small volumes, the potential ecological impacts will be localised and would not have significant impact on the whole KEF.

Water Quality

The discharge of drilled cement, unrecoverable WBM or NWBM and residual annulus fluids is expected to increase turbidity and TSS levels in the water column, leading to minor increased sedimentation rate above ambient levels associated with the settlement of suspended sediment particles in proximity to the seabed or below the sea surface, depending on the location of discharge. Drilled cement discharge is generally intermittent and of short duration while drilling a well. Nelson *et al.* (2016) identified less than 10 mg/L TSS has no effect or sub-lethal minimal effect concentration. 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, the small volumes of discharge and the short period of intermittent discharge, the plume is not expected to 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 (more than 1830 mg/L), such concentrations do not occur as a result of drilled cement and formation rock discharges while drilling new wells (IOGP, 2016), and are therefore not expected from the small volumes associated with the proposed permanent plugging activities. In addition, most fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. 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 within the Operational Areas.

Given the composition and wider representation of the expected benthic communities in the vicinity of Operational Area A, the ecological impacts are considered to be slight and short-term.

Sediment Quality and Habitats and Communities (contamination from and toxicological effects of drilling muds)

Indicative components of the WBM system outlined in **Section 3.12.2** have a low toxicity. Bentonite and a chemical from the family of XC polymers (Xanthan Gum or similar) are listed as ‘E’ category fluids under the OCNS and are included on the OSPAR list of chemicals used and discharged offshore that are considered to ‘pose little or no risk to the environment’ (PLONOR). These metals are present primarily as insoluble mineralised salts. Consequently, they are not released in significant amounts to the pore water of marine sediments and have low bioavailability to those benthic fauna that 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 included on the PLONOR list. 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 drilling fluids (Terrens *et al*., 1998). The dilution of solid elements of the WBM into substrate largely depends on the energy level of the local environment and the ‘mixing’ that occurs, but is expected to occur rapidly after release (especially with WBM). The low sensitivity of the benthic communities/habitats combined with the low toxicity and volume of WBM affirm that any significant impact is considered unlikely.

Base fluids for NWBM (which may be used if needed for milling activities, and may be found in residual volumes in the wells) are designed to be biodegradable in offshore marine sediments. Biodegradation can result in a low oxygen (anoxic) environment, resulting in changes in benthic community structure. However, this depends on the bioavailability of the base fluid. Species sensitive to anoxic environments are eliminated and replaced by tolerant and opportunistic species, resulting in decreased species diversity, but the number of individuals often increases (Neff *et al*., 2000). NWBMs are designed to be low in toxicity and are not readily bioavailable, based on their physical/chemical properties, for bioaccumulation to infauna and epifauna.

Furthermore, the combination of low toxicity, rapid dilution of unrecoverable NWBMs and low volumes discharged in association with drilled cement are of little risk of direct toxicity to water-column biota (Neff *et al*., 2000). A small quantity of WBM and NWBM residue may be discharged at the sea surface during cleaning of mud pits (less than 1%), typically at the conclusion of drilling activities or when changing between mud types. Nedwed *et al*. (2006) found that depth is an important factor for concentrations of NWBM on cuttings, where solids which had a great distance to reach the seabed (950 m) had significantly lower concentrations of OOC, suggesting that loss of base fluid during settling acted to significantly reduce chemical effects from discharges. The study concluded that NWBM discharged in deep water posed very limited environmental impacts (from analysis of difference in benthic fauna between pre- and post-drilling samples (Nedwed *et al*., 2006)). This discharge is expected to dilute rapidly, with potential impacts to the environment considered to be a local, temporary decrease in water quality.

The low sensitivity of the benthic communities/habitats within and in the vicinity of Operational Area A, combined with the low toxicity and low volumes of WBMs and NWBMs, no bulk discharges of NWBM and the highly localised nature and scale of predicted physical impacts to seabed biota, affirm that any significant impact is considered likely but of a slight environmental consequence.

<u>Well Annular Fluids</u>

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.

Cumulative Impacts

No cumulative impacts to water quality are expected to occur, as discharged sediments are predicted to settle in between the plug and abandon activities for each well.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that the drilled cement, formation rock, swarf and drilling muds 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). Any localised impacts to water quality and marine fish is not expected to impact on any commercial fishers in the area.

Demonstration of ALARP

Control Considered	Control Feasibility (F) and Cost/Sacrifice (CS)	Benefit in Impact/ Risk Reduction	Proportionality	Control Adopted
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Fluids and additives will have an environmental assessment completed before 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 the safe execution of activities and therefore no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 5.1**
For drilling fluids, six-monthly chemical review 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 and completions fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes **C 5.2**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
Written NWBM justification process followed.	F: Yes. CS: Minimal cost. Standard practice.	The written justification considers the technical need for NWBM use, receiving environment, cost and additional controls that may be required. By performing formal assessment, the potential impacts are well understood, allowing for development of control measures to reduce the consequence of NWBM use. This provides an overall environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 5.3**
No overboard disposal of bulk NWBM.	F: Yes. CS: Minimal cost. Standard practice.	By restricting the volume of NWBM for overboard discharge, the consequence of the release on the environment is reduced. Although no change in likelihood is provided, the decrease in consequence results in an environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 5.4**
Bulk operational discharges 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 5.5**
SCE used to treat solids with NWBM before discharge.	F: Yes. CS: Minimal – more frequent solids sampling and testing.	Unplanned milling operations may result in NWBM fluid discharges and are estimated to be less than 5 m^3 per 100 m milled section and discharged over several days.	Benefits outweigh cost/sacrifice.	Yes **C 5.6**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
In an SCE failure (where no redundancy is available) while milling/underreaming with NWBM, the initial action will be to cease milling/underreaming and determine whether to repair SCE or continue until next practicable opportunity to trip out of the hole.	F: Yes. CS: Cost and schedule implications due to cessation of drilling.	Ceasing drilling in the event of equipment failure will allow time to assess the feasibility of drilling ahead while less than 5 m³ per 100 m milled section is discharged over several days.	Benefits outweigh cost/sacrifice.	Yes **C 5.7**
Professional Judgement – Eliminate				
None identified.				
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
Mud pit wash residue will be measured for oil content before discharge.	F: Yes. CS: Minimal cost. Standard practice.	Ensuring less than 1% oil content will provide a small reduction in consequence when residue is discharged to the environment.	Benefits outweigh cost/sacrifice.	Yes **C 5.8**
Drilled cement returned to the MODU will be discharged below the water line.	F: Yes. CS: Minimal cost. Standard practice.	Discharge of drilled cement below the water line will reduce carriage and dispersion of solids, thereby reducing the consequence of solids discharges during the Petroleum Activities Program.	Benefits outweigh cost/sacrifice.	Yes **C 5.9**
Water quality and/or sediment monitoring of drilled cement or drilling fluids to verify impact during activity.	F: Yes. CS: • For in-water sampling using ROV – Time and logistics for tool change-out from operational tools to specialised scientific sampling tools. • Additional personnel onboard to operate ROV and coordinate sampling program. • Low ROV availability due to operations can limit time to perform environment monitoring. • If additional ROV is required on the	No environmental benefit would be gained by implementing monitoring during the activity. Monitoring could be used to inform additional control measures in future drilling activities; however, there is a considerable body of scientific literature about potential impacts of drilled cement and impacts are generally well understood. Furthermore, it is not guaranteed that additional controls would be feasible, or	Disproportionate. Cost/sacrifice outweighs benefit to be gained in the context of existing environment (deepwater, open ocean communities with no proximity to sensitive benthic communities or receptors). Although adoption of this control could be used to verify EPOs associated with drilling mud and cutting discharge, alternative controls identified achieve an appropriate outcome.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
	MODU, deck space and resources to run, store, service ROV. • Resources for sample processing (space, equipment, personnel).	if they would provide any environmental benefit, and the volumes that are proposed to be discharged are so small that meaningful monitoring may not be possible.		
Use SCE with secondary treatment for NWBM: Thermomechanical systems (to achieve less than 1% average OOC).	F: Yes – with associated infrastructure including vessels for offline storage and delivery to thermomechanical dryer. CS: The primary cost/sacrifice of this option is the monetary outlay for acquisition and implementation, which is estimated at $800,000 to mobilise, install and demobilise, along with a running cost of about $32,000/day. Other factors considered include: • Estimated to take a minimum of seven months to mobilise, install and commission the system on to the MODU. • Complex and unfamiliar system to integrate with the rig systems. • Increased health and safety exposure due to: – crew of nine engineers and technicians required to run the plant – multiple crane lifting operations, during installation, operations and demobilisation – rotating machinery – heat illness – deck congestion due	A reduction in consequence would be achieved by reducing the average OOC discharged.	Disproportionate. Cost/sacrifice outweighs benefit to be gained in the context of existing environment and drilling activities.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
	to large footprint of the plant.			
WBM drilled cement returned to the MODU will be processed (using SCE equipment), allowing reuse of mud before discharge.	F: Yes. CS: Minimal cost. Standard practice	Returning WBM to the MODU to be processed before discharge allows for the mud to be reused. This also reduces the potential environmental consequence to as low as discharge will contain, less solids.	Benefits outweigh cost/sacrifice.	Yes **C 5.10**
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 a time when discharge of WBM and/or solids might not be permitted. Additional mud storage volume required.	Given the offshore location, oceanographic changes are unlikely to significantly affect the dispersion of solids and therefore no environmental benefit would be gained.	Disproportionate. The cost/sacrifice outweighs the benefit gained – No hard coral or other light-dependent benthic primary producer 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 Type A, **Section 2.7.1**), Woodside considers the adopted, standard 'good practice' controls appropriate to manage the impacts of drilled cement and drilling fluids discharges.

A range of engineered solutions and other elimination options were considered to further reduce the impact of planned discharge of drilled cement 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, which due to the low sensitivity of the environment are already low, without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, routine and non-routine discharges of drilled cement, swarf, formation rock, WBM and NWBM, and well clean-out fluids may result in slight, short-term impact (<1 year) on habitat (but not affecting ecosystem function), physical and biological attributes. The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the impact 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 or marine biota greater than a consequence level of E[11] from discharge of cement cuttings, formation cuttings, WBM or NWBM fluids during the Petroleum Activities Program.	**C 5.1** Fluids and additives will have an environmental assessment completed before use.	**PS 5.1** Reduces to ALARP the impact potential of all chemicals intended or likely to be discharged into the marine environment.	**MC 5.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 5.2 For WBM and NWBM, six-monthly chemical review performed to confirm potential chemical impacts are reduced to ALARP.	**PS 5.2** To evaluate ongoing ALARP and acceptability of approved chemicals (including determining whether alternative products are available).	**MC 5.2.1** Records confirm six-monthly reviews have occurred, and any actions/changes are being tracked to closure.
	C 5.3 Written NWBM justification process followed.	**PS 5.3** Ensures the use of NWBM is consistently challenged.	**MC 5.3.1** Records demonstrate a formal justification has been completed before using NWBM.
	C 5.4 No overboard disposal of bulk NWBM.	**PS 5.4** Reduces the volume of hydrocarbons discharged to the marine environment.	**MC 5.4.1** Incident reports of any unplanned discharges of NWBM.
	C 5.5 Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps).	**PS 5.5** Ensures an increased level of assurance and verification on bulk operational discharges.	**MC 5.5.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 5.6 SCE used to treat solids with NWBM before discharge.	**PS 5.6** Total NWBM discharge limited to 5 m³/100 m milled interval.	**MC 5.6.1** Records confirm the total NWBM volume does not exceed total volume limit.
	C 5.7 In an SCE failure (where no redundancy is available) while drilling with NWBM, the initial action will be to cease milling/underreaming and determine whether to repair SCE or continue operations until the next practicable opportunity to trip out of the hole.	**PS 5.7** The decision whether to repair SCE or continue operations has considered the estimated time for repairs and the amount of drilling until next planned trip out of hole, to ensure the discharge limit is not exceeded.	**MC 5.7.1** Records demonstrate that in the event of SCE failure (where no redundancy is available), active milling/underreaming is initially stopped as soon as safe to do so. Evidence of the decision to continue operations with failed SCE can be produced. Records confirm the total NWBM volume does not exceed total volume limit.
	C 5.8 Mud pit wash residue will be measured for oil content before discharge.	**PS 5.8** Achieves less than 1% by volume oil content achieved before discharge.	**MC 5.8.1** Records after pit clean-out (for pits potentially contaminated with base oil) demonstrate mud pit wash residue was less than

[11] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

			1% by volume oil content before discharge.
	C 5.9 Drilled cement returned to the MODU will be discharged below the water line.	**PS 5.9** Reduces carriage and dispersion of solids by surface currents.	**MC 5.9.1** Records confirm solids discharge chute/line is below the water line.
	C 5.10 WBM drilled cement returned to the MODU will be processed (using SCE equipment), allowing reuse of mud before discharge.	**PS 5.10** WBM drilled cement returned to the MODU, processed using SCE equipment.	**MC 5.10.1** Records demonstrate that operational SCE is in use.

7.6.6 Routine and Non-routine Discharges: Cement, Cementing Fluids, Grout, Subsea Well Fluids, Unused Bulk Products

Context	
MODU based permanent plugging activities – **Section 3.10.1** Cement unit test **– Section 3.10.8**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**

Impacts Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*						*Evaluation*						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Routine and non-routine discharge of cement, cementing fluids, grout, subsea fluids (e.g. BOP control fluids and well suspension fluids) and other down-well products to the seabed and the marine environment	X	X		X			A	F	-	-	GP PJ	Broadly Acceptable	EPO 6

Description of Source of Impact

Cementing Fluids, Cement and Grout

Cementing fluids, including cementing mix water, may require discharge to the marine environment under various scenarios.

After each cement job, leftover 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 5 m³ per well (based on up to four cement jobs per well, with 10 m³ discharged per job). In the unlikely event a respud is required, it would result in additional cement jobs.

Cement spacers can be used as part of the cementing process, within the well casing, to assist with cleaning the casing sections before 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, bentonite and barite (dry bulk, after well operations are completed) will either be: used for subsequent wells; provided to the next operator at the end of the plug and abandon program (as it remains on the rig); or, if these options aren’t practicable, discharged to the marine environment as dry bulk or as a slurry up to 5 m³.

Upon arrival on location at Operational Area B, the MODU may need to perform a cement unit test, or ‘dummy cement job’. Discharges from the test are made through the usual cement unit discharge line, which may be up to 10 m above the sea level, and occur as a cement slurry. The slurry is usually a mix of cement and water (about 10 m³); however, may sometimes contain stabilisers or chemical additives.

Subsea Fluids (BOP and Well Plugging Activity Control Fluids)

Subsea fluids are likely to be released during permanent plugging for abandonment activities including X-mas tree removal. These substances include hydraulic fluids, BOP controls fluids and return fluids.

The BOP is required to be regularly function tested when subsea, 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). The maximum volume of BOP control fluid per function is up to about 90 L.

All other plug and abandon activities that result in subsea discharges are likely to only discharge small, intermittent volumes.

Subsea Fluids – Displacement and Well Bore Clean-Out Fluids

As required throughout activities with the riser connected, wells will be displaced from one fluid system to another. A chemical clean-out pill or fluids train will be circulated between the two fluids. Clean-out fluids and completion brine will be captured and stored on the MODU and discharged if oil concentration is less than 1% by volume, or returned to shore if discharge requirements cannot be met.

Disposal in Well bore

There may be an option to leave equipment, drilled cement and/or swarf in the well to minimise the environmental and cost footprint of disposal on shore. An example of this may be the production tubing and associated accessories which, if appropriate, may be left down the well at the end of the permanent plugging activities. The decision to leave equipment in the well will be made subject to an ALARP assessment. It will depend on the condition of the equipment and other operational considerations at the time.

Marine Riser Clean Out

There is potential for the marine riser and BOP to be susceptible to rust and other minor build-up between wells. This can lead to operational issues. To avoid this, the marine riser will be recovered to deck and inspected. If needed, the equipment will be cleaned over a bunded area with fluids returned to tanks on the MODU. The BOP cavities will also be cleaned before deployment and, if equipment needs to be cleaned after deployment, large diameter brushes, clean drill pile and high rate circulation subs will be available to enable riser cleaning/flushing to the MODU mud pits. If debris continues to be a problem, the riser will be disconnected and an ROV will be used to flush the remaining debris from the top of the X-mas tree cap.

Impact Assessment

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

Pelagic and benthic habitats in Operational Area A are considered to be of low sensitivity (no known significant benthic habitat or infauna habitat). Although the Ancient Coastline at 125 m Depth Contour KEF overlaps with the Operational Areas, the values and sensitivities of this KEF occur on a broad scale outside of the Operational Areas (**Section 4.7.2**). 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 and Grout

Impacts of cement on the marine environment are associated mainly with smothering of 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 and abandon activities. While cement volumes are calculated before 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 and grout (if required) 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 drilled cement (see **Section 7.6.5**).

Cementing Fluids, Subsea Well Fluids (BOP and Well Construction Activity Control Fluids, Completion Fluids and Well Intervention/Workover Fluids) and Other Down-Well Products

All chemicals that may be operationally released or discharged to the marine environment must be selected and approved as per the Chemical Selection and Assessment Environment Guideline (**Section 3.12.1**). 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 an ALARP assessment, additional dilution before 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.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that the routine discharge of cement, cementing fluid, grout, subsea fluids 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 – F). Any localised impacts to marine fish are not expected to impact on any commercial fishers in the area.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Fluids and additives will have an environmental assessment completed before 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 the safe execution of activities and therefore no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 5.1**
For drilling and completions fluids, six-monthly chemical review 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 and Completions fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes **C 5.2**
Bulk operational discharges 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 that bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes **C 5.5**
Displacement fluids contaminated with hydrocarbons will be treated before discharge or contained. If discharge specification not met, the fluid will be returned to shore.	F: Yes. CS: Minimal cost. Standard practice.	Ensuring less than 1% oil content will provide a small reduction in consequence when fluids are discharged to the environment.	Benefits outweigh cost/sacrifice.	Yes **C 6.4**
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 shore-based disposal is significant.	No discharge of 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
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 permanent abandonment schedule is unknown; hence, a commitment to reuse cement may not be feasible. CS: Minor.	Using excess bulk cement for subsequent wells would eliminate the bulk discharge of cement to the marine environment and eliminate the likelihood and consequence of impacts from such activities.	Disproportionate. Given the risk of the cement discharge 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, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the impacts of cement, cementing fluids, grout, subsea fluids (BOP control fluids) and the corrosion of Echo Yodel subsea infrastructure left in-situ. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, routine and non-routine cement, cementing fluids, grout, subsea well fluids, and unused bulk products may result in localised impacts with no lasting effect (<1 month) to marine sediment, water quality and habitat (but not ecosystems). The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the impact 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	**C 5.1** See **Section 7.6.5.**	**PS 5.1** See **Section 7.6.5.**	**MC 5.1.1** See **Section 7.6.5.**
	C 5.2 See **Section 7.6.5.**	**PS 5.2** See **Section 7.6.5**.	**MC 5.2.1** See **Section 7.6.5**.
	C 5.5 See **Section 7.6.5.**	**PS 5.5** See **Section 7.6.5.**	**MC 5.5.1** See **Section 7.6.5.**

of F[12] from discharging cement, cementing fluids, subsea well fluids and unused bulk products during the Petroleum Activities Program.	**C 6.4** Displacement fluids contaminated with hydrocarbons will be treated before discharge or contained. If discharge specification not met, the fluid will be returned to shore.	**PS 6.4** Achieve oil concentration less than 1% by volume before discharge.	**MC 6.4.1** Records demonstrate that discharge criteria were met before discharge or contained.

[12] Defined as 'No lasting effect (less than one month). Localised impact not significant to areas or items of cultural significance)'.

7.6.7 Routine Atmospheric Emissions: Fuel Combustion, Flaring, Incineration and Venting

Context	
Project vessels – **Section 3.7** MODU based permanent plugging activities – **Section 3.10**	Physical environment – **Section 4.4**

Impacts Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*						*Evaluation*						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Internal combustion engines and incinerators on MODU and subsea support vessels			X				A	F	-	-	LCS GP PJ	Broadly Acceptable	EPO 7
Flaring of residual gas and produced formation water			X				A	F	-	-	LCS GP PJ		EPO 8
Venting of residual gas			X				A	F	-	-	LCS GP PJ		EPO 9

Description of Source of Impact

Atmospheric emissions will be generated by the project vessels from internal combustion engines (including all equipment and generators, which may be diesel powered and/or LNG powered) and incineration activities (including onboard 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 plugging for abandonment, residual hydrocarbons from the well may need to be vented or flared. Up to 1 mMscf of gas may be vented or flared per well. During well bleed-off activities, residual produced water will be bled from the well and brought back to the MODU. This water will be flared, or discharged to the marine environment after treatment via the well test water treatment package which cycles the water through a water filtration system with solids and polishing.

During the plug and abandonment, a kick may occur. A kick is an undesirable influx of formation fluid into the well bore. 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, flaring and incineration have the potential to result in 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 subsea 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 localised and temporary reduction in air quality as the gas vents to the atmosphere, and 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 residential receptor (not including the accommodation on the MODU or workforce on the GWA facility) is on Barrow Island, about 127 km south-south-east of Operational Area A; 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 minor.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that fuel combustion, incineration flaring 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)***[13]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 97 – Marine pollution prevention – air pollution), which details requirements for: • International Air Pollution Prevention (IAPP) 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.	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 7.1**
OPGGS (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 zones with flow potential penetrated by the well bore, containing hydrocarbons, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary. • The barriers shall:	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**

[13] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[13]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
– 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 Barrier Standard. • Verification: – Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the permanent plugging of the well.				
As-built checks that shall be completed during well operations.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of occurrence. No reduction in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes **C 9.2**
Good Practice				
Burning and flaring during well bleed-off activities will be conducted using Woodside- and Vendor-approved TPS (Well Test) Package.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of atmospheric emissions impacting air quality. Consequence remains unchanged.	Benefits outweigh cost/sacrifice.	Yes **C 8.1**
Oil burner will have an independent certified emissions testing certificate.	F: Yes. CS: Minimal cost. Standard practice.	This control results in a reduction in likelihood of atmospheric emissions impacting air quality. Consequence remains unchanged.	Benefits outweigh cost/sacrifice.	Yes **C 8.2**
Subsea BOP installed and function tested during permanent plugging operations. The BOP shall meet the Woodside Well Control Procedure, Woodside Engineering Standard – Rig Equipment and shall be subject to	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 9.3**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
API Standard 53 BOP Risk Assessment.				
Well control bridging document for alignment of Woodside and the MODU contractor 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 9.5**
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 safety-critical 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
Do not vent or flare well bleed-off fluids.	F: No. venting or flaring of bleed-off fluids is a safety-critical activity.	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.				

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, **Section 2.7.1**), Woodside considers the adopted controls are considered good oil-field practice/industry best practice, and appropriate to manage the impacts of fuel combustion, flaring, incineration and venting. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, routine atmospheric emissions from fuel combustion, flaring, incineration, and venting may result in localised impacts to air quality with no lasting effect (<1 month). The adopted controls are considered consistent with industry legislation, codes and standards, and professional judgement and meet the requirements of Australian Marine Orders. Therefore, Woodside considers the adopted controls appropriate to manage the impact to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 7 Fuel combustion emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity.	**C 7.1** Marine Order 97 (Marine pollution prevention – air pollution) which details requirements for: • IAPP Certificate, required by vessel class • use of low sulphur fuel when available • Ship Energy Efficiency Management Plan, where required by vessel class • onboard incinerator complies with Marine Order 97.	**PS 7.1** MODU and project 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 before contracting vessels, to ensure suitability and compliance with vessel combustion certification/ Marine Order requirements.	**MC 7.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 97.
EPO 8 Maximise efficiency of combustion during flaring and oil-burning.	**C 8.1** Burning and flaring during well bleed-off activities will be conducted using Woodside- and Vendor-approved TPS (Well Test) Package.	**PS 8.1** Maintain gas flare and oil burner to maximise efficiency of combustion and minimise venting.	**MC 8.1.1** Records demonstrate that a Woodside-approved Well Test package is in use during well bleed-off.
	C 8.2 Oil burner will have an independent certified emissions testing certificate.		**MC 8.2.1** Records demonstrate that oil burner is certified and emissions tested.
EPO 9 Emissions to air as a result of venting from bleed-off or well kick are restricted to those necessary to maintain well integrity.	**C 9.1** OPGGS (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 zones with flow potential penetrated by the well bore, containing hydrocarbons, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary). • 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	**PS 9.1** Wells permanently plugged 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 permanently plug were accepted by NOPSEMA before the activity commenced.
			MC 9.1.2 Records demonstrate minimum of two verified barriers were in place for all zones with flow potential penetrated by the well bore.
			MC 9.1.3 Records demonstrate composition and weight of drilling fluids were applicable to down hole conditions.

	out in the Woodside Barrier Standard. • Verification: – Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the permanent plugging of the well.		
	C 9.2 As-built checks shall be completed during well operations.	**PS 9.2** Achieve a minimum acceptable standard of well integrity.	**MC 9.2.1** Records show Well Acceptance Criteria are developed for each well.
			MC 9.2.2 Records demonstrate Well Acceptance Criteria have been met.
	C 9.3 Subsea BOP installed and function tested during permanent plugging operations. The BOP shall meet the Woodside Well Control Procedure, Woodside Engineering Standard – Rig Equipment and shall be subject to API Standard 53 BOP Risk Assessment.	**PS 9.3** Subsea BOP specification, installation and function testing compliant with internal Woodside Standards and international requirements (API Standard 53) as agreed by Woodside and MODU contractor.	**MC 9.3.1** Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected permanent plugging conditions as agreed by Woodside and MODU contractor.
	C 9.5 Well Control Bridging Document (WCBD) for alignment of Woodside and the MODU contractor to manage the equipment and procedures for preventing and handling a well kick.	**PS 9.5** Well is permanently plugged in accordance with the contractor WCBD to ensure no unplanned emissions to air from a well kick, during operations.	**MC 9.5.1** Records demonstrate well permanently plugged in accordance with WCBD.

7.6.8 Routine Light Emissions: External Lighting on MODU and Project Vessels

Context	
Project vessels **– Section 3.7**	Physical environment – **Section 4.4**

Impacts Evaluation Summary													
Source of Impact	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
External light emissions onboard MODU subsea support vessels and activity support vessels					X		A	F	-	-	PJ	Broadly Acceptable	EPO 10

Description of Source of Impact

The project 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 subsea 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 the safe operation of the MODU and cannot reasonably be eliminated. Note that flaring, which is a relatively bright light source, may occur periodically during the operation of the MODU.

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 (ASL) when the MODU is on station. The highest point on the MODU is the top of the derrick, which is typically about 50 m ASL.

The distance to the horizon at which components of the MODU will be directly visible can be estimated using the formula below:

$$horizon\ distance = 3.57 \times \sqrt{height}$$

where horizon distance is the distance to the horizon at sea level in kilometres and height is the height ASL 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 (about 20 m ASL): about 16 km from MODU
- derrick top (about 50 m ASL): about 25 km from MODU
- flare (about 12 m ASL): about 12 km from MODU.

Impact Assessment
Potential Impacts to Protected Species
Light emissions can affect fauna in two main ways: 1. *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. 2. *Orientation*: Species 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. The fauna within the Operational Areas are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as marine turtles, whale sharks, whales and migratory sea birds. There is no known critical habitat within the Operational Areas for EPBC listed species, nor do the Operational Areas overlap 'habitat critical for the survival of the species' for marine turtles, although there is overlap with BIAs for flatback turtle internesting, whale shark foraging, pygmy blue whale migration and wedge-tailed shearwater breeding. Pygmy blue whales and whale sharks are not expected to be impacted by above-surface light emissions, except indirectly if prey aggregate around the light source. Given the fauna expected to occur within the Operational Areas, impacts from light emissions are considered to be highly unlikely. ***Marine Turtles – Adults*** Artificial lighting may affect where 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, b; Salmon and Witherington, 1995). Such lighting is typically from residential and industrial development overlapping the coastline, rather than offshore from nesting beaches. While the Operational Areas overlap with the north-west extent of a BIA for flatback turtle internesting (described in **Section 4.5.2**), the nearest landfall for this BIA occurs at the Montebello Islands, about 75 km south-east of the Operational Areas. Impacts to nesting turtles are therefore not expected. Given the water depth of the Operational Areas (between 140 to 160 m), turtle species are unlikely to be foraging. However, it is acknowledged that marine turtles may be present transiting the Operational Areas in low densities. ***Migratory Birds*** The Operational Areas may be occasionally visited by migratory and oceanic birds but do not contain any emergent land that could be used as roosting or nesting habitat and contain no known critical habitats (including feeding for any species). The closest emergent artificial structure is the GWA facility, with the nearest island 75 km away. A BIA for wedge-tailed shearwater breeding overlaps with the Operational Areas, with the breeding period occurring from August to April (**Section 4.5.2**). Seabird surveys over the North West Shelf Province have noted that seabird distributions in tropical waters were generally patchy, except near islands (Dunlop *et al*., 1988). Given the Operational Areas lie offshore, with the closest island 75 km away and the GWA facility about 12 km away, seabirds are likely to only transit over the Operational Areas when travelling between emergent land and important foraging 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 (Department of Environment, 2015). 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 Areas. ***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 vessels. Similarly, any localised impacts to marine fish are not expected to impact on any commercial fishers in the area.
Summary of Potential Impacts to Environmental Value(s)
Light emissions from the project vessels will not result in an impact greater than localised and temporary disturbance to fauna in the vicinity of the Operational Areas, with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk 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. Replacement of 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, would result in considerable cost and time expenditure. Considerable logistical effort to source sufficient inventory of the range of light types onboard the MODU.	Given the potential impacts to turtles during this activity is insignificant, implementation of this control would not result in a reduction in consequence.	Grossly disproportionate. Implementation of the control requires considerable cost sacrifice for minimal environmental benefit. The cost/sacrifice outweighs the benefit gained.	No
Flaring restricted to a duration necessary to perform the activity for well bleed-off.	F: Yes. CS: Standard practice.	Eliminates unnecessary flared volumes and corresponding emissions.	Benefits outweigh the cost/sacrifice.	Yes 3.1
Vary the timing of the Petroleum Activities Program to avoid peak turtle internesting periods (December to January).	F: No. The Operational Areas have a minor overlap with the flatback turtle internesting BIA in an area not known to provide foraging habitat. Given the low potential for internesting turtles to be present within the Operational Areas, 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
Do not flare.	F: No. Flaring is the only feasible way to manage the reservoir fluids and achieve the well objectives. 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.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk 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, **Section 2.7.1**), Woodside considers the potential impacts from routine light emissions from the MODU and subsea 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 are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, routine light emissions from external lighting on the MODU and project vessels may result in localised behavioural disturbance to species within the Operational Areas, with no lasting effect (<1 month). BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice.

The adopted control is considered consistent with industry professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the impact to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 10 Flaring emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity to reduce impacts to the environment from light.	**C 10.1** Flaring will be limited to bleed-off requirements.	**PS 10.1** Flaring restricted to a duration necessary to achieve the well objectives.	**MC 10.1.1** Records demonstrate flaring was restricted to a duration necessary to achieve the well objectives.

7.7 Unplanned Activities (Accidents, Incidents, Emergency Situations) for Permanent Plugging Activities

7.7.1 Quantitative Spill Risk Assessment Methodology

Quantitative hydrocarbon spill modelling was performed by RPS APASA, on behalf of Woodside, using a three-dimensional (3D) hydrocarbon spill trajectory and weathering model, Spill Impact Mapping and Analysis Program (SIMAP), which is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

A stochastic modelling scheme was followed in this study, whereby SIMAP was applied to repeatedly simulate the defined credible spill scenarios using different samples of current and wind data. These data samples were selected randomly from a historic time-series of wind and current data representative of the Operational Area and EMBA. Results of the replicate simulations were then statistically analysed and mapped to define contours of probability of contact at identified thresholds around the hydrocarbon release point.

The model simulates surface and subsurface releases and uses the unique physical and chemical properties of a 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 floating hydrocarbons 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 floating hydrocarbons and exposure of organisms to entrained and dissolved aromatic hydrocarbons in the water column.

During each simulation, the SIMAP model records the location (by latitude, longitude and depth) of each of the particles (representing a given mass of hydrocarbons) on or in the water column, at regular time steps. For any particles that contact a shoreline, the model records the accumulation of hydrocarbon mass that arrives on each section of shoreline over time, less any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

The collective records from all simulations are then analysed by dividing the study region into a 3D grid. For surface or floating hydrocarbons, the sum of the mass in all hydrocarbon particles located within a grid cell, divided by the area of the cell, provides hydrocarbon concentration estimates in that grid cell at each model output time interval. For entrained and dissolved aromatic hydrocarbon particles, concentrations are calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell. The process is also subject to the application of spreading filters that represent the expected mass distribution of each distinct particle. The concentrations of hydrocarbons calculated for each grid cell, at each time step, are then analysed to determine whether concentration estimates exceed defined threshold concentrations.

All hydrocarbon spill modelling assessments undertaken by RPS APASA undergo initial sensitivity modelling to determine the 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. This assessment is done by post-processing the sensitivity test results and analysing time-series of median and maximum concentrations in the water and on the surface.

Hydrocarbon Characteristics

As part of the risk identification process, Woodside identified the range of credible hydrocarbon spill scenarios that may occur from the Petroleum Activities Program. These scenarios are considered in the risk assessments of accidental hydrocarbon spill scenarios (**Sections 7.7.2** to **7.7.4**).

The characteristics of the hydrocarbons, used as the basis for the modelling studies used to inform the assessment, are summarised in **Table 7-4**.

Table 7-4: Summary of hydrocarbon characteristics

Hydrocarbon Type	Scenarios	Location of release[14]	Initial Density (g/cm³)	Wax Content (% by Weight)	Asphaltene Content (% by weight)	Pour Point (°C)	Viscosity (cp)	Component boiling point percentage of total (°C)				Aromatic of whole product <380 °C BP
								Volatiles <180 °C	Semi-volatiles 180-264 °C	Low volatility 264-380 °C	Residual >380 °C	
								Non-persistent			Persistent	
Yodel-3 Condensate	Loss of well control	Surface (5 days) and Subsurface (72 days)	0.7605 @ 15.6 °C	~5 %	<0.1 %	<-36	0.5403 @ 20 °C	63.1	25.3	9.1	2.5	8.7
Marine diesel	Vessel collision resulting in fuel tank rupture	Surface	0.829 @ 25 °C	-	-	-	4.0	6	34.6	54.4	5	3

7.7.1.1 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 ecological thresholds could be exceeded by any of the simulations modelled is defined as the EMBA, which is driven by the worst-case credible hydrocarbon spill scenario, which in this instance is the loss of well control.

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 shoreline contact with hydrocarbons above threshold concentrations.

The EMBA covers a larger area than the area that is likely to be affected during any one 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. Given the EMBA comprises the results of many individual simulations, the total area covered at the thresholds has been smoothed to create a continuous boundary for the purpose of describing the environment within it. A conservative approach for defining thresholds for the EMBA was used by adopting the guideline impact thresholds (NOPSEMA 2019) for floating, entrained, dissolved and accumulated hydrocarbons for condensate spills. An additional threshold has been included to define the boundary within which socio-cultural

[14] Surface and seabed hydrocarbon characteristics adopted to account for pressure differential between water surface and the seabed.

impacts may occur, based on surface hydrocarbons (1 g/m^2) impacting on the visual amenity of the marine environment.

The threshold concentration for dissolved and entrained hydrocarbons for diesel spills has been established from Woodside-commissioned ecotoxicity tests on marine diesel oil (Ecotox Services Australia (ESA 2013)). The justification for the different thresholds for diesel is presented below. For floating and accumulated hydrocarbons, the conservative threshold for condensate has also been applied for diesel. These hydrocarbon thresholds for condensate and diesel are presented in **Table 7-5.**

Table 7-5: Summary of environmental impact thresholds applied to the quantitative hydrocarbon spill risk modelling results

Hydrocarbon Type	EMBA				Socio-cultural EMBA
	Surface Hydrocarbon (g/m^2)	Entrained hydrocarbon (ppb)	Dissolved aromatic hydrocarbon (ppb)	Accumulated hydrocarbons (g/m^2)	Surface Hydrocarbon (g/m^2)
Yodel-3 Condensate	10	100	50	100	1
Marine diesel	10	500	500	100	-

Dissolved Marine Diesel Hydrocarbon Threshold Concentration

The ecotoxicity tests were undertaken 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 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 C6 to C36. TPH concentration is representative of the sum of the hydrocarbons in each test solution for C6–C36. Typically, C4 to C10 compounds are volatile (boiling point (BP) < 180 °C), C11 to C15 compounds are semi-volatile (BP 180–265 °C), C16 to C20 compounds have low volatility (265–380 °C) and C21 compounds and above are residual (BP > 380 °C).

Table 7-6 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 (see footnote in **Table 7-6**).

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 7-6: 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[1]
Sea urchin larval development	72 hours	3500[1]
Milky oyster larval development	48 hours	3500[1]
Micro-algal growth test	72 hours	520
Macro-algal (kelp) germination test	72 hours	2530[1]
Rock oyster larval spat	48 hours	3500[1]
Amphipod juvenile survival	96 hours	520
Copepod juvenile survival	48 hours	2530[1]
Larval fish imbalance test	96 hours	2530[1]

[1] Lowest-observable-effect concentration (LOEC) was not reached during test.

Entrained Marine Diesel Hydrocarbon Threshold Concentration

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 7-6**). 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.

7.7.2 Accidental Hydrocarbon Release: Loss of Well Integrity

Context		
Plug and abandon activities – **Section 3.10** Project vessels – **Section 3.7**	Physical environment – **Section 4.4** Biological environment – **Section 4.5** Values and sensitivities –**Section 4.7** Socio-economic environment – **Section 4.6**	Stakeholder consultation – **Section 5**

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 (condensate) to marine environment due to loss of well integrity	X	X	X	X	X	X	B	B	1	M	LCS GP PJ RBA	Acceptable	EPO 11

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.

Likelihood Assessment

Woodside has a good history of implementing industry-standard practice in well design and construction. In the company's 65 year history, it has not experienced any well integrity events that have resulted in significant releases or significant environmental impacts.

The spill likelihood was evaluated using blowout and well release frequencies based on SINTEF offshore blowout database 2012 (Scandpower, 2013). This uses data from 1991 to 2010 to determine likelihood for well blowouts and releases. For permanent plugging of a gas well, the SINTEF calculated probability has been assessed as equivalent to a blowout during drilling completion (2.93×10^{-4}) or three times wireline operations (4×10^{-5}).

Table 7-7: SINTEF offshore blowout data

Operation	***Frequency, average well***	***Frequency, gas well***	***Frequency, oil well***
Development drilling, deep (normal wells)	2.24 E-05	1.33 E-05	3.34 E-05
Completion	1.85 E-04	2.83 E-04	8.72E-05
Total Per well	2.07 E-04	2.93 E-04	1.26 E-04
Per Wireline operation	8.71 E-06	1.33 E-05	4.11 E-06

The SINTEF data supports a likelihood of 'highly unlikely' for a well blowout with potential to result in the worst-case credible spill, as the dataset does not account for Woodside and Industry Process Safety Improvements post the Gulf of Mexico Macondo event and is therefore likely to be conservative. The SINTEF dataset is January 1991 to December

2010, while the Macondo blowout occurred in April 2010. Significant strengthening of barriers is now in place post the dataset period, including:

- revised and more stringent API 53 Subsea BOP requirements in force
- competency assessments of offshore personnel are now more stringent for both Woodside and drilling contractors; for example, through implementation of improvements to well control training as recommended by IOGP and requirements for Woodside personnel in safety-critical roles to complete the Process Safety Management training requirements
- revision to the Woodside barrier installation and verification process, including acceptance criteria and change control management.

When considering likelihood from an 'Experience' perspective, a ranking of 'Has occurred many times in the industry' is considered too high when assessing the worst credible condensate release. When considering likelihood of the environmental consequence of the blowout event, historic blowouts that have had catastrophic impact to the environment ('B' consequence rating) have not occurred many times in the industry. This also further supports the likelihood ranking of 'highly unlikely."

Credible Scenario

A number of Woodside procedures were followed to identify credible spill scenarios, including spill duration. For this scenario, the estimated time to drill a relief well is 77 days, assuming the maximum depth of the hydrocarbon reservoir would be open. The process followed is outlined in **Figure 7-1**.

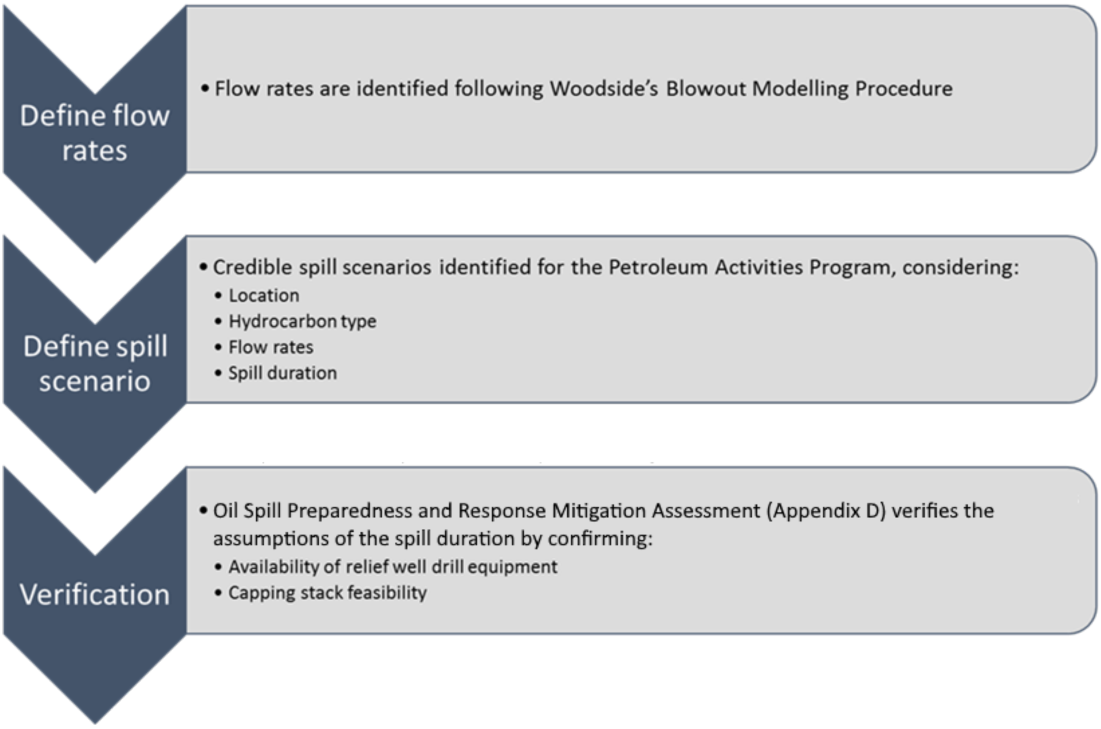

Figure 7-1:Credible hydrocarbon spill scenario identification process

Three wells (Yodel-3, Yodel-4 and Capella-1) will be permanently plugged during the Petroleum Activities Program in accordance with the *Woodside Well Barriers Procedure*. The Procedure requires all zones with flow potential penetrated by a well bore, containing hydrocarbons or over-pressured water, to be isolated from the surface environment by a minimum of two permanent barriers (e.g. cement). A loss of well control could result in a loss of containment at any of these three wells. The location of the Yodel-3 production well was chosen as the release site in the modelling, given this is a representative location resulting in the worst-case flow rates in terms of volume and EMBA compared to the Yodel-4 and Capella-1 wells.

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 72 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 because:

- 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 after the loss of well control in the Gulf of Mexico in April 2010.

The 77 day release duration considers the estimated time to drill a relief well under the Mutual Aid Memorandum of Understanding (MoU).

Woodside determined that the worst case credible release for a well blowout associated with the Petroleum Activities Program is 348,134 m³, based on well design of Yodel-3 well.

It is noted that the integrity of the well bores is not affected by the wellheads remaining in-situ. If the wellheads were to be damaged after completing the plugging for permanent abandonment operations, it is not credible for the reservoir to release hydrocarbons, as the wells will be permanently plugged in accordance with the Woodside Well Barrier Standard.

For each EP well loss of integrity scenario, Woodside assesses whether the standard 77-day release usually modelled is most appropriate, based on the timeframes of:

- mobilisation of relief MODU: 21 days.
- relief well drill time: 42 days.
- intersect and kill: 14 days.

For this scenario, the estimated time to drill a relief well is about 35.6 days, resulting in a total timeframe to kill the well of 70.6 days (**Table 7-8**). To provide added conservatism, the standard 77 days was used for modelling the worst-case scenario.

Table 7-8: Relief well drill times

Phase	Description	Time for completion (days)
Mobilisation	Sourcing a MODU through APPEA MoU and mobilisation	21
Drill relief well	Mooring and spread installation Drilling, casing and look ahead estimate	15.6 20 to 25
Intersect and kill	Relief well intersects uncontrolled well, kills well, ceasing release of hydrocarbons	14
	Total days	**70.6 to 75.6 days**

Quantitative Spill Risk Assessment

Spill modelling was performed by RPS, on behalf of Woodside, to determine the fate of hydrocarbon released for the 77 day blowout scenario at the Yodel-3 well location, based on the assumptions in **Table 7-9**.

Table 7-9: Summary of modelled credible scenario – well blowout

Scenario Description	Results
Maximum continuous liquid hydrocarbon release rate and duration	**Echo-Yodel Decommissioning loss of well control (WCCS)** Hydrocarbon release caused by loss of well control: • Total: 348,134 m³ over 77 days • Subsurface: 26,471 m³ over five days • Seabed: 321,663 m³ over 72 days.

Hydrocarbon Characteristics

Yodel-3 condensate was selected as the representative hydrocarbon for wells proposed under this EP and is described in **Section 7.7.1**. Characteristics of the Yodel-3 condensate based on whether it is a surface or subsea release are described below.

Evaporation rates will increase with temperature, but in general about 63.1% of the Yodel-3 condensate (surface) mass has the capacity to evaporate within the first 12 hours (BP <180 °C); a further 25.3% should evaporate within the first 24 hours (180 °C < BP <265 °C); and a further 9.1% should evaporate over several days (265 °C < BP <380 °C).

A series of model weathering tests were conducted to illustrate the potential behaviour of Yodel-3 condensate (surface and subsea) when exposed to idealised calm constant wind conditions and more representative variable wind conditions.

The results for the constant-wind case (**Figure 7-2**) indicate that Yodel-3 condensate will have a tendency to evaporate fairly rapidly, with 88% of the spilled volume predicted to evaporate and about 10% remaining on the water surface after the first 24 hours under light winds. Negligible levels of entrapment and dissolution are expected under these light wind conditions.

Under the more realistic variable-wind case (**Figure 7-3**), where the winds are of greater strength, a higher percentage of a slightly reduced evaporation rate is predicted in the first 24 hours. Increased entrainment and dissolution rates are predicted in this case, with a corresponding decrease in the floating oil proportion to negligible levels. The variable-wind case also indicates that, once entrained, the oil tends to remain in the water column and may not resurface even during calm wind periods.

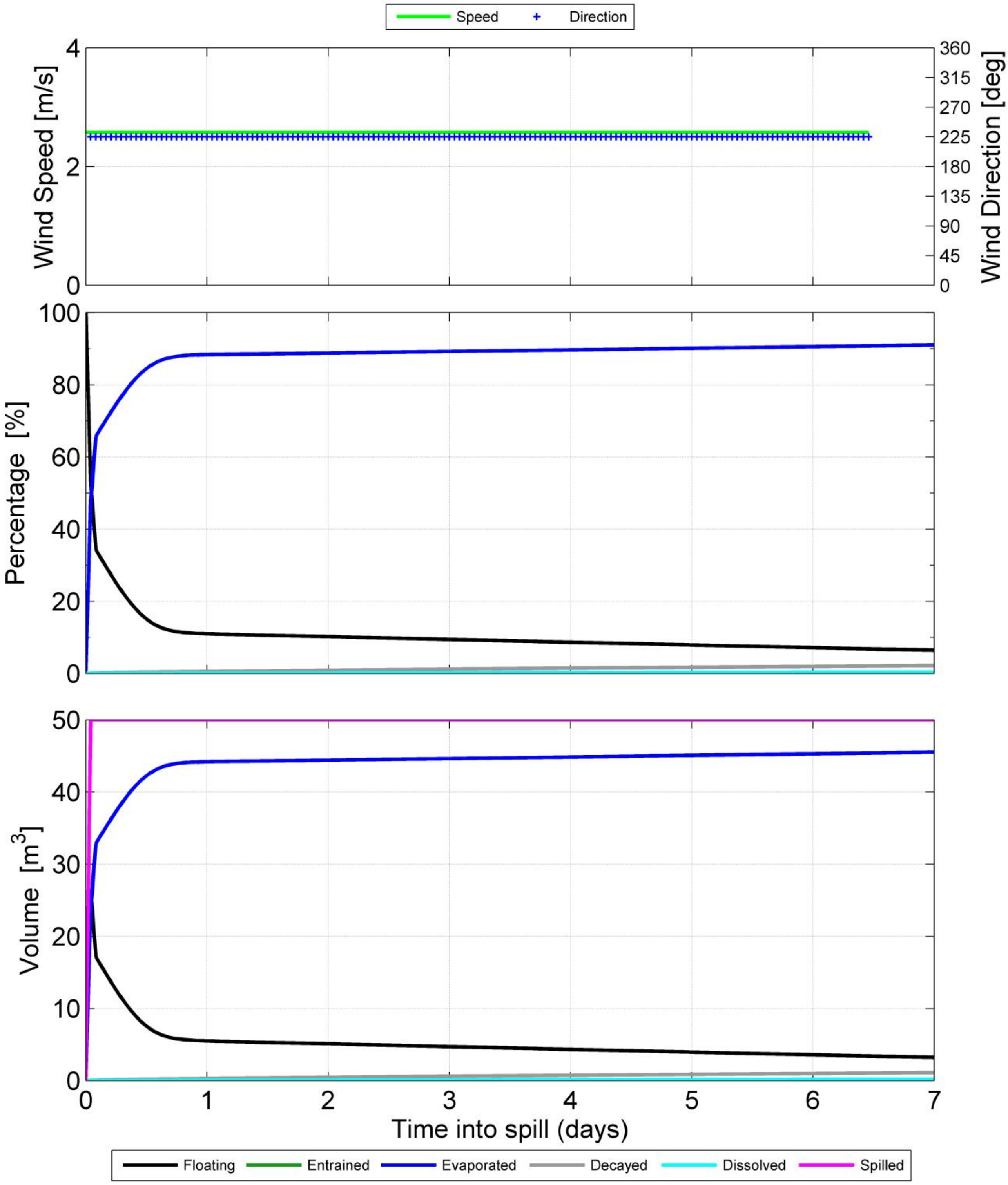

Figure 7-2: Time series wind speed and percentage mass balance plots for the weathering of Yodel-3 condensate spilled onto the water surface as a one-off release (50 m³ over 1 hour) and subject to constant 5 knots (2.6 m/s) wind (top panel) at 27 °C water temperature and 25 °C air temperature.

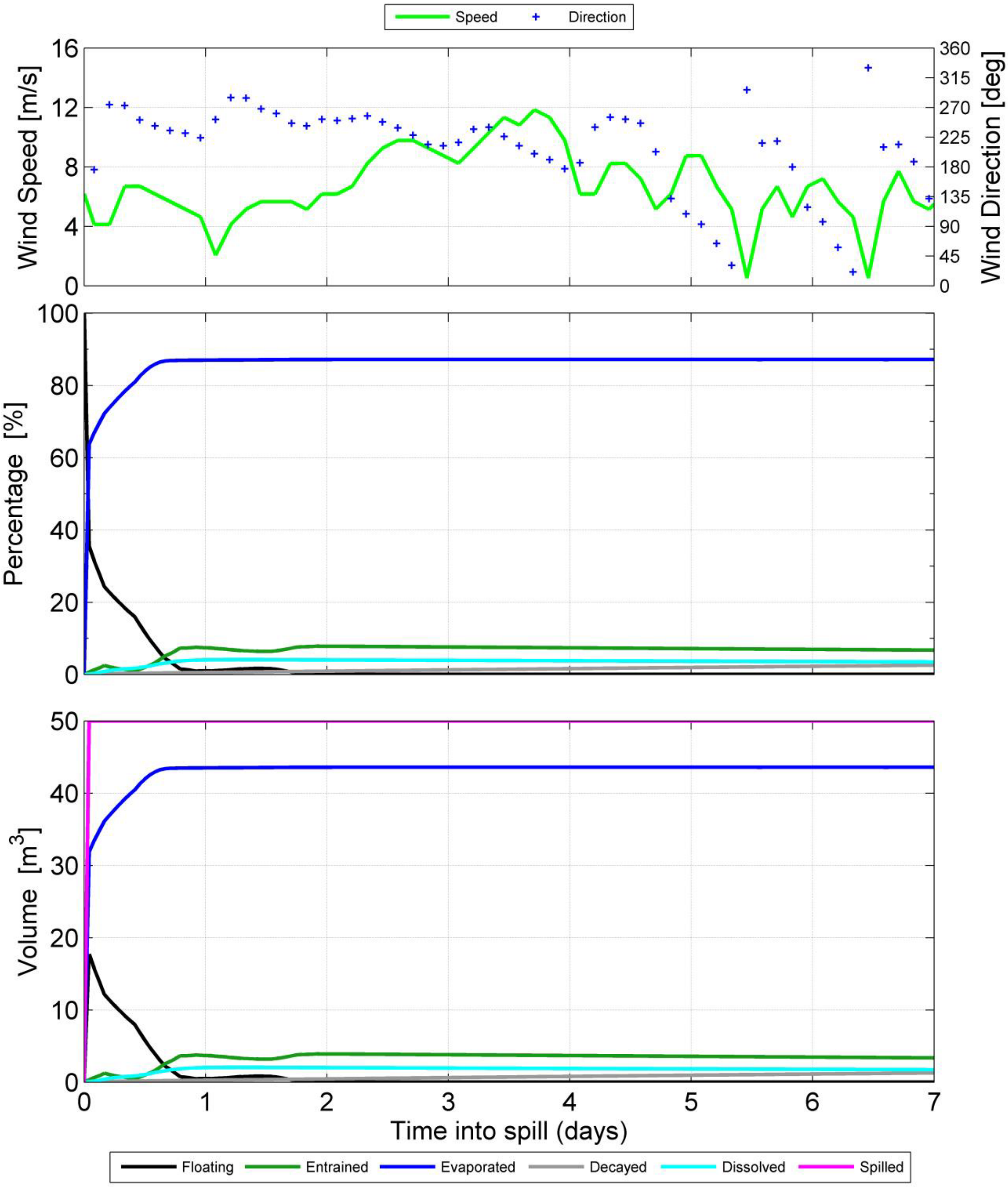

Figure 7-3: Time series wind speed and percentage mass balance plots for the weathering of Yodel-3 condensate spilled onto the water surface as a one-off release (50 m³ over one hour) and subject to variable winds (top panel) at 27 °C water temperature and 25 °C air temperature

<u>Subsea Plume Dynamics</u>

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.

Modelling results predict the discharge would generate a cone of rising gas that would entrain oil 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 about 24 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 about 8.4 m.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate very small oil droplets (1 to 7 µm) that will have very low-rise velocities (less than 0.001 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 to 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, most 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.

Impact Assessment

Potential Consequence 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 spills under a variety of weather and metocean conditions. The EMBA therefore covers a larger area than the area that would be affected during any one 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

Modelling of floating oil indicates that concentrations equal to or greater than the 10 g/m² threshold are predicted at Rankin Bank (53% probability, potentially arriving eight hours after spill commencement) and the Montebello AMP (1% probability, potentially arriving 177 hours after spill commencement). Rankin Bank is a submerged feature. Contact by floating oil at the threshold concentration is unlikely (less than 1% probability) for any other receptors.

Entrained Hydrocarbons ppb

Entrained oil at concentrations equal to or greater than the 100 ppb threshold is predicted to reach 39 receptors as detailed in **Table 7-10.** Contact by entrained oil at this threshold concentration is unlikely (<1% probability) for any other receptors.

Dissolved Hydrocarbons

Entrained oil at concentrations equal to or greater than the 50 ppb threshold is predicted to reach 22 receptors (**Table 7-10**). Contact by dissolved oil at this threshold concentration is unlikely (less than 1% probability) for any other receptors.

Accumulated Hydrocarbons

Modelling shows that there is no predicted shoreline accumulation at the impact threshold (100 g/m²).

Summary of Potential Impacts

Table 7-10 presents the full extent of the EMBA; i.e. the sensitive receptors and their locations that may be exposed to condensate (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the highly 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 condensate release as a result of a loss of well integrity during the Petroleum Activities Program are presented in the next sections.

Table 7-10: Environment that May Be Affected – Key receptor locations and sensitivities with the summary hydrocarbon spill contact for a subsea blowout of crude and condensate

Environmental setting	Location/ name	Environmental, Social, Cultural, Heritage and Economic aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (>1% probability) (Condensate)				
		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 deep-water 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 and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²) (% probability of contact at threshold)	Surface hydrocarbon (1 to 10 g/m²) (% probability of contact at threshold)	Entrained hydrocarbon (≥100 ppb) (% probability of contact at threshold)	Dissolved aromatic hydrocarbon (≥50 ppb) (% probability of contact at threshold)	Accumulated hydrocarbons (>100 g/m²)
Offshore[15]	Commonwealth waters	✓	✓					✓		✓					✓	✓				✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓	N/A
	Ningaloo AMP	✓						✓		✓					✓	✓			✓		✓	✓	✓	✓	✓	✓		✓	✓		-	-	93	49	N/A
	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓*		13	1	80	100	N/A
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	-	-	92	51	N/A
	Argo-Rowley Terrace AMP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓		-	-	21	3	N/A
	Shark Bay AMP	✓	✓					✓							✓	✓			✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	20	1	N/A
	Carnarvon Canyon AMP	✓	✓					✓		✓														✓	✓	✓			✓		-	-	10	1	N/A
	Dampier AMP	✓	✓					✓		✓					✓	✓			✓	✓		✓	✓	✓	✓	✓			✓		-	-	22	2	N/A
	Abrolhos Islands AMP	✓	✓					✓							✓	✓		✓		✓		✓	✓	✓	✓	✓			✓		-	-	23	1	N/A
	Jurien AMP	✓	✓		✓		✓				✓				✓			✓				✓	✓	✓	✓	✓		✓	✓		-	-	8	-	N/A
	Perth Canyon AMP	✓						✓							✓	✓							✓	✓	✓				✓		-	-	3	-	N/A
	South West Corner AMP	✓						✓		✓					✓	✓						✓	✓	✓	✓			✓	✓		-	-	2	-	N/A

[15] 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 (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (>1% probability) (Condensate)				
		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 deep-water 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 and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²) (% probability of contact at threshold)	Surface hydrocarbon (1 to 10 g/m²) (% probability of contact at threshold)	Entrained hydrocarbon (≥100 ppb) (% probability of contact at threshold)	Dissolved aromatic hydrocarbon (≥50 ppb) (% probability of contact at threshold)	Accumulated hydrocarbons (>100 g/m²)
	Two Rocks AMP	✓	✓					✓							✓	✓							✓	✓	✓						-	-	5	-	N/A
Sub-merged Shoals	Glomar Shoal	✓	✓				✓			✓												✓		✓	✓	✓					1	-	58	22	N/A
Sub-merged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			61	53	100	100	N/A
Islands and mainland (nearshore waters)	Barrow Island	✓	✓	✓	✓		✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	-	-	85	42	-
Islands and mainland (nearshore waters)	Dampier Archipelago	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	35	2	-
Islands and mainland (nearshore waters)	Muiron Islands MMA-WHA	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		-	-	81	23	-
Islands and mainland (nearshore waters)	Muiron Islands	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		-	-	76	13	-
Islands and mainland (nearshore waters)	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		-	-	93	49	-
Islands and mainland (nearshore waters)	Pilbara – Middle Pilbara – Islands and Shoreline	✓	✓		✓	✓				✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		-	-	5	-	-
Islands and mainland (nearshore waters)	Pilbara – Northern Pilbara – Islands and Shoreline	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	36	3	-

Environmental setting	Location/ name	Environmental, Social, Cultural, Heritage and Economic aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (>1% probability) (Condensate)				
		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 deep-water 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 and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥10 g/m²) (% probability of contact at threshold)	Surface hydrocarbon (1 to 10 g/m²) (% probability of contact at threshold)	Entrained hydrocarbon (≥100 ppb) (% probability of contact at threshold)	Dissolved aromatic hydrocarbon (≥50 ppb) (% probability of contact at threshold)	Accumulated hydrocarbons (>100 g/m²)
	Pilbara Islands – Southern Island Group	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	85	-	-
	Pilbara – Southern Pilbara – Shoreline	✓	✓		✓	✓					✓	✓		✓		✓			✓	✓		✓	✓		✓	✓		✓	✓		-	-	8	35	-
	Shark Bay Open Ocean Coast	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	40	3	-
	Shark Bay WHA	✓	✓	✓	✓	✓	✓					✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		-	-	40	3	-
	Abrolhos Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	16	-	-
	Bernier and Dorre Islands	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓			✓	✓		✓	✓	✓	✓	✓		✓	✓		-	-	41	4	-
	Exmouth Gulf West	✓	✓		✓		✓					✓			✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓			-	-	24	-	-
	Lowendal Islands	✓	✓	✓	✓		✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		-	-	75	4	-
	Montebello Islands including State Marine Park	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		-	-	81	48	-
	Northern Coast	✓	✓		✓	✓					✓	✓		✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		-	-	2	-	-
	South West Coast – Ngari	✓						✓		✓					✓	✓						✓	✓	✓	✓			✓	✓		-	-	1	-	-

Environmental setting	Location/ name	Environmental, Social, Cultural, Heritage and Economic aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (>1% probability) (Condensate)				
		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 deep-water 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 and Gas Infrastructure (topside and subsea)*	*Surface hydrocarbon (≥10 g/m²) (% probability of contact at threshold)*	*Surface hydrocarbon (1 to 10 g/m²) (% probability of contact at threshold)*	*Entrained hydrocarbon (≥100 ppb) (% probability of contact at threshold)*	*Dissolved aromatic hydrocarbon (≥50 ppb) (% probability of contact at threshold)*	*Accumulated hydrocarbons (>100 g/m²)*
	Capes Marine Park																																		
Oceanic Reefs and offshore islands	Rowley Shoals – Clerke Reef State MP	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓					-	-	5	-	-
	Rowley Shoals – Imperieuse Reef State MP	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓					-	-	8	-	-
	Rowley Shoals – Mermaid Reef MP	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓					-	-	2	-	-
	Rowley Shoals – Clerke Reef, Imperieuse Reef and Mermaid Reef	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓					-	-	2 to 8	-	-

Summary of Potential Impacts to Environmental Value(s)	
Summary of Potential Impacts to Protected Species	
Setting	***Receptor Group***
Offshore, Oceanic Reefs and Islands	***Cetaceans*** Cetaceans 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 (Deepwater Horizon 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 (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). In a review of cetacean observations in relation to large-scale hydrocarbon spills, it was concluded that exposure to oil from the *Deepwater Horizon* resulted in increased mortality to cetaceans in the Gulf of Mexico (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016), and long-term population level impacts to killer whales have been linked to the *Exxon Valdez* tanker spill (Matkin *et al*., 2008). Geraci (1988) also identified behavioural disturbance (i.e. avoiding spilled hydrocarbons) observed in some instances for several species of cetacean, which suggests cetaceans can 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 *Deepwater Horizon* spill, cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias *et al*., 2017). A range of cetaceans were identified as potentially occurring within the Operational Areas and EMBA. In the event of a loss of well containment, surface, entrained and dissolved hydrocarbons exceeding environmental impact threshold concentrations may drift across habitat for oceanic cetacean species and the migratory routes and BIAs of cetaceans considered to be MNES, including humpback whales, blue whales, pygmy blue whales, southern right whales and sperm whales. The BIAs for all of these species overlap the EMBA. Cetacean populations that are resident within the 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 additional information). Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins (e.g. dusky dolphin and Indo-Pacific humpback dolphin) is broadly distributed throughout the region, and as such, impacts are unlikely to affect an entire population. Other species identified in **Section 3** may also have possible transient interactions with the EMBA. Physical contact of these species to hydrocarbons is likely to have biological consequences; however, it is unlikely to affect an entire population and not predicted to impact the overall population viability. Given the nature of the hydrocarbon, it is expected to weather rapidly and remain entrained in the water column; cetaceans that may interact with spilled hydrocarbons are most likely to be subject to physical impacts. As cetaceans maintain thick skin and blubber, external exposure to hydrocarbons may result in irritation to skin and eyes. Entrained hydrocarbons may also be ingested, particularly by baleen whales which feed by filtering large volumes of water. Fresh hydrocarbons (i.e. typically in the vicinity of the release location) may have a higher potential to cause toxic effects when ingested, while weathered hydrocarbons are considered to be less likely to result in toxic effects. A major spill any time throughout the year would coincide with one or more protected cetacean migration seasons. Baleen whales are most likely to be significantly impacted by toxic effects when feeding. Although there is a possible foraging BIA for the pygmy blue whale within the EMBA (off the coast of the North West Cape/Ningaloo Coast and off the coast of Perth), feeding during migrations is low level and opportunistic, with most feeding for both species in the Southern Ocean. Therefore, the risk of ingestion of hydrocarbons is low. Migrations of both pygmy blue whales and humpback whales are intermittent 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 containment is unlikely to affect an entire population. The humpback whale resting area in Exmouth Gulf and the calving area in Camden Sound are not predicted to be contacted by surface, entrained or dissolved hydrocarbons above threshold concentrations. A loss of well containment resulting in a well blowout could result in a disruption to a significant portion of the humpback or pygmy blue whale populations, if the event occurred during the seasonal migration periods during which these species are present in the EMBA. 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. However, such disruptions or impacts are not predicted to impact on the overall population viability.

	Marine Turtles Adult sea turtles exhibit no avoidance behaviour when they encounter hydrocarbon spills (NOAA, 2010). Contact with entrained (or floating) hydrocarbon can result in hydrocarbon adherence to body surfaces (Gagnon and Rawson, 2010), causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection (NOAA, 2019). Given the modelling results indicated concentrations of floating hydrocarbons are not expected to exceed impact thresholds except immediately surrounding the offshore waters around the well, the potential for contact with this hydrocarbon phase is very low. Oiling can also irritate and injure skin which is most evident on pliable areas such as the neck and flippers (Lutcavage *et al*., 1995). 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). 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 vapour which is the most toxic component of the hydrocarbon spill (Milton and 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 adherence to body surfaces (Gagnon and Rawson, 2010), causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection (Gagnon and Rawson, 2010). Given the hydrocarbon is expected to weather rapidly when released to the environment, relatively fresh entrained hydrocarbons (which are typically relatively close to the release location) are considered to have the greatest potential for impact. Marine turtles may be present foraging, nesting, mating and migrating within the EMBA, and the EMBA would overlap a number of BIAs and Habitat Critical for the Survival of the Species as identified in **Section 4.5.2**. The Petroleum Activities Program will also coincide with nesting season for various marine turtle species within the EMBA. In the event of a loss of well containment, there is potential that surface, entrained and dissolved hydrocarbons exceeding environmental impact threshold concentrations will be present in offshore waters. Therefore, a hydrocarbon spill may disrupt a portion of the population, but is unlikely to reduce overall population viability.
	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, resulting in damage to their respiratory system. Given modelling indicated floating hydrocarbons are not expected to exceed impact thresholds, the potential for seasnakes to be exposed to floating hydrocarbons is considered to be very low. In general, seasnakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals. It is acknowledged that seasnakes may be present in the EMBA, particularly in waters less than 100 m deep including near submerged shoals; however, their abundance is not expected to be high in the deep water and offshore environment. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population, but there is not considered to be a threat to overall population viability.
	Sharks and Rays Hydrocarbon contact may affect whale sharks through ingestion (entrained/dissolved hydrocarbons), particularly if feeding. Whale sharks may transit offshore open waters when migrating to and from Ningaloo Reef, where they aggregate for feeding from March to July. A whale shark foraging BIA and a high-density prey foraging BIA overlap the EMBA. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman and 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 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). 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, although there is a BIA for great white sharks within the EMBA, any impact on sharks and rays is predicted to be minor and localised.

	Seabirds and Migratory Shorebirds Seabirds and migratory birds are particularly vulnerable to contact with floating hydrocarbons, which may mat feathers. This may lead to hypothermia from loss of insulation and ingestion of hydrocarbons when preening to remove hydrocarbons; both impacts may result in mortality (Hassan and Javed, 2011). The credible loss of well containment scenario results in highly localised floating hydrocarbons above impact thresholds only around the release location. Hence, considering the distance to any emergent features, the potential for seabird exposure to floating hydrocarbons is considered to be low. Migratory shorebirds are unlikely to interact with spilled hydrocarbons as there would be no accumulation on shorelines above impact thresholds. Offshore waters are potential foraging grounds for seabirds associated with the coastal roosting and nesting habitat, which includes the numerous islands along the WA coast. There are numerous BIAs for seabirds and migratory shorebirds that overlap with the EMBA, as provided in **Section 3**. However, given the relatively low likelihood of encounters between seabirds and floating hydrocarbons, impacts to seabirds in offshore waters are expected to consist of ecosystem-scale effects, such as reduced prey abundance. Impacts from a loss of well containment to prey such as small pelagic fish (prey for the birds) are not expected to be significant; hence, subsequent impacts to a significant portion of seabirds are not expected. A hydrocarbon spill is unlikely to result in the disruption of a significant portion of the foraging habitat for seabirds.
Submerged Shoals	***Marine Turtles*** There is the potential for marine turtles to be present at submerged shoals such as Rankin Bank and Glomar Shoal. These shoals may be contacted by dissolved and entrained hydrocarbons above impact thresholds. However, it is noted that entrained hydrocarbons reaching these shoals will be highly weathered, with the volatile and water soluble (often the most toxic) components expected to have dissipated (minimum time to contact with entrained hydrocarbons is predicted to be three days for Rankin Bank). These shoals and banks may, at times, be a foraging habitat for marine turtles, given the coral and filter-feeding biota associated with these areas. However, these areas are not known foraging locations and satellite tracking of individual green turtles in the nearshore environment of the NWS did not indicate any overlap of the tracked post-nesting migratory routes and the Operational Areas. It is, however, acknowledged that individual marine turtles may be present at these shoals and surrounding areas. However, given the predicted minimum time to contact and the volatile and non-persistent nature of the hydrocarbons, a hydrocarbon spill is expected to result in sub-lethal effects with a minor disruption to a portion of the population (see Offshore section above). There is the potential for marine turtles to be present within the shallower waters of the EMBA for entrained hydrocarbons (**Section 3**). The potential impacts of exposure are as discussed previously in Offshore – Marine Turtles.
	Seasnakes There is the potential for seasnakes to be present at submerged shoals such as Rankin Bank and Glomar Shoal, and within the shallower waters of the EMBA for entrained hydrocarbons. 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 but there is no threat to overall population viability.
	Sharks and Rays There is the potential for resident shark and ray populations to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. Spill model results indicate potential impacts to shallow waters of the EMBA. Sharks and rays present at these reefs may be exposed to fresh, unweathered hydrocarbons, which may have greater potential for toxic impacts. Any direct impacts are expected to be sub-lethal; however, no impacts at the population level. Pelagic 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. It is expected that there will be no impacts at the population level.

Mainland and Islands (Nearshore Waters)	***Cetaceans, Pinnipeds and Dugongs*** In addition to a number of whale species that may occur in nearshore waters (such as spotted bottlenose dolphins, Indo-Pacific humpback dolphins and snubfin dolphins), coastal populations of small cetaceans, pinnipeds and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal islands, Pilbara Southern and Northern Island Groups, Dampier Archipelago, Shark Bay and other areas along the WA coast, which may be potentially impacted by entrained and dissolved hydrocarbons exceeding threshold concentrations in the event of a loss of well containment. BIAs for dugong, pinnipeds and cetaceans that overlap with the EMBA are outlined in **Section 4.5.2.3**. The potential impacts of exposure are as discussed previously in Offshore – Cetaceans. However, nearshore populations of cetaceans, pinnipeds and dugongs are known to exhibit site fidelity and are often resident populations. Therefore, avoidance behaviour may have greater impacts to population functioning. Nearshore dolphin species (e.g. spotted bottlenose dolphins) may exhibit higher site fidelity than oceanic species, although Geraci (1988) observed relatively little impacts beyond behavioural disturbance. Additional potential environment impacts may also include the potential for dugongs to ingest hydrocarbons when feeding on oiled seagrass stands or indirect impacts to dugongs due to loss of this food source from dieback in worse-affected areas. The presence of the Australian sea lion foraging BIA within the EMBA also introduces potential for them to be impacted through ingesting oil residue. However, with no shoreline accumulation expected, it is likely that impacts to the Australian sea lion would be limited. Therefore, a hydrocarbon spill may impact feeding habitats and result in a disruption to a significant portion of the local population, but it is not predicted to result in impacts on overall population viability of either dugongs or coastal cetaceans.
Summary of Potential Impacts to Other Species	
Setting	***Receptor Group***
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 able to eliminate 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) have occurred in sheltered bays. Laboratory studies have shown that adult fish can 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 juvenile and adult fish can avoid 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 containment indicates the potential EMBA for dissolved hydrocarbons is extensive, no time-integrated exposure metrics were modelled; given the oceanographic environment within the wider 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 and 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 and Heck, 2011). More subtle, chronic effects on the life history of fish as a result of exposure of 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 a number of KEFs and AMPs within the EMBA including, but not limited to, the Continental Slope Demersal Fish Communities KEF, Ancient Coastline at 125 m Depth Contour KEF, the Montebello AMP and the Abrolhos AMP which provide habitat for demersal fish species. Coral reefs throughout the EMBA such as Rankin Bank (about 12 km from the Operational Areas) also host a diverse demersal fish assemblage. Fish associated with these features may be exposed to dissolved and entrained 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***
Oceanic Reef and Offshore Islands	The waters overlying oceanic reefs along the WA coast, within the EMBA, such as Rankin Bank, Glomar Shoal and Ningaloo Reef, have the potential to be exposed to entrained and dissolved hydrocarbons above threshold concentrations. These permanently submerged habitats represent sensitive open water benthic community receptors, extending from deep depths to relatively shallow water. For some of the deeper reefs, such as Rankin Bank and Glomar Shoal, 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, particularly in shallower systems. ***Filter Feeders*** Hydrocarbon exposure to offshore filter-feeding communities (e.g. communities within the Montebello AMP where depths range between 15 m and 150 m) may occur depending on the depth of the entrained/dissolved hydrocarbons. Exposure to entrained hydrocarbons/dissolved aromatic hydrocarbons (≥100 ppb and 50 ppb respectively) 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). Any impacts may result in localised long-term effects to community structure and habitat.
Mainland and Islands (Nearshore Waters)	***Seagrass Beds/Macroalgae and Mangroves*** Spill modelling has predicted entrained hydrocarbons more than or equal to 100 ppb and dissolved aromatic hydrocarbons more than or equal to 50 ppb, 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 community 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. Entrained/dissolved hydrocarbon impacts may include sub-lethal stress and mortality to certain sensitive biota in these habitats, including infauna and epifauna. Larval and juvenile fish, and invertebrates that depend on these shallow subtidal and intertidal habitats as nursery areas, may be directly impacted due to the loss of habitats and/or lethal and sub-lethal in-water toxic effects. This may result in mortality or impairment of growth, survival and reproduction (Heintz *et al*., 2000). In addition, there is the potential for secondary impacts on shorebirds, fish, sea turtles, rays and crustaceans that use these intertidal habitat areas for breeding, feeding and nursery habitat purposes. Mangrove habitat and associated mud flats and salt marsh at areas such as the Ningaloo Coast (small habitat areas), the Pilbara islands and the Montebello Islands have the potential to be exposed (see **Table 7-10** for the full list of receptors). Hydrocarbons coating prop roots of mangroves can occur from surface hydrocarbons when hydrocarbons are deposited on the aerial roots. Hydrocarbons deposited on the aerial roots can block the pores used to breathe or interfere with the trees' salt balance, resulting in sub-lethal and potentially lethal effects. Mangroves can also be impacted by entrained/dissolved aromatic hydrocarbons that may adhere to the sediment particles. In low energy environments, such as in mangroves, deposited sediment-bound hydrocarbons are unlikely to be removed naturally by wave action and may be deposited in layers by successive tides (National Oceanic and Atmospheric Administration, 2014). At wave-sheltered or wave-exposed shorelines, the potential for chronic sub-lethal toxicity impacts beyond immediate physical and acute effects (which may delay recovery in an affected area), may be reduced as the condensate comprises a low proportion (5.9%) of persistent residual fractions (BP > 380 °C).

	Depending on the trajectory of the entrained and dissolved hydrocarbon plume, macroalgal/seagrass communities including at the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), Muiron Islands (associated with limestone pavements), Montebello/Barrow/Lowendal islands, Dampier Archipelago, the Pilbara Southern and Northern Islands Groups (documented as low and patchy cover) and Shark Bay may be exposed (refer to **Table 7-10** for a list of identified seagrass/macroalgae receptors). Seagrass and macroalgal beds occurring in the intertidal and subtidal zone may be susceptible to impacts from entrained/dissolved 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/dissolved 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.
Summary of Potential Impacts to Other Habitats and Communities	
Setting	***Receptor Group***
Offshore	***Benthic Fauna Communities*** In the event of a loss of well containment at the seabed, the stochastic spill model predicted hydrocarbons droplets would be entrained in a gas plume, transporting them to the water column and sea surface. As a result, the low-sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) within the EMBA are not expected to be exposed to released hydrocarbons. However, areas of the EMBA with hard substrate may be impacted. 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 (supported by sporadic upwelling events in the offshore waters of the North West Shelf) 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, such as crustaceans (e.g. copepods), and the eggs and larvae of fish and invertebrates (meroplankton). Exposure to hydrocarbons in the water column can result in changes in 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 toxicity, 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 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). The EMBA contains a number of areas where upwelling is observed and where plankton may be in higher numbers. These include the Perth Canyon KEF and the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF. Therefore, impacts on exposed planktonic communities present in the EMBA are likely to be short-term.
Islands and Mainland (Nearshore Waters)	***Open Water – Productivity/Upwelling*** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Montebello/Barrow/Lowendal Islands Group) 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, manta rays and pygmy blue whale foraging 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 condensate. However, recovery would occur (see offshore description above). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and short-term.

	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 hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters, including the Ningaloo Coast, Exmouth Gulf, Montebello/Barrow/Lowendal Islands Group, Pilbara Southern and Northern Islands Groups, Muiron Islands, Dampier Archipelago, Shark Bay and the Abrolhos Islands. This, and the potential for possible exposure to dissolved aromatic hydrocarbons over a more limited area, have 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. Although there is the potential for spawning/nursery habitat to be impacted (e.g. mangroves and seagrass beds, discussed above), losses of fish larvae in worst 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 Deepwater Horizon spill. Results indicated that there was no change to the juvenile cohorts after the Deepwater Horizon spill. Nor were there any significant post-spill shifts in community composition and structure, or changes in biodiversity measures (Fodrie and 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.
Key Ecological Features	***KEFs*** KEFs potentially impacted by the hydrocarbon spill above impact thresholds from a loss of well containment event are: • Continental Slope Demersal Fish Communities (25 km from the Operational Areas) • Glomar Shoal (55 km from the Operational Areas) • Exmouth Plateau (145 km from the Operational Areas) • Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula (221 km from the Operational Areas) • Commonwealth waters adjacent to Ningaloo Reef (268 km from the Operational Areas) • Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (362 km from the Operational Areas) • Western Demersal Slope and Associated Fish Communities of the Central Western Province (745 km from the Operational Areas) • Wallaby Saddle (791 km from the Operational Areas) • Albany Canyons group and adjacent shelf break (more than 1000 km from the Operational Areas) • Western Rock Lobster (901 km from the Operational Areas) • Perth Canyon and adjacent shelf break (965 km from the Operational Areas) • Ancient coastline at 90 to 120 m depth (918 km from the Operational Areas) • Cape Mentelle upwelling (more than 1000 km from the Operational Areas) • Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break) (951 km from the Operational Areas) • Commonwealth marine environment within and adjacent to the west-coast inshore lagoons (940 km from the Operational Areas). 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 containment may impact the values of the KEFs affected (for the values of each KEF, see **Section 4.7.2**). Potential impacts include the contamination of sediments, impacts to benthic fauna/habitats and 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 entrained and dissolved hydrocarbon fates and their predicted extent. Furthermore, water quality is predicted to have 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 the Montebello AMP (Tryal Rocks), Gascoyne AMP, Rankin Bank and Glomar Shoal, which have the potential to be exposed to entrained hydrocarbons at or greater than 100 ppb and/or dissolved hydrocarbons at greater than 50 ppb. Entrained hydrocarbons reaching Rankin Bank will be highly weathered, with the volatile and water soluble (often the most toxic) components expected to have dissipated (minimum time to contact with entrained hydrocarbons is predicted to be three days). The waters surrounding these submerged habitats would 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 be affected/reduced due to hydrocarbon contamination, with modelling predictions indicating that hydrocarbon contact is at or above biological effect concentrations for entrained and dissolved hydrocarbons in nearshore waters of identified islands and the mainland coast (refer to **Table 7-10**). 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 long to medium term.
Submerged Shoals	***Marine Sediment Quality*** There is potential for the reduction of marine sediment quality due to contact and adherence of entrained hydrocarbons with seabed sediments of submerged shoals (Tryal Rocks of the Montebello AMP, Gascoyne AMP and Rankin Bank). If this was to occur, 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 long to medium term. However, given the nature of the hydrocarbon, contact with submerged shoals is considered unlikely.
Mainland and Islands (Nearshore Waters)	***Marine Sediment Quality*** Entrained hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines (refer to **Table 7-10**). Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat.
Summary of Potential Impacts to Air Quality	
A hydrocarbon release during a loss of well containment event has the potential to result in localised, temporary reduction in air quality. 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 human health effects on workers in the immediate vicinity of atmospheric emissions. The ambient concentrations of methane and volatile organic carbons released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments as they are 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 photochemically-produced hydroxyl radicals.	

<table>
<tr><td colspan="2">Due to the unlikely occurrence of a loss of well containment, the temporary nature of any methane or VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons from a loss of well containment), the predicted behaviour and fate of methane and VOCs in open offshore environments, and the significant distance from the Operational Areas to the nearest shore (50 km from Montebello Islands), the potential impacts are expected to be minor and temporary.</td></tr>
<tr><th colspan="2">Summary of Potential Impacts to Protected Areas</th></tr>
<tr><td colspan="2">The quantitative spill risk assessment results indicate that the open water environment protected within the EMBA may be affected by the released hydrocarbons. 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. Conservation values for the AMPs and other nearby State marine parks and reserves located within the EMBA are provided in Section 4.
Impact on the protected areas is discussed in the sections above for the ecological values and sensitivities and below for socio-economic 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 biologically diverse environments.</td></tr>
<tr><th colspan="2">Summary of Potential Impacts to Socio-economic Values</th></tr>
<tr><th>Setting</th><th>Receptor Group</th></tr>
<tr><td rowspan="3">Offshore</td><td>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. Further details are provided below, with the impact assessment relating to spawning discussed above under ‘Summary of Potential Impacts to Other Habitats and Communities’.
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 depends on 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 would result in the 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. Of the four Commonwealth fisheries and nine State fisheries, most have either had no or limited fishing effort concentrated within the Operational Areas.</td></tr>
<tr><td>Tourism including Recreational Activities
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). Limited recreational fishing occurs in the offshore waters of the Operational Areas due to the distance from shore; however, fishing may occur within the offshore waters of the Montebello AMP. Impacts on species that are recreationally fished are described above and under ‘Summary of Potential Impacts to Other Species’ above.
A major loss of hydrocarbon from the Petroleum Activities Program may lead to exclusion of marine nature-based tourist activities, resulting in a loss of revenue for operators.</td></tr>
<tr><td>Offshore Oil and Gas Infrastructure
In the highly unlikely event of a major spill, surface hydrocarbons may affect production from existing petroleum facilities (platforms and FPSOs). 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 activity support vessel access as well as tankers approaching facilities on the North West Shelf. 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 about the operation of production facilities in the event of a spill would be based primarily on health and safety considerations. The closest oil and gas operations are the GWA facility within the Operational Areas and Pluto, North Rankin and Wheatstone platforms, all between 20 and 50 km from the Operational Areas. Operation of these facilities is likely to be affected in the event of a worst-case loss of well containment.</td></tr>
</table>

Submerged Shoals	***Tourism and Recreation*** In the highly unlikely event of a major spill, a temporary prohibition on charter boat recreational fishing trips and any other marine nature-based tourism trips to the Montebello AMP and Rowley Shoals may be put into effect, depending on the trajectory of the plume, resulting in a loss of revenue for operators.
Mainland and Islands (Nearshore Waters)	***Cultural Heritage*** A number of historic shipwrecks have been identified in the vicinity of North West Cape and in the vicinity of the Montebello/Barrow islands, including the two wrecks at Trial Rocks. The spill results do not predict surface slicks contacting the identified wrecks. However, shipwrecks occurring in the subtidal zone could be exposed to entrained/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 the following: 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). The foreshore and hinterland of North West Cape and the Dampier Archipelago contain numerous Indigenous sites such as burial grounds, middens and fish traps. Additionally, artefacts, scatter and rock shelter are contained on Barrow and Montebello islands. Only sites that are located below the high water mark are expected to be impacted from a spill. This could result in hydrocarbon contamination of the site, which may affect the cultural significance and traditional practices associated with the sites. Within the EMBA, a number of places are designated on the National Heritage List. 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.
	Tourism and Recreation In the highly unlikely event of a major spill, the nearshore waters of island groups including the Muiron Islands, Montebello/Barrow/Lowendal islands and the Pilbara islands (Northern and Southern Island groups) and mainland coasts (Ningaloo, Exmouth Gulf and Shark Bay), could be reached by entrained hydrocarbon, depending on prevailing wind and current conditions. These locations offer a number of amenities, such as fishing, swimming and utilisation of beaches and surrounds, and have a recreational value for local residents and visitors (regional, national and international). If a major spill resulted in hydrocarbon contact, there could be restricted access to beaches for a period of days to weeks, until natural weathering or tides and currents remove the hydrocarbons. In the event of a major spill, tourists and recreational users may also avoid areas due to perceived impacts, including after the hydrocarbon spill has dispersed. There is potential for stakeholder perception that this 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 likely to be significant impacts to the tourism industry, wider service industry (hotels, restaurants and their supply chain) and local communities 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 clean-up and change in any public misconceptions regarding the spill (Oxford Economics, 2010).

Summary of Potential Impacts to Environmental Value(s)
In the highly unlikely event of a major hydrocarbon spill due to a loss of well integrity, the EMBA includes the areas listed in **Table 7-10,** including the sensitive offshore marine environments and associated receptors of the Montebello AMP, Gascoyne AMP, Rankin Bank and Glomar Shoal. In summary, long-term impacts may occur at sensitive nearshore and shoreline habitats, particularly areas of the Barrow and Montebello Islands, as a result of a major spill of hydrocarbon from permanent plugging activities within the Operational Areas. The overall environmental consequence is defined as ‘B – Major, long-term impact (ten to 50 years) on highly valued ecosystem, species, habitat, physical or biological attributes’. The likelihood of the event is defined as 1 ‘Highly Unlikely’, resulting in a risk ranking of Moderate.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)*** [16]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
OPGGS (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 zones with flow potential penetrated by the well bore, containing hydrocarbons, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary). • The barriers shall: – be effective over the lifetime of well construction and abandonment – (fluid barriers) remain monitored and provide sufficient pressure to counter pore pressure during well construction and abandonment – (cementing barriers, including conductor, casing and liners) conform to the relevant minimum standards set out in the Woodside Barrier Standard. • Verification: – Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the permanent plugging 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 a loss of well integrity event 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 9.1**
Implement requirements for permanent well abandonment: • well barrier as per the internal Woodside Standard(s) • 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 or 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 11.1**

[16] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)*** [16]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
An approved Blowout Contingency Plan shall exist prior to drilling each 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 11.2**
Good Practice				
Subsea BOP installed, and function tested during permanent plugging operations. The BOP shall meet the Woodside Well Control Procedure, Woodside Engineering Standard – Rig Equipment and shall be subject to API Standard 53 BOP Risk Assessment.	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 9.3**
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 keeping. This will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment.	Benefits outweigh cost/sacrifice.	Yes **C 2.1**
Professional Judgement – Eliminate				
Do not plug and abandon the well.	F: No. CS: Inability to permanently abandon the well.	All risk would be eliminated.	Disproportionate. Yodel and Capella-1 wells will require intervention to reinstate the integrity of the caprock and achieve the status of permanently abandoned.	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 7.7.1**).				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)*** [16]	***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 B), Woodside considers the adopted controls appropriate to manage the risks and consequences of a highly unlikely 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 risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

<table>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><th>Acceptability Criteria and Assessment</th><th>Acceptable Level(s) of Residual Risk</th><th>Statement of Acceptability</th></tr>
<tr><td>Principles of ESD
The Petroleum Activities Program is consistent with the relevant principles of ESD:
• decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
• the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
• the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
Internal Context
The Petroleum Activities Program is consistent with Woodside corporate policies, culture, processes, standards, structure and systems 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)
• Engineering Standards – Well Barriers
• Well Acceptance Criteria Procedure
• Drilling and Completions – Well Control Procedure
• Woodside Engineering Standard – Rig Equipment
• Woodside’s Well Blowout Contingency Planning Procedure
• 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).
External Context
During stakeholder consultation with relevant persons, DoT requested to be consulted on spill risks with a potential to impact State Waters (Section 5). Woodside has also consulted with AMSA 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. No additional queries or concerns relating to a loss of well integrity hydrocarbon spill risk were raised during stakeholder engagement.
Other Requirements</td><td>The Petroleum Activities Program is undertaken in a manner that employs all reasonably practicable controls to effectively reduce the likelihood of a loss of well integrity occurring and to mitigate potential impacts should the event occur to reduce its consequence.</td><td>The predicted level of residual risk (Moderate) is considered to be at or below the defined acceptable levels given the controls implemented will effectively reduce the likelihood of a loss of well integrity occurring to 1 – Highly unlikely.

Environmental Performance Consideration
To manage residual risk from a loss of well integrity to at or below the defined acceptable levels the following EP has been applied:
EPO 11: No loss of well integrity resulting in loss of hydrocarbons to the marine environment during the Petroleum Activities Program.</td></tr>
</table>

Impact assessment has been informed by risk-based analysis, including hydrocarbon spill modelling. The proposed control measures are consistent with industry legislation, codes and standards, good practice and professional judgement including: • API Standard 53 for subsea BOP function testing • OPGGS (Resource Management and Administration) Regulations 2011 to have an accepted WOMP and application to permanently plug for abandonment of the wells • NOPSEMA will be notified of reportable and recordable incidents, if required, in accordance with **Section 8.8** • A mutual aid MoU for relief well drilling is in place and the Drilling Engineering Manager maintains a list of rigs that are currently operating in WA. The EMBA overlaps a number of BIAs for threatened and migratory species, as well as a number of State and Commonwealth MPAs and the Ningaloo Coast and Shark Bay WHAs. Relevant management plans and species recovery plans and conservation advice have been considered during the impact assessment and, given the adopted controls, the Petroleum Activities Program is not considered to be inconsistent with the overall objectives and actions of these plans.		

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 11 No loss of well integrity resulting in loss of hydrocarbons to the marine environment during the Petroleum Activities Program.	**C 9.1** See **Section 7.6.7**.	**PS 9.1** See **Section 7.6.7**.	**MC 9.1.1** See **Section 7.6.7**.
			MC 9.1.2 See **Section 7.6.7**.
			MC 9.1.3 See **Section 7.6.7**.
	C 9.2 See **Section 7.6.7**.	**PS 9.2** See **Section 7.6.7**.	**MC 9.2.1** See **Section 7.6.7**.
			MC 9.2.2 See **Section 7.6.7**.
	C 11.1 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 11.1** Woodside abandons the wells according to internal Woodside Procedure.	**MC 11.1.1** Records demonstrate Well Acceptance Criteria have been met.
	C 11.2 An approved Blowout Contingency Plan shall exist prior to drilling each well, including feasibility and any specific considerations for relief well kill.	**PS 11.2** Feasibility of performing a well kill operation confirmed in an approved blowout contingency plan.	**MC 11.2.1** An approved Well Blowout Contingency Plan.
	C 9.3 See **Section 7.6.7**.	**PS 9.3** See **Section 7.6.7**.	**MC 9.3.1** See **Section 7.6.7**.
	C 2.1 See **Section 7.6.2**.	**PS 2.1** See **Section 7.6.2**	**MC 2.1.1** See **Section 7.6.2**
For oil spill response outcomes, standards and MC refer to **Appendix D**.			

7.7.3 Accidental Hydrocarbon Release: Vessel Collision

Context		
Project vessels – **Section 3.7**	Physical environment – **Section 4.4** Biological environment – **Section 4.5** Socio-economic – **Section 4.6** Values and sensitivities – **Section 4.7**	Stakeholder consultation – **Section 5**

Risks Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 (diesel) 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 12

Description of Source of Risk

Background

The temporary presence of the MODU and project vessels in the Operational Areas will result in a navigational hazard for commercial shipping within the immediate area (as discussed in **Section 7.6.1**). This navigational hazard could result in a third party vessel colliding with the MODU and other vessels which could result in a loss of containment.

A moored MODU typically has a total marine diesel capacity of about 966 to 1400 m³ that are distributed through a number of isolated tanks. MODU fuel tanks are typically located on the inner sides of pontoons, and can be more than 10 m below the waterline.

The marine diesel storage capacity of a support vessel can also be in the order of 1000 m³ (total) that is distributed through multiple isolated tanks typically located mid-ships and can range in typical size from 22 to 105 m³.

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.

From a review of the ATSB marine safety and investigation reports, 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 connected 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 occurring.

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. 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 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 (**Table 7-11**). 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.
- It is highly unlikely that the full volume of the largest storage tank on a support vessel would be lost.

The last scenario considered was a collision between the support vessel with a third party vessel (i.e. commercial shipping, other petroleum related vessels and commercial fishing vessels). This was assessed as being credible but highly unlikely, given the standard vessel operations and equipment in place to prevent collision at sea, the standby role of a support vessel (low vessel speed) and its operation in close proximity to the MODU (exclusion areas), and the construction and placement of storage tanks. The largest tank of the support vessel is unlikely to exceed 105 m³.

Given the offshore location of the Operational Areas, vessel grounding is not considered a credible risk.

Table 7-11: Summary of credible hydrocarbon spill scenario as a result of vessel collision

Scenario	Hydrocarbon Volumes	Preventative and Mitigation Controls	Credibility
Breach of MODU fuel tanks due to support vessel collision.	MODU has a fuel oil storage capacity of about 966 to 1400 m³, distributed through multiple tanks.	Fuel tanks are located on the inside of pontoons and protected by location below water line, protection from other tanks, e.g. bilge tanks. The draught of vessel and location of tanks in terms of water line prevent the tanks from being breached.	**Not credible** Due to location of tanks.
Breach of support vessel fuel tanks due to collision with MODU.	Activity support vessel has multiple marine diesel tanks typically ranging between 22 to 105 m³ each.	Typically, double wall tanks that are located mid ship (not bow or stern). Slow support vessel speeds when in proximity to MODU.	**Not credible** Collision with MODU at slow speeds is highly unlikely and, if it did occur, is highly unlikely to result in a breach of support vessel (low energy contact from slow moving vessel).
Breach of support vessel fuel tanks due to support vessel – other vessel collision including commercial shipping/fisheries.	Activity support vessel has multiple marine diesel tanks typically ranging between 22 to 105 m³ each.	Typically, double wall tanks that are located midship (not bow or stern). Vessels are not anchored and steam at low speeds when relocating within the Operational Areas or providing stand-by cover. Normal maritime procedures would apply during such vessel movements.	**Credible** Activity support vessel – other vessel collision could potentially result in the release from a fuel tank.

Loss of well control due to third party vessel (e.g. large bulk carrier) collision with MODU during permanent plugging for abandonment activities.	Loss of containment of reservoir fluids – see **Section 7.7.2** for estimated volumes.	Refer to **Section 7.7.2** for preventative and mitigation controls.	**Credible** See **Section 7.7.2**.
Dropped object from back-loading/offloading operations rupturing the MODU fuel tanks (e.g. a container or piece of equipment).	MODU has a fuel oil storage capacity of about 966 to 1400 m³, distributed through multiple tanks.	Fuel tanks are located on the inside of pontoons and protected by location below water line, protection from other tanks, e.g. bilge tanks. The draught of vessel and location of tanks in terms of water line prevent the tanks from being breached.	**Not credible** No direct pathway to tanks from dropped objects.

Quantitative Hydrocarbon Risk Assessment

Modelling was performed by RPS, on behalf of Woodside, to determine the fate of marine diesel released from a collision. While specific modelling was not conducted for the Operational Areas, modelling from two nearby developments were considered representative of a vessel collision associated with the Petroleum Activities Program. The two models comprised a 1000 m³ volume (about 50 km from the Operational Areas) and a 343 m³ scenario (about 20 km from the Operational Areas).

The two models used to understand the consequences of this scenario are taken from the library of diesel spill models Woodside has accumulated over the years of performing similar activities to those in this Petroleum Activities Program. These models are considered representative of the actual scenarios considered in the Petroleum Activities Program because:

- both scenarios are above the worst-case credible scenario from this Petroleum Activities Program
- both scenarios are located within 50 km of the Echo-Yodel Operational Areas
- the models have comparable outputs
- the models are relatively recent and so both use the latest and same hydrodynamic assumptions and inputs
- the models have been performed by the same contractor using the same predictive software
- the 1000 m³ release is closer to shorelines than the Operational Areas of this Petroleum Activities Program.

Woodside considered commissioning bespoke modelling for this Petroleum Activities Program 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 (NERA, 2018).

Both models show that:

- spreading and weathering of the surface oil occurs rapidly due to the loss of light, volatile components and the spreading will reduce the effectiveness and available surface area for containment and recovery and surface dispersant operations, as shown in **Figure 7-4** and **Figure 7-5**
- response operations cannot be implemented if the safety of response personnel cannot be guaranteed. Safety circumstances that limit the execution of this control measure include volatile concentrations of hydrocarbons in the atmosphere, high winds (>20 knots), waves and/or sea states (>1.5 m waves) and high ambient temperatures.

Hydrocarbon Characteristics

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). About 5% of the oil is shown to be persistent.

Under a calm constant-wind scenario (**Figure 7-4**), about 40% of the oil is predicted to evaporate within 36 hours. Under these conditions, most of the remaining oil on the water surface will weather at a slower rate. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

Under the more realistic variable-wind scenario (**Figure 7-5**), where the winds are of greater strength, entrainment of marine diesel into the water column is indicated to be significant. Around two days after the spill, about 50% 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 (<2%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (about >6 m/s).

Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks and oil droplets in the water column. However, 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. This long weathering duration will extend the area of potential effect, requiring the break-up and dispersion of the slicks and droplets to reduce concentrations below the thresholds considered.

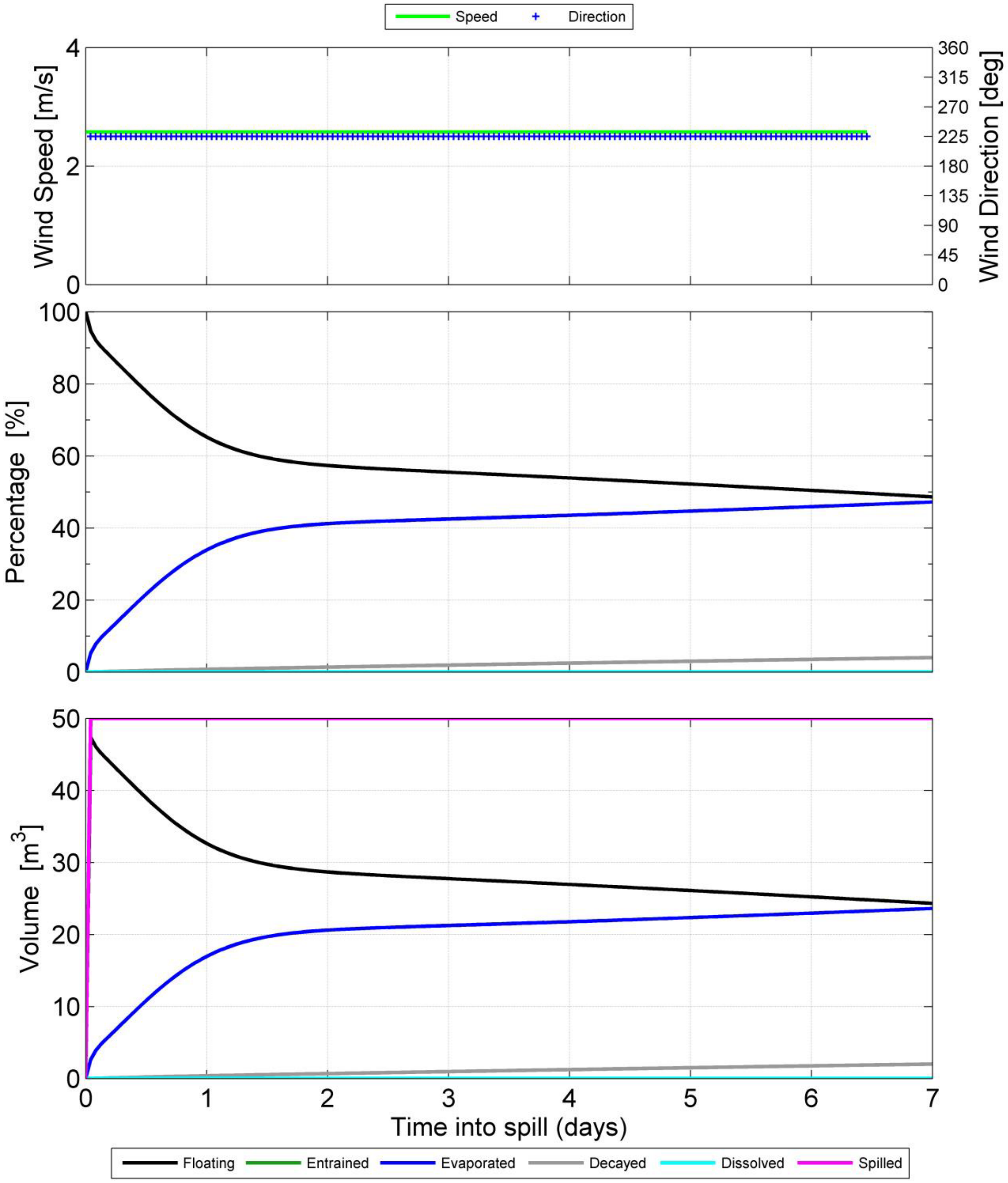

Figure 7-4: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of marine diesel spilled onto the water surface as a one-off release (50 m³ over one hour) and subject to a constant 5 knots (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature

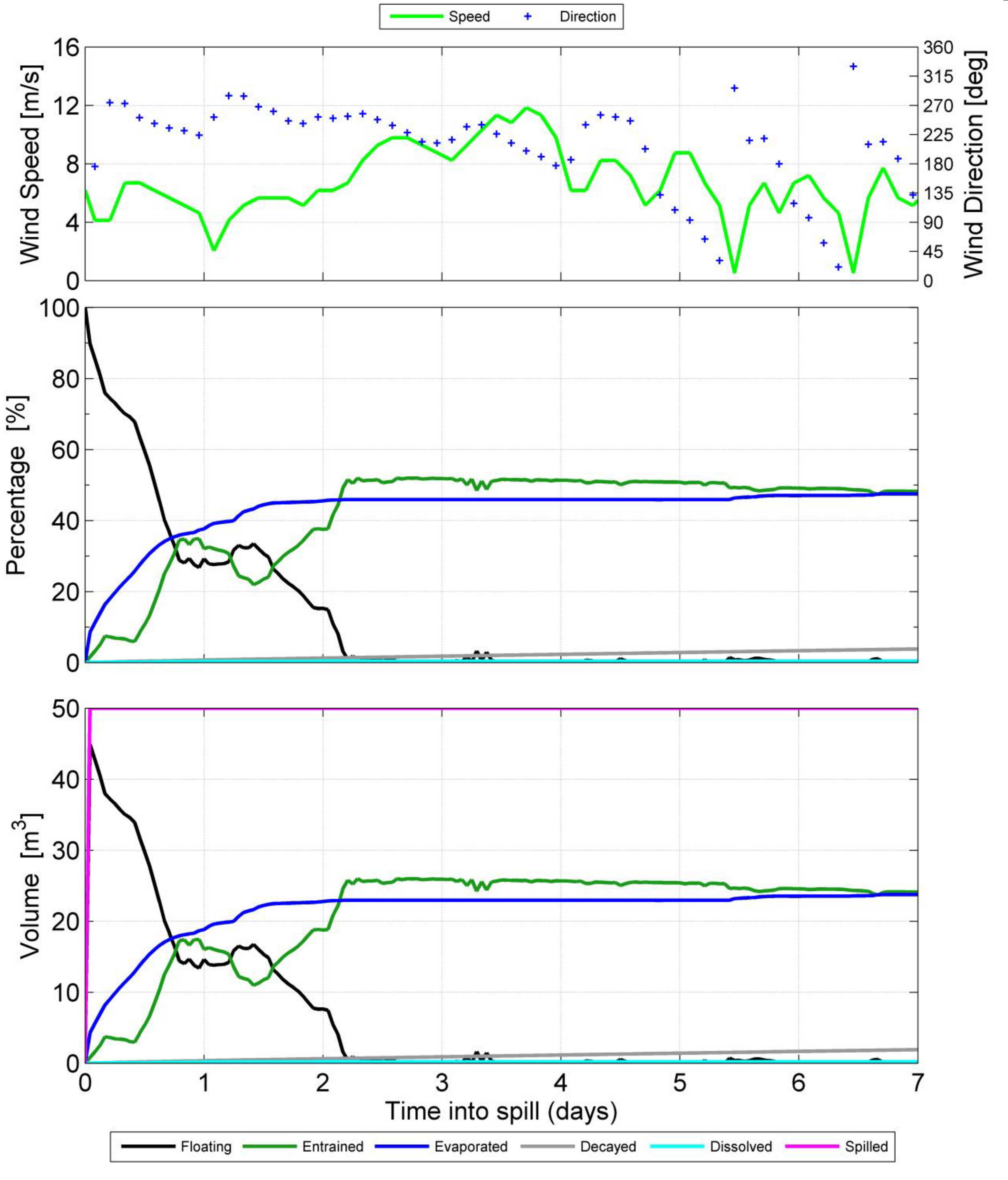

Figure 7-5: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of marine diesel spilled onto the water surface as a one-off release (50 m³ over one hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature

Impact Assessment

Potential Consequence Overview

Environment that May Be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling which compiles data from 200 hypothetical worst-case spills under a variety of weather and metocean conditions. The EMBA therefore covers a larger area than the area that would be affected during any one 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

Modelling of floating oil indicates that concentrations equal to or greater than the 10 g/m² thresholds could potentially be found up to 110 km from the spill site. Only Rankin Bank (2.5% probability), a submerged feature, is predicted to receive floating oil at concentrations equal to or greater than 10 g/m².

Entrained Hydrocarbons

Entrained oil at concentrations greater than or equal to the 500 ppb threshold has a 1% probability of reaching Rankin Bank within 18 hours of the spill (1000 m³ spill scenario only). **Table 7-12** contains details of the receptors where entrained hydrocarbons may reach as well as the expected concentrations and probabilities.

Table 7-12: Potential receptors contacted by entrained diesel more than 500 ppb

Receptor	Probability (%) of entrained oil concentration ≥500 ppb	Minimum time to receptor (hours) for entrained oil at ≥500 ppb	Maximum entrained oil concentration (ppb) averaged over all replicate simulations	Maximum entrained oil concentration (ppb), at any depth, in the worst replicate simulation
Rankin Bank	1	18	72	911

Dissolved Hydrocarbons

Modelling of dissolved hydrocarbons indicates that concentrations equal to or greater than the 500 ppb thresholds is not predicted to reach any sensitive receptors within the EMBA.

Accumulated Hydrocarbons

Potential for accumulation of oil on shorelines is predicted to be low and unlikely to exceed the impact threshold (100 g/m²). The maximum accumulated volumes and maximum local accumulated concentration on shorelines for each diesel spill scenario are as follows. No other receptors would accumulate hydrocarbons:

- 343 m³ diesel spill: Montebello Islands – maximum accumulated volume of <1 m³ and a maximum local accumulated concentration on shorelines of 0.2 g/m²
- 1000 m³ diesel spill:
  - Southern Pilbara Islands – maximum accumulated volume of <1 m³ and a maximum local accumulated concentration on shorelines of 11 g/m²
  - Muiron Islands – maximum accumulated volume of <1 m³ and a maximum local accumulated concentration on shorelines of 6.3 g/m²
  - Ningaloo Coast North – maximum accumulated volume of <1 m³ and a maximum local accumulated concentration on shorelines of 4.1 g/m²
  - Ningaloo Coast Middle – maximum accumulated volume of <1 m³ and a maximum local accumulated concentration on shorelines of 24 g/m².

Summary of Potential Impacts

Table 7-13 presents the full extent of the EMBA; i.e. the sensitive receptors and their locations that may be exposed to condensate (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the highly unlikely event of a diesel spill during the Petroleum Activities Program. Details of these receptors are outlined in **Section 4**. The potential biological and ecological impacts of an unplanned diesel release as a result of a vessel collision during the Petroleum Activities Program are presented in the next sections.

Table 7-13: Environment that May Be Affected – Key receptor locations and sensitivities with the summary hydrocarbon spill contact for an instantaneous release of marine diesel

Environmental setting	Location/name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate (≥1% probability)			
		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 deep-water 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 and Gas Infrastructure (topside and subsea)*	*Surface hydrocarbon (≥10 g/m²)*	*Entrained hydrocarbon (≥500 ppb)*	*Dissolved aromatic hydrocarbon (≥500 ppb)*	*Accumulated hydrocarbon (>100 g/m²)*
Offshore[17]	Commonwealth waters	✓	✓					✓		✓					✓	✓				✓	✓	✓	✓	✓		✓		✓		✓	✓	✓		N/A
Submerged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			N/A	1		N/A

[17] Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent.

Summary of Potential Impacts to Protected Species, Other Habitats and Communities, Water Quality and Socio-economic Values
No receptors are contacted by dissolved aromatic hydrocarbons >500 ppb or floating oil concentrations equal to or greater than 10 g/m². Entrained hydrocarbons >500 ppb may contact receptors, with the greatest likelihood and concentrations found at Rankin Bank (1% probability of contact at concentrations >500 ppb). Other sensitive locations identified are predicted to have less than 1% probability of contact at concentrations >500 ppb. The potential impacts of floating, dissolved and entrained hydrocarbons to species (protected and otherwise), primary producers, other habitats and communities, water quality, marine sediment quality, air quality, protected areas and socio-economic values are described in **Section 7.7.2**. The diesel spill EMBA covers the same area as the loss of containment EMBA. Considering the sensitive receptors potentially impacted are similar for the two spill scenarios, the assessment provided in **Section 7.7.3** would also apply to the potential diesel spill scenario. 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.
Summary of Potential Impacts to Environmental Value(s)
In the highly 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 localised, low and temporary in nature in comparison to background levels. Localised, low and temporary impacts to habitats, populations and shipping/fishing concerns are expected. The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision, as classified in **Table 2-4**, is defined as D, which equates to 'minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems), physical or biological attributes'.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 30 (Prevention of collisions) 2016, including: • 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 noise signals as required.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users resulting in a collision.	Controls based on legislative requirements – must be adopted.	Yes **C 12.1**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control 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 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 resulting in a collision.	Controls based on legislative requirements – must be adopted.	Yes **C 12.2**
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 12.3**
Good Practice				
Support vessel on standby as required during permanent plugging 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 Areas 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 12.4**
When a support vessel is designated for standby it will perform 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 500 m petroleum safety zone. Surveillance shall be conducted by a combination of: – visual lookout – radar watch – other electronic systems available including	F: Yes. CS: Minimal cost – support vessels available routinely in Operational Areas during Petroleum Activities Program. Standard practice.	Provides a reduction in likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice.	Yes **C 12.5**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Automatic Identification System – 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.				
Notify AHS of activities and movements no less than four working weeks before the scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHS will enable them to generate navigation warnings (MSIN and 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 to 48 hours before operations commence.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third party vessel.	Benefits outweigh cost/sacrifice. Control is also Standard Practice.	Yes **C 1.3**
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

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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 7.7.1**).				

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 risks and consequences 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 risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that an accidental hydrocarbon release as a result of a vessel collision represents a moderate current risk rating and may result in minor, short-term impact (1-2 years) on species, habitat (but not affecting ecosystems function), physical or biological attributes and communities. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice.

The adopted controls are considered consistent with industry legislation, codes and standards, good practice and professional judgement and meet the requirements and expectations of Australian Marine Orders, AMSA and AHS identified during impact assessment and stakeholder consultation. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 12 No release of hydrocarbons to the marine environment due to a vessel collision during the Petroleum Activities Program.	**C 12.1** Marine Order 30 (Prevention of collisions) 2016, including: • 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 noise signals as required.	**PS 12.1** Support vessels and MODU compliant with Marine Order 30 (Prevention of collisions) 2016 (which requires vessels to be visible at all times) to prevent unplanned interaction with marine users.	**MC 12.1.1** Marine Assurance inspection records demonstrate compliance with standard maritime safety procedures (Marine Orders 21 and 30).

	C 12.2 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* • Automatic Identification System that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	**PS 12.2** Support vessels and MODU compliant with Marine Order 21 (Safety of navigation and emergency procedures) 2016 to prevent unplanned interaction with marine users.	
	C 12.3 Establishment of a 500 m petroleum safety zone around MODU and communicated to marine users.	**PS 12.3** No entry of unauthorised vessels within the 500 m safety exclusion zone.	**MC 12.3.1** Records demonstrate breaches by unauthorised vessels within the petroleum safety zone are recorded.
			MC 12.3.2 Consultation records demonstrate that AHS has been notified before commencement of 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 12.4 Support vessel on standby as required during permanent plugging activities to assist in third party vessel interactions (including warning to vessels approaching the 500 m petroleum safety zone).	**PS 12.4** Communicate with third-party vessels, prevent unplanned interaction and to assist in emergencies, as required.	**MC 12.4.1** Records demonstrate an activity support vessel was on standby as required as per definition or reference in Woodside's One Marine Charterers Instructions.

<table>
<tr><td rowspan="3"></td><td>C 12.5
When a support vessel is designated for standby it will perform 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 500 m petroleum safety zone. Surveillance shall be conducted by a combination of:
– visual lookout
– radar watch
– other electronic systems available including Automatic Identification System
– monitoring any additional/agreed radio communications channels
– all other means available.
• While complying with the 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
– any buoys in the area are not holding position or are not working as expected.</td><td>PS 12.5
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.</td><td>MC 12.5.1
Records of non-conformance against controls maintained.</td></tr>
<tr><td>C 1.1
See Section 7.6.1.</td><td>PS 1.1
See Section 7.6.1.</td><td>MC 1.1.1
See Section 7.6.1.</td></tr>
<tr><td>C 1.3
See Section 7.6.1.</td><td>PS 1.3
See Section 7.6.1.</td><td>MC 1.3.1
See Section 7.6.1.</td></tr>
<tr><td colspan="4">Detailed preparedness and response performance outcomes, standards and MC for the Petroleum Activities Program are presented in Appendix D.</td></tr>
</table>

7.7.4 Accidental Hydrocarbon Release: Bunkering

Context		
Project vessels – **Section 3.7**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**	Stakeholder consultation – **Section 5**

Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 (diesel/jet fuel) to marine environment from bunkering/refuelling		X			X		A	E	2	M	LCS GP PJ	Broadly Acceptable	EPO 13

Description of Source of Risk

Bunkering of marine diesel between the support vessel(s) and the MODU may occur in Operational Area A. Additionally, refuelling of helicopters using aviation jet fuel may occur 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 shut off fuel pumps, for a period of up to five minutes, could result in about 8 m³ 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 less than 100 L.

Likelihood

The likelihood of 2 ‘Unlikely’ corresponds to ‘Has occurred many times in the industry but not at Woodside’.

A search of the Woodside spill records indicates that, while there have been smaller releases (less than 30 L) associated with bunkering, there have been no recorded partial or total failures of bulk transfer hose or fittings during bunkering, combined with a failure in procedure to shut off fuel pumps for a period of up to five minutes, resulting in the worst-case credible scenario of an 8 m³ loss of diesel.

ITOPF Limited (IOTPF) (2018) data reports that for tanker operations during 1970 to 2017, 7% of small (more than seven tonnes) spills occurred during bunkering and 2% of medium (seven to 700 tonnes) spills. While this data is from the oil tanker industry, it has been used as an indicator of the potential for spills associated with bunkering activities. A risk assessment by AMSA of oil spills in Australian ports and waters (Det Norske Veritas, 2011) identifies transfer spills as a risk.

Quantitative Spill Risk Assessment

Woodside has commissioned RPS to model several small marine diesel spills, including surface spill volumes of 8 m³ in the offshore waters of north-west WA. The results of these models have indicated that exposure to surface hydrocarbons above the 10 g/m² 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 threshold concentrations from an 8 m³ surface spill from bunkering activities would be well within the EMBA for the vessel collision scenario detailed in **Section 7.7.3.** Given this, the offshore location of the Operational Areas, and the fact that the same hydrocarbon type is involved for both scenarios, specific modelling for an 8 m³ 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. Aviation jet fuel would behave similarly to diesel and have similar impacts and, considering small size of spill volumes likely to be contained on the helideck, this has not been modelled.

Hydrocarbon Characteristics

Refer to **Section 7.7.3** 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 Consequence Overview

Previous modelling studies for 8 m³ 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/m² was confined to within the immediate vicinity (about 1 km) of the release sites. Therefore, it is considered that there is no potential for contact with sensitive receptor locations above surface (10 g/m²), entrained (100 ppb) or dissolved (50 ppb) threshold concentrations from an 8 m³ spill of marine diesel within the Operational Areas.

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 7.7.2 and 7.7.3**; 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 7.7.3** for the detailed potential impacts of unplanned hydrocarbon release to the marine environment from vessel collision. 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; hence, potential impacts from bunkering are considered very minor.

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***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.	By ensuring a SOPEP/SMPEP is in place for the vessel, the likelihood of a spill entering the marine environment is reduced. Although no significant reduction in consequence could result, the overall risk is reduced.	Controls based on legislative requirements – must be adopted.	Yes **C 13.1**

[18] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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 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.	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 13.2**
Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • A completed PTW and/or Job Safety Assessment (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 13.3**
Mitigation: Oil spill response.	Refer to **Appendix D**.			

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[18]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
No refuelling of helicopter on MODU.	F: No. Given the distance of the Operational Areas 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
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 257 km). CS: Significant due to schedule delay and vessel transit costs and day rates.	Eliminates the risk in the Operational Areas. 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 risks and consequences of a bunkering spill. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that an accidental hydrocarbon release during bunkering operations represents a moderate current risk rating and may result in slight, short-term impacts (>1 year) on species, habitat (but not affecting ecosystems function) or biological attributes. The EMBA overlaps a number of BIAs for threatened and migratory species, as well as a number of State and Commonwealth MPAs and the Ningaloo Coast and Shark Bay WHAs. Relevant management plans and species recovery plans and conservation advice have been considered during the impact assessment and, given the adopted controls, the Petroleum Activities Program is not considered to be inconsistent with the overall objectives and actions of these plans. The adopted controls are considered consistent with industry legislation, codes and standards, good practice and professional judgement and meet the requirements of Australian Marine Orders. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 13 No unplanned loss of hydrocarbons to the marine environment from bunkering greater than a consequence level of E[19] during the Petroleum Activities Program.	**C 13.1** Marine Order 91 (Marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	**PS 13.1** Appropriate initial responses prearranged and exercised for response to a hydrocarbon spill, as appropriate to vessel class.	**MC 13.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 91.
	C 13.2 Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be placed on 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 13.2.1** Ensure damaged equipment is replaced before failure.	**MC 13.2.1** Records confirm the MODU bunkering equipment is subject to systematic integrity checks.
		PS 13.2.2 Minimise inventory loss in the event of a failure.	**MC 13.2.2** Records confirm presence of dry break of couplings and flotation on fuel hoses.
		PS 13.2.3 Ensure adequate resources are available to allow implementation of SOPEP.	**MC 13.2.3** Records confirm presence of spill kits.

[19] Defined as 'Slight, short-term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

	C 13.3 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 13.3** Comply with Contractor procedures for managing bunkering/helicopter operations.	**MC 13.3.1** Records demonstrate bunkering/refuelling performed in accordance with contractor bunkering procedures.
Detailed oil spill preparedness and response performance outcomes, standards and MC for the Petroleum Activities Program are presented in **Appendix D**.			

7.7.5 Unplanned Discharges: Drilling Fluids

Context	
Project fluids – **Section 3.12**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**

Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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/NWBM/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 14

Description of Source of Risk

Transfers

A support vessel will bulk transfer NWBM/base oil and WBM 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 mud or base oil to either the bunded deck or into the marine environment.

The most likely spill volume of mud is likely to be less than 0.2 m^3, 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 m^3 of mud 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. mud 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 m^3), plus the volume of fluid lost in the one minute (maximum) taken to shut down the pumps. At a flow rate of 3.8 m^3 per minute, this volume would equate to an additional 3.8 m^3. In total, it is expected that this catastrophic failure would result in a loss of 5.3 m^3.

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 m^3) 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. The EDS could be manually activated due to an identified threat to the safety of the MODU, including loss of MODU station keeping resulting from loss of multiple moorings, potential collision by a third-party vessel or a loss of well control.

During operations, this could result in a subsurface release of a combination of WBM and/or NWBM and solids at the seabed and a release of base fluid. The volume of material released depends on the water depth and, hence, the length of the riser (i.e. the entire riser volume would be lost). The base oil of the NWBM would remain in an emulsion with the other components of the mud system and drilled cement.

NWBM Drilling Fluid System

The selection of an NWBM drilling fluid system will be based on Woodside processes (as outlined in **Section 3.12**); however, for the purposes of this risk assessment, an example base oil (Saraline 185V) has been used. Saraline 185V 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 7-14**). At this time, most 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 7-14: Characteristics of the non-water based mud 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 185V)	0.7760	2.0 @ 40 °C	8.5	41.1	50.4	0	0

Impact Assessment

Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species

NWBM is made up of a number of components detailed in **Section 3.12.2**, including base oil, which generally has a high-volatile to semi-volatile fraction. If released to the marine environment at surface, the base oil generally evaporates within the first 48 hours, with the remaining fraction weathering at a slower rate. The worst-case scenario for NWBM being discharged at the surface results from an unplanned discharge of about 8 m³ during bunkering and/or transfer activities. While discharge may also occur at the surface during a slip joint packer failure, the volume from this event is likely to result in a smaller discharge. As a result of volatility of NWBM, combined with the approximate credible volume of 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. Any surface oil would be confined to open waters, with a minor surface slick that would not reach any sensitive receptors. Therefore, impacts on water quality would be minor and temporary in nature. The material safety datasheet for Saraline 185V indicates 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 near the surface of 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.

NWBM may also be discharged to the seabed surrounding the well site during an EDS event. The footprint associated with releasing NWBM 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 expected the weight of NWBM would result in most of the release settling to the seabed and/or remaining at depth within the water column. Impacts to the underlying infauna may occur but are considered unlikely and, if lethal impacts are observed, they would be limited in extent and recolonisation would occur over time. Elevated hydrocarbon and metal concentrations in the localised area of deposition would also occur, with reduction over time. It is likely that any impacts to water and sediment quality and low-sensitivity deeper water benthos would be short-term, localised, and a full recovery expected.

WBM is made up of the components detailed in **Section 3.12.2**, including a variety of chemicals with low toxicity, incorporated into the selected drilling fluid system to meet specific technical requirements. If released to the marine environment at the surface, there would be an extremely small impact footprint area. Any release would be confined to the open waters of the Operational Areas that would not reach any sensitive receptors. Components of the WBM would settle in the water column and be subject to dilution. Given the low toxicity of WBM, any impacts on water quality from unplanned discharges would be minor and temporary in nature.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that accidental discharge of NWBM/base oil or WBM will not result in a potential impact to protected species and water quality greater than E – Slight, with no significant impact on environmental receptors predicted. It is considered that the release of NWBM solids from an unplanned discharge will not result in a potential impact greater than negligible and/or temporary contamination above background levels, water quality standards, or known effect concentrations.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[20]***	***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 4.3**
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 14.4**
Good Practice				
Fluids and additives for drilling will have an environmental assessment completed before 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 likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 14.2**

[20] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[20]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
No overboard disposal of bulk NWBM.	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 5.4**
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 NWBM hoses • transfer hoses to have flotation devised to allow detection of a leak • the valve line-up to 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 will be 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 14.5**
Check the functionality of: • additional SCE (augers and cuttings dryers) • mud tanks • mud tank room • transfer hoses • NWBM base fluid transfer lines • NWBM base fluid transfer station • base fluid 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 14.6**
Professional Judgement – Eliminate				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[20]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Substitute				
Only use WBM.	F: Not feasible. An NWBM drilling fluid system is required for safety and technical reasons; therefore, option to use must be maintained. CS: Not considered – control not feasible.	Not considered, control not feasible.	Not considered, control not feasible.	No
Professional Judgement – Engineered Solution				
Use a MODU that 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 risks and consequences of the accidental discharge of drilling fluids, described above. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that an unplanned discharge of drilling fluids represents a low current risk rating and may result in slight, short-term impacts (>1 year) on species, habitat (but not affecting ecosystems function) or biological attributes. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. However, these species are not expected to be impacted.

The adopted controls are considered consistent with industry legislation, codes and standards, good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 No unplanned loss of WBM, NWBM or base oil greater than a consequence level of E[21] during the Petroleum Activities Program.	**C 4.3** See **Section 7.6.4**.	**PS 4.3** See **Section 7.6.4**.	**MC 4.3.1** See **Section 7.6.4**.
	C 14.2 Fluids and additives will have an environmental assessment completed before use.	**PS 14.2** Reduces to ALARP the impact potential of all chemicals intended or likely to be discharged into the marine environment.	**MC 14.2.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 5.4 See **Section 7.6.5**.	**PS 5.4** See **Section 7.6.5**.	**MC 5.4.1** See **Section 7.6.5**.
	C 14.4 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 14.4** MODU's joint packer designed and maintained to reduce hydrocarbons discharged to the environment.	**MC 14.4.1** Records demonstrate that MODU's joint packer is compliant.
	C 14.5 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 NWBM hoses • transfer hoses to have flotation devised to allow detection of a leak • the valve line-up to be checked before 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 to be locked closed when not in use for mud transfers and operated under a PTW.	**PS 14.5** Compliance with contractor procedures to limit accidental loss to the marine environment.	**MC 14.5.1** Records demonstrate drilling fluid transfers are performed in accordance with the applicable contractor procedures.

[21] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

	C 14.6 Check the functionality of: • SCE (augers and cuttings dryer) • mud tanks • mud tank room • transfer hoses • NWBM base fluid transfer lines • NWBM base fluid transfer station • base fluid storage.	**PS 14.6** Functionality checks on mud handling equipment prevents unacceptable use or discharge of NWBM/base oil.	**MC 14.6.1** Records demonstrate the presence and functionality of the specified equipment.

7.7.6 Unplanned Discharges: Deck and Subsea Spills

<table>
<tr><th colspan="2">Context</th></tr>
<tr><td>Project fluids – Section 3.12
Wells – Section 3.6.1
Project vessels – Section 3.7</td><td>Physical environment – Section 4.4
Biological environment – Section 4.5</td></tr>
</table>

<table>
<tr><th colspan="14">Risks Evaluation Summary</th></tr>
<tr><th rowspan="2">Source of Risk</th><th colspan="6">Environmental Value Potentially Impacted</th><th colspan="7">Evaluation</th></tr>
<tr><th>Marine Sediment</th><th>Water Quality</th><th>Air Quality (incl Odour)</th><th>Ecosystems/Habitat</th><th>Species</th><th>Socio-Economic</th><th>Decision Type</th><th>Consequence</th><th>Likelihood</th><th>Current Risk Rating</th><th>ALARP Tools</th><th>Acceptability</th><th>Outcome</th></tr>
<tr><td>Accidental discharge to the ocean of other hydrocarbons/chemicals from MODU or project vessel deck activities and equipment (e.g. cranes) including subsea ROV hydraulic leaks</td><td></td><td>X</td><td></td><td>X</td><td>X</td><td></td><td>A</td><td>E</td><td>2</td><td>M</td><td>LCS
GP
PJ</td><td>Broadly Acceptable</td><td>EPO 15</td></tr>
</table>

<table>
<tr><th>Description of Source of Risk</th></tr>
<tr><td>Deck spills can result from spills of stored hydrocarbons/chemicals or equipment. MODU, subsea support vessels and activity support vessels typically store hydrocarbon/chemicals in various volumes (20 L, 205 L; up to about 4000 to 6000 L). Storage areas are typically set up with effective primary and secondary bunding to contain any deck spills. Historically, 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).

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.

Minor leaks during wireline activities (a contingent activity) with a live well are described to include leaks such as:
• leaks from the lubricator, stuffing box and hose or fitting failure, which are expected to be less than 10 L (0.01 m³)
• loss of containment – fluids – surface holding tanks
• backloading of raw slop fluids in an intermediate bulk container(s)
• 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 of less than 10 L.

During the Petroleum Activities Program, small volumes of chemicals and hydrocarbons may be discharged intermittently and for short durations during the permanent plugging activities of Yodel-3 and Yodel-4, as a result of a known gas leak from the production wells, emanating from the X-mas tree valves (refer to Section 3.6.1). This was</td></tr>
</table>

identified through ROV inspection. Expected worst-case hydrocarbon releases and expected chemical releases are detailed below:

- The maximum hydrocarbon release expected after removing the temporary barriers from the Yodel-3 well before well kill is less than 100 L, based on the worst-case leak rate measured in July 2011.
- The maximum hydrocarbon release expected following removal of the temporary barriers from the Yodel-4 well before well kill is less than 150 L, based on the worst case leak rate measured in May 2011.

There are currently two temporary barriers installed in each well. As a conservative estimate, exposed time has been assumed to be between when the first shallow set plug is retrieved and when bullhead brine/kill well operation commences.

After this, the leak path, if active, would leak well kill brine. A sleeve may be installed in the well to prevent leaking of well kill brine, if the pressure is unable to be maintained to achieve permanent plug installation testing.

All chemicals that may be released or discharged to the marine environment during the Petroleum Activities Program are assessed as per Woodside Chemical Selection and Assessment. This procedure is used to demonstrate that the potential impacts of the chemicals that may be released are acceptable and ALARP.

The relatively small planned discharges associated with the Petroleum Activities Program are not expected to have impacts beyond the Operational.

Impact Assessment

Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species

Accidental spills of hydrocarbons or chemicals from the MODU, well plugging activities and project vessels will decrease the water quality in the immediate area of the spill; however, the impacts are 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 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, as 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 likelihood of ecological impacts to marine fauna (protected species), other communities and habitats is likely to be negligible.

No impacts on socio-economic receptors are expected, due to the low levels of fishing activity in the Operational Areas, 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 Value(s)

Given the adopted controls, it is considered that other hydrocarbon/chemical spills to the marine environment will not result in a potential impact greater than slight, short-term local impacts on species, habitat (but not affecting ecosystems function), physical and biological attributes (i.e. Environment Impact – E).

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***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 13.1**
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 15.3**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
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 4.3**
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 15.4**
Fluids and additives will have an environmental assessment completed before 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 the safe execution of activities and therefore no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 5.1**
Detailed oil spill preparedness and response performance outcomes, standards and MC for the Petroleum Activities Program are presented in **Appendix D**.				
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

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/ Risk Reduction***	***Proportionality***	***Control Adopted***
A reduction in the volumes of chemicals and hydrocarbons stored onboard MODU/vessels.	F: Yes. Increases the risks associated with transportation and lifting operations. CS: Project delays if required chemicals not onboard. Increases the risks associated with transportation and lifting operations.	No reduction in likelihood or consequence, as chemicals will still be required to enable permanent plugging 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 risks and consequences of the potential unplanned accidental spills described above. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that unplanned discharges from deck and subsea spills represent a moderate current risk rating and may result in slight, short-term impacts (>1 year) on species, habitat (but not affecting ecosystems function) or biological attributes. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. However, these species are not expected to be impacted.

The adopted controls are considered consistent with industry legislation, codes and standards, good practice and professional judgement and meet the expectations of Australian Marine Orders. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 No unplanned spills to the marine environment from deck activities greater than a consequence level of E[22] during the Petroleum Activities Program.	**C 4.3** See **Section 7.6.4**.	**PS 4.3** See **Section 7.6.4**.	**MC 4.3.1** See **Section 7.6.4**.
	C 13.1 See **Section 7.7.4**.	**PS 13.1** See **Section 7.7.4**.	**MC 13.1.1** See **Section 7.7.4**.
	C 15.3 Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/moved temporarily.	**PS 15.3** Failure of primary containment in storage areas does not result in loss to the marine environment.	**MC 15.3.1** Records confirm all liquid chemicals and fuel are stored in bunded/secondarily contained areas when not being handled/moved temporarily.
	C 15.4 Spill kits are positioned in high-risk locations around the MODU (near potential spill points such as transfer stations).	**PS 15.4** Spill kits to be available for use to clean up deck spills.	**MC 15.4.1** Records confirms spill kits are present, maintained and suitably stocked.
	C 5.1 See **Section 7.6.5**.	**PS 5.1** See **Section 7.6.5**.	**MC 5.1.1** See **Section 7.6.5**.

[22] Defined as 'Slight, short-term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

7.7.7 Unplanned Discharges: Release of Solid Hazardous and Non-hazardous Wastes

Context													
Project vessels – **Section 3.7** MODU – **Section 3.7.1**							Physical environment – **Section 4.4** Biological environment – **Section 4.5**						
Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 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 16

Description of Source of Risk
The MODU and project 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 campaigns has primarily been windblown or dropped overboard and has included things such as personal protective equipment and small tools or materials. These events have occurred during backloading activities, periods of adverse weather and incorrect waste storage.
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 Areas, the types, size and frequency of wastes that could occur, and species present.
Summary of Potential Impacts to Environmental Value(s)
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)[23]***	***Benefit in Impact/Risk 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 are passed through a macerator so that it is capable of passing through a screen with no opening wider than 25 mm.	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 4.1**
Good Practice				
Drilling and Completions 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 16.2**
Project 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 16.3**
MODU/project vessel ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable for 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 16.4**
Professional Judgement – Eliminate				
No additional controls identified.				

[23] Qualitative measure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/ Sacrifice (CS)[23]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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 risks and consequences of accidental discharges of waste. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that unplanned discharges from a release of solid hazardous and non-hazardous wastes represent a low current risk rating and may result in localised impacts with no lasting effect (<1 month) to water quality, habitats (but not ecosystems) and species. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice. The adopted controls are considered consistent with industry legislation, codes and standards, good practice and professional judgement and meet the expectations of Australian Marine Orders. Therefore, Woodside considers the adopted controls appropriate to manage risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 16 No unplanned release of solid hazardous or non-hazardous waste to the marine environment greater than a consequence level of F[24] during the Petroleum Activities Program	**C 4.1** See **Section 7.6.4**.	**PS 4.1** See **Section 7.6.4**.	**MC 4.1.1** See **Section 7.6.4**.
	C 16.2 Drilling and Completions 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 16.2** Hazardous and non-hazardous waste will be managed in accordance with the Drilling and Completions waste arrangements.	**MC 16.2.1** Records demonstrate compliance against Drilling and Completions waste arrangements.

[24] Defined as 'No lasting effect (less than one month). Localised impact not significant to areas or items of cultural significance)'.

	C 16.3 Project 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 16.3** Hazardous and non-hazardous waste will be managed in accordance with the project vessels' waste arrangements	**MC 16.3.1** Records demonstrate compliance against project vessels' waste arrangements.
	C 16.4 MODU/project vessel ROV, crane or support vessel may be used to attempt recovery of hazardous solid wastes lost overboard. Where safe and practicable for 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, ROV availability and suitable weather).	**PS 16.4** Any hazardous solid waste dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 16.4.1** Records detail the recovery attempt consideration and status of any hazardous waste lost to the marine environment.

7.7.8 Physical Presence: Vessel Collision with Marine Fauna

Context	
Project vessels **– Section 3.7**	Biological environment – **Section 4.5**

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 project vessels/MODU and protected marine fauna						X		A	E	1	L	LCS GP PJ	Broadly Acceptable	EPO 17

Description of Source of Risk

The project vessels operating in and around Operational Area A may present a potential hazard to cetaceans (e.g. pygmy blue whales) and other protected marine fauna, such as marine turtles and whale sharks. 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. Project vessels would typically be stationary or moving at low speeds when supporting the Petroleum Activities Program; support vessels typically transit to and from the Operational Areas between two and four trips per week (e.g. to port).

Impact Assessment

Potential Impacts to Protected Species

Vessel collisions with marine fauna have potential to occur within Operational Area A. Vessel disturbance is a key threat to a number of migratory and threatened species identified as occurring within the Operational Area including cetaceans, marine turtles and whale sharks. Relevant conservation actions outlined in these plans are outlined in **Table 4-3**. Three of these species have BIAs that intercept Operational Area A:

- pygmy blue whale migration corridor BIA
- flatback turtle internesting buffer BIA
- whale shark foraging BIA

Refer to **Section 4.5** for more information about these species and details of seasonal timings.

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 North West Shelf waters including the Operational Areas during their migrations to and from Ningaloo Reef. However, it is expected that whale shark presence within the Operational Areas would not comprise significant numbers and their presence would be transitory and of a short duration.

Turtles are also at risk from vessel strikes, particularly in shallow coastal foraging habitats and internesting areas where there are high numbers of recreational and commercial vessels (DoEE, 2018). While there is no specific breeding area within the Operational Areas, the presence of the flatback turtle internesting buffer BIA indicates they could be transiting the area, particularly during internesting periods (October to March). It is also acknowledged that there are numerous nesting areas along the mainland coast and islands; other species of turtles associated with these areas may also be observed transiting the Operational Areas. However, considering the distance of the Operational Areas from the nearest nesting beaches (Montebello Islands are more than 75 km away), it is expected that the presence of marine turtles, including flatback turtles, would be very unlikely and only comprise small numbers of individuals for short periods of time.

During the pygmy blue whale migration, there may be species present in the Operational Area. As with turtles and whale sharks, these species are at risk of vessel strikes when they are at the surface and in waters that are too shallow for them to dive. However, they are only expected to be observed in low numbers and for short periods of time.

Other fish and marine mammals may also be at risk of injury or mortality from vessels through being caught in thrusters during station keeping operations (i.e. DP). However, this is unlikely, given the low presence of individuals combined with the avoidance behaviour commonly displayed during station keeping operations.

The likelihood of vessel collisions with marine fauna largely depends on the speed at impact. The greater the speed, the greater the risk of mortality (Jensen and Silber, 2004; Laist *et al*., 2001). As an example of this, Vanderlaan and Taggart (2007) found that the chance of legal injury to a large whale from a vessel strike incident increased from about 20% at 8.6 knots to 80% at 15 knots. Furthermore, reported data contained in the US NOAA database (Jensen and Silber, 2004) shows there have only been two recorded instances of collisions with vessels travelling at less than six knots. Both of these were whale-watching vessels that were deliberately placed among whales and do not necessarily represent how project vessels would be positioned in relation to marine fauna. Specifically in relation to marine turtles, the draft National Strategy for Mitigating Vessel Strike of Marine Megafauna states that ‘a study by Hazel (2007) recorded 60% of green turtles fleeing from vessels travelling at 4 km/h [about two knots] while only 4% fled from vessels travelling at 19 km/h [about ten knots] and the study concluded that most turtles would be unlikely to avoid vessels travelling at greater than 4 km/h’ (DoEE, 2016).

It is unlikely that vessel movement associated with the Petroleum Activities Program will have a significant impact on marine fauna populations, given the low presence of transiting individuals and the low operating speed of the support vessels (generally less than eight knots or stationary, unless operating in an emergency).

Summary of Potential Impacts to Environmental Value(s)

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)***	***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[25]: • Project vessels will not travel greater than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project 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, project vessels will immediately withdraw from the caution zone at a	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 17.1**

[25]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)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
constant speed of less than six knots. • Project vessels will not travel greater 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 and foraging periods.	F: No. Timing of activities is linked to MODU schedule. Timing of all activities is currently not determined and, due to MODU availability and operational requirements, performing activities during migration 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				
No additional controls identified.				
The use of dedicated MFOs on support vessels for the duration of each activity to watch for whales and provide direction about and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes. However, vessel bridge crews already maintain a constant watch during operations in compliance with the Woodside Marine – Charterers Instructions on the requirements of vessel and whale interactions, and crew perform specific cetacean observation training. CS: Additional cost of MFOs considered unnecessary.	Given that support vessel bridge crews already maintain a constant watch during operations in compliance with the Woodside Marine – Charterers Instructions, additional MFOs would not significantly further reduce the risk.	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 risks and consequences of potential vessel collision with protected marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, a vessel collision with marine fauna represents a low current risk rating that may result in slight, short-term impacts (<1 year) to species. Relevant BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting and whale shark foraging BIAs. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice. The adopted controls are considered consistent with industry good practice and professional judgement and meet the requirements of Part 8 (Division 8.1) of the EPBC Regulations 2000. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 No vessel strikes with protected marine fauna (whales, whale sharks, turtles) during the Petroleum Activities Program.	**C 17.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[26]: • Project vessels will not travel greater than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project 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, project vessels will immediately withdraw from the caution zone at a constant speed of less than six knots. • Project vessels will not travel greater 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.	**PS 17.1** Compliance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to minimise the potential for vessel strike.	**MC 17.1.1** Records demonstrate no breaches with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.
		PS 17.2 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, CoA, 2015).	**MC 17.2.1** Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database.

[26]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.

7.7.9 Physical Presence: Disturbance to Seabed from Loss of Station Keeping

Context	
MODU – **Section 3.7.1** Project vessels – **Section 3.7**	Physical environment – **Section 4.4** Biological environment – **Section 4.5** Socio-economic – **Section 4.6** Values and sensitivities – **Section 4.7**

Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 and project vessels leading to seabed disturbance		X		X			A	E	1	L	GP PJ RBA	Broadly Acceptable	EPO 18

Description of Source of Risk

The MODU that is currently proposed to be used for the Petroleum Activities Program is a moored MODU with an eight to 12 point anchor mooring system. Although the specific MODU that will be used may change due to operational and contractual matters, the MODU is likely to have some form of similar anchor mooring system. The project vessels that are currently proposed to be used will hold station using a DP system; therefore, anchor drag from vessels is not credible.

High energy weather events such as cyclones 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 mooring lines and anchors attached to the MODU being trailed across the seabed. If mooring failure is sufficient, the MODU may move off station, increasing the likelihood of anchor drag across the seafloor.

When a moored MODU for the Petroleum Activities Program is used, personnel onboard 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 before MODU evacuation. Support vessels also demobilise from the Operational Areas during the passage of a cyclone and therefore do not present any risk of loss of station keeping during these types of events. 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 Areas as soon as safe to do so after a cyclone evacuation. Operational experience indicates cyclone evacuations typically last for seven days, but this depends on the weather system, and the length of the evacuation will primarily depend on safety considerations.

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 and 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 and Technology Consulting Inc., 2002).

NOPSEMA has recorded four cases of anchor drag due to loss of MODU station keeping during cyclone activity between 2004 and 2015 (NOPSEMA, 2015).

Impact Assessment
Potential Impacts to Benthic Communities
During cyclones, the MODU will stay positioned in Operational Area A. During the unlikely event of a cyclone resulting in the MODU breaking its moorings, the anchors could drag along the seabed, potentially disturbing benthic communities in the area. Anchor drag along the seabed is unlikely to cause significant environmental impact, as the benthic communities associated with Operational Area A are of low sensitivity and are broadly represented throughout the NWMR (**Section 4.7**). As described in **Section 4.7.2**, the Ancient Coastline at 125 m Depth Contour KEF is located within the Operational Areas. The habitat types associated with the hard substrate that characterises the Ancient Coastline at 125 m Depth Contour KEF are not considered to be unique by Falkner *et al*. (2009) in their review of KEFs in the NWMR. Given the depth of the Operational Areas, it is unlikely there will be any habitats other than soft sediments that would be impacted by anchor drag. As mentioned above, anchor drag incidents within the industry are very infrequent, and demobilising staff from the MODU during cyclones is a short-term event. Therefore, in the unlikely event that a MODU lost station, the incident would be responded to within a short period of time, limiting the damage that could be caused. Given the low sensitivity of the environment and the fact that anchor drag incidents are infrequent within the industry, it is unlikely that a loss of station keeping would result in significant impact on benthic communities.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, seabed disturbance from a loss of station keeping will result in impacts to soft sediment benthic communities would result in only slight, short-term local impacts (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***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 21 • 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 18.1**
Professional Judgement – Eliminate				
Only use a DP MODU (no anchoring required) for all wells.	F: No. CS: It is not technically feasible for the MODU to use DP in water depths less than 300 m. Woodside has demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Application of control would eliminate 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.				
Professional Judgement – Engineered Solution				
MODU tracking equipment operational when the MODU is 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 18.2**
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 2.1**
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.	Yes **C 18.3**

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 risks and consequences of seabed disturbance from a loss of station keeping. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that disturbance to seabed from a loss of station keeping represents a low current risk rating and may result in slight, short-term impacts (>1 year) on habitat (but not affecting ecosystems function), physical or biological attributes.

The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 No mooring failure for the MODU during the Petroleum Activities Program resulting in seabed disturbance greater than a consequence level E[27].	**C 18.1** Specifications and requirements for station keeping equipment (mooring systems), require that: • systems are tested and inspected in accordance with API RP 21 • systems have sufficient capability such that a failure of any single component will not cause progressive failure of the remaining anchoring arrangement.	**PS 18.1** MODU mooring system tested and in place to ensure no complete mooring failure.	**MC 18.1.1** Records demonstrate mooring system tests and inspection.
	C 18.2 MODU tracking equipment operational when the MODU is unmanned.	**PS 18.2** Tracking of the MODU is possible when the MODU is unmanned.	**MC 18.2.1** Records show the MODU has functional tracking equipment for instances when MODU is unmanned.
	C 18.3 Mooring system is tested to recommended tension as per API RP 2SK.	**PS 18.3** Monitoring compliant with ISO 19901-7:2013.	**MC 18.3.1** Records confirm mooring system is tested to recommended tension as per API RP 2SK.
	C 2.1 See **Section 7.6.2**.	**PS 2.1** See **Section 7.6.2**.	**MC 2.1.1** See **Section 7.6.2**.

[27] Defined as 'Slight, short term local impact (less than one year), on species, habitat (but not affecting ecosystem function), physical or biological attributes'.

7.7.10 Physical Presence: Dropped Object Resulting in Seabed Disturbance

Context	
MODU-based activities – **Section 3.7.1** Project vessel activities **– Section 3.7** Subsea cleaning and preparation **– Section 3.10.1** Permanent plugging activities – **Section 3.10**	Biological environment – **Section 4.5** Physical environment – **Section 4.4**

Risks Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	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 the disturbance of benthic habitat	X			X			A	F	2	L	LCS GP PJ	Broadly Acceptable	EPO 19

Description of Source of Risk

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

Impact Assessment

Potential Impacts to Benthic Communities

In the unlikely event of loss of an object being dropped into the marine environment, potential environmental effects would be limited to localised physical impacts on benthic communities. In most cases, objects will be able to be recovered and therefore these impacts will also be temporary in nature. However, there may be instances where objects are unable to be recovered due to health and safety, operational constraints or other factors such as the difficulty of recovering dropped objects at depth. When dropped objects are unable to be recovered, the impact will continue to be localised but would also 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 Areas are of low sensitivity and are broadly represented throughout the NWMR. As described in **Section 4.7.2**, the Ancient Coastline at 125 m Depth Contour KEF is located within the Operational Areas. The habitat types associated with the hard substrate that characterises the Ancient Coastline at 125 m Depth Contour KEF are not considered to be unique by Falkner *et al.* (2009) in their review of KEFs in the NWMR. Furthermore, benthic habitats in the Operational Areas are expected to consist of bare unconsolidated sediments dominated by silt and clay fractions, as well as those associated with the Echo Yodel subsea infrastructure proposed to be left in-situ (**Section 4.4.4**). Given the nature and scale of risks and consequences from dropped objects, seabed sensitivities associated with the Operational Areas 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 Value(s)

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)***[28]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
The MODU and project vessels' work procedures for lifts, bulk transfers and cargo loading, which require: • The security of loads shall be checked before commencing lifts. • Loads shall be covered if there is a risk of loss of loose materials. • Lifting operations shall 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 19.1**
MODU and project 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 19.2**
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 risks and consequences of seabed disturbance from dropped objects. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without disproportionate sacrifice, the risks and consequences are considered ALARP.				

[28] Qualitative measure.

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that a dropped object resulting in seabed disturbance represents a low current risk rating and may result in localised impacts with no lasting effect (<1 month) to environmental receptors. The adopted controls are considered consistent with industry good practice and professional judgement. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 No incidents of dropped objects to the marine environment greater than a consequence level of F[29] during the Petroleum Activities Program.	**C 19.1** The MODU and project vessels' work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked before 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 19.1** All lifts conducted in accordance with applicable MODU/ project vessels' work procedures to limit potential for dropped objects.	**MC 19.1.1** Records show lifts conducted in accordance with the applicable MODU/ project vessels' work procedures.
	C 19.2 MODU and project vessel inductions include control measures and training for crew in dropped object prevention.	**PS 19.2** Awareness of requirements for dropped object prevention.	**MC 19.2.1** Records show dropped object prevention training is provided to the MODU/ project vessels.

[29] Defined as 'No lasting effect (less than one month). Localised impact not significant to areas or items of cultural significance)'.

7.7.11 Physical Presence: Accidental Introduction and Establishment of Invasive Marine Species

Context		
Project vessels – **Section 3.7** MODU **– Section 3.7.1**	Physical environment – **Section 4.4** Biological environment – **Section 4.5** Socio-economic **– Section 4.6**	Stakeholder consultation – **Section 5**

Risks Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*						*Evaluation*						
	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 IMS				X	X	X	A	E	0	L	LCS	Broadly Acceptable	EPO 20

Description of Source of Risk

Vessels

During the Petroleum Activities Program, vessels will be transiting to and from the Operational Areas, potentially including traffic mobilising from beyond Australian waters. These project vessels may include the MODU, subsea support vessels, AHVs and support vessels such as vessels and barges (**Section 3.7**).

All vessels are subject to some level of marine fouling whereby organisms attach to the vessel hull. This could particularly occur in areas where organisms can find a good attachment surface (e.g. seams, strainers and unpainted surfaces) or where turbulence is lowest (e.g. niches, sea chests, etc). Organisms can also be drawn into ballast tanks during onboarding of ballast water as cargo is loaded or to balance vessels under load.

During the Petroleum Activities Program, project vessels have the potential to introduce IMS to the Operational Areas through marine fouling (containing IMS) on vessels as well as within high-risk ballast water discharge. Cross contamination between vessels can also occur (e.g. IMS translocated between project vessels) during times when vessels need to be alongside each other.

Impact Assessment

Potential Impacts to Ecosystems/Habitats, Species and Socio-economic Values

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. NIMS are only considered IMS when they result in impacts to environmental values and/or have social/cultural, economic and/or human health impacts.

Once introduced, IMS may prey on local species (which had previously not been subject to this kind of predation and therefore not have evolved protective measures against the attack), 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.

Potential IMS have historically been introduced and translocated around Australia by a variety of natural and human means, including marine fouling 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 deepwater ecosystems and open-water environments where the rate of dilution and the degree of dispersal are high (Williamson and Fitter, 1996; Paulay *et al*., 2002; Geiling, 2014).

While project vessels have the potential to introduce IMS into the Operational Areas, the deep offshore open waters of the Operational Areas (which are more than 100 m deep) are not conducive to the settlement and establishment of IMS. Furthermore, the Operational Areas are away from shorelines and/or critical habitat. The likelihood of IMS being introduced and establishing viable populations within the Operational Areas or immediate surrounds is considered not credible.

Summary of Potential Impacts to Environmental Value(s)

In support of Woodside's assessment of the risks and consequences of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of an IMS translocation. The results of this assessment are presented in **Table 7-15**.

As a result of this assessment, Woodside has assessed the potential consequence and likelihood after implementing the identified controls. This assessment concluded that the highest potential consequence is a 'D' and the likelihood is 'Remote' (0), resulting in an overall 'Low' risk.

Table 7-15: Evaluation of risks and impacts from IMS translocation

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Areas and establishment on the seafloor or subsea structures.	***Not Credible*** The Operational Areas are deep offshore open waters away from shorelines and/or critical habitat; therefore, they are not conducive to the settlement and establishment of IMS.		
Introduced to Operational Areas and establishment on a project vessel.	***Credible*** There is potential for the transfer of marine pests between project vessels within the Operational Areas.	***Environment – Not credible*** The translocation of IMS from a colonised MODU or project vessel to another vessel and then to the environment is not credible. This is because the Operational Areas are in deep open waters away from shorelines and/or critical habitat. Furthermore, the translocation to shallower environments via natural dispersion from a project vessel is not considered credible, given the distances of the Operational Areas from nearshore environments (i.e. greater than 12 nm/50 m water depth). On this basis there is no credible environmental risk. ***Reputation – D*** If IMS were to establish on a project vessel, including the MODU, from another colonised vessel, this could potentially impact the vessel operationally through the fouling of intakes, and potentially cause the infected vessels to be quarantined and requiring costly cleaning. Such introduction would be expected to have minor impact to Woodside's reputation, particularly with Woodside's contractors, and may impact future proposals. This would likely have a reputational impact on future proposals.	***Remote (0)*** Interactions between project vessels will be limited during the Petroleum Activities Program, with minimum 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 or spawning in these open ocean environments is also considered remote.

Transferred between project vessels and from project vessels to other marine environments beyond the Operational Areas.	***Not Credible*** This risk is considered so remote that it is not credible for the purposes of the activity. As described above, the transfer of IMS between project vessels was already considered remote, given the offshore open ocean environment. Project 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 that has good hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from the Operational Areas to shore. If it survived this trip, it would then need conditions conducive to establishing a viable population in the nearshore waters to which the infected vessel travels.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[1]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Project 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.	The use of an approved ballast water treatment system will reduce the likelihood of transfer of marine pests between project vessels within the Operational Areas. No change in consequence would occur.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	Yes **C 20.1**
Good Practice				
Woodside's IMS risk assessment process[30] applied to project vessels that enter the Operational Areas. 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.	F: Yes. CS: Minimal cost. Good practice implemented across all Woodside Operations.	The IMS risk assessment process will identify potential risks and additional controls implemented accordingly. In doing so, the likelihood of transferring marine pests between project vessels within the Operational Areas are reduced. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes **C 20.2**

[1] Qualitative measure.

[30] The correct management of IMS requires careful consideration of multiple complex factors. These range from an understanding of the vectors through which IMS can be introduced and spread, the maintenance and operational history of vessels proposed to be used, climatic conditions, existing baseline data of past and proposed transit and operational areas and consideration of different regulatory frameworks. Woodside's risk-based process also delivers continued value to Woodside by reducing the risk of delays and increased operational costs, while delivering excellent marine biosecurity and environmental outcomes. Woodside's approach has been validated through a proactive program that engaged stakeholders during development of the methodology. This included Woodside personnel, scientific input and review by experienced external IMS consultants, recognised industry experts and liaison with regulatory agencies and vessel contractors. The result is a fit-for-purpose biofouling management process that is now embedded within Woodside's marine systems, procedures and contractual requirements.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[1]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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 vessels including the MODU and support vessels.	F: No. Given that vessels must be used to complete the Petroleum Activities Program, there is no feasible means to eliminate the source of risk. CS: Loss of the project.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
Source project vessels based in Australia only.	F: Potentially. While the project will attempt to source support vessels locally, availability is not guaranteed. There are limited project vessels based in Australian waters and sourcing Australian-based vessels only will cause increases in cost due to pressures of vessel availability. CS: Significant cost and schedule impacts due to supply restrictions.	Sourcing vessels from within Australia will reduce the likelihood of IMS from outside Australian waters; however, it does not reduce the likelihood of introducing species native to Australia but alien to the Operational Areas. It also does not prevent the translocation of IMS that have established elsewhere in Australia. Therefore, the consequence is unchanged.	Disproportionate. Sourcing vessels from Australian waters may result in a slight reduction in the likelihood of introducing IMS to the Operational Areas but it does not completely eliminate the risk. Furthermore, the potential cost of implementing this control could be high, given the potential supply issues associated with only locally sourcing vessels.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[1]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
IMS inspection of all vessels.	F: Yes. CS: Significant cost and schedule impacts. In addition, Woodside's IMS risk assessment process is seen to be more cost-effective as this control allows Woodside to manage the introduction of IMS 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 Areas. However, this reduction is unlikely to be significant, given the other control measures implemented. No change in consequence would occur.	Disproportionate. The cost/sacrifice outweighs the benefit gained, as other controls that are proposed to be implemented achieve an ALARP position.	No
Professional Judgement – Engineered Solution				
None 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 that the adopted controls are appropriate to manage the risks and consequences of IMS introduction. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without disproportionate cost, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that the accidental introduction and establishment of IMS represents a low current risk rating and may result in slight, short-term impacts (>1 year) on habitat (but not affecting ecosystems function) or biological attributes. BIAs within the Operational Area include the pygmy blue whale migration, flatback turtle internesting, whale shark foraging, and wedge-tailed shearwater breeding BIA. However, these species are not expected to be impacted. The adopted controls are considered consistent with industry legislation, codes and standards. Therefore, Woodside considers the adopted controls appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 20 No introduction and establishment of IMS into the Operational Areas as a result of the Petroleum Activities Program.	**C 20.1** Project 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 20.1** Prevents the translocation of IMS within the vessel's ballast water from high-risk locations to the Operational Areas.	**MC 20.1.1** Ballast Water Records System maintained by vessels which verifies compliance against Australian Ballast Water Management Requirements.
	C 20.2 IMS risk assessment process applied to project vessels that enter the Operational Areas. 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.	**PS 20.2** Minimise the likelihood of translocating IMS within a vessel's biofouling to the Operational Areas.	**MC 20.2.1** Records of IMS risk assessments maintained for all project vessels performing the Petroleum Activities Program.
			MC 20.2.2 Records maintained of management measures that have been implemented where identified through the IMS Vessel Risk Assessment process.

7.8 Planned Activities (Routine and Non-routine) for Leaving Infrastructure In-situ

7.8.1 Physical Presence: Disturbance to Other Users from Echo Yodel Subsea Infrastructure Being Left In-situ Permanently

Context		
Leave infrastructure in-situ permanently – **Section 3.14**	Socio-economic environment – **Section 4.6**	Stakeholder consultation – **Section 5**

Impacts Evaluation Summary

Source of Impact	*Context*						*Evaluation*						
	Marine Sediment	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Impact*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Presence of Echo Yodel subsea infrastructure left in-situ permanently causing interference with or displacement to third-party vessels (commercial fishing)						X	B	E	-	-	LCS GP PJ	Broadly Acceptable	N/A

Description of Source of Impact

Presence of Subsea Infrastructure

The Petroleum Activities Program will include the permanent abandonment of Echo Yodel subsea infrastructure in-situ, resulting in a permanent presence on the seabed and an ongoing potential for interaction with third-party activities in Operational Area B.

Impact Assessment

Potential Impacts to Socio-Economic Environment

Displacement or Interference with Commercial Fishing Activities

Operational Area B overlaps three Commonwealth and ten State managed fisheries. However, only the Pilbara Demersal Scalefish Managed Fisheries (Pilbara Trawl, Trap and Line) are considered to be active in the vicinity. Operational Area B is located in water depths ranging from about 140 to 160 m, the shallower extent of which is within the depth range where typical fishing effort occurs for the Pilbara Line Fishery. However, the area surrounding Operational Area B is prohibited to trawling, so there is no risk of impact from Echo Yodel subsea infrastructure being left in-situ.

There is potential for ongoing positive and adverse impacts to commercial fishers from the Echo Yodel subsea infrastructure being left in-situ. The adverse impacts would mostly relate to snagging hazards of fishing gear; however, because trawling activities within Operational Area B are covered under Schedule 5 Prohibited Trawl Fishing and infrastructure will continue to be shown on navigational charts, adverse impacts are unlikely. In terms of positive impacts, the Echo Yodel subsea infrastructure provides habitat for commercial fish species (**Section 4.5.1**) and therefore provides a potential long-term economic benefit to commercial fisheries from leaving the Echo Yodel subsea infrastructure in-situ. This position was validated by the DPIRD who was consulted specifically in relation to this EP (see **Appendix F** and **Section** 5), whereby DPIRD encouraged titleholders to abandon wells and infrastructure sites in conditions that would allow for future fishing operations. Furthermore, and as discussed in **Section 4.5.1**, studies into the relative biomass of commercially important fish species found that biomass was, on average, 7.5 times higher along the Echo Yodel subsea infrastructure than in adjacent natural habitat, and the average catch value of fish observed averaged 8.5 times higher than the catch value of fish off the pipeline (Woodside, 2017). These results indicate there would be benefits to commercial fishers from larger, more valuable catches (Woodside, 2017).

Stakeholder consultation and studies commissioned by Woodside into the habitat and fish species present on and around the Echo Yodel subsea infrastructure were also considered in the comparative assessment, described in **Section 6**, where leaving Echo Yodel subsea infrastructure in-situ was found to deliver better social outcomes than full removal of the Echo Yodel subsea infrastructure.

Displacement of Recreational Fishing

Recreational fishing is unlikely to occur in Operational Area B due to its depth and distance from shore. Stakeholder consultation did not identify any recreational activities that could be impacted by the activity.

Recreational fishing in the region is concentrated around the coastal waters and islands of the NWMR, such as the Montebello Islands (about 75 km from the Operational Area B). Due to the distance offshore and water depths, recreational fishing is unlikely to occur in Operational Area B.

Impacts to recreational fishing from the long-term presence of Echo Yodel subsea infrastructure, including the pipeline, being left in-situ, is not likely. Considering the depth of Operational Area B, distance from shore and the infrastructure being on navigational charts, it is unlikely there will be any interactions between recreational fishers and the infrastructure. The potential impacts to recreational fishing have been further considered during the comparative assessment (**Section 6**), which determined that leaving the Echo Yodel subsea infrastructure in-situ delivered greater social benefits than complete removal of the Echo Yodel subsea infrastructure.

Displacement to Commercial Shipping

A designated shipping fairway overlaps Operational Area B, where the Echo Yodel subsea infrastructure is proposed to be left in-situ. Shipping in the area is mainly related to the resources industry.

Consultation with AMSA confirmed there are minimal concerns to commercial shipping activities from the pipeline and EHU being left in-situ. During Phase 1 stakeholder consultation, AMSA advised that its preference for wellheads was to at least remove the X-mas tree from above the wellhead if left in-situ, to minimise navigational safety aspects of the remaining infrastructure. This information was considered during the comparative assessment (**Section 6**) and it was concluded that there is likely to be a negligible navigational safety risk from the Echo Yodel subsea infrastructure being left in-situ. This concern was not raised by AMSA during Phase 3 stakeholder consultation.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that interference with other marine users from the physical presence of the Echo Yodel subsea infrastructure left in-situ will be localised, with minimal lasting impact to shipping and commercial/recreational fishing interests (i.e. Social and Cultural Impacts – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Remove all Echo Yodel subsea infrastructure.	F: Yes. CS: Expensive compared to alternative options.	Removing Echo Yodel subsea infrastructure will result in the environment being left in a condition close to what it was before the Echo Yodel development. It would remove any potential hazards on the seabed for marine users. However, it would potentially decrease valuable fisheries resource due to the removal of habitat. The benefits of leaving the Echo Yodel subsea infrastructure in-situ are further explained in **Section 6**.	Cost of the control to the marine users and to Woodside is disproportionate to the benefits of leaving the Echo Yodel subsea infrastructure in-situ. Leaving the Echo Yodel subsea infrastructure in-situ was compared to complete removal of it during the comparative assessment detailed in **Section 6**. This assessment found there are social benefits of leaving the Echo Yodel subsea infrastructure in-situ.	No
Ongoing, regular surveys of the Echo Yodel subsea infrastructure left in-situ.	F: Yes. CS: Expensive ongoing control.	Inspections and surveys of the Echo Yodel subsea infrastructure have been performed most recently in 2018, as have studies, that determined the pipeline is behaving as anticipated and it will self-bury over time while slowly degrading (**Section 3.14**). Potential impacts resulting from the degradation have also been considered (**Section 7.8.3**). Regular inspections of the Echo Yodel subsea infrastructure will not result in a tangible social benefit.	Cost of the control is disproportionate to the social benefit that may be gained from it.	No
Professional Judgement – Eliminate				
No controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Engineered Solution				
Over-trawl protection on wellhead and X-mas trees.	F: Yes. Over-trawl protection could mitigate against the potential for commercial fishing trawl gear to damage subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional costs.	Reduce the potential for snagging of trawl nets if subsea infrastructure is left in-situ. However, given the subsea infrastructure is in an area closed to trawling, the benefit is negligible. A comparative assessment, including consultation with commercial fisheries, did not identify the requirement for such controls.	Disproportionate. Significant additional costs.	No
Rock dump along pipeline/umbilical.	F: Yes. Rock dumping could mitigate against the potential for commercial fishing trawl gear to damage subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional costs.	Reduce the potential for snagging of trawl nets if subsea infrastructure is left in-situ. However, given the low level of trawling activity occurring in the Operational Areas, the benefit is low. A comparative assessment, including consultation with commercial fisheries, did not identify the requirement for such controls. Studies have shown that the pipeline/umbilical will self-bury over time.	Disproportionate. Significant additional costs.	No
Trenching and burial of pipeline/umbilical.	F: Yes. Trenching/burial could mitigate against the potential for commercial fishing trawl gear to damage subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional costs.	Reduce the potential for snagging of trawl nets if subsea infrastructure is left in-situ. However, given the low level of trawling activity occurring in the Operational Areas, the benefit is low. A comparative assessment, including consultation with commercial fisheries, did not identify the requirement for such controls. Studies have shown that the pipeline/ umbilical will self-bury over time.	Disproportionate. Significant additional costs.	No

ALARP Statement

On the basis of the environmental impact assessment outcomes, the comparative assessment (**Section 6**) and use of the relevant tools appropriate to the decision type (i.e. Decision Type B; **Section 2.7.1**), Woodside considers that no controls are required to manage the impacts of the physical presence of the Echo Yodel subsea infrastructure left in-situ on other users, such as commercial fisheries, recreational fishing, shipping and defence.

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

Demonstration of Acceptability		
Acceptability Criteria and Assessment	***Acceptable Level(s) of Impact***	***Statement of Acceptability***
Principles of ESD The Petroleum Activities Program is consistent with the relevant principles of ESD: • decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations • the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations • the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. **Internal Context** The Petroleum Activities Program is consistent with Woodside corporate policies, culture, processes, standards, structure and systems 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**). **External Context** Feedback during stakeholder consultation (**Section 5**) supports the outcome from comparative assessment (**Section 6**) that leaving the Echo Yodel subsea infrastructure in-situ delivers greater environmental outcomes than full removal of the infrastructure. Specifically, feedback from DPIRD, a licence holder from the Pilbara Trap Fishery licence, Recfishwest, and WAFIC was supportive of the decision to leave the infrastructure in-situ permanently provided that a robust comparative assessment on the potential decommissioning options had been completed, impact assessment had been undertaken on the selected option and regulatory commitments have been met. No stakeholders raised concerns which were not addressed as part of consultation and through the adoption of controls. **Other Requirements** The decommissioning option selected during comparative assessment is consistent with the *OPGGS Act (2006)* Subsection 270(3) and 572(3) and the *Environmental Protection (Sea Dumping) Act 1981*. No other requirements have been identified. Leaving the Echo Yodel subsea infrastructure in-situ will deliver better social outcomes than full removal of the Echo Yodel subsea infrastructure	The selected decommissioning option meets the requirements of Section 572(3) and Section 270(3)(c) of the OPGGS Act and the Environment Protection (Sea Dumping) Act 1981.	The predicted level of impact to commercial fishers, recreational fishers and commercial shipping is considered to be at or below the defined acceptable levels of impact given • leaving the Echo Yodel subsea infrastructure in-situ will deliver better social outcomes for fishers than full removal of the Echo Yodel subsea infrastructure • the predicted impact to commercial shipping is negligible. **Environmental Performance Consideration** The impact is considered acceptable in its current state. Therefore, no EPO has been applied.

7.8.2 Physical Presence: Disturbance to Benthic Habitat from Echo Yodel Subsea Infrastructure Being Left In-situ Permanently

Context	
Leave infrastructure in-situ permanently – **Section 3.14**	Biological environment – **Section 4.5** Values and sensitivities – **Section 4.7**

Impacts Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Disturbance to benthic habitat from Echo Yodel subsea infrastructure remaining permanently in-situ				X		X	A	E	-	-	-	Broadly Acceptable	N/A

Description of Source of Impact

Echo Yodel Subsea Infrastructure Remains In-Situ

The Petroleum Activities Program includes leaving the Echo Yodel subsea infrastructure in-situ permanently. This will result in infrastructure being left on the seabed, with associated impact being localised to Operational Area B.

Impact Assessment

Potential Impacts to Ecosystems/Habitats

Benthic Habitats

Leaving Echo Yodel subsea infrastructure in-situ is likely to result in localised, physical modification to the seabed and localised disturbance to soft sediments.

Operational Area B overlaps a section of the Ancient Coastline at 125 m Depth Contour KEF. Operational Area B is expected to consist primarily of fine carbonate sediments, which are typical of the broader NWMR, but may have areas of hard substrate, which is typical of the Ancient Coastline at 125 m Depth Contour KEF. Benthic communities of Operational Area A associated with this substrate show typical low diversity representative of the wider region.

Physical impacts from the Petroleum Activities Program are expected to be for the most part confined to sediment-burrowing infauna and surface epifauna invertebrates, particularly filter feeders, inhabiting the seabed directly around the subsea infrastructure locations and on the infrastructure. Activities at the wellhead locations may therefore temporarily disturb these artificial habitat and associated fauna, as well as causing minor disruption to infauna around the wellheads. These impacts are expected to be localised and mainly restricted to the footprint of the infrastructure and small areas around it.

There have been a number of studies into the ecosystem value of the Echo Yodel subsea infrastructure being left in-situ. As discussed in **Section 4.5.1**, these studies found that the Echo Yodel subsea infrastructure provides valuable benthic habitat. In particular, McLean *et al.* (2017) assessed the fish assemblages and habitats formed by colonising invertebrates on a number of wellheads and subsea infrastructure, including the Yodel wellheads. This study found, among other things, that there was habitat for commercially significant fish species as well as EPBC Act listed vulnerable species, such as the grey nurse shark. Bond *et al* (2018a) found that species richness was, on average, 25% higher on the Echo Yodel pipeline than in other areas nearby and species abundance was nearly double. Bond *et al.* (2018a) also confirmed that, compared to adjacent natural seabed habitats, pipeline fish fauna were characterised by higher relative abundance and biomass of commercially important species. While over time this infrastructure may become buried in sediment, in the medium to long term the Echo Yodel subsea infrastructure being left in-situ as part of the Petroleum

Activities Program will retain these hard substrates that provide fauna habitat. As confirmed by Atteris (2018, 2019), the Echo Yodel pipeline is expected to self-bury to an average of about 85% of its overall diameter and the umbilical is expected to self-bury to an average of about 95% of its overall diameter. As the infrastructure self-buries, the habitat will reduce; however, this is expected to occur over a long period of time (up to 1700 years).

Based on the above assessment, seabed disturbance is unlikely to impact the ecological value of the Operational Areas and surrounding environment, including the Ancient Coastline at 125 m Depth Contour KEF, and leaving the Echo Yodel subsea infrastructure in-situ provides additional benthic habitat.

Note that the pipeline was tested for NORMs and mercury contamination, with tests concluding that there was no contamination from either present. As such, no environmental effects from either is expected. The results are explained in further detail below.

Naturally occurring radioactive material (NORM) is the term used to describe materials containing radionuclides that exist in the natural environment. The radionuclides of interest include long-lived radionuclides such as uranium-238 and their radioactive decay products (such as isotopes of radium, radon, polonium, bismuth and lead) (ARPANSA, 2008). NORM is widely distributed, and gives rise to a natural radiation background that varies by approximately two orders of magnitude over the Earth, and even more if localised mineral deposits are taken into account. This means every living species is exposed to this radiation, and in most situations this exposure is not amenable to control. There appears to be no scientific evidence relating general variations in this natural background to health effects (ARPANSA, 2008).

These radiation materials can either precipitate inside the pipeline in the form of scale, or create surface contamination on the inside of pipelines during hydrocarbon production.

As naturally occurring radiation background levels were not practicable to obtain at the sea bed, and no recordings of background readings in the area were found, and no current regulatory limits within Australia have been derived for the protection of non-human biota in marine ecosystem, a conservative approach has been taken to estimate what the readings of up to 0.11 µSv/h mean.

The guidance provided by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) to assessing potential or likely effects of ionising radiation on marine life (and humans) involves estimations of the dose and/or the dose rate (ARPANSA, 2015). The absorbed dose (energy absorbed per unit mass of the material with which the radiation interacts) is measured in the unit gray (Gy). Protection of people from radiation is often measured in equivalent dose and effective dose[31]. Both of these quantities are measured in the unit sievert (Sv). Limits, constraints and reference levels for protection of people are normally set in equivalent or effective dose.

There are currently no defined radiation protection quantities specific for protection of marine flora and fauna. The necessary information of the impact of different types of radiation on marine life does not currently exist (ARPANSA, 2015). However, conservatively it can be assumed that the effect of ionising radiation on the environment is proportional to the absorbed dose and for long-term exposure, the absorbed dose rate. This is measured in microgray per hour (µGy/h). For simplicity, 1 Sv can be assumed to be equivalent to 1 Gy.

ARPANSA conducted an international literature review and analysis of the radiation effects on the environment to identify any exposure levels for a range of organism types. One study was identified that had investigated marine organisms. The International Commission on Radiological Protection (ICRP) reported in 2008, effect level bands for crab, flatfish and brown seaweed, where effects may occur to individuals of that type of reference animal or plant. The following are the reported value (ARPANSA, 2015):

- crab: 400–4000 µGy/h
- flatfish: 40–400 µGy/h
- brown seaweed: 40–400 µGy/h

Based on the above, and assuming that organisms growing or residing in close proximity to the pipeline are exposed to a constant dose, and that the full dose rate (0.11 µSv/h) is the total absorption rate (0.11 µGy/h), the rate of radiation exposure from the Echo Yodel pipeline is less than 1% of the lowest effect level rate measured for marine organisms (40 µGy/h for flatfish and brown seaweed). Further to this, a comparison to the default screening level for environmental impacts used in the ERICA tool (a software system used for assessing radiological risk to terrestrial, freshwater and marine biota) has been made. The ERICA tool uses 10 µGy/h as the default level at which no effects would be observed, which is considered conservative in itself (ARPANSA, 2015). As such, the pipeline is not considered contaminated with NORMs.

Mercury vapour testing, non-destructive and destructive testing for mercury contamination was conducted on a recovered section of the pipeline in 2018. 0.000003 mg/kg mercury was calculated to be present. Mercury is a naturally occurring element that is found in air, water and soil and concentrations in marine sediment varies depending on location. For the Pilbara coast, the background concentration has been recorded as 20 µg/kg (DEC, 2006). The concentration in the pipeline, is well below the naturally occurring concentrations of mercury in the area.

[31] Equivalent dose and effective dose measured in Sv is used to factor in the relative effectiveness of different types of radiation in causing health effects. This is acheived by applying a radiation weighting factor, and to consider sensitivities of tissues and organs, to derive the radiation protection quantities equivalent dose and effective dose (ARPANSA, 2015).

However, for the protection of marine organisms to mercury in sediment, the default trigger values from the Australian and New Zealand Environment and Conservation Council (ANZECC) (ANZECC/ARMCANZ, 2013) for mercury in sediments are:

- Low Trigger Level: 0.15 mg/kg (dry weight) – This is the threshold concentration above which toxic effects may occur.
- High Trigger Level: 1 mg/kg (dry weight) – Above this concentration, toxicity to sediment dwelling organisms is expected.

The concentration of mercury in the Echo Yodel pipeline is therefore far below the Low ANZECC trigger threshold for definition of mercury contamination and negligible in comparison to the local background concentration. The pipeline is therefore not considered mercury contaminated.

Cumulative Impacts

Leaving the Echo Yodel subsea infrastructure in-situ may contribute to broader, region-wide, positive impacts, as it is likely the other oil and gas infrastructure in proximity to the Echo Yodel subsea infrastructure also provides habitat.

Summary of Potential Impacts to Environmental Value(s)

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)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Remove all Echo Yodel subsea infrastructure.	F: Yes. CS: Expensive compared to alternative options.	Removing Echo Yodel subsea infrastructure will result in the environment being left in a condition close to what it was before the Echo Yodel development. However, it would potentially decrease valuable fisheries resource due to the removal of habitat. The benefits of leaving the Echo Yodel subsea infrastructure in-situ are further explained in **Section 6**.	Cost of the control to the environment and to Woodside is disproportionate to the benefits of leaving the Echo Yodel subsea infrastructure in-situ. Leaving the Echo Yodel subsea infrastructure in-situ was compared to complete removal of it during the comparative assessment detailed in **Section 6**. This assessment found that there are environmental benefits of leaving the Echo Yodel subsea infrastructure in-situ.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Ongoing, regular surveys of the Echo Yodel subsea infrastructure left in-situ.	F: Yes. CS: Expensive ongoing control.	Inspections and surveys of the Echo Yodel subsea infrastructure have been performed, as have studies, that determined the pipeline is behaving as anticipated and it will self-bury over time while slowly degrading (**Section 3.14**). Potential impacts resulting from the degradation have also been considered (**Section 7.8.3**). Regular inspections of the Echo Yodel subsea infrastructure will not result in a tangible environmental benefit that cannot be readily predicted based on existing studies.	Cost of the control is disproportionate to the environmental benefit that may be gained from it.	No
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 impact assessment outcomes, comparative assessment (**Section 6**) and use of the relevant tools appropriate to the decision type (i.e. Decision Type A, **Section 2.7.1**), Woodside considers that no additional controls are required to manage the impacts of benthic habitat disturbance from leaving Echo Yodel subsea infrastructure in-situ. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that disturbance to benthic habitat from the Echo Yodel subsea infrastructure being left in-situ permanently may result in slight and short-term effects (<1 year) to habitat (but not affecting ecosystems function), physical and biological attributes of deepwater benthic habitats. **Section 6** of this EP demonstrates that leaving the Echo Yodel subsea infrastructure in-situ delivers greater environmental outcomes than full removal of the infrastructure. Given this, Woodside considers the impact broadly acceptable in its current state.

7.8.3 Routine and Non-routine Discharges: Echo Yodel Subsea Infrastructure Being Left In-situ Permanently

Context	
Leave infrastructure in-situ permanently – **Section 3.14**	Physical environment – **Section 4.4** Biological environment – **Section 4.5**

Impacts Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Impact***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Corrosion and breakdown of the Echo-Yodel subsea infrastructure left in-situ	X	X		X			A	F	-	-	-	Broadly Acceptable	N/A
Discharge of project fluids as Echo Yodel subsea infrastructure left in-situ breaks down	X	X		X		X	A	F	-	-	-		

Description of Source of Impact

Corrosion and Breakdown of the Echo Yodel Pipeline and Umbilical

The studies found that the Echo Yodel pipeline consists of stainless steel coated by polymers; therefore, degradation of the pipeline would primarily be from degradation of polymers and corrosion of the stainless steel. The degradation of the polymers would be through material embrittlement/breakdown and biotic degradation, leading to the eventual release of small polymer fragments (Atteris, 2019a). Corrosion of the stainless steel would primarily be from the exposure to the environment after the polymer coating loses integrity and becomes ineffective (Atteris, 2019b). It was also found that the Echo Yodel pipeline has been subject to self-burial processes, resulting in it lowering into the seabed. Also, during the degradation process, some material will remain buried and some will be dispersed in the marine environment.

It is expected that most of the degradation products will remain buried in the seabed and the rest will be dispersed by wave and current activity. This may result in 2013 tonnes of steel corrosion product remaining buried and 912 tonnes dispersed, as well as 170 tonnes of polymer remaining buried and 77 tonnes being dispersed (Atteris, 2019a). It is expected to take between 700 and 1700 years for the pipeline to degrade; hence, release of degraded pipeline products would be expected to be a negligible rate (Atteris, 2019a) (**Figure 3-8**). Furthermore, the self-burying of the pipeline is expected to average about 85% of the overall outside diameter being buried within about 125 years (Atteris, 2019a).

Testing has been conducted on the Echo Yodel pipeline which has shown that no mercury or NORMs scale are present.

Atteris (2019b) found that the Echo Yodel umbilical and controls systems consists of metals (steel and copper) and polymers (high density polyethylene) and are expected to be subject to degradation of polymers and corrosion of metals. The degradation of the polymers would be through material embrittlement/breakdown and biotic degradation leading to the eventual release of small polymer fragments (Atteris, 2019b). Corrosion of the stainless steel would primarily be from the exposure to the environment after the polymer coating loses integrity and becomes ineffective (Atteris, 2019b). The Echo Yodel umbilical has also been subject to self-burial whereby it is in the advanced stage of burial; therefore, when considering how it might degrade, it is important to understand that some degraded material will remain buried and others will be dispersed to the marine environment.

Corrosion of the umbilical steel is expected to result in 26 tonnes buried and 147 tonnes dispersed; corrosion of the copper is expected to result in 15.3 tonnes left buried and 2.3 tonnes being dispersed (Atteris, 2019b). Degradation of the umbilical polymer is expected to consist of 115 tonnes of buried material and 29 tonnes being dispersed. Due to the exposed nature of the umbilical control system, their full mass is expected to be dispersed and about 18 m³ of MEG, 21 m³ of hydraulic fluid and 270 L of mineral oil will be released. Degradation of the umbilical is expected to occur over about 1500 years and degradation of the control systems is expected to occur over about 130 years; hence, release of degraded pipeline products would be expected to be at a negligible rate (Atteris, 2019b) (**Figure 3-10**). It was also found that the umbilical is already at the advanced stage of this process and is expected to have reached an average of 95% of its overall outside diameter buried within about 60 years (Atteris, 2019a). As the umbilical is exposed, it may attract marine growth (Atteris, 2019b).

Corrosion and Breakdown of the Echo Yodel Wellheads, X-mas Trees, IUTB, UTA and Pig Launcher

Corrosion of the wellheads, X-mas trees, IUTB, UTA and pig launcher over time could result in the release of trace amount of metals (e.g. iron and manganese) and small amounts of elastomeric materials, such as Teflon, to the water column and surrounding sediments (**Section 3.6**). Due to the robustness of the materials involved, corrosion is likely to be a relatively slow process of about 0.2 mm/year (Melchers, 2005).

Iron, which is the main constituent of wellheads (around 97%), is not considered a significant contaminant in the marine environment and is only toxic to marine organisms at extremely high concentrations (Grimwood and Dixon, 1997). As other constituents represent less than 5% of the X-mas tree and wellhead composition, impacts to marine sediments and organisms are not expected over time. This is due to their small mass and the slow rate at which they would enter the marine environment.

Given the low toxicity of iron, the slow release rate and rapid dilution of the open ocean environment, it is likely that any impacts to marine sediments, benthic habitats and water quality will be largely localised and not significant.

Discharge of Project Fluids as Echo Yodel Subsea Infrastructure Breaks Down

Echo Yodel subsea infrastructure will be left in-situ with small amounts of chemicals such as residual hydraulic fluid, treated seawater and MEG. Specifically, the X-mas trees and other well control infrastructure at the Yodel-3 and Yodel-4 wells contain about 27 kg of mineral oil that will be discharged to the marine environment as the equipment corrodes and breaks down; the Echo Yodel pipeline contains just over 1500 m³ of seawater that has been treated with 1000 ppm of biocide, oxygen scavenger and corrosion inhibitor (Hydrosure 0-3670R); and, the Echo Yodel umbilical contains about 18 m³ of MEG and 21 m³ of water-based hydraulic fluid.

Impact Assessment

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

Pelagic and benthic habitats in Operational Area B are considered to be of low sensitivity (no known significant benthic habitat or infauna habitat). Although the Ancient Coastline at 125 m Depth Contour KEF overlaps with Operational Area B, the values and sensitivities of this KEF occur on a broad scale outside of Operational Area B (**Section 4.7.2**).

Over time, the Echo Yodel subsea infrastructure left in-situ will begin to break down, causing contamination of surrounding sediments with metal and plastic flakes. This is expected to occur over a very prolonged time. Impacts are expected to be highly localised (within Operational Area B), with temporary impacts to water quality before the materials settle on the seabed.

Subsea chemicals gradually released to the environment from the Echo Yodel subsea infrastructure, such as MEG, preservation fluid and residual substances from the Yodel-3 and Yodel-4 wells, would be diluted, discharged locally and would pose little threat to the environment. Particularly, MEG is included on OSPAR's PLONOR list as it is biodegradable and water soluble. Furthermore, all subsea chemicals used in the Echo Yodel subsea infrastructure were selected in accordance with Woodside's defined chemical assessment framework, which requires potential impacts to the environment from chemicals to be ALARP before use.

Given the highly localised nature of the small volumes of discharges and potential impacts, cumulative impacts to marine biota, water quality and sediments would be minor.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls, it is considered that the discharge of products from the breakdown of the Echo Yodel subsea infrastructure 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 – F). Any localised impact to marine fish is not expected to impact on any commercial fishers in the area.

It is also considered that the long-term benefit of leaving abandoned infrastructure in-situ outweighs the low volume of substance released to the marine environment from the long-term corrosion of that infrastructure.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Remove all Echo Yodel subsea infrastructure.	F: Yes. CS: Expensive compared to alternative options.	Removing Echo Yodel subsea infrastructure will result in the environment being left in a condition close to what it was before the Echo Yodel development. It would remove any potential hazards on the seabed for marine users. However, it would potentially decrease valuable fisheries resource due to the removal of habitat. The benefits of leaving the Echo Yodel subsea infrastructure in-situ are further explained in **Section 6**.	Cost of the control to the marine users and to Woodside is disproportionate to the benefits of leaving the Echo Yodel subsea infrastructure in-situ. Leaving the Echo Yodel subsea infrastructure in-situ was compared to complete removal of it during the comparative assessment detailed in **Section 6**. This assessment found that there are social benefits of leaving the Echo Yodel subsea infrastructure in-situ.	No
Ongoing, regular surveys of the Echo Yodel subsea infrastructure left in-situ.	F: Yes. CS: Expensive ongoing control.	Inspections and surveys of the Echo Yodel subsea infrastructure have been performed, as have studies, that determined the pipeline is behaving as anticipated and it will self-bury over time while slowly degrading (**Section 3.14**). Regular inspections of the Echo Yodel subsea infrastructure will not result in a tangible social benefit.	Cost of the control is disproportionate to the social benefit that may be gained from it.	No
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 impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the impacts of the corrosion and breakdown of Echo Yodel subsea infrastructure left in-situ. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that routine and non-routine discharges from the Echo Yodel subsea infrastructure being left in-situ permanently may result in localised impacts with no lasting effect (<1 month) to deepwater benthic habitats. **Section 6** of this EP demonstrates that leaving the Echo Yodel subsea infrastructure in-situ delivers greater environmental outcomes than full removal of the infrastructure. Given this, Woodside considers the impact broadly acceptable in its current state.

7.9 Unplanned Activities (Accidents, Incidents, Emergency Situations) for Leaving Infrastructure In-situ

7.9.1 Unplanned Discharges: Instantaneous Release of Fluids from Infrastructure Damage

Context	
Leave infrastructure in-situ permanently – **Section 3.14**	Physical environment – **Section 4.4** Biological environment – **Section 4.64.54.5**

Impacts Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*						*Evaluation*						
	Marine Sediment	*Water Quality*	*Air Quality (incl Odour)*	*Ecosystems/Habitat*	*Species*	*Socio-Economic*	*Decision Type*	*Consequence*	*Likelihood*	*Current Risk Rating*	*ALARP Tools*	*Acceptability*	*Outcome*
Anchor drag rupturing pipeline leading to instantaneous release of preservation fluid in Echo Yodel subsea infrastructure left in-situ	X	X		X		X	A	F	1	L	GP PJ	Broadly Acceptable	EPO 21

Description of Risk

Accidental rupture of the Echo Yodel Pipeline

The Echo Yodel subsea infrastructure will be permanently left in-situ, including the Echo Yodel pipeline which has been decommissioned and left in-situ with preservation fluids inside.

With the Echo Yodel subsea infrastructure left in-situ, its continued permanent presence on the seabed introduces potential for vessel activities in the area to drag anchor over the Echo Yodel pipeline. This would potentially damage and rupture the pipeline, leading to the instantaneous release of the full inventory of the pipeline to the marine environment. Depending on when this happened, it may be that the biocide within the Echo Yodel pipeline would have had less time to degrade within the pipeline before being exposed to the marine environment. The Echo Yodel pipeline contains about 1500 m^3 of seawater that has been treated with 1000 ppm of biocide, oxygen scavenger and corrosion inhibitor (Hydrosure 0-3670R).

Consequence Assessment

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

Pelagic and benthic habitats in Operational Area B are considered to be of low sensitivity (no known significant benthic habitat or infauna habitat). Although the Ancient Coastline at 125 m Depth Contour KEF overlaps with Operational Area B, the values and sensitivities of this KEF occur on a broad scale outside of Operational Area B (**Section 4.7.3**).

The instantaneous release of these fluids may have an instantaneous impact on the environment, compared to a gradual release of fluids that may occur from the Echo Yodel subsea infrastructure breaking down (as assessed in **Section 7.8.3**).

To mitigate potential impacts on the environment, all subsea chemicals used in the Echo Yodel subsea infrastructure were selected in accordance with Woodside's defined chemical assessment framework, which requires potential impacts to the environment from chemicals to be ALARP before use. Furthermore, when considering the preservation fluids to use, the base assumption is that the infrastructure being preserved has the potential to be removed from the seabed eventually. For pipelines, including the Echo Yodel pipeline, removal would require the preservation fluid to be drained to the ocean as the pipeline is reverse S-layed. Full draining of the pipeline would be similar to an instantaneous release resulting from an accidental rupture from anchor drag.

Furthermore, in the long term, the pipeline will self-bury (with up to 85% burial being achieved within about 130 years), incrementally minimising any potential risks of damage from anchor drag over time. Risks to marine biota, water quality and sediments are considered low on the basis that chemicals used have been assessed as ALARP, controls are in place to minimise unplanned interaction with the Echo Yodel subsea infrastructure and long-term the pipeline will self-bury, further protecting itself from anchor drag incidents.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that the potential instantaneous release of preservation fluids from the Echo Yodel pipeline will not result in a potential consequence greater than localised and short-term to infauna and benthic communities, water quality and marine sediment and the overall risk to the environment is low.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No additional controls identified.				
Good Practice				
Notify AHS of activities and movements no less than four working weeks before the scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification of AHS will enable them to update maritime charts, thereby reducing the risk of accidental damage to fishing equipment.	Benefits outweigh cost/sacrifice.	Yes **C 1.1**
Professional Judgement – Eliminate				
Removal all Echo Yodel subsea infrastructure.	F: Yes. CS: Expensive compared to alternative options.	Removing Echo Yodel subsea infrastructure will result in the environment being left in a condition close to what it was before the Echo Yodel development. It would remove any potential hazards on the seabed for marine users. However, it would potentially decrease valuable fisheries resource due to the removal of habitat. Furthermore, removal of the Echo Yodel pipeline will result in draining of the preservation fluid to the environment, which would have the same environmental impact as the instantaneous release of preservation fluid from accidental interactions with other marine users (i.e. anchor drag). The benefits of leaving the Echo Yodel subsea infrastructure in-situ are further explained in **Section 6**.	Cost of the control to the marine users and to Woodside is disproportionate to the benefits of leaving the Echo Yodel subsea infrastructure in-situ. Leaving the Echo Yodel subsea infrastructure in-situ was compared to complete removal of it during the comparative assessment detailed in **Section 6**. This assessment found that there are social benefits of leaving the Echo Yodel subsea infrastructure in-situ.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the risk of damage to the pipeline and instantaneous release of preservation fluids to the environment. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that the instantaneous release of fluids from infrastructure damage represents a low current risk rating and may result in in localised impacts with no lasting effect (<1 month) to deepwater benthic habitats.

The adopted control is considered consistent with industry good practice and meets the expectations of AHS identified during impact assessment and stakeholder consultation. Therefore, Woodside considers the adopted control appropriate to manage the risk to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 21 Woodside will notify marine users of the location of the Echo Yodel subsea infrastructure and that it will remain in-situ permanently.	**C 21.1** Notify AHS of Echo Yodel subsea infrastructure locations to enable AHS to update maritime charts.	**PS 21.1** Woodside will notify AHS of Echo Yodel subsea infrastructure locations.	**MC 21.1.1** Records demonstrate AHS has been notified of Echo Yodel subsea infrastructure locations.

7.9.2 Physical Presence: Accidental Future Impacts to Commercial Trawling

Context	
Leave infrastructure in-situ permanently – **Section 3.14**	Socio-economic – **Section 4.6**

Risks Evaluation Summary													
Source of Risk	***Environmental Value Potentially Impacted***						***Evaluation***						
	Marine Sediment	***Water Quality***	***Air Quality (incl Odour)***	***Ecosystems/Habitat***	***Species***	***Socio-Economic***	***Decision Type***	***Consequence***	***Likelihood***	***Current Risk Rating***	***ALARP Tools***	***Acceptability***	***Outcome***
Presence of Echo Yodel subsea infrastructure permanently left in-situ causing damage to trawling equipment						X	B	F	1	L	LCS GP PJ	Broadly Acceptable	EPO 22 and 23

Description of Source of Risk
The Echo Yodel subsea infrastructure, which extends up to about 7.7 m above the seabed, is currently located in an area that is permanently closed to trawling. If the legislation changes in the future and the area is opened to trawling, the Echo Yodel subsea infrastructure has the potential to displace future fishers or result in future accidental damage to trawling equipment within Operational Area B. All of the Echo Yodel subsea infrastructure is marked on navigational charts and will continue to be marked after the infrastructure is left in-situ. There will be no exclusion zone/Petroleum Safety Zone for any activities within Operational Area B after permanent abandonment.

Consequence Assessment
Potential Impacts to Commercial Fisheries
Operational Area B overlaps three Commonwealth and ten State managed fisheries. However, only the Pilbara Demersal Scalefish Managed Fisheries (Pilbara Trap and Line) are considered to be active in the vicinity. Operational Area B is located in water depths ranging from about 140 to 160 m, the shallower extent of which is within the depth range where typical fishing effort occurs for the Pilbara Line and Trap Fishery. However, the area surrounding Operational Area B is currently prohibited to trawling, so there is currently no risk of impact from Echo Yodel subsea infrastructure being left in-situ (refer to **Section 4.6.3.1**). The State of the Fisheries and Aquatic Resources Report (DPIRD, 2018) shows this as a Permanent Fish Trawl Closure area, and describes the spatial closure as a 'habitat-related marine protected area closure'. Previous consultation with DPIRD also found that this area is unlikely to be reopened to trawling in the future. In accordance with the process to amend any fisheries management plans, any amendments to reopen the area to trawling or other new fishing methods would require commercial fisheries permit holders to be consulted. This would mean that any new stakeholders would be made aware of any potential risks within the area. The work conducted for the comparative assessment (detailed in **Section 6**) found there was a preference to leave the Echo Yodel subsea infrastructure in-situ to encourage increases in commercially valuable fish stocks. The workshop discussed the value of the infrastructure, as a hard substrate that provides potentially valuable habitat for commercial fish in an environment with limited hard substrate was preferred over the complete removal of the infrastructure. The NWS is an area recognised as having limited hard substrate habitat (McLean, *et al*. 2017, 2018, 2019; Bond *et al*. 2018a, 2018b).

Summary of Potential Consequences to Environmental Value(s)
Given that Operational Area B is currently closed to trawling and is unlikely to reopen in the future, and considering the adopted controls, the risk of the physical presence of the Echo Yodel subsea infrastructure resulting in future displacement or accidental damage to fishing equipment in the future is considered low (Isolated social impact).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
OPGGS Act (2006) Subsection 270(3) and 572(3).	F: Yes. CS: Minimal cost. Standard practice.	See **Section 6**: Comparative Assessment.	See **Section 6**.	Yes **This document**
Environmental Protection (Sea Dumping) Act 1981.	F: Yes. CS: Minimal cost. Standard practice.	See **Section 6**: Comparative Assessment.	See **Section 6**.	Yes **C 21.1**
Good Practice				
Notify relevant State and Commonwealth fisheries of Echo Yodel subsea infrastructure left in-situ.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Echo Yodel subsea infrastructure in-situ to other marine users ensures they are informed and aware, thereby reducing the risk accidental damage to fishing equipment.	Benefits outweigh cost/sacrifice.	Yes **C 22.1**
Notify AHS of activities and movements no less than four working weeks before the scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification of AHS will enable them to update maritime charts, thereby reducing the risk of accidental damage to fishing equipment.	Benefits outweigh cost/sacrifice.	Yes **C 22.2**
Professional Judgement – Eliminate				
Remove all Echo Yodel subsea infrastructure.	F: Yes. CS: Expensive compared to alternative options.	Removing Echo Yodel subsea infrastructure will result in the environment being left in a condition close to what it was before the Echo Yodel development. It would remove any potential hazards on the seabed for marine users. However, it would potentially decrease valuable fisheries resource due to the removal of habitat. The benefits of leaving the Echo Yodel subsea infrastructure in-situ are further explained in **Section 6**.	Cost of the control to the marine users and to Woodside is disproportionate to the benefits of leaving the Echo Yodel subsea infrastructure in-situ. Leaving the Echo Yodel subsea infrastructure in-situ was compared to complete removal of it during the comparative assessment detailed in **Section 6**. This assessment found that there are social benefits of leaving the Echo Yodel subsea infrastructure in-situ.	No

Rock dump along Echo Yodel pipeline/umbilical.	F: Yes. Over-trawl protection could mitigate against the potential for commercial fishing trawl gear to damage Echo Yodel subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional cost.	Reduce the potential for snagging of trawl nets if Echo Yodel subsea infrastructure is left in-situ. However, given no trawling activity currently occurs in Operational Area B and it is unlikely these will occur in the future, the benefit is low. A comparative assessment, including consultation with commercial fisheries, did not identify the requirement for such controls. Studies have shown the pipeline/umbilical will self-bury over time.	Disproportionate. Significant additional costs.	No
Over-trawl protection on Echo Yodel wellhead and X-mas trees.	F: Yes. Over-trawl protection could mitigate against the potential for commercial fishing trawl gear to damage Echo Yodel subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional cost.	Reduce the potential for snagging of trawl nets if subsea infrastructure is left in-situ. However, given no trawling activity currently occurs in Operational Area B and it is unlikely these will occur in the future, the benefit is low. A comparative assessment, including consultation with commercial fisheries, did not identify the requirement for such controls.	Disproportionate. Significant additional costs.	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 B, **Section 2.7.1**), Woodside considers the adopted controls appropriate to manage the risk of the physical presence of the Echo Yodel subsea infrastructure being left in-situ in perpetuity to commercial fisheries. With implementation of the proposed controls, the risk and consequences are considered to be ALARP.

<table>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><th>Acceptability Criteria and Assessment</th><th>Acceptable Level(s) of Residual Risk</th><th>Statement of Acceptability</th></tr>
<tr><td>Principles of ESD
The Petroleum Activities Program is consistent with the relevant principles of ESD:
• decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
• the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
• the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
Internal Context
The Petroleum Activities Program is consistent with Woodside corporate policies, culture, processes, standards, structure and systems 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).
External Context
Feedback during stakeholder consultation (Section 5) supports the outcome from comparative assessment (Section 6) that leaving the Echo Yodel subsea infrastructure in-situ delivers greater environmental outcomes than full removal of the infrastructure. Specifically, feedback from DPIRD, a licence holder from the Pilbara Trap Fishery licence, Recfishwest, and WAFIC was supportive of the decision to leave the infrastructure in-situ permanently provided that a robust comparative assessment on the potential decommissioning options had been completed, impact assessment had been undertaken on the selected option and regulatory commitments have been met. No stakeholders raised concerns which were not addressed as part of consultation and through the adoption of controls.
Other Requirements
The proposed control measures are consistent with industry legislation, codes and standards, good practice and professional judgement including:
• OPGGS Act (2006) Subsection 270(3) and 572(3)
• Environmental Protection (Sea Dumping) Act 1981
and meet the requirements and expectations of relevant State and Commonwealth fisheries and AHS identified during impact assessment and stakeholder consultation.</td><td>All reasonably practicable controls to effectively reduce the likelihood of accidental future impacts to commercial trawling occurring are employed as part of the Petroleum Activities Program.</td><td>The predicted level of residual risk (Low) is considered to be at or below the defined acceptable levels given the controls implemented will effectively reduce the likelihood of accidental future impacts to commercial trawling occurring to 1 – Highly unlikely.

Environmental Performance Consideration
To manage residual risk from accidental future impacts to commercial trawling to at or below the defined acceptable levels the following EPOs have been applied:
EPO 22: Woodside meets requirements of the Environment Protection (Sea Dumping) Act 1981.
EPO 23: Woodside will notify marine users of the location of the Echo Yodel subsea infrastructure and that it will remain in situ permanently.</td></tr>
</table>

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 22 Woodside meets requirements of the *Environment Protection (Sea Dumping) Act 1981*.	**C 22.1** Woodside will engage with DoAWE regarding their obligations.	**PS 22.1** Woodside will continue to engage with DoAWE regarding Woodside's obligations under the *Environment Protection (Sea Dumping) Act*.	**MC 22.1.1** Stakeholder consultation records demonstrate DoAWE continues to be engaged on the obligations of the Act.
EPO 23 Woodside will notify marine users of the location of the Echo Yodel subsea infrastructure and that it will remain in-situ permanently.	**C 23.1** Notify AHS of Echo Yodel subsea infrastructure locations to enable AHS to update maritime charts.	**PS 23.1** Woodside will notify AHS of Echo Yodel subsea infrastructure locations.	**MC 23.1.1** Records demonstrate AHS has been notified of Echo Yodel subsea infrastructure locations.
	C 23.2 Notify relevant State and Commonwealth fisheries that the Echo Yodel subsea infrastructure will remain in-situ.	**PS 23.2** Woodside has notified State and Commonwealth fisheries of the Echo Yodel subsea infrastructure locations and that the infrastructure will remain in-situ for perpetuity.	**MC 23.1.2** Records demonstrate State and Commonwealth fisheries have been notified of the Echo Yodel subsea infrastructure locations.

8. IMPLEMENTATION STRATEGY

8.1 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 EPOs and standards outlined in this EP are achieved.

Woodside, as Operator, is responsible for ensuring the Petroleum Activities Program is managed in accordance with this Implementation Strategy and the WMS (see **Section 1.9**).

8.2 Systems, Practice and Procedures

All operational activities are planned and performed in accordance with relevant legislation and standards, management measures identified in this EP and internal environment standards and procedures (**Section 6**).

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 change during the statutory duration of this EP and is managed through a changes register and update process.

8.3 Roles and Responsibilities

Key roles and responsibilities for Woodside and contractor personnel relating to implementing, managing and reviewing this EP are described in **Table 8-1**. Roles and responsibilities for oil spill preparation and response are outlined in **Appendix D** and the *Woodside Oil Pollution Emergency Arrangements (Australia)*.

Table 8-1: Roles and responsibilities

Title (role)	Environmental Responsibilities
Office-based Personnel	
Woodside Project Manager	• Monitor and manage the activity so it is performed as per the relevant standards and commitments in this EP. • Notify the Woodside Environment Adviser in a timely manner of any scope changes. • 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's HSE Reporting and Investigation Procedure. • Monitor and close out corrective actions identified during environmental monitoring or audits.
Woodside Well Delivery Manager	• Ensure permanent plugging operations are performed as per this EP and approval conditions. • Provide sufficient resources to implement the permanent plugging-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 8.4.2** of this EP at the start of the permanent plugging programs. • Confirm controls and performance standards in this EP are actioned, as required, before permanent plugging commences. • Ensure the MODU start-up meets the requirements of the Drilling and Managing Rig Operations Process.
Subsea Delivery Manager	• Ensure the subsea activities are performed as per this EP and approval conditions. • Provide sufficient resources to implement the subsea related management measures (i.e. controls, EPOs, PSs and MC) in this EP. • Ensure vessel personnel are given an Environmental Induction, as per **Section 8.4.2**, of this EP at the start of the activities. • Confirm controls and performance standards in this EP are actioned, as required, before activities commence. • Ensure relevant vessels meet the requirements of Woodside's Marine Operations Operating Standard. • Manage change requests for the activity and notify the Woodside Environment Adviser in a timely manner of any scope changes. • Confirm that site-based personnel are given an Environmental Induction, as per **Section 8.4.2**, of this EP at the start of the activity. • Communicate changes to the subsea program to the Woodside Environmental Adviser in a timely manner. • Ensure all chemicals and drill fluids proposed to be discharged are assessed and approved as per the requirements of the EP.

Title (role)	Environmental Responsibilities
Woodside Drilling Superintendent	• Ensure the permanent plugging program meets the requirements detailed in this EP. • Ensure changes to the permanent plugging 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's HSE Reporting and Investigation Procedure. • Monitor and close out corrective actions identified during environmental monitoring or audits.
Woodside Drilling, Completion and Subsea Engineers	• Ensure changes to the permanent plugging program are communicated to the Woodside Environmental Adviser. • Ensure all drilling and completions fluid chemical components and other fluids that may be used downhole have been reviewed by the Drilling and Completions Environmental Adviser.
Woodside Environmental Adviser	• Verify relevant Environmental Approvals for the activities exist before 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 the review, investigation and reporting of environmental incidents. • Ensure environmental monitoring and inspections/audits are performed as per the requirements of this EP. • Liaise with relevant regulatory authorities as required. • Assist in preparing required external regulatory reports, in line with environmental approval requirements and Woodside incident reporting procedures. • Monitor and close out corrective actions (Campaign Action Register) identified during environmental monitoring or audits. • Provide advice to relevant Woodside personnel and contractors to help them understand their environment responsibilities. • Liaise with contractors to ensure communication and understanding of environment requirements as outlined in this EP and in line with Woodside's Compass values and management systems.
Woodside Corporate Affairs Adviser	• Prepare and implement the Stakeholder Consultation Plan for the Petroleum Activities Program. • Report on stakeholder consultation. • Continuously liaise and provide notification as required as outlined in the EP.
Woodside Marine Assurance Superintendent	• Conduct relevant audit and inspection to confirm vessels comply with relevant Marine Orders and Woodside Marine Charters Instructions requirements to meet safety, navigation and emergency response requirements.

Title (role)	Environmental Responsibilities
Woodside Corporate Incident Coordination Centre (CICC) Duty Manager	On receiving notification of an incident, the Woodside CICC Duty Manager shall: • Establish and take control of the Incident Management Team and establish an appropriate command structure for the incident. • Assess the situation, identify risks and actions to minimise the risk. • Communicate impact, risk and progress to the Crisis Management Team and stakeholders. • Develop the Incident Action Plan (IAP) including objectives for action. • Approve, implement and manage the IAP. • 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 (OIM)	• Ensure the MODU's management system and procedures are implemented. • Ensure 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. • Verify that 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.
Woodside Well Site Manager	• Ensure the permanent plugging program is performed 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 Corporate Event Notification Matrix. Ensure corrective actions for incidents and breaches are 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. Ensure corrective actions from inspections are developed, tracked and closed out in a timely manner.

Title (role)	Environmental Responsibilities
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 help collect and record evidence of implementation (other controls are implemented and evidence collected onshore). • Support the Well Site Manager to ensure the EPOs are met and the PSs 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 Environment Adviser.
Drilling Logistics Coordinator	• Ensure waste is managed on the MODU and sent to shore as per the Drilling and Completions Waste Management Plan (WMP).
Vessel-based Personnel	
Vessels Master	• Ensure the vessel management system and procedures are implemented. • 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. • Verify 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 EPOs or PSs detailed in this EP are reported immediately to the Woodside 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. Ensure close-out of actions is 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 WMP.
Vessel HSE Advisers	Refer to Woodside HSE Offshore Adviser responsibilities detailed above under MODU-based personnel.
Contractor Project Manager	• Confirm activities are performed in accordance with this EP, as detailed in the Woodside-approved Contactor Environmental Management Plan. • 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.

8.4 Training and Competency

8.4.1 Overview

Woodside as part of its contracting process assesses a proposed contractor's environmental management systems to determine the level of compliance with the standard AS/NZ ISO 14001. This assessment is performed for the Petroleum Activities Program as part of the pre-mobilisation process. The assessment determines whether there is a clearly defined organisational structure that clearly defines the roles and responsibilities for key positions. The assessment also assesses 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.

8.4.2 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 MC
- incident reporting.

8.4.3 Petroleum Activities Program Specific Environmental Awareness

Before commencing the subsea campaigns associated with the Petroleum Activities Program, a pre-activity meeting will be held on the MODU 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 project vessels. During these meetings, recent environmental incidents are reviewed and awareness material presented regularly.

8.4.4 Management of Training Requirements

All personnel on the MODU and project 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 performed and identifying minimum training requirements.

8.5 Monitoring, Auditing, Management of Non-conformance and Review

8.5.1 Monitoring

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. This information will be collected using the tools and systems outlined below, developed based on the EPOs, controls, standards and MC in this EP. The tools and systems will collect, as a minimum, the data (evidence) referred to in the MC in **Section 6** and **Appendix D**.

The collection of this data (against the MC) will form part of the permanent record of compliance maintained by Woodside and will form the basis for demonstrating that the EPOs and standards are met, which will be summarised in a series of routine reporting documents.

8.5.1.1 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 to record and submit safety and environment risk observation cards routinely (frequency varies with contractor)
- collection of evidence of compliance with the controls detailed in the EP relevant to offshore activities by the Woodside 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 KPIs
- internal auditing and assurance program as described in **Section 8.5.2**.

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 8.5.2**.

8.5.1.2 Receptor-based Knowledge Updates

Under the Woodside Environmental Knowledge Management System, regular monitoring to maintain currency of receptor knowledge is performed as follows:

- DoAWE EPBC Act listed species status, listed species Recovery/Management and Conservation Plans, and other environmental matters is reviewed quarterly and recorded by Environment Science team. The outcome of each review is summarised and issued to the relevant Environment personnel responsible for implementing the EP for their consideration.
- Under the Oil Spill Scientific Monitoring Programme preparedness, an annual review and update to the environmental baseline studies database is completed and documented.

- Periodic location-focused environmental studies baseline data gap analyses are completed and documented. Any subsequent studies scoped and executed as a result of such gap analysis are managed by the Environment Science Team and tracked via the Corporate Environment Baseline Database.

8.5.2 Auditing

Environmental performance auditing will be performed to:

- identify potential new or changes to existing 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 Performance Outcomes, Controls and Standards detailed in this EP.

Internal auditing will be performed to cover each key project activity as summarised below.

8.5.2.1 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 rig equipment for a newly contracted MODU (if not previously contracted to Woodside within the last two years) against Woodside's Engineering Standard – Rig Equipment. This standard covers functional and technical requirements for Woodside-contracted rigs and their associated equipment. An environment rig 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 a delegate) which may include verifying:
  - bunkering/transfers between support vessels and MODU/project vessels
  - 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 Environment 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 while commencing riser drilling or reservoir interception) during routine MODU visits throughout the MODU campaign, determined by risk, previous incidents or operation specification requirements.

8.5.2.2 Subsea Scope Activities

The following internal auditing will be performed for the subsea scope activities:

- Pre-mobilisation inspection/audit report will be conducted by a relevant person (before commencing). The scope of the audits are risk-based and specific to the relevant activity, but will generally focus on aspects relating to ensuring appropriate understanding of environmental commitments and the operational readiness of the activity scope, including appropriate environmental controls in place. All primary vessels associated with the above scopes will be audited by Woodside. Support or transport vessels will be assessed on a risk-based approach, but will be audited via the primary subsea installation contractor's process.
- At least one operational compliance audit relevant to applicable EP commitments will be conducted by a Woodside Environment Adviser for the subsea campaign. The audit may be conducted offshore or office-based, subject to the duration of the activity and logistics of performing the audit offshore for short duration scopes (e.g. pipelay).
- Contractor-specific HSE audits will also be conducted of the associated support vessels. The audits will consider the implementation of HSE management, risk management, as well as pre-mobilisation and offshore readiness.
- Vessel-based HSE inspections will be conducted fortnightly by vessel HSE personnel. Each inspection will focus on a specific risk area relevant to the project activity and a formal report will be issued (for example, bunkering controls, chemical and discharge management, cetacean reporting, etc).

The internal audits and reviews, combined with the ongoing monitoring described in **Section 8.5.1**, and collection of evidence for MC are used to assess EPOs and standards.

As part of Woodside's EMS and/or assurances processes, activities may also be periodically selected for environmental audits as per Woodside's internal auditing process. Audit, inspection and review findings relevant to continuous improvement of environmental performance are tracked through the Environmental Commitments and Actions Register.

This Environmental Commitments and Actions Register is used to track subsea support vessel and subsea activity compliance with EP commitments, including any findings and corrective actions.

Non-conformances identified will be reported and/or tracked in accordance with **Section 8.5.3**.

8.5.2.3 Marine Assurance

Woodside's marine assurance 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 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
- OVID
- project support for tender review, evaluation and 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.

8.5.2.4 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, 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.

8.5.3 Management of Non-conformance

Woodside classifies non-conformances with EPOs 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 to record and report 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 2.7**). Detailed investigations are completed for all categories A, B, C and high potential environmental incidents.

8.5.4 Review

8.5.4.1 Management Review

Within the Environment Function, senior management regularly monitor and review environmental performance and the effectiveness of managing environmental risks and performance. Within each Function and Business Unit Leadership Team (e.g. Drilling and Completions, Subsea and Developments/Projects), 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 KPIs (leading and lagging)
- tools and systems to monitor environmental performance (detailed in **Section 8.5.1**)
- lessons learned about implementation tools and throughout each campaign.

Reviews of oil spill arrangements and testing are performed in accordance with **Section 8.9**.

8.5.4.2 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.

8.5.4.3 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 MOC process outlined below (**Section 8.6**).

8.6 Environment Plan Management of Change and Revision

Management of changes relevant to this EP, concerning the scope of the activity description (**Section 1**) 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 DoAWE on species protected under the EPBC Act and current requirements for AMPs (**Section 3**); and potential new advice from external stakeholders (**Section 5**), 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 2.6**) 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 formal 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, etc.), 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.

8.7 Record Keeping

Compliance records (outlined in MC in **Section 6**) will be maintained.

Record keeping will be in accordance with Regulation 14(7) that addresses maintaining records of emissions and discharges.

8.8 Reporting

To meet the EPOs and standards outlined in this EP, Woodside reports at a number of levels, as outlined in the next sections.

8.8.1 Routine Reporting (Internal)

8.8.1.1 Daily Progress Reports and Meetings

Daily reports for drilling activities are prepared and issued to key support personnel and stakeholders, by relevant managers responsible for the well. The report provides performance information about drilling activities, heath, safety and environment, 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 resolving issues.

8.8.1.2 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.

8.8.1.3 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 subject matters, including:

- HSE incidents (including high potential incidents and those related to this EP) and recent activities
- corporate KPI targets, which include environmental metrics
- outstanding actions as a result of audits or incident investigations
- technical high and low lights.

8.8.2 Routine Reporting (External)

8.8.2.1 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.

8.8.2.2 Environmental Performance Review and Reporting

In accordance with applicable environmental legislation for the activity, Woodside is required to report information about environmental performance to the appropriate regulator. Regulatory reporting requirements are summarised in **Table 8-2**.

Table 8-2: 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 previous month (if applicable).
Environmental Performance Report	NOPSEMA	Annually, with the first report submitted within 12 months of the commencement of the Petroleum Activities Program covered by this EP (as per the requirements of Regulation 14(2).	Compliance with EPOs, controls and standards outlined in this EP, in accordance with the Environment Regulations.

8.8.2.3 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 completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A of the Environment Regulations.

8.8.3 Incident Reporting (Internal)

The process for reporting environmental incidents is described in **Sections 8.8.3** and **8.8.4** of this EP. It is the responsibility of the Woodside Project Manager to ensure reporting of environmental incidents meets Woodside and regulatory reporting requirements as detailed in the Woodside HSE Event Reporting and Investigation Procedure and this section of this EP.

8.8.4 Incident Reporting (External) – Reportable and Recordable

8.8.4.1 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 2-5**))
- 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 2-5**)).

The environmental risk assessment (**Section 6**) for the Petroleum Activities Program identifies those risks with a potential consequence level of C+ for environment. The incidents that have the potential to cause this level of impact include hydrocarbon loss of containment events to the marine environment resulting from a loss of well integrity.

Any such incidents represent potential events which would be reportable incidents. Incident reporting is performed with consideration of NOPSEMA (2014) guidance stating, 'if in doubt, notify NOPSEMA', and assessed on a case-by-case basis 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) ASAP, 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 (NOPTA) and the Department of the responsible State Minister (DMIRS) ASAP after orally reporting the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0831 – Reportable Environmental Incident (**Appendix E**) which must be submitted to NOPSEMA ASAP, but within three days of the incident or of its detection by Woodside
- provide a copy of the written report to the NOPTA and DMIRS, within seven days of the written report being provided to NOPSEMA.

AMSA will be notified of oil spill incidents ASAP after their occurrence, and DoAWE notified if MNES are to be affected by the oil spill incident.

8.8.4.2 Recordable Incidents

Definition

A recordable incident as defined under Regulation 4 of the Environment Regulations is 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), no later than 15 days after the end of the calendar month using the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (**Appendix E**) detailing:

- 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.

8.8.4.3 Other External Incident Reporting Requirements

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, **Table 8-3** describes the incident reporting requirements that also apply in the Operational Areas.

Table 8-3: External Incident Reporting Requirements

Event	Responsibility	Notifiable party	Notification requirements	Contact	Contact detail
Any marine incidents during Petroleum Activities Program	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 Rescue Coordination Centre (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 Australia	If the ship is at sea, reports are to be made to: Free call: 1800 641 792 Phone: 08 9430 2100 (Fremantle)
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA	Without delay as per *Protection of the Sea Act*, part II, section 11(1), AMSA RCC notified verbally via the national emergency 24-hour notification contact of the hydrocarbon spill; follow up with a written Pollution Report ASAP after verbal notification	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	Vessel Master	DoAWE	Reported verbally, ASAP	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	DoAWE	Within seven days of becoming aware	Secretary of the DoAWE	Phone: 1800 803 772 Email: protected.species@environment.gov.au

The pollution activities should also be reported to AMSA via RCC Australia by the Vessel Master are:

- 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 Echo Yodel Plug and Abandonment Oil Pollution First Strike Plan (**Appendix H**).

External incident reporting requirements under the *OPGGS (Safety) Regulations*, including under Subregulation 2.42, notices and reports of dangerous occurrences will be reported to NOPSEMA under the approved activity safety cases.

8.9 Emergency Preparedness and Response

8.9.1 Overview

Under Regulation 14(8), the implementation strategy must contain an Oil Pollution Emergency Plan 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 8-4**.

Table 8-4: 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 the Echo Yodel Decommissioning EP (**Appendix D**)
Describes the OPEP	Regulation 14(8)	EP: Woodside's oil pollution emergency plan has the following components: • Woodside Oil Pollution Emergency Arrangements (Australia) • Echo Yodel Decommissioning Oil Pollution First Strike Plan (**Appendix H**) • Oil Spill Preparedness and Response Mitigation Assessment for the Echo Yodel Decommissioning EP (**Appendix D**)
Details 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 the Echo Yodel Decommissioning EP (**Appendix D**) Echo Yodel Decommissioning Oil Pollution First Strike Plan (**Appendix H**)
Details the arrangements for updating and testing the oil pollution response arrangements	Regulation 14(8), (8A), (8B), (8C)	EP: **Section 8.9.4** Oil Spill Preparedness and Response Mitigation Assessment for the Echo Yodel Decommissioning EP (**Appendix D**)
Details of provisions for monitoring impacts to the environment from oil pollution and response activities	Regulation 14(8D)	Oil Spill Preparedness and Response Mitigation Assessment for the Echo Yodel Decommissioning EP **(Appendix D**)
Demonstrates that the oil pollution response arrangements are consistent with the national system for oil pollution preparedness and control	Regulation 14(8E)	Oil Pollution Emergency Arrangements (Australia)

8.9.2 Emergency Response Preparation

The CICC, 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 Incident Management Team 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).

Woodside will have an Emergency Response Plan (ERP) in place relevant to the Petroleum Activities Program. The ERP provides procedural guidance specific to the rig 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 rig'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 rig and ensures roles and responsibilities between the contracted rig and Woodside personnel are identified and understood. The ERPs 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 OIM will assume overall onsite command and act as the Incident Controller (IC). All persons aboard the MODU will be required to act under the IC's directions. The MODU/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.
- 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 project vessels will have on-board equipment for responding to emergencies including medical equipment, fire-fighting equipment and oil spill response equipment.

8.9.3 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 result in a serious safety or environmental incident and cause asset and reputational damage if not managed properly. The Woodside Oil Pollution Emergency Arrangements (Australia) document, supported by the Echo Yodel Decommissioning – Oil Pollution First Strike Plan (**Appendix H**) which provides tactical response guidance to the activity/area and **Appendix D** of this EP, cover spill response for this Petroleum Activities Program.

In accordance with Woodside's Hydrocarbon Spill Preparedness and Response Procedure, 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 a Memorandum of Understanding in place to support Woodside in the event of an oil spill.

The Echo Yodel Decommissioning – Oil Pollution First Strike Plan provides immediate actions required to commence a response (**Appendix H**).

The MODU and project 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 EPOs, performance standards and MC to be used for oil spill response during the Petroleum Activities Program, as detailed in **Appendix D**.

8.9.4 Emergency and Spill Response Drills and Exercises

Woodside categorises incidents and emergencies in relation to response requirements as follows:

8.9.4.1 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.

8.9.4.2 Level 2

Level 2 incidents are characterised by a response that requires external operational support to manage the incident. It is triggered if the capabilities of the tactical level response are exceeded. This support is provided to the activity by activating all or part of the responsible CICC.

8.9.4.3 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 manages the strategic impacts to respond to and recover from the threat to the company (material impacts, litigation, legal and commercial, reputation, etc.). The CICC may also be activated as required to manage the operational response to the Level 3 incident.

8.9.4.4 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 8-5**. 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 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 we have 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 8-5: Testing of response capability to incidents

	Response Testing
Level 1 Response	One Level 1 oil spill response exercise to be conducted per week during the activity.
	One oil spill response themed Level 1 drill to be conducted within two weeks of new well commencement. This drill should test elements of the recommended response identified in the Echo Yodel Decommissioning Oil Pollution First Strike Plan in relation to the level of the incident (**Appendix H**).
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 exercises conducted each year is determined by the Chief Executive Officer, in consultation with the Vice President Security and Emergency Management.

8.9.4.5 Testing of Oil Spill Response Arrangements

There are a number of arrangements which in a spill will underpin Woodside's ability to implement a response across its petroleum activities. To ensure each arrangement is adequately tested, the Security and Emergency Management Capability and Development Team ensures tests are conducted in alignment with the Hydrocarbon Spill Arrangements Testing Schedule.

Woodside's testing schedule aligns with international good practice for spill preparedness and response management; the testing is compatible with the International Petroleum Industry Environmental Conservation Association' 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. 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 (**Appendix H**) will be tested in alignment with **Table 8-5**. 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.

8.9.5 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 and subsea 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 project vessels will receive daily forecasts from the Bureau of Meteorology. 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).

8.9.6 Implementation Strategy and Reporting Commitments Summary

Table 8-6 provides a summary of key components within the implementation strategy.

Table 8-6: 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 HSE requirements for the MODU and project vessels, and environmental information specific to the Petroleum Activities Program location.	**MC IS-1.1.1** Induction attendance records.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
	PS IS-1.2 Pre-activity meeting held on the MODU with relevant personnel before performing 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 operations, regular HSE meetings will be held on the MODU and project vessels which cover all crew. Recent environmental incidents are reviewed and awareness material presented on a regular basis.	**MC IS-1.3** Attendance is recorded and lists retained on the MODU/project vessels.
	PS IS-1.4 The rig contractor and vessel contractors must have a CCP accepted by Woodside, and in place outlining the processes and procedures that would be implemented during a cyclone event, if drilling is to occur during cyclone season.	**MC IS-1.4** Record of Woodside approved Contractor CCP in place before 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** This information will be collected using the tools and systems outlined in **Section 8.5**, developed based on the EPOs, standards and MC in this EP.	**MC IS-2.1.1** Monitoring reports.
PO IS-3 Woodside will perform environmental performance auditing.	**PS IS-3.1** Start-up or pre-mobilisation audit for newly contracted MODU (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 conduct a minimum of monthly environmental inspections as detailed in **Section 8.5.2**.	**MC IS-3.2.1** Completed environmental inspection checklists.
	PS IS-3.3 Woodside Environment Adviser (or delegate) completes 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-3.4 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-3.4.1** MODU or vessel compliance action register records demonstrate tracking of audit findings.
	PS IS-3.5 Marine assurance will be performed in accordance with Woodside's Marine Offshore Vessel Assurance Procedure and is mandatory for all vessels hired for Woodside operations as detailed in **Section 8.5.2**. The Procedure defines the marine offshore assurance activities applicable for all vessels chartered directly by or on behalf of Woodside.	**MC IS-3.5.1** Records demonstrate marine assurance reviews conducted as required.
PO IS-4 Woodside employees and Contractors report all environmental incidents and non-conformance with EPOs and standards in this EP.	**PS IS-4.1** Non-conformances to be notified, investigated and reported in accordance with the Woodside HSE Event Reporting and Investigation Procedure.	**PS IS-4.1.1** Records demonstrate non-conformances are notified, investigated and reported in accordance with the Woodside HSE Event Reporting and Investigation Procedure.
PO IS-5 Woodside will perform regular reviews to monitor environmental performance.	**PS IS-5.1** Woodside holds quarterly HSE review meetings.	**PS IS-5.1.1** Records demonstrate meetings reviewed HSE performance.
	PS IS-4.2 Woodside's Drilling and Completions Environment Team is to perform six-monthly reviews of the effectiveness of the implementation strategy and associated tools as detailed in **Section 8.5.4**.	**PS IS-4.2.1** Records demonstrate six monthly reviews of the effectiveness of the implementation strategy.
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 changes relevant to this EP to be managed in accordance with Woodside's Environmental Approval Requirements Australia Commonwealth Guideline as detailed in **Section 8.6**.	**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 external reporting requirements relevant to this EP will be met.	**PS IS-7.1** Woodside will submit an environmental performance report to NOPSEMA (annually with the first report submitted within 12 months of the start of the activity).	**MC IS-7.1.1** Record of submission of environmental performance reports to NOPSEMA.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
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 start of the Petroleum Activities Program at least ten days before the activity commences. Woodside will notify NOPSEMA and DMIRS within ten days of the completion of 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 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 notification to NOPSEMA.
	PS IS-8.4 DoAWE (if MNES affected) will be notified of oil spill incidents ASAP following the occurrence.	**MC IS-8.4.1** Record of notification to DoAWE if MNES is affected.
	PS IS-8.5 Notify the DPIRD (formerly DoF), peak fishing bodies and known regional commercial fishing operators identified in this EP before and upon completion of the proposed activity, including rig and support vessel details.	**MC IS-8.5.1** Records of notification to the department, peak fishing bodies and known commercial regional fishing operators identified in this EP.
	PS IS-8.7 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 AMSA's request.	**MC IS-8.7.1** Records of notification to AMSA.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
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 7.7** are documented in the daily drilling, pipeline or subsea reports.	**MC IS-9.1.1** Records of planned and unplanned emissions and discharges are maintained in daily drilling, pipeline or subsea reports.
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 8-5**. These arrangements are conducted in accordance with Regulation 14 (8B) of the *OPPGS (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 8-5**. • 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 are 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 exercises 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 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.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
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 in the following circumstances: • Implementation of improved preparedness measure. • A change in the availability of equipment stockpiles. • A change in the availability of personnel that reduces or improves preparedness and the capacity to respond. • The introduction of a new or improved technology that may be considered in a response for this activity. • To incorporate, where relevant, lessons learned from exercises or events. • If national or state response frameworks and Woodside's integration with these frameworks changes.	**MC IS-12.1.1** The following records with be maintained: • Woodside's HSPU Testing of Arrangements Register • Woodside Internal Equipment Maintenance Register • OPEP current and available.
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 performed.
PO IS-14 Before recommencing activities after a cessation period greater than 12 months, 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) remain/are 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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Threatened Species Scientific Committee, 2015f. Conservation advice *Calidris ferruginea* curlew sandpiper. Threatened Species Scientific Committee, Canberra.

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10. GLOSSARY AND ABBREVIATIONS

10.1 Glossary

Term	Meaning
(the) Regulator	The Government Agency (State or Commonwealth) that is the decision maker for approvals and performs ongoing regulation of the approval once granted
3D seismic data	A set of numerous closely-spaced seismic lines that provide a high spatially sampled measure of subsurface reflectivity and 3D image
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 stakeholdings have been considered by assessment of 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 that 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 that 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 that is used as a starting point for subsequent measurements

Term	Meaning
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
dB re 1 μPa^2	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 mPa2/Hz), or over a broadband that has not been filtered. Where a frequency is not specified, it can be assumed that the measurement is a broadband measurement.
dB re 1 μPa^2.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 the well bore, keeping the drill bit cool and clean during drilling, performing drilled cement, and suspending the drilled cement 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 the starfishes, sea urchins and sea cucumbers, that 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)
EP	Prepared in accordance with the *OPGGS (Environment) Regulations 2009*, which must be assessed and accepted by the Designated Authority (NOPSEMA) before any petroleum-related activity can be performed
Environment Regulations	OPGGS (Environment) Regulation 2009
Environmental approval	The action of approving something, which has the potential to have an adverse impact on 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.

Term	Meaning
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
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 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 objective 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 that minimise and manage undesirable consequences
NOHSC (1008:2004)	National Occupational Health and Safety Commission – Approved Criteria for Classifying Hazardous Substances
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 that 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.
Stereo-BRUVS	Stereo-baited remote underwater video systems
Sessile	Organism that is fixed in one place; immobile
Syngnathids	Family of fish which includes the seahorses, the pipefishes, and the weedy and leafy sea dragons
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

10.2 Abbreviations

Abbreviation	Meaning
μm	Micrometer
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACS	Australian Custom Service
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHS	Australian Hydrographic Service
AHV	Anchor Handling Vessels
AIMS	Australian Institute of Marine Science
ALARP	As Low As Reasonably Practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
AS (NZS)	Australian Standard (New Zealand Standard)
ASAP	As soon as practicable
ASL	Above sea level
ATSB	Australian Transport Safety Bureau
bbl	Oil barrel
BC	Bioconcentration
BCF	Bioconcentration Factor
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blow-out Preventer
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
CFA	Commonwealth Fisheries Association
CICC	Corporate Incident Coordination Centre
CoA	Commonwealth of Australia
COLREGS	International Regulations for Prevention of Collisions at Sea
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
CV	Company Values
DAA	Department of Aboriginal Affairs
DAWR	Department of Agriculture and Water Resources (now DoAWE)

Abbreviation	Meaning
dB	Decibel
DEC	Department of Environment and Conservation
DEWHA	Department of Environment, Water, Heritage and the Arts
DIIS	Department of Industry Innovation and Science
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Department of Mines and Petroleum
DNP	Director of National Parks
DoAWE	Department of Agriculture, Water and the Environment
DoD	Department of Defence
DoEE	Department of the Environment and Energy
DoF	Department of Fisheries
DoT	Department of Transport
DP	Dynamically Positioned
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EC_{50}	half maximal effective concentration
EDS	Emergency Disconnect Sequence
EEZ	Exclusive Economic Zone
EHU	Electrohydraulic umbilical
EMBA	Environment that May Be Affected
EMS	Environmental Management System
ENVID	Environmental hazard Identification
EP	Environment Plan
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
ERP	Emergency Response Plans
ESD	Ecological Sustainable Development
FPSO	Floating Production, Storage and Offtake vessel
FRDC	Fisheries Research and Development Centre
g/m^2	Grams per square metre
GDSF	Gascoyne Demersal Scalefish Fishery
GHG	Greenhouse Gas
GP	Good Practice
GWA	Goodwyn Alpha
GWF-1	Greater Western Flank – 1
GWF-2	Greater Western Flank – 2
HDPE	High Density Polyethylene
HOCNF	Harmonised Offshore Chemical Notification Format

Abbreviation	Meaning
HQ	Hazard Quotient
HSE	Health, Safety and Environment
HSPU	Hydrocarbon Spill Preparedness Unit
IAP	Incident Action Plan
IAPP	International Air Pollution Prevention
IC	Incident Controller
IC_{50}	Half maximal inhibitory concentration
IMMR	Inspection, Maintenance, Monitoring, Repair
IMO	International Marine Organisation
IMS	Invasive Marine Species
IOPP	International Oil Pollution Prevention
ISPP	International Sewage Pollution Prevention Certificate
ITF	Indonesian Through Flow
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
IUTB	Infield umbilical termination basket
JRCC	Joint Rescue Coordination Centre
JSA	Job Safety Analysis
KBGFC	King Bay Game Fishing Club
KEF	Key Ecological Feature
kHz	Kilohertz
km	Kilometre
kPa	Kilopascal
KPI	Key Performance Indicator
L	Litres
LBL	Long Baseline
LC_{50}	Lethal concentration, 50%
LCS	Legislation, Codes and Standards
LNG	Liquefied Natural Gas
MC	Measurement Criteria
MCDA	Multi Criteria Decision Assessment
MEG	Mono-ethylene Glycol
MIMI	Japan Australia LNG Pty Ltd
MMA	Marine Management Area
MNES	Matters of National Environmental Significance
MODU	Mobile Offshore Drilling Unit
MoU	Memorandum of Understanding
MP	Marine Park

Abbreviation	Meaning
MPA	Marine Protected Areas
MPRA	Marine Parks and Reserves Authority
ms^1	Metres per second
MSIN	Maritime Safety Information Notifications
NBSFC	Nickol Bay Sport Fishing Club
NCDSF	North Coast Demersal Scalefish Fishery
NIMS	Non-indigenous Marine Species
nm	Nautical mile (1,852 m) a unit of distance on the sea
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORM	Naturally Occurring Radioactive Material
NRC	North Rankin Complex
NTM	Notice to Mariners
NWBM	Non Water Based Mud
NWMR	North-west Marine Region
NWP	Northwest Province
NWS	North-west Shelf
NWSTF	North West Slope Trawl Fishery
OCNS	Offshore Chemical Notification Scheme
OIM	Offshore Installation Manager
OIW	Oil in Water
OOC	Oil on cuttings
OPEP	Oil Pollution Emergency Plan
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OSPAR	Oslo and Paris Commission for the 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	Polyaromatic Hydrocarbon
PJ	Professional Judgement
PLONOR	OSPAR definition of a substance Poses Little Or NO Risk to the environment
PMST	Protected Matters Search Tool
PPA	Pearl Producers Association
ppb	Parts Per Billion
ppm	Parts Per Million
psi	Pounds per square inch

Abbreviation	Meaning
PSU	Practical Salinity Unit
PTW	Permit To Work
RBA	Risk Based Analysis
RCC	Rescue Coordination Centre
RMS	Root Mean Square
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
SA	South Australia
S-BRUVS	Stereo-baited Remote Underwater Video System
SBTF	Southern Bluefin Tuna Fishery
SCE	Solids Control Equipment
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 Levels
SSIV	Subsea Isolation Valve
SV	Societal Values
SW	Southwest
SWMR	South-west Marine Region
TGB	Temporary Guide-base
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
UK	United Kingdom
USBL	Ultra-short baseline
VOC	Volatile Organic Hydrocarbons
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WBM	Water Based Mud
WCC	Woodside Communication Centre
WCBD	Well Control Bridging Document
WDTF	Western Deepwater Trawl Fishery
WEL	Woodside Energy Ltd
WHA	World Heritage Area
WMP	Waste Management Plan
WMS	Woodside Management System
WOMP	Well Operation Management Plan
Woodside	Woodside Energy Ltd

APPENDIX A: WOODSIDE ENVIRONMENT AND RISK MANAGEMENT POLICIES

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

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.

APPENDIX B: RELEVANT REQUIREMENTS

This appendix refers to Commonwealth Legislation related to the project. Western Australian State Legislation relevant to an accidental release of hydrocarbons in WA State waters is outlined in the Julimar Phase 2 Drilling and Subsea Installation Oil Pollution Emergency Plan.

Commonwealth Legislation	Legislation Summary
Air Navigation Act 1920 • *Air Navigation Regulations 1947* • *Air Navigation (Aerodrome Flight* • *Corridors) Regulations 1994* • *Air Navigation (Aircraft Engine* • *Emissions) Regulations 1995* • *Air Navigation (Aircraft Noise)* • *Regulations 1984* • *Air Navigation (Fuel Spillage) Regulations 1999*	This Act relates to the management of air navigation.
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.
Australian Radiation Protection and Nuclear Safety Act 1998	This Act relates to the protection of the health and safety of people, and the protection of the environment from the harmful effects of radiation.
Biosecurity Act 2015 • *Quarantine Regulations 2000* • *Biosecurity Regulation 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.

Commonwealth Legislation	Legislation Summary
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.
Navigation Act 2012 • *Marine order 12 – Construction – subdivision and stability, machinery and electrical installations* • *Marine order 30 - Prevention of collisions* • *Marine order 47 - Mobile offshore drilling units* • *Marine order 57 - Helicopter operations* • *Marine order 60 - Floating offshore facilities* • *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*	This Act regulates navigation and shipping including Safety of Life at Sea (SOLAS). The Act will apply to some activities of the MODU and project vessels. This Act is the primary legislation that regulates ship and seafarer safety, shipboard aspects of marine environment protection and pollution prevention.
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.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 • *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*	This Act provides for measures to protect ozone in the atmosphere by controlling and ultimately reducing the manufacture, import and export of ozone depleting substances (ODS) and synthetic greenhouse gases, and replacing them with suitable alternatives. The Act will only apply to Woodside if it manufactures, imports or exports ozone depleting substances.

Commonwealth Legislation	Legislation Summary
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* *Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007* MARPOL Convention	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.

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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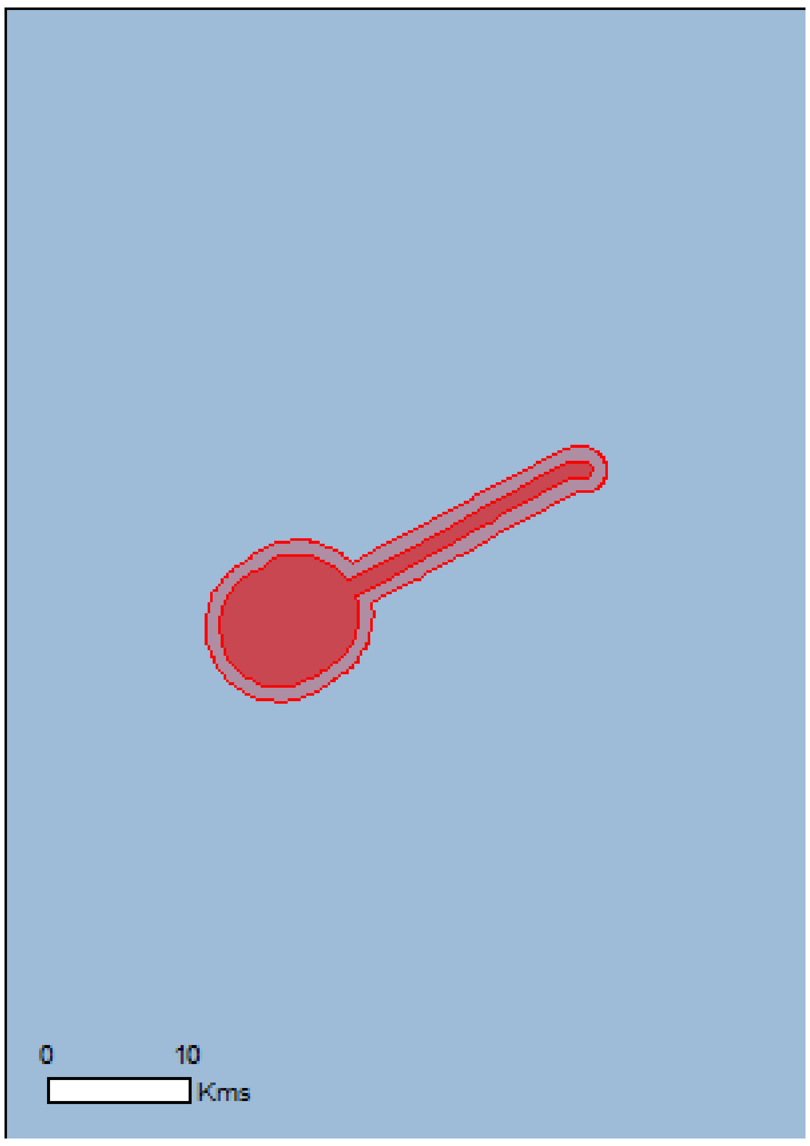

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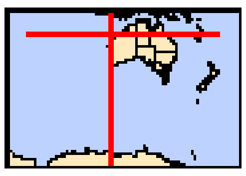

Summary

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:	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:	16
Listed Migratory Species:	30

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:	48
Whales and Other Cetaceans:	23
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
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	Species or species habitat likely 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 habitat likely to occur within area

Name	Status	Type of Presence
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	Species or species habitat 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 likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		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 may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely 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 likely 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
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

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 likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys 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
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 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

Name	Threatened	Type of Presence
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
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
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

Name	Threatened	Type of Presence
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
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 may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common 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
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

Name	Status	Type of Presence
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
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
Ancient coastline at 125 m depth contour	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

-19.726167 115.784312,-19.727172 115.784724,-19.729272 115.785354,-19.732176 115.786007,-19.735128 115.786369,-19.737193 115.786497,-19.739351 115.786485,-19.741637 115.786322,-19.74369 115.78603,-19.745977 115.785599,-19.748812 115.784794,-19.751588 115.783744,-19.754726 115.782251,-19.757398 115.780594,-19.760186 115.778611,-19.763219 115.775799,-19.765937 115.772731,-19.768154 115.769512,-19.769472 115.767295,-19.770592 115.765044,-19.771478 115.762897,-19.77219 115.762139,-19.774022 115.759782,-19.775445 115.757752,-19.776891 115.755198,-19.778186 115.752514,-19.779423 115.749388,-19.780403 115.745947,-19.780963 115.743158,-19.781278 115.740919,-19.781441 115.73904,-19.781511 115.737046,-19.781511 115.735074,-19.781231 115.731539,-19.780799 115.728821,-19.780146 115.725998,-19.779131 115.722802,-19.778035 115.72013,-19.77681 115.717622,-19.775445 115.715289,-19.774127 115.713364,-19.772528 115.711276,-19.77107 115.709608,-19.769472 115.707893,-19.766369 115.70535,-19.763546 115.703413,-19.760629 115.70178,-19.757783 115.700543,-19.754983 115.699587,-19.751693 115.698793,-19.7474 115.698257,-19.743387 115.698303,-19.740494 115.698583,-19.737414 115.699167,-19.734964 115.69989,-19.730788 115.701383,-19.727778 115.703016,-19.725608 115.704416,-19.722739 115.706563,-19.720335 115.708779,-19.717722 115.711742,-19.715762 115.714449,-19.714199 115.716969,-19.712916 115.719535,-19.711819 115.721892,-19.709976 115.724178,-19.708296 115.726441,-19.70643 115.729638,-19.704493 115.733907,-19.70335 115.737384,-19.70272 115.739997,-19.70223 115.74289,-19.701903 115.746507,-19.70188 115.750006,-19.70216 115.753296,-19.70293 115.757659,-19.704003 115.761299,-19.705217 115.764355,-19.706826 115.767598,-19.708716 115.770678,-19.710116 115.772591,-19.711749 115.774481,-19.713196 115.776068,-19.715039 115.777748,-19.716672 115.779148,-19.717746 115.779871,-19.707596 115.801056,-19.693971 115.827514,-19.684941 115.845059,-19.675632 115.862885,-19.665319 115.882997,-19.655427 115.902059,-19.647611 115.917364,-19.646864 115.919604,-19.646351 115.921634,-19.646094 115.924014,-19.646048 115.930173,-19.646304 115.93141,-19.647074 115.93295,-19.648241 115.934116,-19.649547 115.934746,-19.650667 115.935026,-19.65195 115.934956,-19.653304 115.934583,-19.654354 115.934023,-19.655264 115.93316,-19.655917 115.932133,-19.65636 115.930873,-19.656407 115.929357,-19.656127 115.928097,-19.655474 115.926977,-19.655567 115.92371,-19.656127 115.921751,-19.666579 115.901475,-19.667979 115.899259,-19.669053 115.896996,-19.670662 115.893589,-19.674069 115.886893,-19.679365 115.876837,-19.682795 115.870514,-19.685618 115.864588,-19.694694 115.847089,-19.695931 115.844966,-19.697167 115.84254,-19.699734 115.83743,-19.706873 115.823268,-19.707806 115.821634,-19.709276 115.819371,-19.71077 115.815802,-19.715016 115.807496,-19.721245 115.79555,-19.726167 115.784312

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

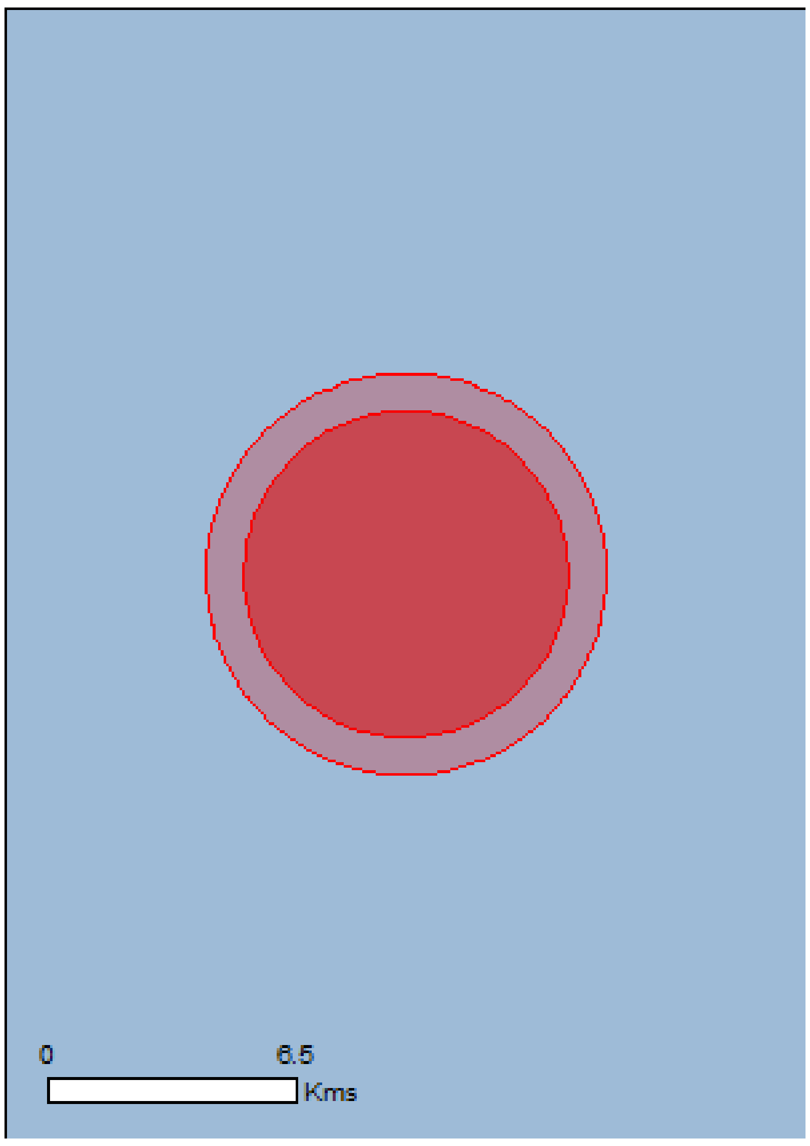
EPBC Act Protected Matters Report

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.

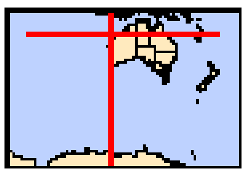
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/10/19 12:49:57



Coordinates
Buffer: 1.0Km



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:	15
Listed Migratory Species:	30

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:	53
Whales and Other Cetaceans:	22
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
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	Species or species habitat likely 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 habitat likely to occur within area

Name	Status	Type of Presence
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	Species or species habitat likely to occur within area
Sharks		
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 likely to occur within area
Fregata minor		
Great Frigatebird, Greater Frigatebird [1013]		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 may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
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 likely 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely 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
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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

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 likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys 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
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 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

Name	Threatened	Type of Presence
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
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
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

Name	Threatened	Type of Presence
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 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	Species or species habitat likely 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 borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common 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

Name	Status	Type of Presence
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (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
Ancient coastline at 125 m depth contour	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

-19.550823 116.03892,-19.550823 116.037221,-19.550751 116.035525,-19.550608 116.033833,-19.550393 116.03215,-19.550108 116.030478,-19.549752 116.028822,-19.549326 116.027184,-19.548832 116.025567,-19.54827 116.023976,-19.547641 116.022412,-19.546947 116.02088,-19.546189 116.019381,-19.545368 116.01792,-19.544487 116.016499,-19.543546 116.015121,-19.542548 116.013788,-19.541495 116.012504,-19.540388 116.01127,-19.539231 116.01009,-19.538025 116.008965,-19.536772 116.007898,-19.535476 116.006891,-19.534138 116.005945,-19.532762 116.005064,-19.53135 116.004248,-19.529904 116.0035,-19.528429 116.002819,-19.526927 116.002209,-19.5254 116.001671,-19.523852 116.001204,-19.522285 116.000811,-19.520704 116.000492,-19.519111 116.000247,-19.517509 116.000077,-19.515901 115.999983,-19.514291 115.999965,-19.512682 116.000022,-19.511077 116.000154,-19.509479 116.000362,-19.507891 116.000645,-19.506317 116.001002,-19.50476 116.001433,-19.503222 116.001936,-19.501707 116.002511,-19.500218 116.003157,-19.498758 116.003872,-19.497329 116.004655,-19.495935 116.005504,-19.494578 116.006418,-19.493261 116.007395,-19.491986 116.008432,-19.490757 116.009529,-19.489575 116.010682,-19.488443 116.011889,-19.487363 116.013148,-19.486338 116.014457,-19.485369 116.015813,-19.484458 116.017212,-19.483607 116.018654,-19.482817 116.020133,-19.482091 116.021649,-19.48143 116.023196,-19.480835 116.024774,-19.480307 116.026378,-19.479847 116.028005,-19.479456 116.029651,-19.479136 116.031315,-19.478886 116.032992,-19.478707 116.034679,-19.478599 116.036373,-19.478563 116.03807,-19.478599 116.039768,-19.478707 116.041462,-19.478886 116.043149,-19.479136 116.044826,-19.479456 116.046489,-19.479847 116.048136,-19.480307 116.049763,-19.480835 116.051367,-19.48143 116.052944,-19.482091 116.054492,-19.482817 116.056008,-19.483607 116.057487,-19.484458 116.058929,-19.485369 116.060328,-19.486338 116.061684,-19.487363 116.062993,-19.488443 116.064252,-19.489575 116.065459,-19.490757 116.066612,-19.491986 116.067709,-19.493261 116.068746,-19.494578 116.069723,-19.495935 116.070637,-19.497329 116.071486,-19.498758 116.072269,-19.500218 116.072984,-19.501707 116.073629,-19.503222 116.074205,-19.50476 116.074708,-19.506317 116.075139,-19.507891 116.075496,-19.509479 116.075779,-19.511077 116.075986,-19.512682 116.076119,-19.514291 116.076176,-19.515901 116.076158,-19.517509 116.076064,-19.519111 116.075894,-19.520704 116.075649,-19.522285 116.07533,-19.523852 116.074937,-19.5254 116.07447,-19.526927 116.073931,-19.528429 116.073321,-19.529904 116.072641,-19.53135 116.071893,-19.532762 116.071077,-19.534138 116.070195,-19.535476 116.06925,-19.536772 116.068243,-19.538025 116.067176,-19.539231 116.066051,-19.540388 116.064871,-19.541495 116.063637,-19.542548 116.062353,-19.543546 116.06102,-19.544487 116.059642,-19.545368 116.058221,-19.546189 116.056759,-19.546947 116.055261,-19.547641 116.053729,-19.54827 116.052165,-19.548832 116.050574,-19.549326 116.048957,-19.549752 116.047319,-19.550108 116.045663,-19.550393 116.043991,-19.550608 116.042308,-19.550751 116.040616,-19.550823 116.03892

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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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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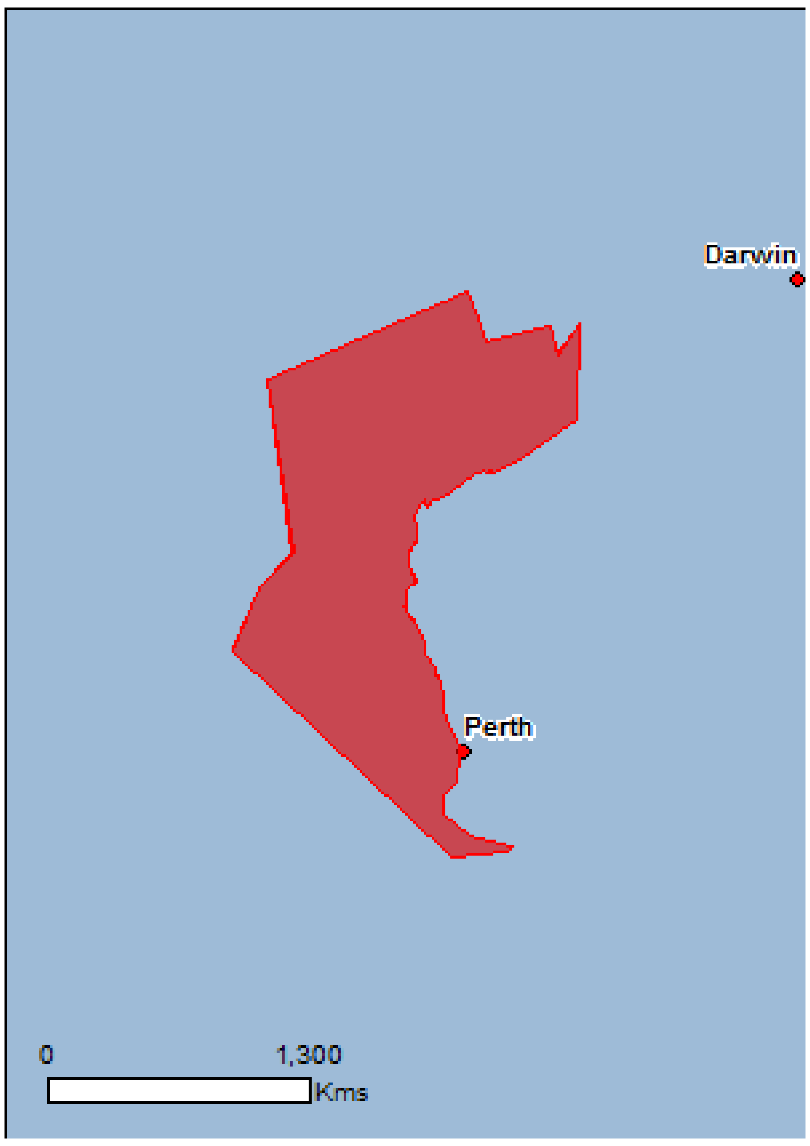
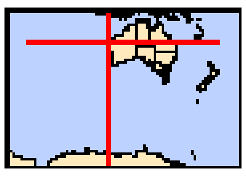


Coordinates
Buffer: 1.0Km



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:	3
National Heritage Places:	8
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	126
Listed Migratory Species:	97

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:	8
Commonwealth Heritage Places:	10
Listed Marine Species:	184
Whales and Other Cetaceans:	43
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	34

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	75
Regional Forest Agreements:	1
Invasive Species:	54
Nationally Important Wetlands:	10
Key Ecological Features (Marine)	19

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Australian Convict Sites (Fremantle Prison Buffer Zone)	WA	Buffer zone
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Lesueur National Park	WA	Listed place
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Batavia Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos	WA	Listed place
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place
Fremantle Prison (former)	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Becher point wetlands	Within Ramsar site
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west
South-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	Endangered	Community known to occur within area

Name	Status	Type of Presence
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely 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 tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to 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
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	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
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	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
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
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
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Turnix varius scintillans Painted Button-quail (Houtman Abrolhos) [82451]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Nannatherina balstoni Balston's Pygmy Perch [66698]	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
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may 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	Foraging, feeding or related behaviour 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
Bettongia lesueur lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat known to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within

Name	Status	Type of Presence
		area
Lagorchestes hirsutus bernieri Rufous Hare-wallaby (Bernier Island) [66662]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus dorreae Rufous Hare-wallaby (Dorre Island) [66663]	Vulnerable	Species or species habitat known to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Species or species habitat known to occur within area
Leporillus conditor Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding 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
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Species or species habitat known 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
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat known to occur within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat likely to occur within area
Beyeria lepidopetala Small-petalled Beyeria, Short-petalled Beyeria [18362]	Endangered	Species or species habitat likely to occur within area
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat may occur within area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat known to occur within area
Caladenia caesarea subsp. maritima Cape Spider-orchid [64856]	Endangered	Species or species habitat may occur within area
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat likely to occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Caladenia lodgeana Lodge's Spider-orchid [68664]	Critically Endangered	Species or species habitat known to occur within area
Caladenia viridescens Dunsborough Spider-orchid [56776]	Endangered	Species or species habitat likely to occur within area
Chorizema varium Limestone Pea [16981]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat likely to occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat may occur within area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat may occur within area
Eucalyptus x phylacis Meelup Mallee [87817]	Endangered	Species or species habitat known to occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat may occur within area
Grevillea humifusa Spreading Grevillea [61182]	Endangered	Species or species habitat may occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat likely to occur within area
Kennedia lateritia Augusta Kennedia [45985]	Endangered	Species or species habitat likely to occur within area
Lechenaultia chlorantha Kalbarri Leschenaultia [16763]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat may occur within area
Marianthus paralius [83925]	Endangered	Species or species habitat known to occur within area
Pityrodia augustensis Mt Augustus Foxglove [4962]	Vulnerable	Species or species habitat likely to occur within area
Sphenotoma drummondii Mountain Paper-heath [21160]	Endangered	Species or species habitat may occur within area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat known to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Wurmbea calcicola Naturaliste Nancy [64691]	Endangered	Species or species habitat known to occur within area
Wurmbea tubulosa Long-flowered Nancy [12739]	Endangered	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

Name	Status	Type of Presence
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 lancelini Lancelin Island Skink [1482]	Vulnerable	Species or species habitat known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Liopholis pulchra longicauda Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	Species or species habitat 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	Foraging, feeding or related behaviour known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	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

Name	Threatened	Type of Presence
Migratory Marine Birds		
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]		Breeding known to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding 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
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur

Name	Threatened	Type of Presence
		within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat 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
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to 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*	Foraging, feeding or related behaviour likely to 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*	Breeding known to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		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	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	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 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	Foraging, feeding or related behaviour 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]		Foraging, feeding or related behaviour known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
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 known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus		
Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Gallinago megala		
Swinhoe's Snipe [864]		Roosting likely to occur

Name	Threatened	Type of Presence
		within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - GERALDTON TRAINING DEPOT "A" Company 16th Battalion
Defence - HMAS STIRLING-ROCKINGHAM ;HMAS STIRLING - GARDEN ISLAND
Defence - LANCELIN TRAINING AREA
Defence - LEARMONTH - AIR WEAPONS RANGE
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Garden Island	WA	Listed place
Lancelin Defence Training Area	WA	Listed place
Learmonth Air Weapons Range Facility	WA	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
Historic		
Cape Leeuwin Lighthouse	WA	Listed place
Cliff Point Historic Site	WA	Listed place
Geraldton Drill Hall Complex	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place
J Gun Battery	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
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known 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]		Breeding known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known 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 known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting 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]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	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 known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		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
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding likely to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Puffinus huttoni Hutton's Shearwater [1025]		Foraging, feeding or related behaviour known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species

Name	Threatened	Type of Presence
		habitat known 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
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to 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*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area

Name	Threatened	Type of Presence
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys 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

Name	Threatened	Type of Presence
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 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
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		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 breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		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

Name	Threatened	Type of Presence
Hippocampus subelongatus West Australian Seahorse [66722]		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
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		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

Name	Threatened	Type of Presence
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
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		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
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	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

Name	Threatened	Type of Presence
		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	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
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
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to 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

Name	Threatened	Type of Presence
		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	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known 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
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		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

Name	Status	Type of Presence
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
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may 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
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		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]		Foraging, feeding or related behaviour known to 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

Name	Status	Type of Presence
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		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
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Abrolhos	Special Purpose Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Dampier	National Park Zone (IUCN II)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Geographe	Multiple Use Zone (IUCN VI)
Geographe	Special Purpose Zone (Mining
Jurien	National Park Zone (IUCN II)
Jurien	Special Purpose Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Perth Canyon	Habitat Protection Zone (IUCN IV)
Perth Canyon	Multiple Use Zone (IUCN VI)
Perth Canyon	National Park Zone (IUCN II)
Shark Bay	Multiple Use Zone (IUCN VI)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)

Name	Label
South-west Corner	Special Purpose Zone (IUCN VI)
South-west Corner	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)
Two Rocks	National Park Zone (IUCN II)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Airlie Island	WA
Barrow Island	WA
Bedout Island	WA
Beekeepers	WA
Bernier And Dorre Islands	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Bundegi Coastal Park	WA
Cape Range	WA
Carnac Island	WA
Dirk Hartog Island	WA
Escape Island	WA
Flinders Bay	WA
Freycinet, Double Islands etc	WA
Jurabi Coastal Park	WA
Kalbarri	WA
Koks Island	WA
Lancelin And Edwards Islands	WA
Leeuwin-Naturaliste	WA
Lesueur	WA
Little Rocky Island	WA
Locker Island	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
Murujuga	WA
Nambung	WA
Nilgen	WA
North Sandy Island	WA
One Tree Point	WA
Part Murchison house	WA
Penguin Island	WA
Port Kennedy Scientific Park	WA
Rottnest Island	WA
Round Island	WA
Seal Island (WA25645)	WA
Serrurier Island	WA
Southern Beekeepers	WA
St Alouarn Island	WA
Sugar Loaf Rock	WA
Tamala Pastoral Lease (Part)	WA
Unnamed WA26400	WA
Unnamed WA33799	WA
Unnamed WA34039	WA
Unnamed WA36907	WA
Unnamed WA36909	WA

Name	State
Unnamed WA36910	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA37338	WA
Unnamed WA37383	WA
Unnamed WA37500	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA42469	WA
Unnamed WA43903	WA
Unnamed WA44004	WA
Unnamed WA44665	WA
Unnamed WA44667	WA
Unnamed WA44672	WA
Unnamed WA44682	WA
Unnamed WA44688	WA
Unnamed WA48858	WA
Unnamed WA48968	WA
Unnamed WA49220	WA
Unnamed WA49994	WA
Victor Island	WA
Wanagarren	WA
Wedge Island	WA
Y Island	WA
Yalgorup	WA
Zuytdorp	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

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		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pavo cristatus Indian Peafowl, Peacock [919]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Phasianus colchicus Common Pheasant [920]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		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 norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus declinatus Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		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
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Bundera Sinkhole	WA
Cape Leeuwin System	WA
Cape Range Subterranean Waterways	WA
Hutt Lagoon System	WA
Lake Thetis	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Mermaid Reef	EXT
Rottnest Island Lakes	WA
Shark Bay East	WA
Swan-Canning Estuary	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west

Name	Region
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Wallaby Saddle	North-west
Albany Canyons group and adjacent shelf break	South-west
Ancient coastline at 90-120m depth	South-west
Cape Mentelle upwelling	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Commonwealth marine environment within and	South-west
Naturaliste Plateau	South-west
Perth Canyon and adjacent shelf break, and other	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-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

-24.545423 113.452903,-24.670747 113.550107,-25.198466 113.740978,-25.444578 113.463076,-25.469963 113.374602,-25.715599 113.340258,-25.937329 113.369788,-26.236502 113.342574,-26.236132 113.333317,-26.022119 113.298512,-26.150812 113.244135,-26.171547 113.192133,-26.146934 113.160234,-26.287069 113.26668,-26.392224 113.308643,-26.651291 113.564429,-26.899353 113.758735,-27.344148 114.035338,-27.569241 114.113412,-27.709428 114.131294,-27.852778 114.113376,-27.987915 114.135774,-28.080495 114.123828,-28.293408 114.366941,-28.512784 114.534465,-28.638577 114.598356,-28.875052 114.623534,-29.103354 114.868201,-29.828315 114.97086,-30.209088 114.997738,-30.572992 115.094906,-31.694492 115.699275,-32.184252 115.755271,-32.246594 115.745191,-32.281685 115.704501,-32.343654 115.735859,-32.590036 115.606695,-33.019699 115.605706,-33.512068 115.009334,-34.24229 114.939969,-35.016822 116.153368,-35.411771 118.085984,-35.59608 117.843749,-35.769858 115.416131,-27.927439 105.536754,-25.433752 106.758213,-23.952473 108.251438,-16.752104 107.165176,-12.929002 116.075217,-15.112577 116.942012,-14.425693 119.743303,-15.650138 120.125569,-14.335019 121.114761,-18.395091 120.956782,-20.286895 118.237561,-20.690236 117.236119,-20.66663 117.204446,-20.664763 117.171968,-20.638258 117.180181,-20.626312 117.170848,-20.633779 117.194367,-20.61474 117.188767,-20.61474 117.180554,-20.599027 117.17194,-20.627059 117.141731,-20.640125 117.142104,-20.65655 117.122692,-20.649084 117.099547,-20.629905 117.100947,-20.627806 117.093107,-20.636578 117.084335,-20.638912 117.073415,-20.637512 117.06091,-20.62034 117.071922,-20.631352 117.044671,-20.637045 117.050644,-20.649457 117.037205,-20.676536 116.932256,-20.656295 116.864127,-20.589168 116.812101,-20.524773 116.861751,-20.531493 116.825167,-20.584502 116.794556,-20.587489 116.77813,-20.642738 116.703469,-20.678575 116.539214,-20.819736 116.358742,-21.68563 115.032553,-21.816413 114.675668,-21.813427 114.508427,-22.061302 114.38001,-22.076235 114.239646,-21.992614 114.132134,-21.801481 114.159012,-21.874958 114.005193,-22.285705 113.834377,-22.590309 113.669486,-22.684164 113.680993,-22.709945 113.673807,-22.713842 113.701525,-22.767131 113.754348,-22.810715 113.775627,-22.939345 113.821541,-23.042031 113.821788,-23.106087 113.795746,-23.120279 113.763004,-23.128865 113.772337,-23.142118 113.77215,-23.179262 113.764497,-23.187848 113.774577,-23.318619 113.788341,-23.402854 113.783589,-23.459875 113.777418,-23.504785 113.760391,-23.535396 113.737246,-23.589152 113.68125,-23.624989 113.630854,-23.768712 113.551713,-23.768058 113.542794,-23.872865 113.49945,-23.910942 113.471825,-23.94006 113.469212,-23.988983 113.458374,-24.032267 113.443081,-24.03509 113.427728,-24.044866 113.422409,-24.056263 113.428218,-24.075821 113.428586,-24.082581 113.427565,-24.087154 113.424765,-24.087714 113.421312,-24.090328 113.419072,-24.098074 113.421872,-24.101527 113.422992,-24.103953 113.426632,-24.106193 113.426818,-24.112651 113.430542,-24.15435 113.428872,-24.180918 113.425945,-24.22572 113.409777,-24.225089 113.391354,-24.252087 113.397353,-24.270331 113.398424,-24.357032 113.396277,-24.48472 113.407731,-24.491724 113.420051,-24.515147 113.429179,-24.520894 113.435749,-24.545423 113.452903

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-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D: OIL SPILL PREPAREDNESS AND RESPONSE STRATEGY SELECTION AND EVALUATION

Oil Spill Preparedness and Response Mitigation Assessment for Echo Yodel and Capella Plugging and Echo Yodel Decommissioning

Security & Emergency Management
Hydrocarbon Spill Preparedness

April 2020
Revision 0

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Woodside Energy Ltd (Woodside) has developed its oil spill preparedness and response position for the Echo-Yodel and Capella Plugging and Decommissioning, 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 Scenario	Hydrocarbon release caused by a well loss of containment Subsea release of 348,134 m^3 over 77 days of Yodel-3 Condensate. Yodel-3 Condensate contains a high proportion of highly volatile components and a low proportion of residual components.	Section 2.2
Hydrocarbon Properties	Yodel-3 Condensate (API 54.4) Contains a low proportion (~2.5% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. The un-weathered mixture has a dynamic viscosity of 0.54 Cp. The pour point of the whole oil (< -36 °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 63.1% of the oil mass should evaporate within the first 12 hours (Boiling Point (BP) < 180 °C); a further 25.3% should evaporate within the first 24 hours (180°C < BP < 265 °C); and a further 9.1% should evaporate over several days (265 °C < BP < 380 °C). Marine Diesel (API 35) 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 then be subject to more gradual decay through biological and photochemical processes.	Appendix A of the First Strike Plan

Modelling Results	A quantitative, stochastic assessment has been undertaken for credible spill scenarios to help assess the environmental risk of a hydrocarbon spill. Deterministic assessment has not been undertaken because there is no shoreline contact predicted. 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). No shoreline receptors are predicted to be contacted by floating oil concentrations at the 10 g/m^2 threshold. No surface receptors are predicted to be contacted by floating oil at the 50 g/m^2 threshold. Potential for accumulation of residual oil on shorelines is predicted to be moderate, with a maximum accumulated volume of 8.3 g/m^2 at Ningaloo Coast North World Heritage Area (WHA) predicted in one of the hundred scenarios, and 24 g/m^2 at Ningaloo Coast Middle A maximum local accumulated concentration on shoreline less than 3 g/m^2 at all the other contacted receptors.	Section 2.3
Net Environmental Benefit Assessment	Source control, and Oiled Wildlife Response, are identified as potentially having a net environmental benefit (dependant on the actual spill scenario) and carried forward for further assessment. Monitor and evaluate activities would be used to support these activities and verify planning assumptions.	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 risk presented in Section 2, with the implementation of considered additional, alternative or improved control measures.	Section 7

1 INTRODUCTION

1.1 Overview

Woodside Energy Ltd (Woodside) has developed its oil spill preparedness and response position for the Echo-Yodel and Capella plugging and Decommissioning, hereafter known as the PAP. 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 Echo-Yodel Decommissioning Environment Plan (EP)
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- The Echo-Yodel Decommissioning Oil Pollution Emergency Plan (OPEP) including:
  - First Strike Plan (FSP)
  - Relevant Operations Plans
  - Relevant Tactical Response Plans (TRPs)
  - Relevant Supporting Plans
  - Data Directory.

The purpose of this document is to demonstrate that the risks and impacts from an unplanned hydrocarbon release and the associated response operations are controlled to ALARP and Acceptable levels.

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.

The Oil Pollution FSP 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 Oil Pollution 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.

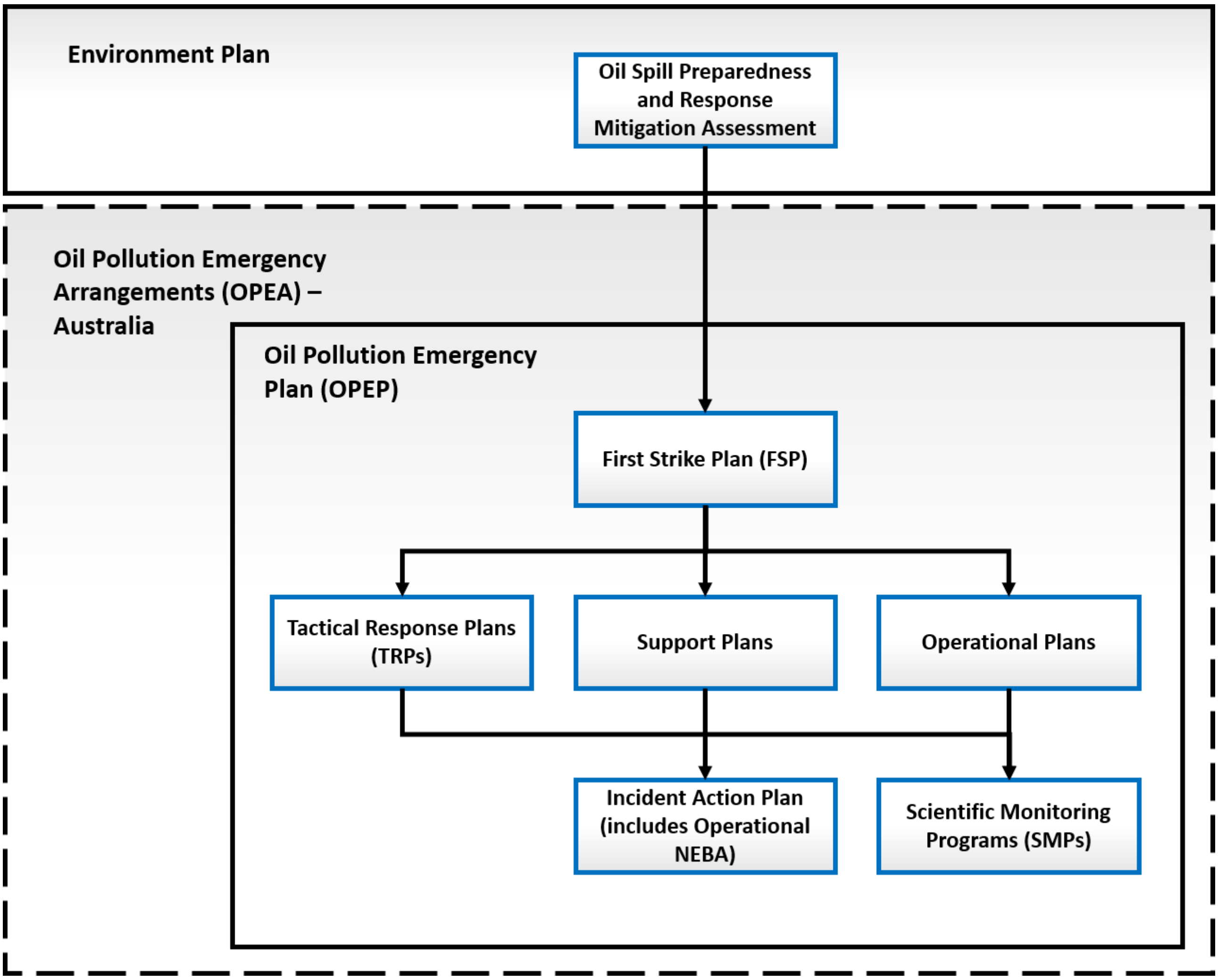


Figure 1-1: Woodside hydrocarbon spill document structure

Table 1-1: Hydrocarbon Spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information
Echo-Yodel Decommissioning Environment Plan (EP)	Demonstrates that potential adverse impacts on the environment associated with the PAP for the Echo-Yodel Decommissioning (during both routine and non-routine operations) are mitigated and managed to ALARP and will be of an acceptable level.	NOPSEMA Woodside internal	EP Section 5 (Identification and evaluation of environmental risks and impacts, including credible spill scenarios) EP Section 6 (Implementation strategy – including emergency preparedness and response) EP Section 6 (Reporting and compliance) EP Section 6 (Performance outcomes, standards and measurement criteria)
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
Oil Spill Preparedness and Response Mitigation Assessment for the Echo-Yodel Decommissioning (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.
Echo-Yodel Decommissioning Oil Pollution First Strike Response Plan	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 IAP specific to the event is developed. Oil Pollution First Strike Response Plans 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 activity-specific response information.	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 modelling (OSTM), 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.	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.

Document	Document overview	Stakeholders	Relevant information
	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.		
TRPs	Provides options for response techniques in selected 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.
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.	Technique for mobilising and managing additional resources outside of Woodside's immediate preparedness arrangements.

2 RESPONSE PLANNING PROCESS

This document details Woodside's process for identifying potential response options for the hydrocarbon release scenarios. 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 Echo-Yodel Decommissioning First Strike Response Plan 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.

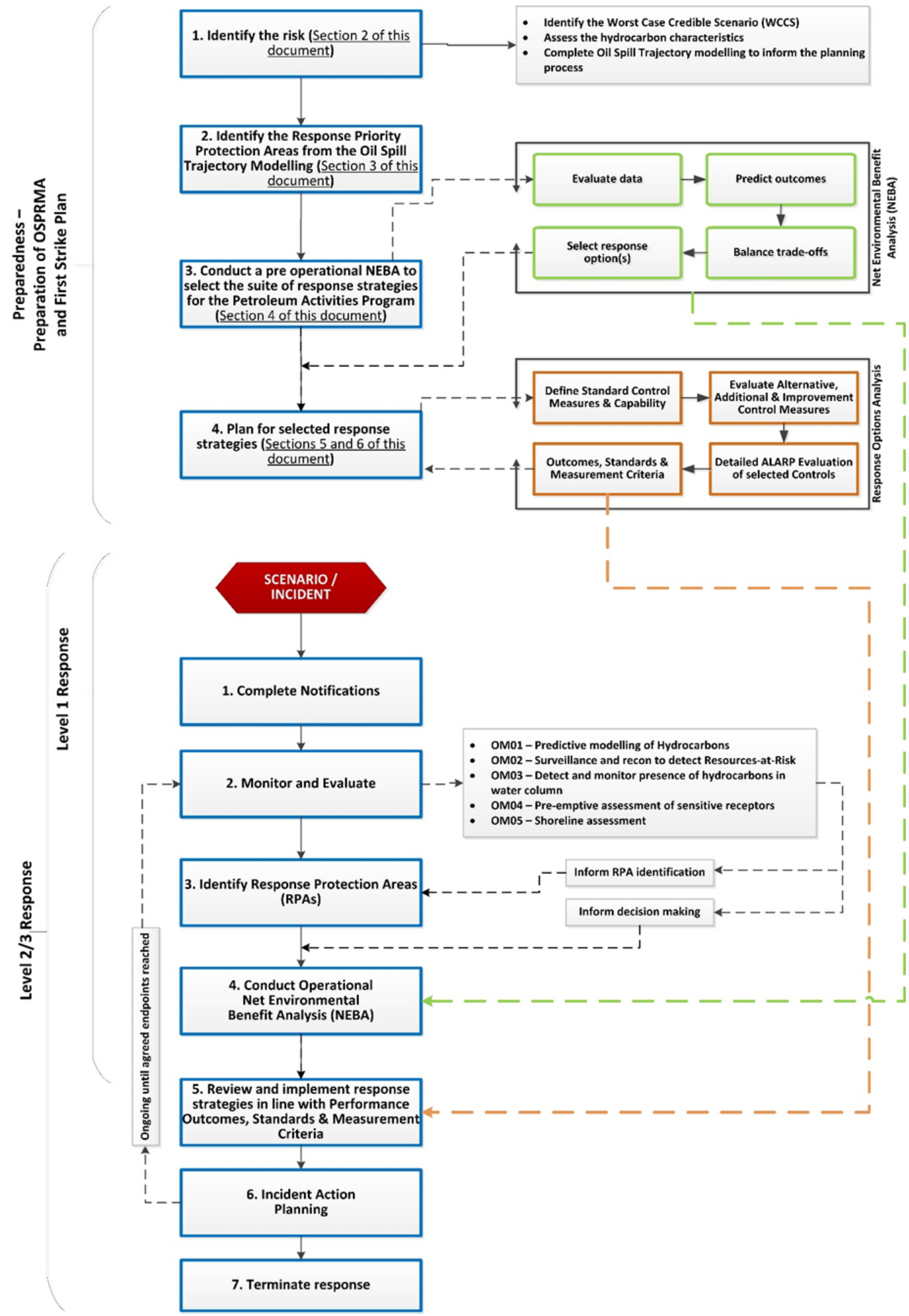


Figure 2-1: Response planning and selection process

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 RPAs
- Areas predicted to be contacted at concentration >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

2.2.1 Response Planning Assumptions- Timing, Resourcing and Effectiveness

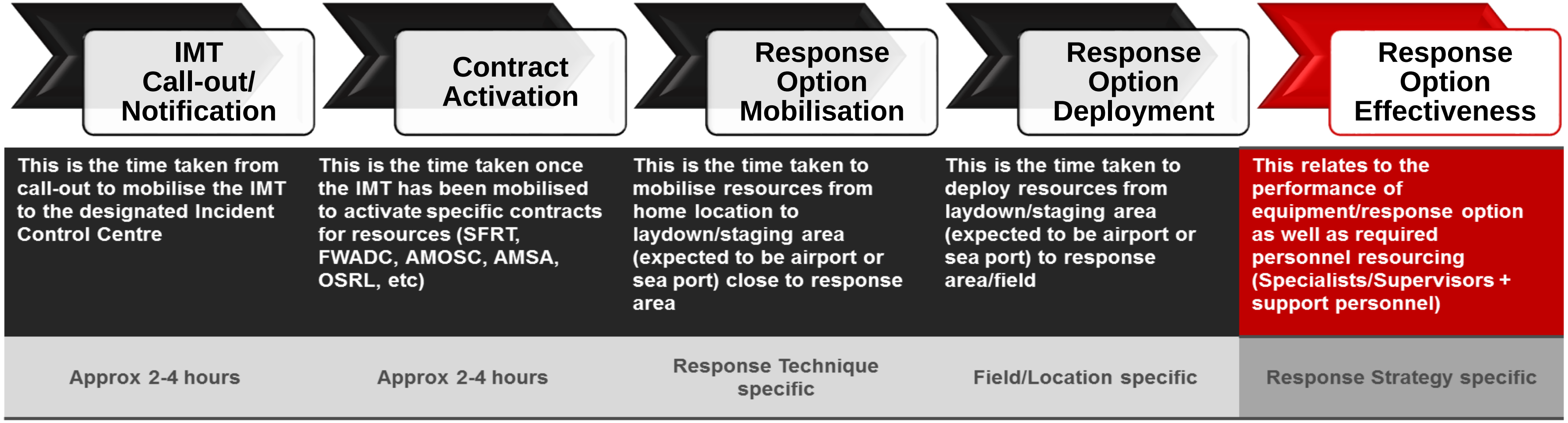


Figure 2-2: Response Planning Assumptions – Timing, Resourcing and Effectiveness

2.2 Environment plan risk assessment (credible spill scenarios)

Potential hydrocarbon release scenarios from the PAP have been identified during the risk assessment process. Two 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.

A loss of well containment is an uncontrolled release of reservoir hydrocarbon or other well fluids to the marine environment, resulting from an over-pressured reservoir and Woodside has considered this the WCCS.

Table 2-1: Petroleum Activities Program credible spill scenarios

Scenarios	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m^3)	Incident Level	Hydrocarbon (HC) type	Residual proportion (%)	Residual volume (liquid m^3)	Key credible scenarios informing response planning
Scenario 1	Yes	77-day subsea hydrocarbon release of Yodel-3 Condensate caused by loss of well containment	348,134	3	Yodel-3 Condensate	2.5	8,703	This scenario is used because it is the only loss of well containment scenario.
Scenario 2	Yes	Instantaneous surface hydrocarbon release of marine diesel cause by loss of marine diesel from Heavy Lift Vessel or Accommodation Support Vessel operations	105	2	Marine Diesel	5	5.25	The modelled scenario ($343m^3$ &$1000m^3$) is used because it is a scenario that has been modelled previously and it represents a similar oil type and larger release volume. The actual worst case from this scenario is significantly less.

2.2.1 Hydrocarbon characteristics

Yodel 3 Condensate (API 54.4) (Scenario 1)

Yodel-3 Condensate contains a low proportion (2.5% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures (residual). These compounds will persist in the marine environment; however, the majority of the hydrocarbons that comprise this oil (97.5%) will volatilise at ambient temperatures.

The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 63.1% of the oil mass should evaporate within the first 12 hours (Boiling Point (BP) < 180°C); a further 25.3% should evaporate within the first 24 hours (180°C < BP < 265°C); and a further 9.1% should evaporate over several days (265°C < BP < BP 380°C).

The remaining 2.5% of the unweathered hydrocarbon mixture has low density (0.76 g/cm^3) and very low dynamic viscosity (0.54 cP). The pour point of the whole mixture (< -36°C) indicates that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

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 density, viscosity and pour point.

The whole oil has an asphaltene content (< 0.1%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle. The whole oil also contains ~ 5% wax, therefore there is potential for residual hydrocarbons to be found as wax in the marine environment if this oil is spilled.

Soluble aromatic hydrocarbons contribute approximately 8.7% by mass of the whole oil, mostly in the C11-C20 range of hydrocarbons. These compounds would evaporate slowly if exposed to the atmosphere, leaving the potential for dissolution of a proportion of them into the water column.

Marine Diesel (API 35) (Scenario 2)

Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. The entrainment of marine diesel will remain in the upper water column or sea surface for an extended period of time due to the heavier (low volatility) component of the oil.

Modelling shows 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. Under calm conditions the majority of the remaining oil on the water surface will weather at a slower rate due to being compromised of the longer-chain compounds with higher boiling points.

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 then be subject to more gradual decay through biological and photochemical processes.

Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks and oil droplets in the water column at an approximate rate of around 0.50% per day, for an accumulated total of about 3-4% after seven days in each wind case. However, given the large proportion of entrained oil and the tendency of 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. This long weathering duration will extend the area of potential effect, requiring the break-up and dispersion of the slicks and droplets to reduce concentrations below the thresholds considered in this study.

2.3 Hydrocarbon spill 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 impact 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 Natural Resource Damage Assessment (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

Stochastic modelling has been completed for the following scenarios outlined in Table 2-1. A quantitative, stochastic assessment has been undertaken for credible spill scenarios to help assess the environmental consequences of a hydrocarbon spill.

For scenario 2, two existing models have been analysed to understand the consequences of this type of incident. The two models were selected because they are both located close to the Echo-Yodel site within the PAP. The 1000 m^3 volume greatly exceeds the credible spill scenario (105 m^3) and the 343 m^3 volume is located adjacent to the Echo-Yodel location. For this analysis both models were overlayed to the Echo-Yodel location. Whilst the hydrodynamics of the locations will not be identical the differences are considered to be insignificant in understanding the consequences of the scenario. Any variance in the hydrodynamics will be offset by the larger spill volumes used that are above the credible scenario.

A total of 100 replicate simulations were completed for each model 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).

2.3.1.1 Environmental impact thresholds – 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 Environment that May Be Affected (EMBA). 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.

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.

Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine EMBA and environmental impacts

Hydrocarbon Type	EMBA				Socio-cultural EMBA
	Surface Hydrocarbon (g/m2)	Entrained hydrocarbon (ppb)	Dissolved aromatic hydrocarbon (ppb)	Accumulated hydrocarbons (g/m2)	Surface Hydrocarbon (g/m2)
Yodel-3 Condensate	10	100	50	100	1
Marine diesel	10	500	500	100	-

For this petroleum activities program, deterministic modelling was not required because the stochastic spill modelling predicted no contact with shorelines from floating oil at response thresholds.

2.3.1.2 Surface hydrocarbon concentrations

The surface thickness of oil at which dispersants are typically effective is approximately 100 g/m^2. 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/m^2) (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 AMSA (AMSA, 2015) indicates that spreading of spills 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.

Table 2-3: Surface hydrocarbon thresholds for response planning

Surface hydrocarbon concentration (g/m²)	Description	Bonn Agreement Oil Appearance Code (BAOAC)	Mass per area (g/m²)
>10	Predicted minimum threshold for commencing operational monitoring	Code 3 – Dull metallic colours	5 - 50
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [1]	Code 4 – Discontinuous true oil colour	50 - 200
100	Predicted optimum floating oil threshold for containment and recovery and surface dispersant application	Code 5 – Continuous true oil colour	>200
Shoreline hydrocarbon concentration (g/m²)	**Description**	**National Plan Guidance on Oil Contaminated Foreshores**	**Mass per area (g/m²)**
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations	Stain	>100
250	Predicted minimum threshold for commencing shoreline clean-up operations	Level 3 - Thin Coating	200 - 1000

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 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 the National Oceanic and Atmospheric Administration (NOAA) in the United States is found in the document: *Characteristics of Response Techniques: A Guide for Spill Response Planning in Marine Environments 2013 (NOAA 2013).*

[1] 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.

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 50 g/m^2 was chosen as an average / equilibrium thickness (50 g/m^2 is an average is 50% coverage of 0.1 mm 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.

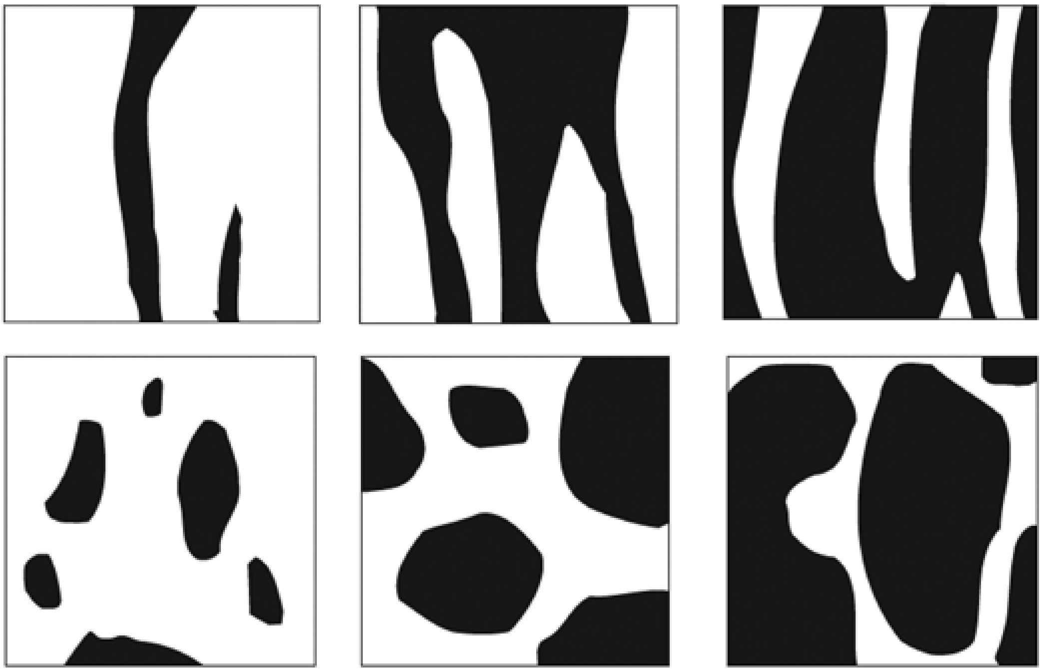


Figure 2-3: Proportion of total area coverage (AMSA, 2014)

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.

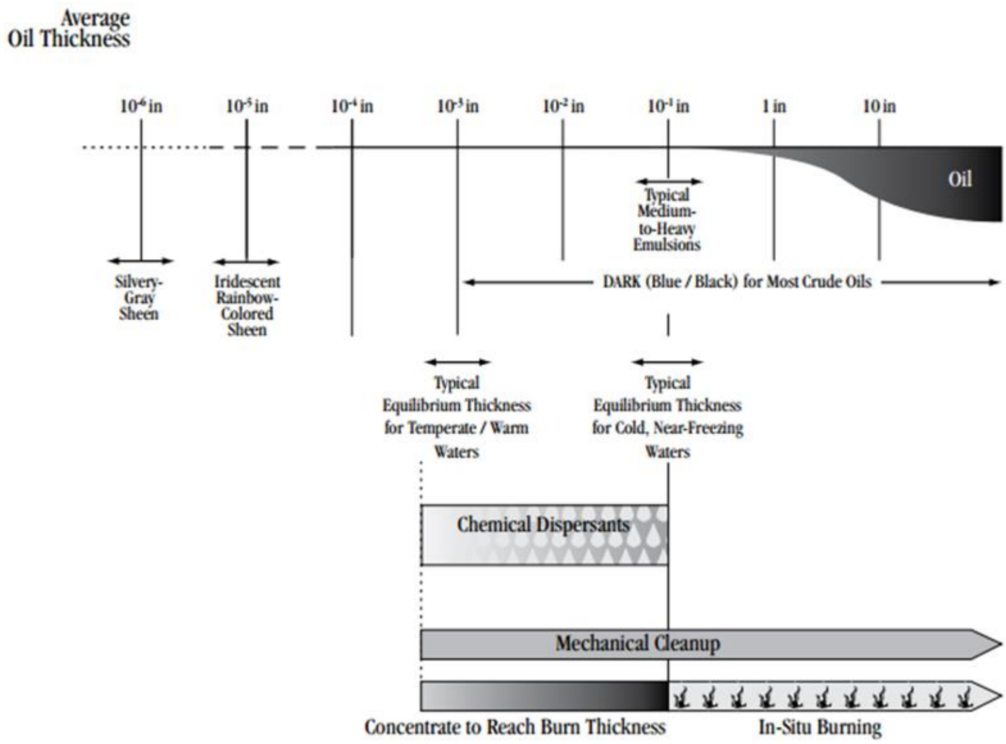


Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and waves influence the feasibility of mechanical clean-up operations, dropping the effectiveness significantly because of entrainment and/or splash-over as short period waves develop beyond two to three feet (0.6–0.9 m) in height. Waves and wind can also be limiting factors for the safe operation of vessels and aircraft.

2.3.1.3 Surface hydrocarbon viscosity

Table 2-4: Surface hydrocarbon viscosity thresholds

Surface viscosity (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	500-5000
10,000	Predicted maximum viscosity for effective surface dispersant operations	Sometimes possible to disperse	5,000-10,000

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.s (1,000 – 2,000 cSt) and then declining to a low level with an oil viscosity of 10,000 mPa.s (10,000 cSt). It was considered

that some generally applicable viscosity limit, such as 2,000 or 5,000 mPa.s (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.s (5,000 cSt) or more, and their performance gradually decreases with increasing viscosity; oils with a viscosity of more than 10,000 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 – 10,000 cSt at sea temperature above pour point are sometimes possible to disperse, with products beyond 10,000 cSt at sea temperature below pour point are generally impossible to disperse.

To support decision making and response planning, a threshold of 10,000 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).

2.3.2 Spill modelling results

Details of the worst-case credible scenario and modelling outputs are included in Table 2-5. Modelling was conducted for all scenarios, with neither predicting to have shoreline accumulation above 100g/m^2 and thus deterministic modelling was not run.

Table 2-5: Worst case credible scenario modelling results

Scenario description	Results
Maximum continuous liquid hydrocarbon release rate and duration	Echo-Yodel Decommissioning loss of well control (WCCS) Hydrocarbon release caused by loss of well control Total- 348,134 m^3 over 77 days
Maximum residual surface volume remaining post-weathering	No floating oil predicted to contact shoreline receptors

The maps below display the predicted surface concentration of oil at 0-50 g/m^2 (BAOAC Code 1-3 sheen - light grey), 50–200 g/m^2 (BAOAC Code 4 – discontinuous true oil colour - brown) and 200 g/m^2 and above (BAOAC Code 5 – continuous true oil colour - black) over the initial five days of the two scenarios and have been chosen for planning purposes.

2.3.2.1 Loss of well containment

The model suggests that a subsea release results in surface concentrations for minor containment and recovery and surface dispersant operations from the WCCS as the surface oil appears only in small discrete patches. There is a very small, daily area where surface oil concentration is greater 50 g/m^2 and viscosity is below 10,000 cSt. Weathering predictions for the oil indicate the residual portion of hydrocarbons reaching the surface will be extremely weathered with viscosity predicted to be greater than 1,000,000 cSt for most of the surface oil.

The model also suggested that volatile concentrations of hydrocarbons may be in the atmosphere, high winds (>20 knots), waves and/or sea states (>1.5 m waves) and high ambient temperatures which would limit response operations on personnel safety grounds.

2.3.2.2 Vessel collision

The two models used to understand the consequences of this scenario are taken from the library of diesel spill models Woodside has accumulated over the years of undertaking similar activities to those in this PAP. These models are considered representative of the actual scenarios considered in the PAP because:

- Both scenarios are above the worst-case credible diesel scenario from this PAP.
- Both scenarios are located within 50Nm of the Echo-Yodel operational area.
- The models have comparable outputs.
- The models are relatively recent and so both use the latest and same hydrodynamic assumptions and inputs.
- The models have been carried out by the same contractor using the same predictive software.
- The 1000 m^3 release is closer to shorelines than the operational area of this PAP.

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 (NERA 2018).

Both models show that spreading and weathering of the surface oil occurs rapidly due to the loss of light, volatile components and the spreading will reduce the effectiveness and available surface area for containment and recovery and surface dispersant operations. Both models also suggested that volatile concentrations of hydrocarbons may be in the atmosphere, high winds (>20 knots), waves and/or sea states (>1.5 m waves) and high ambient temperatures which would limit response operations on personnel safety grounds.

3 IDENTIFY RESPONSE PROTECTION AREAS (RPAs)

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.

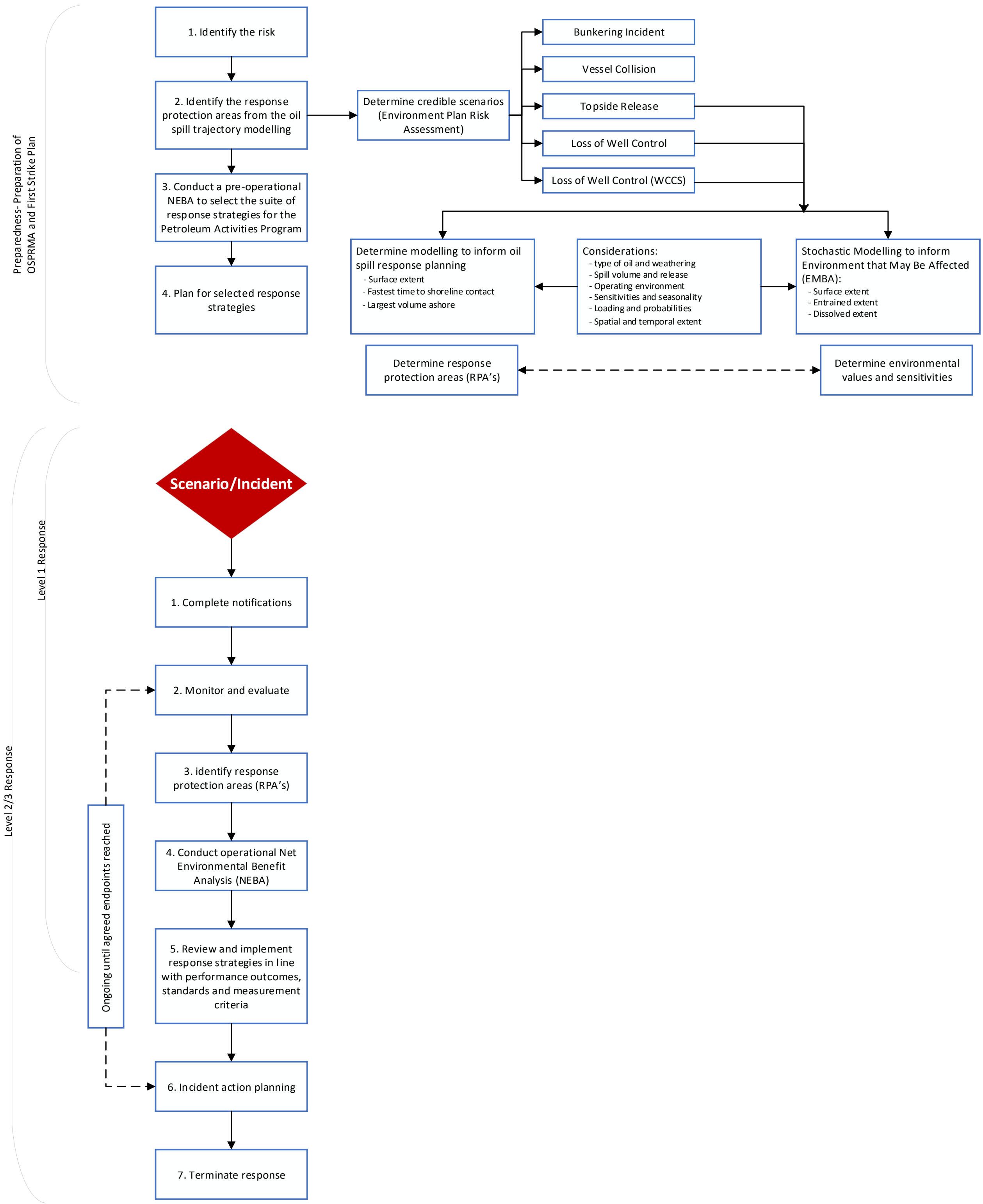


Figure 3-1: Identify Response Protection Areas (RPAs) flowchart

3.1 Identified sensitive receptor locations

RPAs are selected on the basis of their environmental (ecological, social, economic, cultural and heritage) values and sensitivities and considering the minimum response thresholds and the ability to conduct a response.

Contact from floating hydrocarbons above 10 g/m^2 is not predicted for any shoreline receptor based on the stochastic modelling. Additionally, accumulation above 100 g/m^2 on any shoreline is not predicted and no accumulated volume of hydrocarbons is predicted at any shorelines. Consequently, no RPAs have been selected for response planning.

For this PAP deterministic modelling was not required because the stochastic spill modelling predicted no contact with shoreline from floating oil at threshold.

4 NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

A 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.

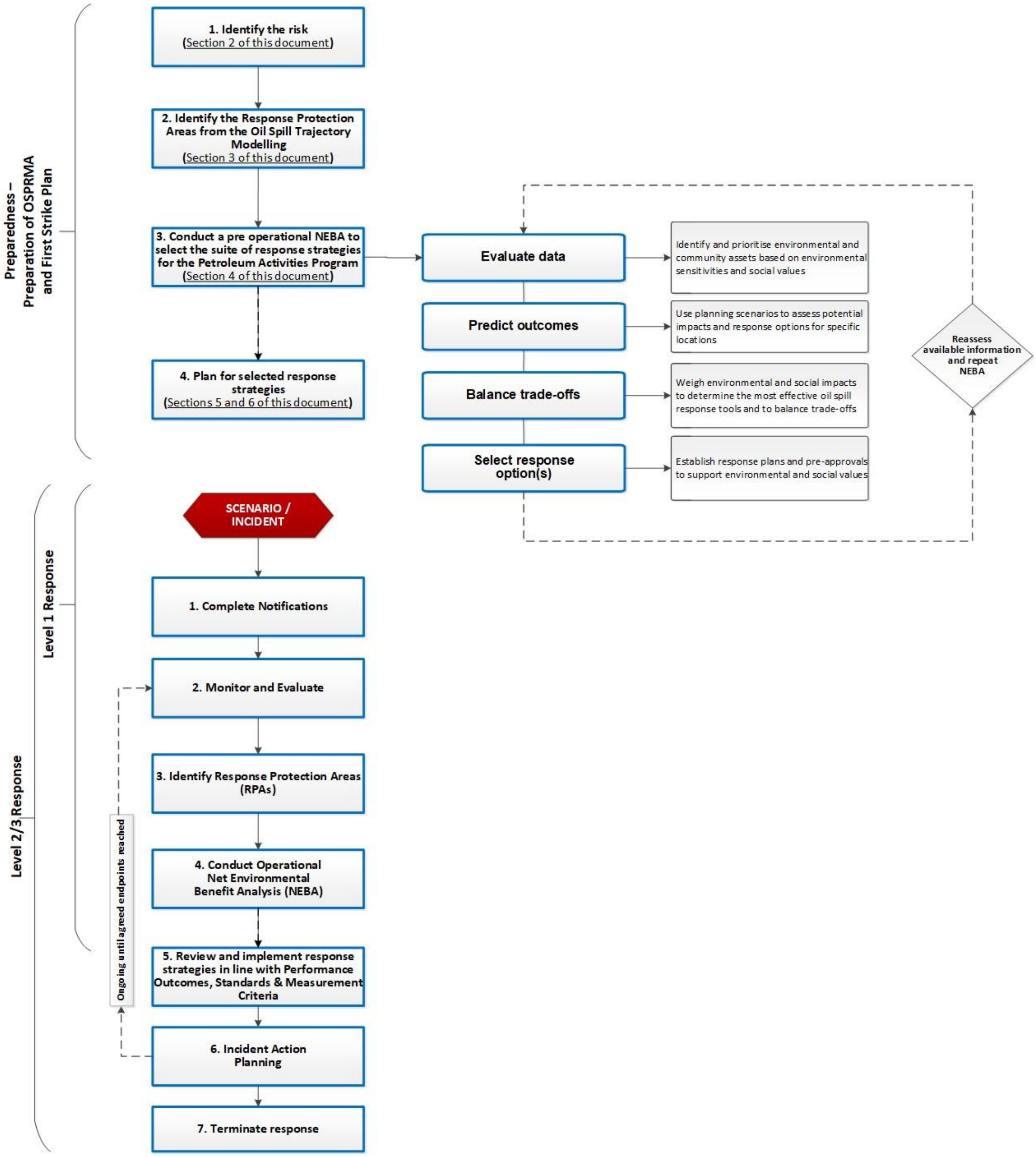


Figure 4-1: NEBA flowchart

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).

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 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. 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 (Yodel-3 Condensate WCCS)	
Scenario	Hydrocarbon release caused by well loss of containment
Location	Yodel-3 well
Oil Type	Yodel-3 Condensate
Fate and Weathering	63.1% of the oil mass should evaporate within the first 12 hours (BP < 180°C); 25.3% should evaporate within the first 24 hours (180°C < BP < 265); 9.1% should evaporate over several days (265°C < BP < 380°C).
Volume and duration of release	348,134 m^3 over 77 days
Scenario summary information (Marine Diesel credible scenario)	
Scenario	Hydrocarbon release cause by loss of marine diesel from Heavy Lift Vessel or Accommodation Support Vessel operations
Location	Echo-Yodel
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	105 m^3 (instantaneous)

4.2.1.1 Hydrocarbon characteristics

Yodel-3 Condensate

Modelling results predict that the discharge would generate a cone of rising gas that would entrain the oil 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 24 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 8.4 m.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate very small oil droplets (1-7 µm) that will have very low-rise velocities (<0.001 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.

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 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 soil 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.

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
- Subsea dispersant injection (SSDI)
- Containment and recovery
- In-situ burning
- Surface dispersant application:
  - aerial dispersant application
  - vessel dispersant application
- 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
- 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. 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 and when and timings throughout the response.

4.2.2.1 Table 4-2: Response technique evaluation – Yodel-3 Condensate

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Condensate				
Source control via Blowout Preventer (BOP) intervention using ROV and Hotstab	Controlling a loss of well containment at source through BOP intervention using ROV and hot stab 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, ROV operations to locally operate the BOP would be attempted.	Yes	The use of source control through BOP intervention using ROV and hot stab may be feasible (depending on local concentration of atmospheric volatiles) and may reduce or stop 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 installation would cap the quantity of hydrocarbon entering the marine environment. Debris clearance using the Subsea First Response Toolkit (SFRT) would be implemented prior to capping stack installation.	Woodside commissioned an independent, subsea site-specific plume analysis, landing study and capping stack deployment feasibility assessment for EYC campaign and compared with the deployment analysis for the Julimar Phase 2 and GWF-3 Drilling & Subsea Installation projects (WWC, 2019) due to the proximity and similarities of the conditions. The study indicates that shallow water in combination even with lower absolute open hole flow rates, in the event of a worst-case blowout the surface conditions will prohibit the safe deployment of a capping stack for the Echo-Yodel and Capella-1 abandonment activities. 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	Yes	No shoreline accumulation >100 g/m^2 is predicted, therefore successful Capping Stack deployment will contribute minor environmental reduction to total hydrocarbon volume in open water. The environmental benefit gained from implementing source control outweigh the risks. Capping stack will be deployed if the conditions are appropriate (blowout rates within safe operating limits, see section 6.2), informed through operational monitoring.

		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 time frames. A site-specific landing force analysis through computational fluid		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).

		dynamic (CFD) modelling confirms the ability to land the capping stack on either a wellhead, horizontal xmas tree or BOP. For EYC, attempting to land a capping stack directly on the wellhead during a LOWC would only be attempted where the tree has been removed prior to the event-removing the tree post event has the potential to increase the release from a restricted flow via the xmas tree to an unrestricted flow if the xmas tree is removed post event.		
Source control via relief well drilling	A subsea release of condensate will be over approximately 77 days. Relief well drilling will be the primary option to stop the release.	For a spill from the Yodel-3/4 and Capella-1 wells, 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. Impacts and risks from this response technique are already covered in this PAP.
Monitor and evaluate	Will be effective in informing other response techniques and predicting potential impacts.	Monitoring of condensate is a feasible response technique and outputs can be used to guide decision making on the use of other response techniques. Techniques include predictive modelling, surveillance and reconnaissance, monitoring of hydrocarbon presence in water, pre-emptive assessment of sensitive receptors at risk, and monitoring of contaminated resources.	Yes	The ability to utilise response resources more effectively is a greater consequence reduction than the additional effects arising from adopting this strategy.
Containment and Recovery	Predicted to be ineffective on the hydrocarbon due to rapid spreading, entrainment and evaporation leading to inadequate rapid reduction of surface hydrocarbons. Likely to provide no further benefit	Highly volatile hydrocarbon likely to weather, spread and evaporate quickly. Only concentrations for feasible surface dispersant application are within one km of the release location. In this area it is likely containment and recovery is not safe due to the potential for the plume to breach the water surface presenting other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles.	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 Yodel-3 condensate

	over natural attrition and evaporation.			would make containment and recovery an unsuitable response technique.
Subsea Dispersant Injection	Not predicted to be effective on the subsea hydrocarbon release due to the oil properties and predicted gas release volumes.	Subsea dispersant application is feasible, however the environmental benefit gained is minimal, potentially impacting the marine environment through the dispersant toxicity.	No	The predicted low effectiveness associated with implementing a dispersant response outweigh the potential environmental benefit.
Surface dispersant application	Predicted to be ineffective on the hydrocarbon due to rapid spreading, entrainment and evaporation leading to inadequate rapid reduction of surface hydrocarbons. Likely to provide no further benefit over natural attrition and evaporation.	Highly volatile hydrocarbon likely to weather, spread and evaporate quickly. Volatile nature of the oil likely unsafe conditions in the vicinity of fresh hydrocarbon. Only concentrations for feasible containment recovery are within one km of the release location.	No	The safety concerns associated, and the predicted low effectiveness associated with implementing a dispersant response outweigh the potential environmental benefit.
In-situ Burning	Due to the surface concentrations/thickness and the gas/volatiles close to the release location prior to the oil thinning and spreading in situ burning is not considered a feasible response strategy.	Due to the surface concentration/thickness and the gas/volatiles close to the release location prior to the oil thinning and spreading, in situ burning is not considered a feasible response strategy.	No	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Shoreline Protection and Deflection	No surface slicks above 10 g/m^2 are expected to contact the shorelines, therefore this strategy will not protect or deflect	Although the response strategy may be feasible, the effectiveness at reducing hydrocarbons reaching sensitive receptors is limited given no hydrocarbon contact >10 g/m^2. No environmental benefit is predicted.	No	No accumulation of oil is modelled on shorelines, therefore unnecessary to implement shoreline protection and deflection as a response strategy.

	any hydrocarbons from sensitive receptors.			
Shoreline Clean-up	No surface slicks above 10 g/m^2 are expected to contact the shorelines.	A shoreline clean-up response is feasible, however due to the lack of hydrocarbon accumulation i.e. <10 g/m^2 there is no environmental benefit.	No	No accumulation of oil is modelled on shorelines, therefore unnecessary to implement shoreline clean-up as a response strategy.
Oiled wildlife	May lead to ensuring the survival of vulnerable wildlife populations. Potential to be effective depending on collection method and wildlife treatment method. Wildlife response typically has a very high mortality rate for seabirds and waders.	Oiled wildlife may be prevented through the initiation of preventative measures (i.e. hazing or pre-emptive capture). The level of oiled wildlife response can be scalable based on the predicted number of animals oiled. No shoreline contact from floating hydrocarbon above 10 g/m^2 concentration is predicted, however, an open water oiled wildlife response may be conducted.	Yes	The detrimental effects from a wildlife response are low, well understood, temporary and localised. This strategy is relatively low cost and could support survival of threatened and migratory bird species.

Table 4-3: Response technique evaluation – Marine Diesel

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Marine Diesel				
Source Control	Vessel source control will be managed under the vessel Shipboard Oil Pollution Environment Plan (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 achieve whilst responding to the incident.	Yes	A spill of diesel from a vessel collision will be instantaneous and source control will be limited to what the vessel or facility can achieve whilst responding to the incident.
Monitor and Evaluate	Will be effective in informing other response techniques and predicting potential impacts.	Monitoring of a diesel spill is a feasible response technique and outputs can be used to guide decision making on the use of other response techniques. Techniques include predictive modelling, surveillance and reconnaissance, monitoring of hydrocarbon presence in water, pre-emptive assessment of sensitive receptors at risk, and monitoring of contaminated resources.	Yes	The ability to utilise response resources more effectively is a greater consequence reduction than the additional effects arising from adopting this strategy.
Containment and Recovery	Containment and recovery have an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5	Marine diesel has a high portion of non-persistent (light-ends) component, prone to rapid spreading and evaporation.	No	It is preferred that a diesel spill be allowed to spread as far and thin as possible to accelerate microbial breakdown of the hydrocarbon.
Surface Dispersant Application	Dispersants are not considered effective when applied on thin surface films such as diesel. The dispersant droplets tend to pass through the surface films without binding to the hydrocarbon.	Marine diesel has a high portion of non-persistent (light-ends) component and is prone to rapid spreading and evaporation thus the use of dispersant would be deemed an unnecessary response technique.	No	Not feasible for this scenario
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 the rapid spreading and	No	Not feasible for this scenario

		evaporation. 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.		
Shoreline Protection and Deflection	Shoreline protection and deflection can be effective at preventing contamination of at-risk areas.	Use of shoreline protection and deflection for a spill of marine diesel is unlikely to provide any significant environmental benefit as the diesel will be subject to rapid spreading and evaporation prior to contact with any sensitive areas.	No	Not feasible for this scenario
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/m2	Use of shoreline clean-up for a spill of marine diesel is unlikely to provide any significant environmental benefit as the diesel will be subject to rapid spreading and evaporation prior to contact with any sensitive areas. In addition, coverage from marine diesel on a shoreline would not be high enough to allow effective hydrocarbon removal.	No	Not feasible for this scenario
Oiled Wildlife	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 fauna from being contaminated and through rehabilitation of fauna already subject to contamination.	Due to the likely volatile atmospheric conditions surrounding a diesel spill, response options would be limited to hazing to ensure the safety of response personnel. In addition, any rehabilitation could not only be undertaken by trained specialists.	Yes	The detrimental effects from a wildlife response are low, well understood, temporary and localised. This strategy is relatively low cost and could support survival of threatened and migratory bird species.

4.2.3 Exclusion of response techniques

4.2.3.1 Subsea dispersant injection

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. Additionally, due to water depth around the well locations and the associated gas plume, subsea dispersant injection is unlikely to be able to be deployed safety.

While the high discharge velocity and turbulence generated by the release is expected to result in the droplets reaching the surface, due to wind and wave activity droplets are predicted to remain entrained within the wave-mixed layer of the water column where they are likely to remain due to their relative weak buoyancy.

The initial small droplet size means much of the subsea component is predicted to remain entrained within the water column for the duration of the modelling. Therefore, any application of subsea dispersant would be unlikely to have any appreciable effect on the behaviour or extent of the oil plume.

4.2.3.2 Surface dispersant application

Modelling results for a hydrocarbon release caused by a well loss of containment from condensate or diesel release indicate that surface thresholds for surface dispersant application will not be reached and shoreline accumulation, although above threshold accumulated concentrations, has a very low probability of thickness >1 g/m^2 during the spill. Therefore, surface application of dispersant is unlikely to be effective in preventing isolated incidents of accumulation.

Additionally, the ongoing nature of the release combined with the potential for the plume to breach the surface may cause conditions leading to high local concentrations of atmospheric volatiles producing a health and safety risk, thus limiting the ability of a surface dispersant response to safely target fresh condensate.

Surface application of dispersants is therefore considered ineffective, with no incremental benefit over natural weathering processes.

4.2.3.3 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.

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 Dampier 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 Dampier 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 a hydrocarbon release caused by a Scenario 1 indicate that surface thresholds required for containment and recovery (>50 g/m^2) will not be reached and shoreline accumulation, although above threshold accumulated concentrations, has a very low probability of thickness > 1 g/m^2 during the spill. Therefore, containment and recovery are unlikely to be effective in preventing isolated incidents of accumulation. The effectiveness of containment and recovery is predicted to be very low based Dampier met-ocean conditions, the inherent inefficiency of containment and recovery operations, and the light, volatile nature of the condensate.

4.2.3.6 Shoreline protection and deflection

Shoreline surface contact (above thresholds), as a result of a hydrocarbon spill modelling conducted for this petroleum activity program, is not expected to occur. Therefore, shoreline protection and deflection is not considered feasible. As the modelling indicates there is potential for entrained contact and subsequent accumulation at shoreline receptors, shoreline clean-up has been retained as a feasible response technique. Localised instances of accumulated hydrocarbons are likely to be the result of surface hydrocarbons below threshold concentrations contacting shorelines or entrained hydrocarbons resurfacing and becoming stranded on shorelines.

4.2.3.7 Shoreline clean-up

Shoreline surface contact (above thresholds), as a result of a hydrocarbon spill modelling conducted for this petroleum activity program, is not expected to occur. Therefore, shoreline clean-up is not considered feasible. As the modelling indicates there is limited contact and <100 g/m^2 of accumulation at shoreline receptors.

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.

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 4-4: Selection and prioritization of response techniques

Response planning scenario	Key characteristics for response planning	Feasibility of response techniques									
		Monitor and evaluate	**Subsea dispersant injection**	**Surface dispersant application**	**Source control**	**Containment and recovery**	**Shoreline protection and deflection**	**Shoreline clean-up**	**Oiled wildlife response**	**Waste management**	**Outline response technique**
A 77-day loss of well control on Echo-Yodel with a release of 348,134 m^3 of Yodel-3 condensate at Yodel-3 well.	No contact above impact assessment or response thresholds.	Yes Primary response technique	No	No	Yes Primary response technique	No	No	No	Yes	No	Monitor and evaluate. Initiate source control if feasible. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Release of up to1,000 m^3 marine diesel from a vessel collision	No contact above impact assessment or response thresholds	Yes Primary response technique	No	No	Yes	No	No	No	Yes	No	Monitor and evaluate. Initiate source control if feasible Plan for oiled wildlife response and implement if oiled wildlife is observed.

From the NEBA undertaken on the WCCS identified Echo-Yodel Decommissioning, well loss of containment and vessel collision, the primary response techniques are;

- Monitor and Evaluate
- Source control (Relief Well)

Additional response strategies would be considered based on ME inputs and field reports. This may include:

- Oiled wildlife response
- Source control (capping stack, well intervention)
- SMPs

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 Hydrocarbon Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Development 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; or
    - 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.

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 operations 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* (W0000AH9329605). If shoreline contact is predicted, 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 Dampier to the spill event location means that multiple logistical options are available to monitor the spill in relatively short timeframes. The primary mobilisation base for initial monitoring activities would be Dampier. However, in the event of an extended spill with potential to impact receptors further afield, monitoring activities may also be mobilised from Exmouth.

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:

- No shoreline contact is predicted from floating hydrocarbons.
- 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 extend up to 77 days.

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**
1	OSTM	1.1	Initial modelling available within six hours using the Rapid Assessment Tool	1, 3B, 3C, 4
		1.2	Detailed modelling available within four 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 two 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 techniques.	1, 3B, 4
3	Satellite imagery	3.1	Contract in place with third party provider to enable access and analysis of satellite imagery. Imagery source/type requested on activation of service.	1, 3C, 4
		3.2	Third party provider will confirm availability of an initial acquisition within two hours	1, 3B, 3C, 4
		3.3	First image received with 24 hours of Woodside confirming to third party provider its acceptance of the proposed acquisition plan.	1
		3.4	Third 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 techniques.	1, 3B, 4
		3.6	Satellite Imagery services available and employed during response	1, 3C, 4
4	Aerial surveillance	4.1	Two trained aerial observers available to be deployed by day one from resource pool.	1, 2, 3B, 3C, 4
		4.2	One aircraft available for two sorties per day, available for the duration of the response from day one	1, 3C, 4
		4.3	Observer to compile report during flight as per first strike plan. Observers report available to the IMT within two hours of landing after each sortie.	1, 2, 3B, 4
5	Hydrocarbon detections in water	5.1	Activate third party service provider as per first strike plan. Deploy resources within 2.5 days: • Three specialists in water quality monitoring • Two monitoring systems and ancillaries • One 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 seven 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 operational NEBA confirms conventional methods are unsafe or not possible.	1, 2, 3C, 4
6	Pre-emptive assessment of sensitive receptors	6.1	Within 10 days, deployment of two 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 RPAs and maximise effective utilisation of resources	1, 3B, 4

The control measures and capability of Woodside and its third-party service providers are shown to support Monitor and Evaluate activities. 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 grossly 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 via vessel SOPEP

Vessel source control will be conducted, where feasible and in accordance with MARPOL 73/78 Annex I, by the Vessel Master under the Shipboard Oil Pollution Environment Plan (SOPEP) triggered by any loss of containment from the PAP vessels.

The SOPEP provides guidance to the Master and Officers on board the vessel with respect to the extra steps to be taken when an unexpected pollution incident has occurred or is likely to occur. The SOPEP contains all information and operational instructions required by IMO Resolution MEPC.54 (32) adopted on 6 March 1992, as amended by resolution MEPC.86 (44) adopted on 13 March 2000.

Its purpose is to set in motion the necessary actions to stop or minimise oil discharge and mitigate its effects and outlines responsibilities, pollution reporting requirements, procedures and resources needed in the event of a hydrocarbon spill from vessel activities.

In the event of the vessel collision event, the vessel master may engage precautionary marine manoeuvres to avoid collision or commence pumping operations to transfer marine diesel and thus minimise the release.

5.2.1 Environmental performance based on need

Woodside has established control measures, environmental performance outcomes, performance standards and measurement criteria to be used for vessel-source oil spill response during the PAP which are detailed in Section 6.7 of the EP. The vessel master’s roles and responsibilities are described in EP Section 7.3.

Performance standards for each contracted PAP vessel are detailed in the vessel’s specific SOPEP.

These standards ensure that sufficient resources are available and are adequately tested to ensure implementation of the SOPEP in the event of a hydrocarbon spill.

5.3 Source control and well intervention

The worst-case credible scenario is a loss of well control during abandonment 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. A moored MODU is suitable for the Echo-Yodel and Capella water depths, 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 and high ambient temperatures.

5.3.1 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 77 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 77 days with response operations completing in month 3 based on the predicted time to complete shoreline clean-up operations.

In addition, several 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 and Subsea Installation project (Wild Well Control, 2019) and a gap analysis of this study was then completed for the Echo-Yodel and Capella PAP due to the 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 surface gas 10% LEL limit could extend up to 59/45 m from the well centre (for Yodel and Capella-1 wells respectively) 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 followed by relief well drilling for the Capella-1, Yodel-3, or Yodel-4 wells. 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 less than 25 m. The following approaches outline Woodside's hierarchy for relief well drilling; • Primary – Review internal 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 – Source and contract a MODU outside Australia with an approved Australian Safety Case

5.3.2 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**
7	Well intervention	7.1	Frame agreements with ROV providers in place to be mobilised upon notification. ROV equipment deployed within 7 day.	1, 3B, 3C
		7.2	Frame agreements for ISVs require vessels to maintain/enforce regulatory approvals and provide support in the event of an emergency	
		7.3	Source control vessels will have the following minimum specifications: - Activate Heave Compensated crane, rated to at least 120MT - At least 90m in length - Deck has water/electricity supply Deck capacity to hold at least 110T of capping stack.	
		7.4	Identify source control vessel availability within 24 hours and begin contracting process. Vessel mobilised to site for deployment within 16 days for conventional capping	
		7.5	Wild Well Control staff available all year round, via contract, to assist with the mobilization, deployment, and operation of the Capping Stack and Well intervention equipment.	1, 3B, 3C, 4
		7.6	Contract in place with Wild Well Control and Oceaneering to provide trained personnel.	
		7.7	MODU mobilised to location for relief well drilling within 21 days	1, 3C
		7.8	First well kill attempt within 77 days	1, 3B, 3C
		7.9	Open communication line(s) to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B
		7.10	Monthly monitoring of the availability of MODUs through existing market intelligence to meet specifications for source control.	3C
		7.11	ROV available on MODU ready for deployment within 48 hours to attempt initial BOP well intervention.	1, 3B, 3C
		7.12	Staged deployment of multiple BOP SFRTs in the event the first system deployed fails.	1, 3B, 3C
		7.13	Staged deployment of additional capping and well intervention equipment in the event the first system deployed fails.	1, 3B, 3C
		7.14	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
8	SFRT	8.1	Oceaneering support staff available all year round, via contract, to assist with the mobilization, 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	Support vessels	9.1	At least two communication methods, one of which will include the capability to communicate with aviation.	1, 3A
		9.2	Monthly monitoring of the availability of larger vessels through existing Frame Agreements and market intelligence to meet specifications for source control.	3C
		9.3	Frame agreements for installation support vessels (ISVs) require vessels to maintain in-force safety case approvals covering ROV operations and provide support in the event of an emergency.	1, 3B, 3C
		9.4	MODU and vessel contracts include clause outlining requirement for support in the event of an emergency	1, 3C
		9.5	Quarterly monitoring of Registered Operators and Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for Safety Case guidance.	1, 3B, 3C

		9.6	Capella-1 & Echo-Yodel Decommissioning Operations Safety Case includes inspection, maintenance and repair to allow for ROV inspection.	1, 3
10	Safety Case	10.1	Woodside will prioritize MODU or vessel(s) for intervention work(s) that have an existing safety case	1, 3C
		10.2	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
		10.4	Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for Safety Case guidance.	1, 3C
		10.5	Capella-1 & Echo-Yodel Decommissioning Operations Safety Case includes inspection, maintenance and repair to allow for ROV inspection.	

The resulting source control capability has been assessed against the WCCS. The range of techniques provide a feasible and viable approach to 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 grossly 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.

5.4 Oiled wildlife response (including hazing)

Woodside would implement a response in accordance with the *Oiled Wildlife Operational Plan* (W0000AH9756292). 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 Biodiversity 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 fauna 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 Karratha and Perth. Additional personnel would be sourced through Woodside's arrangements to support an oiled wildlife response as required.

5.4.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Modelling predicts no shoreline impact from floating hydrocarbons >10 g/m^2
- No shoreline accumulation >100 g/m^2 threshold is expected.

- The offshore location of the release site is expected to initially result in low numbers of at-risk or impacted wildlife.
- Given there is no potential shoreline accumulation >100 g/m^2 and surface concentrations above 10 g/m^2 are not expected, it is estimated that the oiled wildlife response would be between Level two and four, as defined in the West Australian Oiled Wildlife Response Plan WA OWRP (Table 5-12).

Table 5-5: Key at-risk species potentially in Priority Protection Areas and open ocean

Species	Open ocean
Marine turtles (including foraging and inter-nesting areas and significant nesting beaches)	√
Whale sharks (migration to and from waters at Ningaloo)	√
Seabirds and/or migratory shorebirds	√
Cetaceans – migratory whales	√
Cetaceans – dolphins and porpoises	√
Dugongs	
Sea snakes	√

The oiled wildlife response technique targets key wildlife populations at risk within Commonwealth open waters and the nearshore waters. Responding to oiled wildlife consists of eight key stages, as described in Table 5-6 below.

Table 5-6: 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 fauna from entering areas potentially contaminated by spilled hydrocarbons, as well as dispersing, displacing or relocating fauna 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 Dampier have been identified in the draft Regional Oiled Wildlife Response Operational Plan (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 fauna is 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 fauna 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 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* (Woodside doc. W0000AH9420020).

The WA OWRP provides indicative oiled wildlife response levels (**Table 5-**7)and the resources likely to be needed at each increasing level of response.

Table 5-7: Indicative oiled wildlife response level (adapted from the WA OWRP, 2014)

OWR 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	None	None	None	None	None
Level 2	26	> 4–14 days	1–5/day < 20 total	None	< 20 hatchlings No juv/adults	None	None	None
Level 3	59	> 4–14 days	5–10/day	1–5/day < 10 total	< 5 juv/adults < 50 hatchlings	None	< 5	None
Level 4	77	> 4–14 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	> 4–14 days	10–100/ day > 200 total	10–50/day	> 20 juv/adults > 500 hatchlings	< 5 dolphins	> 50	Dugongs oiled
Level 6	122	> 4–14 days	> 100/day	10–50/day	> 20 juv/adults > 500 hatchlings	> 5 dolphins	> 50	Dugongs oiled

Woodside has access to oiled wildlife equipment specified in Table 5-8. Each oiled fauna kit provides the capability to treat approximately 100 wildlife, and each containerised washing station can treat up to 250 wildlife for a five-day period. Therefore, the equipment in Table 5-8 can treat up to 600 wildlife per day by day 6 (Level 5 OWR), The wildlife response strategy may need to be escalated, as guided by the operational monitoring.

Table 5-8: Equipment available in the timeframe to meet and exceed level 5 OWR.

Type of Equipment and Number	Available to be mobilised
1 x Oiled fauna kit (Dampier)	Day 1
1 x Portable containerised washing station* (Fremantle) 1 x Oiled fauna kit (Karratha) 1 x Oiled fauna kit (Exmouth)	Day 2
1 x Oiled fauna kit	Day 3
1 x Portable containerised washing station 2 x Oiled fauna kits	Day 5
Oil Spill Response Limited (OSRL) has equipment to support intake and triage; cleaning and rehabilitation and a wildlife rehabilitation unit	Day 6

* Container treats up to 250 units for 5-days.

5.4.2 Environmental performance based on need

Table 5-9: 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 fauna under the Animal Welfare Act 2002.		
Control measure		**Performance Standard**		**Measurement Criteria**
11	Wildlife response equipment	11.1	Contracted capability to treat 100 individual fauna for immediate mobilisation to RPAs	1, 3A, 3B, 3C, 4
		11.2	Contracted capability to treat up to an additional 250 individual fauna within a five-day period.	
		11.3	National plan access to additional resources under the guidance of the DoT (up to a Level 5 oiled wildlife response as specified in the WA OWRP), with the ability to treat about 600 individual fauna by the time hydrocarbons contact the shoreline.	1, 3C, 4
		11.4	Three vessels used in hazing/pre-emptive capture will approach fauna at slow speeds to ensure animals are not directed towards the hydrocarbons.	1, 3A, 3B, 4
		11.5	Facilities for the rehabilitation of oiled wildlife are operational 24/7 as per WAOWRP.	1, 3A, 4
12	Wildlife responders	12.1	Wildlife divisional commanders to lead the oiled wildlife operations who have completed an Oiled Wildlife Response Management course	1, 2, 3B
		12.2	Wildlife responders to be accessed through resource pool and additional agreements with specialist providers	1, 2, 3A, 3B, 3C, 4
		12.3	Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA.	1
		12.4	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. No RPA's are contracted above response thresholds of hydrocarbons.

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 one central wildlife treatment and rehabilitation locations at Dampier in accordance with WA OWRP.

No additional capability will be required for this activity, given the oiled wildlife response will be limited to open water.

Recovered wildlife from open water would be transported to a central treatment location at Dampier.

5.5 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).

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 7 of the EP for further information on applicable thresholds and the EMBAs). The Petroleum Activities Program worst-case credible spill scenario 1 and 2 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**.

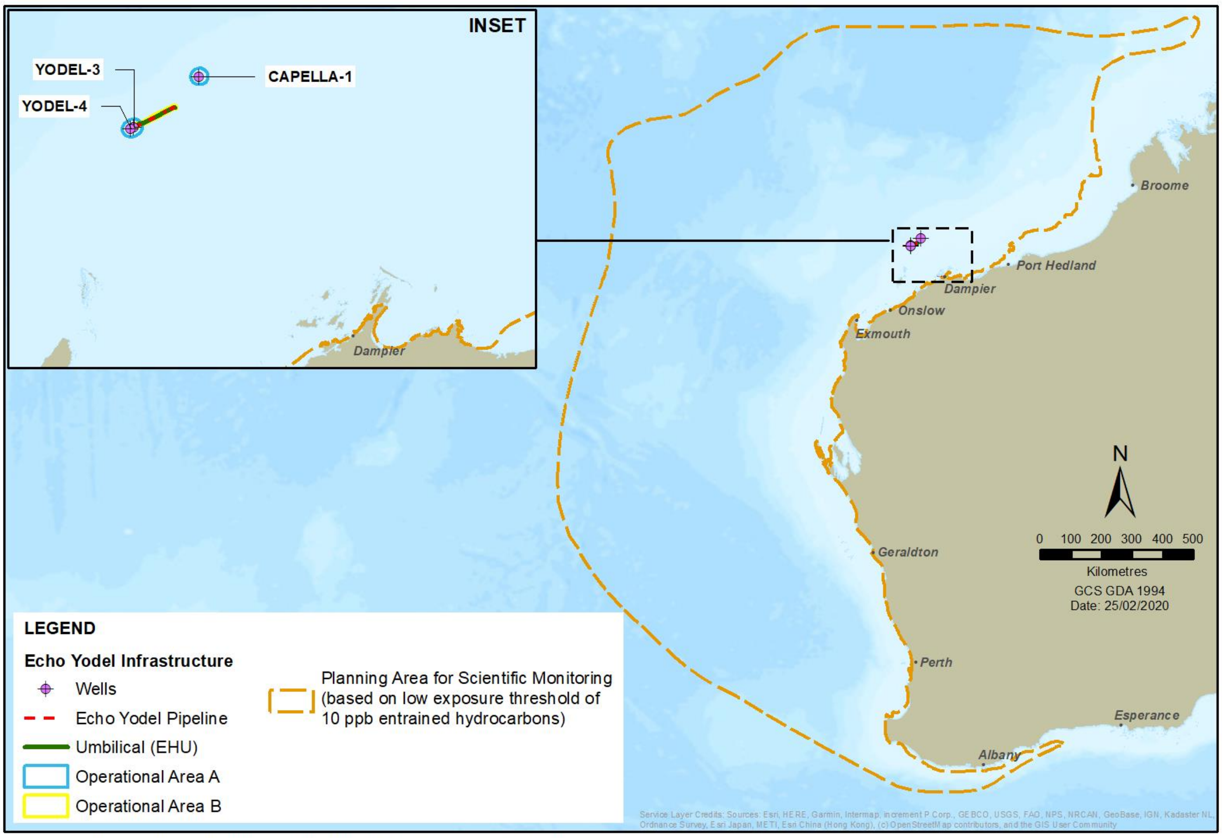


Figure 5-1: The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (Scenario 1).
Please note that Figure 5-1 represents the overall combined extent of the oil spill model outputs based on a total of 100 replicate simulations over an annual period for Scenario 1 and therefore represents the largest spatial boundaries of 100 Scenario 1 oil spill combinations, not the spatial extent of a single Scenario 1 spill.

5.5.1 Scientific Monitoring Deployment Considerations

Table 5-11: 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 Echo-Yodel Decommissioning 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.

5.5.2 Response planning assumptions

Table 5-12: 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 Echo-Yodel Decommissioning. PBAs for Echo-Yodel Decommissioning 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: • Montebello Islands • Barrow Island • Rankin Bank [2] • Glomar Shoal • Lowendal Islands[3] • Montebello State Marine Park For example, adequate baseline data are available for Glomar Shoal 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 All the Australian Marine Parks (AMPs) are located in offshore waters where hydrocarbon exposure is possible on surface waters and in the water column.
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 and Middle[4] • Ningaloo AMP • Muiron Islands[4] • Southern Pilbara Islands • Gascoyne AMP • Argo-Rowley Terrace AMP 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 Echo-Yodel Decommissioning, priority would be focused on Ningaloo Coast north and middle and Muiron Islands.

[2] Floating oil will not accumulate on submerged features and at open ocean locations, therefore, no surface contact is possible with only entrained hydrocarbon contact predicted at Rankin Bank ≤10 days.

[3] ≤10 days' time to contact is specifically applicable to Barrow Island and Montebello Islands; however, the Lowendal Islands are being included as a precautionary approach, given the spill modelling does not encompass the complex hydrographic processes for these island groups.

[4] Ningaloo Coast and Muiron Islands includes the WHA, State Marine Park and Marine Management Area.

	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. Argo-Rowley Terrace AMP. 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 scenarios 1 and 2, is presented in the Echo-Yodel Decommissioning EP (Section 7). 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 scenarios one and two. 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).

5.5.3 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.

5.5.4 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 in the event of a spill are:

- Ningaloo Coast, north and middle
- Muiron Islands
- Southern Pilbara Islands
- Ningaloo Australian Marine Park (AMP)
- Argo-Rowley Terrace AMP

Documented baseline studies are available for certain sensitive receptor locations including the Barrow Island, Montebello Islands, Lowendal Islands, Rankin Bank, Glomar Shoal 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 and Muiron Islands not immediately contacted 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 6.3 considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.5.5 Environmental performance based on need

Table 5-13: 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**
13	• 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.	13.1	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.
14	• 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.	14.1	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 stand up, activation and implementation of the SMP on an annual basis.	• 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.

15	• 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 Australasian Inter-Service Incident Management System (AIIMS) framework utilised in Australia. • Woodside utilises an online Incident Management System (IMS) 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 FSP. • Step by step process to activation of individual SMPs provided in the SMP Operational Plan. • All decisions made regarding SMP logged in the online IMS (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 IMS. • 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 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 (refer to the SMP Document Register).	15.1	• 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.

16	• 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 hydrocarbon contact required to support the post-response SMP.	16.1	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.
17	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:	17.1	• Annual reviews of environmental baseline data. • PAP specific Pre-emptive Baseline Area baseline gap analysis.	• Annual review/update of Woodside Baseline Environmental Studies Database.

	• 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).			• 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**
18	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.	18.1	**PBA baseline data acquisition in the response phase** 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.
		18.2	**Post Spill contact** For the receptors contacted by the spill in where baseline data are available, SMPs programs to assess and monitor receptor condition will be implemented post spill (i.e. after the response phase):	• SMP planning document. • SMP Decision Log. • IAPs.

Environmental Performance Outcome		Implementation of the SMP (response and post-response phases).		
Control measure		**Performance Standard**		**Measurement Criteria**
19	• 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.	19.1	**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.
		19.2	**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.
		19.3	**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 Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C):	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for specific receptor types.

5.6 Incident management system

The Incident Management System is both a control measure and a measurement criterion. 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 criterion 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.

5.6.1 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 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.

5.6.2 Operational NEBA process

In the event of a response Woodside will confirm that the response techniques adopted at the time of Environment Plan/Oil Pollution Emergency Plan (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 Oil Pollution Emergency Arrangements (Australia). In effect the operational NEBA will determine whether there is net environmental benefit to continue response operations.

5.6.3 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 First-Strike Response Plan). This includes notification to mariners to communicate navigational hazards introduced through response equipment and personnel.
- In the event of a response, identify and engage with relevant stakeholders and continually assess and review.

5.6.1 Environmental performance based on need

Table 5-10: Environmental Performance – Incident Management System

<table>
<tr><th colspan="2">Environmental Performance Outcome</th><th colspan="3">To support the effectiveness of all other control measures and monitor/record the performance levels achieved.</th></tr>
<tr><th colspan="2">Control measure</th><th colspan="2">Performance Standard</th><th>Measurement Criteria</th></tr>
<tr><td rowspan="3">13</td><td rowspan="3">Operational NEBA</td><td>14.1</td><td>Confirm that the response techniques adopted at the time of acceptance remain appropriate to reduce the consequences of the spill within 24 hours.</td><td rowspan="6">1, 3A</td></tr>
<tr><td>14.2</td><td>Record the evidence and justification for any deviation from the planned response activities.</td></tr>
<tr><td>14.3</td><td>Record the information and data from operational and scientific monitoring activities used to inform the NEBA.</td></tr>
<tr><td rowspan="3">14</td><td rowspan="3">Stakeholder engagement</td><td>15.1</td><td>Prompt and record all notifications (including government notifications) for stakeholders in the region are made</td></tr>
<tr><td>15.2</td><td>In the event of a response, identification of relevant stakeholders will be re-assessed throughout the response period.</td></tr>
<tr><td>15.3</td><td>Undertake communications in accordance with:
Woodside Crisis Management Functional Support Team Guideline – Reputation;
External Communication Operating Standard (Woodside doc. WM1070SG5487719);
External Stakeholder Engagement Operating Standard (Woodside doc. WM1070SG5494491).</td></tr>
<tr><td rowspan="7">15</td><td rowspan="7">Personnel required to support any response</td><td>16.1</td><td>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.</td><td>1, 3B</td></tr>
<tr><td>16.2</td><td>A duty roster of trained and competent people will be maintained to ensure that minimum manning requirements are met all year round.</td><td>3C</td></tr>
<tr><td>16.3</td><td>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.</td><td rowspan="4">1, 2, 3B, 3C, 4</td></tr>
<tr><td>16.4</td><td>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.</td></tr>
<tr><td>16.5</td><td>S&EM advisors will be integrated into ICC to monitor performance of all functional roles.</td></tr>
<tr><td>16.6</td><td>Continually communicate the status of the spill and support Woodside to determine the most appropriate response by delivering on the responsibilities of their role.</td></tr>
<tr><td>16.7</td><td>Follow the OPEA, Operational Plans, FSPs, support plans and the IAPs developed.</td><td>1, 2, 3A, 4</td></tr>
</table>

		16.8	Contribute to Woodside's response in accordance with the aims and objectives set by the Duty Manager.	1, 2, 3B, 3C, 4

5.7 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.

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 S&EM competency dashboard

The 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 5-1 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
- Australian Marine Oil Spill Centre (AMOSC) core group
- AMOSC
- OSRL
- Marine Spill Response Corporation (MSRC)
- AMSA
- Woodside contracted workforce

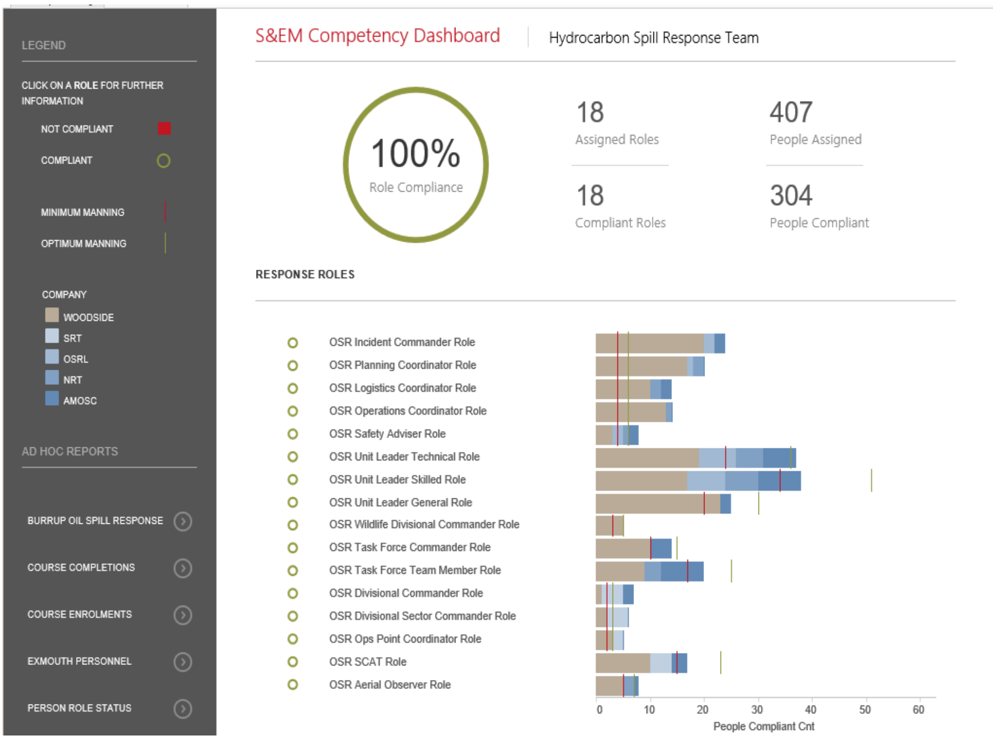
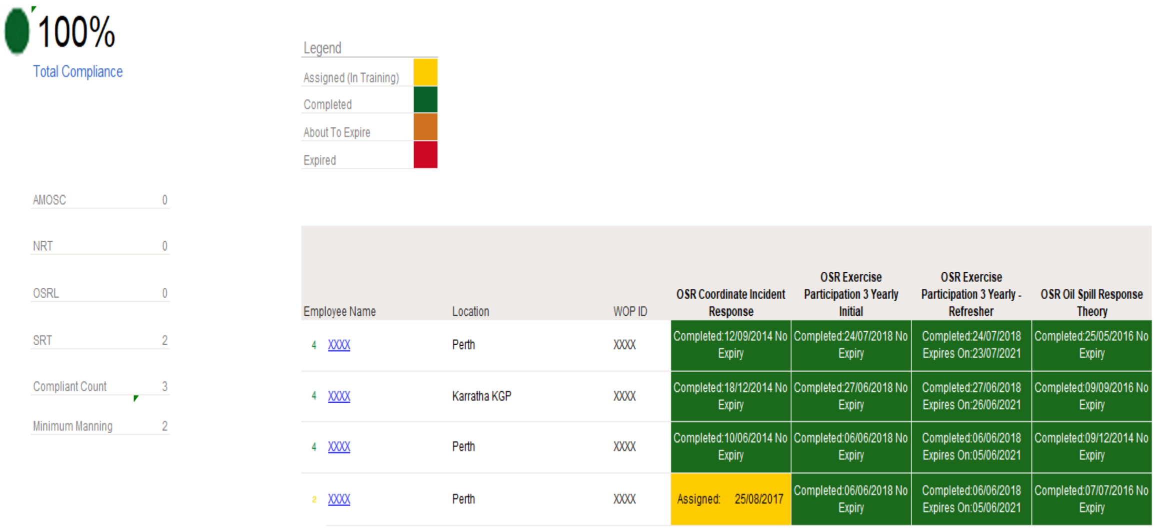


Figure 5-1: Example screen shot of the HSP competency dashboard

The Dashboard is one of Woodside's key means of monitoring its readiness to respond. It also and shows that Woodside can meet the requirements of the environmental performance standard that relate to filling certain response roles. Figure 5-2 shows deeper dive into the Ops 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 5-2: Example screen shot for the Ops 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: Oil Pollution Emergency Arrangements, first strike response plans, 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[5] 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

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:

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[5] 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

- 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

Table 6-1: Monitor and Evaluate – Alternative Control Measure Options considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Aerostat (or similar inflatable observation platform) for localised aerial surveillance	The system provides a very limited field of visibility around the vessel it is deployed from reducing any environmental benefits compared to standard aerial surveillance.	Long lead time to access (>10 days). Each system would require an operator to interpret data and direct vessels accordingly.	Purchase cost per system is approx. $300,000 and multiple systems would be required in a response.	No
Dedicated aviation platform on standby by aerial surveillance and operational monitoring	Woodside has access to helicopters as required at short notice from the operational fleet from day one. Additional platforms can be sourced as per the Aviation Support Plan. Therefore, current capability meets need and this option offers no additional environmental benefit.	A dedicated aviation platform would have to be located at Dampier airport, with trained observers living locally and able to mobilise at short notice. This option is feasible.	The cost would be approx. $3M per annum.	No
Alternate analysis technologies and methods to conduct in the field water quality monitoring such as gravimetric, colorimetric, infra-red and UV absorption.	Gravimetric analysis- involves lab analysis so cannot be completed on location. Colorimetric analysis- requires chemical addition and catalysts no standard method, needs specialist training. Infra-red analysis- droplet size too small for infra-red analysis. Hydrocarbons need to be extracted from water for test, therefore requires a laboratory test.	These alternate technologies have been considered not feasible in the field.	This option is not considered feasible, therefore no further ALARP assessment is conducted.	No

Table 6-2: Monitor and Evaluate- Additional Control Measure Options considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Additional oil spill modelling system	The additional oil spill modelling system provides no environmental benefit above already adopted assessment and modelling arrangements.	While feasible, Woodside has no internal rapid assessment tool available for short notice trajectory modelling, and a contract in place for an external provider to produce additional more detailed and complex models. Additional modelling is available as per current participant's agreement with OSRL.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No
Unmanned Aerial Vehicles/Systems (UAV/UASs) to support SCAT, containment and recovery and surface dispersal and pre-emptive assessments additional to helicopters and fixed wing aircrafts	Use of UAVs may provide an environmental benefit when compared to the use of helicopters/fixed wings only in circumstances where specific areas are inaccessible for safety or other reasons there may be net environmental benefit associated with using UAVs.	UAVs have the following limitations: - UAV command and control systems are not well tested in spill response operations to date. - UAVs may not be feasible with concurrent helicopter and fixed wing aircraft operations due to safety concerns.	The use of UAVs could provide environmental benefit in areas where a specific area in inaccessible for safety or other reasons would be implemented where net environmental benefit is identified.	No
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 approximately: $25,000	No
Additional aerial platform to allow for constant back to back surveillance	Woodside has access to helicopters as required at short notice from the operational fleet. Additional platforms can be sourced as per the Aviation Support Plan. Current capability meets need and is accessible by day one. Therefore, this option offers no additional environmental benefit.	Additional aerial platforms could be acquired; however, Woodside has access to helicopters as required at short notice from the operational fleet and additional platforms can be sourced as per the Aviation Support Plan (W0000AH9707314)	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No
Additional vessels for increased surveillance	Increased capability does not provide an environmental benefit compared to the flexibility to leverage from the integrated fleet when required.	Additional vessels may be feasible; however, Woodside operates an integrated fleet which could be re-tasked as required for surveillance operations if required.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	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.	Additional satellite tracking buoys is feasible; however, tracking buoys will be on location at manned facilities, additional needs are met from Woodside owned stacks in King Bay Supply Facility (KBSF) and Exmouth or can be provided by service providers in a timely manner.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No
Additional trained aerial observers	Having additional trained aerial observers isn't expected to have environmental benefit, with current arrangements providing enough contingency if needed.	Woodside currently 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. While this option is feasible it is not considered required, based on the need.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No
Fixed Wing aircraft for pre-emptive assessment	The use of this method does not provide any additional environmental benefit due to operational limitations.	While feasible, the speed of an aircraft and its inability to remain in a single position along with flight height restrictions and, short loiter time over sensitives compared to existing helicopter access inhibits data collection.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No

Table 6-3: Monitor and Evaluate- Improved Control Measures considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Faster activation time (one hour for Rapid Assessment tool and Automated Data Inquiry for Oil Spills)	There is no contact to sensitive receptors. The standard two-hour activation allows gathering of information to ensure accurate modelling. A quicker activation time by one hour would not provide any environmental benefit.	The faster activation time is feasible; however, Woodside's Intelligence unit has remote access to modelling software should it be required, and modelling is already available within four-six hours of incident and allows time for mobilisation and information gathering to ensure accurate modelling results.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No
Faster turnaround time from modelling contractor	No ALARP assessment is conducted because this option is not considered feasible.	Current capability allows for initial modelling results using Rapid Assessment Tool within 6 hours of the spill. While external contractors would provide detailed modelling results within four hours of receiving required information from Woodside. Optimal response times have therefore already been considered in the base capability. This option is not considered feasible.	This option is not considered feasible, therefore no further ALARP assessment is conducted.	No
Night-time aerial surveillance	No ALARP assessment is conducted because this option is not considered feasible.	No improvement can be made without risk to personnel health and safety and breaching Woodside's golden safety rules. The images would be of low quality and as such this control measure is not feasible.	This option is not considered feasible, therefore no further ALARP assessment is conducted.	No
Faster mobilisation time for water quality monitoring- Support vessel on standby in Dampier.	The option would offer faster mobilisation by having support vessels on standby to conduct water quality monitoring from start of day two. However, the minimum contact time at sensitive receptors is 57 hours. Current Woodside arrangements allow for water quality monitoring to commence by day three, which meets the needs. Therefore, decreasing the mobilisation by one day, would provide no environmental benefit over standard mobilisation time.	Operations are not feasible on day one as the hydrocarbon will take time to surface, the Volatility has potential to cause health and safety concerns within the first 24 hours of the response, Current Woodside arrangements allow for water quality monitoring to commence by day three. Shortening the timeframes for vessels availability would require dedicated response vessels on standby in KBSF and would accelerate the initiation of monitoring by one day.	The cost and organisational complexity of employing a dedicated response vessel is approximately $7M/year, $35M over the life of the Petroleum Activities Program. Dedicated equipment and personnel, living locally and on short notice to mobilise would further increase the cost by approx. $1M per annum, $5M over the life of the Petroleum Activities Program.	No

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 source control and well intervention techniques which would be conducted concurrently;

- ROV intervention
- Capping stack
- Relief well drilling

6.2.1 ROV intervention

Following confirmation of an emergency event, Woodside would mobilise inspection class ROVs to attempt a manual activation of 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). It is not expected that any additional regulatory approvals would be required as inspection, maintenance and repair is within the scope of activities for the Yodel and Capella Operations Safety Case as well as the scope of activities for contracted Frame Agreement vessels.

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. A hydraulic accumulator contained as part of the SFRT can be mobilised and deployed with well intervention attempted within 11 days.

Table 6-1: ROV timings

	Estimate ROV inspection duration for Yodel/Capella (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.*

6.1.1.1 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 6-4 and Figure 6-5 for implementing this response would be “no safety case revision required”. Timeframes for well intervention are detailed in Figure 6-2 and Figure 6-3 and would be implemented concurrently to the actions required by the “no Safety Case” revision scenario detailed in Figure 6-4 and Figure 6-5, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.1.2 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.

6.1.2.1 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 6-4 and Figure 6-5 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 Figure 6-3 and would be implemented concurrently to the actions required by the “No Safety Case” revision scenario detailed in Figure 6-4 and Figure 6-5, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.1.3 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 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 both the Yodel and Capella abandonment activities.

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 59 / 45 m radius for Yodel and Capella respectively) 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.

6.1.3.1 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 90m 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 6-4 and Table 6-4. 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 permission 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.

6.1.4 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 Yodel and Capella 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 the Yodel and Capella PAP due to the high certainty of rig availability.

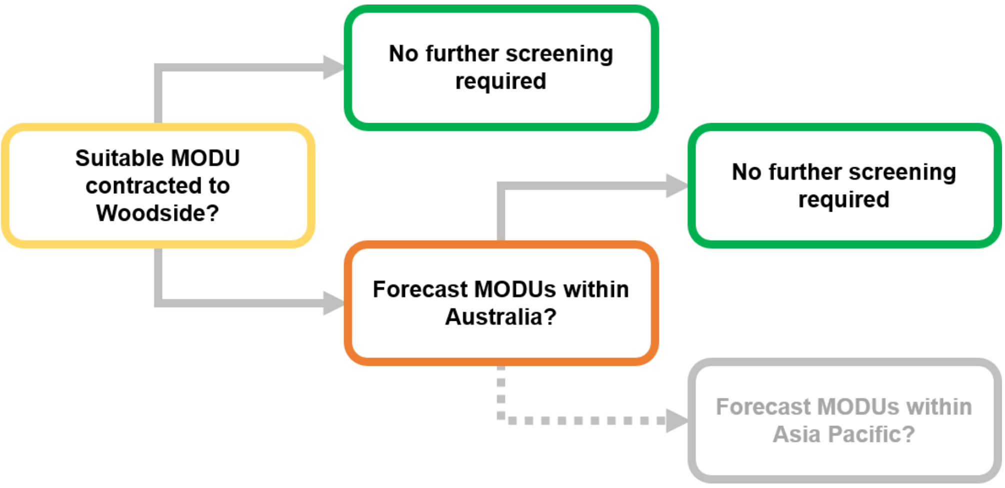

Figure 6-1: Yodel and Capella process for sourcing relief well MODU

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 77 days for Yodel and Capella. 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.

6.1.4.1 Relief Well drilling timings

The duration of a blowout (from initiation to a successful kill) is assessed as 75.6 days for Yodel for conservatism modelling was carried out for a 77 day duration.

Details on the steps and time required to drill a relief well is shown in Table 6-2 below. A moored MODU is suitable for the Capella and Yodel PAPs, and as a moored MODU is 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 Yodel and Capella Wells (days) – moored
Source and contract MODU comprising the following stages:	**21 days total:**
Activate MOU. Secure and suspend well. *Complete relief well design.* *Secure relief well materials.*	*8 days*
Transit to location based on mobilisation from Northwest shelf region.	*2 days*
Backload and loadout bulks and equipment, complete internal assurance of relief well design.	*2 days*
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**
Mooring Spread Installation *NB Occurs in parallel with the 21 days to mobilise the rig, so the timing included here is the difference*	**15.6 days**
Drilling, casing and look ahead estimate *Intersection point assumed to be into the production liner/casing of the blowing out well for both wells analysed.*	**20 - 25 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*
	~77 days (75.6 days)

The following conditions and assumptions are applicable:

- A dynamically positioned MODU is not available.
- A pre-lay mooring spread is required to moor the rig over subsea infrastructure. Estimated duration to procure and install the pre-lay moorings is five (5) weeks, which would occur in parallel to MODU mobilisation. The breakdown of this timeframe is as follows:

Table 6-3: Mooring Spread installation timings

Activity	Duration (days)
Design mooring spread and commence sourcing equipment	7
Source equipment and mobilise to supply base (carried out concurrently while sourcing rig)	21
Install pre-lay spread	7
Run anchors and prepare to spud	1.6
Total	**36.6**

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.

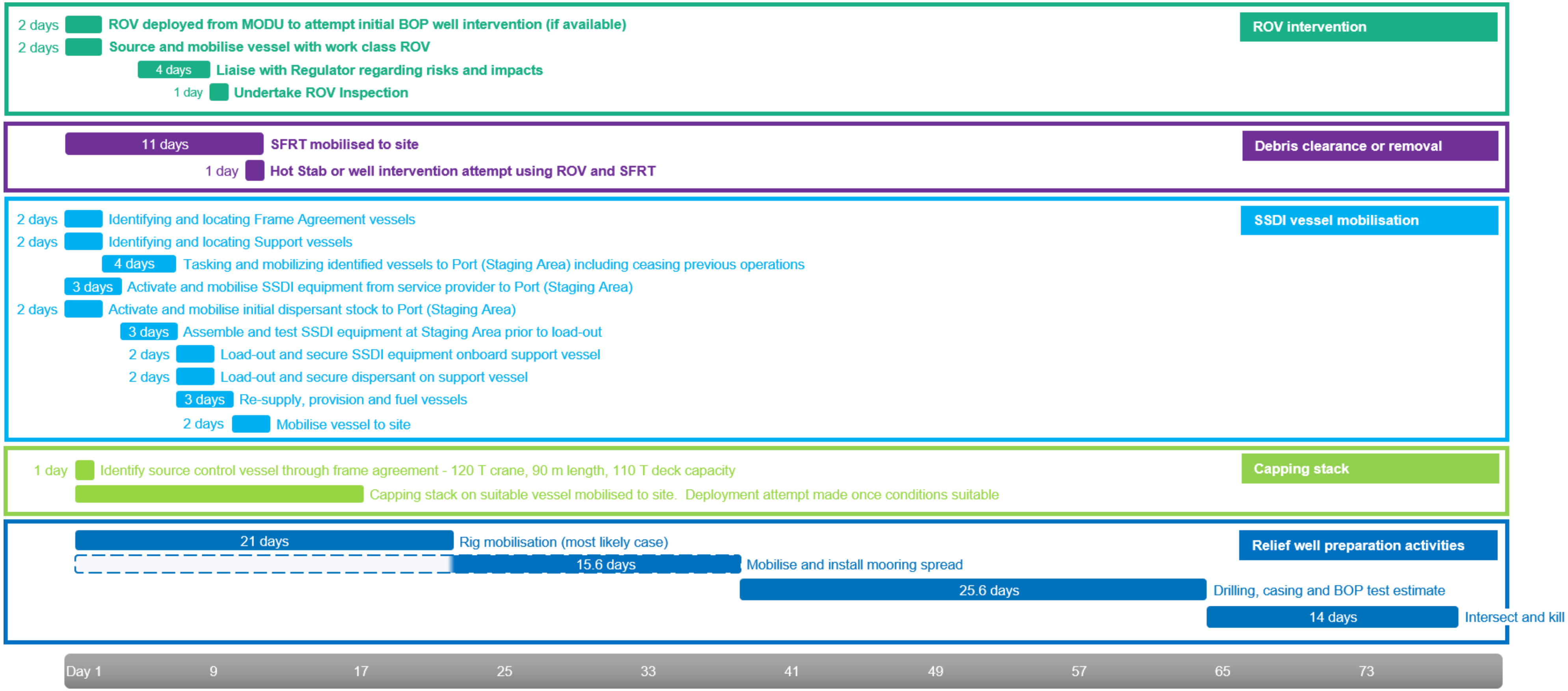

Figure 6-3: Source control and well intervention response strategy deployment timeframes for Yodel

6.1.4.2 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. If 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 6-4 and Figure 6-5. The assumptions for each of the cases are detailed in subsequent Table 6-4.
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 Yodel and Capella abandonment and GWF-3 operations, 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.

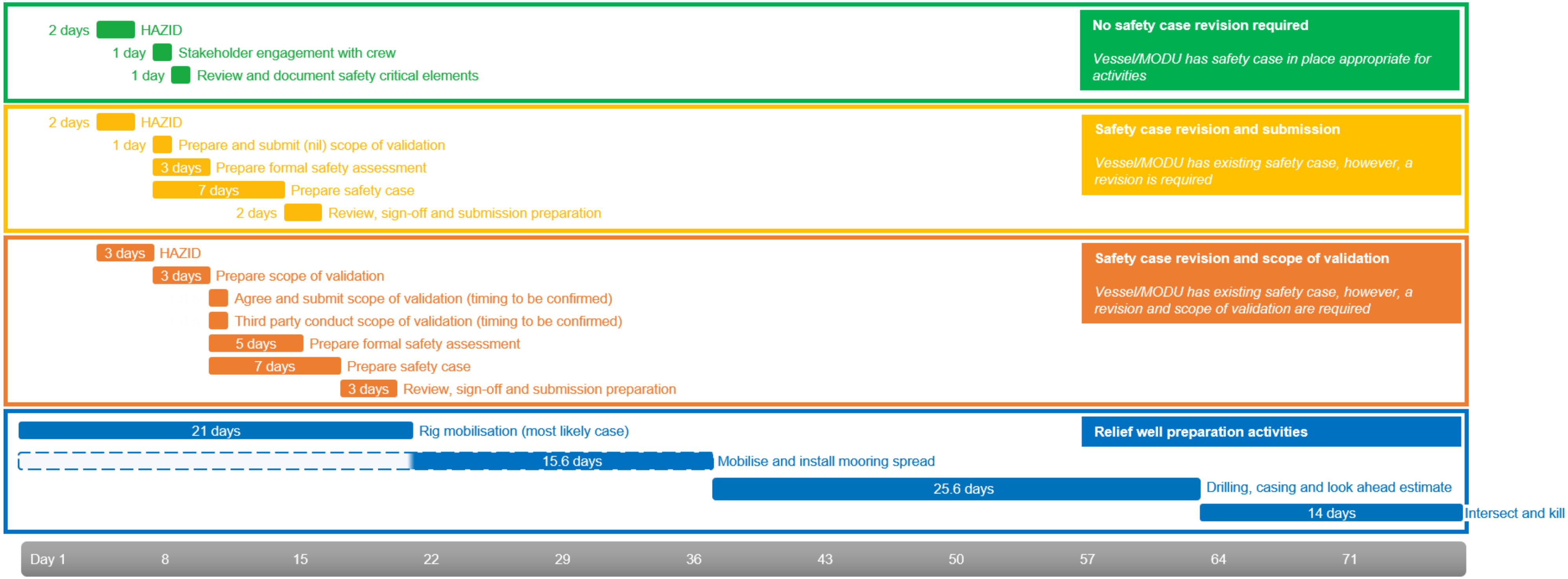

Figure 6-5: Timeline showing safety case revision timings alongside other relief well preparation activity timings for Yodel

Table 6-4: 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.

6.1.5 Source Control – Control Measure Options Analysis

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.

6.1.5.1 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

6.1.5.2 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).

6.1.6 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 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.

6.1.6.1 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$1.095 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 several 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

6.1.6.2 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

6.1.6.3 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 rig 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 rig 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 rigs	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

6.1.7 Deployment – Control Measure Options Analysis

6.1.7.1 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 Yodel and Capella wells (~135 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 Yodel and Capella locations. 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 Yodel and Capella wells (~135 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 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 77 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 >90 days which is longer than the expected 77 days 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 mobilisation 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

6.1.7.2 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

6.1.8 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

6.2 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.

6.2.1 Existing capability – wildlife response

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-fueling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.2.2 Wildlife response - control measure options analysis

Table 6-13: Wildlife Response – Alternative Control Measure Options considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Direct contracts with service providers instead of those sourced through the OSRO contracts	Adoption of this control would provide minimal net environmental benefit as the resources supplied through AMOSC and OSRL would likely be shared by the direct contracts.	It is feasible to have direct contracts with service providers; however, this option duplicates the capability accessed through AMOSC and OSRL, potentially completing for the same resources.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No

Table 6-14: Wildlife Response- Additional Control Measure Options considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Additional wildlife treatment systems	Current arrangements allow for all wildlife to be treated. Hydrocarbon is only limited to open water above the impact threshold. Therefore, there is no environmental benefit for having additional wildlife treatment systems as current capability meets the need.	Current arrangements allow response equipment and personnel to be delivered by day one, scaling up by day six, enough to treat up to 600 wildlife. An additional wildlife treatment system is feasible and would potentially reduce the time to deploy additional wildlife systems.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	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.	Providing additional trained wildlife responders is feasible, however current capacity provides the capacity to treat approximately 600 wildlife units (primarily avian fauna) by day six, with additional capacity available from OSRL.	Given there is no environmental benefit, any costs are disproportionate to the benefit gained.	No

Table 6-15: Wildlife Response- Improved Control Measure Options considered

Option considered	Environmental consideration	Feasibility	Cost	Implemented
Faster mobilisation time for wildlife response through pre-positioned equipment and personnel.	Response time is limited by specialist personnel mobilisation time. Current timing is sufficient considering there is no potential for shoreline receptors to be contacted. This control measure provides increased effectiveness through faster mobilisation of specialists. However, no significant net environmental benefit is expected due to shoreline stranding times.	The selected delivery options provide the capacity to mobilise an oiled wildlife response capable of treating up to 600 wildlife from at least day six and exceeds the estimated Level 4 OWR 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 cost of having dedicated equipment and personnel available to respond faster is considered disproportionate to the environmental benefit.	No

6.2.3 Selected control measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.3 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.

6.3.1 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.

6.3.2 Scientific Monitoring – Control Measure Options Analysis

Table 6-18: 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	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.

				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).	
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 6-19: 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	Yes	Address resourcing needs to collect post spill (pre-contact) baseline data as spill expands in the event of a loss of well control or instantaneous marine diesel release 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 or instantaneous marine diesel release from the PAP activities based on receptors predicted to have hydrocarbon contact >10 days.

		hydrocarbon release			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.

6.3.3 Improved Control Measures

Improved Control Measures considered – No reasonably practicable improved Control Measures identified.

6.3.4 Selected Control Measures

Following review of alternative, additional and improved control measures, 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.

6.3.5 Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-20.

Table 6-20: Scientific monitoring program operational plan actions

Responsibility	Action
Activation	
Perth ICC Planning (ICC Planning – Environment Unit)	Mobilises 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 assesses all outputs from OM01, OM02 and OM03 (Section 5 and ANNEX B) 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 stands 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. Determines practicable baseline acquisition program based on predicted timescales to contact and anticipated SMP mobilisation times. Determines scope for preliminary post-contact surveys during the Response Phase. Determines 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 ICC.

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 SMP 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 Coordinator (ICC).
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 SMP contractor SMP Duty Manager. Agree SMP mobilisation timeline and induction procedures with the Operations Coordinator (ICC)
Perth ICC Logistics	Coordinate with SMP standby contactor SMP Duty 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 Operations Coordinator (ICC)

6.3.6 ALARP and Acceptability Summary

<table>
<tr><th colspan="3">ALARP and Acceptability Summary</th></tr>
<tr><td colspan="3">Scientific Monitoring</td></tr>
<tr><td rowspan="4">ALARP Summary</td><td>X</td><td>All known reasonably practicable control measures have been adopted</td></tr>
<tr><td>X</td><td>No additional, alternative and improved control measures would provide further benefit</td></tr>
<tr><td>X</td><td>No reasonably practical additional, alternative, and/or improved control measure exists</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td>Acceptability Summary</td><td colspan="2">• 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 or instantaneous marine diesel release.
• 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.</td></tr>
<tr><td colspan="3">On the basis from the impact assessment above and in Section 7 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.</td></tr>
</table>

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.

7.1.1 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*
- *Vessel operations and anchoring*
- *Increase in entrained hydrocarbons*

Additional impacts and risks associated with the control measures not included within the scope of the EP include:

- *Additional stress or injury caused to wildlife*

7.1.2 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		✓	✓		✓	✓	✓
Oiled Wildlife					✓	✓	
Scientific Monitoring	✓	✓	✓	✓	✓	✓	✓

7.1.3 Evaluation of impacts and risks from implementing response techniques

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
- Stabilization of 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.

7.1.4 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 First Strike Response Plans.

Additional stress or injury caused to wildlife

- Operations conducted with advice from the DBCA Oiled Wildlife Advisor and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan (PS 20.3)

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 have 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 scenario 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 Environmental Protection and Biodiversity Conservation (EPBC) Act *1999*.
- 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 International Union for Conservation of Nature (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.
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 Oil Pollution Emergency Arrangements (Australia) 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 strategy	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. These are defined as: surface hydrocarbon concentration – ≥10 g/m^2, dissolved – ≥100 ppb and entrained hydrocarbon concentrations – ≥500 ppb.
Environment that May Be Affected	The summary of quantitative modelling where the marine environment could be exposed to hydrocarbons levels exceeding hydrocarbon threshold concentrations.
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
ABS	Above the seabed
ADIOS	Automated Data Inquiry for Oil Spills
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
ANZECC	Australian and New Zealand Environment and Conservation Council
APASA	Asia Pacific ASA
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AUV	Autonomous Underwater Vehicles
BAOAC	Bonn Agreement Oil Appearance Code
BOP	Blowout Preventer
CAR	Containment and Recovery
CERCLA	Environmental Response, Compensation, and Liability Act
CEDRE	Documentation, Research and Experimentation on Accidental Water Pollution
CF	Conditional Factor
CICC	Corporate Incident Coordination Centre
CMR	Commonwealth Marine Reserve
COP	Close of Play
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DGV	Default Guideline Values
DM	Duty Manager
DoT	Western Australia Department of Transport
DP	Dynamically Positioned
DPaW	former Western Australian Department of Parks and Wildlife
D&C	Drilling and Completions
EMBA	Environment that May Be Affected
EROD	Ethoxyresorufin-O-Deethylase
FST	Functional Support Team
DWH	Deepwater Horizon
EMSA	European Maritime Safety Agency
EP	Environment Plan
Environment Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
ESI	Environmental Sensitivity Index
ESD	Emergency Shut Down
ESP	Environmental Services Panel

Abbreviation	Meaning
FPSO	Floating Production Storage Offloading
FSP	First Strike Response Plan
FWADC	Fixed Wing Aerial Dispersant Capability
GIS	Geographic Information System
GPS	Global Positioning System
GSI	Gonado-Somatic Index
HSP	Hydrocarbon Spill Preparedness
IAP	Incident Action Plan
ICC	Incident Coordination Centre
IGEM	Industry Government Environmental Meta-database
IMS	Invasive Marine Species
IMT	Incident Management Team
ISV	Installation Support Vessel
IPIECA	International Petroleum Industry Environment Conservation Association
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
KBSF	King Bay Supply Facility
KICC	Karratha Incident Coordination Centre
KSAT	Kongsberg Satellite
LMT	Long Term Monitoring
LSI	Liver Somatic Index
MARPOL	The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78)
ME	Monitor and Evaluate
MODU	Mobile Offshore Drilling Unit
MoU	Memorandum of Understanding
NEBA	Net Environmental Benefit Analysis
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NRT	National Response Team
OILMAP	Oil Spill Model and Response System
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act
OSMP	Operational and Scientific Monitoring Program
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organisation
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response

Abbreviation	Meaning
OWRP	Oiled Wildlife Response Plan
OWROP	Regional Oiled Wildlife Response Operational Plan
PAH	Polycyclic Aromatic Hydrocarbon
PAP	Petroleum Activities Program
PEARLS	People, Environment, Asset, Reputation, Livelihood and Services
PBA	Pre-emptive Baseline Areas
PPA	Priority Protection Area
PPB	Parts per billion
PPM	Parts per million
ROV	Remotely Operated Vehicle(s)
RPA	Response Protection Area
SCAT	Shoreline Contamination Assessment Techniques
SDA	Surface Dispersant Application
SDH	Sorbitol Dehydrogenase
SHC	Shoreline Clean-up
SIMAP	Integrated Oil Spill Impact Oil System
SSDI	Subsea Dispersant Injection
SFRT	Subsea First Response Toolkit
SME	Subject Matter Expert
SMP	Scientific monitoring program
SOP	Standard Operating Procedure
S&EM	Security and Emergency Management
SQGV	Sediment Quality Guideline Values
TRP	Tactical Response Plan
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicles
WAOWRP	West Australian Oiled Wildlife Response Plan
WEL	Woodside Energy Limited
WHA	World Heritage Area
Woodside	Woodside Energy Limited
WCC	Woodside Communication Centre
WWC	Wild Well Control
WCCS	Worst Case Credible Scenario
WMS	Woodside Management Systems
ZoA	Zone of Application

ANNEX A: NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA) DETAILED OUTCOMES

A 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 marine diesel (representing platform surface release during operations). The complete list of potential receptor locations within the EMBA within the PAP is included in the EP. As there were no RPAs identified the locations utilized for the NEBA were based on receptors closest to the Yodel-3 well site.

The detailed NEBA assessment outcomes are shown below.

Table A-1: NEBA assessment technique recommendations for diesel

Receptor	Monitor and Evaluate	Containment and Recovery	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response	In situ burning	Mechanical dispersion	Source control
Argo-Rowley Terrace MP	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Barrow Island	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Dampier Archipelago	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Glomar Shoal	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Montebello Islands	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Murion Islands MMA-WHA	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Ningaloo Coast Middle	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Ningaloo Coast Middle WHA	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Ningaloo Coast North WHA	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Ningaloo RUZ	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Pilbara Islands – Southern Island Group	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Rankin Bank	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Montebello MP	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
Murion Islands	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
South West MPN – Gascoyne MP	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes
WA Coastline	Yes	No	No	No	No	No	No	No	Potentially	No	No	Yes

Overall assessment

Sensitive receptor (Sites identified in EP)	Monitor and Evaluate	Containment and Recovery	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled Wildlife Response	In situ burning	Mechanical dispersion	Source control
Is this response Practicable?	Yes	No	No	No	No	No	No	No	Yes	No	No	Yes
NEBA identifies Response potentially of Net Environmental Benefit?	Yes	No	No	No	No	No	No	No	Yes	No	No	Yes

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 • Response activities have ceased • Hydrocarbon spill modelling (as verified by OM02 surveillance observations) predicts no additional natural resources will be impacted

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 2 (OM02) 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

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 3 (OM03) 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 (2000) trigger values for 99% species protection.

Operational Monitoring <u>Operational Plan</u>	Objectives	Activation triggers	Termination criteria
<u>Operational Monitoring Operational Plan 4 (OM04)</u> 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.	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 fauna and habitats contacted by hydrocarbons at sensitive habitat and shoreline locations. The primary objectives of OM05 are: • Record evidence of oiled fauna (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 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 fauna 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 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 SMP service providers who hold a standby contract for SMP (SMP Standby Contractor) via the Woodside Environmental Services Panel (ESP). In the event that additional resources are required, other consultancy capacity within the Woodside ESP will be used (as needed and may extend to specialist contractors such as research agencies engaged in long-term marine monitoring programs). In consultation with the SMP Standby 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 SMP Lead/Manager 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 (SMP Liaison Officer)	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 lead in-field by a party chief).

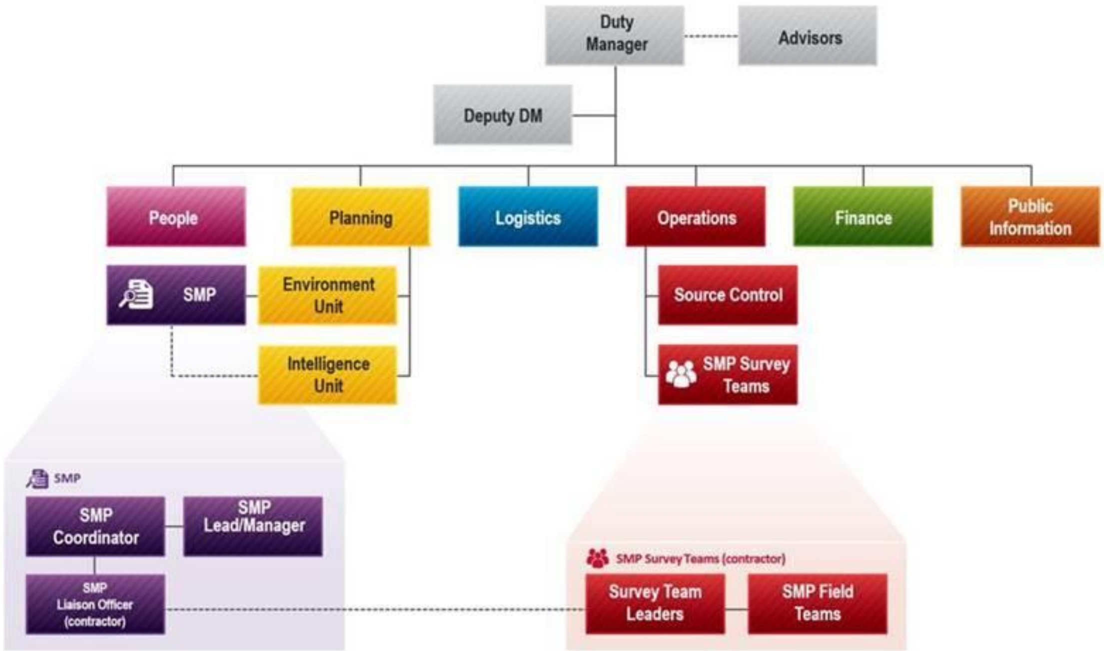

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to ICC organisational structure.

Document to be read in conjunction with EY decommissioning Environment Plan.

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[6]) concentrations of 1 g/m^2 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, five ppb for entrained/dissolved hydrocarbons and ≥one 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[7]) 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, five ppb for entrained/dissolved hydrocarbons and ≥one 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 • 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.	SM04 will be activated in the event of a Level two or three 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; and	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. • Recovery of impacted mangrove/saltmarsh habitat has been evaluated.

[6] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf
[7] 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
		• Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, five ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for mangrove/saltmarsh habitat.	• 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, five 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; • Dugongs; • Whale sharks and other shark and ray populations; • Sea snakes; and	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 records of dead, oiled or injured non-avian marine megafauna during the spill/ response phase.	SM08 will be terminated when the results of the post-spill monitoring have quantified impacts to non-avian megafauna. • 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 (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Crocodiles. The desk-based assessment will include population analysis to infer potential impacts to marine megafauna species populations.		
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), gonadosomatic 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 ≥five 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 FSP for the PAP. 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 what SMPs are activated and 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. PBAs (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 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).

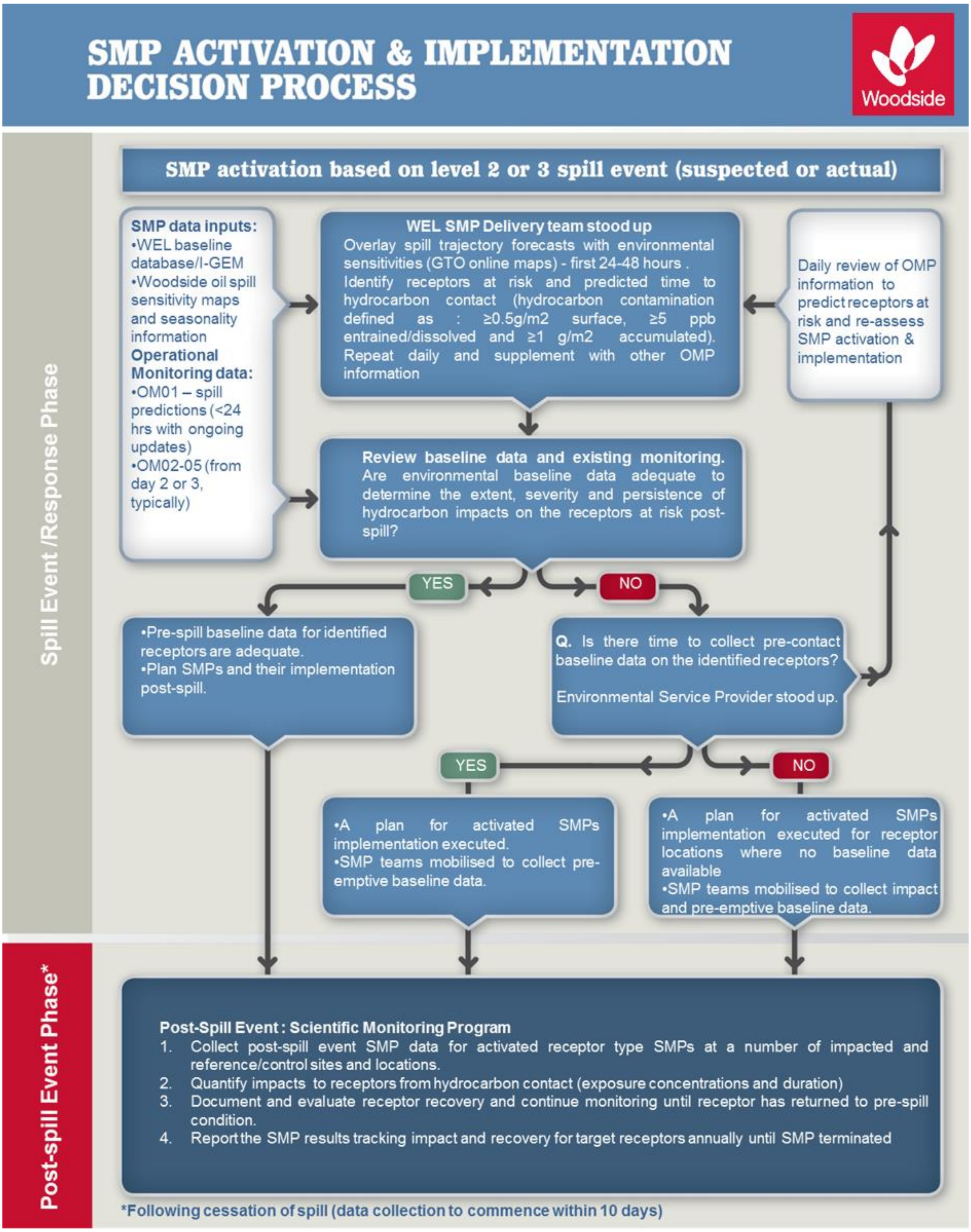

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

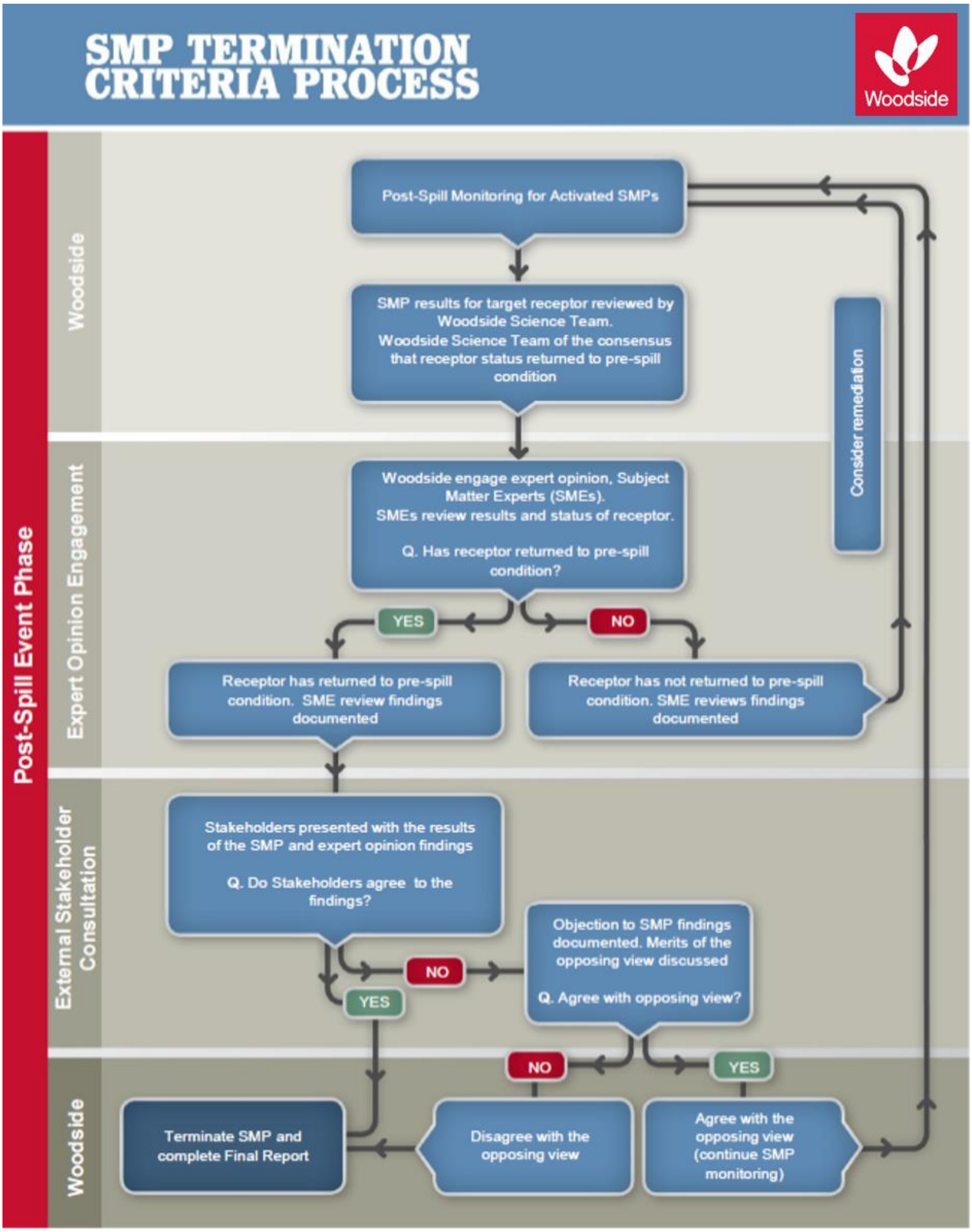

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

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 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 Meta-database, IGEM) 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 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 worst-Case Credible spill Scenarios 1 and 2

Receptors to be Monitored	Applicable SMP	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

Receptor Areas - Potential Impact and Reference Scientific Monitoring Sites (marked 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 D-2: Baseline Studies for the SMPs applicable to identified Pre-emptive Baseline Areas for the PAP

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	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. Broad benthic habitat classifications and habitat maps for the Montebello islands by DBCA. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3. Benthic community monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing). 4. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of corals for the Gorgon Gas Development. Marine Baseline Program (2008), Marine Monitoring Program (2010) Post Development Surveys (2011 – 2013). 2.Coral monitoring at sites around Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3.Benthic community (coral, seagrass and macroalgae) monitoring as part of DBCA's Western Australian Marine Monitoring Program (2015-ongoing). 4.Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats surrounding the Lowendal Islands for the Gorgon Gas Development. Coral assemblages on the eastern side of Double Island, and coral bommies on the south-western edge of the Lowendal Shelf. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Glomar Shoal 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 Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 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. Habitat mapping. 2. Quantitative assessment details not available. 3. Drop camera. 4. Fixed long-term monitoring sites. Diver video transect. 5. Towed video, benthic trawl and sled.	1. Belt transect, size class frequency, video transects, photo quadrat, tagged colonies and terracotta tiles for coral recruitment. 2. Quantitative assessment 3. Fixed long-term monitoring sites. Diver video transects. 4. Towed camera, benthic trawl and sled.	Benthic habitat mapping, diver swum transects, tagged colonies. Quantitative assessment Towed video, benthic trawl and sled.	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.

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		References and Data:				
		1. DBCA 2007. DATAHOLDER: DBCA. 2. RPS, 2012. DATAHOLDER: Santos. 3. DATAHOLDER: DBCA. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS, 2012. DATAHOLDER: Santos. 3. Bancroft 2009. DATAHOLDER: DoEE. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS, 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	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)	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. Santos, macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 2. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of Seagrass and Macro algae habitats for the Gorgon Gas Development project. Marine baseline Program (2008, 2009), Marine Monitoring Program (2010), Post Dredge Survey one (2011) 2. Chevron study by RPS in 2004 on Barrow Island intertidal zone. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats including seagrass and macroalgae for the (Lowendal Islands, Chevron Janz Feed Gas Pipeline Project.) Gorgon Gas Development Project. 2. Santos macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Glomar Shoal 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 Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	N/A – see table D – 1

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		Methods:				
		1. Quantitative assessment details not available. 2. Towed video, benthic trawl and sled.	1. Diver transects, photo quadrats, biomass. 2. Physical observational survey of intertidal habitats on Barrow Island. 3. Towed video, benthic trawl and sled.	1. Diver Transects, Photo Quadrats. 2. Quantitative assessment details not available. 3. Towed video, benthic trawl and sled.	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. RPS 2012. DATAHOLDER: Santos. 2. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron Australia. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	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
	SM03	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
Benthic Habitat (Deeper Water Filter Feeders)	Quantitative assessment using image capture using towed video. Post analysis into broad groups based on taxonomy and morphology.	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	1. Glomar Shoal 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 Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	N/A – see table D – 1
		Methods:				
		N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	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	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	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:				
		1. Atmospheric correct and land cover classification, NW Cape. 2. Advanced Land Observing Satellite (ALOS) images taken in 2006, 2008, and 2010 by DBCA. Digital Aerial Photos were taken in 2009, and the area ground-truthed in 2006. 3. Ground truthing aerial photography to map the spatial extent of mangroves on the Montebello Islands. 4. Mangrove monitoring as part of DBCA Western Australian Marine Monitoring Program (ongoing).	Chevron LTM of Mangroves for the Gorgon Gas Development project. Marine Baseline Program (2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2013). Baseline state of the mangroves 2008.	1. Atmospheric correct and land cover classification, NW Cape. 2. Santos Mangrove baseline (2010). 3. Santos - Long-term mangrove monitoring (1999-2011).	N/A – See Table D-1	N/A – see table D – 1
		Methods:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		1. Modular Inversion Program. May 2017 2. ALOS and Digital aerial photos, ground truthing, for Mangrove extent and mangrove relative canopy density. 3. Species Composition, LUX, canopy density. 4. Methods unknown.	1.Health scoring system, percentage cover, mean canopy density, qualitative health assessment. 2. Annual Mangrove composition, canopy density, pneumatophore density, leaf pathology, qualitative health.	1. Modular Inversion Program. May 2017 2.Aerial imagery (resolution of 0.2 m2 captured in 2010). 3. Qualitative data includes the presence of new growth, reproductive state, extent of defoliation and pneumatophore condition. Quantitative data, collected at the tree level, includes seedling density, stem diameter, number of defoliated branches and a number of canopy condition parameters.	N/A – See Table D-1	N/A – see table D – 1
		References and Data:				
		1. EOMAP, 2017 DATAHOLDER: Woodside. 2.DBCA unpublished data. DATAHOLDER: DBCA. 2. Voga unpublish data DATAHOLDER: Voga Contact: voga.envrironment@vermilionenergy.com 3. DBCA. DATAHOLDER DBCA.	Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. Chevron 2014. DATAHOLDER: Chevron.	1. EOMAP, 2017 DATAHOLDER: Woodside. 2.Santos 2014. DATAHOLDER: Santos. 3. Santos 2011. DATAHOLDER: Santos.	N/A – See Table D-1	N/A – see table D – 1
Seabirds	SM05	Studies:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
	Visual counts of breeding seabirds, nest counts, intertidal bird counts at high tide.	No recent studies. A DBCA/WAM study of terrestrial fauna of the islands was published in 2000 (Burbidge et al 2000). The most recent bird survey referenced in this review was 1998 by DBCA (DPaW, CALM).	1. Barrow Island migratory behaviour, nesting and foraging behaviour. 2. Migratory waders at Barrow Island. 3. LTM on Barrow island (island wide) Study September 2003 – 2006. 4. Chevron - Gorgon Gas Development. Terrestrial and subterranean environment monitoring program (2008-2015). Monitoring of Wedge-tailed Shearwaters, Bridled Terns, Silver Gulls.	1. Ongoing study of Bridled Terns from 2009. 2. Quadrant Energy seabird nesting on Lowendal Island, study 2013. 3. Lowendal Islands, common breeding bird species, structure, feeding and disturbances to the population. 4. Quadrant Energy/Santos – Integrated Shearwater Monitoring Program (1994-2016).	N/A – See Table D-1	Present, in open water, no breeding habitat.
		Methods:				
		Bird observations and counts.	Species, total numbers, Distribution, Roosting locations and foraging numbers. Migratory behaviour. High tide roost counts, abundance counts. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows; collapsed burrows and predation and mortality records. Barrow Island: Variation in abundance and spatial/temporal distribution on beaches. Middle Island: Abundance; nest density; Presence and absence of eggs/chicks in nest.	1. Nest Density, presence and absence of chicks, predation and mortality counts. 2. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows. 3. Burrowscopes, Ultrasonic monitors to monitor burrows. 4. The distribution and abundance of other nesting seabirds within the Lowendal Island group, including up to 45 islands and islets, also occurred from 2004 onwards.	N/A – See Table D-1	N/A

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		References and Data:				
		DBCA/WAM – Burbidge et al 2000.	Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. Chevron, 2013. DATAHOLDER: Chevron. Chevron 2013. DATAHOLDER: Chevron.	1. Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. 2. Surman 2012. DATAHOLDER: Santos. 3. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. 4. DATAHOLDER: Santos.	N/A – See Table D-1	N/A
Turtles	SM06 Beach surveys (recording species, nests, and false crawls).	Studies:				
		1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex for Chevron. 2. Marine turtle monitoring as part of DBCA long-term turtle monitoring program (ongoing).	Chevron - Gorgon Gas Development. Long-term Turtle Monitoring Program - Flatback tagging program and marine turtle track census program (2005 – ongoing).	1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex. 2. Santos 2013 turtle nesting survey on the Lowendal islands. 3. Varanus Island Turtle monitoring program (2005 – present).	N/A – See Table D-1	Present, in open water, no nesting habitats.
		Methods:				
		Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion).	Island wide (though primary nesting occurs on east coast). Mundabullangana on mainland is the reference location for the Flatback tagging program.	1. Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion). 2. Tagging and nest counts. 3. Tagging and nest counts. Varanus, Beacon, Bridled, Abutilon and Parakeelya islands.	N/A – See Table D-1	N/A
		References and Data:				
		1. AMOSC/DPaW 2014. DATAHOLDER: Chevron. 2.DBCA.	Pendoley Environmental (2005-ongoing). DATAHOLDER: Chevron.	1. Pendoley 2005. AMOSC/DBCA (DPaW) 2014. DATAHOLDER: Chevron/ Santos. 2. Santos, 2014. DATAHOLDER: Santos. 3. Santos (2005 – present)	N/A – See Table D-1	N/A

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
Fish	SM09 Baited Remote Underwater Video Stations (BRUVS), Visual Underwater Counts (VUC), Diver Operated Video (DOV).	Studies:				
		1. DBCA diver surveys 2009-2012. 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~8-20m) in 2014 and deeper (20-60m) in 2015 inside and outside sanctuary zones at the Montebello Islands and in the area from Cape Preston to the Montebello Islands in 2015. 3. Finfish monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing).	1. Chevron LTM of demersal fish for the Gorgon Gas Development project. Marine Baseline Program (2008, 2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2012). 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) from Exmouth to Barrow Islands in 2015. 3. Finfish monitoring as part of DBCAs Western Australian Marine Monitoring Program (2015-ongoing).	1. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) Montebello Sanctuaries 2015. 2. WA Museum fish surveys of Dampier Archipelago 1998- 2000 (Hutchins 2004).	1. Glomar Shoal 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 Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	1. CSIRO – Fish Diversity. 2. Fish species richness and abundance.
		Methods:				
		1. Diver Operated Video - species richness, community composition, and biomass were recorded from 2009-2012. 2. Stereo BRUVS. 3. Diver UVS.	1. Intertidal and subtidal surveys using BRUVS and Netting. 2. Stereo BRUVS. 3. Diver UVS.	1. Stereo BRUVS 2. Diver surveys _ Underwater Visual Census (UVC).	1. BRUVs. 2. BRUVs. 3. BRUVs. 4. BRUVs.	1. Semi V Wing trawl net or an epibenthic sled. 2. ROV Video.
		References and Data:				

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Montebello Islands	Barrow Island	Lowendal Islands	Rankin Bank & Glomar Shoal	Montebello AMP
		1. DBCA data. DATAHOLDER: DBCA 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011. Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. UWA. The UWA Oceans Institute & School of Biological Sciences. 2. DATAHOLDER: Woodside and WAM.	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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Chevron Australia (2011). Gorgon Gas Development and Jansz Feed Gas Pipeline: Dredging and spoil disposal Management and Monitoring Plan, Document number: G1-NT-PLNX0000373. Pp. 255. https://www.chevronaustralia.com/docs/default-source/default-documentlibrary/gorgon-emp-dredging-and-spoil-disposal-plan.pdf?sfvrsn=2

Chevron Australia (2013). Wheatstone Project, Oil Spill Operational Scientific Monitoring Program-OPS 5 Shorebird and Seabird Rapid Assessment. Document Number: WS0-0000-HESRPT-CVX-000-00144-000. https://www.chevronaustralia.com/docs/default source/defaultdocument-library/wheatstone-ops5-shorebird-and-seabird-rapid-assessment.pdf?sfvrsn=2

Chevron Australia (2014). Gorgon Gas Development and Jansz Feed Gas Pipeline: Post-Development Coastal and Marine State and Environment Impact Survey Report, Year 2:2012-2013. Document number G1-NT-REPX0005152. Pp. 362 https://www.chevronaustralia.com/docs/default-source/default-document-library/gorgon-emp-post-development-coastal-and-marine-state-and-environmental-impact-survey.pdf?sfvrsn=4

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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 Shoal
Barrow and Lowendal Islands
Pilbara Islands - Southern Island Group
Montebello Is - Stephenson Channel Nth
Montebello Is Champagne Bay & Chippendale channel
Montebello Is - Claret Bay
Montebello Is - Hermite/Delta Is Channel
Montebello Is - Hock Bay
Montebello Is - North & Kelvin Channel
Montebello Is - Sherry Lagoon Entrance
Withnell Bay
Holden Bay
King Bay
No Name Bay / No Name Beach
Enderby Is -Dampier

Document to be read in conjunction with EY decommissioning Environment Plan.

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

APPENDIX F: STAKEHOLDER CONSULTATION

Echo Yodel Decommissioning Environment Plan Appendix F

April 2020
Revision: 0

TABLE OF CONTENTS

1. Phase 1 consultation

1.1 Email sent to AFMA, AHO, AHS, AMSA (marine safety), DPIRD, DoT, Pilbara Trap Fishery licence holder, CFA, Recfishwest, WAFIC, King Bay Game Fishing Club and Nickol Bay Sport Fishing Club – 13 June 2017

Dear stakeholder

As part of Woodside's ongoing consultation for its current and planned activities, we advise that we're preparing an Environment Plan (EP) to support decommissioning activities for the Echo Yodel pipeline, located in the North West Shelf.

We're currently assessing our decommissioning options for the 23 km Echo Yodel pipeline, subsea umbilicals and two subsea production wells. We're still in the planning phase to determine the most suitable decommissioning options, which will take into account all environmental, safety, social and economic aspects. Comprehensive engineering and environmental studies have been undertaken to date.

Woodside has identified your organisation as a relevant stakeholder and would like to meet in the coming weeks to discuss the decommissioning options. We will provide an overview of the project and proposed activities. Stakeholder feedback will be considered as part of the planning phase to determine the most suitable decommissioning option.

I will follow up with a telephone call to schedule an appointment, should you be available to meet to discuss the Echo Yodel decommissioning options.

Please do not hesitate to contact me should you have any queries.

Kind regards

[redacted]

[redacted]
Corporate Affairs Adviser
Woodside Energy Ltd

1.2 Presentation made to AFMA (18 December 2017), AMSA (22 June 2017), DPIRD (1 February 2018), Pilbara Trap Fishery Licence holder (25 July 2017), Pilbara Trawl Fishery Licence holder (12 June 2018), Recfishwest (14 May 2018) and WAFIC (18 July 2017)

Disclaimer and important notice

This presentation contains forward looking statements that are subject to risk factors associated with oil and gas businesses. It is believed that the expectations reflected in these statements are reasonable but they may be affected by a variety of variables and changes in underlying assumptions which could cause actual results or trends to differ materially, including but not limited to: price fluctuations, actual demand, currency fluctuations, drilling and production results, reserve estimates, loss of market, industry competition, environmental risks, physical risks, legislative, fiscal and regulatory developments, economic and financial market conditions in various countries and regions, political risks, project delay or advancement, approvals and cost estimates.

All references to dollars, cents or $ in this presentation are to US currency, unless otherwise stated.

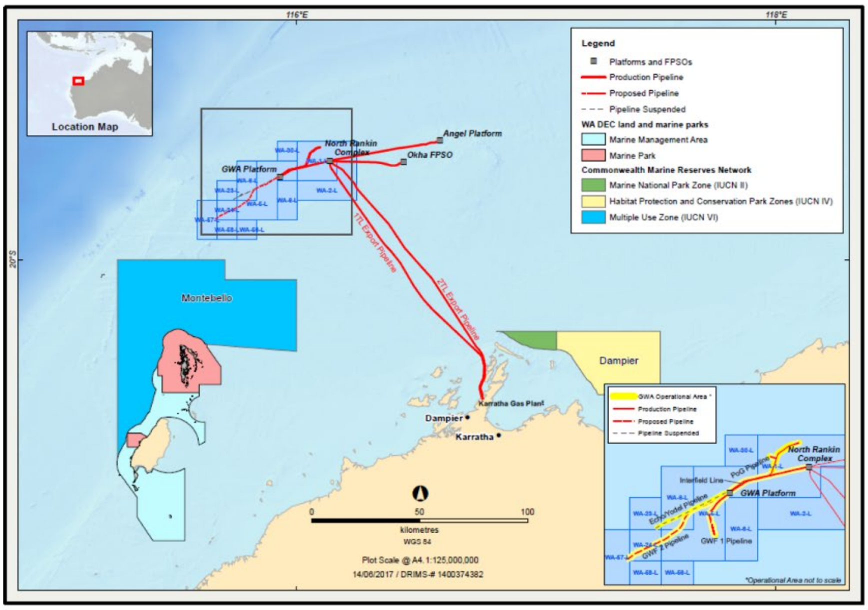
References to “Woodside” may be references to Woodside Petroleum Ltd. or its applicable subsidiaries.

Echo Yodel background

- The Echo Yodel gas field lies approximately 25 km southwest of the Goodwyn Alpha (GWA) platform in the North West Shelf (NWS).
- Echo Yodel is located 140 km north west of Dampier and lies in 140 m water depth.
- The gas field was developed by two subsea wells and tied back to GWA platform via 23 km 12-inch Echo Yodel pipeline.
- The Echo Yodel infrastructure is located in petroleum production licences WA-23-L; and pipeline licence WA-9-PL, located within Commonwealth waters.
- Woodside is the designated Operator on behalf of the NWS Project.
- Participants are made up of:
  - BHP Billiton Petroleum (North West Shelf) Pty Ltd 15.78%;
  - BP Developments Australia Pty Ltd 15.78%;
  - Chevron Australia Limited 15.78%;
  - CNOOC NWS Private Limited 5.3%;
  - Japan Australia LNG (MIMI) Pty Ltd 15.78%; and
  - Shell Australia Pty Ltd 15.78%.

22 June 2017

Echo Yodel location map



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Echo Yodel background

- Echo Yodel commenced operations in 2001.
- Echo Yodel field reached end of its economic production life in 2012.
- Wells were suspended in 2012.
- Pipeline was cleaned and preserved, and the well tie-in spools removed in 2016.
- Woodside, under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, proposes to decommission the Echo Yodel subsea infrastructure.
- Planning is underway to determine the most suitable decommissioning options for:
  - Echo Yodel pipeline
  - Umbilicals
  - Wellheads

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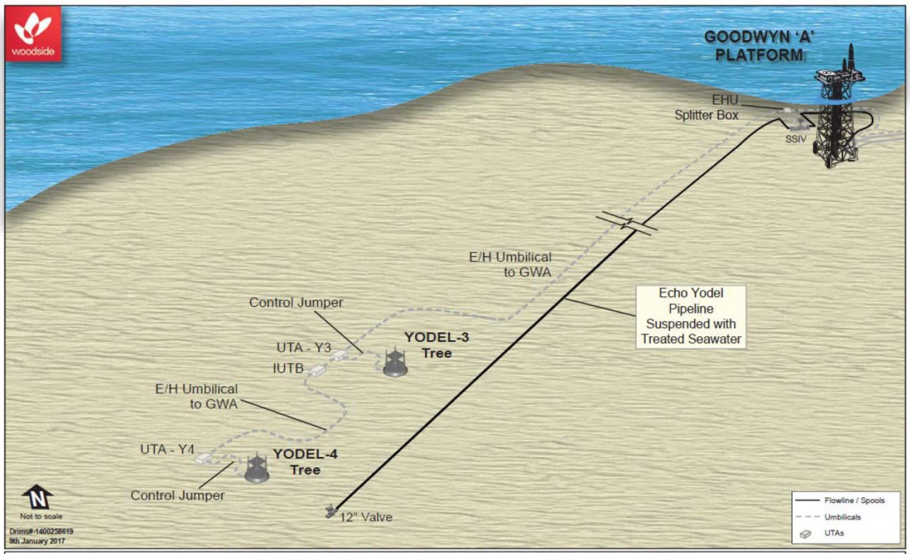
Echo Yodel subsea infrastructure



NORTH WEST SHELF VENTURE SUBSEA PROJECTS
ECHO-YODEL FIELD SCHEMATIC

22 June 2017

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Supporting studies and research

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- University of Western Australia
  - Fish surveys (BRUV and ROV)
  - Long-term pipeline stability
- CSIRO
  - Long-term fate and effect of subsea infrastructure
- WAMSI
  - Stakeholder feedback

BRUV survey

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Pipeline decommissioning

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Pipeline decommissioning

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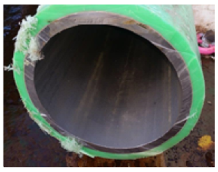
- In preparation for decommissioning pipelines are flushed and cleaned by pigging the system.
- Decommissioning can involve partially or fully removing the pipeline, or leaving in-situ.

Internal of recovered subsea infrastructure

Pipeline considerations

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- Technical
  - Studies show that the pipeline will remain stable and the surrounding seabed will be maintained if left in-situ.
  - Our surveys show that a significant proportion of the Echo Yodel pipeline is already buried and the exposed surfaces are covered in significant established marine growth.
- Safety
  - By leaving the pipeline in place, safety risks to the workforce and other marine users are reduced due to the minimal scope of work that needs to be completed in the field.
- Environmental
  - The pipeline has been extensively cleaned of hydrocarbons and other contaminants.
  - Studies demonstrate that the pipeline is likely to maintain integrity for hundreds of years.
  - UWA research on Echo Yodel suggests that pipelines may enhance, rather than simply attract, fish stocks.
    - More than 40 species and 25 families of fish have been recorded on the Echo Yodel pipeline.
    - Thousands of larval fish, in addition to juveniles, sub-adults and adults.
    - There is likely to be ~100,000 fish along the pipeline.
  - Leaving the pipeline in-situ presents an attractive environmental option as there will be no disturbance to established benthic communities/marine growth and any associated biodiversity as observed on the pipeline.
  - Studies underway to confirm that there is no significant long-term environmental impacts from degradation if left in-situ.
- Community
  - Commercial fishers use the Echo Yodel pipeline to fish the abundance of important fish habitat that the pipeline provides. If left in-situ the pipeline route will be appropriately marked on marine charts.

Umbilical decommissioning

Umbilical decommissioning

+ Electro / hydraulic umbilicals transfer electrical power and signals with hydraulic control fluids from the topsides processing facility to subsea systems.
+ Hydraulic control fluids are water based and pose negligible risk to the environment
+ Decommissioning can involve removing umbilicals or leaving in-situ.

Umbilical considerations

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- Technical
  - Umbilicals will maintain stability and no disruption to the seabed if left in-situ.
  - Our technical studies show that a significant proportion of the Echo Yodel umbilical is already buried and the exposed surfaces are covered in established marine growth.
- Safety
  - Leaving umbilicals in-situ reduces risks for workforce personnel and is of low impact to other marine users.
- Environment
  - Leaving umbilicals in-situ presents a suitable environmental option as there will be no disturbance to established benthic communities/marine growth and any associated biodiversity as observed on the umbilical.
  - Studies underway to confirm that there is no significant long-term environmental impacts from degradation if left in-situ.
- Community
  - Consultation will be undertaken with relevant stakeholders to ensure awareness of umbilicals if left in-situ.

Wellheads decommissioning

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Marine life on Echo Yodel trees

Wellhead decommissioning

- During decommissioning each production well is 'plugged and abandoned', which means that it is made safe in accordance with offshore petroleum regulations.
- Decommissioning a well usually requires using a drill rig to re-enter the well and cement is pumped into the well to create a permanent barriers to prevent hydrocarbon flow.
- The wellhead and tree, which are located at the top of the well and controls flow from the well, can then be removed or left in-situ.

Wellhead considerations

- Technical
  - Feasible to plug and abandon wells without removing x-trees.
- Safety
  - Our risk assessment shows leaving the wellheads in-situ requires minimal scope of work to be completed in the field, reducing risks to the workforce.
- Environment
  - Studies show that wellheads in NWS water depth will develop a significant persistent environmental habitat with diverse species including hard substrates, invertebrates and fish.
  - There will be no significant disturbance to the established benthic communities and associated biodiversity at the wellhead locations.
- Community
  - The presence of the wellhead infrastructure has the potential to attract and promote fish habitat in the area.
  - There is potential for snagging fishing gear if the wellheads are left in-situ at 130 m water depth, however the area is not part of an active trawl fishery.

Environment plan process

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- Phase 1 stakeholder engagement
  - Consultation about decommissioning options
  - Meetings held with relevant stakeholders
- Phase 2 stakeholder engagement
  - Proposed decommissioning option
  - Information sheet issued and feedback requested
  - Additional meetings
- Environment plan will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for assessment.

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2. Phase 2 consultation

2.1 Email to DPIRD – 5 April 2019

Hi [redacted]

Thanks so much for your time on the phone today.

As discussed, we're starting work on decommissioning planning for Echo Yodel. This consists of a 23km long pipeline, two production wells and some other supplementary subsea infrastructure. The two production wells will need to be permanently plugged. As we will have to have a drilling vessel for that activity, we also intend to add additional downhole barriers to a suspended exploration wellhead (Capella-1) at the same time, and aim to also decommission the well. I've attached two maps of their locations for your reference in relation to the 29 wells with wellheads we did the Comparative Assessment workshop on last year.

The workshop last year was held in October and Steve Newman and Patrick Cavalli attended from the department. This workshop was for 29 wellheads that are shown on the maps. Before that workshop we also spoke to Mark Pagano about what different options might mean, for example, from an artificial reef perspective.

Below is the last email we sent out to the workshop participants, with the summary report attached.

We would like to conduct a decommissioning Comparative Assessment workshop for the Echo Yodel infrastructure, in the same format as the wellheads, with an aim to submit an EP to NOPSEMA for acceptance in Q3 this year, for the final decommissioning option selected in the workshop.

The workshop would be ~4hrs, and we'd aim to have it on Wed 15th or Thurs 16th May or Fri 17th May.

Obviously for options such as installing structures with an aim to create an artificial reef environment, the department would need to agree to accept liability under the Artificial Reef application permit system. That acceptance is a critical requirement for the option of an artificial reef to be realized, and as such, needs to be worked through from many different angles. This will be no small task, nor a quick one. It was also a question that was raised in the workshop, and I have attached an email with some correspondence with the department on this query. There is much to work through on a few different fronts, but from the outcome of the workshop for the NWS wellheads, it looks like a concept that is worth working through. Alternatively, if it's not an option that the department can foresee being possible in the foreseeable future, it would be great to know that too, so we can rule out the option from the beginning.

Please feel free to call myself or [redacted] if you have any questions.

We'll keep in touch about locking in a date for the workshop as we hear back from other participants.

Kind regards,

[redacted] | Developments
Woodside Energy Ltd

2.2 Email sent to Pilbara Trawl Fishery licence holder – 8 April 2019

Hi [redacted],

Many thanks for your time on the phone today, my apologies for trying to organise something at such a busy time of the year for you. As discussed, we're seeking a decommissioning option agreement for infrastructure in the Pilbara Trawl Closure Zone. Our aim is to have an outcome from the workshop that we would seek acceptance of by NOPSEMA through an Environment Plan (EP). As discussed, your key points that we are aiming to address through the workshop are:

1. Clear understanding of who's responsible for liability under different decommissioning options (e.g. leave in place and do nothing vs leave in place with artificial structures as an artificial reef).
2. Agree on an option that if accepted through the EP process, sets a precedent for decommissioning infrastructure in this Pilbara Trawl Closure Zone.

As discussed, we're aiming to hold a Comparative Assessment workshop for decommissioning options for Echo Yodel infrastructure on Wed 15th May, Thurs 16th May or Fri 17th May.

The relevant line and trap fishers will be invited, as will WAFIC and DPIRD representatives so that a clear understanding and agreement can be gained to take the option forward in an EP to be submitted at the end of the year.

Location and information on the infrastructure is attached. If you have any questions, please feel free to contact me on my details below.

Kind regards,

[redacted] | Developments
Woodside Energy Ltd

2.3 Email sent to WAFIC – 8 April 2019

Hi [redacted]

I hope this email finds you well. I have called and left a couple of messages on your phone. We are working towards decommissioning the Echo Yodel infrastructure with an aim to submit an EP towards the end of the year. The infrastructure is located in the Pilbara Trawl Permanently Closed Zone. As such we're aiming to hold a Decommissioning Comparative Assessment workshop with the relevant fishers (trap and line) and government departments after the busy Easter fishing period, nominally mid-May.

The aims of the workshop will be:

1. Clear understanding of who's responsible for liability under different decommissioning options (e.g. leave in place and do nothing vs leave in place with artificial structures as an artificial reef).
2. Agree on an option that if accepted through the EP process, sets a precedent for decommissioning infrastructure in this Pilbara Trawl Closure Zone.

Can you please indicate if you would be available to attend the workshop on Wed 15th May, Thurs 16th May or Fri 17th May?

Many thanks,

[redacted] | Developments
Woodside Energy Ltd

2.4 Email sent to WAFIC – 7 May 2019

Dear [redacted]

As requested please find below and attached further information and an agenda for the Echo Yodel Decommissioning Comparative Assessment Workshop on 15 May.

We have invited DPIRD, and Pilbara Line, Pilbara Trap and Pilbara Trawl fishers to the Workshop.

Please let me know if you would be interested in participating in the Workshop, and whether WAFIC would be open to hosting at your office? Woodside would obviously cover the costs for morning tea, lunch and afternoon tea.

Woodside is currently undertaking planning activities to support the decommissioning of subsea infrastructure on the North West Shelf and we are seeking your input to that process as a potential long-term user of the region.

The infrastructure is the Echo Yodel development and comprises a 23 km subsea pipeline and umbilical, and two subsea production wells and Xmas trees. The infrastructure is located about 140 km north west of Dampier and is about 140 m water depth. Please see map attached.

To progress decommissioning options we are holding a comparative assessment workshop on 15 May 2019 at which we will consider decommissioning options and undertake an independently facilitated assessment of impacts and benefits for stakeholders with an interest in the region. As the infrastructure is located in an area fished by Pilbara trap and line fishers, but is in an area permanently closed to the Pilbara trawl fishery, we consider you relevant to the decision making process.

Workshop details are:

Date: Wednesday, 15 May
Time: 8:30am – 4pm
Location: Woodside will confirm shortly / teleconference details to be provided
Duration: ~7.5 hours

Once a decommissioning option is selected, broader consultation will be undertaken with all relevant stakeholders to inform planning and decision-making for an Environment Plan, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for consideration and acceptance.

We look forward to hearing from you and hope that you can attend.

Please contact myself or [redacted] (details below) should you required further information.

Best regards,

[redacted] Corporate Affairs
Woodside Energy Ltd

[redacted] | Developments
Woodside Energy Ltd

2.5 Email to Licence holders in the Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries – 7 May 2019

Dear stakeholder,

Woodside is currently undertaking planning activities to support the decommissioning of subsea infrastructure on the North West Shelf and we are seeking your input to that process as a potential long-term user of the region.

The infrastructure is the Echo Yodel development and comprises a 23 km subsea pipeline and umbilical, and two subsea production wells and Xmas trees. The infrastructure is located about 140 km north west of Dampier and is about 140 m water depth. Please see map attached.

To progress decommissioning options we are holding a comparative assessment workshop on 15 May 2019 at which we will consider decommissioning options and undertake an independently facilitated assessment of impacts and benefits for stakeholders with an interest in the region. As the infrastructure is located in an area fished by Pilbara trap and line fishers, but is in an area permanently closed to the Pilbara trawl fishery, we consider you relevant to the decision making process.

Workshop details are:

Date: Wednesday, 15 May
Time: 8:30am – 4pm
Location: Woodside will confirm shortly / teleconference details to be provided
Duration: ~7.5 hours

Please note that this invitation is being sent as a placeholder, ahead of provision of more detailed information on decommissioning options, contextual scientific research and an overview of the comparative assessment process.

Once a decommissioning option is selected, broader consultation will be undertaken with all relevant stakeholders to inform planning and decision-making for an Environment Plan, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for consideration and acceptance.

We look forward to hearing from you and hope that you can attend.

Please contact myself or [redacted] (details below) should you required further information.

Best regards,

[redacted] | Corporate Affairs
Woodside Energy Ltd

[redacted] | Developments
Woodside Energy Ltd

2.6 Email to DPIRD and licence holders in the Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries – 7 May 2019

Dear stakeholder,

Further to our previous email below [Appendix F Ref 2.5], please find attached an agenda and background information for the Echo Yodel Comparative Assessment Workshop on 15 May.

Please let me know if you're able to attend either by accepting this invitation or by response email.

We hope you are able to attend.

Regards

[redacted] | Corporate Affairs
Woodside Energy Ltd

2.7 Comparative assessment workshop agenda sent to DPIRD, WAFIC and Licence holders in the Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries – 7 May 2019

Woodside

Echo Yodel Infrastructure Decommissioning – Comparative Assessment Stakeholder Workshop

Wednesday, 15 May 2019

[Location TBC]

Agenda

	8:45	**Arrival**	
1	9:00	**Welcome**	Woodside
	9:05	**Introductions and Aim**	
		Health and safety/logistics	Facilitator
		Round the room	
		Aim for the workshop	
		Agenda	
2	9:16	**Echo Yodel Background**	
		What and where is it/setting	Woodside
		Progress to date on decommissioning	
		Assumptions	
		Decommissioning options	
		Overview of stakeholder engagement to date	
3	10:01	**Comparative Assessment and MCDA Process Overview**	
		Overview of CA process including stakeholder participation	Facilitator
	10:11	MORNING TEA	
4	10:26	**Comparative Assessment**	
		Part 1: Pipeline	
		Description of specific options	All
		Scoring of criteria	
		Weighting sub-criteria	
	12:21	LUNCH	
5	12:51	Part 2: Umbilical	
		Description of specific options	All
		Scoring of criteria	
		Weighting sub-criteria	
6	14:21	Part 3: Wellheads and XTs	
		Description of specific options	All
		Scoring of criteria	
		Weighting sub-criteria	
	15:51	AFTERNOON TEA	
7	16:06	**Results and next steps**	
		Show results	Facilitator
		Next steps	
8	16:21	**Close**	
		Thanks	Woodside

2.8 Comparative assessment workshop pre-read material sent to DRPID, WAFIC and licence holders in the Pilbara Trap and Line Fisheries – 7 May 2019

Echo Yodel Infrastructure Decommissioning
North-West Shelf, North-West Australia

Comparative Assessment Information Sheet
May 2019

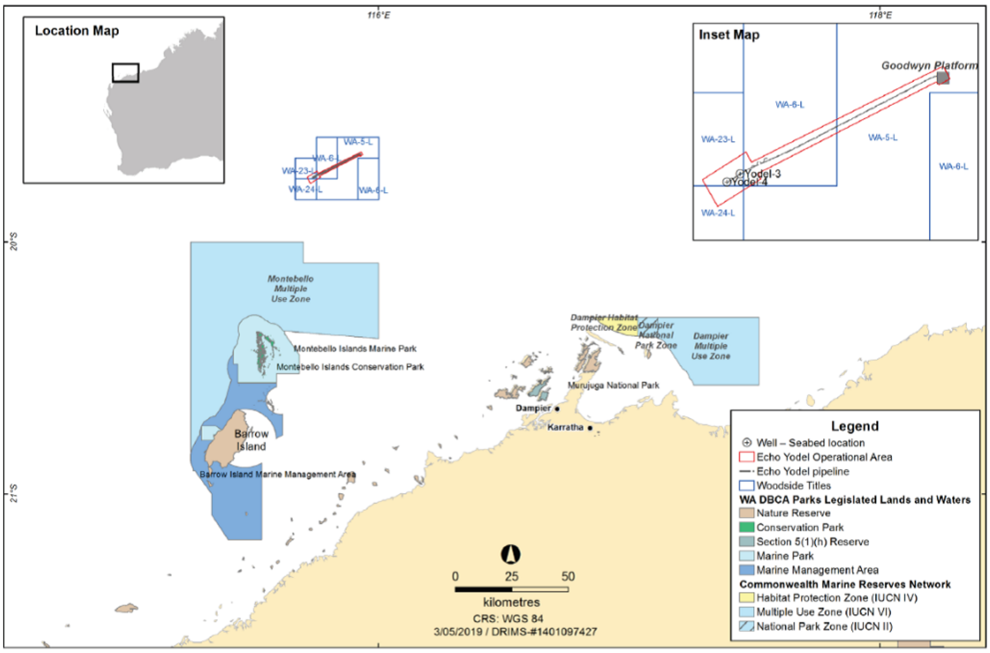
BACKGROUND

Woodside will be developing an Environment Plan for the decommissioning of the Echo Yodel infrastructure off the North-West Shelf.

The infrastructure is no longer required for production activities and includes a 23 km, 12 inch diameter pipeline, a 23 km, 5 inch diameter umbilical and two subsea production wells with Xmas Trees. The two wells were tied back to the Goodwyn Alpha platform and ceased production in 2012. The pipeline was flushed of hydrocarbons in 2016 and is currently filled with seawater and preservation fluid.

Two phases of consultation will be undertaken. This first phase will be used for the assessment and selection of the permanent decommissioning option, with feedback given will be considered as part of the comparative assessment.

Once the decommissioning option is selected, a second phase of consultation will be undertaken on the activities that are required to achieve the option.



Location of Echo Yodel infrastructure

Woodside, as Operator, has completed studies that show that complete removal of the infrastructure, which is the base case under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act), may not be the best outcome for the environment and social perspectives.

Woodside is undertaking a comparative assessment to see if an alternate decommissioning option in accordance with Commonwealth Government's Offshore Petroleum Decommissioning Guideline. This guidance requires demonstration that an alternate option provides equal or better environmental, safety and well integrity outcomes when compared to the base case of complete removal.

As part of this assessment, Woodside has identified all options that could be undertaken for decommissioning the infrastructure. It has ruled out the options that are either not feasible or unlikely to be suitable. Two options for decommissioning the infrastructure are being taken forward for comparative assessment:

1. Complete removal (as required as base case under the OPGGS Act).
2. Remain in-situ.

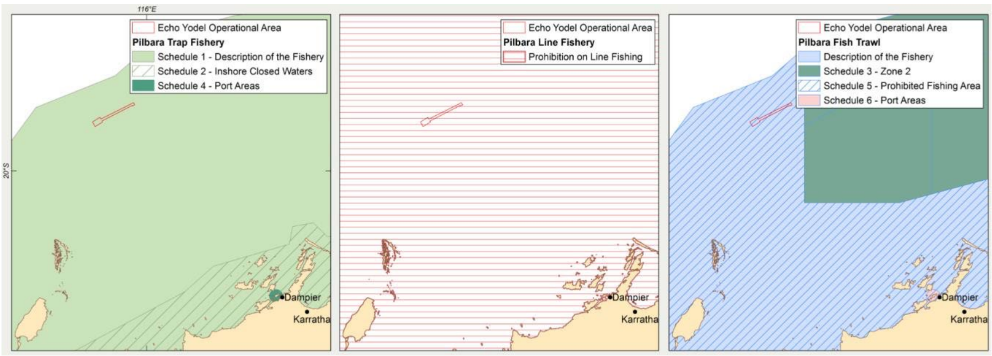
STAKEHOLDER INTEREST

Woodside has undertaken a preliminary assessment to identify those stakeholders who may be most impacted by the decommissioning options, based on the activity location, water depth and known stakeholder activities in the area.

These stakeholders will be invited to provide input to the comparative assessment, ahead of broader consultation of all relevant stakeholders once a preferred option has been selected as part of consultation for Environment Plan (EP) acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for this activity.

STATE COMMERCIAL FISHERIES

The Echo Yodel site is in an area listed under Schedule 5 of the Pilbara Trawl Fishery (permanently prohibited to trawl fishing) and overlaps the Pilbara Line fishery and the Pilbara Trap fishery. Licence holders within these fisheries will be consulted as part of the comparative assessment process and the Environment Plan consultation process once a preferred decommissioning option has been selected.



State fisheries – relevant fisheries map

Woodside recognises the importance of engaging potentially affected fishers on decommissioning activities given the long-term implications of decision-making and met with WAFIC and fishery licence holders in 2017 to discuss other decommissioning activities in the region. General support was provided at the time to leave infrastructure in-situ. The outcomes of the initial discussions are at **Appendix A** and will inform and understanding of positions/views on the Echo Yodel decommissioning options.

POTENTIAL RISKS TO COMMERCIAL FISHING

	Complete Removal		Remain in-situ	
Potential risk	**Risk description**	**Mitigation and/or management measures**	**Risk description**	**Mitigation and/or management measures**
Planned Activities				
Vessel interaction	The presence of the MODU, subsea installation vessel, intervention vessel and other support vessels may preclude other marine users from access to the area.	- 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.	No vessels required for this option.	N/A - No interactions.
Seabed disturbance	Disturbance to the seabed from removal of all infrastructure.	Woodside will seek to minimise seabed disturbance for the removal activities, including: - Reverse reeling the pipeline from seabed onto pipelay vessel, with no cutting of pipeline at seabed.	No seabed disturbance.	N/A - No seabed disturbance.
Underwater noise	Noise will be generated by the pipelay and other support vessels for complete removal of infrastructure. Due to the low acoustic source levels associated with vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.	- Acoustic impacts to marine fauna from the operation of vessels are considered not significant with no lasting effect. Therefore, the risks associated with implementation of additional management measures is considered disproportionate to the potential reduction in impact achieved.	No underwater noise generated.	N/A – no underwater noise.
Marine discharges	Discharges from the operation of the vessels include sewage, grey water, cooling water, desalination brine, deck drainage, ballast and bilge water 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.	- Implementation of chemical assessment and approval process.	No immediate marine discharges. Small quantities of preservation fluid will leak out over time as the pipeline degrades, but the quantities and significant mixing that occurs on the NWS, these effects of a PLONAR chemical is insignificant.	N/A – already minimised risk to marine environment through chemical selection process.
Unplanned Risks				
Hydrocarbon release	Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting a tank rupture.	- In the unlikely event of an oil spill or unplanned discharge into the environment, 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 assessed based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.	No risk of hydrocarbon release. During P&A activity, the wells will be permanently plugged, eliminating the risk of hydrocarbon spill from wells. Also no vessels associated with leaving infrastructure in-situ, so no risk of hydrocarbon loss from a vessel collision.	N/A – no risk of hydrocarbon release.
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.	No vessels used for this option, therefore no risk of introducing marine pests. The pipeline has been inspected for IMS and none were identified.	N/A – no risk of introducing IMS

COMPARATIVE ASSESSMENT

A comparative assessment is a decision-making tool that can be used to assess and compare options to identify what the 'most preferred' option may be. Guidelines for Comparative Assessment in Decommissioning Programmes for the North Sea was released by the Oil & Gas UK in 2015 (Oil & Gas UK, 2015). The Australian Petroleum Production and Exploration Association has proposed to adopt the guidelines for use in Australia and is in the process of revising the guidelines to align them to Australian legislation and an Australian context.

Woodside is in the process of developing an approach to comparative assessment, with a particular emphasis on active stakeholder engagement which align with these guidelines. As such, Woodside proposes to host a workshop with relevant parties to jointly assess and determine the most preferred decommissioning option. This workshop would enable stakeholders to play a role in the comparative assessment for the Echo Yodel infrastructure, to explore how active stakeholder engagement can work in practice.

The two options will be assessed using the same five criteria and sub-criteria as the NWS wellheads decommissioning (**Appendix B**). These five criteria are catch-all categories: Technical Feasability, Safety, Environmental, Socio-Economic and Costs. The comparative assessment will identify the key benefits and risks of each option under each category and the stakeholders in the workshop will rate the preference of importance to minimise what are agreed to be the key risks and maximise what are agreed to be the key benefits. The process will identify the most preferred option given the input from all stakeholders, with all parties able to discuss and understand the key important aspects of each party present.

DECOMISSIONING OPTIONS AND RELEVANCE TO FISHERIES

1. **Base Case – Complete Removal**

This is the base case for all decommissioning assessments.

Complete removal of the Echo Yodel infrastructure would take one to two months to complete and all infrastructure would be transported onshore for disposal, as it could not be reused. Fishers would permanently lose the infrastructure as a fish attractanct device, and there may be an economic loss to line and trap fishers. A study of fish on and off the Echo Yodel pipeline undertaken in 2017 estimated that the average value of commercial fish observed on the pipeline was AU$65.11 ± $11.14 SE per video deployment of one hour, approximately 8.6 times higher than the value of fish observed off the pipeline in the same time frame (AU$7.57 ± $2.41) (Bond et al. 2018). The economic effect to line and trap fisheries of removal of the Echo Yodel infrastructure may potentially be small however, given there are substantial other pipelines and infrastructure that support benthic habitat that supports fish on the NWS.

There is assumed to be no residual safety risk to fishers or other users of the sea from removal of the Echo Yodel infrastructure, as the seabed would be cleared of snag hazards.

If complete removal is selected as the decommissioning option, consultation for removal activities will follow a normal EP process, to gain information to avoid high-fishing periods and other stakeholder feedback. To minimise risks to fishers during the activities, a notification to mariners would be issued, and an exclusion zone established during removal activities to ensure vessel collision and other vessel interactions are minimised. The Australian Hydrographic Office would then be notified that all infrastructure had been removed in order for navigation charts to be updated.

There are no petroleum safety zones associated with the Echo Yodel infrastructure, but if there were, these would be removed.

2. **Alternate Option: Infrastructure to Remain Permanently In-situ**

If the most preferred option identified in the comparative assessment process is for the infrastructure to remain in-situ permanently, then it would be checked to ensure that it meets the Commonwealth guidance on decommissioning. This is that the alternative option is equal or better from an environment, safety and well integrity outcome compared to the base case of complete removal.

If the infrastructure remained in-situ, the pipeline, and umbilical are expected to maintain their integrity for hundreds of years. Engineering studies have shown that the pipeline and umbilical will remain stable. Surveys have shown that a significant portion of the pipeline and umibilical are already buried and the exposed surfaces are covered in significant established marine growth. A study on and off the pipeline has shown that species richness was, on average 25% higher on the pipeline than off, relative abundance of fish was nearly double on the pipeline than in adjacent natural habitats and that the pipeline was characterised by large, commercially important fish species known to associate with complex epibenthic habitat (Bond et al. 2018).

Studies on the burial of the pipeline and umbilical have predicted that they are expected to continue to self-bury, with eventually ~80-90% of their lengths becoming approximately 85-95% buried (i.e. just the top of the pipeline or umbilical remaining exposed). The study has estimated that the HDPE coating of the pipeline and umbilical will degrade over decades, and due to the burial, 70-80% will remaining in-situ, with the remainder dissipating slowley into the marine environment.

The long-term commercial impact to fishers is an immediate loss of a fish attractant device, with an average value of commercial fish on the pipeline in 2017 estimated to be 8.6 times higher than the value of fish observed off the pipeline (AU$65.11 ± $11.14 SE per hour versus approximately AU$7.57 ± $2.41 per hour) (Bond et al. 2018). The long-term economic effect to line and trap fisheries of removal of the Echo Yodel infrastructure may potentially be small however, given there are substantial other pipelines and infrastructure that support benthic habitat that supports fish on the NWS.

If the EP is accepted to leave the infrastructure in place there would be no further activities undertake. The infrastructure would remain marked on navigation charts, and although Echo Yodel does not have a petroleum safety zone associated with the infrastructure, if there was, it would be removed.

IMPLICATIONS AND FEEDBACK FROM STAKEHOLDERS

Woodside proposes to host a comparative assessment workshop on **15 May 2019**, facilitated by Catalyze, an independent company that specialises in multi-criteria decision analysis for comparative assessments.

We welcome feedback and your interest in attending the proposed workshop by 10 May 2019.

Our intent is to select the most preferred decommissioning option for this infrastructure, and we are seeking any interest or comments you may have to inform our decision making.

An Environment Plan for the proposed activity 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).

[redacted]

Woodside Energy Ltd

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.

REFERENCES:

T. Bond, J.C. Partridge, M.D. Taylor, T.J. Langlois, B.E. Malseed, L.D. Smith and D.L. McLean (2018). *Fish associated with a subsea pipeline and adjacent seafloor of the North West Shelf of Western Australia*, Journal of Marine Environmental Research,

APPENDIX A – Collation of previous stakeholder feedback – 2017

- Need to develop an environment plan for leaving infrastructure in-situ.
- Need to demonstrate how the site has ‘potential for future use’.
- Exclusion zones must not be put in place and snagging risks fall to fishery licence holders, not oil and gas operators. Line and anchor snag can occur over a natural habitat.
- Every fishery that overlaps petroleum titles for Echo Yodel should be consulted.
- Strong support leaving all subsea infrastructure in-situ including pipeline, umbilical and wellheads (including Xmas trees).
- Interest and support of further enhancement of infrastructure left on seafloor if there are any opportunities (i.e. Subcon/Recfishwest artificial reef technology).
- No snagging risk associated with trap fishing around oil and gas infrastructure (even wellheads with trees left in place).
- Trawlers target pipelines, and that navigation and sensors are capable of doing so relatively safely. However, the Echo Yodel pipeline lies within the no-trawl zone.
- High Density Polyethylene in subsea infrastructure (i.e. pipeline) may garner negative attention from other stakeholders and a strong position around value of fish/biodiversity may be needed to balance the argument.

APPENDIX B - Comparative Assessment Criteria

Criteria	Sub-criteria	Description of sub-criteria
Technical Feasibility	Technical feasibility	The risk of unsuccessful completion of the decommissioning option due to technical feasibility, including: the ability to recover from unplanned excursions; the need for unproven technology; and the level of industry experience.
Health and Safety	Offshore personnel risk (during)	Safety risk to project personnel offshore during decommissioning operations.
	Onshore personnel risk (during)	Safety risk to project personnel onshore dealing with transporting, handling, cutting up and disposing of infrastructure once removed.
	Other marine users' risk (during)	Safety risk to personnel onboard commercial vessels (fishing and shipping) during decommissioning operations.
	Other marine users' risk (ongoing)	Ongoing safety risk to personnel onboard commercial vessels (fishing and shipping) once decommissioning operations complete. Including risk of injury due to snag impacting vessel safety.
Environment	Water quality and sediment impacts	Assessment of water quality and potential impacts to seabed, including potential for short term and long term contamination.
	Environmental benefit	Long-term environmental benefits due to the support or growth of the marine habitat. (The assumption in scoring this is that more habitat is more desirable – as opposed to restoring the location to its original situation).
	Emissions	Emissions as a result of operations, including operations vessels emissions, manufacture of structures and emissions from machinery/plant for disposal.
	Waste	Impact of the waste created, including waste from operations vessels and scrap material removed.
	Spill risk	Risk of spill event from operations vessels (e.g. due to collision).
Socioeconomic	Commercial fishing impact (during)	Short-term impacts on commercial fishing during the decommissioning operations.
	Commercial fishing benefits (ongoing)	Ongoing/future commercial benefits once decommissioning complete. (Note the previous comparative assessment group speculated that this sub-criterion might better be named 'Stock benefit').
	Socio-economic (commercial fishing) impacts	Ongoing/future Impacts on commercial fishing once decommissioning complete. Includes impacts due to net or vessel damage and time to repair.
Economic	Total Project Cost	Total cost for option

2.9 Comparative assessment workshop presentation

1. INTRODUCTION & AIMS

Workshop Aims

+ Stakeholders understand the Comparative Assessment process
  - And the part it plays in decommissioning decision making
+ Actively involve stakeholders in the Comparative Assessment process
+ Identify the ‘in principle’ preferred decommissioning option
  - Considering all the different (stakeholder, Woodside, Dept etc.) perspectives

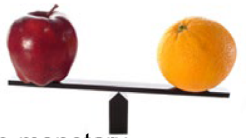
To support decision making

+ What this is NOT
  - Negotiation or commitment to a decommissioning option

1. INTRODUCTION & AIMS

CA using Multi-Criteria Decision Analysis

Woodside is committed to using an MCDA for decommissioning because:



+ A theoretically sound approach for
  - Assessing your Preference
  - Understanding relative importance
+ A way of looking at complex problems with mixed monetary and non-monetary objectives (hard/soft)
+ Enables apples and oranges to be compared using a common metric of value
+ Serves as an aid to decision-making
+ Over 30-year academic background
  - Leading US Universities
  - Decision science

In association with LSE Enterprise

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1. AGENDA

Agenda

1. 9:00am Welcome, introduction and aims
2. EY background
   - What it is/setting, progress to date, assumptions, decommissioning options
3. CA and MCDA introduction and process
   - CA criteria
4. Comparative Assessment Part 1: Pipeline, Umbilical, Wellheads & XTs)
   1. Description of specific options
   2. Scoring of criteria (including review of SME-scored criteria)
   3. Weighting sub-criteria (including review of SME-weighted sub-criteria)
5. Comparative Assessment Part 2: Umbilical
6. Comparative Assessment Part 3: Wellheads & XTs
7. Results and next steps
   1. Review of initial results
   2. (If time) Review of whole-field results
8. 4:20 Close

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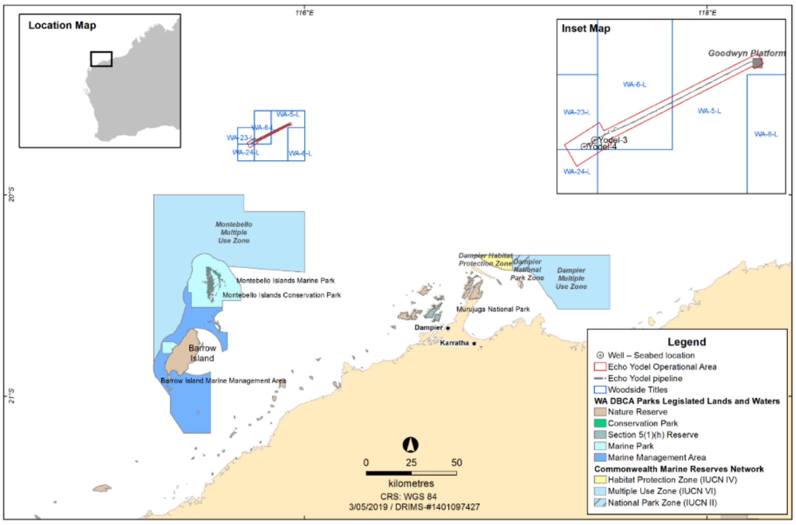
2. Echo Yodel Background

2. BACKGROUND

Echo Yodel location and history

- Located west of Goodwyn A platform in ~140 m water
- 140 km north-west of Dampier on North West Shelf
- Commenced operation in 2001
- Field/wells suspended 2012 – Phase 1
- Pipeline flushed 2016 – Phase 2

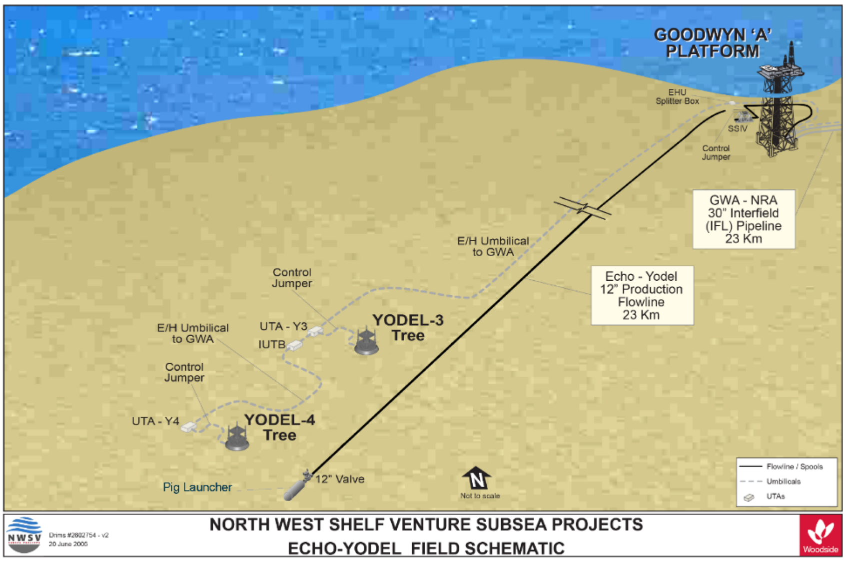


2. BACKGROUND

Echo Yodel (EY) infrastructure

Infrastructure:

- Pipeline - 23km, 12 inch diameter and attached:
  - Pig launcher
- Umbilical - 23km, 5 inch diameter and attached:
  - 2 x Umbilical Termination Assemblies (UTAs)
  - 1 x Infield Umbilical Termination Basket (IUTB)
  - Infield jumpers
- Subsea Trees (XTs) and wellheads - Yodel-3 and Yodel-4

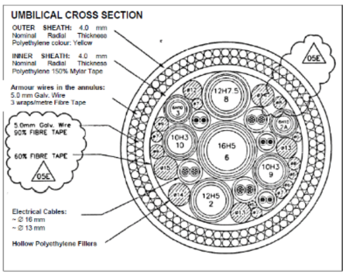


2. BACKGROUND

Echo Yodel Infrastructure (Cont.)

Pipeline – steel, polypropylene
- 23km; 12 inch diameter
- 13% Chromium Stainless Steel
- 4 layer polypropylene coating – 13.5mm

Umbilical – steel, copper, HDPE
- 132mm diameter (5 inch)
- 2 layers of armour wire
- 7 hydraulic hose cores
- 6 electrical cores
- 18m^3 Mono-ethylene Glycol (MEG)
- 21m^3 hydraulic fluid (water based)
- 2 x UTAs and 1 x IUTB –Steel (~27kg mineral oil)

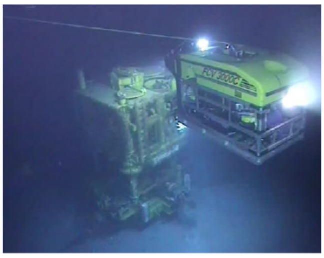


2. BACKGROUND

Echo Yodel Infrastructure (Cont.)

Yodel-3 and Yodel-4 XTs and wellheads

- 4.5 m (H) x 3.65 m (W) X 3.3 m (D)
- steel
- cathodic anodes



2. BACKGROUND

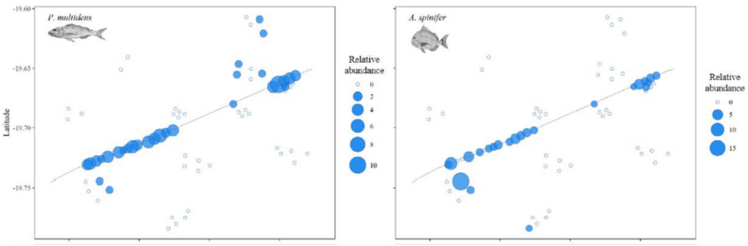
Progress so far…

+ EY Phase 1 & 2 – wells suspended (2012) and pipeline extensively cleaned of hydrocarbons and other contaminants (2015-16).
+ EY Phase 3 - Decommissioning preparation commenced in 2017
+ This was the first Woodside decommissioning project to look at alternate options to complete removal in 2017
+ An internal Comparative Assessment was completed (2017), but some data gaps were identified, and the project put on hold while the additional data was sourced:
  - Was there residual mercury in the pipeline?
  - December 2018 testing - no mercury was detected.

2. BACKGROUND

Progress so far…

+ UWA research on Echo Yodel suggests that pipelines may enhance, rather than simply attract, fish stocks.
  - More than 40 species and 25 families of fish have been recorded on the Echo Yodel pipeline.
  - Thousands of larval fish, in addition to juveniles, sub-adults and adults.
  - There is likely to be ~100,000 fish along the pipeline.
  - 8 times more fish on the pipeline than off



2. BACKGROUND

Pipeline, umbilical and XTs surveys

ROV survey footage analysed for fish and habitats on the pipeline, umbilical and Yodel-3 & Yodel-4 XTs.

Results show that compared to adjacent natural seabed habitats, the pipeline was characterised by a higher relative abundance and biomass of commercially important fish species (~8 times higher).

In natural habitats, this commercial fish assemblage is commonly associated with sponges and epibenthic communities with high structural complexity, a habitat composition once common throughout the Pilbara Region, but now thought to be sparse and patchy with the exception of two submerged reefs, the Glomar Shoal and Rankin Bank, and the Echo Yodel pipeline, umbilical and XTs.

2018 studies of umbilical also showed significant marine life, less than pipeline, but significantly more than surrounding environment.

Woodside

2. BACKGROUND

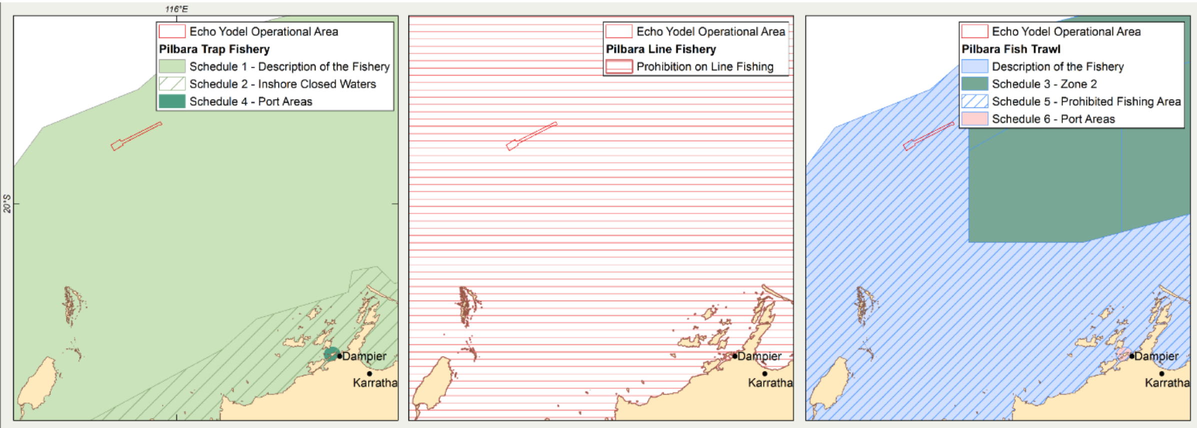
Yodel-3 & Yodel-4 XTs ROV fish and habitat assessments

The XTs provide structural complexity of habitat compared to pipelines and umbilicals, and support slightly different habitats and species.

There has been observed an increase in the number of commercially important fish species observed on the XTs over time from 4 species and 16 individuals in 2013 to 8 species and 95 individuals in 2018 (McLean et al. 2018).

2. BACKGROUND

Other users of the sea



2. BACKGROUND

Progress so far…

+ Studies have confirmed that there is no significant long-term environmental impacts from degradation if left in-situ (steel, plastic and fluids):
    - The pipeline and umbilical are self-burying (estimates are: pipeline ~85% buried within 125 years; umbilical >90% length buried >95% in ~40 years)
    - The plastic is a High Density Polyethelyne (HDPE) or polypropylene. The degradation of the polymer elements is expected to proceed at an almost unmeasurably low rate (see figures below).
    - The plastic is non-toxic
    - Most will remain in-situ buried in the sediments
    - Degradation and biodegradation will be immeasurably slow
    - Does not float
    - For context: total volume is <0.01% than goes into the ocean each year

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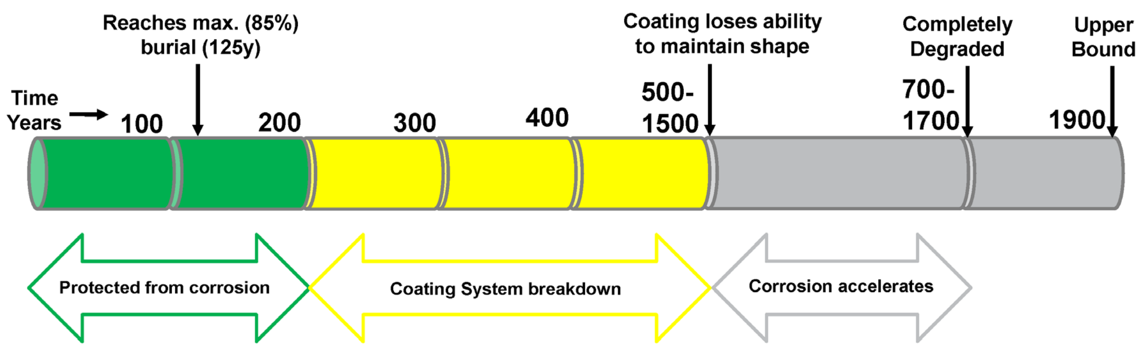
2. BACKGROUND

Semi Quantitative Estimate of Pipeline Degradation (Atteris Study)

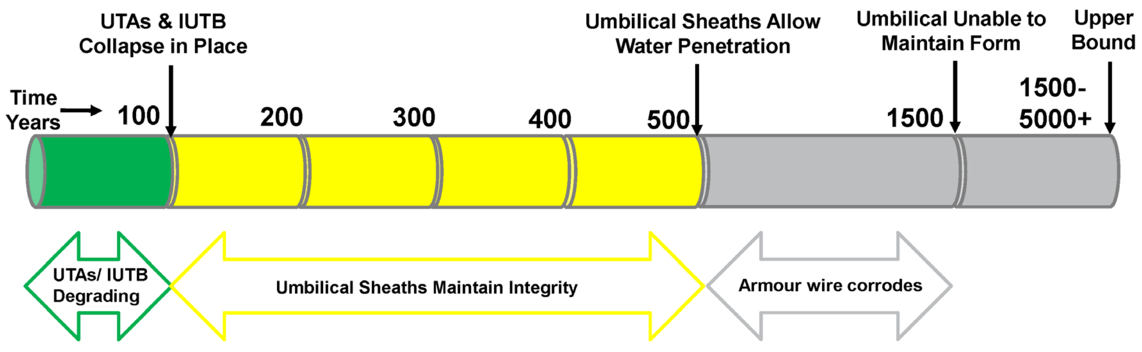


- ~69% of pipeline material will remain in-situ, with the remainder dispersed to the wider environment over 300-1200 years
- The products will be evenly distributed over the 23km length of pipelines:
    - 2013 tonnes of steel corrosion product in-situ, with 912 tonnes dispersed
    - 170 tonnes of the pipeline coating system in-situ, with 77 tonnes dispersed

Woodside

2. BACKGROUND

Semi Quantitative Estimate of Umbilical Degradation (Atteris Study)



- ~73% of umbilical material will remain in-situ with the rest dispersed to the wider environment over 1000-4000 years
  - 366 tonnes of steel corrosion product in-situ with 147 tonnes dispersed
  - 15.3 tonnes of copper corrosion products in-situ with 2.3 tonnes dispersed
  - 115 tonnes of umbilical polymer products in-situ with 29 tonnes dispersed

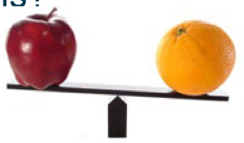
2. BACKGROUND

Greenhouse Gas Emissions

- Pipeline removal using reverse reel
  - removal and recycling are approximately 5072 tCO_2e
  - avoided virgin steel emissions -9683 tCO_2e
  - net saving in GHG emissions is approximately 4618 tCO_2e = emissions from driving 905 cars for a year
- Based on steel recycling in Australia, however no facilities capable of dealing with volume -> no GHG benefit if recycling in Malaysia
- Umbilical contains significantly less steel, and therefore is assumed to have no GHG reduction benefits if removed and recycled, and would be a net GHG negative.
- It is unknown if there are GHG reduction benefits from recycling the plastics from the pipeline and umbilical.

3. CA/MCDA INTRO

Why CA and Multi-Criteria Decision Analysis?



+ A theoretically sound approach for
  - Assessing Preference
  - Understanding relative importance
+ A way of looking at complex problems with mixed monetary and non-monetary objectives (hard/soft)
+ Enables apples and oranges to be compared using a common metric of value
+ Serves as an aid to decision-making
+ Over 30-year academic background
  - Leading US Universities
  - Decision science
+ Transparent, auditable, best-practice and enables active stakeholder participation

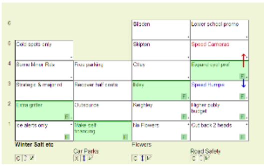
In association with LSE Enterprise

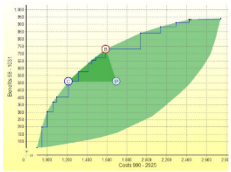
3. CA/MCDA INTRO

MCDA in Practice: Decision Conferencing

+ A technical process (MCDA) to:
  - Support the social process
  - Provide real-time modeling
  - Conform to the axioms of decision theory
  - Perform sensitivity and robustness analysis
  - Act as knowledge repository or 'corporate memory'

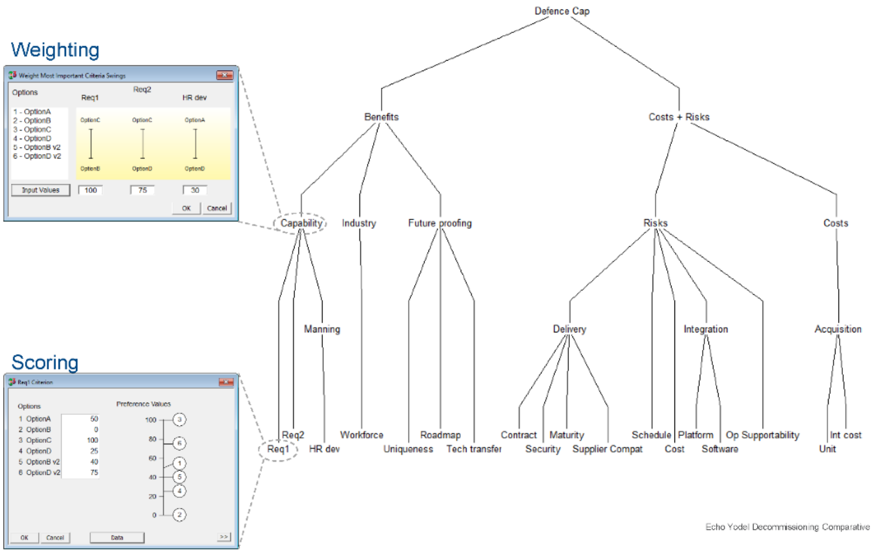
+ A social (group) process to:
  - Establish a shared understanding of project issues
  - Develop a sense of common purpose
  - Understand different perspectives and objectives
  - Gain agreement & commitment to the way forward from those implementing the decisions





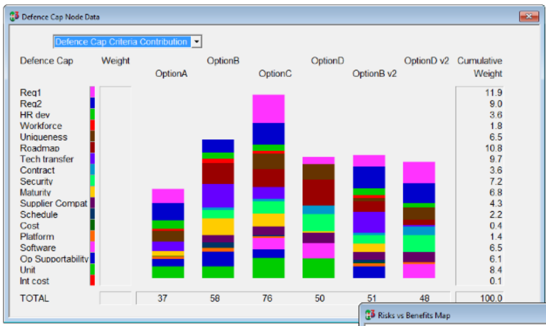
3. CA/MCDA INTRO

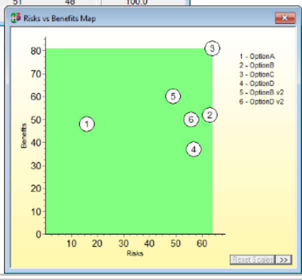
MCDA Comparative Assessment - Criteria



3. CA/MCDA INTRO

MCDA Comparative Assessment - Results





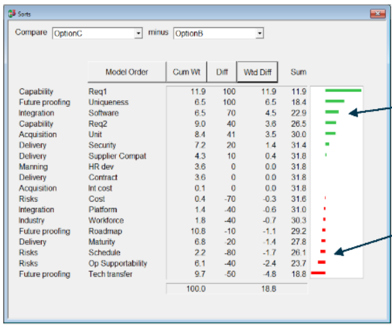
+ Contribution to Criteria
  - Preferred option is C (tallest bar)
  - Next preferred is B
  - D, Bv2 and Dv2 close together
  - Lest preferred is A
  - C Preferred mostly due to:

    Strong benefits for Req1 and Req2 and Uniqueness
    Low security and maturity risk
+ Risks vs Benefits Map
  - No 3 (OptionC) is most beneficial and least risky
  - No 2 (OptionB) is equally low risk but less beneficial
+ Result:
  - Identify overall 'most preferred' option

Woodside

3. CA/MCDA INTRO

MCDA Comparative Assessment - Results

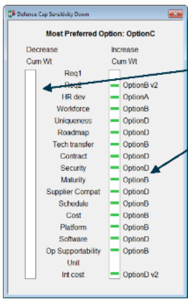

Sorts

Compare OptionC minus OptionB

	Model Order	Cum Wt	Diff	Wtd Diff	Sum
Capability	Req1	11.9	100	11.9	11.9
Future proofing	Uniqueness	6.5	100	6.5	18.4
Integration	Software	6.5	70	4.5	22.9
Capability	Req2	9.0	40	3.6	26.5
Acquisition	Unit	8.4	41	3.5	30.0
Delivery	Security	7.2	20	1.4	31.4
Delivery	Supplier Compat	4.3	10	0.4	31.8
Manning	HR dev	3.6	0	0.0	31.8
Delivery	Contract	3.6	0	0.0	31.8
Acquisition	Int cost	0.1	0	0.0	31.8
Risks	Cost	0.4	-70	-0.3	31.6
Integration	Platform	1.4	-40	-0.6	31.0
Industry	Workforce	1.8	-40	-0.7	30.3
Future proofing	Roadmap	10.8	-10	-1.1	29.2
Delivery	Maturity	6.8	-20	-1.4	27.8
Risks	Schedule	2.2	-80	-1.7	26.1
Risks	Op Supportability	6.1	-40	-2.4	23.7
Future proofing	Tech transfer	9.7	-50	-4.8	18.8
		100.0		18.8	

Compare Option C and B

C is stronger on Req1, Uniqueness, S/w integration, Req2 etc.
C is weaker on Tech transfer, Op supportability, Schedule risk etc.



Sensitivity on weights

Decreasing weight makes no difference
Would need large increase (green) in weight to change preferred option

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4. ASSUMPTIONS

General Assumptions

1. Well P&A completed. No spill risk associated with wells.
2. The infrastructure sits in the Pilbara Fish Trawl – Prohibited Fishing Area: This area will remain closed to trawl fishing.
3. Decisions are for 'in perpetuity' meaning for the long term future.
4. Whatever option is selected for these infrastructure, it is not guaranteed that the same option would be selected for different infrastructure or the same infrastructure but in a different location.
5. Only precedent this sets is the robustness of the Comparative Assessment process.

Woodside

4. ASSUMPTIONS

Regulatory Assumptions

6. Complete removal is the base case for all infrastructure under the Offshore Petroleum and Greenhouse Gas Storage Act.
7. "Options other than complete removal may be considered, however the titleholder must demonstrate that the alternative decommissioning approach delivers equal or better environmental, safety and well integrity outcomes compared to complete removal.." Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science, 2018)

Woodside

4. ASSUMPTIONS

Augmentation

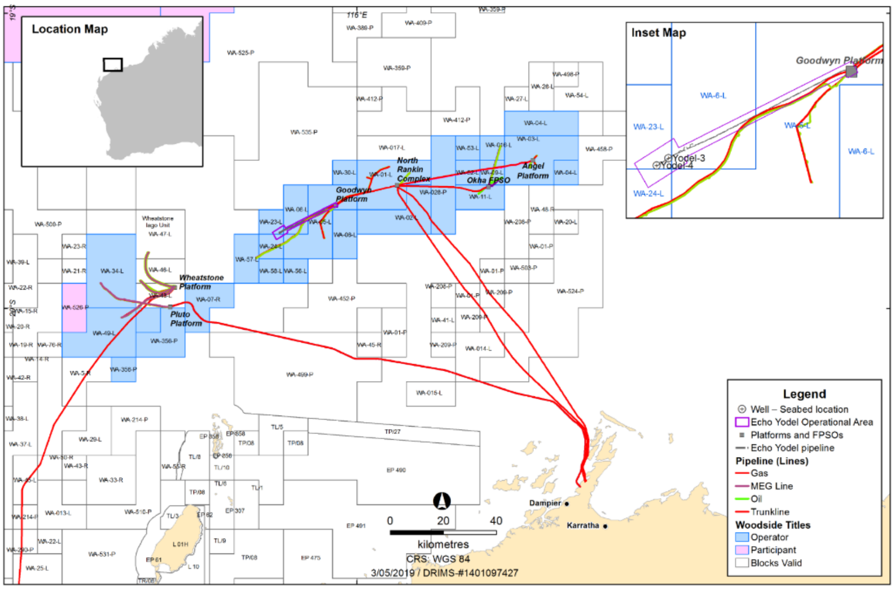
- Augmentation has been considered for Echo Yodel decommissioning.
- Once burial has stabilised, Echo Yodel infrastructure will continue to provide ~4200 m^2 of habitat.
- EY provides much larger and concentrated habitat area than the NWS wellheads (single, isolated and relatively small islands of structures).
- The EY infrastructure being linear in nature provides a concentrated area for fauna and fish catch
- The NWS wellheads overtrawlable structures are safety-driven to prevent snagging by trawl nets, and intent is for them to have habitat benefit. EY not a safety risk to other marine users.
- Augmentation would only be driven by desire to increase habitat, but habitat augmentation already in place (35km long, 16 inch GWF 2 pipeline already installed adjacent to EY).

Echo Yodel Decommissioning Comparative Assessment 7 April 2020 27

4. ASSUMPTIONS

Other Infrastructure

- GWF 2 (35km, 16inch)
- GWF 1 (15km, 16inch)



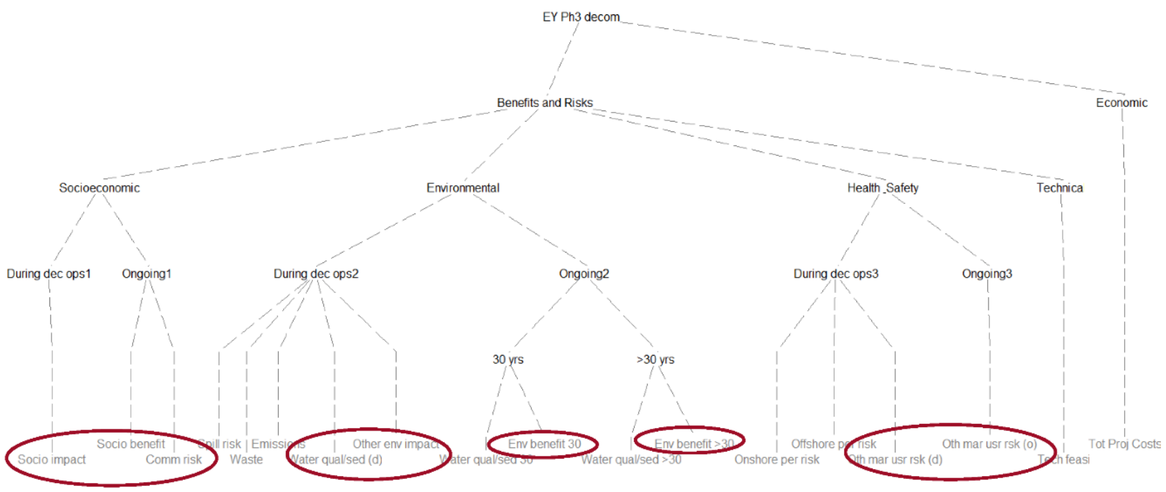
Echo Yodel Decommissioning Comparative Assessment 7 April 2020 28

5. CRITERIA

Criteria

Headings	Criteria		No	Sub-Criteria	Description	Some Considerations	Stakeholder scored?	SME scored?
Risks and Benefits	Socioeconomic	During decommissioning operations	1	Socioeconomic impact (during ops)	The extent to which the option economically impacts commercial (and other) fishing and other activities in the short term, during decommissioning operations	Temporary closure of fisheries, exclusion of fishing vessels etc. This excludes safety risks which are covered in 'orher marine users' risk	Y	N
		Ongoing (30 years)	2	Socioeconomic benefit (ongoing)	The extent to which the option supports or enhances commercial (e.g. commercial fishing) and social (e.g. recreational fishing) activities following decommissioning	Supporting or enhancing presence of commercially fished species, recreationally fished species, etc.	Y	N
			3	Commercial risk (ongoing)	The extent to which the option risks commercial impacts following decommissioning	Net damage from snagging, vessel collisions, downtime due to repair, etc.	Y	N
	Environmental	During decommissioning operations	4	Spill risk	The risk of spill events into the marine environment	Spill risk from decommissioning vessel fuel (e.g. from collision), etc.	N	Y
			5	Waste	The extent to which the option generates waste and impacts end-points (e.g. landfill, recycle)	Waste from decommissioning vessels, scrap, etc.	N	Y
			6	Emissions	The extent to which the option produces emissions	Emissions as a result of decommissiong operations. Incudes impacts from operations vessels, waste processing, manufacture of structures, CO2 emissions, etc.	N	Y
			7	Water quality/sediment (during)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) during the decommissiong operation		Y	N
			8	Other environmental impacts	The extent to which the option has other environmental impacts in the short-term, during the decommissioning operation	Seabed disturbance, desctruction of habitat from removal, etc.	Y	N
		Ongoing (30 years)	9	Water quality/sediment (30 yrs)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the 30 years following completion of decom.	Contaminants on insitu equipment (including NORMS, Mercury, plastics), etc., considering short term and long term	N	Y
			10	Environmental benefit (30 yrs)	The extent to which the option provides overall environmental benefit over the 30 years following decommissioning	Supporting or enhancing marine life and habitats (It is assumed that more habitat is positive for envinronmental benefit). This excludes the benefit from commercial fishing,recreation etc.	Y	N
		Ongoing (beyond 30 years)	11	Water quality/sediment (>30 yrs)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the longer terms (30 - 1,000 years)	Contaminants on insitu equipment (including NORMS, Mercury, plastics), etc., considering short term and long term	N	Y
			12	Environmental benefit (>30 yrs)	The extent to which the option provides overall environmental benefit over the longer terms (30 - 1,000 years)	Supporting or enhancing marine life and habitats (It is assumed that more habitat is positive for envinronmental benefit). This excludes the benefit from commercial fishing,recreation etc.	Y	N
	Health & Safety	During decommissioning operations	13	Onshore personnel risk (during ops)	The extent to which the option risks harm to onshore personnel (decommissioning team) during decommissioning operations	Onshore work required (e.g. scrap handling, transporting, cutting up, disposal), etc.	N	Y
			14	Offshore personnel risk (during ops)	The extent to which the option risks harm to offshore personnel (decommissioning team) during decommissioning operations	Duration of operations, complexity of operations, number and size of lifts, etc.	N	Y
			15	Other marine users' risk (during ops)	The extent to which the option risks harm to other marine users (e.g. commercial fishing, shipping, etc.) during decommissioning operations	Collision with decommissiong vessels, etc.	Y	N
		Ongoing (30 years)	16	Other marine users' risk (ongoing)	The extent to which the option risks harm to other marine users (e.g. commercial fishing, shipping, etc.) following decommissioning operations	Vessel foundering/sinking, etc. due to snag or collision with remaining infrastructure (Note this criterion only considers the risk of harm, not financial risk from equipment loss etc.)	Y	N
	Technical feasibility		17	Technical feasibility	The technical feasibility (likelihood of success) of the completion of the decommissioning option, including gaining any specific licenses/approvals (other than EP)	-the ability to recover from unplanned excursions and complete the planned decommissioning option. - the extent to which the option requires the use of proven technology	N	Y
Costs	Economic		18	Total project cost	The total cost of the decommissioning activity	Total CAPEEX	N	Y

5. CRITERIA



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6. OPTION ASSESSMENT

Activities for Today – for each Infrastructure Type

1. Scoring – agreeing the relative value each option provides compared to the others
   1. Review 'SME' scored criteria scores
   2. Agree 'most-preferred' and 'least preferred'
2. Weight sub-criteria – agreeing the relative significance of each sub-criterion (considering the difference between most- and least- preferred)
   1. Review weights on 'SME' sub-criteria
   2. Agree weights for other sub-criteria
3. Weight top-level criteria (using highest-weighted sub-criteria)
   1. Agree weights for top-level criteria
4. Look at results
   1. Do they make sense?

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5. CRITERIA

Criteria/Scoring Assumptions

1. The 'score' considers the total scale and scope of the impact or benefit (e.g. how many people affected, for how long, to what extent)
2. 'During ops' criteria are assessed as the total impact or benefit only during the period of decommissioning operations
3. Scoring will be relative (comparative) between the decommissioning options under consideration, and at a minimum compared to the NOPSEMA stated 'base case' of 'complete removal' (as opposed to compared to 'current situation')
4. All equipment types will be scored using the same criteria.
5. Note
   - For 'benefits' – 'most beneficial' scores 100, least scores 0
   - For 'impacts' – 'most impactful' scores 100, least scores 0
   - For 'risks' – 'most risky' scores 100, least risky scores 0

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6. OPTION ASSESSMENT

Decision Conference Roles & Responsibilities

+ Chair (also an evaluator)
  - Only required to make a call in the case of impasse
+ Evaluators
  - Perform the scoring and weighting
  - All have equal standing
  - Bring the relevant stakeholder perspective
+ Facilitator (Independent)
  - Expert in MCDA/Decision Conferencing, NOT content
  - Ensures the decision conference reaches a conclusion
+ Subject matter experts
  - Brief options and provide clarifications/detail when requested by evaluators
  - Raise any factual errors
+ Scribes
  - Capture rationale to support results
  - Capture narrative for the EP

4. ASSUMPTIONS

Pipeline Decommissioning Options

	Summary	Description
1	Complete removal	Full pipeline to be removed via reverse reel, using dedicated reel-lay vessel. The length of pipeline that can be recovered is limited by the size and capacity of the reel. This method is typically used to install and recover flexible pipelines. - Requires a dedicated vessel - 250 m/hr recovery rate - Requires onshore site for spooling and handling of pipe. [redacted]
2	Leave in situ	Pipeline to be left in situ on the sea floor. No further activities are required.

Activity	Duration (days)	People on Board (POB)	Man Days
Reel lay vessel mob + transit (from Singapore)	14	45	630
Reel lay vessel crew mob	2	120	240
Pipeline removal (in field)	4	120	480
Interim mob (to Malaysia)	20	45	900
Offload pipe to onshore base (Malaysia)	2	120	240
Reel lay vessel demob	8	45	360
Onshore site setup	20	8	160
Onshore site process for transport	20.5	15	308
Recycle / disposal operations	5	15	75
Total Operations	95.5		3,393

4. ASSUMPTIONS

Reel Lay Vessel (Indicative only)

4. ASSUMPTIONS

H&S Hazard Comparison

Completely Remove	Leave In-Situ
Offshore: 1. Vessel collision with the Goodwyn Alpha Platform and subsequent hydrocarbon release due to close proximity of vessel to the platform during pipeline/umbilical removal. 2. Dropped object onto GWF subsea infrastructure and subsequent hydrocarbon release during pipeline/umbilical removal. 3. Crash during helicopter transfer of personnel to offshore resulting in fatalities. 4. Dropped objects and/or failure of lines under tension (pipeline/umbilical removal) on deck resulting in injury to personnel or fatalities. 5. Injury due to use of cutting tools.	**Offshore:** 1. Pipeline/infrastructure shifts and impacts other infrastructure resulting in hydrocarbon release. This has been assessed as non-credible due to the pipeline being inherently stable and self-burying over time. 2. Snagging of marine users' equipment during trawling and subsequent injury on deck or fatalities due to foundering of vessels. The pipeline and infrastructure are in a no trawling zone and as such this hazard should not eventuate.
Onshore: 1. Working on lines under tension for offloading EHU/ Flowline to quayside 2. Injury due to repeated use of cutting tools and lifting (~2000 x12m long sections) of pipe into sections for transport. Dropped object hazards present potential for injury to personnel or fatalities. 3. Road transport and collision. 4. Personnel exposure to low levels of hazardous substances during the cutting/recycling process.	**Onshore:** None

4. ASSUMPTIONS

1. 'Complete Removal' Assumptions

+ Option assumptions
  - Assume all infrastructure can be completely removed.
  - During the removal activities, fishing vessels will be notified of activities to prevent collision or other safety risks. Vessel activities would be planned following consultation with fishermen to plan around known trawling periods to minimise short-term impact.
  - Following removal there will result in no residual safety risk from snagging.
  - The activity would expose 120 people to high safety risks offshore risks such a lifting, crew transfer by helicopter, adverse weather and accommodation fires.
  - There would be moderate health and safety risks to people onshore cutting up, lifting and disposing of the infrastructure.
+ In-perpetuity assumptions
  - Long-term economic impact to fishers is undetermined but assume with decrease in hard substrate and complex epi-benthic habitat that supports commercially targeted fish species, that there may be an economic loss.

4. ASSUMPTIONS

2. ‘Leave In-situ’ Assumptions

+ Option assumptions
  - Will continue to support the habitat and fish already established on the infrastructure.
+ In-perpetuity assumptions
  - It will not be snagging hazard to commercial trawl nets as the infrastructure is in an area closed to trawlers for the foreseeable future.
  - All infrastructure is marked on navigation charts and will remain on navigation charts.
  - Infrastructure left in-situ would result in no change in economic income to commercial fishers as the habitat that supports commercial fish would remain (no change to current).

6. OPTION ASSESSMENT

Activities (1/3)

Scoring:

+ Socioeconomic
  - Socioeconomic (during decommissioning operations)
  - Socioeconomic benefit (ongoing – 30 years)
  - Commercial risk (ongoing – 30 years)
+ Environmental
  - Water quality/sediment (during decommissioning operations)
  - Other environmental impacts (during decommissioning operations)
  - Environmental benefit (ongoing – 30 years)
  - Environmental benefit (ongoing beyond 30 years)
+ Health and Safety
  - Other marine users’ risk (during decommissioning operations)
  - Other marine users’ risk (ongoing – 30 years)

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6. OPTION ASSESSMENT

Activities (2/3)

Weighting sub-criteria:

+ Socioeconomic
  - Socioeconomic (during) vs Socioeconomic benefit (ongoing) vs Commercial risk (ongoing)
+ Environmental
  - Other environmental impacts (during) vs *Spill risk* vs *Waste* vs *Emissions* vs Water Qual/Sed
  - *Water quality/sed (<30 yrs)* vs Environmental benefit (<30 yrs) vs *Water quality/sed (>30 yrs)* vs Environmental benefit (>30 yrs)
  - Environmental (during) vs Environmental (ongoing)
+ Health and Safety
  - *Onshore per risk (during)* vs *offshore pers risk (during)* vs Other marine users' risk (during)

6. OPTION ASSESSMENT

Activities (3/3)

Weighting criteria:

+ Socioeconomic vs Environmental vs Health & Safety vs Technical
+ Benefits/risks vs Economic

4. ASSUMPTIONS

Umbilical Decommissioning Options

	Summary	Description
1	Complete removal	Mobilise an Installation Support Vessel (ISV) with tensioner Recovery system and 3-4 reels installed. Recover umbilical until reels full (approx. 7.8km). Speed >400m/hour. Recovery the UTAs and IUTB at the same time. [redacted]
2	Leave in situ	Umbilical, UTAs, IUTB and jumpers/flying leads to be left in situ on the sea floor. No further activities are required.

Activity Description	Duration (days)	POB	Man Days
ISV vessel mob + transit (from Singapore)	15	45	675
ISV crew mob	2	120	240
ISV recovery operations (in field)	5	120	600
ISV offload EHU reels to onshore base	2	120	240
ISV demob	15	45	675
Onshore Site Setup	2	8	16
Onshore site process for transport	7	15	105
Recycle/ Disposal Operations	5	10	50
Total	53		2601

4. ASSUMPTIONS

Onshore Processing of Umbilical

6. OPTION ASSESSMENT

Activities (1/3)

Scoring:

+ Socioeconomic
  - Socioeconomic (during decommissioning operations)
  - Socioeconomic benefit (ongoing – 30 years)
  - Commercial risk (ongoing – 30 years)
+ Environmental
  - Water quality/sediment (during decommissioning operations)
  - Other environmental impacts (during decommissioning operations)
  - Environmental benefit (ongoing – 30 years)
  - Environmental benefit (ongoing beyond 30 years)
+ Health and Safety
  - Other marine users' risk (during decommissioning operations)
  - Other marine users' risk (ongoing – 30 years)

6. OPTION ASSESSMENT

Activities (2/3)

Weighting sub-criteria:

+ Socioeconomic
  - Socioeconomic (during) vs Socioeconomic benefit (ongoing) vs Commercial risk (ongoing)
+ Environmental
  - Other environmental impacts (during) vs *Spill risk* vs *Waste* vs *Emissions* vs Water Qual/Sed
  - *Water quality/sed (<30 yrs)* vs Environmental benefit (<30 yrs) vs *Water quality/sed (>30 yrs)* vs Environmental benefit (>30 yrs)
  - Environmental (during) vs Environmental (ongoing)
+ Health and Safety
  - *Onshore per risk (during)* vs *offshore pers risk (during)* vs Other marine users' risk (during)

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6. OPTION ASSESSMENT

Activities (3/3)

Weighting criteria:

+ Socioeconomic vs Environmental vs Health & Safety vs Technical
+ Benefits/risks vs Economic

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4. ASSUMPTIONS

Wellheads and XTs Decommissioning Options

	Summary	Description
1	Complete removal	Assume that the wellhead and XT are cut and removed using an Inspection, Maintenance and Repairs (IMR) vessel after P&A. Lift XT to surface. Cut well casing ~5m below seabed and remove wellhead. Assume vessel is in Australia [redacted]
2	Leave in situ	XTs to be left in situ. No further activities are required.

Activity Description	Duration (days)	POB	Man Days
IMR vessel mob	2	45	90
IMR vessel crew mob	2	80	160
XT and wellhead recovery operations - field	4	80	320
IMR vessel offload XTs, wellheads to onshore base	2	80	160
IMR vessel demob	2	45	90
Onshore site setup	2	8	16
Onshore site process for transport	5	15	75
Recycle / disposal operations	5	10	50
Total	24		961

6. OPTION ASSESSMENT

Activities (1/3)

Scoring:

+ Socioeconomic
  - Socioeconomic (during decommissioning operations)
  - Socioeconomic benefit (ongoing – 30 years)
  - Commercial risk (ongoing – 30 years)
+ Environmental
  - Water quality/sediment (during decommissioning operations)
  - Other environmental impacts (during decommissioning operations)
  - Environmental benefit (ongoing – 30 years)
  - Environmental benefit (ongoing beyond 30 years)
+ Health and Safety
  - Other marine users' risk (during decommissioning operations)
  - Other marine users' risk (ongoing – 30 years)

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6. OPTION ASSESSMENT

Activities (2/3)

Weighting sub-criteria:

+ Socioeconomic
  - Socioeconomic (during) vs Socioeconomic benefit (ongoing) vs Commercial risk (ongoing)
+ Environmental
  - Other environmental impacts (during) vs *Spill risk* vs *Waste* vs *Emissions* vs Water Qual/Sed
  - *Water quality/sed (<30 yrs)* vs Environmental benefit (<30 yrs) vs *Water quality/sed (>30 yrs)* vs Environmental benefit (>30 yrs)
  - Environmental (during) vs Environmental (ongoing)
+ Health and Safety
  - *Onshore per risk (during)* vs *offshore pers risk (during)* vs Other marine users' risk (during)

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6. OPTION ASSESSMENT

Activities (3/3)

Weighting criteria:

+ Socioeconomic vs Environmental vs Health & Safety vs Technical
+ Benefits/risks vs Economic

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5. RESULTS

Next Steps

+ Summary report from today
    - Ensure captured everything accurately
    - Please check it reflects the day
+ Stakeholder Engagement Phase 2
    - Present back preferred approach (based on today and whole of Comparative Assessment)
+ Develop EP submission

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Thank you for your active participation

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2.10 Email to comparative assessment workshop attendees (DPIRD and Pilbara Trap Fishery licence holder) – 5 July 2019

Good afternoon all

Thank you for attending the decommissioning comparative assessment workshop on 15 May 2019 comparing two options for decommissioning the Echo Yodel subsea infrastructure (complete removal, or leave in-situ).

Based on the workshop outcome the preferred decommissioning option was to leave the infrastructure in-situ which will now be considered in an Environment

Plan and subject to further consultation in Q4 2019. Please find attached the outcomes of the workshop.

We have identified and assessed potential risks and impacts to commercial Pilbara Trap, Pilbara Line and Pilbara Trawl fishers, the fish resource and the marine environment. These risks are summarised below. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance.

Activity overview

Activity purpose:	Permanent abandonment in-situ of the Echo Yodel subsea infrastructure (pipeline, umbilical, wellhead and Xmas Trees)
Activity location:	140 km north-west of Dampier, Western Australia
State fisheries identified as relevant to the proposed activity*:	Pilbara Demersal Scalefish Managed Fisheries • Pilbara Trap • Pilbara Line • Pilbara Trawl (although prohibited from fishing in this area)
Approximate Water depth:	~140 m
Exclusion Zone:	No exclusion zones exist for this infrastructure and none will be added.

* Fisheries have been identified as being relevant on the basis of fishing licence overlap with the Echo Yodel infrastructure, as well as consideration of fishing effort data, fishing methods and water depth. Individual licence holders were invited to the workshop and will be provided with the outcomes.

Potential risks to commercial fishing

Given the infrastructure will remain in situ there will be no planned activity risks to vessel interactions, seabed disturbance from infrastructure removal, underwater noise, marine discharges; or unplanned risks including hydrocarbon release, or invasive marine species. The pipeline will self-bury to 85% in the next ~125 years, which may result in reducing the marine life and commercial fish that it currently supports, however, the marine growth may also increase on the pipeline over this time. In the next decades to centuries it is predicted to degrade and eventually disappear.

Your feedback

Woodside is proposing to support the most preferred option as identified in the Comparative Assessment workshop. The option will be considered as part of the Environment Plan for the infrastructure due to developed in Q4 2019. Consultation will occur with the fishing sector and other relevant stakeholders as part of the development of the Environment Plan.

If you have any questions or feedback on the proposed decommissioning option please let me know.

Your feedback and our response will be included in the Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Regards

[redacted] | Corporate Affairs
Woodside Energy Ltd

2.11 Comparative assessment workshop report sent to comparative assessment workshop attendees – 5 July 2019

INTRODUCTION & AIMS

Workshop Overview

- On 15 May 2019 Woodside held a Comparative Assessment workshop with relevant stakeholders to consider the preferred decommissioning option for the Echo Yodel infrastructure (pipeline, umbilical, wellheads and Xmas trees) off the North West Shelf

Workshop aims

- Stakeholders understand the assessment process and the part it plays in decommissioning decision making
- Stakeholders are actively involved in the assessment process
- Workshop participants identify the ‘in principle’ preferred decommissioning option
- The assessment process is not a negotiation or commitment to a decommissioning option.

Workshop Participants

[redacted]

Workshop Invitees

- WAFIC
- Pilbara Trap, Trawl and Line fishers

CRITERIA

Assessment Criteria

+ A range of broad criteria (socio-economic, environment, health and safety, technical feasibility, and cost) and sub-criteria were considered and weighted when considering the decommissioning option (leave in situ or complete removal). Refer to Appendix A for the criteria description
+ The criteria was assessed at different time scales (during decommissioning and/or medium or long term) for both decommissioning options
+ Weightings against each sub-criteria were considered based on the size of the difference between the lowest valued and the highest valued option (i.e. on a scale of 0 for the lowest value option vs 100 for the highest value option)
+ The top level criteria was then weighted. The participants in the workshop then reviewed the results which identified the most preferred decommissioning option.

CRITERIA / WEIGHTING

Pipeline Criteria Weighting

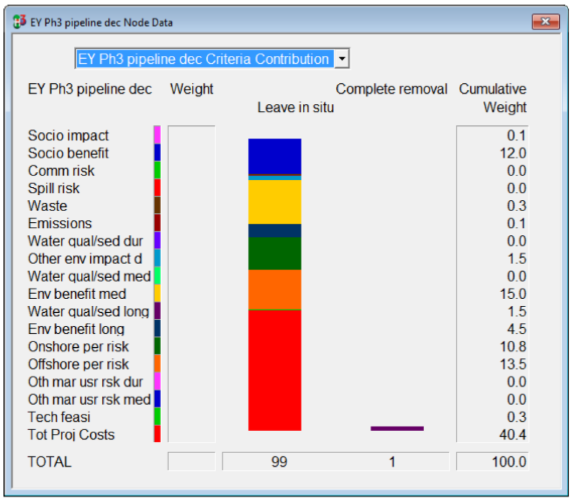
+ Weighting against the criteria for the pipeline found that leave in situ is the preferred decommissioning option with, apart from costs, mid term environmental benefit being the most important factor followed by health and safety, and socio-economic benefit.

Criterion	Highest weighted sub-criterion	Highest valued option	Lowest valued option	Swing Weight	Rationale/notes
Socioeconomic	Socioeconomic benefit	Leave in situ	Complete removal	80	The third most significant factor influencing the overall preferred option is the increase in socioeconomic benefit between 'complete removal' and 'leave in situ', and this is close to, but a little less significant again than the offshore personnel risk reduction. The combination of the med-term env benefit increase and the socioeconomic benefit increase (80 + 90) is a little over 1.5 times more significant than the increase in med-term env benefit (100)
Environmental	Med-term Env Benefit	Leave in situ	Complete removal	100	Apart from costs, the single most significant factor influencing the overall preferred option is the increase in mid-term environmental benefit between 'complete removal' and 'leave in situ'. This was due to the size and scale of the pipeline and the level of life currently being supported
Health & Safety	Offshore pers risk	Leave in situ	Complete removal	90	The second most significant factor influencind the overall preferred option is the 'reduction' in offshore personnel risk between 'complete removal' and 'leave in situ', and this is close to, but a little less significant than the med-term environmental benefit. This was due to the high level of risk from offshore operations with high loads, proximate to an operational platform
Technical	Tech feasibility	Leave in situ	Complete removal	2	Both options are technical very faseaible and are tried-and-tested with existing technology, so there is very little feasibility difference between 'leave in situ' and 'complete removal'
Economic	Total project costs	Leave in situ	Complete removal	270	The total project cost/investment is approximately equivalent to total benefit/risk reduction across all other highest-weighted sub-criteria (270 = 80 + 100 + 90) when considering the significance of cost on the preferred option

RESULTS

Pipeline Results

+ Leave in-situ is the most preferred option driven by:
  - Socio-economic benefit
  - Medium term environmental benefit
  - Risk to offshore personnel
  - Project costs
+ Complete removal of the pipeline is only preferred for eliminating long-term water quality/sediment impacts if all infrastructure is removed



CRITERIA / WEIGHTING

Umbilical Criteria Weighting

+ Weighting against the criteria for the umbilical found that leave in situ is the preferred decommissioning option with socio-economic benefit being the most important factor followed by medium term environmental benefit, and risk to offshore personnel.

Criterion	Highest weighted sub-criterion	Highest valued option	Lowest valued option	Swing Weight	Rationale/notes
Socioeconomic	Socioeconomic benefit	Leave in situ	Complete removal	80	The third most significant factor influencing the overall preferred option is the increase in socioeconomic benefit between 'complete removal' and 'leave in situ', and this is close to, but a little less significant again than the offshore personnel risk reduction. The combination of the socioeconomic benefit increase and the the offshore pers risk reduction (80 + 90) is a little over 1.5 times more significant than the increase in med-term env benefit (100)
Environmental	Med-term Env Benefit	Leave in situ	Complete removal	100	Apart from costs, the single most significant factor influencing the overall preferred option is the increase in mid-term environmental benefit between 'complete removal' and 'leave in situ'. This was due to the size and scale of the umbilical and the level of life currently being supported
Health & Safety	Offshore pers risk	Leave in situ	Complete removal	90	The second most significant factor influencind the overall preferred option is the 'reduction' in offshore personnel risk between 'complete removal' and 'leave in situ', and this is close to, but a little less significant than the med-term environmental benefit. This was due to the high level of risk from offshore operations with high loads, proximate to an operational platform
Technical	Tech feasibility	Leave in situ	Complete removal	2	Both options are technically very faseaible and are tried-and-tested with existing technology, so there is very little feasibility difference between 'leave in situ' and 'complete removal'
Economic	Total project costs	Leave in situ	Complete removal	80	The weight on cost was considered significantly lower than for the pipeline due to the much lower project costs (approx 1/3rd of the cost)

RESULTS

Umbilical Results

+ Leave in-situ is the most preferred option driven by:
  - Socio-economic benefit
  - Medium term environmental benefit
  - Risk to offshore personnel
+ Similar to the pipeline results, with less emphasis on costs and greater emphasis on onshore personnel risk
+ Complete removal of the umbilical is only preferred for eliminating long-term water quality/sediment impacts if all infrastructure is removed

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CRITERIA / WEIGHTING

Wellheads and Xmas Trees Criteria Weighting

+ Weighting against the criteria for the wellheads and Xmas Trees found that leave in situ is the preferred decommissioning option with the medium term environmental benefit being the most important factor followed by risk to offshore personnel.

Criterion	Highest weighted sub-criterion	Highest valued option	Lowest valued option	Swing Weight	Rationale/notes
Socioeconomic	Socioeconomic benefit	Leave in situ	Complete removal	10	The third most significant factor influencing the overall preferred option is the increase in socioeconomic benefit between 'complete removal' and 'leave in situ', but this is only about 1/5 as significant as the offshore personnel risk reduction. The combination of the socioeconomic benefit increase and the offshore pers risk reduction (10 + 60) is a little over 2/3 as significant as the increase in med-term env benefit (100). This is due to the limited size of the wellheads and therefore reduced attractiveness to commercial fishing
Environmental	Med-term Env Benefit	Leave in situ	Complete removal	100	Apart from costs, the single most significant factor influencing the overall preferred option is the increase in mid-term environmental benefit between 'complete removal' and 'leave in situ'. This was due to the attractiveness of the Xmas treeas as a habitat and the level of life currently being supported
Health & Safety	Offshore pers risk	Leave in situ	Complete removal	60	The second most significant factor influencind the overall preferred option is the 'reduction' in offshore personnel risk between 'complete removal' and 'leave in situ', and this is about 2/3 as significant as the med-term environmental benefit. This was noted to be much lower risk than the pipeline and umbilical situation because the operations were shorter and simpler and NOT proximate to an operational platform
Technical	Tech feasibility	Leave in situ	Complete removal	2	Both options are technically very faseaible and are tried-and-tested with existing technology, so there is very little feasibility difference between 'leave in situ' and 'complete removal'
Economic	Total project costs	Leave in situ	Complete removal	4	The weight on cost was considered significantly lower than for the umbilical due to the much lower project costs again (approx 5% of the cost)

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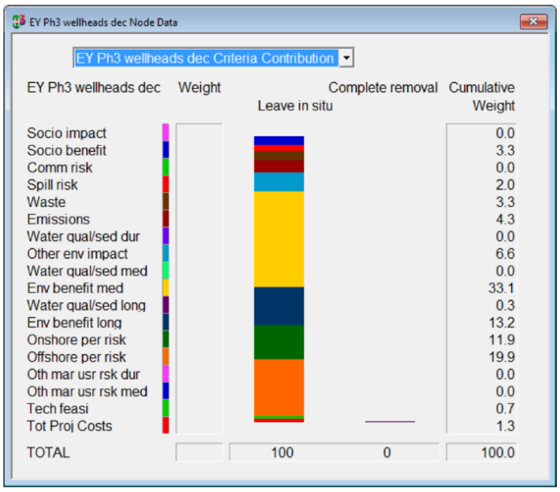
RESULTS

Wellheads and XTs Results

+ Leave in-situ is the most-preferred option driven by:
  - Medium term environmental benefit
  - Risk to offshore personnel
+ Similar to the pipeline and umbilical results, with much less emphasis on costs
+ Complete removal is only preferred for eliminating long-term water quality/sediment impacts if all infrastructure is removed.



Thank you for your active participation

Woodside is proposing to support the most preferred option as identified in the Comparative Assessment workshop. If you have any questions or concerns with this option, please contact:

[redacted]

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.

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APPENDIX A

Appendix A - Criteria

Headings	Criteria		No	Sub-Criteria	Description	Some Considerations	Stakeholder scored?	SME scored?
Risks and Benefits	Socioeconomic	During decommissioning operations	1	Socioeconomic impact (during ops)	The extent to which the option economically impacts commercial (and other) fishing and other activities in the short term, during decommissioning operations	Termporary closure of fisheries, exclusion of fishing vessels etc. This excludes safety risks which are covered in 'orher marine users' risk	Y	N
		Ongoing (med term)	2	Socioeconomic benefit (med)	The extent to which the option supports or enhances commercial (e.g. commercial fishing) and social (e.g. recreational fishing) activities following decommissioning over the medium term	Supporting or enhancing presence of commercially fished species, recreationally fished species, etc.	Y	N
			3	Commercial risk (med)	The extent to which the option risks commercial impacts following decommissioning over the medium term	Net damage from snagging, vessel collisions, downtime due to repair, etc.	Y	N
	Environmental	During decommissioning operations	4	Spill risk	The risk of spill events into the marine environment	Spill risk from decommissioning vessel fuel (e.g. from collision), etc.	N	Y
			5	Waste	The extent to which the option generates waste and impacts end-points (e.g. landfill, recycle)	Waste from decommissioning vessels, scrap, etc.	N	Y
			6	Emissions	The extent to which the option produces emissions	Emissions as a result of decommissiong operations. Incudes impacts from operations vessels, waste processing, manufacture of structures, CO2 emissions, etc.	N	Y
			7	Water quality/sediment (during)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) during the decommissiong operation		Y	N
			8	Other environmental impacts	The extent to which the option has other environmental impacts in the short-term, during the decommissioning operation	Seabed disturbance, desctruction of life attached to infrastructure as a resutl of removal, etc. This only considers impacts at the time of the decommissioning operation, other impacts (such as loss of habitat) are captured under the 'ongoing' environmental criteria	Y	N
		Ongoing (med term)	9	Water quality/sediment (med)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the medium term following completion of decom.	Contaminants on insitu equipment (including NORMS, Mercury, plastics), etc., considering short term and long term	N	Y
			10	Environmental benefit (med)	The extent to which the option provides overall environmental benefit over the medium term following decommissioning	Supporting or enhancing marine life and habitats (It is assumed that more habitat is positive for envinronmental benefit). This excludes the benefit from commercial fishing,recreation etc.	Y	N
		Ongoing (long term)	11	Water quality/sediment (long)	The extent to which the option impacts water and/or sediment quality (and therefore marine life) over the long term	Contaminants on insitu equipment (including NORMS, Mercury, plastics), etc., considering short term and long term	N	Y
			12	Environmental benefit (long)	The extent to which the option provides overall environmental benefit over the long term	Supporting or enhancing marine life and habitats (It is assumed that more habitat is positive for envinronmental benefit). This excludes the benefit from commercial fishing,recreation etc.	Y	N
	Health & Safety	During decommissioning operations	13	Onshore personnel risk (during ops)	The extent to which the option risks harm to onshore personnel (decommissioning team) during decommissioning operations	Onshore work required (e.g. scrap handling, transporting, cutting up, disposal), etc.	N	Y
			14	Offshore personnel risk (during ops)	The extent to which the option risks harm to offshore personnel (decommissioning team) during decommissioning operations	Duration of operations, complexity of operations, number and size of lifts, etc.	N	Y
			15	Other marine users' risk (during ops)	The extent to which the option risks harm to other marine users (e.g. commercial fishing, shipping, etc.) during decommissioning operations	Collision with decommissiong vessels, etc.	Y	N
		Ongoing (med term)	16	Other marine users' risk (med)	The extent to which the option risks harm to other marine users (e.g. commercial fishing, shipping, etc.) following decommissioning operations over the medium term	Vessel foundering/sinking, etc. due to snag or collision with remaining infrastructure (Note this criterion only considers the risk of harm, not financial risk from equipment loss etc.)	Y	N
	Technical feasibility		17	Technical feasibility	The technical feasibility (likelihood of success) of the completion of the decommissioning option, including gaining any specific licenses/approvals (other than EP)	-the ability to recover from unplanned excursions and complete the planned decommissioning option. - the extent to which the option requires the use of proven technology	N	Y
Costs	Economic		18	Total project cost	The total cost of the decommissioning activity	Total CAPEEX	N	Y

Woodside

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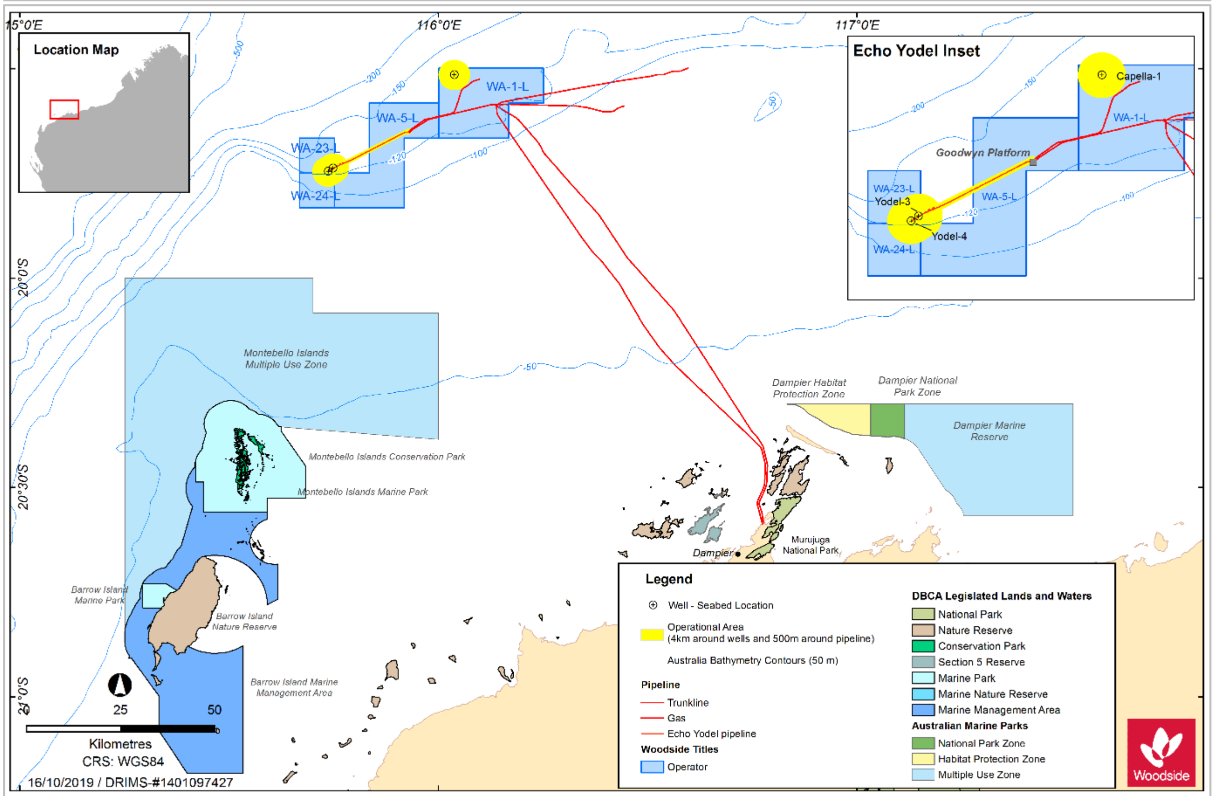

2.12 Email to WAFIC and licence holders in Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries – 5 July 2019

Dear Fishery Licence Holder

Woodside held a decommissioning comparative assessment workshop with interested stakeholders on 15 May 2019 comparing two options for decommissioning the Echo Yodel subsea infrastructure (complete removal, or leave in-situ).

Based on the workshop outcome the preferred decommissioning option was to leave the infrastructure in-situ which will now be considered in an Environment Plan and subject to further consultation in Q4 2019. I have attached a succinct document outlining the outcomes of the workshop as it relates to fishers.

We have identified and assessed potential risks and impacts to commercial Pilbara Trap, Pilbara Line and Pilbara Trawl fishers, the fish resource and the marine environment. These risks are summarised below. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance.

Activity overview

Activity purpose:	Permanent abandonment in-situ of the Echo Yodel subsea infrastructure (pipeline, umbilical, wellhead and Xmas Trees)
Activity location:	140 km north-west of Dampier, Western Australia
State fisheries identified as relevant to the proposed activity*:	Pilbara Demersal Scalefish Managed Fisheries • Pilbara Trap • Pilbara Line • Pilbara Trawl (although prohibited from fishing in this area)
Approximate Water depth:	~140 m
Exclusion Zone:	No exclusion zones exist for this infrastructure and none will be added.

* Fisheries have been identified as being relevant on the basis of fishing licence overlap with the Echo Yodel infrastructure, as well as consideration of fishing effort data, fishing methods and water depth.

Potential risks to commercial fishing

Given the infrastructure will remain in situ there will be no planned activity risks to vessel interactions, seabed disturbance from infrastructure removal, underwater noise, marine discharges; or unplanned risks including hydrocarbon release, or invasive marine species. The pipeline will self-bury to 85% in the next ~125 years, which may result in reducing the marine life and commercial fish that it currently supports, however, the marine growth may also increase on the pipeline over this time. In the next decades to centuries it is predicted to degrade and eventually disappear.

Your feedback

Woodside is proposing to support the most preferred option as identified in the Comparative Assessment workshop. The option will be considered as part of the Environment Plan for the infrastructure due to developed in Q4 2019. Consultation will occur with the fishing sector and other relevant stakeholders as part of the development of the Environment Plan (which will also include plugging for abandonment of the two wells).

If you have any questions or feedback on the proposed decommissioning option please let me know.

Your feedback and our response will be included in the Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please note under public transparency arrangements implemented by NOPSEMA, the Environment Plan for this activity will be published in full following acceptance by the Authority. Please advise Woodside if you do not wish any part of your feedback to be published and we will ensure it is included in the sensitive information part of the Environment Plan. The information received will form part of the EP assessment however it will not be released publicly and will remain confidential to NOPSEMA throughout.

Regards

[redacted] | Corporate Affairs
Woodside Energy Ltd

2.13 Comparative assessment workshop summary report sent to licence holders in Pilbara Trap, Pilbara Line and Pilbara Trawl Fisheries – 5 July 2019

Echo Yodel Infrastructure Decommissioning
North-West Shelf, North-West Australia

Comparative Assessment Workshop Results

SUMMARY

Woodside held a Comparative Assessment workshop with fisheries stakeholders on 15 May 2019 comparing two options for decommissioning the Echo Yodel subsea infrastructure:

+ Complete removal[1]
+ Leave in-situ.

The Echo Yodel infrastructure was installed in 2001, field and wells suspended in 2012, and pipeline flushed of hydrocarbons in 2016. The infrastructure consists of a 23km long, 12 inch diameter pipeline, a 23km long, 5 inch diameter umbilical, and two wellheads with Xmas trees (Figure 1).

LOCATION AND FISHERIES

Given the location of the infrastructure (140 km north-west of Dampier in ~140 m of water) Pilbara trap fishers and Pilbara line fishers may be impacted by the decommissioning decision. The Echo Yodel infrastructure is also located in an area prohibited to Pilbara trawl fishers (Map at Appendix A).

Figure 1: Echo Yodel pipeline (Left), umbilical (Centre), and Yodel-3 X-mas tree (Right)

A Comparative Assessment process is a decision making tool that uses criteria to assess and compare options to identify the 'most preferred' option. Critical to the decision making process is considering stakeholder perspectives.

WORKSHOP OUTCOMES – FISHERIES CONSIDERATIONS

The two decommissioning options for the infrastructure were assessed against five criteria (socioeconomic, environment, health and safety, technical, and economic). Based on the assessment against these criteria the preferred decommissioning option was to leave the infrastructure in situ (97 per cent favourability) The key drivers for this option as determined by workshop participants were:

1. The socio-economic benefit to commercial fishers for the infrastructure to continue providing substrate that supports habitat and commercial fish species that it currently supports (~8 times more commercial fish on the pipeline than off).
2. Medium term (30 years) environmental benefit of the infrastructure to continue to support the marine life it has has already created (18 years of marine growth, fish and other marine life).
3. High risks to offshore personnel would be eliminated if the infrastructure is left in-situ
4. Project cost saving.

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[1]As required as the base case under the *Offshore Petroleum and Greenhouse Storage Act 2006*

The only criterion which favoured complete removal of the infrastructure was impacts on water quality and longer term impacts to the sediment as the infrastructure degrades and breaks down over time.

WORKSHOP PARTICIPANTS

The following participants attended the workshop:

+ Pilbara Trap Licence Holder
+ The Department of Primary Industries and Regional Development
+ The Australian Instiute of Marine Science (Observer - Subject Matter Expert)
+ Woodside
+ Catalyze (Workshop facilitator)

NEXT STEPS AND PROVIDING COMMENT

Woodside is proposing to support the most preferred option as identified in the Comparative Assessment workshop. The option will be considered as part of the Environment Plan for the infrastructure due to developed in Q4 2019. Consultation will occur with the fishing sector and other relevant stakeholders as part of the development of the Environment Plan.

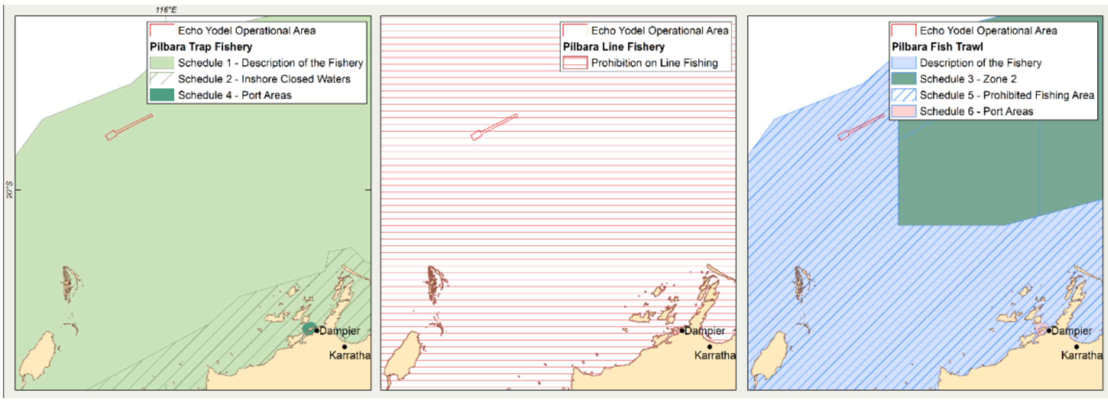
If you have any questions or feedback on the proposed decommissioning option please contact:

[redacted]

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.

Appendix A – location of the Echo Yodel Infrastructure and State Fisheries



3. Phase 3 consultation

3.1 Email sent to relevant stakeholders – 25 October 2019

Woodside sent the email below and consultation Information Sheet below to:

- *Australian Customs Service*
- *DIIS*
- *DMIRS*
- *APPEA*
- *Recfishwest*

Dear stakeholder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m

Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, rig and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible mobile offshore drilling unit (MODU). • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your feedback
Your feedback on the proposed activity 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 **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.2 Woodside consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION
SHEET

October 2019

ECHO YODEL DECOMMISSIONING ENVIRONMENT PLAN

CARNARVON BASIN, NORTH-WEST AUSTRALIA

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field as part of the North West Shelf Project, commencing in the period between Q1 and Q3 2021, subject to approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads.

The preferred decommissioning option was selected by Woodside following a comparative assessment workshop involving interests from commercial fishing, marine science and Western Australian Government Department representatives.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

If the Environment Plan is accepted there will be no further activities to undertake following the permanent plugging and abandonment of all Yodel wells and removal of the Capella-1 wellhead. The infrastructure will remain marked on navigation charts, with no petroleum safety zones associated with the infrastructure.

Woodside is Operator of the Echo Yodel and Capella-1 infrastructure on behalf of the North West Shelf Project participants. The participants are Woodside Energy Ltd, BHP Billiton Petroleum (North West Shelf) Pty Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd and Shell Australia Pty Ltd.

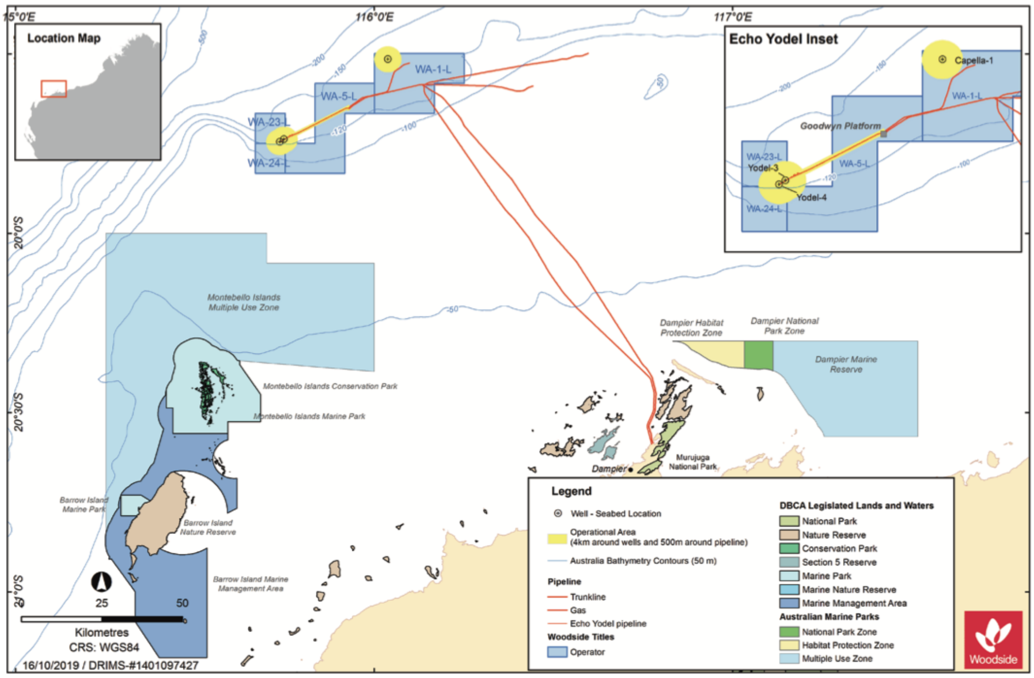


Figure 1. Petroleum Activity Program Operational Areas

Table 1. Activity summary

Echo Yodel Decommissioning Activities	
Commencement date	+ Activities are to commence between Q1-Q3 2021, subject to approvals, vessel availability and weather constraints
Approximate estimated duration	+ 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells + 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead
Water depth	+ 140 m to 160 m
Infrastructure	+ 23 km, 12 inch pipeline + 23 km, 5 inch umbilical + Yodel-3 and Yodel-4 production wells with wellhead and Xmas trees + Capella-1 exploration well and wellhead + 2 umbilical termination assemblies, 1 infield umbilical termination basket and 2 infield jumpers + 1 Pipeline Inspection Gauge (PIG) launcher
Project vessels	+ Moored semi-submersible mobile offshore drilling unit (MODU) + Support vessels, including general supply and anchor handling vessels
Distance to nearest port	+ Echo Yodel infrastructure – 140 km north west of Dampier + Capella-1 well – 140 km north west of Dampier
Distance to nearest marine park	+ 24 km north of the Montebello Marine Park - Multiple Use Zone (Cwlth)

Table 2. Approximate locations

Structure	Water Depth m	Latitude	Longitude	Permit Area
Yodel-3 production well	140	19° 44' 17.062" S	115° 44' 53.85" E	WA-23-L
Yodel-4 production well	140	19° 44' 43.262" S	115° 44' 11.389" E	WA-23-L
Capella-1 exploration well	162	19° 30' 54.033" S	116° 02' 19.57" E	WA-1-L
Eastern end of pipeline	130	19° 39' 04.585" S	115° 55' 47.881" E	WA-9-PL
Western end of pipeline	140	19° 44' 44.342" S	115° 44' 12.229" E	WA-9-PL

Echo Yodel decommissioning planning

In mid-2017 Woodside commenced consultation with stakeholders on the decommissioning of Echo Yodel subsea infrastructure, seeking stakeholder views over a 12-month period on decommissioning options, as well the long-term management implications of those options.

In May 2019, an independently facilitated comparative assessment workshop was held to identify the most preferred decommissioning option for the infrastructure. The workshop was attended by a commercial fishing licence holder, as well as representatives from the Department of Primary Industries and Regional Development.

Comparative assessment workshops are used globally as a recognised tool for complex decision-making, taking account of stakeholder views and the impacts of decision options on the interests of all stakeholders.

Criteria for the assessment of decommissioning options included socio-economic, environmental, health and safety, technical feasibility and economic factors. Feedback from stakeholders at the workshop was unanimous, supporting a decommissioning option that would permanently leave Echo Yodel subsea infrastructure in-situ. Woodside acknowledged the views of the stakeholders and selected the option.

Proposed activity – Decommissioning in-situ

No further activities are required for the decommissioning of the pipeline, umbilical and other subsea infrastructure to be left in-situ. The pipeline was flushed and cleaned of hydrocarbons in 2016 and contains treated seawater with the ends capped.

Proposed activity – Plugging for abandonment

Permanently plugging and abandoning the three wells will involve several steps and will build on work undertaken for the Yodel wells between 2012 and 2016 to clean the pipeline of hydrocarbons, remove pipeline spools and set temporary plugs in the wells.

The activities will include permanently plugging the three wells using a MODU, supported by anchor handling vessels. The Yodel-3 and Yodel-4 Xmas trees will be left in place.

Following plugging activities at the Capella-1 well, Woodside will make every reasonable attempt to remove the wellhead. Woodside will consider management measures in accordance with the Environment Plan in the event that attempts to remove the wellhead are unsuccessful.

The plugging activities are being planned as a single campaign but could be undertaken individually on an opportunistic basis between other drilling campaigns. Stakeholders will be advised should this occur.

Plugging activities will be 24 hours per day, seven days per week. The duration of these activities is subject to change due to project schedule requirements, drill rig and vessel availability, weather or unforeseen circumstances. It is estimated it will take 60 days per well to permanently plug the Yodel-3 and Yodel-4 wells, and 60 days to permanently plug and remove the wellhead at Capella-1.

Implications of the proposed decommissioning option

The Echo Yodel infrastructure will continue to provide habitat and support marine fauna including commercial fish species that have become established on the infrastructure over the last 18 years, as identified by studies undertaken by The University of Western Australia.

The infrastructure is outside shipping fairways and does not pose a hazard to commercial shipping.

Project vessels

Several vessel types will be required to complete the activities associated with permanently plugging the wells under the Petroleum Activities Program.

Plugging and abandonment activities are planned to be undertaken by a moored MODU. The activities may be supported by an anchor handling vessel and supply support vessels.

Two or three vessels may support the plugging activities, with one vessel in the vicinity to complete standby duties. Supply vessels from Dampier Port will visit the MODU at regular intervals.

Communications with mariners – Decommissioning in-situ

The Operational Area has been defined for the purposes of assessing the environmental impacts and risks of leaving the infrastructure in-situ as assessed in the Environment Plan:

+ A radius of 500 m (1000 m corridor) around the subsea infrastructure to be left in-situ.

The infrastructure will remain marked on navigation charts, with no petroleum safety zones associated with the infrastructure.

Communications with mariners – Plugging for abandonment

A temporary petroleum safety zone of 500 m will be in place around the MODU for the duration of the permanent plugging activities. The following Operational Areas will also apply:

+ A radius of 4000 m around each well.

Marine notices will be issued prior to activity commencement to alert vessels which may be 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 the permanent plugging activities.

A number of mitigation and management measures during the permanent plugging activities will be implemented and are summarised in Table 4. Mitigation and management measures implemented for decommissioning infrastructure in-situ are summarised in Table 3. Further details will be provided in the Environment Plan.

Table 3. Summary of key risks and/or impacts and management measures for decommissioning infrastructure in-situ

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Physical presence of infrastructure on seafloor causing interference or displacement	+ Wellhead location marked on marine charts.
Interests of relevant stakeholders including: + Commercial fishing activities, petroleum activities and shipping activities	+ Consultation with relevant commercial fishers and their representative organisations, petroleum titleholders 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 at the Yodel and Capella wells.

Table 4. Summary of key risks and/or impacts and management measures during permanent plugging for abandonment

Potential Risk and/or Impact	Mitigation and/or Management Measure
Planned	
Chemical use	+ Chemical use will be managed in accordance with Woodside and contractor chemical selection and approval procedures.
Interests of relevant stakeholders including: + Commercial fishing activities, petroleum activities and shipping activities	+ Consultation with relevant commercial fishers and their representative organisations, petroleum titleholders, 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 and groundings.
Marine discharges	+ All routine marine discharges will be managed according to legislative and regulatory requirements and Woodside's Environmental Performance Standards where applicable.
Seabed disturbance	+ MODU mooring analysis, anchor deployment, if required, in accordance with Woodside standards. + Logging/retrieval of wet-stored items. + No anchoring of support vessels.
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 petroleum safety zone radius around the MODU for the duration of activities. + A 4000 m Operational Area radius around each well. + Commercial fishers and other marine users are permitted to use but should take care when entering the Operational Area.
Waste generation	+ Waste generated on the vessels will be managed in accordance with legislative requirements and a Waste Management Plan. + Wastes 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.
Unplanned	
Hydrocarbon release	+ 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 **25 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).*

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 Winter, Senior Corporate Affairs Adviser
Woodside Energy Ltd
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.

Woodside

www.woodside.com.au

3.3 Email sent to DPIRD, WAFIC and PPA – 25 October 2019

Dear stakeholder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

Woodside has identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlaps the proposed Operational Areas in the development of the proposed Environment Plan for this activity. These risks and impacts are summarised below.

Woodside has endeavoured to reduce these risks and impacts 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.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity Operational Areas, as well as from 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:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).

Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, rig and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible mobile offshore drilling unit (MODU). • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.

Relevant fisheries consulted for this activity*:	• State Fisheries:
	  ○ Pilbara Line Fishery
	  ○ Pilbara Trap Fishery
	  ○ Mackerel Fishery

Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

* Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of fishing effort data, 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.

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 primary project vessels and MODU and subsea infrastructure may result in the exclusion of other users or interactions between vessels and the facility.	• Woodside will implement a 500 m petroleum safety zone radius around the primary project vessels and 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 the mooring of the MODU.	• Woodside will seek to minimise seabed disturbance for planned activities through:

		• MODU mooring analysis and anchor deployment in accordance with internal standards. • Laying the mooring chains in a pre-defined area defined to minimise disturbance.
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	• 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	• All vessels will be assessed and managed as appropriate to prevent

	invasive marine species to the area via vessels ballast water or biofouling.	the introduction of invasive marine species. • Compliance with Australian biosecurity requirements and guidance.

Your feedback
Your feedback on the proposed activity 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 **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.4 Email sent to licence holders in the Pilbara Trap and Trawl fisheries – 14 November 2019

Dear Licence Holder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

Woodside has identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlaps the proposed Operational Areas in the development of the proposed Environment Plan for this activity. These risks and impacts are summarised below.

Woodside has endeavoured to reduce these risks and impacts 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.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity Operational Areas, as well as from 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:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Relevant fisheries consulted for this activity	• Pilbara Line Fishery • Pilbara Trap Fishery • Mackerel Fishery
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities.

	• A 4000 m Operational Area radius around each well 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 primary project vessels and MODU and subsea infrastructure may result in the exclusion of other users or interactions between vessels and the facility.	Woodside will implement a 500 m petroleum safety zone radius around the primary project vessels and 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 the mooring of the MODU.	Woodside will seek to minimise seabed disturbance for planned activities through: • MODU mooring analysis and anchor deployment in accordance with internal standards. • Laying the mooring chains in a pre-defined area defined to minimise disturbance.
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	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
Your feedback on the proposed activity 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).

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 **16 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.5 Letter sent to licence holders in the Mackerel fishery (Area 2) – 14 November 2019

Woodside Energy Ltd.
ACN 005 482 986
Mia Yellagonga
11 Mount Street
Perth WA 6000
Australia
T +61 8 9348 4000
F +61 8 9214 2777
www.woodside.com.au

Please direct all responses/queries to:

[redacted]

14 November 2019

Dear Licence Holder

CONSULTATION INFORMATION – ECHO YODEL DECOMMISSIONING PLAN

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

Woodside has identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlaps the proposed Operational Areas in the development of the proposed Environment Plan for this activity. These risks and impacts are summarised below.

Woodside has endeavoured to reduce these risks and impacts 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.

Activity purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.

Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Relevant fisheries consulted for this activity	• Pilbara Line Fishery • Pilbara Trap Fishery • Mackerel Fishery
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

A consultation Information Sheet is enclosed with this letter, which provides background on the proposed activity, as well as a State fisheries map. The information sheet is also available on our website at: https://www.woodside.com.au/sustainability/transparency/consultation-activities.

Your feedback on the proposed activity 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).

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 **20 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.

Kind Regards

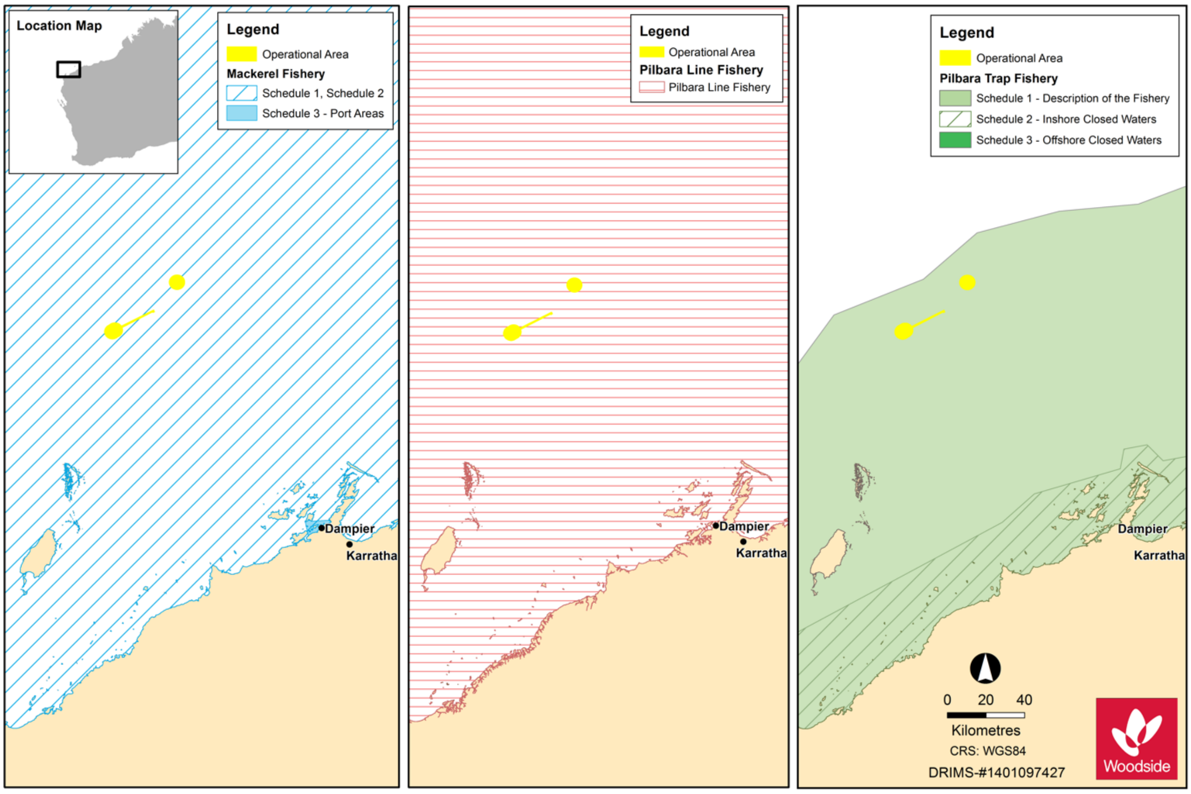
[redacted]

APPENDIX A

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Physical presence	The presence of the primary project vessels and MODU and subsea infrastructure may result in the exclusion of other users or interactions between vessels and the facility.	Woodside will implement a 500 m petroleum safety zone radius around the primary project vessels and 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 the mooring of the MODU.	Woodside will seek to minimise seabed disturbance for planned activities through: - MODU mooring analysis and anchor deployment in accordance with internal standards. - Laying the mooring chains in a pre-defined area defined to minimise disturbance.
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	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.

3.6 State Fisheries map sent to DPIRD, WAFIC, PPA and Recfishwest (25 October 2019) and licence holders in the Mackerel, Pilbara Line and Pilbara Trap fisheries (14 November 2019)



3.7 Email sent to AMSA (marine safety) and AHO – 25 October 2019

Dear stakeholder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 fairways relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, rig and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible mobile offshore drilling unit (MODU). • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your feedback

Your feedback on the proposed activity 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.

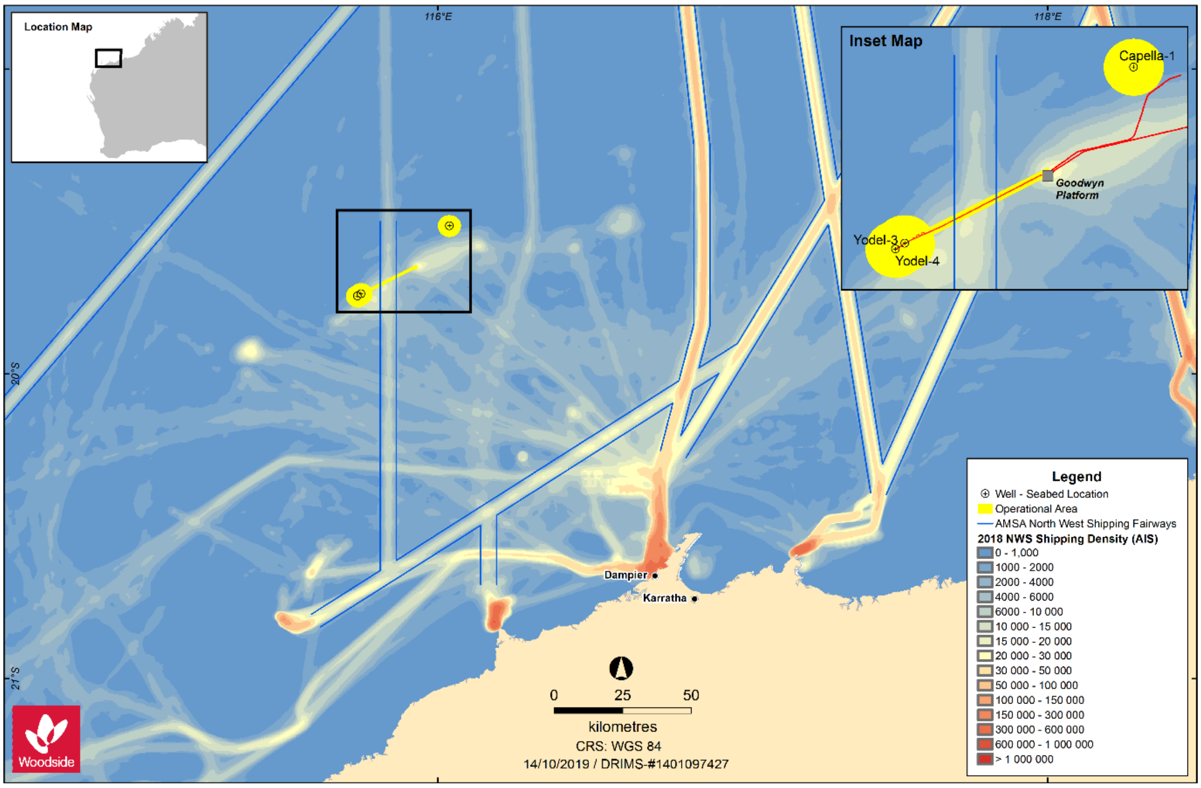
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.8 Shipping fairways map sent to AMSA (marine safety) and AHO – 25 October 2019



3.9 Email sent to adjacent titleholders – BP Developments and Mobil Australia – 25 October 2019

Dear stakeholder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, rig and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible mobile offshore drilling unit (MODU). • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your feedback

Your feedback on the proposed activity 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.

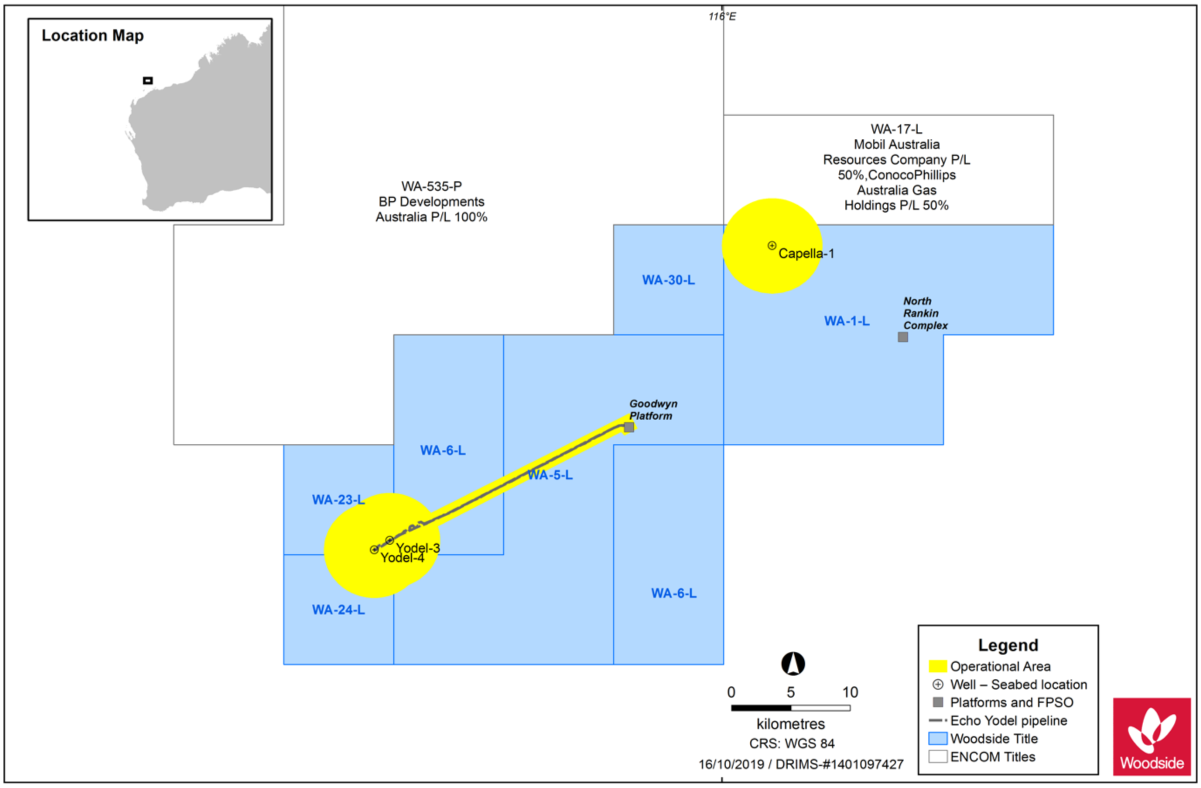
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.10 Titles map sent to adjacent titleholders – BP Developments and Mobil Australia – 25 October 2019



3.11 Email sent to DAWR – 28 October 2019

Dear DAWR

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government

Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

A Consultation Information Sheet (also available on our website) and a map of Commonwealth Fisheries relevant to the proposed activities is attached.

Activity Overview

Activity purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Commercial fishing
Whilst three Commonwealth Fisheries overlap the proposed Operational Area (see attached map), it is our assessment that these fisheries have not been active in the Operational Area in the last five years.

Biosecurity
With respect to the biosecurity matters, please note the following information below.

Vessels:	• Vessels that may be utilised to undertake the activities include: • Moored semi-submersible mobile offshore drilling unit • Support vessels, including anchor handling vessels, installation vessels and activity 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 seabed around Echo Yodel infrastructure is relatively flat and featureless sandy habitat. It is approximately 24.5 km north of the Montebello Marine Park.
Ballast and biofouling management:	• 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 risk:	• 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 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

Your feedback on the proposed activity 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.

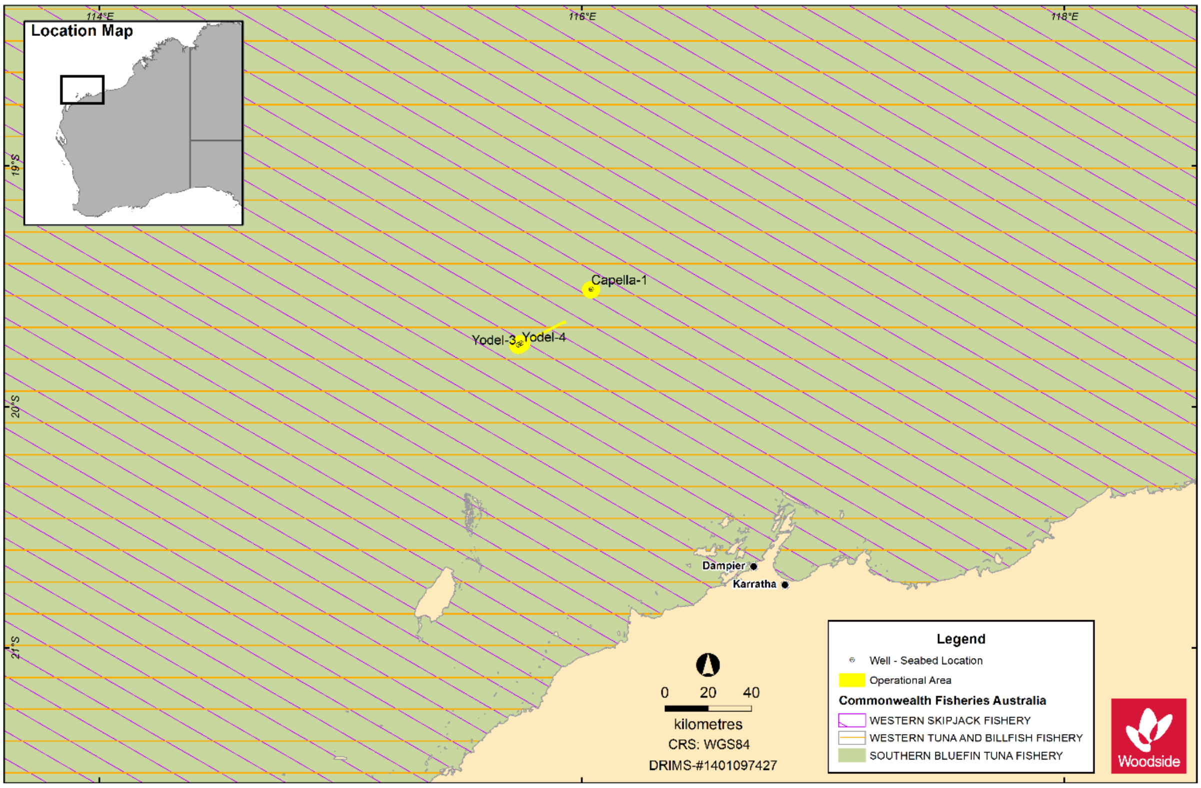
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.12 Commonwealth fisheries map sent to DAWR – 28 October 2019



3.13 Email sent to King Bay Game Fishing Club and Nickol Bay Sport Fishing Club – 25 October 2019

Dear [redacted]

In 2017 we contacted you advising that Woodside was planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.

This planning has progressed, with Woodside planning to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

These activities will commence between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.

Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your Feedback
Your feedback on the proposed activity 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 **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.14 Email sent to Pilbara Trap and Line Fisheries – 14 November 2019

Dear Pilbara Line Fishery Licence Holder

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

Woodside has identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlaps the proposed

Operational Areas in the development of the proposed Environment Plan for this activity. These risks and impacts are summarised below.

Woodside has endeavoured to reduce these risks and impacts 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.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity Operational Areas, as well as from 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:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, rig and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible mobile offshore drilling unit (MODU). • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Relevant fisheries consulted for this activity*:	• State Fisheries: ○ Pilbara Line Fishery ○ Pilbara Trap Fishery ○ Mackerel Fishery
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

* Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of fishing effort data, 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.

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 primary project vessels and MODU and subsea infrastructure may result in the exclusion of other users or interactions between vessels and the facility.	• Woodside will implement a 500 m petroleum safety zone radius around the primary project vessels and 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 the mooring of the MODU.	• Woodside will seek to minimise seabed disturbance for planned activities through: • MODU mooring analysis and anchor deployment in accordance with internal standards. • Laying the mooring chains in a pre-defined area defined to minimise disturbance.
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	• 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	• Discharges are compliant with industry best practice standards. • Implementation of chemical. assessment and approval process.

	diluted and dispersed in the water column.	
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
Your feedback on the proposed activity 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).

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 **16 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.15 Email sent to AMSA (marine pollution) – 25 October 2019

Dear [redacted]

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.

Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your Feedback
Your feedback on the proposed activity 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 **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.16 Email sent to AMSA (marine pollution) with first strike plan – 4 December 2019

Good Afternoon [redacted],

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 *Echo Yodel Decommissioning 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 Echo Yodel Decommissioning *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 15th 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

[redacted]

[redacted] | Security & Emergency Management

3.17 Email sent to DoT – 25 October 2019

Dear [redacted]

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following engagement with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure.

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 purpose:	• Decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf.
Activity:	• Permanently plug and abandon the Yodel-3 and Yodel-4 production wells. • Permanently plug and abandon and attempt to remove the Capella-1 exploration wellhead. • Permanently leave in-situ the Echo Yodel infrastructure including the pipeline, umbilical and subsea wellheads (Yodel-3 and Yodel-4).
Activity location:	• Approximately 140 km North West of Dampier, Western Australia.
Approximate water depth:	• 140 m – 160 m
Earliest commencement date:	• Between Q1 and Q3 2021, pending approvals, mobile offshore drilling unit (MODU) and vessel availability, and weather constraints.
Estimated duration:	• 20–60 days per well for permanently plugging the Yodel-3 and Yodel-4 production wells. • 20–60 days for permanently plugging the Capella-1 exploration well and 2–6 days for attempting to remove the wellhead.
Vessels:	• Moored semi-submersible MODU. • Support vessels, including anchor handling vessels, installation vessels and activity support vessels.
Exclusion zones:	• A 500 m petroleum safety zone radius around the MODU for the duration of activities. • A 4000 m Operational Area radius around each well for the duration of activities.

Your Feedback

Your feedback on the proposed activity 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 **25 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

[redacted] | Corporate Affairs
Woodside Energy Ltd

3.18 Email sent to DoT with first strike plan – 13 December 2019

Good Morning [redacted],

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 *Echo Yodel Decommissioning 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 *Echo Yodel Decommissioning 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.

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 31st 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.

[redacted]

Information Requested in the Offshore Petroleum Industry Guidance Note (September 2018)	Information Provided & Reference
Description of activity, including the intended schedule, location (including coordinates), distance to nearest landfall and map.	Included in the consultation information sheet
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 spill and 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. Note: Modelling predicts there will be no impacts in state water or shorelines above response thresholds.	Maximum accumulated volume along shoreline: (Loss of Well Containment)– MEE-001) Ningaloo Coast – North (8.3g/m3) No floating oil >10 g/m2 is predicted in State Waters. No shoreline contact is predicted at 100 g/m2
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 Level 1 oil spill response exercise to be conducted within two weeks of commencing well intervention activities. The drill will test elements of the recommended response identified in the Gemtree Anchor Hold

	Test 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 some of the links in the document are still being finalised, and as such may show a reference error in the attached version.

[redacted] | Security & Emergency Management

3.19 Email sent to DNP – 20 December 2019

Dear [redacted]

Woodside is planning to decommission subsea infrastructure no longer required for production activities from the Echo Yodel field on the North West Shelf, commencing between Q1 and Q3 2021, pending approvals, vessel availability and weather constraints.

As part of decommissioning activities, Woodside plans to permanently plug and abandon the two production wells (Yodel-3 and Yodel-4), as well as permanently leave in-situ the Echo Yodel infrastructure, including the pipeline, umbilical and subsea wellheads.

The decommission in-situ option was endorsed by Woodside following extensive consultation with representatives from Commonwealth and State Government Departments and the commercial fishing industry to identify stakeholders' preferred decommissioning outcome.

Woodside also plans to permanently plug and abandon and remove the Capella-1 exploration wellhead, which is about 40 km to the north-east of the Echo Yodel infrastructure. Final decommissioning of this well will be subject to another Environment Plan.

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 the Montebello Marine park – Multiple Use Zone (Cwlth), which is 24 km south 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 the Environment Plan for this activity is the unlikely event of a subsea well blow-out at the Yodel-3 well. Given the controls in place, it is considered that the risk associated with such as event is managed to as low as reasonably practicable (ALARP)

In the unlikely event of a loss of hydrocarbons, there is a risk of hydrocarbons entering the following Marine Parks:

- Montebello AMP
- Dampier AMP
- Argo – Rowley Terrace AMP

- Gascoyne AMP
- Geographe AMP
- Jurien Bay AMP
- Kimberley AMP
- Ningaloo AMP and Ningaloo Coast WHA
- Perth Canyon AMP
- Mermaid Reef AMP
- Shark Bay AMP and WHA
- Carnarvon Canyon AMP
- Eighty Mile Beach AMP
- South-west Corner AMP
- Two Rocks AMP
- Abrolhos AM

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. The Director of National Parks will be advised if an environmental incident occurs that may impact on the values of a marine park.

For information, a Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Can you please provide feedback on the proposed activity by **8 January 2019**, noting that your feedback 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). Comments can be made by email, letter or by phone.

Regards

[redacted] | Corporate Affairs
Woodside Energy Ltd

APPENDIX G: DEPARTMENT OF ABORIGINAL AFFAIRS HERITAGE SEARCH RESULTS

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

2 Registered Aboriginal Sites in Shapefile - Socio_CONVEX_HULL_z50

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 AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

Copyright

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 AboriginalHeritage@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.

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

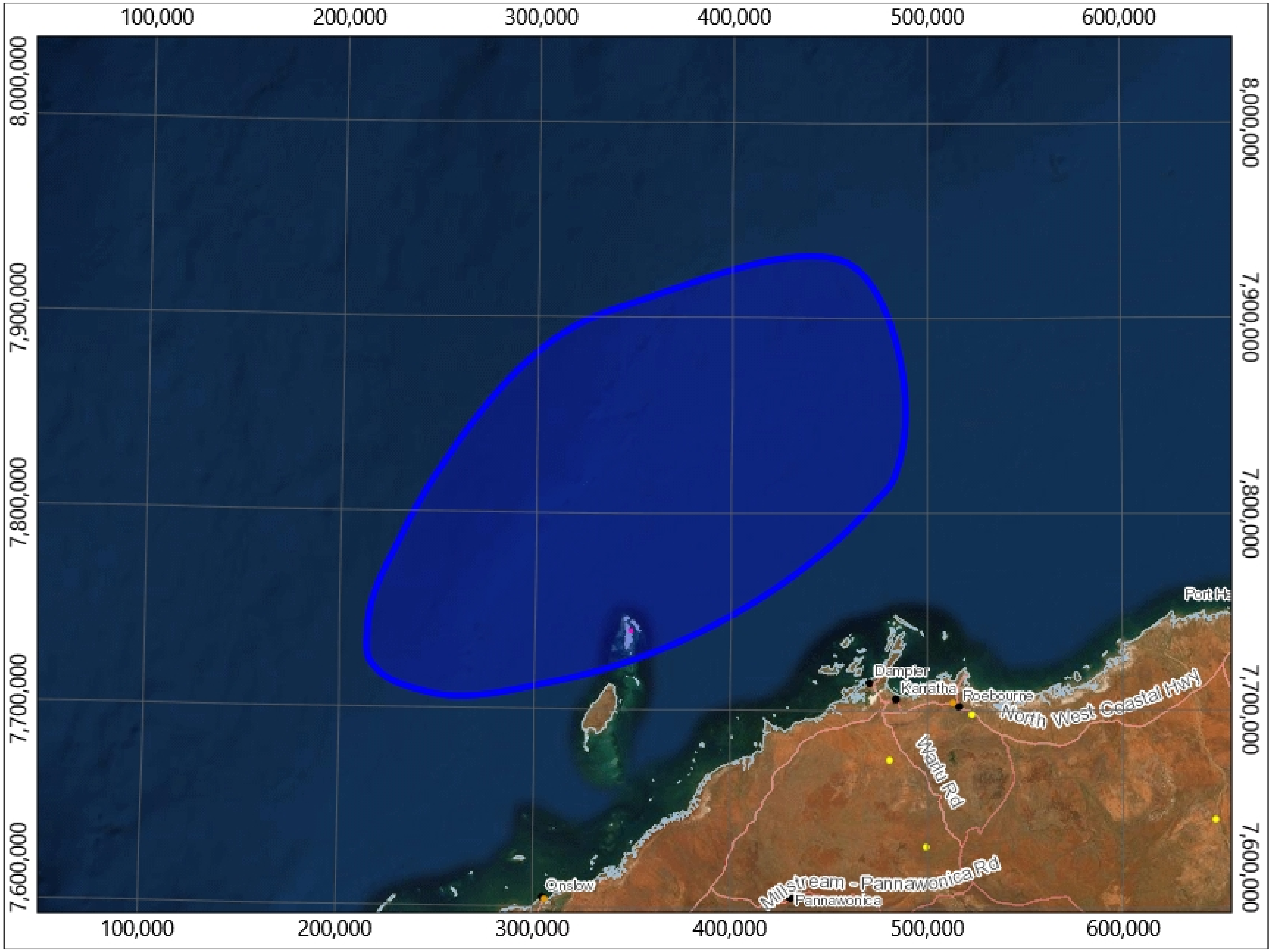
ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
873	MONTEBELLO IS: NOALA CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, BP Dating: 27,220 +/- 640	*Registered Knowledge Holder names available from DAA	348188mE 7741053mN Zone 50 [Reliable]	P07287
926	MONTEBELLO IS: HAYNES CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, Arch Deposit	*Registered Knowledge Holder names available from DAA	348289mE 7741005mN Zone 50 [Reliable]	P07286

Department of Planning, Lands and Heritage
GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

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



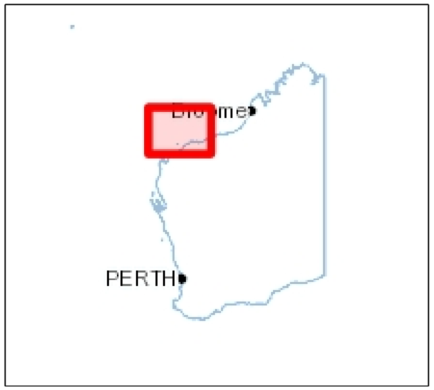
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

103.89 kilometres

Map Scale 1 : 3,150,000

MGA Zone 50 (GDA94)



APPENDIX H: OIL SPILL PREPAREDNESS AND RESPONSE MITIGATION ASSESSMENT FOR THE ECHO YODEL AND CAPELLA PLUGGING AND ECHO YODEL DECOMMISSIONING OIL POLLUTION FIRST STRIKE PLAN

Oil Spill Preparedness and Response Mitigation Assessment for the Echo Yodel and Capella Plugging and Echo Yodel Decommissioning Oil Pollution First Strike Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness

April 2020
Revision 0

TABLE OF CONTENTS

ECHO-YODEL DECOMMISSIONING 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 & 3

CONTROL AGENCY:	**WOODSIDE**
INCIDENT CONTROLLER:	**CICC DUTY MANAGER**

SPILL FROM FACILITY ENTERING STATE WATERS

LEVEL 1

CONTROL AGENCY:	**WOODSIDE**
INCIDENT CONTROLLER:	**CICC DUTY MANAGER**

LEVEL 2 & 3

CONTROL AGENCY:	**DoT**
INCIDENT CONTROLLER:	**DoT 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 & 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 a response is required beyond 48 hours.	Response may extend beyond weeks.
Woodside Emergency Management (EM)/ EM)/Crisis Management Team (CMT) Activation	Onsite Incident Controller (IC) activated. Use of ICC support may be required.	Handover of Control from Onsite IC Corporate Incident Coordination Center (CICC) Duty Manager (DM) in Peth.	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 (WA).	National media coverage.	International media coverage.

For guidance on credible spill scenarios and hydrocarbon characteristics refer to Appendix A.

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 (DoT).
- If the spill impacts State waters/shorelines and is a Level 1, Woodside will remain as 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.
- Initially Woodside will be required to make available an appropriate number of suitably qualified persons to work in the DoT IMT (see Appendix G).
- 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.

Response Process Overview

<table>
<tr><td colspan="3">Use the below to determine actions required and which parts of this plan are relevant to the incident.</td></tr>
<tr><td colspan="3">For guidance on credible scenarios and hydrocarbon characteristics, refer to <u>Appendix A</u>.</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 Oil Pollution First Strike Plan.</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 Oil Pollution First Strike Plan.
Remember to download each Operational Plan.</td><td>Upon agreement with AMSA: Coordinate pre-identified tactics in Table 2-1 of this Oil Pollution First Strike Plan.
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.</td><td>Handover control to AMSA and stand up CICC to assist.</td></tr>
<tr><td>Undertake quick revalidation of the recommended strategies on 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 on 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 (insert drms link to worst case HC release scenario 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 NEBA see (insert drms link to worst case vessel scenario 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 Echo-Yodel Decommissioning Environmental 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] or Sat phone: [redacted]	Verbally notify WCC of event and estimated volume and hydrocarbon type.	Verbal	
Within 2 hours	OIM or Woodside Site Rep (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 NOPTA and DMIRS).	App B Form 1	
Within 3 days	WSR				Provide a written NOPSEMA Incident Report Form as soon as practicable (no later than 3 days after notification) (cc to NOPTA and DMIRS) NOPSEMA: submissions@nopsema.gov.au	App 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 (✓)**
					NOPTA: resources@nopta.gov.au DMIRS: petreps@dmirs.wa.gov.au		
As soon as practicable	WSR	Woodside	Hydrocarbon Spill Preparedness Manager	[redacted]	Verbally notify HSP Manager of event and estimated volume and hydrocarbon type.	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.	App B Form 3	
ADDITIONAL LEVEL 2/3 NOTIFICATIONS							
As soon as practicable	CICC DM or Delegate	AMOSC	AMOSC Duty Manager	+61(0) 438 379 328	Notify AMOSC that a spill has occurred and follow-up with an 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	App B Form 4	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					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: App B Form 6a Mobilisation: App 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 Woodside IMT.	App B Form 5	
As soon as practicable if there is potential for oiled wildlife or the spill is expected to contact land or waters	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 (✓)
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 Net Environmental Benefits Analysis (NEBA) presented in the EP Appendix D.

Table 2-1: Level 1 Response Summary

Response Techniques	Hydrocarbon Type		Pre- Identified Tactics	Responsible	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	Yodel -3 Cond				
Monitor and Evaluate (Operational Monitoring)	Yes	N/A	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 KBSB Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within 2 hours.	Operations		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan.
	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.					
	Yes	N/A	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		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan. *Planning to download immediately and follow steps*
	Yes	N/A	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		N/A
	Yes	N/A	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in Appendix B Form 8.	Logistics - Aviation		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	N/A	The Intelligence duty manager should be instructed to stand up KSAT to provide satellite imagery of the spill.	Intelligence		
	Yes	N/A	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).

	Yes	N/A	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment		Pre-emptive Assessment of Sensitive Receptors (OM04 of The Operational Monitoring Operational Plan).
	Yes	N/A	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment		Shoreline Assessment (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 techniques and pre-identified tactics have been identified from the pre-operational Net Environmental Benefits Analysis (NEBA) presented in EP Appendix D.

Table 3-1: Level 2/3 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	Yodel-3 Condensate					
Monitor and Evaluate (Operational Monitoring)	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 KBSB Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within 2 hours.	Operations	To be deployed within 2 hours of the identification of the spill.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with Appendix Appendix D.
	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	Initial modelling available within six-hours using the rapid assessment tool		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan).
	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form (Appendix B Form 7) to RPS APASA.	Intelligence	Detailed modelling available within four-hours of APASA receiving infromation from Woodside.		N/A
	Yes	Yes	If a vessel is on location, confirm whether the tracking buoy has been deployed. Consider the need to mobilise the satellite tracking buoys from the KBSB Stockpile. If a surface sheen is visible from the facility, deploy the	Operations	To be deployed within two- hours of the identification of the spill.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring 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	Yodel-3 Condensate					
			satellite tracking buoy within 2 hours.				
	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 One: Two trained aerial observers available to be deployed by day one from resource pool.		
	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up Kongsberg Satellite Services (KSAT) to provide satellite imagery of the spill. [redacted]	Intelligence	First image received with twenty-four hours of Woodside confirming to third-party provider its acceptance of the proposed acquisition plan.		
	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		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment			Pre-emptive Assessment of Sensitive Receptors (OM04 of The Operational Monitoring Operational Plan).
	Yes	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment			Shoreline Assessment (OM05 of The Operational Monitoring Operational Plan).
Oiled Wildlife Response	Yes	Yes	If oiled wildlife is a potential impact, request and mobilise AMOSC oiled wildlife containers, first	Logistics and Planning			Oiled Wildlife Response 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	Yodel-3 Condensate					
			strike kits and relevant personnel. Refer to relevant Tactical Response Plan for potential wildlife at risk. Consider whether additional equipment is required from local suppliers.				
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:							
Subsea First Response Toolkit	**No**	**Yes**	Attempted to activate closure mechanisms on well head via ROV.	Operations and Logistics	**Day 11:** AMOSC Subsea First Response Toolkit equipment Deployed.		Subsea First Response Toolkit (SFRT) and Capping Stack Operational Plan
Capping Stack	**No**	**Yes-if plume radius ~25m**	As per EYC blow-out contingency plan	Operations (Source Control Unit)	**Day 16:** Capping stack deployed by a chartered construction vessel.		
Relief Well	**No**	**Yes**	As per Well Blowout Contingency Planning Procedure				

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 there are no identified Response Protection Areas (RPAs) [2]. Consideration should be given to other stakeholders in the vicinity of the operational location. Table 4-2 indicates the assets within the vicinity of the Echo-Yodel wells. Please note that impact thresholds (10 g/m^2 surface hydrocarbon concentration, 100 g/m^2 shoreline accumulation, and 500 ppb entrained hydrocarbon concentration) are used to determine the Environment that May be Affected (EMBA) identified in the Environment Plan and are lower than response thresholds (Table 4-1).

Table 4-1 Response Thresholds

Surface Hydrocarbon (g/m^2)	Description
>10	Predicted minimum threshold for commencing operational monitroing
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [3]
100	Predicted optimum floating oil threshold for containment and recovery and surface dispersant application
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations
250	Predicted minimum threshold for commencing shoreline clean-up operations

Hydrocarbon spill modelling results indicate no sensitive receptors have the potential to be contacted by hydrocarbons beyond 48 hours of a spill. Oil Spill Trajectory Modelling specific to the spill event will be required to validated that no sensitive receptors will be contacted beyond 48 hours of a spill. Figure 4-1 illustrates the location of regional sensitive receptors in relation to the Echo-Yodel operational area and identifies priority protection areas.

Table 4-2 Assets in the vicinity of the Echo-Yodel Decommissioning operational area.

Asset	Approximate Distance and Direction from Operational Areas (Km)	Operator
Goodwyn Alpha	0.1 Km	Woodside
Wheatstone	40 km	Chevron
Pluto	46 km	Woodside
North Rankin Complex (NRC)	22 km	Woodside

[2] The Tactical Response Plans 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.

[3] At 50g/m^2 containment and recovery and surface dispsperant 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.

Asset	Approximate Distance and Direction from Operational Areas (Km)	Operator
OKHA	54 km	Woodside
Angel	72 km	Woodside

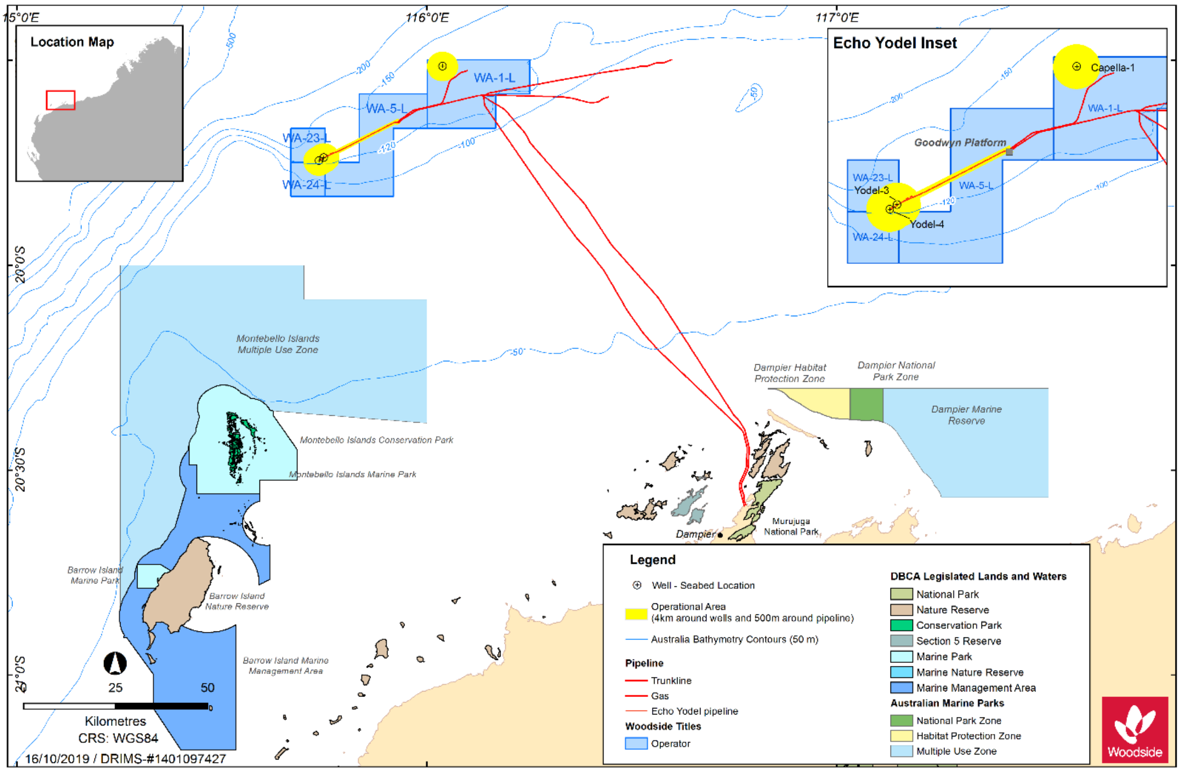


Figure 4-1 Regional Sensitive Receptors – Echo-Yodel Decommissioning (these are not Response Protection Areas)

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*
A 77-day loss of well control on Echo-Yodel 3 well	Yodel-3 Condensate	348,134m^3 surface/subsurface release	Condensate API of 54.4
Instantaneous release from vessel operations	Marine Diesel	105m^3 release volume resulting in 5.25 m^3 residual oil on water surface.	Diesel Fuel Oil (Southern USA 1) API of 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.

Yodel-3 Condensate

Yodel-3 Condensate (API 54.4) contains a low proportion (2.5% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures (residual). These compounds will persist in the marine environment; however, the majority of the hydrocarbons that comprise this oil (97.5%) will volatilise at ambient temperatures.

The mixture is composed of hydrocarbon that have a wind range of boiling points and volatilities at atmospheric temperatures and which would begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 63.1% of the oil mass should evaporate within the first 12 hours (BP< 180 °C); a further 25.3% should evaporate within the first 24 hours (180°C < BP < 265°C); and a further 9.1% should evaporate over several days (265°C < bp < 380°C).

The unweathered hydrocarbon mixture has low density (0.76g/cm^3) and very low dynamic viscosity (0.54cP). The pour point of the whole mixture (<-36°C) indicates that it will remain in a liquid state over the annual temperature range observed on the North West Shelf.

The results for the constant-wind case (Figure A-1) indicate that Yodel-3 Condensate will have a tendency to evaporate fairly rapidly, with 88% of the spilled volume predicted to evaporate and around 10% remaining on the water surface afterthe first 24 hours under light winds. Negligible levels of entrainment and dissolution are expected under these light wind conditions.

A slightly reduced evaporation rate is predicted in the first 24 hours for the variable-wind case (Figure A-2). Increased entrainment and dissolution rates are predicted in this case, with a corresponding decrease in the floating oil proportionto negligible levels. The variable-wind case also indicates that, once entrained,the oiltends to remain in the water column and may not resurface even during calm wind periods.

Biological and photochemical degradation is predicted to contribute to the decay of the floating slicks and oil droplets in the water column at an approximate rate of 0.35% per day, for an accumulated total of about 2-3% after seven days. Adding this to the loss through evaporation (approximately 90%) indicates that less than 10% of the spilled volume is predicted to remain afloat or in the water column after seven days under light or moderate winds, respectively.

Some of the heavier hydrocarbons will evaporate and/or degrade over time scales of several weeks to a few months. This long weathering duration will extend the area of potential effect, requiring the break-up and dispersion of the slick sand droplets for concentrations to drop below the thresholds.

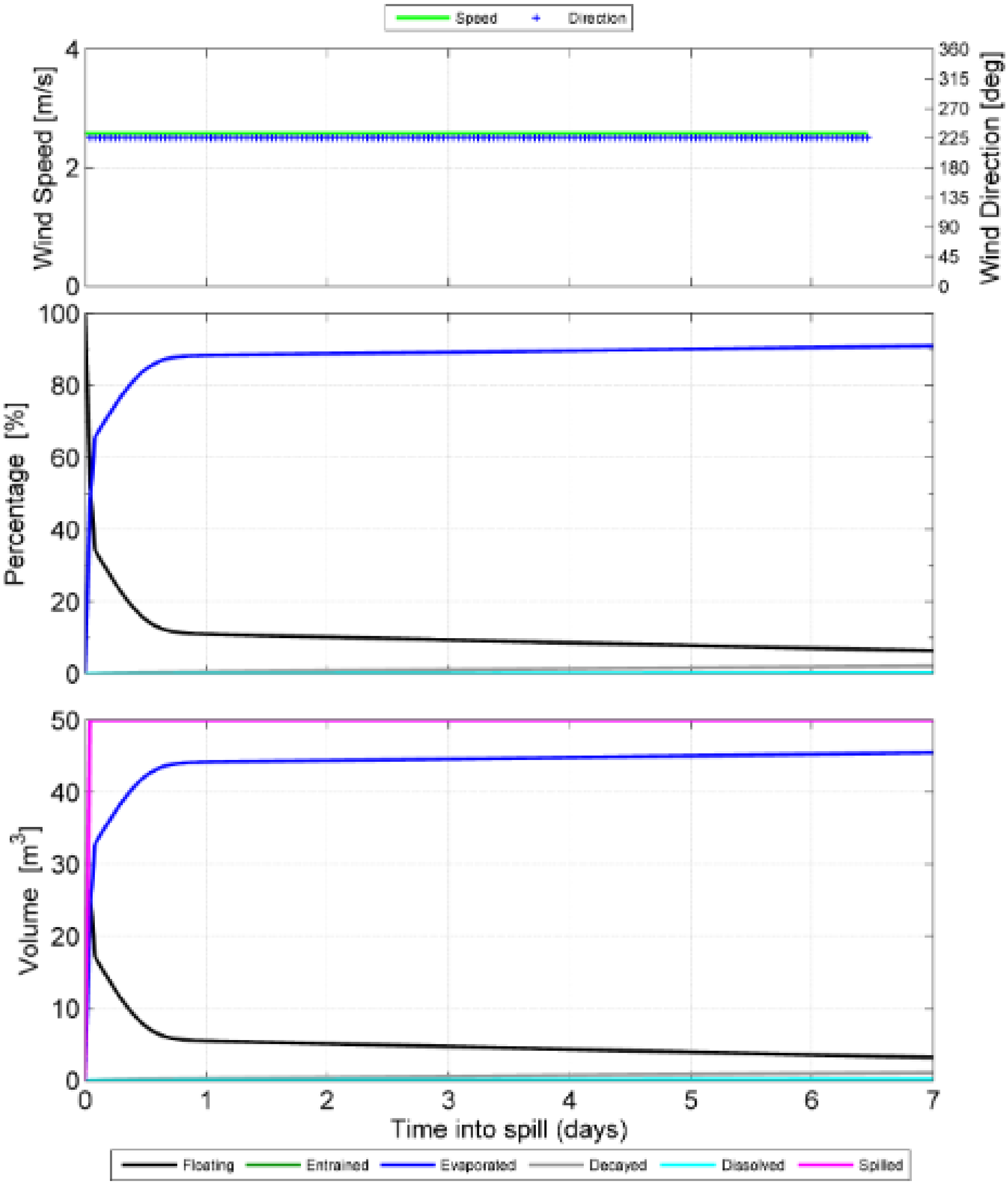


Figure A-1: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of Yodel-3 Condensate spilled onto the water surface as a one-off release (50m^3 over 1 hour) and subject to a constant 5kn (2.6m/s) wind (top panel) at 27°C water temperature and 25°C air temperature.

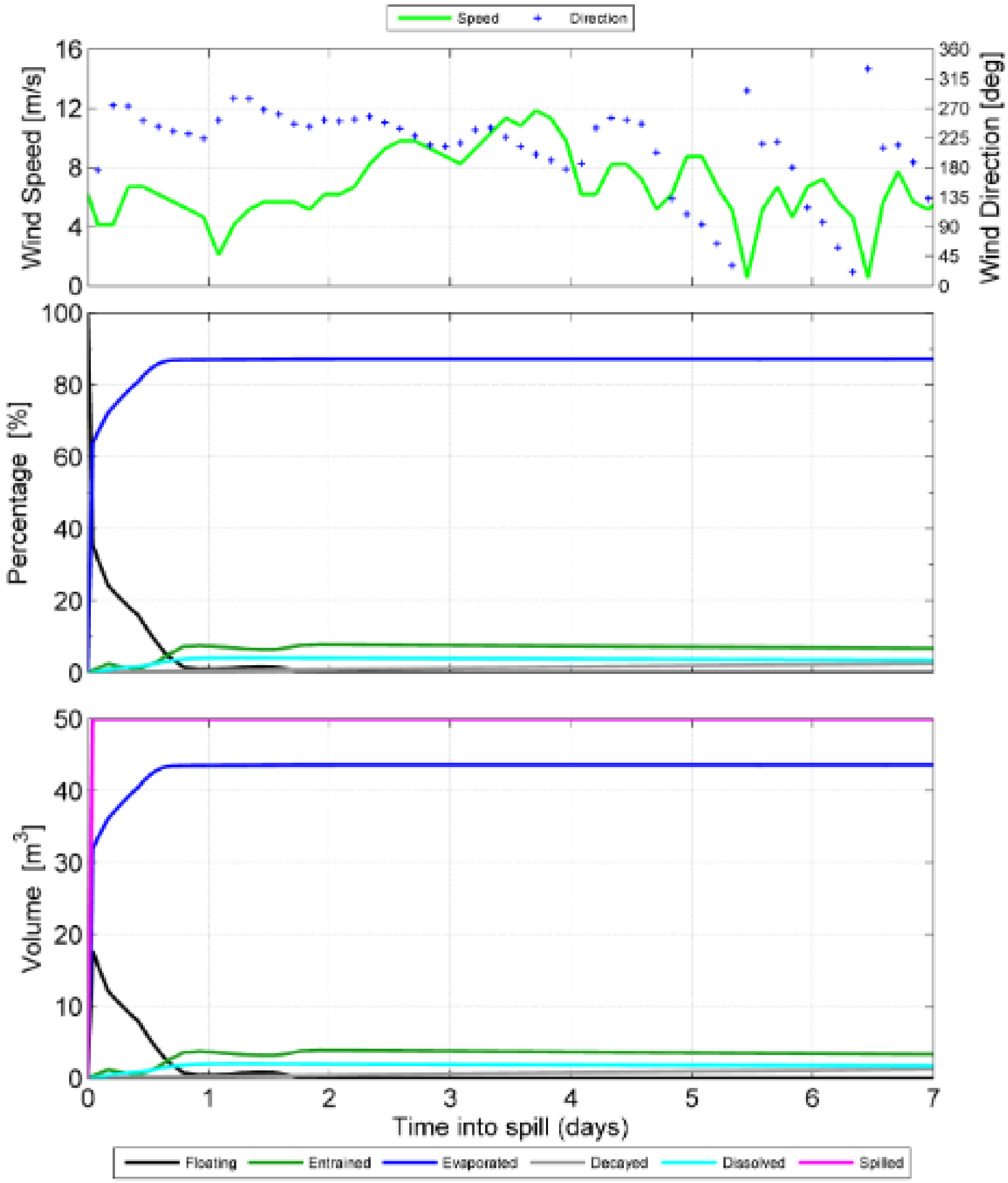


Figure A-2 Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of Yodel-3 Condensate spilled onto the water surface as a one-off release (50m^3 over 1-hour) and subject to variable winds (top panel) at 27°C water temperature and 25°C air temperature.

Marine Diesel

Marine diesel is a mixture of volatile and persistent hydrocarbons, with approximately 40-50% by mass predicted to evaporate over the first day or two, depending upon the prevailing conditions, with further evaporation slowing over time. The heavier components of diesel have a strong tendency to entrain into the upper water column due to wind waves, but can refloat to the surface if wind waves abate.

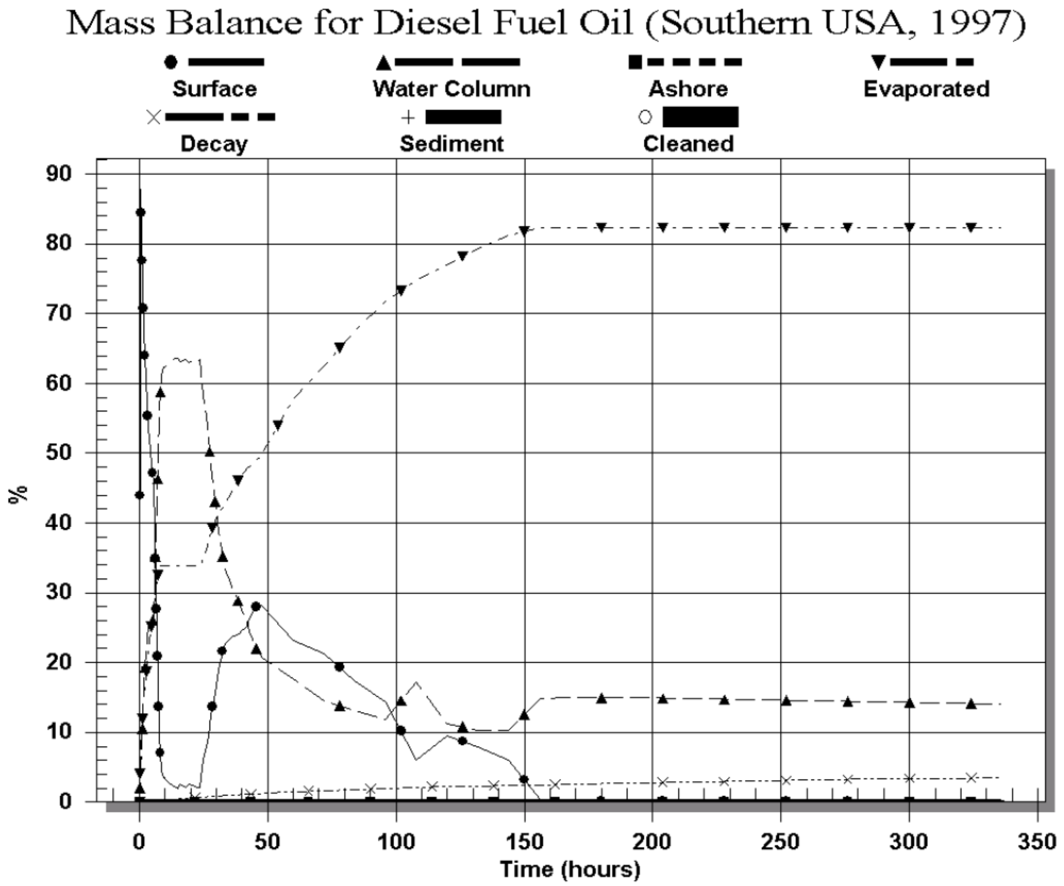


Figure A-3 Predictions for the partitioning of oil mass over time through weathering processes for diesel fuel oil. Predictions are based on sample environmental conditions.

Source: Data available from the APASA oil database (Diesel Fuel Oil (Southern USA 1997)). NOTE: This information is provided as guidance only. Spill event OSTM should be sought.

APPENDIX B – FORMS

Form No.	Form Name	Link
1	Record of Verbal Notification to Regulator Template	Link
2	NOPSEMA Notification Template	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	APASA Oil Spill Trajectory Modelling Request	Link
8	Aerial Surveillance Observer Log	Link

FORM 1

Record of initial verbal notification to NOPSEMA

Woodside

____

(NOPSEMA ph: (+61) 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. **DMP** **petroleum.environment@dmp.wa.gov.au**

FORM 2

[insert Marine Pollution Report (POLREP – AMSA) when printing]

Link

[for exploration/development activities]

[insert NOPSEMA Incident Report Form when printing]

Link

FORM 3

[insert AMOSC Service Contract note when printing]

Link

FORM 4

[insert Marine Pollution Report (POLREP – DoT) when printing]

Link

FORM 5a

[insert OSRL Initial Notification Form when printing]
Link

FORM 5b

[insert OSRL Mobilisation Activation Form when printing]
Link

FORM 6

[insert APASA Oil Spill Trajectory Modelling Request form when printing]
Link

FORM 7

[insert Aerial Surveillance Observer Log when printing]

Link

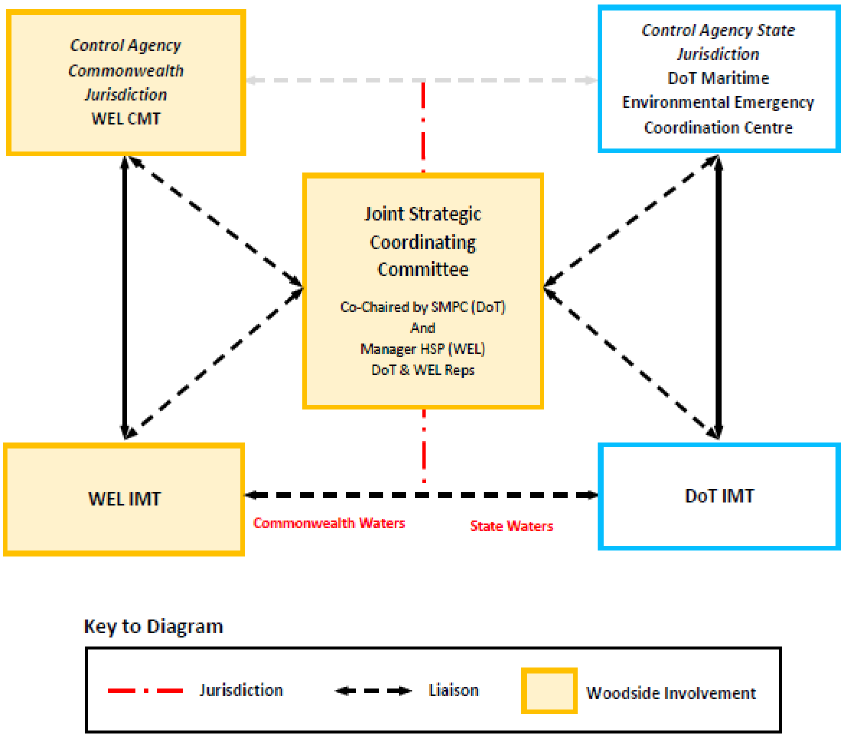
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

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[4]



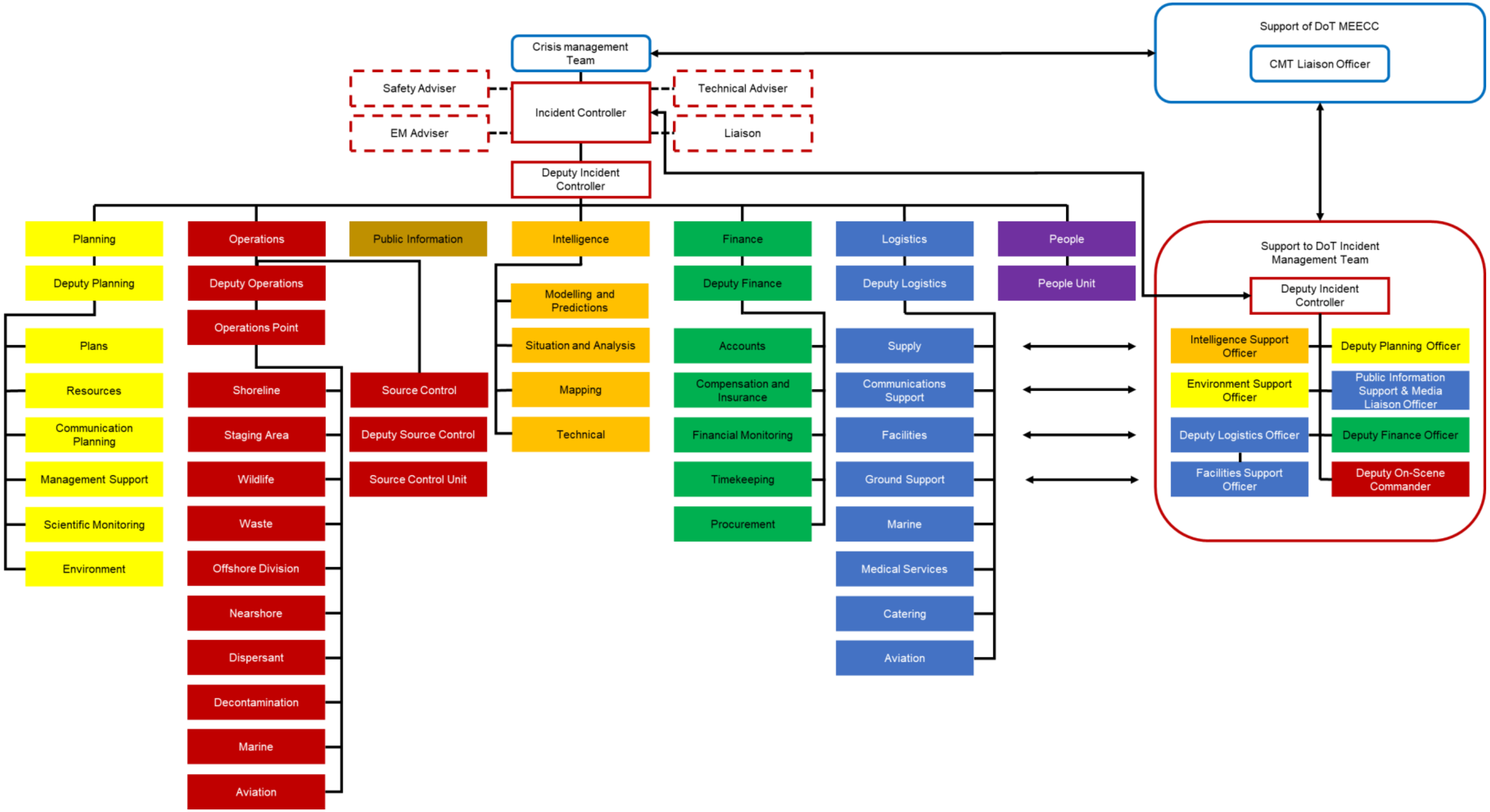
The Control Agency for a Level 1 hydrocarbon spill in Commonwealth waters resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder).

The Control Agency for a Level 2/3 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.

[4] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements January 2017. Note: For full structure up to Commonwealth Cabinet/Minister refer to OPEA (Aust) Link Section 4.3.3.

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	Woodside Liaison Role	Personnel Sourced from[5]:	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 (SMEEC). • Offer advice to SMEEC on matters pertaining to Petroleum Titleholder (PT) crisis management policies and procedures.	1
DoT IMT Incident Control	Woodside 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 Petroleum TItlegholder (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

[5] See Combined CICC, KICC, CMT roster & Preparedness Schedule DRIMS#4992584 / AMOSC Service Contract DRIMS#8697281

Area	Woodside Liaison Role	Personnel Sourced from[6]:	Key Duties	#
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
DoT IMT Public Information-Media/ Community Engagement	Public Information Support & 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 & 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

[6] See Combined CICC, KICC, CMT roster & Preparedness Schedule DRIMS#4992584 / AMOSC Service Contract DRIMS#8697281

Area	Woodside Liaison Role	Personnel Sourced from[7]:	Key Duties	#
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

[7] See Combined CICC, KICC, CMT roster & Preparedness Schedule DRIMS#4992584 / AMOSC Service Contract DRIMS#8697281

DoT Liaison Officer Resources to Woodside

Once DoT activates a State waters/shorelines IMT, DoT will make available the following roles to Woodside.

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
Woodside 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
Woodside 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 & 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