Bratwurst Environment Plan Summary

Department	HSE
Document Number	
Document Status	Final
Revision Number	1
Issue Date	22/05/2019
Owner	
Author/s Reviewer	
Security Classification	Unrestricted
Export Control	No US Content

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1 Introduction

Shell Australia Pty Ltd (SA) proposes to drill a single exploration well (to fulfil NOPTA permit award requirements) in the Petroleum permit AC/P64 as part of the Bratwurst-1 drilling campaign. The Bratwurst-1 exploration well will be located within the Northern Browse Basin in Commonwealth Waters with a water depth of approximately 155 m (**Figure 1 - 1**). Drilling is planned be carried out by a semi-submersible Mobile Offshore Drilling Unit (MODU or rig). If significant gas/condensate volumes are discovered during this campaign, there is a future potential for a tie-back to the Prelude facilities. The Prelude facility is located approximately 160 km southwest of the Bratwurst -1 well location. Drilling is proposed to commence as early as mid-2019.

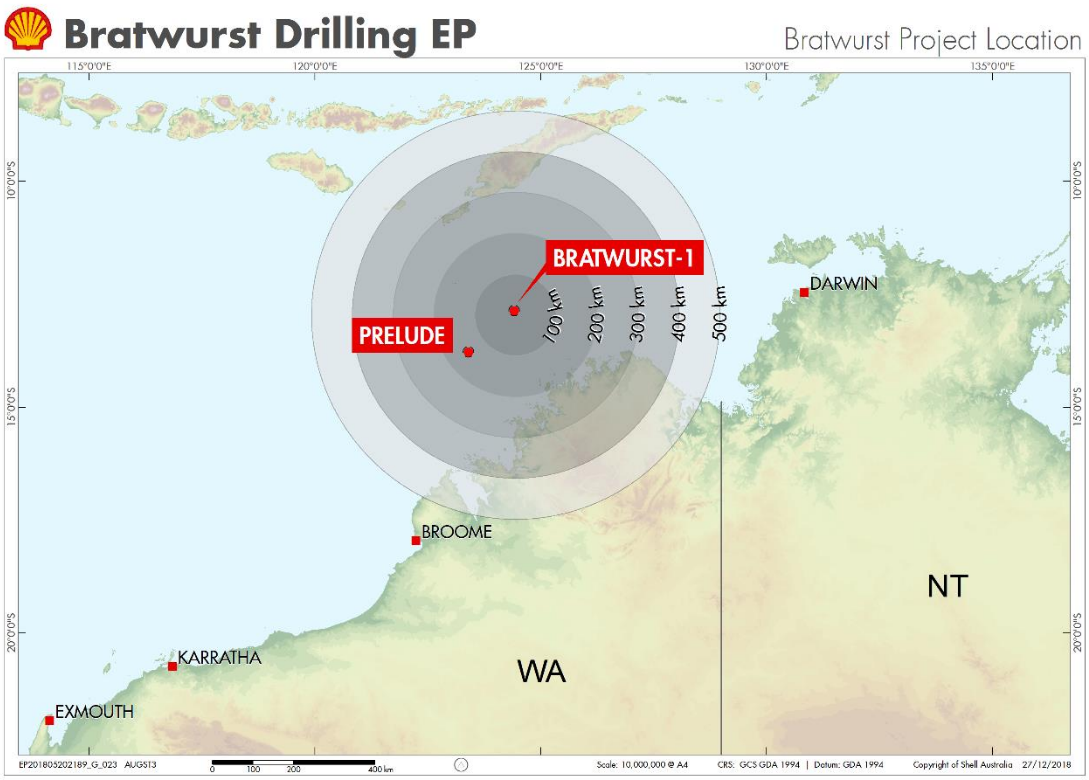


Figure 1 - 1: Location of the Bratwurst-1 Drilling Campaign

Environmental management for the Bratwurst-1 drilling campaign will be undertaken in agreement with this Environment Plan (EP), which is prepared in accordance with the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)) Regulations*, and describes the following:

- the area of operations, the proposed activities and their expected time frame;
- the environmental management framework for the activity including legislation and other requirements;
- the existing environment of the region, including issues or sensitivities relevant to the activity;
- the impacts and risks to the environment from the activity;
- Shell's Health, Security, Safety and Environment and Social Performance (HSSE and SP) Commitment and Policy and the environmental performance objectives that derive from the Policy;
- the performance standards and measurement criteria against which environmental performance will be measured;
- the Implementation Strategy, including key roles and responsibilities that will be employed to achieve the program's environmental performance goals; and
- a system for documenting, monitoring and reviewing the success of the Implementation Strategy to facilitate improvement of environmental performance.

The overall purpose of this EP is to demonstrate that appropriate management controls are in place so that the potential for environmental impacts and risks to occur as a result of the activity are managed to “as low as reasonably practicable” (ALARP) and reduced to an acceptable level.

2 Description of the Activity

2.1 Project Overview

In accordance with Regulation 13(1) of the OPGGS(E) Regulations, this section describes the activities to be undertaken as part of the Bratwurst drilling campaign in adequate detail to appropriately assess the environmental impacts and risks associated with the project.

Shell proposes to drill a Goal Zero (a cultural mindset where no harm to people or environment occurs for all our activities), HSSE&SP Control Framework compliant single exploration well within the AC/P64 permit area to fulfil the primary term work program commitments before 13/9/2021. Drilling operations are planned to be conducted after 1 July 2019 on a semi-submersible moored mobile offshore drilling unit (MODU), supported from Shell Australia’s supply bases in Broome. The well will be plugged and abandoned or suspended if further investigation is required. This EP also covers the potential for future sidetracking and/or testing in the event of exploration success.

2.1.1 Titleholder

Table 2 - 1: Details of Titleholder and Liaison Person

Titleholder Details:	**Liaison Person Details:**
Company Name: Shell Australia Pty Ltd	Name: [redacted]
562 Wellington St, Perth WA 6000	Position: Exploration Team Lead
Phone: (08) 9338 6600	
ACN: 14 009 663 576	

Should there be a change in title holder, a change in arrangements for notifying the Regulator of a change in the titleholder, a change in the titleholder’s nominated liaison person or a change in the contact details for either the titleholder or the liaison person, Shell Australia will contact NOPSEMA within 2 weeks of becoming aware of the change.

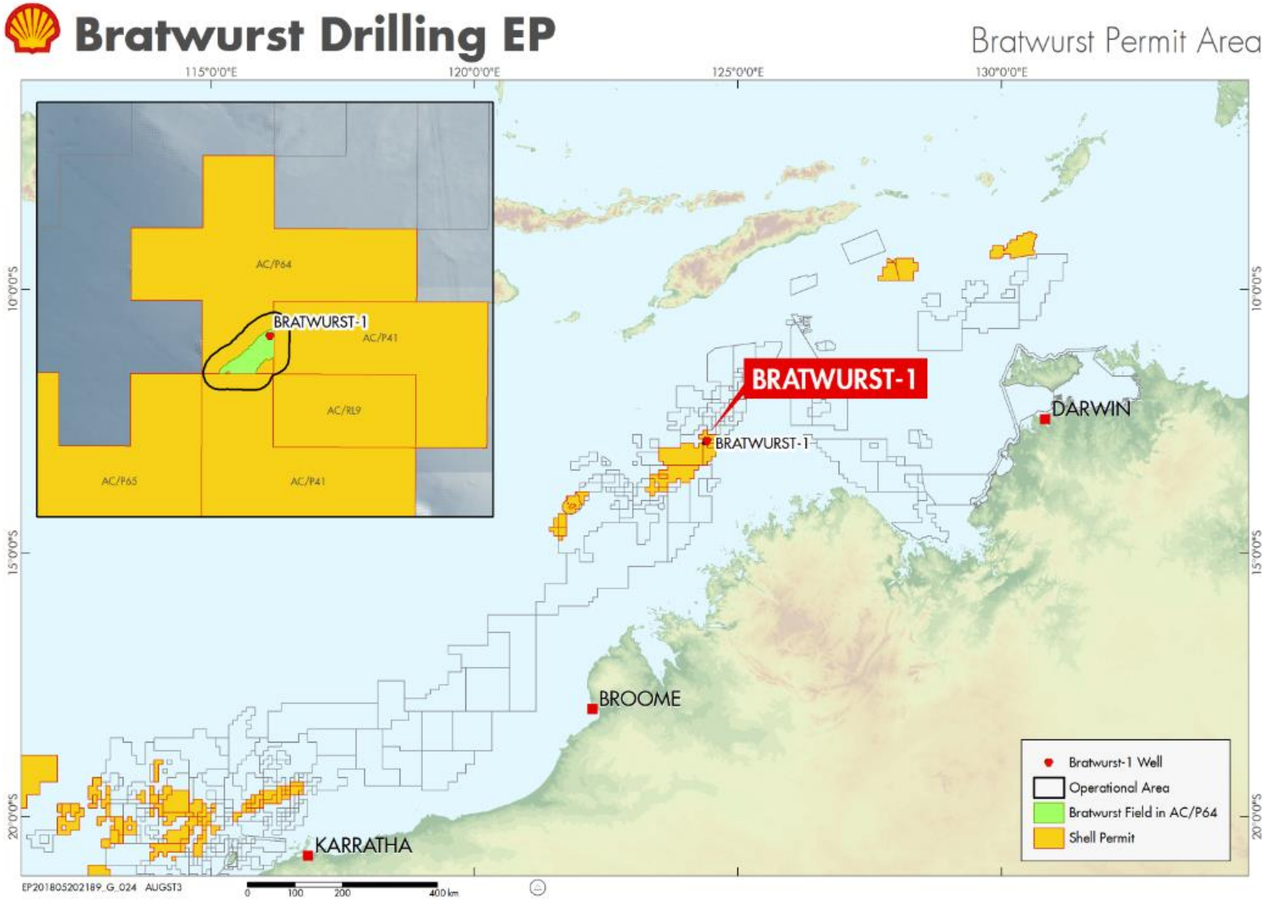


Figure 2 - 1: Location of AC/P64 Commonwealth Permit

2.1.2 Location and Timing

AC/P64 is located within the Northern Browse Basin in Commonwealth waters with an approximate water depth of 155 m. The well lies approximately 200 km north of the Kimberley coast and 600 km north north-east of Broome (**Figure 2 - 2**). The Bratwurst-1 exploration well is proposed to be drilled to a total vertical depth of approximately 4,750 m. The confirmed well location is defined below in **Table 2 - 2**.

Operations are planned to take place after 1 July 2019, with a nominal spud date after 1 August 2019. The exact timing of the activity will be dependent on the availability of a suitable MODU and weather conditions.

Table 2 - 2: Location Bratwurst-1

Well	Latitude	Longitude
Bratwurst-1	12° 52' 18.385" S	124° 24' 50.050" E

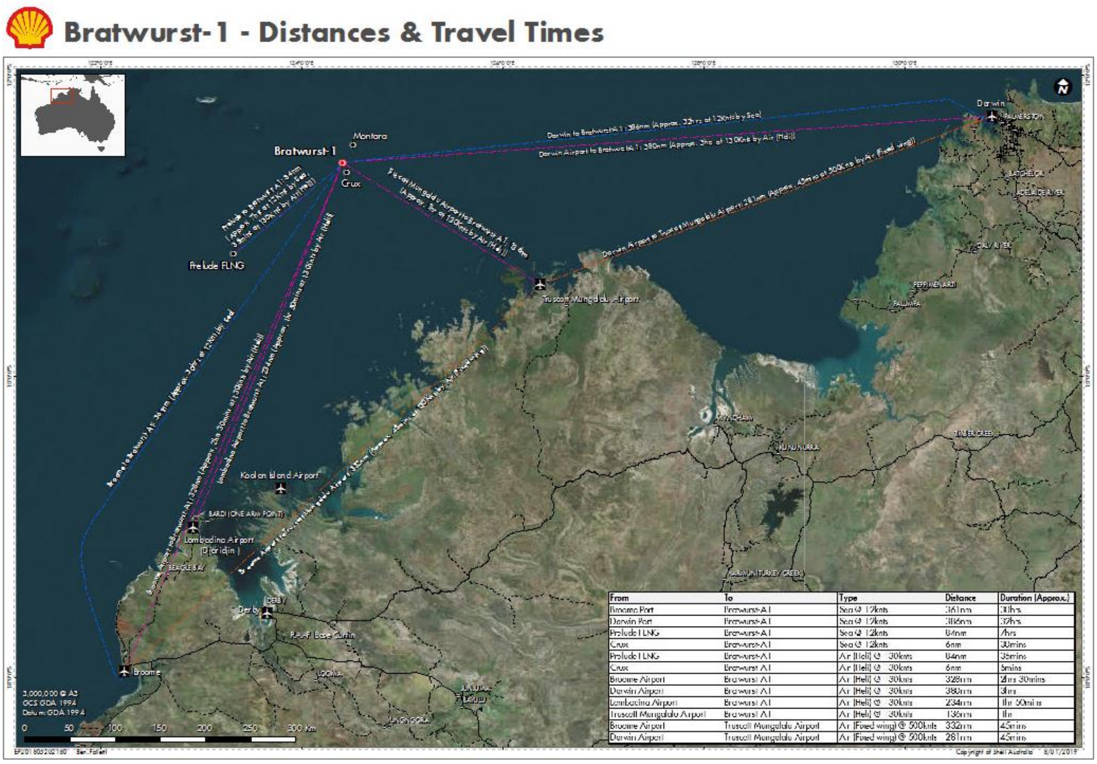


Figure 2 - 2: Location of Brawurst-1 and Shell Operational Bases

2.1.3 Operational Area

At the commencement of planning and risk assessment for this EP, a buffer area around the potential well location was used to ensure the full range of environmental and safety risks were taken into consideration when confirming the exact spud location (**Table 2 - 2**). To enable the assessment of impacts and risks to the environment, an approximate well location polygon was defined, within which the well would be located (see **Figure 1 - 1**). A further 2,000 m buffer around the polygon was added as the basis for identifying and assessing potential impacts from planned activities, including mooring and vessel related activities, and for conducting associated information searches (**Sections 4.1** and **4.4.1**). The approximate well location polygon (plus 2,000 m buffer) used for the impact assessment is referred to as the Operational Area for the Bratwurst-1 drilling campaign.

Vessels and helicopters transiting to and from the Operational Area are managed under shipping legislation and are outside the scope of this EP, including towing of the MODU to and from the Operational Area by anchor handling tugs (AHTs). A 500 m exclusion zone will also be established around the well location. Therefore, vessel and helicopter operations within the 500 m exclusion zone will be considered petroleum activities for the purposes of this environment plan.

2.2 Project Activities

2.2.1 Drilling Methodology

In accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011*, detailed well designs will be submitted to the Well Integrity department of National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) as part of the Approval to Drill and the accepted WOMP.

Once the MODU is on location and moored (**Section 2.3.1**), drilling operations will commence. The Bratwurst-1 scope comprises conventional exploration activities, including top and bottom hole drilling, installation of a blowout preventer (BOP), formation evaluation, and either well suspension or abandonment. The well will be drilled in stages. The top-hole sections are planned to be drilled riserless using a water-based mud (WBM) system. When using WBMs, drilling fluids and cuttings will be either discharged directly to the seabed or returned to the rig using a Riserless Mud Return System (RMR) prior to discharge.

The top-hole section is planned to be drilled with a 42” bit with WBM (seawater and pre-hydrated bentonite) sweeps. Following drilling of the 42” section a 36” conductor is planned to be run and cemented in place to form the surface casing. Approximately 300% excess cement is planned to be pumped to compensate for potential wash-outs and get the cement to the seabed.

The next interval is planned to be drilled with a 17 1/2” bit. This hole section is planned be drilled riserless. A riserless mud return (RMR) system may be used to allow the section to be drilled using a basic bentonite-based WBM instead of sea water and sweeps. If RMR is not used, WBM sweeps (dispersed bentonite/polymer) are planned to be used to assure good hole cleaning. A 13 5/8” casing (and 18-3/4” wellhead) is planned to be run and cemented into place and the well is planned to be flushed with WBM mud which will be discharged to the seabed.

A BOP and riser is planned to be installed following top-hole drilling and casing installation. The control fluids are water-based and will contain a hydraulic fluid (i.e. Stack Magic Eco, Erifon HD603 HP or an equivalent chemical) diluted as per manufacturer’s instructions to achieve an OCNS Group D/E ranking. The bottom, more technically challenging sections of the well may be drilled using a closed synthetic-based mud (SBM) system due to the predicted high temperature of the reservoir and shale inhibition. When drilling using a closed mud system, cuttings and fluids will be brought back to the surface where cuttings will be separated from muds using solids control equipment (SCE). The SCE includes a cuttings drier and centrifuge. Following installation of the 13 5/8” casing, BOP and riser, the bottom hole section is planned to be drilled using a 12 1/4” bit. If significant mud losses occur, a 9 7/8” casing may be run and cemented above the reservoir, and an 8 1/2” hole is planned to be drilled.

Table 2 – 3 Summarises the details of the drilling activity. Chemical assessment of all fluids during drilling is outlined in **Section 7.1.1.**

Table 2 – 3: Bratwurst-1 Summary of Drilling and Completions

Permit Area		AC/P64
Basin		Northern Browse
Type of Well		Exploration
Water Depth (MSL)		Approximately 155 m
Commencement Timing Estimate		1 July 2019
End of Activity Estimate		13 September 2021
Activity Duration Estimate		45 days
Drill Rig/AHTs		MODU (semi-submersible, moored) / up to 4 AHTs vessels
Proposed Total Depth (MDRT)		Approximately 4,750 m TVDSS
Drilling Fluids	1067 mm (42”)	WBM drilling with seawater and pre-hydrated bentonite sweeps. Riserless section – all returns to seabed.
	445 mm (17 ½”)	WBM drilling (bentonite/polymer based). Riserless section – all returns to seabed.
	311 mm (12 ¼”)	WBM/SBM drilling (linear alpha olefins or Saraline 185V (linear and branched paraffins). Closed system (riser in place) with SBM recovery and cuttings discharged overboard.
	216 mm (8 ½”)	WBM/SBM drilling (LAO or Saraline 185V, or combination). Closed system with SBM recovery and cuttings discharged overboard.
Volume of cuttings (estimate only- assuming 15% wash out for the WBM sections per well)	1067 mm (42”)	~80 m^3 (WBM)
	445 mm (17 ½”)	~420 m^3 (WBM)
	311 mm (12 ¼”)	~200 m^3 (WBM or SBM)
	216 mm (8 ½”)	~35 m^3 (WBM or SBM)
	Base Case Total	**~735 m^3 (WBM or SBM)**
	Contingency Siderack	~235 m^3 (WBM or SBM)
	Contingency Respud (42 and 17 ½”)	~500 m^3 (WBM or SBM)
	Total Potential Cuttings	**~1,470 m^3 (WBM or SBM)**
Formation Evaluation		Logging while drilling, Wireline logging and vertical seismic profiling (VSP)
Coring		Potentially, depending on results of formation evaluation
Well Testing and Completions		Potentially, depending on results of formation evaluation
Well Suspension		Potentially, depending on results of formation evaluation
Well Abandonment		Yes, by the end of AC/P64 permit period.

2.2.2 Cementing

Cement is used for conductor or casing installation during well drilling and is essential for well integrity. Cement is also used to provide barriers when suspending or abandoning wells.

2.2.3 Formation Evaluation

Formation evaluation, may include logging while drilling (LWD), wireline logging and VSP. These methods involve taking measurements from inside the wellbore to characterise the drilled formations and evaluate and quantify the presence of hydrocarbons in the formation surrounding the well.

Wireline logging is the measurement of formation properties by running instruments down the wellbore. Different tools may be used to record (or log) information about the formation including whether hydrocarbons are present and the resistivity, conductivity, density, mechanical properties and pressure of the formation. VSP involves firing an acoustic source over a 12 to 20-hour period while a receiver tool is run inside the wellbore to validate time – depth conversion values used in the seismic interpretation of the geology surrounding the well.

2.2.4 Well Plugging and Abandonment

Following the completion of well evaluation activities, the Bratwurst-1 well will be abandoned as per Shell Well Abandonment Manual and the WOMP. Well abandonment is planned to involve installing cement plugs to form permanent barriers to the hydrocarbon bearing and/or geologically pressured formations and cutting the wellhead/casing strings below the level of the sea floor and recovering the wellhead to surface.

2.2.5 Contingent Activities

In the event of hydrocarbon discovery or for operational reasons, the well may be suspended to either allow future re-entry for subsurface information gathering purposes or to re-enter and continue exploration drilling after 2019. Should this occur, this EP will be reviewed, as per the EP review process and a MOC will be undertaken. In the event that significant changes arise in the MOC, this will trigger an EP resubmittion. In this situation, relevant stakeholders will be consulted prior as per NOPSEMA requirements.

Future scope may include:

2.2.5.1 *Well Testing*

Well testing is the flowing of hydrocarbons from the reservoir to the rig to allow the assessment of reservoir properties and the collection of reservoir fluid samples. For well testing to be conducted, a temporary well test spread and flare booms will be installed on the rig. The flow stream may include gas and liquid hydrocarbons, drilling fluids, solids and formation water. The function of the well test spread is to separate the mud, solids and formation water from the produced hydrocarbons which are burned off via the flare(s) as there is no ability to store the produced hydrocarbons onboard the rig.

Information on reservoir properties is derived both from well flow and shut in pressure responses. As such, a typical well test programme would consist of a series of flow and shut in periods. The well test in its entirety is unlikely to exceed 2 weeks with a combined flow period not exceeding 7 days. A typical well test package would be capable of handling up to 75 MMscf/day of gas on surface.

2.2.5.2 *Coring*

Coring is similar to drilling, but rather than removing drilled solids from the well as “cuttings”, the formation is drilled using a hollow core head, with formation cut retained inside a “core barrel”. As coring allows whole sections of rock of up to 6-1/2” diameter to be recovered, drilled cores enable a more in-depth physical characterisation and analysis of subsurface rock formations.

2.2.5.3 *Sidetracking*

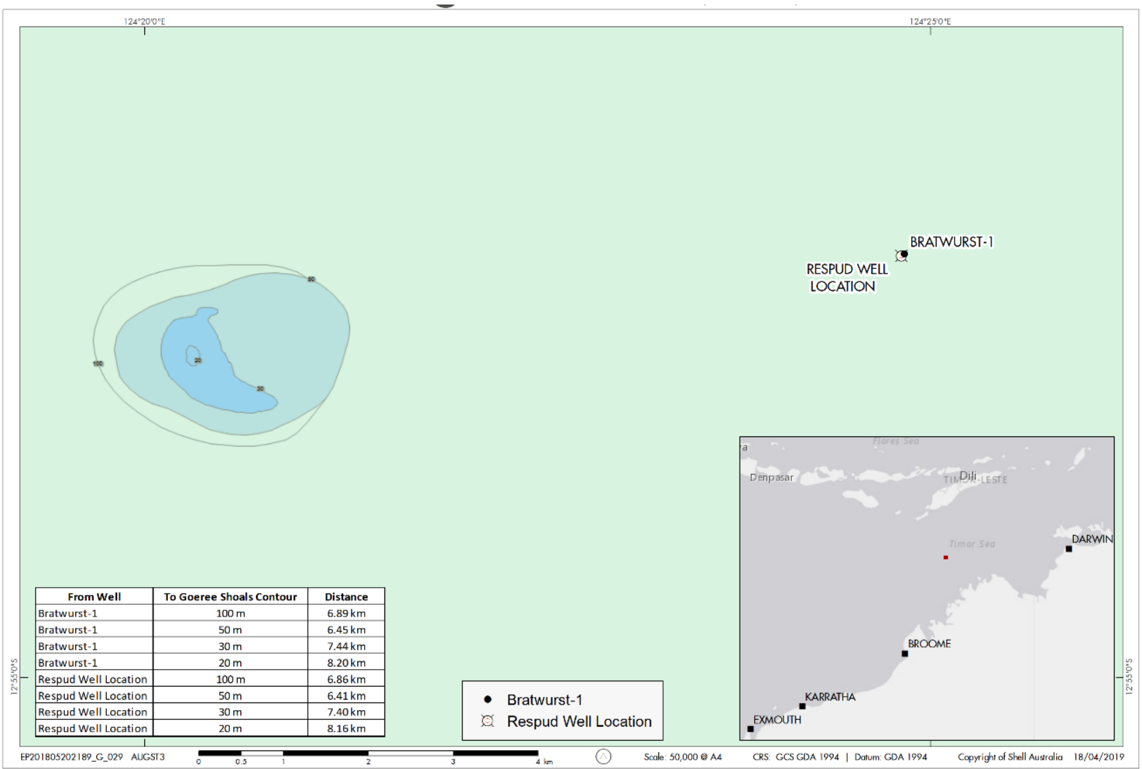
Sidetracking for this activity includes sidetracking due to operational challenges or planned redrilling of a hole section for the purposes of subsurface evaluation.

2.2.5.4 *Well Suspension*

Once drilling and initial formation evaluation is completed, the Bratwurst-1 well may be suspended to allow future evaluation as described above. Well suspension may involve subsurface abandonment i.e. installing sufficient permanent barriers to isolate formations with the potential for flow (cement), or alternatively a suspension with the 9-7/8" casing remaining in tact and the 9-7/8" seal assembly remaining as a barrier. Complete future abandonment of Bratwurst -1 will only include removing the wellhead, as per NOPSEMA requirements, installing sufficient permanent barriers to isolate formations with the potential for flow (cement).

2.2.5.5 *Respudding*

Respudding may be required if well problems result in it being impractical to continue to drill in the current well location. In this situation the MODU would be moved to another suitable location near the original well and top-hole drilling repeated. Well problems requiring a respud typically occur during riserless operations, where remediation options are more limited. Respudding will result in an increased volume of cuttings and slightly increased area of impacted seabed and benthic habitat.



From Well	To Goeree Shoals Contour	Distance
Bratwurst-1	100 m	6.89 km
Bratwurst-1	50 m	6.45 km
Bratwurst-1	30 m	7.44 km
Bratwurst-1	20 m	8.20 km
Respud Well Location	100 m	6.86 km
Respud Well Location	50 m	6.41 km
Respud Well Location	30 m	7.40 km
Respud Well Location	20 m	8.16 km

Figure 2 - 3: Location of Brawurst-1 and respud location relative to Goree Shoal

2.2.5.6 *9 7/8" Casing Installation*

To mitigate the potential losses and hole instability, during 12 1/4" hole drilling, a 9 7/8" casing string will be installed. This is not expected to result in an increase in drill cuttings, nor is it expected to result in an increase in cement discharged to the seabed as neither the 13 5/8" casing or the 9 7/8" casing are cemented to the seabed.

2.3 Details of MODU and AHTs

2.3.1 Semi-submersible MODU

A semi-submersible MODU is planned to be used for drilling. For the 2019 operation, the Ocean Apex has been contracted for use with mobilisation from the North West Shelf. The MODU is planned to be towed to the Operational Area by AHTs at a maximum speed of approximately 5 knots, and once on site will be moored via an anchor system. A 500 m petroleum safety zone will be in place around the MODU for maritime safety, in accordance with the OPGGS Act.

Table 2 – 4: Specifications of a Typical Semi-submersible MODU

Approximate size of MODU	90-100m long by 70-80m wide by 30m deep
Mooring system	Up to 12-point anchor system. Anchor spread up to 2,000m from MODU
Accommodation	Maximum capacity 200 persons
Power generation	Diesel Generators
Bulk mud and cement capacity	730.6 m^3 (25,800 ft^3)
Liquid mud capacity	1,603.4 m^3 (10,085 bbls)
Base Oil	476.9 m^3 (3,000 bbls)
Brine Storage	806.7 m^3 (5,074 bbls)
Fuel capacity	1,997.5 m^3 (12,564 bbls)
Drill water capacity	1,630.3 m^3 (10,254 bbls)
Potable water capacity	177.6 m^3 (1,117 bbls)

2.3.2 Project AHTs

It is expected approximately 2-3 vessels (depending on the size of the MODU) may be used to tow the MODU safely to the location of the proposed well. Once on location, AHTs will be used to deploy and accurately position the MODU's anchors. At least two AHTs are planned to support the MODU during drilling operations and make supply runs to and from the supply base to service the MODU. The Marine support activities for this programme will be based out of Broome WA and will interface with the Port of Broome throughout the Bratwurst drilling campaign. There is a one-way sailing time of approximately 36 hours between the Port of Broome and the Operational Area.

2.3.3 Other Support

2.3.3.1 *Helicopters*

Aviation support and crew changes to the MODU will be conducted through Broome International Airport via Djarajin (if required for refuelling purposes), and then 90 mins to location. However, airfields at Truscott, Derby and Curtin could also be used for alternate landing sites if certain weather conditions exist.

2.3.3.2 *Remotely Operated Vehicles (ROVs)*

ROVs may be deployed from the MODU and AHTs to undertake several support tasks prior to and during drilling operations, such as visual surveys of the seabed before drilling, installing the BOP, monitoring drilling, retrieving the BOP and visual surveys of the seabed after drilling. ROVs may also be used to assist if an incident occurs.

Hydraulic control fluids are used to operate ROVs and negligible amounts may be released to sea during some ROV functions such as opening/closing valves.

3 Environment Management Framework

3.1 Shell Global Framework

The Shell Commitment and Policy on HSSE & SP applies across Shell globally and is designed to protect people and the environment. The Shell HSSE & SP Policy is outlined below and is presented in **Appendix C**.

Key features of the policy are:

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

All Shell's operations are conducted in accordance with Shell's HSSE & SP Control Framework, a comprehensive corporate management framework. This Framework contains the HSSE and SP requirements that apply to every Shell company, contractor and joint venture under Shell's operational control. It contains a simplified set of mandatory requirements that define high level HSSE & SP principles and expectations, which are documented in a set of supporting manuals. The framework covers areas including contractor HSSE & SP management, safety, environment, health, security and social performance management systems.

The requirements of Shell's HSSE & SP Control Framework and Shell Australia HSSE & SP Management System are included in the Shell Australia Business Management System and are included in the contractual requirements for all contractors.

3.2 Applicable Legislation, Conventions and Other Regulations

A broad range of legislation, conventions and other regulations apply to the Bratwurst-1 drilling campaign and are outlined below. The specific aspects or components of the various requirements are referred to in later sections of this document as appropriate.

The well is in Commonwealth marine waters and is subject to Commonwealth legislation. The principal acts and regulations governing petroleum operations in Commonwealth waters are as follows:

- Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act);
- Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations);
- Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009;
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act); and
- Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations).

Other Commonwealth legislation of potential relevance to the proposed activity includes:

- Environment Protection (Sea Dumping) Act 1981;
- Protection of the Sea (Prevention of Pollution from Ships) Act 1983;
- Australian Maritime Safety Authority Act 1990;

- *Biosecurity Act 2015* and associated regulations – Australian ballast water management requirements;
- Navigation Act 2012; and
- Australian Maritime Safety Authority Act 1990.

The principal international agreement governing petroleum operations in both State and Commonwealth waters is the United Nations Convention on the Law of the Sea, 1982 (UNCLOS). Australia is also a signatory to several international conventions of potential relevance to the activity, including:

- The International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL 73/78);
- The Convention on Wetlands of International Importance (Ramsar 1975);
- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979;
- The International Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC 90);
- International Convention for the Safety of Life at Sea (SOLAS);
- The Protocol to International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (London Dumping Convention);
- The Convention for the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal 1989 (Basel Convention);
- Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS);
- The Japan Australia Migratory Birds Agreement (JAMBA);
- The Republic of Korea Migratory Birds Agreement (ROKAMBA);
- The China Australia Migratory Birds Agreement (CAMBA); and
- United Nations Framework Convention on Climate Change.

Guidance documents relevant to this EP include:

- National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009;
- Australian National Guidelines for Whale and Dolphin Watching 2017; and
- Australian Quarantine and Inspection Service Australian Ballast Water Management Requirements.

4 Description of the Existing Environment

4.1 Introduction

This section describes the key physical, biological, socio-economic and cultural characteristics of the existing environment that may be affected (EMBA) by the Bratwurst-1 drilling campaign, both from planned activities and unplanned events. The Operational Area defines the exposure zone for potential impacts predicted from planned activities, while the EMBA defines the exposure zone for risks and potential impacts from credible unplanned events.

The EMBA has been derived using the maximum extent of the exposure zone thresholds (**Table 5 - 32**) for hydrocarbons released to the marine environment in the event of the maximum credible loss of well containment spill scenario (**Section 5.6.4.2**). It is important to note that impacts are not expected to occur within the entire EMBA (Refer to **Section 5.6.4.1** for a discussion on stochastic modelling).

This approach has facilitated the conservative assessment of all environmental values and sensitivities that could potentially be affected by the Bratwurst-1 drilling campaign and has formed the basis of the EPBC Protected Matters search to identify listed threatened and/or migratory species which may occur within the area. Therefore, the description of the environment describes the environmental values and sensitivities, including all Matters of National Environmental Significance (MNES) as defined under the Commonwealth EPBC Act, within two areas:

- the Operational Area, which consists of the approximate well location (given this was determined prior to confirmation of the well location) and a 2,000 m buffer around this area (as defined in **Section 2.1.3**); and
- the EMBA, which comprises an area approximately 3,300 km west of the Operational Area (to account for spills that may occur during winter months), 1,400 km east of the Operational Area (spills during transitional months), 1,100 km north of the Operational Area (spills during summer months), and south of the Operational Area to parts of the Western Australian and Northern Territory coastline (all seasons) (Refer to **Table 5 - 33** and **Appendix B** for a summary of sensitive receptors that could be impacted in the event of a loss of containment spill).

The description provided in this section has informed a detailed evaluation of all impacts and risks associated with the project for the project, as presented in **Section 5**.

4.2 Physical Environment

4.2.1 Climate

The Browse Basin and Timor Sea region experience a tropical climate with two distinct monsoonal seasons, a winter or “dry” season from April to September and a summer or “wet” season from October to March (RPS 2017). This is a result of the two major atmospheric pressure systems of the region; a subtropical ridge of high pressure cells (highs or anticyclones) and a broad tropical low pressure (LP) region (the monsoon trough or inter-tropical convergence zone) (RPS 2017). The southeast trade winds originating over the mainland provide a steady easterly air flow to the region in the dry season. The monsoon trough is characterised by the reversal of these winds and brings high rainfall when it is near or over the mainland (RPS 2017).

Observations from the RPS (2017) metocean study, which comprised collection of 12 months of data in the offshore operational area, noted that air temperatures remained relatively stable, with mean monthly temperatures ranging between 27°C in August and 30°C in December (RPS 2017).

4.2.2 Oceanography

The oceanography of the Operational Area and the wider region is influenced by large scale ocean currents, monsoonal seasonality in wind and wave action, as well as storm and tropical cyclone events. The Operational Area is located within the North West Marine Region (NWMR), as defined by the Commonwealth Department of the Environment and Energy (DoEE), which experiences semi-diurnal tides. Tides (up to 5m) have been shown to strongly influence regional currents in the NWMR due to their large tidal range (Brewer et al. 2007; Ivey et al. 2016; RPS 2017). Notably, tidal amplitudes seem to be retained at large distances offshore and travel initially in a north-east direction in the deeper waters of the region (RPS 2017).

The Indonesian Throughflow (ITF) and Holloway surface currents are the predominant currents affecting the North West Shelf (NWS) from February through to June. The Holloway current is the prevailing seasonal current, travelling south-west along the north West Australian coast in winter and north-east in summer (Brewer et al. 2007). During this period the ITF produces flows of warm, low-salinity water onto the NWS (Shell 2014). The reversal of these currents caused by strong south-westerly winds at other times of the year may cause anti-clockwise circulation and a northward movement of water and upwellings of cold water onto the NWS (Department of Environment, Water, Heritage and the Arts (DEWHA) 2008a).

The NWMR is an area of high cyclone activity (Brewer et al. 2007). Tropical cyclones typically form in the Timor and Arafura Sea areas during an active monsoonal trough and are associated with torrential downpours and potentially destructive winds. While tropical cyclones commonly form during the summer season (October to March), they may also occur within transitional seasons. The average tropical cyclone frequency for the Timor and Arafura Seas region is one cyclone per year with cyclones most commonly occurring between November and April (Bureau of Meteorology (BoM) 2018c).

4.2.3 Bathymetry and Seabed Features

Water depths at the Operational Area range between approximately 140 m and 200 m (**Figure 4 – 1**). A survey to characterise the benthic habitat and map bathymetry and seabed characteristics was undertaken for the Crux project in 2017 (Fugro 2017a). The survey area was approximately 2 km southeast of the Operational Area and found the seabed to be generally relatively flat with a gentle gradient falling from the north-east toward the deeper south-west (**Figure 4 – 1**). Seabed morphology was typically smooth and absent of hard substrates, with predominantly sandy sediments observed (Fugro 2017a).

Gravelly sand with hard substrate and a large outcropping reef area was identified in the shallower north-eastern zone of the survey area (approximately 5 km east of the Operational Area). The outcropping reef structure is thought to be similar in origin to the many other shoals in the wider region of the Browse Basin, however lies at an approximate depth of 80 m (Fugro 2017a). Other seabed features observed across the surveyed area included clusters of pockmarks, sand waves, megaripples and some anchor drag scars (Fugro 2017a).

There are a number of Shoals proximal to the Operational Area with the closest being Goeree Shoal, with it’s 20 m depth plateau located approximately 1.4 km northwest of the Operational Area and 8 km from the Bratwurst-1 well location). Water depths surrounding Goeree Shoal reach 100 m at a distance of 80 m from the Operational Area and, given this, this the sensitive feature is not considered to overlap the Operational Area.

Seabed within the Operational Area is expected to be relatively flat and comprise of mainly soft sediments with little, if any, available hard substrate. A description of Goeree Shoal and other shoals in proximity to the Operational Area, as well as offshore reefs and islands is presented in **Section 4.3.2** and **4.3.3**.

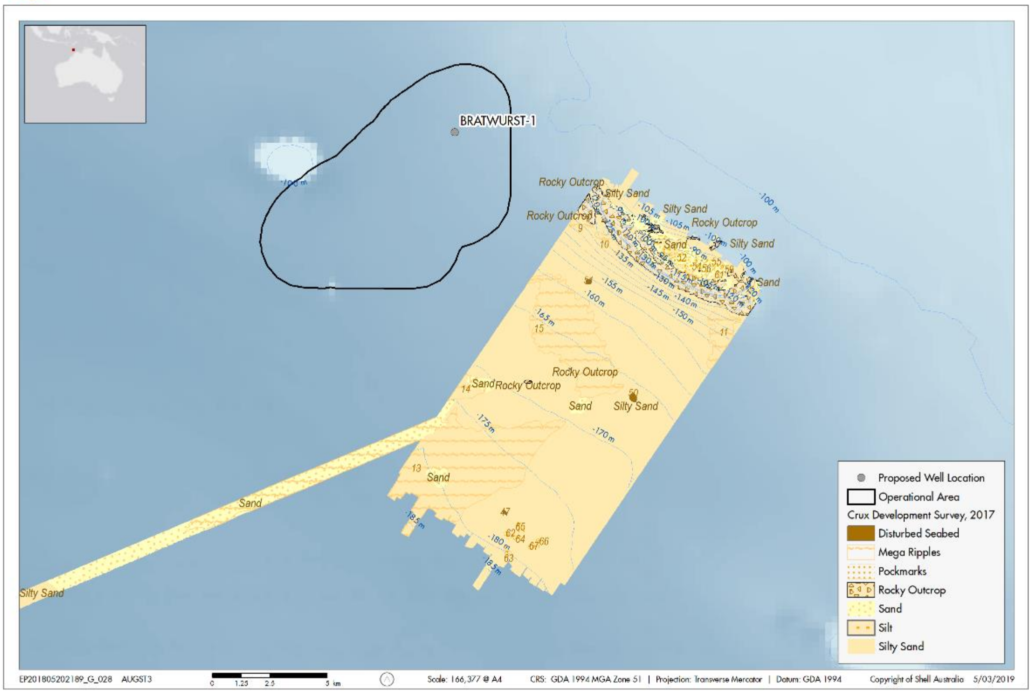


Figure 4 – 1: Bathymetry within and in proximity to the Operational Area (see Figure 4-2 for a more accurate depiction of the proximity of the Operational Area to Goeree Shoal)

4.2.4 Water Quality

Two separate surveys have been recently conducted by Shell Australia to assess water quality within the Browse Basin as part of the Crux project. The surveys sampled 24 sites within the Crux retention lease (AC/RL9) in April/May 2016 and October/November 2016 to reflect seasonality (AECOM 2016, 2017). The Operational Area is directly to the northwest of the Crux retention lease, with it expanding into the far northwest corner of the lease by approximately 150 m. The closest sampled site to the Operational Area is the northwest reference site (<1 km from the Operational Area), and all sites are <20 km from the Operational Area. Given this and that the water depth and general environmental conditions are similar within the Operational Area as in the Crux retention lease area, data collected as part of this survey is considered applicable to the Bratwurst-1 drilling campaign.

In summary, the surveys reported that water quality was of high quality (AECOM 2016, 2017). Temperature, salinity, pH and dissolved oxygen (DO) showed minor seasonal variation, however, overall measurements were relatively consistent across all sites and well within expected ranges when compared to previous studies in the region, such as Prelude (Shell 2009), Ichthys (INPEX 2010) and Barossa (ConocoPhillips 2018). Surface temperatures (in the shallow profile up to 10 m depth) ranged between approximately 30°C to 31 °C for both surveys (AECOM 2016, 2017).

Average surface salinities (0 m – 10 m) were recorded between 34 – 35 Practical Salinity Unit (PSU). Salinity was generally slightly lower near the seabed when compared to the surface waters. Turbidity was consistently low throughout the water column (< 1 NTU), which can be expected for offshore marine environments. Nutrient concentrations, including nitrite and nitrate, total nitrogen and total phosphorus, were consistently low across sites for both surveys, as were levels of photosynthetic pigments indicating little seasonal variation in these properties and no obvious nutrient loads.

4.2.5 Sediment Quality

In addition to the water quality surveys discussed in **Section 4.2.4**, Shell also assessed sediment quality during the October/November 2016 survey (AECOM 2017). The survey sampled 20 sites within the Crux retention lease. Three of these samples, northwest reference sites 1-3, are <1 km from the Operational Area and all sites <20 km from the Operational Area.

Concentrations of metals, hydrocarbons and radionucleotides were generally consistent across all sites, indicating no obvious existing anthropogenic impacts on sediment quality in the area. Across the Crux retention lease, sediment samples were typically characterised by medium to fine sands with variable amounts of silt and clay (5 to 42%). Particle Size Distribution (PSD) was variable across sites, with an expected higher percentage of fine sediments found at sites in deeper waters. Given that the depth of the Crux retention lease is shallower than that of the Operational Area (90 – 180 m versus 140 – 200 m in the Operational Area), The Operational Area is expected to be more similar to these deeper sites (i.e. comprise mainly fine sediments).

4.2.6 Air Quality

No specific information concerning air quality in the Operational Area is available. However, the location is approximately 190 km from the Kimberley coastline, which itself is a remote and unindustrialised area. Therefore, the air quality is unlikely to be subject to significant anthropogenic effects. Commercial shipping is likely to represent the main source of localised and temporary reductions in air quality. Production facilities in the broader region, such as the Montara FPSO facility (approximately 22 km northeast of the Operational Area), and the Prelude and Ichthys projects, are also expected to incrementally influence local and regional air quality.

4.3 Ecological Environment

4.3.1 Benthic Communities

Seafloor communities in offshore deeper waters, such as those found within the Operational Area, are generally expected to be less abundant and diverse than shallower coastal areas. Notably, the absence of hard substrate at depth in areas of soft sediment is also considered a limiting factor for the recruitment of epifaunal benthic communities (Shell 2009).

Camera observation and benthic grab surveys for benthic fauna and community characterisation were undertaken near the Operational Area within the Crux retention lease by Fugro (2017a) and AECOM (2017) (see **Section 4.2.3** to **4.2.5** for context of Crux retention least to the Operational Area). The towed video and camera survey was conducted in April/May, recording benthic communities along 10 transects. Grab sampling sites for the sediment benthic fauna analysis by AECOM (2017) were the same sites as for the sediment quality assessment summarised in **Section 4.2.5**. All sites are within 5 km of the Operational Area and similar depths. Given this and the similar depth profile within these two areas, benthic communities within the Operational Area are expected to be broadly the same as observed during these surveys.

In summary, the benthic surveys observed a very low fauna abundance (AECOM 2017). The dominant phyla were Annelida, Mollusca, Porifera and Arthropoda, as expected for the region. The amount of hard substrate present at each site appeared to have the greatest effect on the composition of the benthic community present (Fugro 2017a). Overall epifaunal abundance was low with some habitats having little to no visible fauna. Most habitats had low faunal abundance with a few characterising taxa. There were no evident spatial trends in benthic infauna based on sediment physicochemical attributes.

4.3.2 Shoals and Banks

There are a large number of shoals and banks within the Browse Basin and open offshore waters off northern Australia that have recognised biodiversity habitat value.

Shoals and banks are known to support highly diverse tropical communities and are generally similar in terms of seabed habitats, sediments, and biota; as are the drivers behind the species composition, diversity and abundance. Shoals/banks support many of the same species found on emergent reef systems of the Indo West Pacific region such as Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (Heyward et al. 2017b). This indicates a high level of ecological connectivity among the reef systems and between the shoals/banks.

While the benthic communities on each shoal/bank reveal a degree of connectivity, it is acknowledged that they may vary in the abundance and diversity of dominant benthic species, with subsets of species featuring more prominently on some than others (Heyward et al. 2017b). This variability may reflect different disturbance events (e.g. cyclones, storm damage and coral bleaching) and recruitment histories, as well as potentially different ecosystem trajectories (Heyward et al. 2017b).

The closest shoal to the Operational Area is Goeree Shoal. Distances from the Operational Area and Bratwurst-1 well location to the relevant depth contours associated with the shoal include:

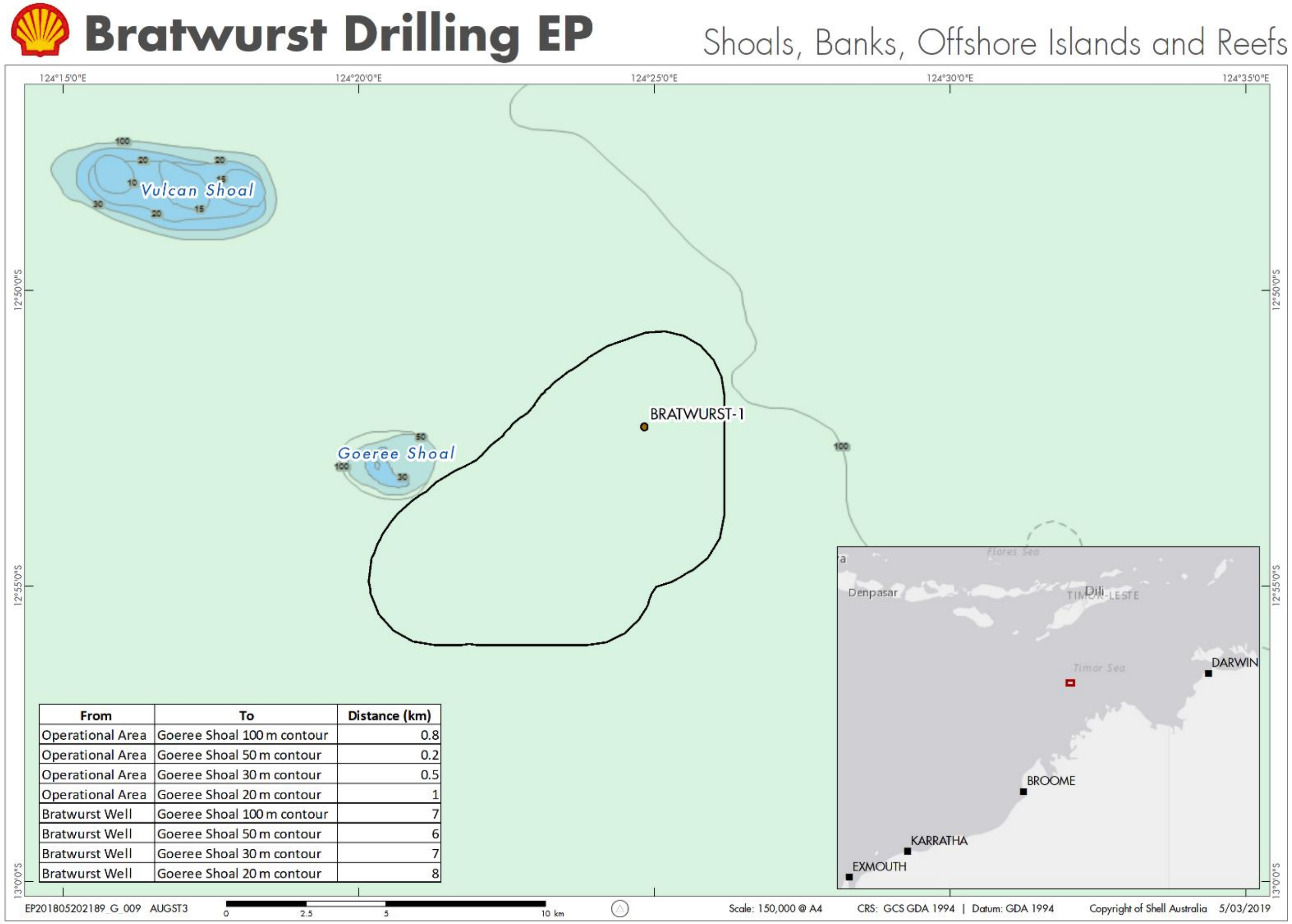
- 20 m depth plateau, located 1.4 km from the Operational Area and 8 km from the Bratwurst-1 well location; 30 m depth contour, located 480 m from the Operational Area and 7.4 km from the Bratwurst-1 well location;
- 50 m depth contour, located 220 m from the Operational Area and 6.4 km from the Bratwurst-1 well location; and
- 100 m depth contour (deepest contour associated with this shoal feature), located 80 m from the Operational Area and 6.9 km from the Bratwurst-1 well location.

Additional shoals in proximity to the Operational Area include (**Figure 4 – 2**):

- Vulcan Shoal – located approximately 12 km northwest of the Operational Area;
- Eugene McDermott Shoals – located approximately 23 km southeast of the Operational Area;
- Barracouta Shoals – located approximately 50 km northwest of the Operational Area; and
- Heywood Shoals – located approximately 65 km northwest of the Operational Area.

These shoals typically range in depth from approximately 16 m – 50 m below sea level and have steep sides which rise to plateau-like tops (Heyward et al. 2012; Heyward et al. 2017b). Eugene McDermott Shoal has the deepest plateau ranging from approximately 19 m to 60 m depth. The size of the shoals' plateaus ranges from small areas of < 3 km^2 (Goeree Shoal) up to approximately 32 km^2 (Heywood Shoal) (Heyward et al. 2012).

In summary, the benthic communities across shoals in proximity to the Operational Area have been found to be typical of shallow tropical reef systems in the region, with many coral and algae species shared between the shoals and the emergent coral reefs (Heyward et al. 2012).



From	To	Distance (km)
Operational Area	Goeree Shoal 100 m contour	0.8
Operational Area	Goeree Shoal 50 m contour	0.2
Operational Area	Goeree Shoal 30 m contour	0.5
Operational Area	Goeree Shoal 20 m contour	1
Bratwurst Well	Goeree Shoal 100 m contour	7
Bratwurst Well	Goeree Shoal 50 m contour	6
Bratwurst Well	Goeree Shoal 30 m contour	7
Bratwurst Well	Goeree Shoal 20 m contour	8

Figure 4 – 2: Shoals and Banks, and Offshore Islands / Reefs in proximity to the Operational Area

4.3.3 Offshore Reefs and Islands

There are no known offshore reefs or islands within or near the Operational Area. However, there are several emergent oceanic reefs and islands within the EMBA (**Figure 4 – 2**). The following list provides a brief description reefs and islands in proximity to the Operational Area:

- Cartier Island lies approximately 86 km northwest of the Operational Area. Cartier Island is an un-vegetated sand cay surrounded by a wide platform, that rises steeply from the seabed, and fringing coral reef flats (ConocoPhillips 2018). The coarse sandy beaches of the island support large populations of nesting green turtles. The island and surrounding reefs are protected by the Cartier Island Marine Park (**Section 4.5.8**).
- Ashmore Reef is located approximately 135 km northwest of the Operational Area. Ashmore Reef is a large platform reef complex containing an atoll-like structure with two lagoons, large areas of drying flats that become exposed at low tide, shifting sand banks and three vegetated sandy cays: West Island (281,000 km^2), East Island (134,200 km^2), and Middle Island (129,800 km^2) (ConocoPhillips 2018). The area is protected by the Ashmore Reef Marine Park (**Section 4.5.8**) and is also a designated Ramsar wetland of international significance (**Section 4.5.7**).
- Hibernia Reef is located approximately 140 km northwest of the Operational Area. The reef complex contains a deep central lagoon and drying sand flats, however, is less extensive than that at Ashmore Reef and Cartier Island (ConocoPhillips 2018; Shell 2009). There is no permanent land at Hibernia Reef, however, large areas of the reef are exposed at low tide.
- Browse Island lies approximately 152 km southwest of the Operational Area. The island and surrounding waters within three nautical miles are WA State Territorial Waters. Browse Island is a sand and limestone cay situated on a limestone and coral reef, covering an area of 13 ha (0.13 km^2) (Shell 2009). The island is a known turtle nesting site for green turtles.

Other notable reefs and islands within Australia which the EMBA overlaps include Seringapatam Reef, Scott Reef (both recognised as Key Ecological Features (KEFs) (**Section 4.3.6**), Adele Island, the Tiwi Islands, as well as Christmas Island, and Cocos (Keeling) Islands. Although some of these islands are significantly distant from the Operational Area. Outside of Australian waters the EMBA overlaps Timor-Leste and a number of islands within the southern Indonesian provinces of Maluku and East Nusa Tenggara. The environmental values of these areas are discussed further in **Sections 4.3.5** and **4.5.10**.

4.3.4 WA and NT Mainland Coastline

The WA and NT mainland coastlines are only of relevance in the context of the areas of the coastline within the EMBA that may be contacted in an unlikely unplanned event resulting in a large-scale release of hydrocarbons (see **Section 5.6.4**).

The Operational Area is located 190 km from the nearshore and coastal environments of the Kimberley on the WA coastline. The Kimberley coastline supports a diverse array of marine habitats and communities including coral reefs, sandy beaches, rocky shores, seagrass meadows, mangroves, sponge gardens, wetlands, estuaries, creeks and rivers (Department of Environment and Conservation (DEC) 2009a). These environments in turn support several fauna, including EPBC listed seabirds and migratory shorebirds, turtles, sea snakes, dugongs, cetaceans, fish, sharks and rays (DEC 2009a). The values and sensitivities of the Kimberley coastline are considered representative of those for the extended northern WA coastal area.

The NT coastline, located more than 550 km east of the Operational Area, supports a variety of marine habitats including coral reefs, seagrass meadows, mangroves and sand or mudflats (NT Government 2018a). These coastal habitats in turn provide important areas for breeding, nursery and foraging for numerous marine species such as fish, marine turtles, cetaceans, dugongs and sharks (NT Government 2018a).

Threatened marine species that occur within the EMBA where it is predicted to contact the WA/NT mainland coastline are described in **Section 4.4.1.**

The WA/NT nearshore and coastal areas provide Indigenous and European heritage value, as well as cultural, social and economic values such as local tourism and recreation. The nearshore and coastal habitats also support culturally and commercially significant marine fauna species such as marine turtles, dugongs, fish and prawns (DEC 2009a).

4.3.5 Indonesian and Timor-Leste Coastlines

The Indonesian and Timor-Leste Coastlines are located approximately 250 km and 380 km north of the Operational Area at their closest points. The EMBA overlaps Timor-Leste as well as islands within the East Nusa Tengarra, Maluku and West Java provinces of Indonesia.

Indonesia is the world's largest archipelagic state and Indonesian waters play an important role in the global water mass transport system (Asian Development Bank (ADB) 2014). Indonesia boasts some of the most biologically rich coral reefs in the world with over 590 coral species having been identified. These coastal reefs are a primary source of food and income for coastal communities, as well as forming an integral part of the country's tourism industry (ADB 2014).

In addition to coral reefs, coastal habitats include extensive seagrass meadows, which provide habitat and foraging grounds for marine animals including dugongs and marine turtles, and mangroves, of which Indonesia has the highest plant, animal and microorganism mangrove ecosystem diversity in the world (ADB 2014). There are also numerous cetacean species in Indonesian coastal waters.

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

4.3.6 Key Ecological Features

KEFs are elements of the Commonwealth marine environment that are considered to be of regional importance for either the marine region's biodiversity or its ecosystem function and integrity. A number of KEFs occur within or adjacent to the EMBA, however, no KEFs overlap the Operational Area (**Figure 4 – 3**). A summary of the KEFs is provided in **Table 4 – 1** (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a; 2012b).

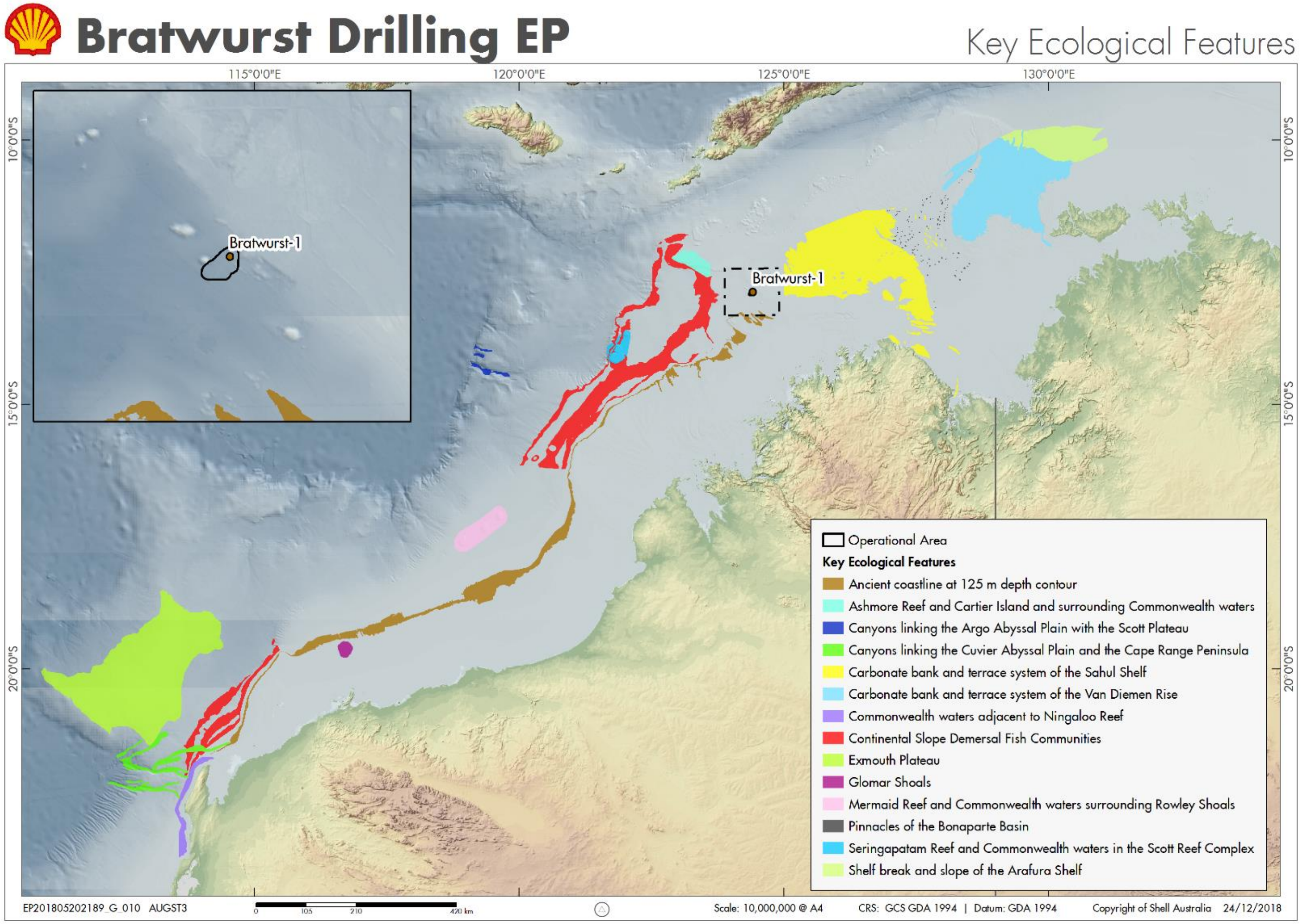


Figure 4 – 3: Key Ecological Features

Table 4 – 1: KEFs Overlapping the EMBA

KEF	Proximity to the Operational Area	Summary of Key Values
Ancient coastline at 125 m depth contour	Located approximately 36 km south of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* The areas of hard substrate along this ancient coastline, which follows the 125 m depth contour, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments; thereby providing for higher species diversity and richness relative to the wider region. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment. The KEF encompasses an area of approximately 16,190 km^2.
Continental slope demersal fish communities	Located approximately 61 km west of the Operational Area	*Communities with high species biodiversity and endemism* There is a high diversity of demersal fish assemblages on the Australian continental slope from the North West Cape to the edge of the NMR. Specifically, the continental slope between North West Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in the whole of Australia (DEHWA 2008). The Timor Province and Northwest Transition bioregions, in which the Operational Area and near EMBA is located, are the second-richest areas for demersal fish across the entire continental slope. The KEF covers a vast area of approximately 33,182 km^2.
Carbonate bank and terrace system of the Sahul Shelf	Located approximately 61 km east of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* While little is known about this KEF, the carbonate banks and terrace system of the Sahul Shelf is considered regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds, largely due to the presence of elevated hard substrates. The seabed features are thought to create enhanced productivity and biodiversity because of upwellings of cold nutrient-rich water at the heads of the channels. The KEF covers an area of approximately 41,158 km^2. The banks rise to depths of 150 m – 300 m and are separated from each other by narrow meandering channels which are up to 150 m deep. The hard substrates of the banks are thought to support a high diversity of organisms including reef-fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter feeders.
Ashmore Reef and Cartier Islands and surrounding Commonwealth waters	Located approximately 86 km northwest of the Operational Area	*High productivity and aggregations of marine life* Ashmore Reef is the largest of only three emergent oceanic reefs present within the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The emergent reefs are known to provide areas of enhanced primary productivity in otherwise oligotrophic environments. Ashmore Reef and Cartier Islands and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of seabirds and shorebirds, and other marine life. Ashmore Reef regularly supports more than 40,000 waterbirds (those ecologically dependant on wetlands) and is estimated to support as many as 100,000 seabirds in a twelve-month period (Hale 2013). The marine habitats supported by the reefs are nationally and internationally significant, providing habitat for diverse and abundant marine reptile (including feeding, nesting and

KEF	Proximity to the Operational Area	Summary of Key Values
		internesting areas for green, hawksbill and loggerhead turtles) and marine mammal populations, including dugongs. Species at Ashmore and Cartier include more than 225 reef-building corals, 433 molluscs, 286 crustaceans, 192 echinoderms, and 709 species of fish. Thirteen species of sea snakes occur in high numbers at Ashmore and Cartier reefs but are in decline. Additionally, Ashmore Reef supports the highest number of coral species of any reef off the WA coast and plays a primary role in the maintenance of the biodiversity of reef systems in the region.
Seringapatam Reef and Commonwealth waters in the Scott Reef complex	Located approximately 255 km southwest from the Operational Area	*High productivity and aggregations of marine life* The coral communities at Seringapatam and Scott Reefs play a key role in maintaining species richness and aggregations of marine life. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species, around 720 fish species and several species of sea snakes.
Pinnacles of the Bonaparte Basin	Located approximately 303 km east of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* The limestone pinnacles in the western Bonaparte Depression are expected to support a diverse community in an otherwise oligotrophic system. More than 110 pinnacles occur in the Bonaparte Depression, covering a total area of more than 520 km^2. The pinnacles are thought to be the eroded remnants of underlying strata and can be up to 50 m high and 50 km–100 km long.
Carbonate bank and terrace system of the Van Diemen Rise	Located approximately 426 km northeast of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* The bank and terrace system of the Van Diemen Rise covers approximately 31,278 km^2 and forms part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east. The complex topographic features of the area consist largely of raised geomorphic features (e.g. terraces and banks) with relatively high proportions of hard substrate, supporting sponge and octocoral gardens.
Shelf break and slope of the Arafura Shelf	Located approximately 626 km northeast of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* The shelf break and slope of the Arafura Shelf is described as a biogeographic crossroad of biota from the Timor-Indonesian-Malay region. Demersal fish communities are diverse, and the area is likely to support whale sharks, sharks and marine turtles.
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	Located approximately 668 km southwest of the Operational Area	*High productivity and aggregations of marine life* The Rowley Shoals consist of three atoll reefs; Clerke, Imperieuse and Mermaid Reef which support 214 coral species and around 530 species of fish. The steep changes in slope around the reef also attract a range of migratory pelagic species such as dolphins, tuna, billfish and sharks.
Canyons linking the Argo Abyssal Plain with Scott Plateau	Located approximately 517 km southwest of the Operational Area	*High productivity and aggregations of marine life* Canyons linking the Argo Abyssal Plain with Scott Plateau covers an area of approximately 836 km^2. The ocean area above the canyons is thought to be an area of moderately enhanced productivity, attracting aggregations of fish, sharks, toothed whales and dolphins.

KEF	Proximity to the Operational Area	Summary of Key Values
Tributary Canyons of the Arafura Depression	Located approximately 992 km northeast of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* The canyons are remnants of Pleistocene era river systems, of which the largest canyon extends approximately 400 km into the Arafura Depression. Marine life identified within the KEF includes marine turtles, deep sea sponges, barnacles and stalked crinoids.
Glomar Shoals	Located approximately 1,090 km southwest of the Operational Area	*High productivity and aggregations of marine life* The Glomar Shoals (approximately 786 km^2) are a submerged littoral feature located approximately 150 km north of Dampier on the Rowley shelf at depths of 33 m – 77 m. While biological data is limited, the fish of Glomar Shoals are believed to be a subset of reef-dependent species.
Exmouth Plateau	Located approximately 1,276 km southwest of the Operational Area	*Unique seafloor feature with ecological properties of regional significance* Due to its large size (approximately 49,310 km^2), the plateau is thought to modify deepwater flow and be associated with the generation of internal tides in the Exmouth region. These oceanic processes may contribute to the upwelling of nutrients, which result in areas of increased productivity.
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	Located approximately 1,404 km southwest of the Operational Area	*Unique seafloor features with ecological properties of regional significance* The nutrient-rich and high productivity waters of the KEF are associated with aggregations of whale sharks, manta rays and sharks, humpback whales, sea snakes, sharks, large predatory fish and seabirds. The canyons are thought to connect to the Commonwealth waters adjacent to Ningaloo Reef, as well as the Exmouth Plateau.
Commonwealth waters adjacent to Ningaloo Reef	Located approximately 1,451 km southwest of the Operational Area	*High productivity and aggregations of marine life* Ningaloo Reef is of global significance as it is the only coral reef in the world that fringes the west coast of a continent and is a seasonal aggregation site for the whale shark. The reef supports aggregations and migration pathways of whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish and seabirds.

4.3.6.1 *Anthropogenic Pressures*

The DoEE Commonwealth Marine Report Cards for the North and North-west Marine Regions (NWMRs) provide a high-level analysis of the anthropogenic pressures on the KEFs (DSEWPaC 2012a; 2012b). The analysis defines five categories in which each pressure impacts on the designated KEF including 'of concern', 'of potential concern', 'of less concern', 'not of concern' and 'data deficient or not assessed'.

For the purposes of this EP only pressures applicable to the Bratwurst-1 drilling campaign activities outlined in **Section 5** have been considered. Given no KEFs overlap the Operational Area, the only relevant pressure to these receptors is hydrocarbon pollution from rigs. **Table 4 – 2** outlines the risk category from hydrocarbon pollution for all KEFs overlapping the EMBA. From this, hydrocarbon pollution is considered a credible risk to four KEFs (listed as 'Of potential concern'). A detailed assessment of the potential impact to these KEFs from oil pollution is provided in **Section 5.6.4**.

Table 4 – 2: Relevant Pressures to KEFs from the Bratwurst-1 Drilling Campaign

Pressure	Risk Category
Ancient coastline at 125 m depth contour	Of less concern
Continental slope demersal fish communities	Data deficient or not assessed
Carbonate bank and terrace system of the Sahul Shelf	Not of concern
Ashmore Reef and Cartier Islands and surrounding Commonwealth waters	Of potential concern
Seringapatam Reef and Commonwealth waters in the Scott Reef complex	Of potential concern
Pinnacles of the Bonaparte Basin	Not of concern
Carbonate bank and terrace system of the Van Diemen Rise	Not of concern
Shelf break and slope of the Arafura Shelf	Not of concern
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	Of potential concern
Canyons linking the Argo Abyssal Plain with Scott Plateau	Not of concern
Tributary Canyons of the Arafura Depression	Of potential concern
Glomar Shoals	Of less concern
Exmouth Plateau	Not of concern
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	Of less concern
Commonwealth waters adjacent to Ningaloo Reef	Of potential concern

4.4 Threatened Species and Ecological Communities

4.4.1 EPBC Listed Threatened Species

An online EPBC Protected Matters Database Search was conducted for both the Operational Area and the EMBA (**Table 4 – 3**; DoEE 2018a). A summary of the results is presented below:

- Operational Area – the search identified 20 listed threatened fauna species and 33 listed migratory species (17 of which are also listed as threatened) that may occur or have habitat in the area (DoEE 2018b); and
- EMBA – the search identified 37 listed threatened fauna species and 84 listed migratory species (25 of which are also listed as threatened) that may occur or have habitat in the area (DoEE 2018c). Eighty-one species were excluded from **Table 4 – 3** as they are not considered relevant to the project given they are commonly associated with terrestrial habitats that are generally not present on shorelines (e.g. wetlands, forests).

The EPBC Protected Matters results also lists a number of marine and other cetacean species which are not listed as MNES under the EPBC Act. Refer to **Appendix A** for further details. The EPBC Act also lists species which are considered conservation dependent, however, these species are not considered MNES for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals). Two conservation dependent species overlap the Operational Area and EMBA, the scalloped hammerhead (*Sphyrna lewini*) and the southern bluefin tuna (*Thunnus maccoyii*).

An additional four marine bird species are also known to breed at Ashmore Reef; the eastern great egret (*Ardea modesta*), little egret (*Egretta garzetta*), eastern reef egret (*Egretta sacra*) and nankeen night-heron (*Nycticorax caledonicus*) (Clarke et al. 2011).

Table 4 – 3: EPBC Listed Threatened and Migratory Species of Potentially Occurring within the Operational Area and EMBA

Species	Threatened Status	Listed as Migratory	Search Area	
			Operational Area	EMBA
Marine Mammals				
Sei whale (*Balaenoptera borealis*)	Vulnerable	X	X	X
Blue whale (*Balaenoptera musculus*)	Endangered	X	X	X
Fin whale (*Balaenoptera physalus*)	Vulnerable	X	X	X
Humpback whale (*Megaptera novaeangliae*)	Vulnerable	X	X	X
Southern right whale (*Eubalaena australis*)	Endangered	X		X
Antarctic minke whale (*Balaenoptera bonaerensis*)		X		X
Bryde's whale (*Balaenoptera edeni*)		X	X	X
Killer whale (*Orcinus orca*)		X	X	X
Sperm whale (*Physeter macrocephalus*)		X	X	X
Spotted bottlenose dolphin (*Tursiops aduncus*)		X	X	X
Dugong (*Dugong dugon*)		X		X
Australian snubfin dolphin (*Orcaella heinsohni*) (formally known as the Irrawaddy dolphin, *O. brevirostris*)		X		X
Indo-Pacfic humpback dolphin (*Sousa chinensis*)		X		X
Marine Reptiles				
Loggerhead turtle (*Caretta caretta*)	Endangered	X	X	X
Green turtle (*Chelonia mydas*)	Vulnerable	X	X	X
Leatherback turtle (*Dermochelys coriacea*)	Endangered	X	X	X
Hawksbill turtle (*Eretmochelys imbricata*)	Vulnerable	X	X	X
Olive ridley turtle (*Lepidochelys olivacea*)	Endangered	X	X	X
Flatback turtle (*Natator depressus*)	Vulnerable	X	X	X
Short-nosed sea snake (*Aipysurus apraefrontalis*)	Critically Endangered			X

Species	Threatened Status	Listed as Migratory	Search Area	
			Operational Area	EMBA
Leaf-scaled sea snake (*Aipysurus foliosquama*)	Critically Endangered			X
Salt-water Crocodile, Estuarine Crocodile (*Crocodylus porosus*)		X		
Birds				
Australian lesser noddy (*Anous tenuirostris melanops*)	Vulnerable		X	X
Red knot (*Calidris canutus*)	Endangered	X	X	X
Curlew sandpiper (*Caladris ferruginea*)	Critically Endangered	X	X	X
Eastern curlew (*Numenius madagascariensis*)	Critically Endangered	X	X	X
Abbott's booby (*Papasula abbotti*)	Endangered		X	X
Great knot (*Calidris tenuirostris*)	Critically Endangered	X		X
Greater sand plover (*Charadrius leschenaultii*)	Vulnerable	X		X
Lesser sand plover (*Charadrius mongolus*)	Endangered	X		X
Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri*)	Vulnerable			X
Northern siberian bar-tailed godwit (*Limosa lapponica menzbieri*)	Critically Endangered			X
Southern giant-petrel (*Macronectes giganteus*)	Endangered	X		X
Soft-plumaged petrel (*Pterodroma mollis*)	Vulnerable			X
Christmas Island frigatebird (*Fregata andrewsi*)	Endangered	X		X
Campbell albatross (*Thalassarche impavida*)	Vulnerable	X		X
Australian fairy tern (*Sternula nereis nereis*)	Vulnerable			X
Round Island petrel (*Pterodroma arminjoniana*)	Critically Endangered			X
Common noddy (*Anous stolidus*)		X	X	X
Fork-tailed swift (*Apus pacificus*)		X		X
Flesh-footed shearwater (*Ardenna carneipes*)		X		X

Species	Threatened Status	Listed as Migratory	Search Area	
			Operational Area	EMBA
Wedge-tailed shearwater (*Ardenna pacifica*)		X		X
Streaked shearwater (*Calonectris leucomelas*)		X	X	X
Lesser frigatebird (*Fregata ariel*)		X	X	X
Greater frigatebird (*Fregata minor*)		X	X	X
Caspian tern (*Hydroprogne caspia*)		X		X
Bridled tern (*Onychoprion anaethetus*)		X		X
White-tailed tropicbird (*Phaethon lepturus*)		X		X
Red-tailed tropicbird (*Phaethon rubricauda*)		X		X
Roseate tern (*Sterna dougallii*)		X		X
Little tern (*Sterna albifrons*)		X		X
Masked booby (*Sula dactylatra*)		X		X
Brown booby (*Sula leucogaster*)		X		X
Red-footed booby (*Sula sula*)		X		X
Oriental reed-warbler (*Acrocephalus orientalis*)		X		X
Common sandpiper (*Actitis hypoleucos*)		X	X	X
Ruddy turnstone (*Arenaria interpres*)		X		X
Sharp-tailed sandpiper (*Calidris acuminata*)		X	X	X
Sanderling (*Calidris alba*)		X		X
Pectoral sandpiper (*Calidris melanotos*)		X	X	X
Oriental plover (*Charadrius veredus*)		X		X
Oriental Pratincole (*Glareola maldivarum*)		X		X
Bar-tailed godwit (*Limosa lapponica*)		X		X
Black-tailed godwit (*Limosa limosa*)		X		X

Species	Threatened Status	Listed as Migratory	Search Area	
			Operational Area	EMBA
Whimbrel (*Numenius phaeopus*)		X		X
Osprey (*Pandion haliaetus*)		X		X
Grey plover (*Pluvialis squatarola*)		X		X
Crested tern (*Thalasseus bergii*)		X		X
Common greenshank (*Tringa nebularia*)		X		X
Red-necked stint (*Calidris ruficollis*)		X		X
Long-toed stint (*Calidris subminuta*)		X		X
Little ringed plover (*Charadrius dubius*)		X		X
Swinhoe's snipe (*Gallinago megala*)		X		X
Pin-tailed snipe (*Gallinago megala*)		X		X
Broad-billed sandpiper (*Limocola falcinellus*)		X		X
Asian dowitcher (*Limnodromus semipalmatus*)		X		X
Little curlew (*Numenius minutus*)		X		X
Pacific Golden Plover *(Pluvialis fulva)*		X		X
Grey-tailed tattler *(Tringa brevipes)*		X		X
Wood sandpiper *(Tringa glareola)*		X		X
Wanderling tattler (Tringa incana)		X		X
Marsh sandpiper *(Tringa stagnatilis)*		X		X
Terek sandpiper *(Xenus cinereus)*		X		X
Sharks and Rays				
Great white shark (*Carcharodon carcharias*)	Vulnerable	X	X	X
Northern river shark (*Glyphis garricki*)	Endangered		X	X
Largetooth/Freshwater sawfish (*Pristis pristis*)	Vulnerable	X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Operational Area	EMBA
Green sawfish (*Pristis zijsron*)	Vulnerable	X	X	X
Whale shark (*Rhincodon typus*)	Vulnerable	X	X	X
Grey nurse shark (*Charcharius taurus*)	Vulnerable			X
Speartooth shark (*Glyphis glyphis*)	Critically Endangered			X
Dwarf sawfish (*Pristis clavata*)	Vulnerable	X		X
Shortfin mako (*Isurus oxyrinchus*)		X	X	X
Longfin mako (*Isurus paucus*)		X	X	X
Reef manta ray (*Manta alfredi*)		X	X	X
Giant manta ray (*Manta birostris*)		X	X	X
Narrow sawfish (*Anoxypristis cuspidata*)		X	X	X

4.4.2 EPBC Listed Threatened Communities

The EPBC Protected Matters Database does not list any Threatened Ecological Communities (TECs) occurring in the marine environment within the Operational Area or EMBA (DoEE 2018b).

4.4.3 Biologically Important Areas

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

A review of the DoEE National Conservation Values Atlas (an interactive web-based tool which supports the implementation of Marine Bioregional Plans) (DoEE 2018f) determined that the Operational Area is located within a BIA for whale sharks. The whale shark is listed as vulnerable under the EPBC Act and is discussed in detail in **Section 4.4.5**. No other BIAs are intersected or overlapped by the Operational Area.

The EMBA includes a number of BIAs including migration corridors for pygmy blue whales and humpback whales; breeding, calving and foraging areas for the three nearshore dolphin species; nursing/foraging areas for dugongs; foraging and nesting/internesting areas for marine turtles; breeding/foraging/resting areas for a number of seabird and shorebird species; and a migration corridor for whale sharks. These BIAs are discussed under the relevant species-specific sections in **Section 4.4.5**.

4.4.4 Habitat Critical to the Survival of a Species

The EPBC Act Significant Impact Guidelines 1.1 – MNES (DoE 2013a) define 'habitat critical to the survival of a species' as areas necessary:

- "for activities such as foraging, breeding or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species);
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species."

Such habitat may be, but is not limited to, habitat identified in a recovery plan and/or habitat listed on the Register of Critical Habitat.

The Operational Area does not overlap any habitat critical to the survival of a species. Within the EMBA Ashmore Reef, Cartier Island and Browse Island provide nesting habitat critical to the green turtle. Other mainland and island coastlines within the EMBA also provide habitat critical to the flatback turtle, green turtle, leatherback turtle, loggerhead turtle, and olive ridley turtle. Further discussion of habitat critical to the survival of marine turtles is provided in **Section 4.4.5**.

4.4.5 Key Fauna Species of Relevance to the Bratwurst-1 Drilling Campaign

4.4.5.1 *Marine Mammals*

Marine mammals are generally widely distributed and highly mobile. In general, distribution patterns reflect seasonal feeding areas, characterised by high productivity, and migration routes associated with reproductive patterns.

Eight migratory species listed under the EPBC Act, including baleen whales, toothed whales and dolphins, were identified as potentially occurring or having habitat within the Operational Area and wider EMBA (**Table 4 – 3**). This includes four threatened species; the blue whale, humpback whale, sei whale and fin whale. An additional three listed migratory species were identified as potentially occurring or having habitat within the EMBA; the dugong, Australian snubfin dolphin and Indo-Pacific humpback dolphin.

Of those species identified in the EPBC Protected Matters search, the pygmy blue whale and humpback whale are most likely to occur in the Operational Area based on historical distribution and habitat preference; albeit in low numbers. The species of primary relevance, and other threatened marine mammal species that may traverse through the Operational Area, are discussed in detail below.

Whales

Pygmy Blue Whale

The pygmy blue whale is known to migrate along the WA shelf edge at depths between the 500 m and 1,000 m depth contours from the North West Cape south to Geographe Bay (DoE 2015a). The species has also been opportunistically sighted in the NWMR region during offshore surveys (pers. Comm. R. Clarke, Monash University, 2018).

A migration corridor BIA is recognised in the deep offshore waters off WA (DoEE 2018f). The northerly migration toward the calving grounds near the equator occurs in March/April to June (DoE 2015a). Noise monitoring for the Barossa project, which is located in the Timor Sea approximately 710 km northeast of the Operational Area, detected the presence of blue whales in the months of May to August during their northbound seasonal migration (McPherson et al. 2016). The southerly migration to the feeding grounds in the high-latitudes of the southern hemisphere occurs in September/October to December (DoE 2015a). Pygmy blue whales appear to travel as individuals or in small groups when making their migrations, based on acoustic data from noise loggers deployed around Scott Reef for the Woodside Browse project (Woodside 2014).

A foraging BIA encompassing Seringapatam Reef, Scott Reef and the open waters to the west of these features overlaps the EMBA, as shown in **Figure 4 – 4**. These steep gradient reef-features tend to stimulate upwelling and, in turn, increased productivity (seasonally variable) which provides a favourable foraging area (ConocoPhillips 2018).

Based on the known distribution, preferred feeding habitats and migration pathways of pygmy blue whales, individuals of the species may be encountered in low numbers within the Operational Area and are expected to occur within the EMBA during their seasonal migrations.

Humpback Whale

The humpback whale has a wide distribution with recordings throughout Australian Antarctic waters and offshore from all Australian states (Bannister et al. 1996). The species migrates between summer feeding grounds in Antarctica and winter breeding and calving grounds in the sub-tropical and tropical inshore waters of north-west Australia (Jenner et al. 2001). A migration BIA for humpback whales is recognised in nearshore waters (<100 km) along the WA coast from west of Esperance to 100 km north of Broome (DoEE 2018f). The northbound migration peaks between late July and early August, and the southbound migration peaks between late August and early September (Jenner et al. 2001).

Humpback whales breed and calve in the NWMR between Broome and the northern end of Camden Sound in the months of June to September each year (DoE 2015b; DoEE 2018g). The nearshore waters adjacent to the northern half of the Dampier Peninsula and encompassing Camden Sound are considered important for humpback whale nursing, calving and resting. Each of these areas have been defined as BIAs which overlap the EMBA (**Figure 4 – 4**; DoEE 2018g). Relatively few humpback whales have been known to travel north of Camden Sound (Jenner et al. 2001). Noise monitoring undertaken for the Barossa project, which is located within the NMR, did not detect any humpback whale calls in the Timor Sea (McPherson et al. 2016).

Based on their known distribution and movements, humpback whales may be encountered in low numbers within the Operational Area and are expected to occur in high numbers within the EMBA during their seasonal migrations.

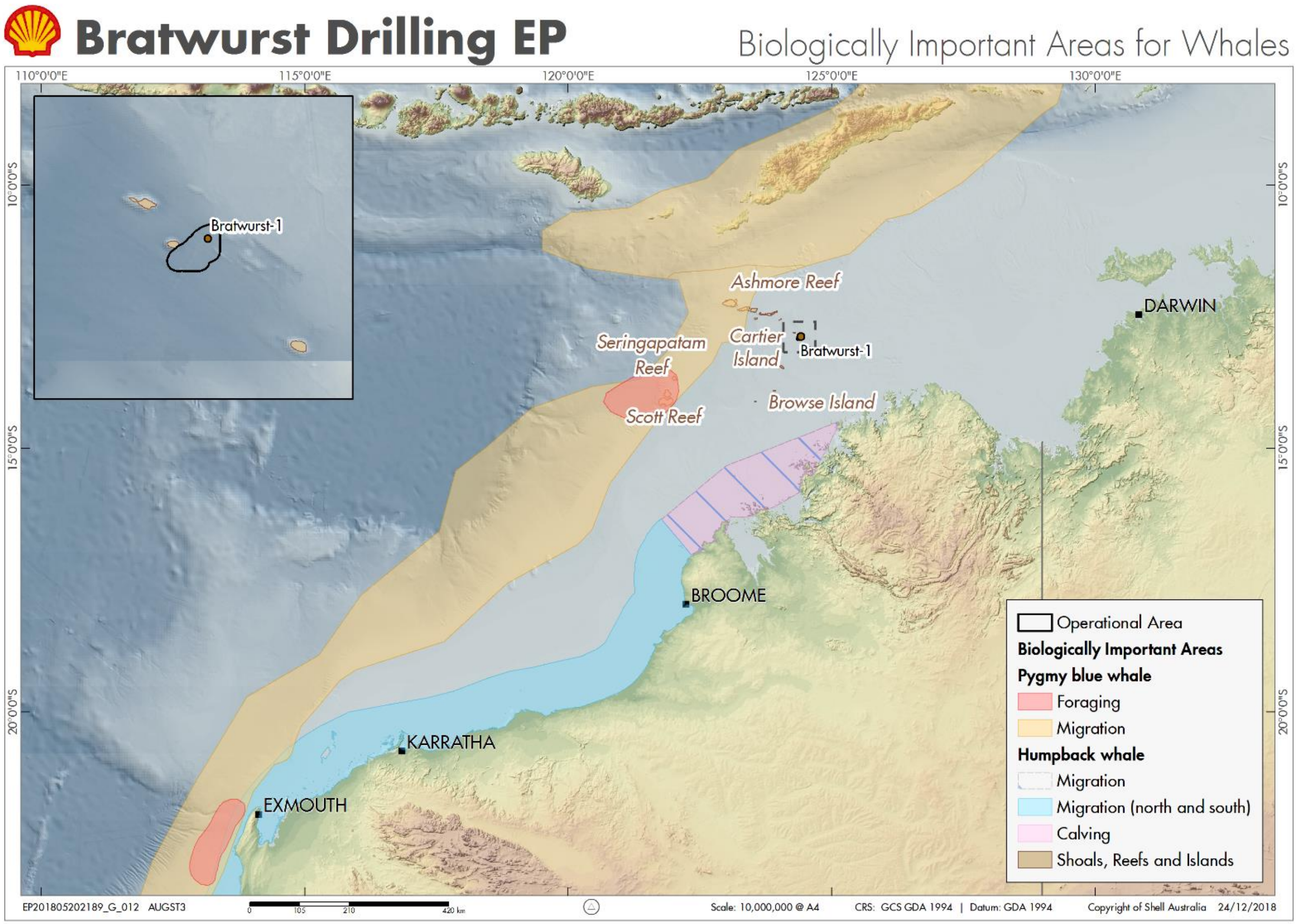


Figure 4 – 4: Biologically Important Areas for Whales

Sei Whale

Sei whales have a wide distribution. Although sightings are rare, the species has been identified as occurring in coastal and offshore waters throughout Australia, as well as the waters surrounding Christmas and Cocos Keeling Islands (DoEE 2018h; Bannister et al. 1996). The species is able to utilise a diverse range of marine habitats, which has been attributed to a combination of dynamic physical and prey processes (DoEE 2018h).

Sei whale migratory movements are well defined (distinctly north-south) with the species moving between polar, temperate and tropical waters for foraging and breeding. The species feeds intensively between the Antarctic and sub-Antarctic boundary on planktonic crustacea (Bannister et al. 1996; DoEE 2018h). The species does not dive, rather it sinks, and tends to swim at shallower depths comparative to other species (DoEE 2018h). There have been no mating or calving areas for Sei whales identified in Australian waters.

Based on their known distribution and movements, Sei whales are unlikely to be encountered within the Operational Area. However, the species is likely to occur in low numbers within the EMBA, particularly during their seasonal migrations.

Fin Whale

Fin whales are widely distributed from polar to tropical waters and have been recorded in all Australian states, other than NSW and the NT (Bannister et al. 1996). The species rarely occupies inshore waters and displays well defined migratory movements (essentially north-south) between polar, temperate and tropical waters (Bannister et al. 1996; DoEE 2018i). Migration within Australian waters does not appear to follow a clear route and is thought to occur in summer and autumn. Breeding in the Southern hemisphere occurs in tropical and sub-tropical latitudes between May and July (DoEE 2018i).

Fin whales feed on planktonic crustacea, such as Antarctic krill, and primarily forage in high latitudes (Bannister et al. 1996; DoEE 2018i). Within Australian waters, Antarctic waters and the Bonney Upwelling are thought to be important foraging grounds for this species. Based on their known distribution and movements, fin whales are unlikely to be encountered within the Operational Area. However, the species may occur in low numbers within the EMBA, particularly during their seasonal migrations.

Bryde's Whale

Bryde's whale distribution encompasses tropical and warm temperate waters with individuals being recorded in all Australian states, except the NT. The species typically moves between 40 °N and 40 °S, with these movements seeming to be primarily linked to prey availability (DoEE 2018j). Bryde's whale are thought to be divided into offshore and onshore forms with the distinction between the two based on prey preference (DoEE 2018j). The offshore form is found in deeper waters (500 m to 1,000 m) and is thought to migrate seasonally in favour of warmer waters in winter months. The onshore form generally inhabits waters <200 m and displays no distinct migratory movements (DoEE 2018j). The noise monitoring study undertaken for the Barossa project detected Bryde's whales almost year-round (January to October) (McPherson et al. 2016).

Based on their known distribution and movements, individual Bryde's whales may occasionally transit through the Operational Area and are likely to occur in low numbers within the EMBA.

Sperm Whale

Sperm whales occur in deep waters in all oceans, typically remaining at depths of 200 m or greater, and are known to occur throughout Australian waters (Bannister et al. 1996). Key areas for sperm whales are known to occur in WA waters between Cape Leeuwin and Esperance (WA) and along the continental shelf approximately 20 – 30 nm offshore (Bannister et al. 1996). Migration patterns vary between male and female sperm whales. Mature females and juveniles are thought to be resident in tropical and subtropical waters throughout the year, whereas mature males are thought to migrate between the tropics and Antarctic (Bannister et al. 1996; DoEE 2018k).

Based on their known distribution and movements, sperm whales may occasionally transit through the Operational Area and are likely to occur in low numbers within the EMBA.

Killer Whale

Killer whales have a vast global distribution and utilise a wide range of habitats. However, they appear to be primarily concentrated in coastal waters and cooler regions of high productivity (Bannister et al. 1996; DoEE 2018n).

The species is distributed throughout Australian waters, in particular near Tasmania and the waters surrounding Macquarie Island (1,500 km south-south east of Tasmania) (Bannister et al. 1996; DoEE, 2018n). Within Australian waters, the species is typically observed moving along the continental slope and shelf, and near seal colonies (Bannister et al. 1996). There are no key localities identified within continental Australian waters for this species. Killer whales are carnivores and their diet varies seasonally and regionally (Bannister et al. 1996; DoEE, 2018n).

Globally killer whales are known to migrate; however, specific routes and seasonal movement patterns are not known in detail and are thought to relate to prey availability (Bannister et al. 1996). Migration movements within Australian waters include a summer migration from subantarctic islands to Macquarie Island (DoEE 2018n). Mating occurs year-round and there are no known calving areas in Australian waters (Bannister et al. 1996).

Based on their known distribution and movements, killer whales are unlikely to be encountered in within the Operational Area. However, they may occur in low numbers within the EMBA.

Dolphins

A search of the EPBC Protected Matters database identified three migratory dolphin species as potentially occurring within EMBA; the spotted bottlenose dolphin (Arafura/Timor Sea populations), Indo-pacific humpback dolphin, and the Australian snubfin dolphin. Of these species, only the spotted bottlenose dolphin was identified as potentially occurring within the Operational Area; this species is described further below.

No BIAs for any dolphin species overlaps the Operational Area, however, a number of BIAs occur within inshore areas of the WA coastline, including breeding, calving, foraging, and resting BIAs. These areas are depicted in **Figure 4 – 5**. Dolphins are expected to occur throughout the inshore regions of the EMBA.

Spotted Bottlenose Dolphin

The spotted bottlenose dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus;* migratory) occurs primarily in continental shelf waters (< 200 m deep), and in nearshore areas with rocky or coral reefs, sandy or soft sediments, or seagrass beds (DSEWPaC

2012c). Small populations also occur in the inshore waters of some oceanic islands. The species also inhabits slightly the deeper and more open water estuarine habitats, when compared to those favoured by the Australian snubfin and humpback dolphins (Reeves and Brownell 2009, cited in DSEWPaC 2012c). Migration patterns for the species in Australia are variable, including of year-round residency in small areas, long-range movements and migration (DoEE 2018o).

Due to their tendency to occupy shallow water areas it is unlikely that the species will occur in the Operational Area. However, they are expected to occur within the EMBA which intersects a number of BIAs for this species where they are likely to occur in high numbers (**Figure 4 – 5**).

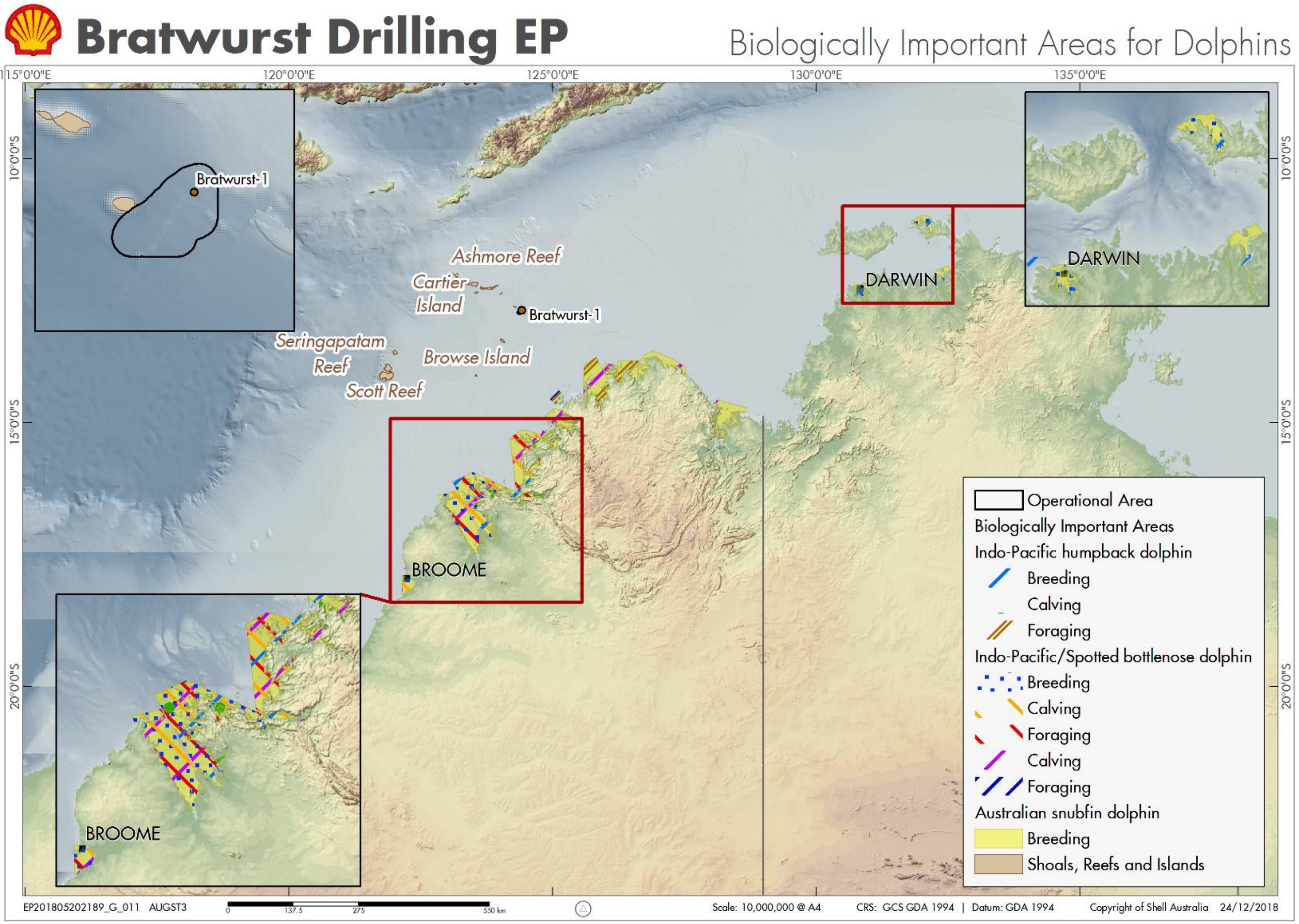


Figure 4 – 5: Biologically Important Areas for Dolphins

Dugong

Dugongs occur in tropical and sub-tropical coastal and inland waters broadly coincident with the distribution of seagrasses, which typically occur in shallow intertidal zone areas to water depths of around 25 m (DoEE 2018r). Dugong feeding aggregations tend to occur in large seagrass meadows within wide shallow protected bays, shallow mangrove channels and in the lee of large inshore islands. The movements of most individuals are limited to within tens of kilometres within the vicinity of seagrass beds (National Oceans Office 2004). However, some individuals have been observed to travel large distances of up to 600 km over a few days (National Oceans Office 2004).

Dugongs and areas of potential dugong habitat exist along the majority of WA coastline north from Shark Bay. A number of designated BIAs have also been established within WA waters. One of these areas, a foraging BIA on the Dampier Peninsula in the Kimberley, overlaps the Operational Area or EMBA. A small population of approximately 50 individuals exists at Ashmore Reef (within the EMBA), which is considered to be genetically distinct from other nearby Australian or Indonesian populations (DoE 2014a). It is possible that the range of this population extends to Cartier Island where individuals maintain a presence (DoE 2014a). Dugongs may also frequent other shallow shoals on the Sahul Banks; however, there has only been a single sighting of this occurrence in 1996 (Whiting and Guinea 2003).

The north coast of the Tiwi Islands (within the EMBA) is recognised as a key site for the conservation of dugongs (Parks and Wildlife Service of the NT (PWSNT) 2003). A well-known major dugong aggregation of approximately 4,400 individuals occurs in waters seaward (within approximately 50 km) of the Tiwi Islands and ranks in the top eight of dugong populations in Australia (PWSNT 2003).

Considering the habitat preference of the species, it is unlikely that dugongs will occur within the Operational Area, however, they are expected to occur within the EMBA, particularly near the Tiwi Islands and at Ashmore Reef.

EPBC Management/Recovery Plans and Conservation Advices for Marine Mammals

EPBC Management/Recovery Plans and conservation advices have been developed for a number of marine mammal species that have been identified as occurring within the Operational Area and EMBA. Key threats identified within these plans that are relevant to the Bratwurst-1 drilling campaign are summarised in **Table 4 – 4**.

Table 4 – 4: Summary of EPBC Management / Recovery Plans and Conservation Advices Relevant to Marine Mammals

Species	EPBC Management Plan / Recovery Plan/ Conservation Advice	Key Threats Identified in relevant Management Plan / Recovery Plan / Conservation Advice	Cross-reference to EP Impact and Risk Evaluation
Blue whale[P]	Conservation management plan for the blue whale; A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015-2025 (October 2015) (DoE 2015a)	Vessel disturbance	Section 5.6.3
		Noise interference	Section 5.5.4
		Habitat modification including presence of oil and gas platforms/rigs, marine debris infrastructure and acute/chronic chemical discharge	Section 5.5.1, Section 5.5.2, Section 5.6.2, Section 5.6.4
Humpback whale[P]	Conservation advice on humpback whale (*Megaptera novaeangliae*) (October 2015)	Vessel disturbance and strike	Section 5.6.3
		Noise interference	Section 5.5.4
		Entanglement – marine debris	Section 5.6.2

Species	EPBC Management Plan / Recovery Plan/ Conservation Advice	Key Threats Identified in relevant Management Plan / Recovery Plan / Conservation Advice	Cross-reference to EP Impact and Risk Evaluation
	(DoE 2015b)		
Sei whale[P]	Conservation advice on sei whale (*Balaenoptera borealis*) (October 2015) (DoE 2015c)	Vessel strike	Section 5.6.3
		Anthropogenic noise and acoustic disturbance	Section 5.5.4
		Pollution (persistent toxic pollutants)	Section 5.5.2, Section 5.6.2, Section 5.6.4
Fin whale[P]	Conservation advice on fin whale (*Balaenoptera physalus*) (October 2015) (DoE 2015d)	Vessel strike	Section 5.6.3
		Anthropogenic noise and acoustic disturbance	Section 5.5.4
		Pollution (persistent toxic pollutants)	Section 5.5.2, Section 5.6.2, Section 5.6.4
Southern right whale	Conservation management plan for the southern right whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011-2021 (DSEWPaC 2012d)	Vessel disturbance and strike	The EPBC Protected Matters search has not recorded the species within the Operational Area. Consideration is given to this species in the context of habitat degradation from pollution associated with emergency/ unplanned events (Section 5.6.4).
		Entanglement – marine debris	
		Noise interference	
		Habitat modification including infrastructure/coastal development and energy production facilities, and acute/chronic chemical discharge	

[P] The species was identified as potentially occurring or having habitat in the Operational Area.

4.4.5.2 *Marine Reptiles*

A search of the EPBC Act Protected Matters database identified a range of threatened and/or migratory marine reptiles (turtles, sea snakes and crocodiles) as potentially occurring or having habitat within the EMBA. Of these, six species of threatened and migratory marine turtles; the flatback turtle, green turtle, olive-ridley turtle, hawksbill turtle, loggerhead turtle, and leatherback turtle, were also identified as potentially occurring within the Operational Area. Within the wider EMBA two critically endangered species of sea snake may occur, as well as the migratory salt-water crocodile.

In addition to species considered MNES, a number of other listed marine sea snake species and other reptiles were also identified as potentially occurring in the Operational Area (see **Appendix A**). Twenty-five species of sea snake are known to occur in the NWMR, including eight endemic species (Guinea 2006). Sea snakes generally inhabit shallow inshore regions and islands, both near the coastline and offshore, as they feed in shallow, benthic habitats. Sea snakes also inhabit waters surrounding offshore atolls and shoals/banks in the Timor Sea (Guinea 2013). Most sightings of sea snakes have been in water depths of 10 m to 50 m deep (RPS 2010), however, some species are known to dive to deeper depths. The non-pelagic sea snake species rarely, if ever, dive deeper than 100 m (Heatwole and Seymour 1975). Based on known species distributions and habitat preferences of sea snakes, sea snakes are expected to only rarely transit the Operational Area in associated with shoals in proximity to the area. However, sea snakes will occur throughout the wider EMBA (e.g. Ashmore Reef).

Threatened and/or migratory species identified as potentially occurring or traversing through the Operational Area are discussed in detail below.

Marine Turtles

Turtles are oceanic species except during seasonal onshore nesting periods, which are species-dependent and vary along the north Australian coastline (Commonwealth of Australia 2017a). While the incubation time between turtle nesting and emergence of hatchlings varies between species, it is generally about 2 months (Commonwealth of Australia 2017a). Female turtles also exhibit an internesting phase in which they spend 2–3 months in shallow waters in the vicinity of the nesting beach or rookery while they produce the next clutch of eggs (Guinea 2013; Commonwealth of Australia 2017a). The female turtles will rest on the seabed during the internesting period but are not known to feed (ConocoPhillips 2018).

The Operational Area does not contain any emergent land or shallow features that may be of importance to nesting or foraging turtles. Therefore, turtles are unlikely to be present in the area in significant numbers. However, low numbers are likely to transit the Operational Area as they move from nesting beaches and offshore areas.

The broad distribution and habitats of each marine turtle species is summarised below, with further detail on BIAs and habitat critical to the survival of these species (based on geographically distinct genetic stocks) also provided in **Table 4 – 5** and **Table 4 – 6**, respectively.

- Green turtle: Within Australian waters green turtles are predominately found off the WA, NT, Queensland coastlines (Commonwealth of Australia 2017a). The green turtle is the most common marine turtle breeding in the NWMR and WA supports one of the largest remaining green turtle populations in the world (DSEWPaC 2012e). The species is primarily herbivorous and forages on algae, seagrass and mangroves, including where these habitats exist at offshore coral reef habitats (Commonwealth of Australia 2017a). Green turtles are also known to travel large distances of up to 2,600 km between nesting and feeding areas (DSEWPaC 2012e).
- Loggerhead turtle: The species is known to range along most of the Australian coastline and throughout the NWMR (Commonwealth of Australia 2017a). Loggerhead turtles are carnivorous and mainly feed on benthic invertebrates in a wide range of habitats ranging from nearshore to 55 m in depth (Commonwealth of Australia 2017a).
- Flatback turtle: The species is known to occur along the WA, NT, Queensland coastlines, and forages widely across the Australian continental shelf and into the continental waters off Indonesia and Papua New Guinea (Commonwealth of Australia 2017a). Flatback turtles are primarily carnivorous and feed predominantly on soft-bodied invertebrates (Commonwealth of Australia 2017a). Flatback turtles that nest within the Pilbara region typically migrate along the continental shelf to foraging grounds as far north as Darwin at the end of the nesting season (Commonwealth of Australia 2017a).
- Hawksbill turtle: Hawksbill turtles predominately occur along the northern WA, NT and northern Queensland coastlines. Hawksbill turtles are omnivorous and feed on algae, sponges, soft corals and soft bodied-invertebrates. This species is typically associated with rocky and coral reef habitats and is expected to be found foraging within these habitats along the WA coastline, from Shark Bay to the northern extent of the NWMR (Commonwealth of Australia 2017a).
- Olive ridley turtle: Olive ridley turtles are primarily carnivorous and feed predominantly on soft-bodied invertebrates (Commonwealth of Australia 2017a). The species is known to feed in water depths between 15 m and 200 m, and to migrate up to 1,130 km between their nesting and foraging grounds (Whiting et al. 2005). Nesting is known to occur in the NT and on western Cape York (QLD). Low density nesting has also been described on the Kimberley coast (Commonwealth of Australia

2017a). This species appears to remain on the Australian continental shelf into waters off Indonesia (Commonwealth of Australia 2017a).

- Leatherback turtle: Leatherback turtles are known to forage and migrate throughout the open offshore waters of Australia, with foraging more common in along the east coast and the Bass Strait. Records of leatherback turtle nesting in Australia are sparse and limited to the Cobourg Peninsula and Queensland coast (Commonwealth of Australia 2017a). There have been no confirmed accounts of nesting on beaches along the WA coastline. Leatherback turtles eat almost exclusively jellyfish and are pelagic throughout their life in oceanic waters around Australia (Commonwealth of Australia 2017a).

BIAs for foraging, breeding, nesting and internesting activities identified for marine turtle species in the EMBA are listed in **Table 4 – 5** (Commonwealth of Australia 2017a) and shown in **Figure 4 – 6**.

Table 4 – 5: BIAs for Marine Turtles overlapping the EMBA

BIA	General Location(s)
Green Turtle	
Internesting/nesting	Islands north-east of Cobourg Peninsula, North-west of Melville Island, Scott Reef – Sandy Islet, Ashmore Reef, Cartier Island, Cassini Island, Lacepede Island, Islands in Dampier Archipelago, Barrow Island,
Foraging	Ashmore Reef, Browse Island, Kakadu National Park coastal areas, Joseph Bonaparte Gulf, Seringapatam Reef, North Turtle Island, De Grey River to Bedout Island, James Price Point
Mating	Ashmore Reef
Loggerhead Turtle	
Foraging	Western Joseph Bonaparte Depression, De Grey River to Bedout Island, James Price Point, Dampier Archipelago Islands, Karratha coastal area and nearby Islands
Internesting/nesting	Coastal waters and islands adjacent to the Pilbara coastline, Lacepede Island, Cape Domett, Darwin coastal area and Cobourg Peninsula extending to include Melville Island
Flatback Turtle	
Internesting/nesting	Holothuria Zone (Northern Kimberley, Holothuria Banks), Western Joseph Bonaparte Depression
Foraging	Melville Island in the Cobourg Peninsula
Hawksbill Turtle	
Internesting/nesting	Ashmore Reef, Scott Reef, Greenhill Island, Islands north-east of Cobourg Peninsula, Islands adjacent to the Pilbara and Dampier coastline
Foraging	Ashmore Reef, Cartier Island, De Grey River area out to Bedout Island, Dampier and Pilbara inshore islands
Olive-ridley Turtle	
Internesting	Bathurst Island/Melville Island – North-west and Melville Island – North, Fog Bay to Cox Peninsula, Greenhill Island, Islands north-east of Cobourg Peninsula
Foraging	Fog Bay, Joseph Bonaparte Gulf and Western Joseph Bonaparte Gulf – banks, Western Joseph Bonaparte Depression
Leatherback Turtle	
Internesting/nesting	Danger Point in the Cobourg Peninsula

Habitat Critical to the Survival of Marine Turtles

Habitat identified as critical to the survival of marine turtles which occur within the EMBA are listed in **Table 4 – 6** (Commonwealth of Australia 2017a) and shown in **Figure 4 – 7**.

Table 4 – 6: Habitat Critical to the Survival of Marine Turtles

Genetic Stock	Habitat Critical Area within the EMBA	Internesting Buffer	Nesting Season
Green Turtle			
Cobourg Peninsula, NT	Croker Island and McCluer Island groups, including Black Pt to Smith Pt.	20 km radius	October to April
Kimberley, WA	Mainland east of Mary Island to mainland adjacent to Murrara Island including all offshore islands, Adele Island, Lacepede Islands	20 km radius	November to March
Ashmore Reef	Ashmore Reef and Cartier Reef	20 km radius	December and January
Scott-Browse	Scott Reef (Sandy Islet) and Browse Island	20 km radius	November to March
Loggerhead Turtle			
No habitat critical area identified to overlap the EMBA			
Flatback Turtle			
Arafura Sea	Waigait Beach to south of Point Blaze including offshore islands, Tiwi Islands, Field Island (Coburg Peninsula)	60 km radius	June to September
South-west Kimberley	Eighty Mile Beach, Eco Beach, Lacepede Islands	60 km radius	October to March
Unknown genetic stock Kimberley, WA	Maret Islands, Motilivet Islands, Cassini Island, Coronation Islands (includes Lamarck Island), Napier-Broome Bay Islands (West Governor Island, Sir Graham Moore Island – near Kalumbaru), Champagny, Darcy and Augustus Islands (Camden Sound)	60 km radius	Unknown genetic stock Kimberley, WA
Pilbara	Mundabullangana Beach, Cemetery Beach, Dampier Archipelago (including Delambre Island and Huay Island)	60 km radius	October to March
Hawksbill turtle			
Cobourg Peninsula, NT	New Year Island	20 km radius	All year (peak July to December)
Olive ridley turtle			
Cobourg Peninsula, NT	Tiwi Islands (Brace Point to Pirlangimpi and Brace Point to One Tree Point), Coburg Peninsula, Croker Island and west of Murganella to the West Alligator River	20 km radius	April to August
South-west Kimberley	Cape Leveque	20 km radius	May to July
Unknown genetic stock Kimberley, WA	Vulcan Island, Darcy Island	20 km radius	May to July
Leatherback turtle			
Cobourg Peninsula, NT	All sandy beaches from Cobourg Peninsula to Cape Arnhem including Danger Point, Wessel Islands and Elcho Island	20 km radius	December-January

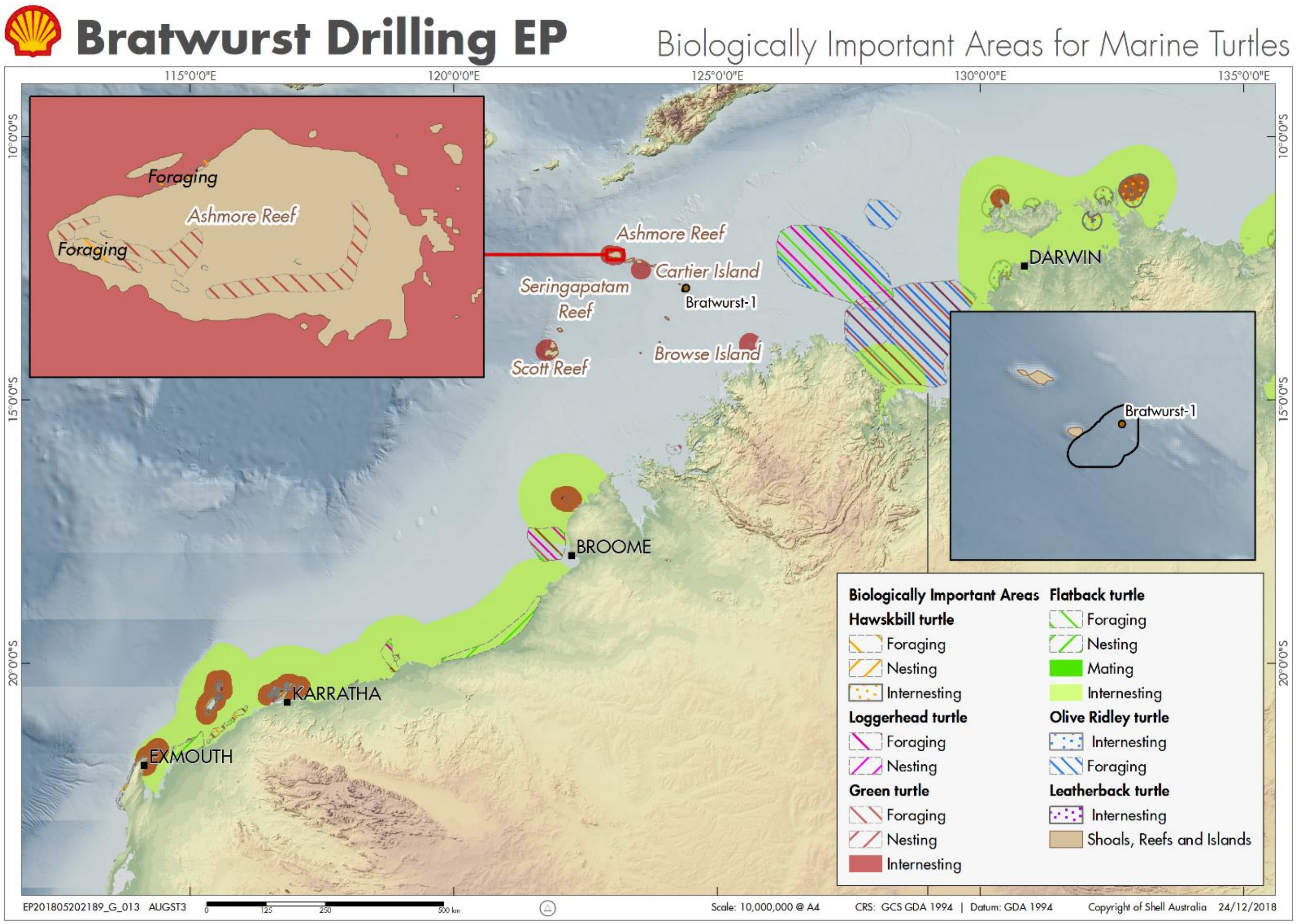


Figure 4 – 6: Biologically Important Areas for Marine Turtles

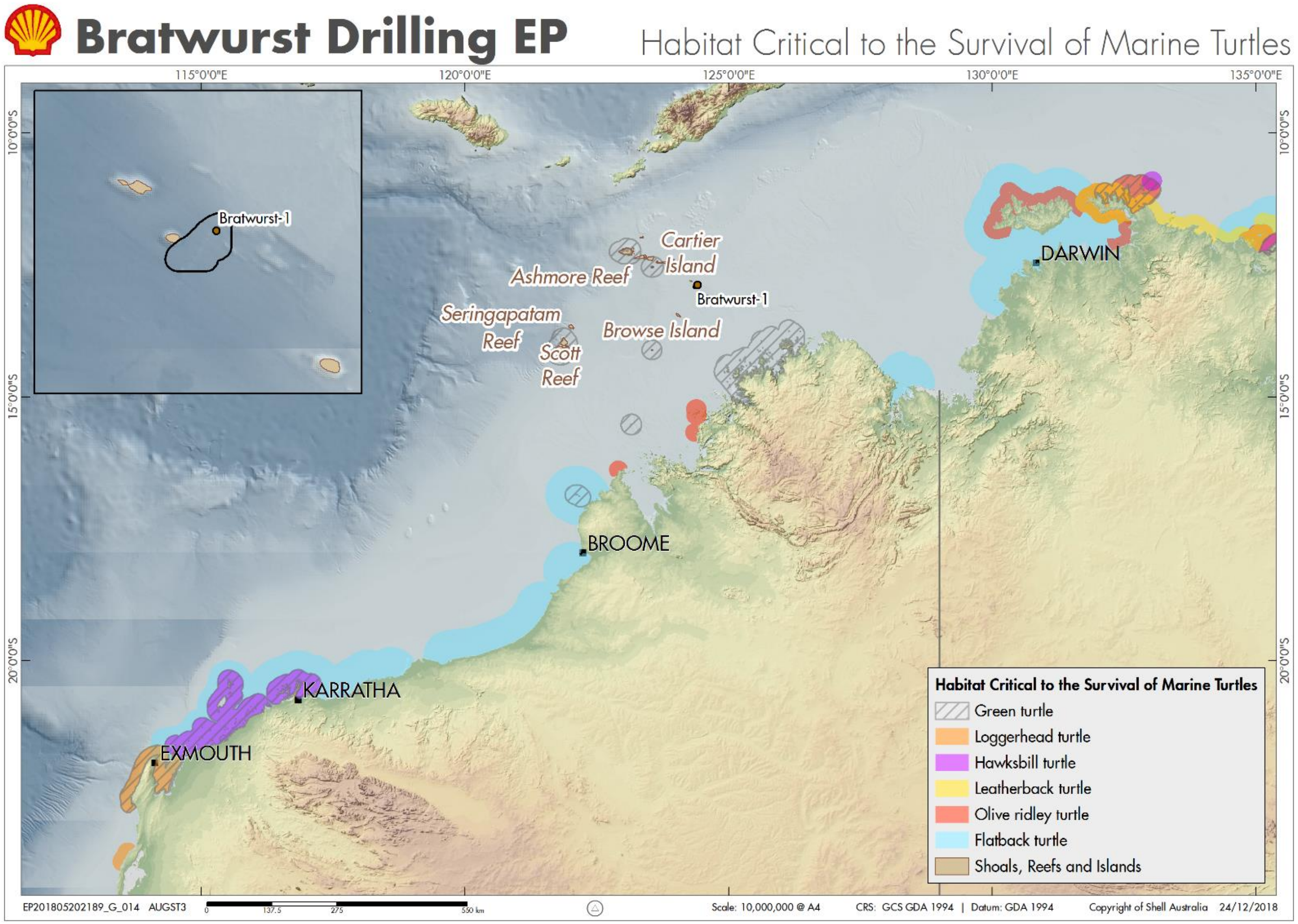


Figure 4 – 7: Habitat Critical to the Survival of Marine Turtles

EPBC Management/Recovery Plans and Conservation Advices

A Recovery Plan has been developed for the marine turtle species identified as occurring within the Operational Area and EMBA, in addition to specific conservation advice for the leatherback turtle (Commonwealth of Australia 2017a; DEWHA 2009a). Key threats identified within these plans that are relevant to the Bratwurst-1 drilling campaign are summarised in **Table 4 – 7**.

Additionally, conservation advices have been developed for the short-nosed sea snake and leaf-scaled sea snake (DSEWPaC 2010a; 2010b). Relevant threats to these species identified in the conservation advices was oil and gas exploration, however, neither of these species were identified as occurring within the Operational Area. Consideration is given to this species in the context of habitat degradation from pollution associated with emergency/unplanned events in **Section 5.6.4.**

Table 4 – 7: Summary of EPBC Management / Recovery Plans and Conservation Advices Relevant to Marine Reptiles

Species	EPBC Management Plan/ Recovery Plan/ Conservation Advice	Key Threats Identified in relevant Management Plan/Recovery Plan/Conservation Advice	Cross-reference to Impact and Risk Evaluation
Loggerhead turtle[P] Green turtle [P] Leatherback turtle[P] Hawksbill turtle[P] Olive ridley turtle [P] Flatback turtle[P]	Recovery plan for marine turtles in Australia 2017-2027 (June 2017) (Commonwealth of Australia 2017a) Conservation advice on leatherback turtle (*Dermochelys coriacea*) (DEWHA 2009a)	Habitat modification	Section 5.5.1, Section 5.6.4
		Vessel disturbance	Section 5.6.3
		Light pollution	Section 5.5.3
		Noise interference	Section 5.5.4
		Marine debris	Section 5.6.2
		Chemical and terrestrial discharge	Section 5.5.2, Section 5.6.2, Section 5.6.4

[P] The species was identified as potentially occurring or having habitat in the Operational Area.

4.4.5.3 *Birds*

A number of seabirds and migratory shorebirds are known to occur within the NWMR as they range over large distances to forage over the open ocean (DSEWPaC 2012f). The EPBC Protected Matters search identified 12 bird species as potentially occurring within the Operational Area, five of which are threatened; the curlew sandpiper, eastern curlew, Australian lesser noddy, red knot and the Abbott's booby. These species are discussed below.

An additional 59 listed migratory species (including eleven threatened species) were identified to potentially occur within the EMBA (**Table 4 – 3**). There are eleven bird species with BIAs within the EMBA, these are indicated in **Table 4 – 8** and **Figure 4 – 8.** Most migrant birds are expected to fly over the regional area as part of their large-scale transitory movements and are unlikely to land on the sea for significant periods of time (ConocoPhillips 2018). Considering this, and the general absence of landing areas at a regional offshore scale, the majority of seabird activity is likely to comprise foraging and migration pathways, as opposed to seabird stopover and roosting points during annual migrations. Whilst seabirds spend much of their lives at sea, migratory shorebirds overfly offshore areas during migratory periods and typically do not interact with the sea surface (DSEWPaC 2012f; ConocoPhillips 2018). Migratory wetland species also do not interact with open offshore waters. However, these species may land on offshore oil and gas infrastructure, especially during inclement weather, while flying between land masses (ConocoPhillips 2018).

No emergent land exists in the shoals or surrounding offshore areas in the immediate vicinity of the Operational Area to support breeding populations of seabirds or migratory shorebirds. The nearest shorelines to the operational area being Cartier Island and Ashmore Reef, which are located 86 km and 135 km northwest of the Operational Area, respectively. More broadly, Scott Reef and Browse Island may provide additional connectivity for shorebirds of the NWMR (DSEWPaC 2012f).

Curlew Sandpiper

The curlew sandpiper has a vast distribution, being recorded along the coasts of all Australian states and territories (DoEE 2018u). The species preferred habitat is intertidal mudflats in sheltered coastal areas as they forage in nearshore waters or mud at the edge of wetlands (DoEE 2018u). However, they are also widespread inland; albeit in smaller numbers. The curlew sandpiper migrates along the East Asian-Australasian (EAA) Flyway (Flyway) from their breeding grounds in Siberia to Australia, generally arriving in Australia around late August/early September and departing by mid-April (DoEE 2018u). Some non-breeding individuals may not undertake the migration northward but stay in Australia (DoEE 2018u).

Based on the known distribution, preferred feeding and roosting habitats, it is considered highly unlikely that individuals will interact with the operational area due to the absence of any land.

Eastern Curlew

The eastern curlew is the world's largest species of shorebird (Menkhorst et al. 2017; DoEE 2018v). The species is restricted to the Flyway, undertaking an annual migration to breeding grounds in Russia and north-eastern China, before returning to Australia in August to forage, primarily in intertidal mudflats on larger prey items such as crab (Bamford et al. 2008; DoEE 2018v; Menkhorst et al. 2017). There are two internationally important non-breeding sites in northern WA; Roebuck Bay and Eighty Mile Beach (Bamford et al. 2008).

Considering the species preferred habitat and diet, the eastern curlew is very unlikely to land or interact with offshore waters during its migration through the Flyway. Therefore, while some individuals may occur within the Operational Area, they are not expected to occur in significant numbers or for significant durations.

Australian Lesser Noddy

The Australian lesser noddy is a tropical species of tern endemic to Australia (DoEE 2018w; DEWHA 2015a). Whilst the Australian lesser noddy has a large range, the species utilises primarily a small area in Houtman Abrolhos for breeding (outside the EMBA) (DoEE 2018w; DEWHA 2015a). The species is also known to breed in small numbers at Ashmore Reef (Menkhorst et al. 2017). Individuals generally remain in close proximity to the breeding islands throughout the year. Therefore, while some individuals may occur within the Operational Area, they are not expected to occur in significant numbers.

Red Knot

The red knot is an omnivorous wading bird which utilises the intertidal mudflats, sandflats and sandy beaches of sheltered coastal areas, estuaries, bays and other similar marine habitats. The red knot may also utilise saline wetlands but rarely freshwater water sources (DoEE 2018x). The red knot is present throughout coastal and offshore Australia, including Christmas and Cocos Keeling Islands (outside the EMBA). Notably, large numbers of red knot are regularly recorded in the north-west of Australia (specifically at 80 Mile Beach and Roebuck Bay) and the species is present along the Ningaloo coast and at Lake Macleod (DoEE 2018x; Bamford et al. 2008).

While the species utilises the Flyway, the exact migration route of Australian populations of red knot to their Arctic breeding grounds is unknown (DoEE 2018x, Watkins 1993). It is, however, thought that individuals may begin the journey by moving south across the west Pacific Ocean and then north along the east Asian coast (DoEE 2018x). The species is thought to make minimal stop overs during this migration. At the end of the breeding season the species returns south, arriving in northern Australia in late August to early September to take up residence, as well as settling in other areas primarily in eastern Australia and New Zealand (DoEE 2018x; Watkins 1993).

Given the species' habitat preference, the red knot is unlikely to land or interact with offshore waters during its migration over the Timor Sea. Therefore, while some individuals may occur within the Operational Area, they are not expected to occur in significant numbers or for significant durations.

Abbott's Booby

The Abbott's booby spends the majority of its time at sea and generally only comes ashore to breed. Within Australia, the Abbott's booby breeds exclusively on Christmas Island (outside the EMBA), displaying a preference for nesting in the forests on the island and foraging in the surrounding waters (DEWHA 2015b). Recent population estimates on Christmas Island are of 2,500 breeding pairs (Menkhorst et al. 2017). The species' restricted geographical location is thought to be attributed to areas of upwelling in the waters surrounding Christmas Island, which may provide prey items that are seasonal and necessary for raising offspring. However, data suggests that individuals may travel up to hundreds of kilometres from Christmas Island in order to forage (DoEE, 2018y). Considering the operational area is significantly distant from Christmas Island (greater than 2,000 km), it is likely that only a few individuals may utilise the open waters of the Operational Area.

Greater Frigatebird

The greater frigatebird is widespread and breeds on a number of small and remote tropical and sub-tropical islands (DSEWPaC 2012f; Birdlife International 2017a). Whilst the species typically nests in mangroves or bushes, it may also nest on the bare ground (Birdlife International 2017a). The greater frigatebird forages both inland and along coastlines, potentially straying up to 200 km from the colony to forage during the early breeding season (Birdlife International 2018; DSEWPaC 2012f). The species' diet consists largely of fish, squid and the chicks of other bird species (Birdlife International 2017a; DSEWPaC 2012f).

There are large breeding populations of this species in the tropical waters of the Pacific and Indian Oceans (Birdlife International 2017a). Within WA, the greater frigatebird has a small breeding colony at Ashmore Reef and is found throughout the north and eastern coastal and offshore areas of Australia (DoEE 2018z; DSEWPaC 2012f). The species also breeds on Christmas and North Keeling Islands (outside the EMBA) (Menkhorst et al. 2017).

There are breeding BIAs for the greater frigatebird over the Kimberley and Ashmore Reef (overlapping the EMBA), as shown in **Figure 4 – 8** and outlined in **Table 4 – 8**. Considering the species' distribution and foraging habits, individuals are likely to utilise the open waters within the Operational Area. Satellite tracking studies undertaken from Ashmore Reef have also shown the species traverses the Operational Area (Mott 2016).

Lesser Frigatebird

The lesser frigatebird occurs throughout the tropical and warmer waters of northern and eastern Australia (DSEWPaC 2012f), breeding on islands such as Ashmore Reef and North Keeling, as well at a number of other islands located off the north coast of WA (Menkhorst et al. 2017). There are breeding BIAs for the lesser frigatebird within the EMBA, as shown in **Figure 4 – 8** and outlined in **Table 4 – 8**. The lesser frigatebird feeds on prey items such as flying fish by catching their prey at or just above the ocean surface (DSEWPaC, 2012f). This species also occasionally feeds on squid, octopus and other species chicks, and typically does not forage far from the breeding colony (DSEWPaC 2012f; Birdlife International 2017b).

As with the greater frigatebird, individuals are likely to utilise the open waters within the Operational Area based on the species' distribution and feeding preferences. Satellite tracking studies have also shown the species traverses the Operational Area (Mott 2016).

Common Noddy

The common noddy is has a widespread distribution in tropical and subtropical areas of the Pacific, Indian and Atlantic Oceans. The common noddy is a seabird that forages in coastal waters around nesting sites, taking prey such as small fish. Nesting occurs broadly across tropical and subtropical Australia in coastal areas, particularly on islands such as the Houtman Abrolhos island group (outside the EMBA). The common noddy is thought to undertake seasonal movements. The species is not expected to occur within the Operational Area, aside from individuals occasionally transiting through during migration periods. The species will occur within the wider EMBA, particularly around offshore and coastal islands.

Streaked Shearwater

The streaked shearwater is a migratory seabird with a broad distribution in the western Pacific Ocean. The species breeds and nests on offshore islands in temperate East Asia, including Japan and the Korean peninsula. During winter months the species migrates south, between Papua New Guinea and northern Australia, where is occurs around islands and inshore waters. The species may occur in the Operational Area and wider EMBA, particularly during winter months.

Common Sandpiper

The pectoral sandpiper breeds in the northern hemisphere during the boreal summer and migrates to feeding grounds in the southern hemisphere for the austral summer. The species occurs throughout the mainland Australia between spring and autumn. While in Australia, the pectoral sandpiper inhabits coastal and near-coastal environments such as wetlands, estuaries and mudflats. Given the species' preferred habitat the pectoral sand piper is not expected to occur within the Operational Area but is expected to occur within the wider EMBA during spring and autumn months.

Sharp-tailed Sandpiper

The sharp-tailed sandpiper is a migratory wading shorebird. The species breeds in the northern hemisphere and undertakes long distance seasonal migrations to the southern hemisphere for the austral summer (Bamford et al., 2008). Similar to the common sandpiper, the species is unlikely to occur within the Operational Area due to the lack of suitable habitat, however may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the wider EMBA between spring and autumn months.

Pectoral Sandpiper

Similar to other sandpiper species described above, the pectoral sandpiper breeds in the northern hemisphere during the boreal summer, before undertaking long distance migrations to feeding grounds in the southern hemisphere. Similar to the common and sharp-tailed sandpiper species, the pectoral sandpiper is unlikely to occur within the Operational Area due to the lack of suitable habitat but may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the wider EMBA between spring and autumn months.

Table 4 – 8: Summary of BIAs relevant to Birds within the EMBA

Species	BIAs within the EMBA	General Location(s)
Bridled tern	Breeding	Cobourg Peninsula (Sandy Island No. 2)
Roseate tern	Resting	Eighty Mile Beach (northern end)
	Breeding	Haul Round Island (Boucat Bay), Grant Island, WA (Kimberley, Pilbara) coastline and offshore islands (including Ashmore Reef)
Lesser crested tern	Breeding	WA (Kimberley, Pilbara) coastline and offshore islands (including Ashmore Reef).
White-tailed tropicbird		Ashmore Reef, Cartier Island, WA (Kimberley, Pilbara) coastline and offshore islands (including Cunningham Island and Bedwell Island)
Lesser frigatebird	Breeding/foraging	Ashmore Reef, Cartier Island, WA (north west Kimberley and Pilbara) coastline
Greater frigatebird		Ashmore Reef, Cartier Island, WA (north west Kimberley) coastline
Red-footed booby		
Wedge-tailed shearwater		Ashmore Reef, Cartier Island, WA (Kimberley, Pilbara) coastline and offshore islands
Crested tern		Crocodile Islands, north-east of Milingimbi (Large Island), Haul Round Island (Boucat Bay), Cobourg Peninsula (No. 2 Sandy Island), Seagull Island
Brown booby		Kimberley and northern Pilbara coastlines and adjacent islands, Ashmore Reef
Little tern	Breeding	WA (Kimberley and Pilbara) coastline
	Resting	Ashmore Reef, WA (Kimberley, Pilbara) coastline and offshore islands

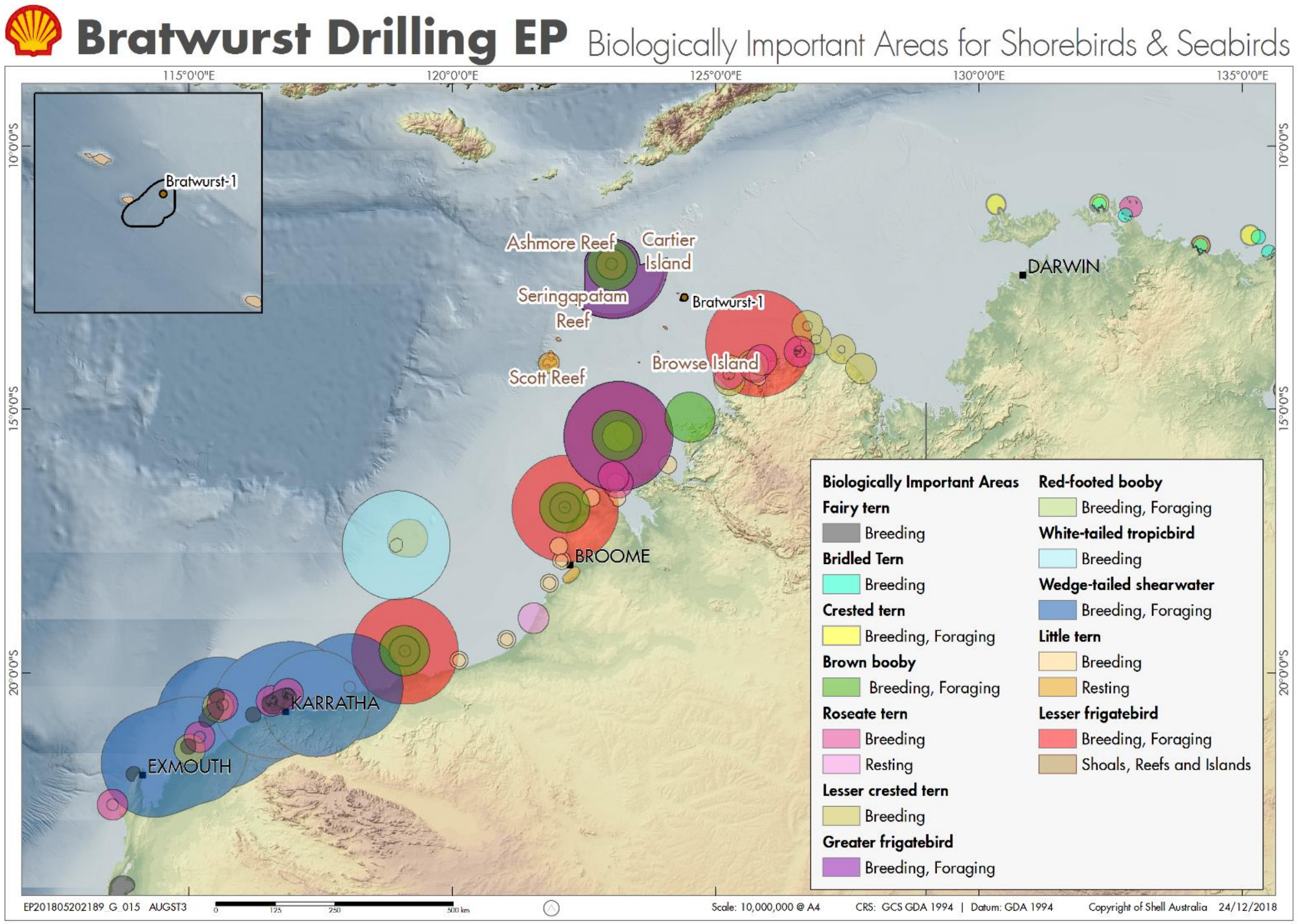


Figure 4 – 8: Biologically Important Areas for Birds

EPBC Management / Recovery Plans and Conservation Advices

EPBC Management/Recovery Plans and conservation advices have been developed for a number of shorebird and sea bird species that have been identified as occurring within the Operational Area and EMBA. Relevant key threats identified within these plans are summarised in **Table 4 – 9**. A number of threats were discounted as being relevant to the Bratwurst-1 drilling campaign if (1) the species was not identified as occurring within the Operational Area and the threat was specific to risks/impacts restricted to this area, or (2) if the threat was specific to terrestrial areas (e.g. anthropogenic lighting) or a location outside the EMBA (e.g. the Yellow Sea (DoE 2015h; 2015i).

Table 4 – 9: Summary of EPBC Management/Recovery Plans and Conservation Advices Relevant to Birds

Species	EPBC Management Plan/Recovery Plan/Conservation Advice	Key Threats Identified in relevant Management Plan /Recovery Plan/ Conservation Advice	Cross-reference to Impact and Risk Evaluation
Sandpipers (includes snipes and plovers listed in **Table 4 – 3**	Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015e)	Modification habitat (e.g. from acute pollution from oil/ chemical spills	Consideration is given in the context of habitat degradation from pollution associated with unplanned waste management (Section 5.6.2) and emergency/unplanned events (Section 5.6.4).
Black-browed albatross Southern giant-petrel	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPaC 2011a)	Marine pollution	Section 5.6.2, Section 5.6.4 These species are only relevant with regards to the EMBA.
Australian fairy tern	Conservation advice on fairy tern (*Sternula nereis nereis*) (February 2011) (DSEWPaC 2011b)	Oil spills (main potential threat; particularly in Victoria)	Section 5.6.4 Species is only relevant with regards to the EMBA.
Australian lesser noddy[P]	Conservation advice on Australian lesser noddy (*Anous tenuirostris melanops*) (October 2015) (DoE 2015j)	Habitat loss from pollution	Section 5.6.2, Section 5.6.4
Red knot[P]	Conservation advice on red knot (*Calidris canutus*) (May 2016) (DoE 2016a)	Pollution/contamination	Section 5.6.2, Section 5.6.4
		Direct mortality from chemical spills and oil spills	Consideration is given to this species in the context of disturbance from chemical/oil spills (Section 5.6.2, Section 5.6.4).
Great knot	Conservation advice on great knot (*Calidris tenuirostris*) (May 2016) (DoE 2016b)	Pollution/contaminants	Section 5.6.2, Section 5.6.4
		Habitat loss and degradation from environmental pollution	Consideration is given to this species in the context of habitat degradation from pollution associated with unplanned waste management (Section 5.6.2) and emergency/unplanned events (Section 5.6.4).
Greater sand plover	Conservation advice on greater sand plover (*Charadrius*	Pollution/contamination	Section 5.6.2, Section 5.6.4

Species	EPBC Management Plan/Recovery Plan/Conservation Advice	Key Threats Identified in relevant Management Plan /Recovery Plan/ Conservation Advice	Cross-reference to Impact and Risk Evaluation
Lesser sand plover	*leschenaultii*) (May 2016) (DoE 2016c) Conservation advice on Lesser sand plover (*Charadrius mongolus*) (May 2016) (DoE 2016d)		
Northern Siberian bar-tailed godwit	Conservation advice on bar-tailed godwit (northern Siberian) (*Limosa lapponica menzbieri*) (May 2016) (DoE 2016e)	Pollution/contamination	Section 5.6.2, Section 5.6.4

4.4.5.4 *Fish*

The Timor Sea supports a variety of fish species of high conservation value as well as fisheries of commercial and recreational importance. The current state of knowledge of fishing activities within the Operational Area in a socio-economic and indigenous use context is discussed further in **Section 4.5**.

A search of the EPBC Act Protected Matters database identified 31 fish species that may occur or have habitat in the Operational Area, and 52 species which may occur in the EMBA (see **Appendix A**). These are ray-finned fishes and are either pipefish or seahorses (family Syngnathidae). All species of Syngnathidae are listed marine species under the EPBC Act. These species may pass through the offshore waters of the operational area but are more likely to be associated with the shallow waters around the nearby shoals/banks (**Section 4.3.2**) and close to the WA coastline where benthic communities provide suitable shelter and foraging habitats (DSEWPaC 2012g). Knowledge about the distribution, abundance and ecology of Syngnathidae within the NWMR is limited, however, almost all species live in nearshore and inner shelf habitats, usually in shallow coastal waters (DSEWPaC 2012g). Therefore, these species are unlikely to be present within the Operational Area but are expected to be present within the EMBA.

Two additional fish species listed as conservation dependent under the EPBC Act, the scalloped hammerhead and southern bluefin tuna, also may occur within the Operational Area and EMBA.

Fish Communities at Shoals

Fish communities found at the submerged shoals within the EMBA are described in **Section 4.3.2**. In summary, the pelagic biota of the shoals was found to be similar to those on coral reefs and biologically rich. Of the species recorded, nearly all were teleost fish with the remainder consisting predominantly of sharks and rays.

Sharks and Rays

The NWMR has a rich fauna of sharks and rays due to the diverse marine habitats within the regions waters (DSEWPaC 2012h). A search of the EPBC Act Protected Matters database identified 14 listed threatened and/or migratory shark and ray species that may occur in or have habitat in the EMBA, of which ten may occur within the Operational Area. Listed threatened shark and ray species identified within the Operational Area (four of which are also listed as migratory) include the whale shark, great white shark, northern river shark, green sawfish, and sawfish (**Table 4 – 3**). These species are discussed in detail below.

Whale Shark

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

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

A foraging BIA for whale sharks is located in northern WA, offshore of the Pilbara and Kimberley coastline, and broadly follows the 200 m isobath (**Figure 4 – 9**; DoEE 2018aa, DEWHA 2015c). The BIA is listed as a foraging habitat, however the Conservation Advice (DEWHA 2015c) for this species indicates this BIA up the north west coast is a migration corridor than significant foraging habitat. This is consistent with tagging studies; Meekan and Radford (2010) showed that whale sharks migrated up the coast from Ningaloo Reef and dispersed individually over a broad migratory area either north-west into the open Indian Ocean, northward towards Sumatra and Java, or north-east towards the Timor Sea.The Operational Area and EMBA overlap a portion of this vast BIA. Therefore, whale sharks are expected to transit through the Operational Area and EMBA.

Great White Shark

The great white shark was identified by the EPBC Protected Matters database search as potentially occurring within the Operational Area. The species is primarily temperate, however, there are no known aggregation sites within the NWMR and the species is most likely to be found south of North West Cape (some 1,400 km south-southwest of the Operational Area) (DSEWPaC 2012h). Ongoing research into the seasonal movements of this species along the WA coast suggests great white sharks travel northward during spring, returning to more southern waters in summer (DoEE 2018ab). Little information is available on reproductive activities of great white sharks in Australian waters, with no pupping grounds having been identified (DSEWPaC 2012h).

Due to their relatively wide ranging and migratory behaviour along the WA coast, it is likely that great white sharks may transit the EMBA and Operational Area in low numbers.

Mako

The shortfin mako and longfin mako were identified by the EPBC Protected Matters database search as potentially occurring in the Operational Area and EMBA. The shortfin mako is a highly migratory epipelagic species widely distributed in tropical and temperate waters of temperatures above 16 °C (Groeneveld et al. 2014). The distribution and biology of the longfin mako is less documented, however, it is also an epipelagic shark inhabiting tropical and warm-temperature waters (Reardon et al. 2006). Makos exhibit sexual segregation and segregation throughout developmental stages; juveniles spend

90% of their time near the surface whereas adults dive much deeper (Groeneveld et al. 2014).

There are no known BIAs for the shortfin or longfin mako within the EMBA. Due to their migratory nature and known species distribution it is possible that these species may transit the Operational Area and are expected to occur within the EMBA.

Sawfish

The listed threatened green sawfish, largetooth sawfish and narrow sawfish occur mainly in inshore coastal waters and riverine environments in northern Australia. Considering declining global populations of these sawfishes, northern and northwest Australia may contain the last significant populations of these species (DSEWPaC 2012h).

The largetooth sawfish has been recorded in river, estuarine and marine environments within north-west Australia. Newborns and juveniles occur primarily in the freshwater areas of rivers and in estuaries, while adults mostly occupy marine and estuarine environments (DSEWPaC 2012h). The green sawfish does not occupy freshwater habitats and has been recorded in depths of up to 70 m. However, it is predominately recorded as occurring in inshore coastal areas, including estuaries and river mouths (DSEWPaC, 2012h). It is therefore unlikely that these species of sawfish will transit the Operational Area. There are BIAs for all three sawfish species along the WA coastline within the EMBA, as shown in **Figure 4 – 9.**

Rays

The giant manta ray and reef manta ray are globally distributed in both tropical and temperate waters. Whilst considered the more solitary of the two species, the giant manta ray is often sighted in high numbers to engage in foraging, mating or cleaning activities (Marshall et al. 2011a). The giant manta ray also exhibits seasonality in habitat preference and is known to frequent offshore seamounts and islands, including the Cocos Islands (Marshall et al. 2011a). The giant manta ray is less frequently sighted than the reef manta ray (Marshall et al. 2011a).

The reef manta ray typically utilises productive nearshore habitats, including island groups, atolls and continental coastlines (Marshall et al. 2011b). However, the species has been known to undertake coastal migrations of significant distances and traverse international waters. As with the giant manta ray, this species is often sighted in high numbers, predominately when undertaking foraging activities as a group or migrating.

There are no known foraging or breeding aggregation areas for these species within the Operational Area. Based on the nearshore habitat preference of both the giant manta ray and reef manta ray, and the offshore location of the Operational Area, it is considered highly unlikely that they will occur in significant numbers in this area. If present, they would most likely be restricted to individuals transiting through the area.

Northern River Shark

Sharks of the genus *Glyphis* are considered among the most threatened elasmobranchs worldwide and appear to have limited habitat preferences (Stevens et al. 2005). Northern river sharks also exhibit segregation during developmental stages and similarly occupy rivers, tidal sections, large tropical estuarine systems, macrotidal embayments, inshore and offshore marine habitats (DSEWPaC, 2010d). The northern river shark has been recorded in offshore waters, however, the frequency of this occurrence is unknown.

The northern river shark has a known distribution including locations in the west and east Kimberley (DSEWPaC 2010c; 2010d). The species was listed threatened in 2001 due to their limited geographical distribution and low population estimates of mature individuals which was considered likely to continue to decline (DSEWPaC 2010c; 2010d). Given their typically limited distribution in proximity to estuarine environments, neither species are expected to transit the Operational Area, but may occur in discrete locations within the EMBA.

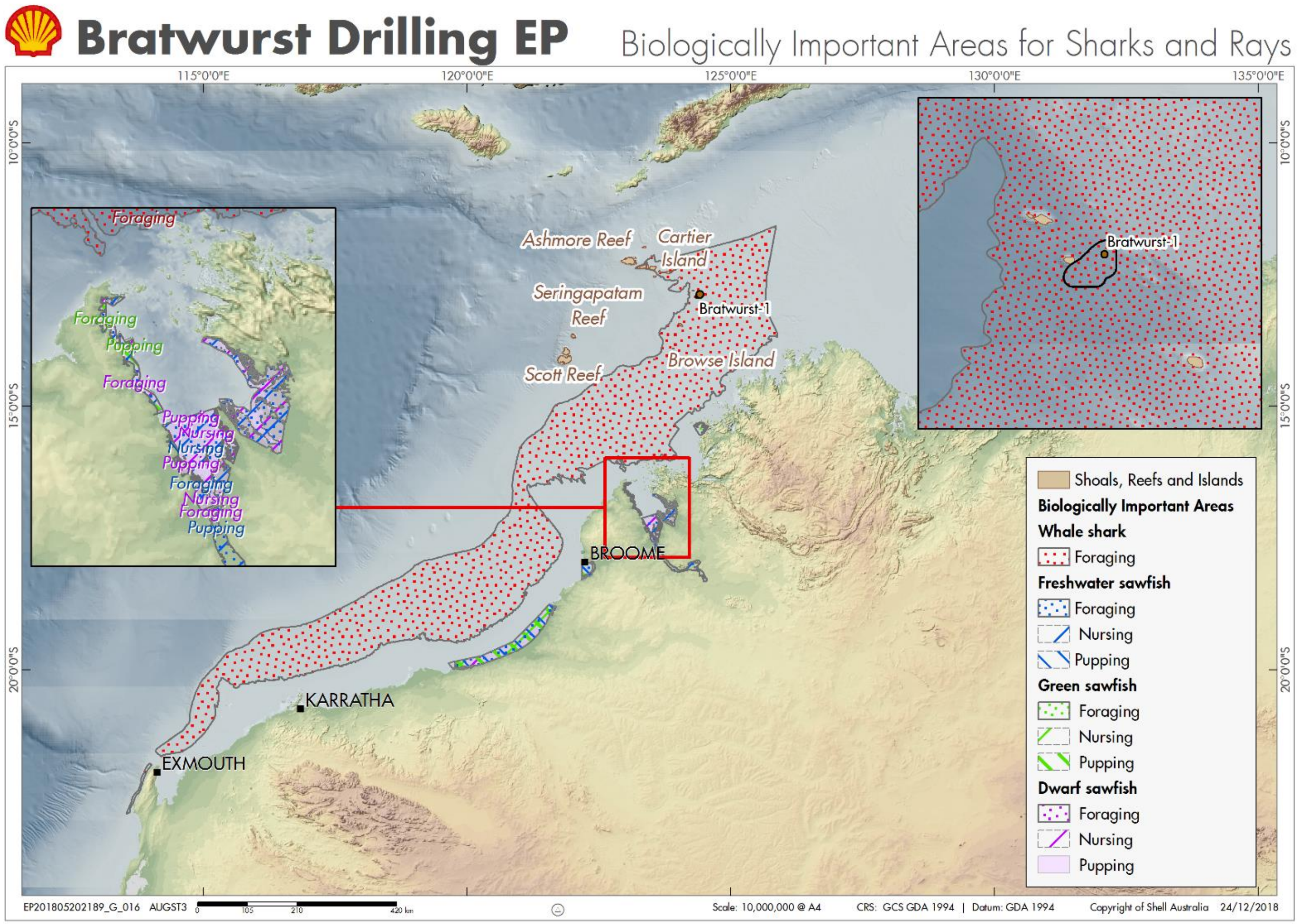


Figure 4 – 9: Biologically Important Areas for Sharks and Rays

Table 4 – 10: Summary of BIAs relevant to Birds within the EMBA

Species	BIAs within the EMBA	General Location(s)
Dwarf sawfish	Foraging	Camden Sound, Fitzroy River Mouth, May and Robinson River
Green sawfish	Foraging	Camden Sound
Freshwater sawfish	Nursing	King Sound
Whale shark	Foraging	Northward from Ningaloo along the 200 m isobath

EPBC Management / Recovery Plans and Conservation Advices

EPBC Management/Recovery Plans and conservation advices have been developed for a number of shark and ray species that have been identified as occurring within the Operational Area and EMBA. Key threats identified within these plans that are relevant to the Bratwurst-1 drilling campaign are summarised in **Table 4 – 11**.

Table 4 – 11: Summary of EPBC Management / Recovery Plans and Conservation Advices Relevant to Sharks and Rays

Species	EPBC Management Plan / Recovery Plan / Conservation Advice	Key Threats Identified in relevant Management Plan / Recovery Plan / Conservation Advice	Cross-reference to Impact and Risk Evaluation
Whale shark[P]	Whale shark (*Rhincodon typus*) Recovery Plan (2005) (May 2005) (Department of Environment and Heritage (DEH) 2005a) Conservation advice on whale shark (*Rhincodon typus*) (October 2015) (DoE 2015l)	Habitat disruption from mineral exploration, production and transportation	Section 5.5.1
		Vessel strike	Section 5.6.3
		Pollution and marine debris	Section 5.5.2, Section 5.6.2, Section 5.6.4
Great white shark[P]	Recovery Plan for the White Shark (*Carcharodon carcharias*) (August 2013) (DSEWPaC 2013b)	Habitat modification/ degradation (e.g. development, pollution) (note, coastal habitat degradation and anthropogenic activities in near-coast areas are of primary relevance as they are often a preferred habitat)	Section 5.6.4
Speartooth shark Northern river shark[P] Green sawfish[P] Largetooth sawfish[P] Dwarf sawfish	Sawfish and River Sharks Multispecies Recovery Plan (November 2015) (DoE 2015m) Conservation advice on speartooth shark (*Glyphis glyphis*) (April 2014) (DoE 2014c), northern river shark (*Glyphis garricki*) (April 2014) (DoE 2014d), dwarf sawfish (*Pristis clavata*) (October 2009) (DEWHA 2009b) and green sawfish (*Pristis zijsron*) (2008) (DEWHA 2008b)	Habitat degradation and modification (note, the recovery plan focusses on river and estuarine barriers that affect the migration of river sharks/sawfish)	Section 5.6.4
		Marine debris (potential threat)	Section 5.6.2

[P] The species was identified as potentially occurring or having habitat in the Operational Area.

4.5 Socio-economic and Cultural Environment

The primary focuses for the socio-economic and cultural setting of the Bratwurst-1 drilling campaign is the existing marine users and interests relevant to the activities and associated impacts and risks presented within this EP. Given the remote distance of the Operational Area there are limited socio-economic interactions, and these interactions are expected to be primarily related to other marine users (specifically other marine traffic, oil and gas facilities and commercial fishing).

4.5.1 Kimberley Region

The Kimberley region is remote from metropolitan areas, with the major towns of Broome being 2,213 km and Kununurra being 3,205 km from Perth by road. Other major towns include Derby, Halls Creek, Wyndham and Fitzroy Crossing. Throughout the region there are over 100 Aboriginal communities of varying population sizes. The most populous local government area in the Kimberley region is the Shire of Broome, with approximately 43% of the regional population (Department of Regional Development, 2014). Broome is also the regional employment hub and a significant centre for servicing and growing the region's industries.

The Kimberley is renowned to be rich in both natural and cultural assets and enjoys a broad-based and diverse economy (Kimberley Development Commission, 2015). With a geographic area in excess of 420,000 square kilometres, equivalent to one-sixth of WA, the Kimberley has a population of 34,364 (Australian Bureau of Statistics (ABS) 2016), with the principal towns of Broome and Kununurra having populations of 16,222 and 5,308 respectively (ABS 2016b, 2016c). As noted above, the main interaction with regional onshore communities will be limited to Broome and community of Djarindjin-Lombadina.

In line with our social performance policies and our commitments to acting as a good neighbour, Shell Australia continually engages with stakeholders in Broome and Djarindjin-Lombadina and has in place existing grievance and community feedback mechanisms to facilitate community engagement.

4.5.2 Darwin

Darwin is the capital city of the NT and is located approximately 700 km to the east of the Operational Area and approximately 1,100 km northeast of Broome. Darwin has an established industrial and commercial centre and is serviced by the Darwin Port. Darwin Port's facilities predominantly serve shipping and cargo markets for livestock exports, dry bulk imports and exports, container and general cargo, cruise and naval vessels, petroleum and other bulk liquids and offshore oil and gas rig services (Darwin Port 2015). Commercial and recreational fishing industries are both represented in Darwin, operating in Darwin Harbour (recreational only) and offshore.

4.5.3 Commonwealth Marine Area and Land

4.5.3.1 *Commonwealth Marine Area*

The Operational Area and large majority of the EMBA are located within the Commonwealth marine area, which includes "any part of the sea, including the waters, seabed and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not state or NT waters. The Commonwealth marine area stretches from three to 200 nm from the coast (DoEE 2018aj).

4.5.3.2 *Commonwealth Land*

Commonwealth land includes land owned or leased by the Commonwealth or a Commonwealth agency, land in the external territories, and any other area of land that is included in a Commonwealth reserve (DSEWPaC 2013c).

Given the remote offshore location context of the Operational Area within Commonwealth waters, the consideration of Commonwealth land is only of relevance to this EP in the context of one of Australia's external territories, Ashmore Reef. This feature is only relevant in the context of the EMBA and is discussed in detail in **Section 5.6.4**.

4.5.4 World Heritage Properties

There are no World Heritage properties in, or in the immediate surrounds of, the Operational Area. Kakadu National Park, which is approximately 800 km to the east of the Operational Area, is the only World Heritage Property to overlap the EMBA (**Figure 4 – 10**).

Kakadu National Park encompasses an area 19,804 km^2 and was made a World Heritage Property due to its outstanding natural and cultural values (DoEE 2018ac). The National Park has been cared for by generations of Aboriginal people known as Bininj/ Mungguy and boasts rock art documenting one of the longest historical records of any group of people in the world. The National Park is also known as a biodiversity hotspot with a number of rare species of birds, mammals, reptiles and plants (DoEE 2018ac). While the majority of the National Park encompasses the NT mainland, the site also includes the mangrove-fringed coast from Wildman River to East Alligator River and offshore islands of Barron Island and Field Island in the Van Diemen Gulf (DoEE 2018ac).

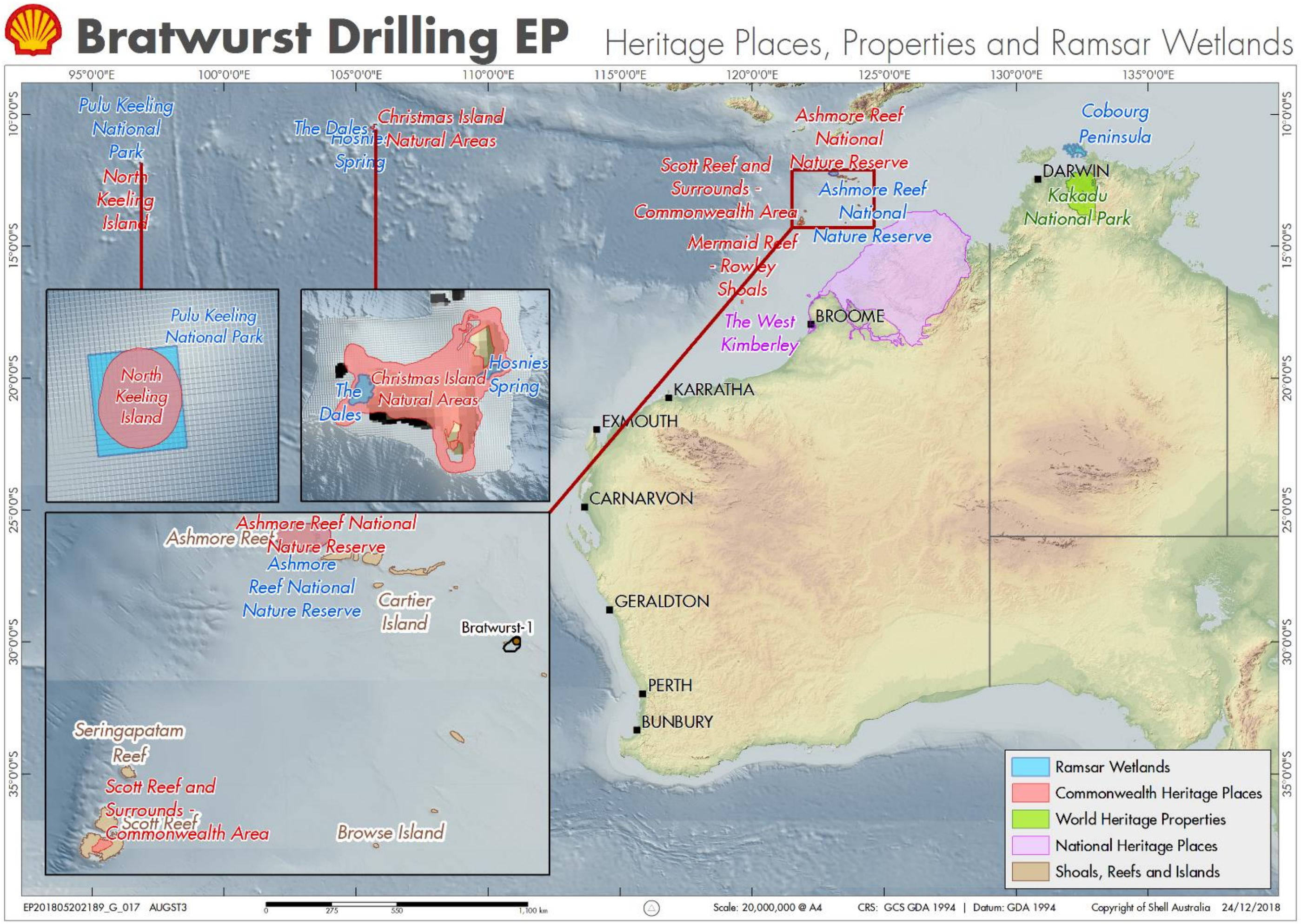


Figure 4 – 10: Heritage Properties, Places and Ramsar Wetlands overlapping the EMBA

4.5.5 National Heritage Places

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. There are no National Heritage properties in, or in the immediate surrounds of, the Operational Area. Within the EMBA, the West Kimberley National Heritage Place is listed as a National Heritage Place is located approximately 165 km from the Operational Area. The Kakadu protected area is also considered a National Heritage place. See **Section 5.4.5** for a description of this area.

The West Kimberley is known for its ancient geology, Aboriginal culture, stunning landscapes, and biological richness (DoEE 2018ad). The West Kimberley coastline includes a range of landforms, including cliffs, rocky headlands, sandy beaches, rivers, waterfalls and numerous islands located off the coast. The West Kimberley holds extensive history of Aboriginal people who have lived in the area for at least 40,000 years. The West Kimberley also provides remnant habitats for many native animals and plants which are now absent elsewhere in Australia (DoEE 2018ad).

4.5.6 Commonwealth Heritage Places

The Commonwealth Heritage List is a list of Indigenous, historic and natural heritage places owned or controlled by the Australian Government. The project is not located in, or in the immediate surrounds of, any Commonwealth Heritage places. There are three Commonwealth Heritage Places that overlap the EMBA. These are listed in **Table 4 – 12**, with a supporting summary of their key values as Commonwealth Heritage Places.

Table 4 – 12: Commonwealth Heritage Places within the EMBA

Commonwealth Heritage Place	**Approximate Distance from The Operational Area (km)**	**Description**
North West Marine Region		
Ashmore Reef National Nature Reserve	135	The Ashmore Reef National Nature Reserve protects Ashmore Reef, a large platform reef with coral reefs, sand flats and three vegetated islands (DoEE 2018ae; see also **Section 4.3.6**). Specific values of this site include (DoEE 2018ae; Environment Australia 2002): • Breeding and foraging habitat for marine turtles • Considered to have the world's greatest abundance and diversity of sea snakes • Habitat for 569 species of fish, 255 species of corals and 433 species of mollusc, as well as species not previously recorded or rarely recorded in Australia • An important seabird rookery and provides an important staging/feeding area for many seabirds and migratory shorebirds • Provides breeding and feeding habitat for a small dugong population (< 50 individuals)
Scott Reef and surrounds	293	Scott Reef (see also **Section 4.3.6**) is considered regionally important for the following features: • High diversity of marine fauna, including corals, fish and marine invertebrates • Physical characteristics of the reefs create environmental conditions which are rare for shelf atolls, including clear deep oceanic water and large tidal ranges that provide a high physical energy input to the marine ecosystem • High representation of species not found in coastal waters off WA and for the unusual nature of their fauna which has

Commonwealth Heritage Place	Approximate Distance from The Operational Area (km)	Description
North West Marine Region		
		affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region. • Important for scientific research and benchmark studies into long term geomorphological and reef formation processes due to the age of the reef and the documentation of its geophysical and physical environmental characteristics (DoEE 2018af)
Mermaid Reef – Rowley Shoals	670	Mermaid Reef (see also **Section 4.3.6**) is one of three reef systems, located 30 – 40 km apart, which make up the Rowley Shoals. The shoal consists of a reef flat roughly 500 to 800 m wide, shallow back reefs and a large lagoon. The Rowley Shoals have been described as the most perfectly formed shelf atolls in Australian waters, and the clear, deep water and large tidal range of the atolls are considered rare environmental conditions for shoals (DoEE 2018ag). The specific values of Mermaid Reef include (DoEE 2018ah; DoEE 2018ag): • High diversity of marine reef fauna, including corals, fish and marine invertebrates • Important area for sharks, marine turtles and toothed whales, dolphins, tuna and billfish • Important resting and feeding site for migratory seabirds • Regionally significant due to the presence of many species not found in inshore tropical waters of Northern Australia, and species that are close to their geographical ranges. Includes 216 species of fish, 39 species of mollusc and seven species of echinoderms • Considered a genetic stepping stone between the Indonesian archipelago and reefs to the south
North Keeling Island	3,000	The North Keeling Island forms the northern atoll of the Cocos (Keeling) Islands. The island is significant as it is: • One of the remaining pristine islands in the Indian Ocean • The only seabird rookery within 900 km • Home to rare species including robber crabs and the buff banded rail • Important habitat for crabs, and provides nesting area for marine turtles and the red footed booby (DoEE 2018ae)
Christmas Island Natural Areas	2,060	This 1,220 km^2 listing includes the entirety of Christmas Island. The site has the following values: • A unique ecosystem which makes the study of species evolution in relative isolation possible, as well as the study of adaptions of migrant species to new habitats • A diverse range of land crabs • Globally significant seabird island with regards to both diversity and abundance • Unique relict populations of black-mangrove species and cycads, including a globally significant wetland (DoEE 2018ae)

4.5.7 Declared Ramsar Wetlands

There are no “Wetlands of International Importance” under the Convention on Wetlands of International Importance (Ramsar 1975) in, or in the immediate surrounds of, the operational area. The area of influence, however, encompasses a number of Ramsar Wetlands. A summary of the values relevant to each Ramsar site is provided in **Table 4 – 13**.

Table 4 – 13: Ramsar Wetlands within the EMBA

Ramsar Wetland	Approximate Distance from the Operational Area (km)	Description
North West Marine Region		
Ashmore Reef National Nature Reserve (now part of Ashmore Reef Marine Park)	135	The Ashmore Reef Marine Park, also a KEF (see **Section 4.5.8** and **Section 4.3.6**), was designated a Ramsar site primarily due to its importance in supporting large seabird breeding colonies and as a resting place for migratory shorebirds. The boundary of the Ramsar site coincides with the Marine Park (Hale and Butcher 2013). Notably, Ashmore Reef has been managed for conservation purposes for more than thirty years. The five wetland types that have been identified within this Ramsar site are permanent shallow marine waters, sand, shingle or pebble shores, marine subtidal aquatic beds, coral reefs, and intertidal mud, sand or salt flats. Each of these wetland types are in near natural condition and have been recorded as having low densities of coral predators and disease (Hale and Butcher 2013). The three islands of the Ramsar site are the only vegetated islands in the Timor Province bioregion. At the time of listing, this Ramsar site boasted 62 threatened species, including 42 corals, five sea cucumber, eight fish, six reptile and one mammal species. Historically, the site was also significant with regards to sea snake abundance and diversity. The site supports breeding and/or foraging areas for green, loggerhead and hawksbill turtles, and breeding areas for dugongs (Hale and Butcher 2013). The site has been identified as hotspot of biological diversity within the Timor province bioregion, and broader NWMR.
Cobourg Peninsula	820	The Cobourg Peninsula Ramsar site is located in the NT, approximately 163 km north-east of Darwin. The site was the first Ramsar Wetland in the world, designated thus for its diversity of coastal and inland wetland habitats, support for populations of endangered species and life-cycle functions (BMT WBM 2011). Wetland types include coral reefs, rocky marine shores, intertidal mud, sand or salt flats, karst, and intertidal marshes. Notably, the majority of the site is terrestrial land, with large areas of Eucalypt-dominated woodlands, and does not support wetland habitat (BMT WBM 2011). Whilst the site contains no towns or settlements the area has been inhabited continuously for at least 50,000 years, and therefore has significant cultural characteristics.
"The Dales" Christmas Island	2,074	The Dales Ramsar site refers to a system of seven watercourses within the Christmas Island National Park (Butcher and Hale 2010). Three of The Dales support permanent streams and four support intermittent streams. These are predominately surrounded by semi-deciduous forest and a range of karst features typical of Christmas Island (Butcher and Hale 2010). The Ramsar site boasts nine wetland types, including coral reefs, karst and other subterranean hydrological systems, and freshwater, tree-dominated wetlands (Butcher and Hale 2010). The site features many endemic and rare species of plants and animals. The Dales features habitats which support roosting and breeding habitat for seabirds and migratory birds,

Ramsar Wetland	Approximate Distance from the Operational Area (km)	Description
North West Marine Region		
		including populations of the endangered Abbott's Booby and vulnerable Christmas Island frigatebird (Butcher and Hale 2010).
Hosnies Spring Christmas Island	2,060	The Hosnies Spring Ramsar site refers to a freshwater spring which surrounds terrestrial vegetation and a small portion of coast within the Christmas Island National Park (Hale and Butcher 2010). The Ramsar site was expanded from approximately 0.3 to 202 ha in 2010 in order to provide greater protection for unique freshwater mangrove stand estimated to be 120,000 years old. These mangroves occur at an elevation which has not been recorded elsewhere in the world (Hale and Butcher 2010). The site features a permanent, shallow freshwater wetland fed by a natural spring system, surrounded predominately by rainforest. This is one of the few permanent freshwater features on Christmas Island. Three wetland types have been identified in the Hosnies Spring Ramsar site; permanent rivers/streams/creeks, freshwater, tree dominated wetlands, and freshwater springs; oases (Hale and Butcher 2010). The site also encompasses shallow coral reefs and supports a number of crab, wetland and terrestrial bird species (Hale and Butcher 2010).
"The Dales" Christmas Island	2,074	The Dales Ramsar site refers to a system of seven watercourses within the Christmas Island National Park (Butcher and Hale 2010). Three of The Dales support permanent streams and four support intermittent streams. These are predominately surrounded by semi-deciduous forest and a range of karst features typical of Christmas Island (Butcher and Hale 2010). The Ramsar site boasts nine wetland types, including coral reefs, karst and other subterranean hydrological systems, and freshwater, tree-dominated wetlands (Butcher and Hale 2010). The site features many endemic and rare species of plants and animals. The Dales features habitats which support roosting and breeding habitat for seabirds and migratory birds, including populations of the endangered Abbott's Booby and vulnerable Christmas Island frigatebird (Butcher and Hale 2010).

4.5.8 Australian Marine Parks

AMPs (formerly Commonwealth Marine Reserves) are recognised under the EPBC Act for protecting and maintaining biological diversity and contributing to a national representative network of marine protected areas. Under the relevant management plans, AMPs are allocated conservation objectives (International Union for Conservation of Nature (IUCN) Protected Area Category) based on the Australian IUCN reserve management principles in Schedule 8 of the EPBC Regulations 2000. These principles determine what activities are acceptable within a protected area under the EPBC Act. Given no AMPs directly overlap the Operational Area where the petroleum activities will be undertaken, no approval is required from the Director of National Parks for the Bratwurst-1 drilling campaign, however, the Director is considered a relevant stakeholder. Refer **Section 6.3** for information on stakeholder consultation.

A search of the EPBC Protected Matters Database confirmed that the Operational Area does not overlap with any Australian Marine Parks (AMPs). However, there are a number of AMPs that overlap the EMBA (refer **Figure 4 – 11**). These are described in **Table 4 – 14**.

Table 4 – 14: Australian Marine Parks within the EMBA

AMP	Approximate Distance from the Operational Area (km)	Description
North West Marine Region		
Argo-Rowley Terrace	444	The 146,099km^2 Argo Rowley Terrace Marine Park comprises 83,379 km^2 of Multiple Use Zone (IUCN Category VI) and 62,720 km^2 of Marine National Park Zone (IUCN Category II). The depth ranges between 220 m and 6,000 m. It is important for foraging areas for migratory seabirds and the endangered loggerhead turtle as well as sharks. It provides connectivity between the Mermaid Reef Marine Park. The area includes canyons linking the Argo Abyssal Plain with the Scott Plateau, which is a unique seafloor feature with enhanced productivity and feeding aggregations of species (DoEE 2018ak).
Ashmore Reef	135	The 583 km^2 Ashmore Reef Marine Park comprises a Sanctuary Zone (IUCN category Ia) and a Recreational Use Zone (IUCN category II). It provides an important area for a number of EPBC listed species, including sea snakes, marine turtles, dugongs and migratory seabirds. Ashmore Reef also supports important cultural and heritage sites, such as Indonesian artefacts and grave sites. In 2003, the Ashmore Reef Marine Park was declared a Ramsar Wetland of International Importance due to its conservation values (refer to **Section 4.5.7** for further information) (DoEE 2018al).
Cartier Island	86	The Cartier Island Marine Park covers a reasonably small area (172 km^2) and is comprised of a Sanctuary Zone (IUCN category Ia). The Marine Park provides an important area for a number of EPBC listed species, including sea snakes, turtles and migratory seabirds. Additionally, it supports some of the most important seabird rookeries on the NWS (DoEE 2018am).
Eighty Mile Beach	707	Eighty Mile Beach Marine Park comprises a 10,785 km^2 Multiple Use Zone. It contains major foraging areas for migratory seabirds, marine turtles, and part of the migratory pathway for humpback whales. It also contains important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish. The Marine Park provides protection for the shelf with depths ranging from 15 m to 70 m (DoEE 2018ao).
Gascoyne	1,423	The Gascoyne Marine Park encompasses an area of 81,766 km^2 and is comprised of a Multiple Use Zone (IUCN Category VI), Habitat Protection Zone (IUCN Category IV) and Marine National Park Zone (IUCN Category II). The reserve provides protection to many seafloor features and to sponge gardens, as well as providing important foraging areas for seabirds, marine turtles and the whale shark. The reserve also provides a corridor of connectivity from shallow depths of approximately 15 m to deep offshore waters on the abyssal plain at more than 5,000 m depth (DoEE 2018ap).
Kimberley	100	The 74,469 km^2 Kimberley Marine Park is comprised of a National Park Zone (IUCN category II), Habitat Protection Zone (IUCN category IV, specifically intended to protect humpback whale calving) and Multiple Use Zone (IUCN category VI). The Marine Parks numerous conservation values include the provision of important foraging areas for migratory seabirds, dugongs, dolphins, marine turtles and a migration pathway and nursery areas for humpback whales. The Marine Park also lies adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles.

AMP	Approximate Distance from the Operational Area (km)	Description
North West Marine Region		
		The Marine Park ranges in depth from less than 15 m to 800 m and provides protection for the communities and habitats of waters offshore of the Kimberley coastline. Ancient coastline and continental slope demersal fish communities are two KEFs are represented in the reserve (refer to **Section 4.3.6**) (DoEE 2018aq). The Kimberley Marine Park supports or is adjacent to recreational and commercial fishing, tourism activities and areas of Native Title claims and determinations (DoEE 2018aq).
Mermaid Reef	668	The 540 km^2 Mermaid Reef Marine Park is a key area for over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition. It is also an important area for sharks, marine turtles, toothed whales, dolphins, tuna and billfish. The Marine Park also has important nesting and feeding sites for migratory seabirds. Mermaid Reef Marine Park is listed on Australia's Commonwealth Heritage List due to its conservation values (DoEE 2018ah).
North Marine Region		
Arafura	918	The Arafura Marine Park is a 22,924 km^2 IUCN Category VI Multiple Use Zone. The Marine Park includes important resting (or internesting) areas for marine turtles, as well as important foraging habitat for breeding aggregations of the migratory roseate tern. The tributary canyons of the Arafura Depression, a unique seafloor feature, occur within this Marine Park (DoEE 2018au).
Arnhem	1,011	The Arnhem Marine Park ranges in depth from 5 to 30 m. It is a 7,125 km^2 IUCN Category VI Special Purpose Zone. The marine park has important internesting habitat for the flatback turtle, as well as important foraging habitat for three species of tern (DoEE 2018av).
Oceanic Shoals	178	The Oceanic Shoals Commonwealth Marine Park comprises a 71,743 km^2 area, with a large proportion (39,964 km^2) designated as Multiple Use Zone (IUCN Category VI). There are smaller areas designated for National Park Zone (Category II, 406 km^2), Habitat Protection Zone (Category IV, 6,929 km^2), and Special Purpose Zone for Trawling (Category VI, 10,461 km^2). The depth ranges between approximately 5 m and 500 m. The Marine Park provides important foraging areas for loggerhead and olive ridley turtles, as well as important internesting areas for flatback and olive ridley turtles. KEFs represented in the reserve are carbonate banks, pinnacles and the shelf break and slope of the Arafura Shelf (further detail in **Section 4.3.6**) (DoEE 2018ax).

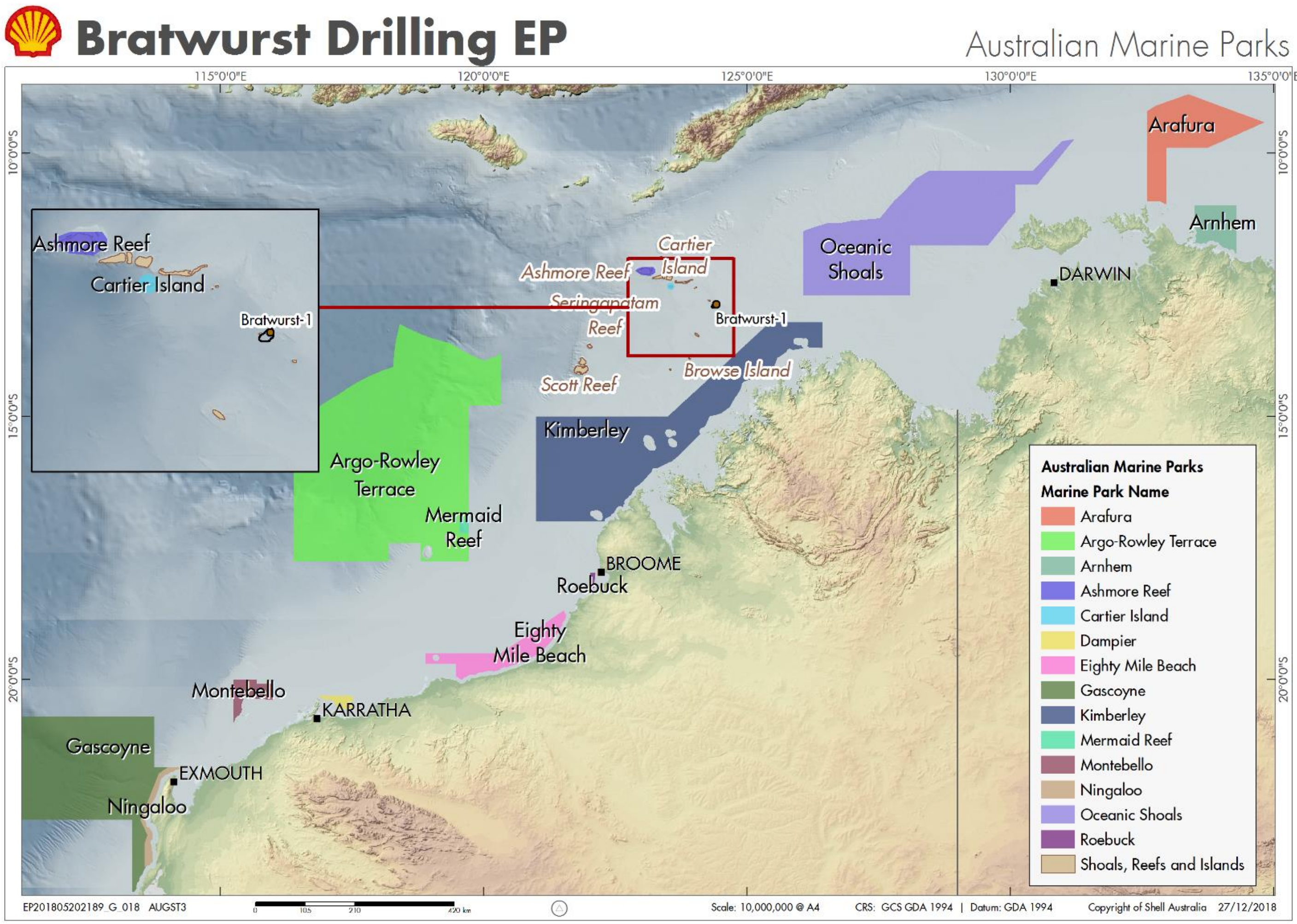


Figure 4 – 11: Australian Marine Parks

4.5.9 Commercial Fisheries

The Operational Area overlaps with a number of Commonwealth and WA State and NT commercial fishing management areas. This section identifies fisheries interests within the Operational Area and broader EMBA. Commercial fishing is typically concentrated mostly in coastal waters and minimum fishing effort is known to occur within the vicinity of the Operational Area, given its remoteness offshore. This assessment has been validated through direct engagement with fisheries and fisheries organisations who have interests in the area and other relevant stakeholders (e.g. WA Department of Fisheries (DoF) (see **Section 6.3**).

4.5.9.1 *Commonwealth Fisheries*

There are six Commonwealth managed commercial fisheries occurring with the EMBA (as shown in **Figure 4 – 12**). Of these, three fishery management areas are indicated to overlap the Operational Area – the Western Tuna and Billfish Fishery, Western Skipjack Fishery, and the Southern Bluefin Tuna Fishery. An additional fishery, the North West Slope Trawl Fishery (NWSTF), lies approximately 4 km northwest of the Operational Area. None of these fisheries were identified during stakeholder consultation as actively fishing within the Operational Area (**Table 7 - 7**). A description and status of each of the Commonwealth managed commercial fisheries relevant to the context of the Bratwurst-1 drilling campaign is provided in **Table 4 – 15**.

4.5.9.2 *WA Managed Fisheries*

There are ten WA managed commercial fisheries occurring within the EMBA (**Figure 4 – 13**). Of these, seven WA fisheries management areas are indicated to occur in the Operational Area – the Northern Demersal Scalefish Fishery (NDSF), Mackerel Fishery, Northern Shark Fishery, Pearl Oyster Fishery, Specimen Shell Managed Fishery, Marine Aquarium Fish Managed Fishery (MAFMF), and the West Coast Deep Sea Crustacean Fishery. Only one of these fisheries, the NDSF, was identified as potentially operating within the Operational Area (**Table 7 - 7**). A description and status of each of the WA managed commercial fisheries relevant to the context of the Bratwurst-1 drilling campaign is provided in **Table 4 – 16**.

4.5.9.3 *NT Managed Fisheries*

The Operational Area does not directly overlap with any fisheries in NT waters. However, NT fisheries are relevant in the context of the broader EMBA and are described below for completeness.

The NT commercial fisheries occurring within the EMBA are shown in **Figure 4 – 14**, and further described in **Table 4 – 17**. These fisheries primarily operate in the NT “Top End” in nearshore island and mainland waters, including intertidal zones. Exceptions to this include the Demersal Fishery, Timor Reef Fishery, situated offshore north-west of Darwin, and the Spanish Mackerel Fishery and those fisheries targeting snapper species which are known to operate in areas further offshore.

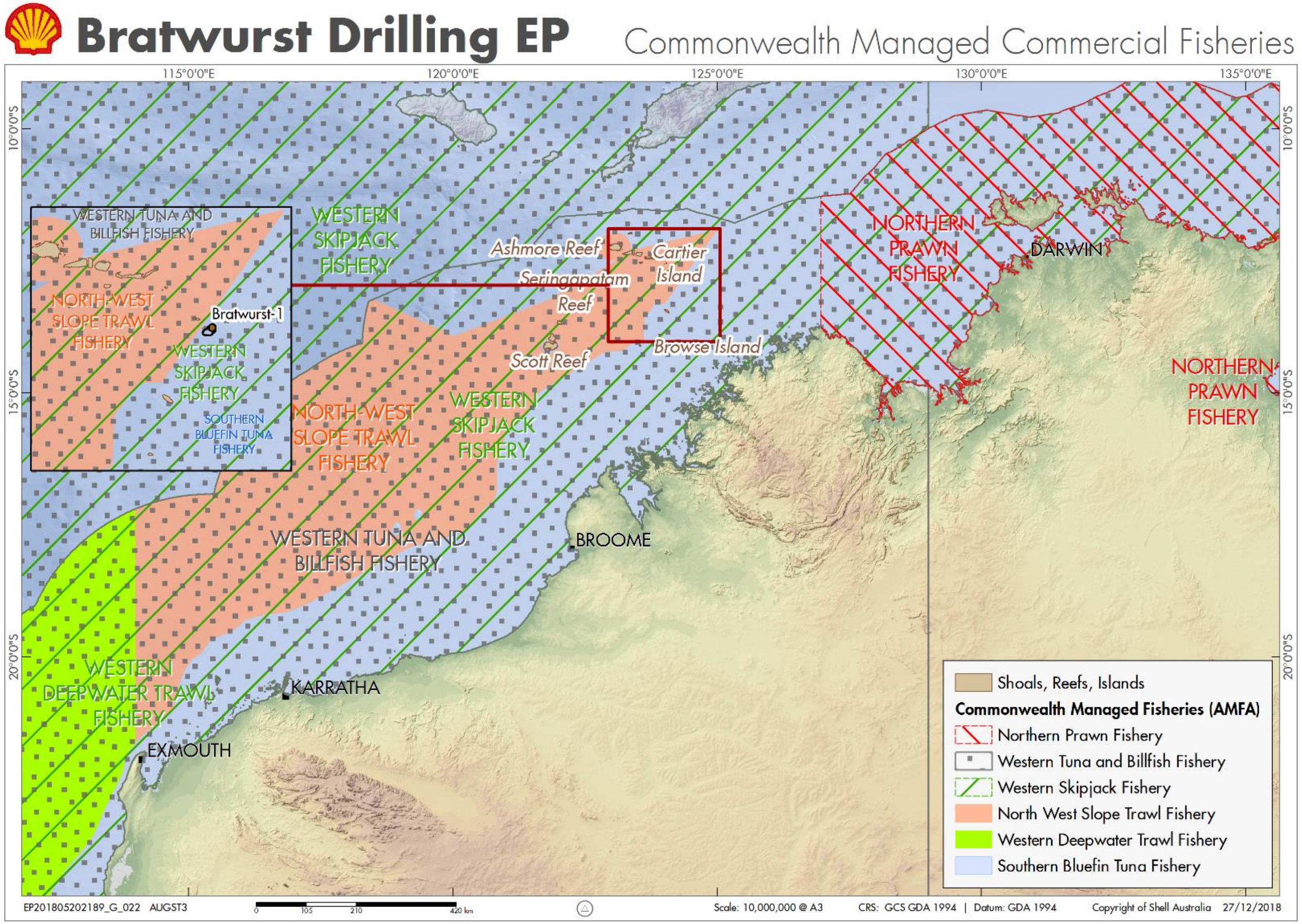


Figure 4 – 12: Commonwealth Managed Commercial Fisheries overlapping the EMBA

Table 4 – 15: Commonwealth Managed Fisheries overlapping the EMBA

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
Western Tuna and Billfish Fishery (WTBF)	Overlaps the Operational Area and EMBA	Fishery operates within the Australian Exclusive Economic Zone and the high seas of the Indian Ocean. Key species in the WTBF are swordfish, striped marlin, yellowfin tuna and bigeye tuna.	Main method is pelagic longline with some minor-line fishing.	After peaking in 2000 at 50 active vessels, fishing effort has declined and since 2005 there has been less than five vessels active each season. Catch effort for the fishery was 320 tonnes in the 2016 season with 95 boat statutory fishing rights (SFRs), and three active fishing vessels. Notably, whilst the fishery extends throughout the Operational Area, fishing effort in the 2016 season did not extend north of Exmouth. Effort was concentrated off the south-west of WA and South Australia. Stakeholder consultation (with AFMA) have confirmed that there are only a few active permit holders in the fishery and that they do not currently operate within the Operational Area (**Section 7.14**).
Western Skipjack Fishery (WSF)	Overlaps the Operational Area and EMBA	Fishery comprises the same area as the Western Tuna and Billfish Fishery. Part of the Skipjack Tuna Fishery which collectively describes the Western and Eastern Skipjack Tuna Fishery.	Majority of fishing effort uses purse-seine gear, small amount of pole-and-line effort.	14 fishing permits for the 2015-16 season, however there were no active vessels. No effort since the 2008-09 fishing season, coinciding with the closure of the main cannery in Port Lincoln in 2010. Stakeholder consultation (with WAFIC) have confirmed there are no active vessels operating within the Operational Area (**Section 7.14**).
Southern Bluefin Tuna Fishery	Overlaps the Operational Area and EMBA	The SBTF fishery extends throughout the AFZ. There is a single spawning location for southern bluefin tuna located in the north-east Indian Ocean. Juveniles move southwards from this location along the WA coast.	The majority of catch is taken by purse-seine netting methods. Pelagic long-line (of which southern bluefin tuna is bycatch) and minor line (troll and poling) catch methods are also used.	During the 2015-16 season there were 89 SFR owners; 6 active Purse-seine and 19 active long-line vessels within the fishery. The majority of fishing effort is currently focused in the Great Australian Bight and waters off South Australia, targeting juveniles for transfer to aquaculture farming operations off Port Lincoln, South Australia. In the 2015-16 season a total effort of 5,636 t was recorded for the fishery. Stakeholder consultation (with WAFIC) have confirmed there are no active vessels operating within the Operational Area (**Section 7.14**).

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
North West Slope Trawl Fishery (NWSTF)	Overlaps the EMBA	The NWSTF operates within the 200 m isobath and the Australian Fishing Zone (AFZ), between 114 E and 125 E. The Memorandum of Understanding (MOU) box falls within this fishery. Target species is scampi, including Australian scampi, velvet scampi and Boschma's scampi.	The NWSTF primarily uses demersal trawl methods.	Since 2008-09 the number of active fishing vessels per season has been one to two. Total catch in the entire permit area for the 2015-16 season was 54.8 tonnes from two fishing vessels, 33 tonnes of which was scampi. There were five fishing permits in the 2015-16 season. Fishery does not overlap the Operational Area.
Northern Prawn Fishery (NPF)	Overlaps the EMBA	The fishery extends from the NT high tide mark to the extent of the AFZ. Target species include a number of tropical prawn species including white banana prawn, brown tiger prawn, and grooved tiger prawn, which comprise 80% of catch.	Otter trawl gear is used.	The total catch for the NPF was 5,807 tonnes in 2016, 375 tonnes of which was by-product species. Fifty-two permits were all utilised with 52 licensed vessels active in this season. Notably, seasonal fishing effort fluctuates naturally with variability in banana prawn availability. The highest fishing effort for the NPF is concentrated within inshore coastal areas of the Gulf of Carpentaria. Fishery does not overlap the Operational Area.
Western Deepwater Trawl Fishery	Overlaps the EMBA	Fishery extends seaward of approximately the 200 m depth contour. Target species number greater than 50, though catch is historically dominated by six commercial finfish species. In recent years, deep water bugs (*Ibacus* spp.) have become an important target species group.	Demersal trawl fishing methods used.	There were 11 fishing permits in the 2015-16 season, but no active vessels and no catch reported. This follows relatively low catch levels in recent years. Fishery does not overlap the Operational Area.

Source: Patterson et al. 2017

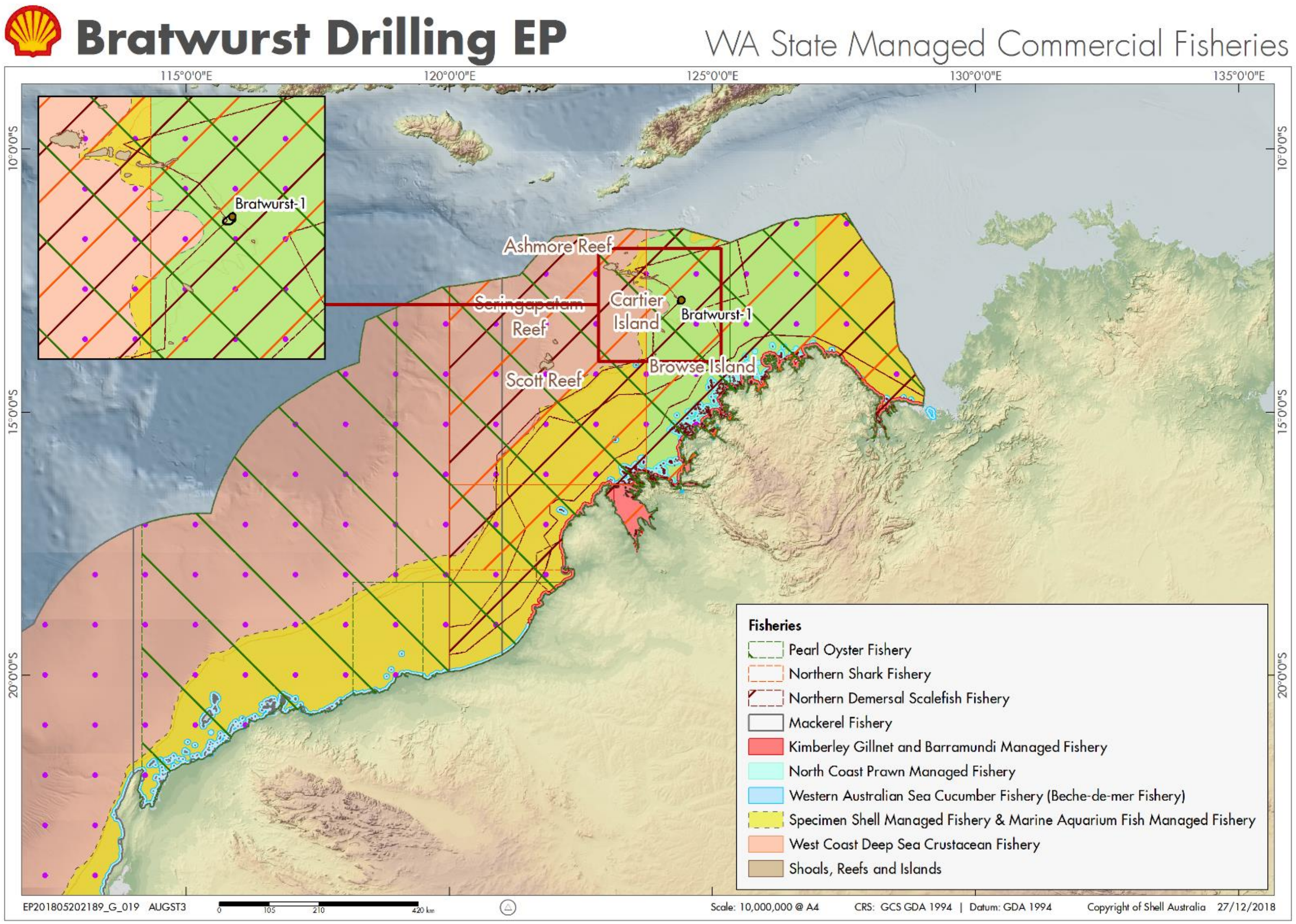


Figure 4 – 13: WA Managed Commercial Fisheries overlapping the EMBA

Table 4 – 16: WA Managed Commercial Fisheries within the EMBA

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
Mackerel Fishery	Overlaps the Operational Area and EMBA	The Mackerel Fishery extends north from the West Coast Bioregion to the NT border (Department of Primary Industries and Regional Development (DPIRD) 2018a).	Dominant fishing method is trolling, also use jigging methods to catch grey mackerel in some areas (Mackie et al. 2010).	Catch effort in the 2016 season was 276 tonnes (DPIRD 2018b). The primary fishing effort is typically concentrated in the North Coast Bioregion, which encompasses the Pilbara and Kimberley coastline (DPIRD 2018a). Stakeholder consultation (with WAFIC) have indicated there are no licenses active within the Operational Area (**Section 7.14)**
Northern Demersal Scalefish Fishery (NDSF)	Overlaps the Operational Area and EMBA	The NDSF includes all waters of the Indian Ocean and Timor Sea off the north coast of WA that are east of 120° 00.079' and north of 19°59.917'. There are some restricted areas within the fishery. The fishery is divided into two fishing areas; Area 1 – inshore and Area 2 – offshore. Area 2 is further divided into Zone A, B and C (DoF 2016).	The fishing method is restricted to either hand-line, drop-line or fish traps (DoF 2016).	Fishing effort for the 2016 season was 1,173 tonnes (DoF 2017) Stakeholder consultation (with WAFIC) identified that there are two active fishing licence permit holders operating within the Operational Area (**Section 7.14**).
Northern Shark Fishery	Overlaps the Operational Area and EMBA	The Northern Shark Fishery comprises the WA North Coast Shark Fishery (Pilbara and Kimberley regions) and the Joint Authority Northern Shark Fishery (JANSF) (Eastern Kimberley) (DPIRD 2018b).	Pelagic net and longline fishery (DEH 2003).	No catch effort has been recorded since the 2008/09 season (DPIRD 2018b). Stakeholder consultation (with WAFIC) indicated this fishery is not currently active within the Operational Area (**Section 7.14**).
Pearl Oyster Fisheries	Overlaps the Operational Area and EMBA	This fishery targets only the silver lipped pearl oyster (*Pinctada maxima*) and operates from Exmouth to the NT border, effort is predominately focused along the shallow coastal waters of the NWS (Fletcher et al. 2006).	This is a dive-based fishery. Divers collect oysters individually as they are towed along behind the fishing vessel, using hookah or surface compressor supplied air (Fletcher et al. 2006).	Catch effort for the 2016 season was 541,260 oysters (DoF 2017). Historically as many as 16 vessels would operate each season, however, since 2009 numbers have been much lower and only 5 were active in 2013 (WAFIC 2018a). WAFIC advised Shell in writing that this fishery does not fish in the Operational Area.

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
West Coast Deep Sea Crustacean Fishery	Overlaps the Operational Area and EMBA	The fishery operates off the WA coast from 34° 24' S to the NT border, from the 150 m isobath out to the Australian Exclusive Economic Zone (DoF 2015).	Fishery uses fish traps with an average of 120 per line (DoF 2015).	Catch effort for the 2016 season occurred primarily south of Exmouth and totalled 153.3 tonnes of crystal crab (99.6% of catch) and 30 kg of champagne crab (DPIRD 2018d). Stakeholder consultation (with WAFIC) advised this fishery mostly operates in water depths of 500-800 m along the continental shelf of the West Coast and Gascoyne Bioregions (i.e. outside the Operational Area) (**Section 7.14**).
Specimen Shell Managed Fishery	Overlaps the Operational Area and EMBA	Fishery encompasses the entire WA coastline between the high-water mark and the 200 m isobath (DEH 2005b).	Dive based fishery (some new methods include controlled underwater vehicles at depths of 60 – 300 m, and baited habitat structures at depths) (DPIRD 2018d)	Primary areas of effort include Broome, Karratha, Shark Bay, metropolitan Perth, Mandurah, the Capes area and Albany. Total catch in 2016 was 8,531 shells (DPIRD 2018d). Given water depths within the Operational Area (155 m) this fishery is not expected to operate within the area.
Marine Aquarium Fish Managed Fishery (MAFMF)	Overlaps the Operational Area and EMBA	The MAFMF encompasses all WA State waters. The Fishery has the capacity to target 950 marine aquarium fish species (DPIRD 2018d).	Primarily dive based using hand-held nets (DPIRD 2018d).	In recent years effort has been in waters from Esperance to Broome, with a focus around the Capes region, Perth, Geraldton, Exmouth and Dampier (DPIRD 2018b). The total catch in the MAFMF and Hermit Crab Fishery in 2016 was 128,610 fishes, 16.4 tonnes of coral, live rock and living sand, and 75 L of marine plants (DPIRD 2018d). Given water depths within the Operational Area (155 m) this fishery is not expected to operate within the area.
Kimberley Gillnet and Barramundi Managed Fishery	Overlaps the EMBA	This fishery operates in nearshore and estuarine zones from the NT border to the top end of Eighty Mile Beach (DPIRD 2018d).	Gillnet fishery.	There are three principal fishing areas: Cambridge Gulf (including the Ord River), Kimberley coast (six small river systems) and King Sound (DPIRD 2018b). Fishing effort for the 2016 season was 74.6 tonnes (DPIRD 2018d). Fishery does not overlap the Operational Area.
WA Sea Cucumber Fishery (formerly	Overlaps the EMBA	The fishery comprises all WA State waters (with some minor exceptions) (WAFIC 2018c).	Hand harvest (DPIRD 2018d)	There is only one active operator. Catch effort for 2016 was 21 tonnes sandfish, 70 tonnes sandfish, and 2 tonnes redfish (DPIRD 2018d).

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
Beche-de-mer Fishery)				Fishery does not overlap the Operational Area.
North Coast Prawn Fishery	Overlaps the EMBA	This fishery is comprised of the Onslow, Nickol Bay, Broome, and Kimberley Prawn Managed Fisheries. The fishery extends south from Cape Londonderry (and the Northern Prawn Managed Fishery boundary) to the north-eastern extent of the Exmouth Gulf Prawn Fishery (WAFIC, 2018b).	Trawl fishery (WAFIC 2018b). Most of the fishing occurs at night, except for targeted fishing for banana prawns which occurs mostly during the day (DPIRD 2018c).	Catch effort from the 2016 (DoF 2017) season was: - Kimberley: 155 tonnes - Nickol Bay: 17 tonnes - Onslow: Negligible - Broome: Negligible Fishery does not overlap the Operational Area.

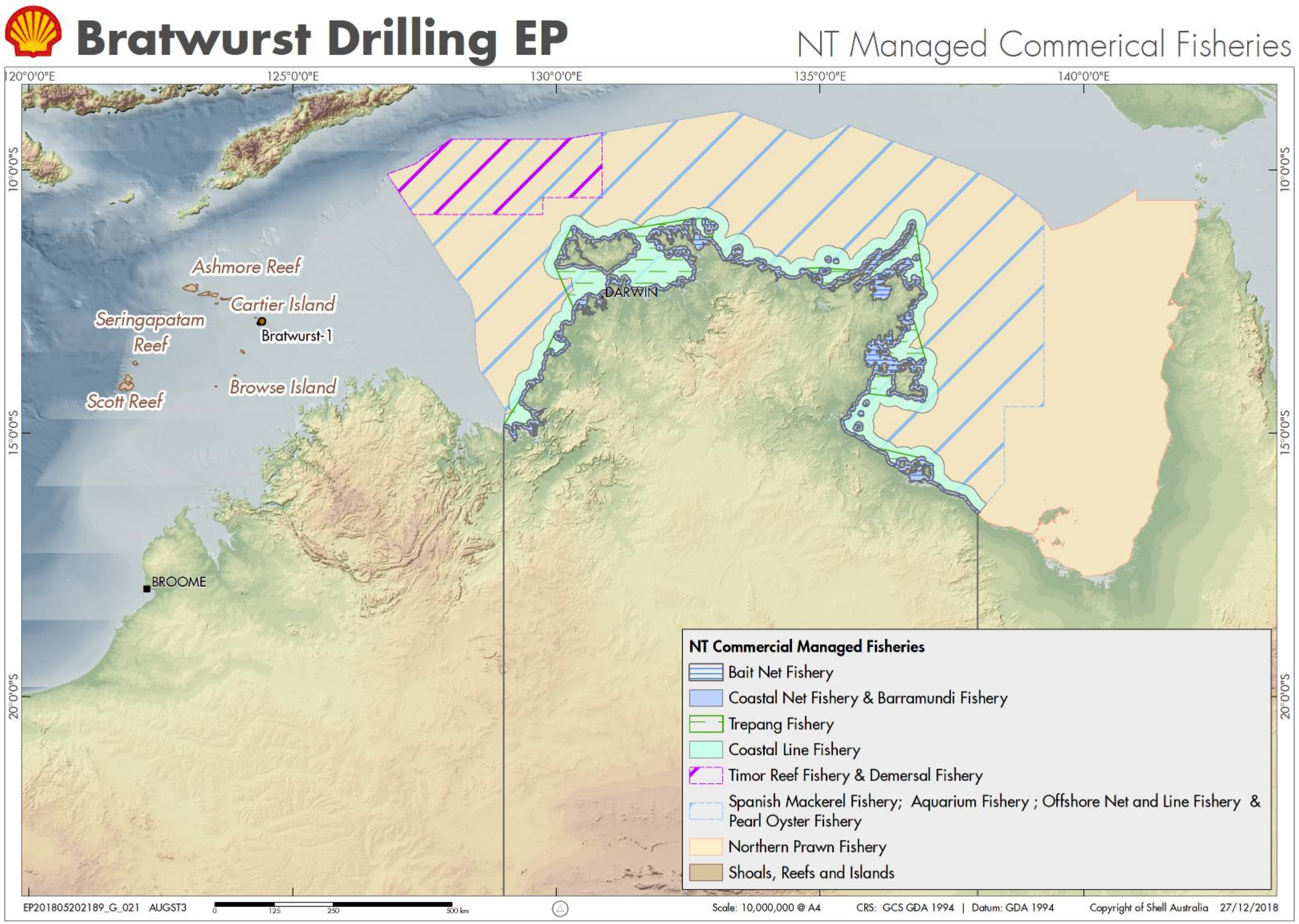


Figure 4 – 14: NT Managed Commercial Fisheries overlapping the EMBA

Table 4 – 17: NT Managed Commercial Fisheries overlapping the EMBA

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
Barramundi Fishery	Overlaps the EMBA	Fishery extends from the NT coast high water mark to three nm seaward of the low water mark. Some area exclusions apply. Fishing typically takes place over tidal mud flats and inside a restricted number of rivers. Primary species include barramundi and king threadfin.	Use of gill nets.	Catch effort in 2015 was 661 tonnes, 58% of which was Barramundi and 38% of which was king threadfin. Fishing effort is primarily focused in Anson Bay, Van Diemen Gulf, East Arnhem Land, Central Arnhem Land and Limmen Bight. Fishery is restricted to 14 licences Fishery does not overlap the Operational Area.
Coastal Line Fishery	Overlaps the EMBA	Fishery extends seaward from the high-water mark to 12 nm from the low water mark, within the Territory water boundaries. Primary target species is Black Jewfish	Hook and line gear primarily. Also permitted to use rod and line, hand lines, cast nets (bait only), scoop nets or gaffs throughout the fishery. Restrictions apply to the use of droplines and fish traps within the fishery.	Majority of fishing effort is concentrated around rocky reeds within 150 km of Darwin. 2015 catch effort was 139 tonnes. The fishery is limited to 52 licences. All 52 are currently allocated. Fishery does not overlap the Operational Area.
Coastal Net Fishery	Overlaps the EMBA	Fishery extends seaward 3 nm from the high-water mark along the NT coast. Target species include mullets, blue threadfin, sharks and queenfish.	The fishery uses gill nets and cast nets which adhere to fishery specific specifications.	The fishery is limited to five licences. 2015 catch effort was recorded at 11.7 tonnes. Fishery does not overlap the Operational Area.
Spanish Mackerel Fishery	Overlaps the EMBA	Fishery extends to the outer limit the AFZ from the high-water mark, along the NT coastline. Target species is Spanish Mackerel.	Trolled lines, floating hand lines or rods.	Primary fishing effort is concentrated in waters near Bathurst Island, New Year Island, the Wessel Islands and the sir Edward Pellew Group of Islands. Catch effort for 2015 was 346 tonnes, 95% of which was Spanish mackerel, 5% grey Mackerel. The fishery is limited to 15 licences. All licences are currently allocated. Fishery does not overlap the Operational Area.
Demersal Fishery	Overlaps the EMBA	Fishery extends to the outer limit of the AFZ (with exclusion of the Timor Reef Fishery area) to 15 nm from the low water mark off the NT coastline.	Demersal trawl nets are restricted to two defined zones, whereas fish traps, hand lines and droplines are permitted throughout the fishery.	Catch effort in 2015 was 3,107 tonnes, primarily comprising of rad snappers and gold band snappers.

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
				There are currently 18 licences that have been issued within the fishery. Unlike other fisheries, these may not be bought or sold. Fishery does not overlap the Operational Area.
Offshore Net and Line Fishery	Overlaps the EMBA	Fishery extends seaward to the outer limit of the AFZ from the high-water mark of the NT coastline. Target species include Australian blacktip sharks, common blacktip sharks, spot tail sharks and grey mackerel.	Pelagic gillnet (primary method) and pelagic longline methods are restricted within the fishery, whereas demersal longline gear may be used throughout.	Catch effort in 2015 was 522 tonnes (78% grey mackerel). The Fishery is limited to 17 licences, all of which are currently allocated. Fishery does not overlap the Operational Area.
Mud Crab Fishery	Overlaps the EMBA	The Mud Crab Fishery is restricted to tidal waters of the Top End. Some areas of exclusion apply including Darwin Harbour. Primary target species is mud crabs, *Scylla* spp.	Baited pots, and restricted bait nets (gillnets) up to 100 m in length as crab bait within specific areas of the fishery.	There are 49 licences within this fishery and each licence holder is allowed 60 pots. Catch effort is focused primarily in the Gulf of Carpentaria. Catch effort in 2015 was 186 tonnes. Fishery does not overlap the Operational Area.
Aquarium Fish/Display Fishery	Overlaps the EMBA	Fishery operates within tidal and non-tidal waters of the Top End out to the AFZ boundary. Target species include a range of fish and invertebrates, coral rubble and live rock (substrates covered in encrusting organisms).	Various methods permitted including several types of nets, hand pumps, freshwater pots and hand-held instruments.	No record of catch effort. Catch limits in place. Fishery does not overlap the Operational Area.
Trepang Fishery	Overlaps the EMBA	This fishery is also known as the Sea Cucumber Fishery. The Fishery extends from the high-water mark of the NT coastline to 3 nm offshore. Target species is sandfish and is the only species taken between 2005-15.	Hookah diving. Sea cucumbers may only be taken by hand.	Fishing effort is typically concentrated along the Arnhem land coast, from Cobourg Peninsula and Groote Eylandt. There are six licences which are owned by a single entity. Each licence is restricted to four collectors. Only four of the licences were active in 2015. Fishery does not overlap the Operational Area.

Commercial Fishery	Relevance	Description	Method	Number of Licences/Vessels and Effort
Timor Reef Fishery	Overlaps the EMBA	Fishery operates in an 8,400 nm^2 zone, known as the Timor Box, offshore north-west of Darwin bordering the NT/WA border and the AFZ. Target species is tropical snapper species.	Fishing methods include baited traps, hand lines, droplines and demersal longlines. Trawl gear is currently being trialled in the fishery.	Catch effort in 2015 was 806 tonnes. There are currently 15 licences issued within the Fishery, licences cannot be bought or sold but new licences can be purchased. Fishery does not overlap the Operational Area.
Fishing Tour Operator Fishery	Overlaps the EMBA	Typically comprised of a recreational and sport fishing client target group. Target species of this fishery include sport fish, with barramundi and golden snapper forming the highest portion of catch.	Primary fishing method is hook and line.	Number of licences: Not applicable. Must also hold an approved operator card as of 01/01/17. Fishing effort is typically located near coastal population centres. Approximately three quarters of catch is released with survivorship high for barramundi but not so for reed fish Fishery does not overlap the Operational Area.
Pearl Oyster Fishery	Overlaps the EMBA	This fishery operates from the high-water mark along the NT coastline out to the AFZ.	Dive based fishery. Oysters must only be taken by hand.	There are currently five licences within this fishery. Annual catch limit is 138,000 oysters for the fishery. Fishery does not overlap the Operational Area.
Bait Net Fishery	Overlaps the EMBA	The fishery is limited three nm offshore of the high-water mark. This excludes Darwin Harbour and Shoal Bay.	Bait net, cast net or scoop nets are permitted.	The fishery is limited to two licences which have been allocated. These licences cannot be bought, leased or sold. Fishery does not overlap the Operational Area.

Source: NT Government 2016; NT Government 2018b

4.5.10 Traditional Indigenous Fishing

In 1974, Australia recognised access rights for traditional Indonesian fishers in shared waters to the north of Australia, granting long-term fishing rights in recognition of the long history of traditional Indonesian fishing in the area (Department of Agriculture and Water Resource (DAWR) 2018). The resulting MOU between the Governments of Australia and Indonesia enables Indonesian traditional fishers to continue their customary practices. This includes the harvest of species such as trepang, trochus, clams, finfish, abalone, shark (for dried fins) and sponges in Australian waters, using traditional fishing methods only (Environment Australia 2002; DAWR 2018). This area is known as the 'MOU Box'.

The Operational Area is located approximately 40 km outside of the edge of the MOU Box. Given this and that only shallow water species are targeted, traditional Indonesian fishermen are unlikely to fish within the Operational Area, however, there is a low potential for them to occur in the Operational Area during transit to and from targeted reef locations. Therefore, they are unlikely to be affected by activities associated with the Bratwurst-1 drilling campaign.

4.5.11 Marine Archaeology

Information on historic shipwrecks is maintained in the Australian National Shipwrecks Database (ANSD), a searchable database of Australian shipwrecks containing records provided by the Australian State and Territory Governments. A search of the ANSD did not locate any shipwrecks, aircraft wrecks or other maritime cultural heritage sites in the Operational Area (DoEE 2018ay).

A number of shipwrecks occur within the EMBA. They include a number of unnamed Indonesian fishing vessels and the *Sinar Bonerate* in the vicinity of Ashmore Reef and Cartier Island, and the *Unident* and *Selina* in the vicinity of Browse Island (DoEE 2018ay).

4.5.12 Cultural Heritage

There are no known sites of Aboriginal cultural significance within the Operational Area, given that the location is approximately 200 km from the mainland. Due to the distance from the mainland it is highly unlikely that the Operational Area is used for hunting or fishing by Australian Aboriginal people. There are no islands or land within the operational area and therefore there are no land based Aboriginal heritage sites. A review of the Aboriginal Heritage Inquiry System (Department of Planning, Lands and Heritage (DPLH) 2018) indicates that the nearest registered sites are on the coastal islands of the Bonaparte Archipelago off the Kimberley coast, a minimum 170 km away from the Operational Area.

4.5.13 Tourism and Recreation

Currently, there are no known recreational fishing activities in the Operational Area as the site is too far from shore to be accessed by recreational fishermen in small boats. Even at relatively high speed (30 km/hour), it would take at least 15 hours for a recreational boat to reach the Operational Area from the nearest port of Broome. Consultation with RecFishWest indicated that that given the location of the activity, the Bratwurst-1 drilling campaign is unlikely to affect recreational fishing industry.

Whilst charter fishing companies frequent the broader region there are no known tourist attractions or destinations within the Operational Area or surrounding marine waters. Tourism, however, has a much larger presence along the coast from Exmouth to Darwin, largely confined to coastal waters and inshore islands, with Cape Leveque, Beagle Bay, Cockatoo Island and the Buccaneer Archipelago all being popular destinations for coastal cruises. Fishing and diving charters operate out of Broome and Derby and the occasional charter vessel may visit Scott Reef, Ashmore Reef, Browse and Adele Island. A search of recreational fishing charters in the north-west region of WA did not reveal any recreational fishing to the marine waters representing the Operational Area.

Birdwatching tours operate occasionally out of Broome, with annual expeditions visiting Ashmore Reef and associated offshore islands such as the Lacepede Islands, Adele Island, Browse Island, and Scott Reef.

4.5.14 Military / Defence

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

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

4.5.15 Ports and Commercial Shipping

There are no major shipping routes traversing the Operational Area. The nearest major shipping channel is approximately 560 km to the west of the Operational Area. Given the distances to shipping channels, the Bratwurst-1 drilling campaign and related activities pose a minimal navigational risk to commercial shipping.

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

A summary of the regional shipping movements and port areas relevant to the operational area is presented in **Figure 4 – 15**.

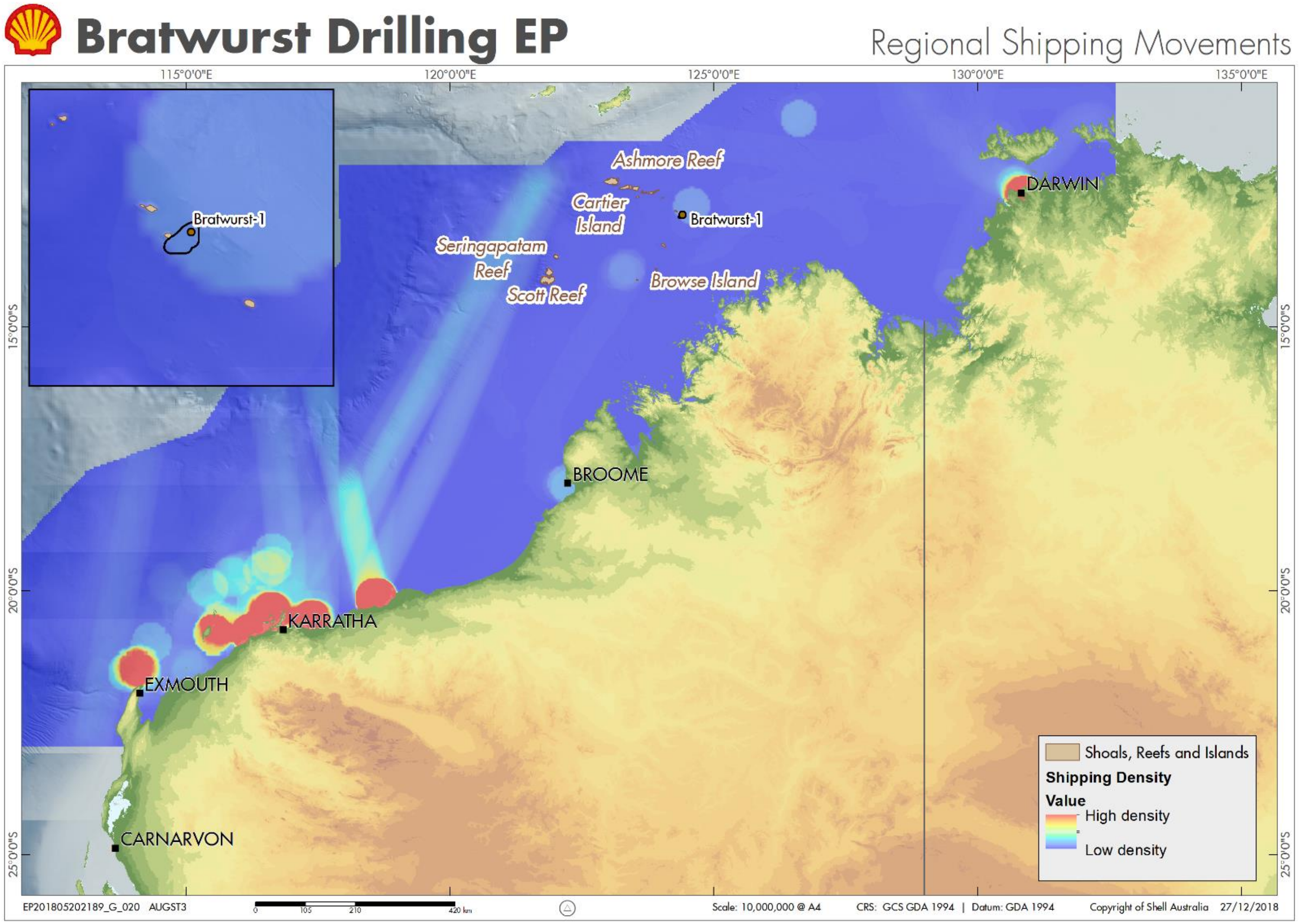


Figure 4 – 15: Overview of Regional Shipping Movements

4.5.16 Offshore Petroleum Exploration and Operations

Since the 1960s there has been significant growth in exploration, production and the oil and gas market. Energy companies have undertaken petroleum activities such as seismic and exploration in WA State and Commonwealth waters for a number of years. Specifically, petroleum exploration commenced in the Browse Basin in 1967, with several commercial discoveries since that time. The fourth well drilled in the basin, Scott Reef 1 (completed in 1971), was significant in discovering the large Torosa gas field. Since then, more than 105 wells have been drilled and there have been over 20 hydrocarbon discoveries.

The petroleum exploration and production industry is a significant user of offshore waters in northern WA, particularly within and adjacent to the Browse and Northern Bonaparte basins (DMP 2014). The closest facility to the Operational Area is the Montara production FPSO facility, which is located approximately 22 km north. The Ichthys project offshore facilities and the Prelude FLNG are both approximately 160 km to the south-west of the Operational Area.

Summary of Key Values and Sensitivities of Relevance to the Bratwurst-1 Drilling Campaign

Taking into account the existing environmental setting described in the preceding sections, the key values and sensitivities identified to be of relevance to the Bratwurst-1 drilling campaign are summarised in **Table 4 – 18**.

Table 4 – 18: Summary of Key Values and Sensitivities of Relevance to the Bratwurst-1 Drilling Campaign

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
Physical environment					
Climate	N/A – the Bratwurst-1 drilling campaign is not expected to influence physical climate				Not applicable
Oceanography	N/A – the Bratwurst-1 drilling campaign is not expected to influence physical oceanographic processes				Not applicable
Bathymetry and seabed features	Y	Seabed features	Y	Seabed features	Physical environment (including seabed features, water quality, sediment quality, air quality)
Water quality	Y	Water quality	Y	Water quality	
Sediment quality	Y	Sediment quality	Y	Sediment quality	
Air quality	Y	Air quality	N/A	Not relevant in a regional context	
Ecosystems, Communities and Habitats					
Benthic communities	Y	Benthic communities associated with predominantly silty sand or muddy sand.	Y	Benthic communities have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	Physical environment (seabed features)
Shoals and banks	N	No shoals or banks are located within the Operational Area	Y	The shoals/banks nearest to the Operational Area include Goeree Shoal, Eugene McDermott Shoals, Vulcan Shoal, Barracouta Shoals, Heywood Shoals, with other shoals and banks in the broader EMBA. These have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	Shoals and banks

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
Offshore reefs and islands	N	No offshore reefs or islands are located within the Operational Area	Y	The offshore reefs and islands in the wider EMBA include: Cartier Island, Ashmore Reef, Hibernia Reef, Browse Island, Seringapatam Reef, Scott Reef, Adele Island with other offshore reefs and islands in the broader region (e.g. Christmas Island and Cocos Keeling). These have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	Offshore reefs and islands
WA and NT mainland coastline	N	No coastlines are located within the Operational Area	Y	Some areas of the WA and NT coastlines have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	WA and NT mainland coastline
Indonesian and Timor-Leste coastline	N	No coastlines are located within the Operational Area	Y	Some areas of the Indonesian and Timor-Leste coastlines have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	Indonesian and Timor-Leste coastline
Key Ecological Features	N	No KEFs are located within the Operational Area	Y	Fifteen KEFs overlap the wider EMBA. Those within 100 km include: • Ancient coastline at 125 m depth contour • Continental slope demersal fish communities • Carbonate bank and terrace system of the Sahul Shelf • Ashmore Reef and Cartier Islands and surrounding Commonwealth waters KEFs have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	KEFs

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
Threatened Species and Ecological Communities					
Listed threatened and migratory species of conservation significance	Y	Potential for 20 listed threatened fauna species and 33 listed migratory species to occur or pass through the Operational Area. Only one BIA overlaps the Operational Area – the BIA for whale shark. The Operational Area does not overlap any habitat critical to the survival of a species.	Y	Potential for 37 listed threatened fauna species and 84 listed migratory species to occur or pass through the EMBA. The EMBA overlaps a number of BIAs including foraging, nesting and mating areas for marine turtles, a migration corridor for pygmy blue whales, migration area for humpback whales, foraging areas for whale sharks, breeding/foraging/resting areas for a number of seabird and shorebird species, and a breeding, calving and foraging areas for dolphins. Within the EMBA Ashmore Reef, Cartier Island and Browse Island provide critical nesting habitat for the green turtle as well as the dugong. These have potential to be affected by the potential scenario of an unplanned (emergency) discharge.	Marine mammals Marine reptiles Birds Fish Sharks and rays
Socio-economic and Cultural Environment					
Commonwealth Marine Area	Not relevant – there are no distinct values or sensitivities associated with this feature which are not otherwise addressed in other values and sensitivities elsewhere				Not applicable
Commonwealth land	N/A	Not relevant to the Operational Area	Y	Ashmore Reef Cartier Island (as addressed above)	AMPs
World Heritage Properties	N	No heritage sites are located within the Operational Area	Y	Kakadu National Park is approximately 800 km to the east of the Operational Area.	World Heritage Properties

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
National Heritage Places	N	No heritage sites are located within the Operational Area	Y	The West Kimberley, located 165 km from the Bratwurst-1 drilling campaign Operational Area, is the only National Heritage Place overlapping the EMBA.	WA and NT Mainland Coastline
Commonwealth Heritage Places	N	No heritage sites are located within the Operational Area	Y	Three Commonwealth Heritage Places are located within the EMBA: • Ashmore Reef National Nature Reserve • Scott Reef and surrounds • Mermaid Reef – Rowley Shoals • North Keeling Island • Christmas Island Natural Areas	Other offshore reefs, islands and WA and NT mainland coastline
Declared Ramsar wetlands	N	No declared Ramsar wetlands are located within the Operational Area	Y	Two Ramsar wetlands are located within the EMBA: • Ashmore Reef National Nature Reserve • Cobourg Peninsula • “The Dales” Christmas Island • Hosnies Spring Christmas Island • Pulu Keeling National Park	Other offshore reefs, islands and WA and NT mainland coastline
Australian Marine Parks	N	No AMPs are located within the Operational Area	Y	The following AMPs overlap the EMBA: • Ashmore Reef Marine Park • Cartier Island Marine Park • Argo-Rowley Terrace Marine Park • Eighty Mile Beach • Kimberley Marine Park • Dampier Marine Park • Gascoyne Marine Park • Mermaid Reef Marine Park North Marine Region (NMR) • Oceanic Shoals Marine Park	AMPs

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
				• Arafura Marine Park • Arnhem Marine Park.	
Commercial fisheries	Y	Commonwealth – 3 fisheries of relevance: WTBF, WSF, Southern Bluefin Tuna Fishery WA – 7 fisheries of relevance: NDSF, Mackerel Fishery, Northern Shark Fishery, Pearl Oyster Fishery, Specimen Shell Managed Fishery, Marine Aquarium Fish Managed Fishery, West Coast Deep Sea Crustacean Fishery Of these, only one fishery (NDSF) was identified as currently operating within the Operational Area.	Y	Commonwealth – 6 fisheries of relevance. Fisheries additional to those presented for the Operational Area include: NPF, Western Deepwater Trawl Fishery. WA – 10 fisheries of relevance. Fisheries additional to those presented for the Operational Area include: Kimberley Gillnet and Barramundi Managed Fishery, North Coast Prawn Managed Fishery, Western Australian Sea Cucumber Fishery (Beche-de-mer Fishery). Up to 13 NT managed commercial fisheries overlap the EMBA.	Commercial fisheries
Traditional Indigenous fishing	Y	MOU Box – while 40 km away from the Operational Area, there is potential for fishers to traverse the Operational Area.	Y	MOU Box, traditional/customary fishing by Indonesian fishermen and Indigenous fishing around the WA and NT coastline and surrounding nearshore islands exist within the EMBA	Indigenous fishing
Marine archaeology	N	No historic shipwrecks or other known archaeological sites are located within the Operational Area.	Y	A number of shipwrecks occur within the EMBA, including unnamed wrecked Indonesian fishing vessels and the Sinar Bonerate shipwreck in the vicinity of Ashmore Reef and Cartier Island. These shipwrecks are Federally protected.	Marine archaeology
Cultural heritage	N	No known heritage sites exist within the Operational Area	Y	The northern Kimberley coastline, and surrounding offshore islands, is of high intrinsic indigenous heritage value. Similarly, the NT	Other offshore reefs, islands and WA and NT mainland coastline

Value/Sensitivity	Present in the Operational Area?	Values/Sensitivities of Relevance	Present in the EMBA?	Values/Sensitivities of Relevance	Relevance in the Evaluation of Environmental Impacts and Risks (Section 5)
				coastline and offshore islands (e.g. Tiwi Islands) is of high indigenous heritage value. These are relevant only in the context of the area of influence.	
Tourism and recreation	N/A	Not relevant to the Operational Area	Y	There is potential for low intensity tourism and recreational marine users in the offshore marine environment, including around the offshore islands and reefs in the region.	Tourism and recreation
Military/defence	N/A	Not relevant to the Operational Area	Y	Defence activities are expected to occur in the offshore marine environment in the region.	Defence activities
Ports and commercial chipping	N/A	Not relevant to the Operational Area	Y	While no major shipping routes traverse the Operational Area, commercial shipping transits through the offshore marine environment in the region and EMBA.	Ports and commercial shipping
Offshore petroleum exploration and operations	N/A	Not relevant to the Operational Area	Y	The closest facility to the proposed Operational Area is the Montara production FPSO facility, which is located approximately 22 km north.	Offshore petroleum exploration and operations
Indonesian and Timor-Leste coastlines	N/A	Not relevant to the Operational Area	Y	The Indonesian and Timor-Leste Coastlines are relevant only in the context of the EMBA.	Indonesian and Timor-Leste coastlines

5 Evaluation of Environmental Impacts and Risks

5.1 Introduction

This section documents the process used to identify and evaluate potential environmental and socio-economic impacts and risks of the Bratwurst-1 drilling campaign and develop means of mitigating the identified impacts and risks.

The proposed management controls form the basis of the Environmental Performance Framework (**Section 6.3**) which will be implemented during the Bratwurst-1 drilling campaign.

5.2 Shell Company Approach to Risk Management

The Hazards & Effects Management Process (HEMP) is the process by which Shell identifies and assesses hazards, implements measures to manage them, and demonstrates that risks are reduced to a level that is ALARP. This is consistent with the principles outlined in the Australian Standard AS/NZS ISO 31000:2009 Risk Management and HB 203:2006 Environmental Risk Management (**Figure 5 – 1**). The HEMP is a fundamental element of the Shell Group HSSE & SP Control Framework and is a process that is applied at every phase of projects and operations.

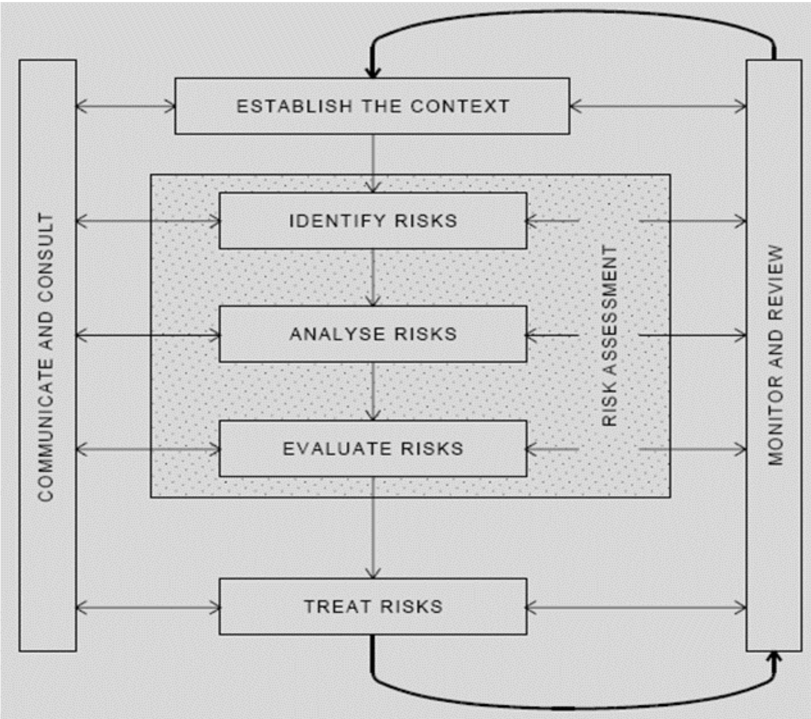


Figure 5 – 1: Risk Management Framework (AS/NZS 4360:2004 Risk Management)

5.3 Impact Assessment Methodology

A risk analysis was undertaken for all aspects of the Bratwurst-1 drilling campaign in accordance with the Shell HSSE and SP Control Framework, which is consistent with the principles outlined in the Australian Standard AS/NZS ISO 31000:2009 Risk Management and HB 203:2006 Environmental Risk Management.

Planned activities give rise to environmental impacts, while unplanned and accidental events pose a risk of environmental impact, if they occur. The risk of environmental impacts resulting from unplanned or accidental events is evaluated by taking the likelihood of the event occurring into consideration. For this assessment, key terminology is defined in **Table 5 – 1**.

Table 5 – 1: Definition of Key Terminology for Impact Assessment.

Term	Definition
Activity	Components or elements of work associated with the project. All activities associated with the project have been considered at a broad level (as outlined in **Section 5**).
Aspect	Elements of the proponent's activities or products or services that can interact with the environment. These include planned and unplanned (including those associated with emergency conditions) activities.
Event	An occurrence of a particular set of circumstances. An event can be one or more occurrences and can have several causes.
Value/ Sensitivity (i.e. Factor)	An element or aspect of the environment (ecosystems, natural and physical resources, qualities and locations of places and area, heritage value of places) including its social, economic and cultural features
Impact	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from a proponent's environmental aspects.
Inherent Impact (planned activities)	The level impact when existing controls are in place, but before the application of additional controls arising from impact assessment ** The Inherent Impact rating is derived from Magnitude and Sensitivity*
Magnitude	Magnitude of an impact or predicted change which considers: • nature of the impact and its reversibility • duration and frequency of an impact • extent of the change, and • potential for cumulative impacts.
Sensitivity	The sensitivity of the receiving receptors, based on: • important of the receptor at local, national or international level, • sensitivity/vulnerability of a receptor and its ability to recover, and • sensitivity of the receptor to certain impacts.
Inherent risk (unplanned events)	The level of risk when existing controls are in place, but before the application of additional risk controls arising from risk assessment processes. ** The Inherent Risk rating is derived from Significance and Likelihood*
Significance	As determined from magnitude and sensitivity for planned impacts, significance is used in combination with likelihood to determine inherent risk for unplanned events.
Likelihood	Description of probability or frequency of a consequence occurring with safeguards in place.
Control	A measure which mitigates risk through the reduction of the likelihood for a consequence to occur. Controls include existing controls (i.e. Company management controls or industry standards) or additional controls (i.e. additional measures identified during the risk assessment processes).
Residual Risk/Impact	The level of risk/impact remaining after treatment, i.e. application of additional controls (inclusive of unidentified risk).

5.3.1 Impact Identification and Aspects

The identification of potential impacts from planned activities is carried out prior to any detailed assessment of the relative importance of each issue, the sensitivity of the existing environmental and/or socio-economic values or the magnitude of the potential impact and does not consider potential mitigation measures.

As summarised in **Section 5.5**, the key planned activities arising from the Bratwurst-1 drilling campaign have been identified as:

- physical presence (including vessel movements, MODU anchoring and well suspension/abandonment);
- lighting;
- generation of underwater noise;
- release of liquid discharges into the marine environment;
- discharge of cement and additives; and
- release of atmospheric emissions.

The following key unplanned events (**Section 5.6**) were assessed for the Bratwurst-1 drilling campaign risk review:

- invasive marine species;
- improper waste and equipment management;
- unplanned discharges;
- accidental collision between vessels and conservation significant species; and
- accidental hydrocarbon releases.

5.3.2 Evaluation of Impacts

The significance of environmental impacts is assessed in terms of:

- magnitude based on the size, extent and duration/frequency of the impact;
- the sensitivity of the receiving receptors; and
- the likelihood of an unplanned event occurring.

These are described further below.

Magnitude

Levels of magnitude of environmental impacts are outlined in **Table 5 – 2**. The magnitude of an impact or predicted change is defined by taking into account the following criteria: the nature of the impact (i.e. does the impact cause any damage); its reversibility (can the impact be reversed or will is cause permanent damage), duration and frequency of the impact, extent of the change (is the impact localised, or is it widespread?) and potential for cumulative impacts. The level of magnitude depends on the scale of each of these criteria, for example a slight impact (magnitude is defined as slight effect in **Table 5 – 2**) will cause slight damage within the Operational Area and the impact will be short-term or localised whereas an impact of moderate magnitude (moderate effect) will spread beyond the Operational Area, may have cumulative effects and can cause widespread change in habitats that last approximately 1-2 years..

The impact magnitude is defined differently according to the type of impact. For readily quantifiable impacts, such as noise or liquid discharge plume extent, numerical values can be used whereas for other topics (e.g. communities and habitats) a more qualitative definition is applicable. These criteria capture high level definitions, adapted as appropriate to the offshore context of the Bratwurst-1 drilling campaign.

Table 5 – 2: Magnitude Criteria.

Definition	Environmental Impact
Positive effect	Net positive effect arising from a proposed aspect of the Project
No effect	No environmental damage or effects
Slight effect	• Slight environmental damage contained within the Project boundary (i.e. Operational Area)

Definition	Environmental Impact
	• Effects unlikely to be discernible or measurable • No contribution to trans-boundary (i.e. outside the Operational Area) or cumulative effects • Short-term or localised decrease in the availability or quality of a resource, not effecting usage
Minor effect	• Minor environmental damage, no lasting effects or persistent effects are highly localised • Minor change in habitats or species • Unlikely to contribute to trans-boundary (i.e. outside the Operational Area) or cumulative effects • Short-term or localised decrease in the availability or quality of a resource, likely to be noticed by users
Moderate effect	• Moderate environmental damage that will persist or require cleaning up • Widespread change in habitats or species beyond natural variability • Observed off-site effects or damage, e.g. fish kill or damaged habitats • Decrease in the short-term (1-2 years) availability or quality of a resource affecting usage • Local or regional stakeholders' concerns leading to complaints • Minor trans-boundary (i.e. outside the Operational Area) and cumulative effects
Major effect	• Severe environmental damage that will require extensive measures to restore beneficial uses of the environment • Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort • Major oil spill over a wide area leading to campaigns and major stakeholders' concerns • Trans-boundary effects (i.e. outside the Operational Area) or major contribution to cumulative effects • Mid-term (2-5 year) decrease in the availability or quality of a resource affecting usage • National stakeholders' concern leading to campaigns affecting Company's reputation
Massive effect (to be used only for unplanned events)	• Persistent severe environmental damage that will lead to loss of use or loss of natural resources over a wide area • Widespread long-term degradation to the quality or availability of habitats that cannot be readily rectified • Major impact on the conservation objectives of internationally/nationally protected sites • Major trans-boundary (i.e. outside the Operational Area) or cumulative effects • Long-term (>5 y) decrease in the availability or quality of a resource affecting usage • International public concern

Receptor Sensitivity

For this EP, receptors are categorised into different groups (as described in **Section 1.1**):

- physical environment;
- ecosystems, communities and habitats;
- non-conservation significant species;
- conservation significant species and ecological communities; and
- socio-economic and cultural environment.

Receptor sensitivity criteria are classified as low, medium and high (**Table 5 - 3**) and are based on the following key factors:

- importance of the receptor at local, national or international level – for instance, a receptor will be of high importance at international level if it is categorised as a designated protected area (such as a Ramsar site);
- sensitivity/vulnerability of a receptor and its ability to recovery – for instance, certain species could adapt to changes easily or recover from an impact within a short period of time. Thus, as part of the receptor sensitivity criteria, professional judgement considers immediate or long-term recovery of a receptor from identified impacts. This also considers if the receptor is under stress already; and
- sensitivity of the receptor to certain impacts – for instance, atmospheric emissions from MODU and vessel engines will potentially cause air quality impacts but do not affect receptors such as the seabed.

Table 5 - 3: Receptor Sensitivity Criteria

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

Significance Criteria for Planned Events

The magnitude of the impact and sensitivity of receptors is then combined to determine the impact significance as shown in **Table 5 – 4**. Key management controls are then identified to reduce the potential magnitude of the impact, which enables the residual impact to be determined and informs an assessment of acceptability.

Table 5 – 4: Impact Significance Matrix (Planned)

		Sensitivity		
		Low	**Medium**	**High**
Magnitude	**+1 – Positive**	Positive effect	Positive effect	Positive effect
	0 – No effect	No effect	No effect	No effect
	1 – Slight effect	Slight	Slight	Minor
	2 – Minor effect	Minor	Minor	Moderate
	3 – Moderate effect	Minor	Moderate	Major
	4 – Major effect	Moderate	Major	Major

Likelihood and Significance Criteria for Unplanned Events.

For unplanned events the likelihood of such an event occurring also requires consideration. For example, based on magnitude and sensitivity alone a hydrocarbon spill associated with the loss of well control would be classed as having major impact significance, however, the likelihood of such an event occurring is very low. In addition, the mitigation measures for unplanned events focus on reducing the likelihood of the event occurring as opposed to reducing the magnitude of the impact itself. Thus, unplanned events also require assessment in terms of environmental risk.

As with planned activities, the potential impacts of unplanned events are identified, and the impact significance is determined, which inherently considers the sensitivity of the relevant receptor(s). The significance of the impact is then combined with the likelihood of the event occurring (**Table 5 – 5**) in order to determine its overall environmental risk as summarised in **Table 5 – 6**. Key management controls are then identified to reduce the risk of such an event occurring in order to determine residual risk and inform assessment of acceptability.

Table 5 – 5: Likelihood Criteria

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

Table 5 – 6: Environmental Risk Matrix (Unplanned Events)

		Likelihood				
		A	**B**	**C**	**D**	**E**
Impact Significance	0 – **No effect**	No effect				
	1 – Slight	Negligible	Negligible	Minor	Minor	Minor
	2 – Minor	Negligible	Minor	Minor	Moderate	Moderate
	3 – Moderate	Minor	Minor	Moderate	Moderate	Major
	4 – Major	Moderate	Moderate	Moderate	Major	Major
	5 – Massive	Major	Major	Massive	Massive	Massive

5.3.3 Demonstration of ALARP

Controlling risks to ALARP for Shell means meeting legal requirements and other agreed tolerability criteria (e.g. Shell/ industry standards) (for the purpose of this EP tolerability is deemed to satisfy the 'acceptability criteria' – see next section) and going beyond them to the extent that is reasonably practicable i.e. the option which is at least acceptable and with the lowest residual risk achievable without incurring significant incremental costs or effort that is grossly disproportionate to the additional risk reduction obtained.

There is no scientific formula to calculate ALARP. ALARP can be achieved through several mechanisms via:

- a quantitative method, where the costs of the various options can be compared with the respective risk reduction;
- semi quantitative method where risks within a certain level on the Risk Matrix require a pre-defined number of barriers of a certain effectiveness in place to prevent this hazard being released; or via
- qualitative analysis, whereby ALARP is established using standards, legislative requirements and judgement based on experience.

Quantitative and semi-quantitative ALARP demonstration methods are generally employed for major installation investment decisions, design or major facilities, where ensuring that the decision-making process is transparent and systematically addresses the full spectrum of business risks is important.

In accordance with Regulation 10A(b) of the OPGGS(E) Regulations, Shell demonstrates that risks are reduced to ALARP where:

The residual risk is **green**, **blue** or **yellow**:

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

The residual risk is **orange**:

- Good industry practice is applied.
- All mitigation measures according to the hierarchy of control (**Figure 5 – 2**) are considered. Where these measures are reasonably practicable, they are implemented. This qualitative analysis approach has been used to justify that the risk has been managed to ALARP and is suitable for the risks presented by this activity.

The residual risk is **red** or **dark red**:

- Good industry practice is applied.
- The hierarchy of control is applied.
- Apply a Bow-Tie or equivalent methodology.

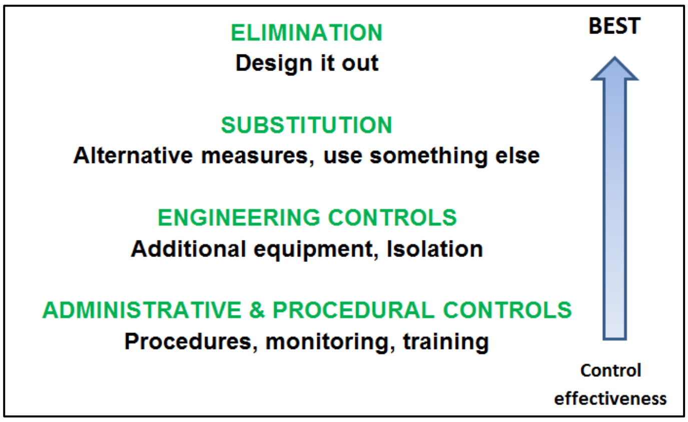


Figure 5 – 2: Hierarchy of Controls

5.3.4 Definition of Residual Risk Acceptability

Environmental risks are only deemed acceptable when all reasonably practicable mitigating and management measures have been taken to reduce the potential impacts to ALARP.

In accordance with Regulation 10AI of the OPGGS(E) Regulations, the following process has been applied to demonstrate acceptability:

- **Green**, **blue** and **yellow** risks are 'Acceptable', if they meet legislative requirements, industry codes and standards, regulator expectations, Shell Standards and industry guidelines.
- **Orange**, **red** and **dark red** risks are 'Acceptable' if ALARP can be demonstrated, if legislative requirements are met, stakeholder concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

In this acceptability evaluation, the following criteria are accounted for:

- Principles of Ecological Sustainable Development (ESD) as defined under the EPBC Act.
- Internal context – the proposed controls and residual risk level are consistent with Shell policies, procedures and standards.
- External context – consideration of the environment consequence and stakeholder expectations.
- Other requirements – the proposed controls and residual risk level are consistent with national and international standards, laws and policies.

5.4 Summary

The succeeding sections detail the environmental risks associated with the Bratwurst-1 drilling campaign on the local and wider environment, including socio-economic considerations. Activities are described in terms of the scale and likelihood of impact and an assessment of environmental consequence of the potential impact generated by the activity. A description of management actions proposed to reduce any effect on the environment to ALARP is presented.

The residual risk rankings detailed in **Table 5 – 7** and **Section 5.5** to **5.6** represent a summary of the various individual environmental value/sensitivity rankings. The rankings were defined during a detailed environmental risk workshop (ENVID) that was attended by specialist environmental scientists together with key members of the Shell Australia project team who are directly responsible for the design and execution of the Bratwurst-1 drilling campaign. The residual impact rankings provided represent the highest residual impact for that receptor group (i.e. physical environment, threatened species and ecological communities, ecosystems, communities and habitats, and socio-economic and cultural environment), and therefore may be a conservative assessment for some individual environmental values/sensitivities.

Table 5 – 7: Summary of Planned Impacts, Potential Effects and Environmental Risks

Planned Impact	Potential Environmental Impact	Magnitude	Sensitivity	Residual Risk Level
Physical presence of MODU and AHTs	Socio-economic and cultural environment – Disruption to commercial or recreational fishing, shipping activity and other marine users.	1 – Slight effect	Low	Slight
	Threatened species and ecological communities – Disturbance of conservation significant individuals (e.g. change in fauna behaviour/ movement)	1 – Slight effect	Low	Slight
Anchoring of MODU and AHTs	Physical environment – Physical damage and/or disturbance to seabed and benthic habitat (not unique/significant)	1 – Slight effect	Low	Slight
Well suspension and / or abandonment	Physical environment – Physical damage and/or disturbance to seabed and benthic habitat (not unique/significant)	1 – Slight effect	Low	Slight
Discharge of deck drainage and bilge water	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
Discharge of treated sewage, grey-water and putrescible waste	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
Discharge of cooling water and brine	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
Disposal of drilling fluids and cuttings	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
	Localised displacement, smothering (mainly associated with discharge of drill fluids and cuttings) or toxicity of benthic habitats/communities that are regionally widespread	1 – Slight effect	Low	Slight
Discharge of cement and additives	Disturbance of non-conservation significant populations/ communities (e.g. benthic infauna)	1 – Slight effect	Low	Slight
BOP control fluid discharge and well annular fluids	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
Well annulus fluids from abandoned wells	Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment	1 – Slight effect	Low	Slight
Light emissions: Physical presence of MODU and AHTs	Threatened species and ecological communities – unmeasurable behavioural disturbance to sensitive marine fauna including mainly turtles and birds	1 – Slight effect	Low	Slight
Noise emissions during drilling and operations and MODU/vessel movements	Threatened species and ecological communities – unmeasurable behavioural disturbance to sensitive marine fauna including mammals, turtles, birds and fish	1 – Slight effect	Medium	Slight

Planned Impact	Potential Environmental Impact	Magnitude	Sensitivity	Residual Risk Level
Noise emissions during VSP	Threatened species and ecological communities – unmeasurable behavioural disturbance to sensitive marine fauna including mammals, turtles, birds and fish	1 – Slight effect	Medium	Slight
Atmospheric emissions from fuel consumption, flaring (well testing) and ODS	Physical environment – Localised reduction in air quality	1 – Slight effect	Low	Slight

Unplanned Event	Potential Environmental Impact	Significance	Likelihood	RAM Residual Risk Level
Introduction of invasive marine species	Disturbance of non-conservation significant populations/ communities (e.g. benthic infauna)	1 – Slight effect	C – Unlikely	Minor
Unplanned loss of solid waste (hazardous/non-hazardous) or dropped objects overboard	Physical environment – Physical damage and/or disturbance to seabed and benthic habitat (not unique/significant) Physical environment – Temporary and localised reduction in water quality, i.e. pollution or contamination of the marine environment Threatened species and ecological communities – minor, localised impacts to fauna including mammals, turtles and sharks.	1 – Slight effect	C – Unlikely	Minor
Unplanned discharge of chemicals or hazardous liquid waste	Threatened species – slight physiological/behavioural impacts to fauna confined within the Operational Area. Physical environment – unmeasurable impacts to water, sediment and air quality.	1 – Slight effect	C – Unlikely	Minor
Accidental collision between vessels and threatened species	Threatened species and ecological communities – minor, localised impacts to fauna including mammals, turtles and sharks.	2 – Minor effect	C – Unlikely	Minor
Loss of well containment resulting in long-term hydrocarbon release	Threatened species – direct toxic or physiological effects on marine biota, including mammals, reptiles, birds, fish and sharks/rays. Physical environment – persistent and widespread impacts to water, sediment and air quality. Ecosystems, communities and habitats – potential widespread degradation to the quality of availability of habitat. Socio-economic and cultural environment – potential impacts to heritage sites, protected areas, fisheries and tourism.	4 – Massive effect	B – Remote	Major

Unplanned Event	Potential Environmental Impact	Significance	Likelihood	RAM Residual Risk Level
250m^3 MDO spill due to vessel to vessel collision	• Threatened species – direct toxic or physiological effects on marine biota, including mammals, reptiles, birds, fish and sharks/rays. • Physical environment – widespread impacts to water, sediment and air quality. • Socio-economic and cultural environment – potential impacts to heritage sites, protected areas, fisheries and tourism.	4 – Major effect	B – Remote	Moderate
10m^3 hydrocarbon spill during bunkering	• Threatened species – slight physiological/behavioural impacts to fauna confined within the Operational Area. • Physical environment – unmeasurable impacts to water, sediment and air quality.	1 – Slight effect	B – Remote	Negligible
Liquid hydrocarbons dropping out whilst flaring	• Physical environment – unmeasurable impacts to water, sediment and air quality.	1 – Slight effect	B – Remote	Negligible

5.5 Planned Activities

5.5.1 Physical Presence

5.5.1.1 *Physical presence of MODU and AHTs – Interaction with Other Marine Users*

Activity

The MODU and AHTs will be present at the drilling location for approximately 45 days, resulting in a physical presence that could potentially affect social and economic receptors in the region.

If the well is suspended (**Section 2.2.5.4**), the well head will be left in situ until further formation evaluation is undertaken. There is potential for the wellhead to present a snag risk to commercial fishermen.

Assessment

With regards to cultural heritage receptors, there are no known shipwrecks close to the Operational Area, nor are there any known sites of indigenous cultural significance within the Operational Area. No tourism activities are known to occur in the area due to the water depths and distance offshore. Therefore, impacts to cultural heritage and tourism receptors are unlikely.

The nearest marine protected area (Cartier Island) is 86 km from the Bratwurst-1 well location and physical presence from the drilling campaign is not expected to affect Cartier Island or the more distant protected areas. The closest permanent petroleum infrastructure to the well location is the Montara production FPSO facility, approximately 22 km north. Due to the distance from other petroleum activities and the short duration of the drilling campaign, the Bratwurst-1 campaign is unlikely to affect other petroleum activities. The Operational Area is outside any commercial shipping routes, therefore physical presence of the MODU and AHTS during the drilling campaign is not expected to affect commercial shipping receptors.

A number of Commonwealth and WA state commercial fishery management areas overlap the Operational Area, however, only one fishery was identified as currently operating within the Operational Area (**Section 4.5.9** and **Table 7 - 7**). This fishery, the NDSF, is restricted to using hand-line, drop-line and trap methods. Stakeholder consultation identified that two NDSF permit holders actively fish in the area of the Operational Area (**Table 7 - 7**). As part of the stakeholder engagement, WAFIC has requested that a cautionary zone rather than an exclusion zone is placed on the region. However, Shell will not be requesting an exclusion or cautionary zone due to the 155 m water depth and the very low fishing effort within the Operational Area. Shell will inform the Australian Hydrographic Service (AHS) of the position of the wellhead if it is left in situ so the location can be communicated to other marine users. Impacts on Commonwealth and WA state fisheries from the physical presence of the MODU and AHTs are, therefore, expected to be slight. The Operational Area does not overlap with any NT commercial fisheries, therefore impacts to NT fisheries are unlikely.

Due to the water depths and distance offshore, the Operational Area is not considered suitable for traditional or recreational fishing. There are no known traditional or recreational fishing activities in the area, and the Bratwurst-1 drilling campaign is not expected to affect these receptors. There are no designated military or defence exercise areas in the Operational Area.

Table 5 - 8: Risk Assessment for Physical Presence of MODU and AHTs – Interaction with Other Marine Users

Project Component/ Activity	Environmental Value/Sensitivity				Evaluation – Planned		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Physical presence of MODU and AHTs – interference with and/or exclusion of other marine users	-	-	-	X	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Compliance with petroleum safety zone as per Section 6161 of the OPGGS Act.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with Marine Orders 30: Prevention of Collisions and Marine Orders 21: Safety of Navigation and emergency procedures.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with Navigation Act and Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) – Part B Steering and Sailing Rules.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
'Notice to Mariners' issued via RAN Australian Hydrographic Service (AHS) prior to the commencement of the drilling campaign.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
If well suspension occurs, AHS will be notified of well head location if wellhead is left in situ	Standard practice. Reduces likelihood of impact.	Yes
Elimination		
None identified - The physical presence of the MODU and AHTS is vital to the drilling campaign and cannot be eliminated.	-	-
Substitution		
None identified – Substitution of the MODU with another type of drilling rig does not alter physical presence.	-	-
Reduction		
None identified – AHTs numbers and duration of drilling campaign are optimised for safe operations and adequate operational support of MODU.	-	-
Mitigation		
Consultation with relevant and interested stakeholders	Standard practice. Reduces likelihood of impact.	Yes
Communication with AMSA (including AMSA JRCC) and AFMA to ensure the location of the MODU is known by vessels that may be operating in the region	Standard practice. Reduces likelihood of impact.	Yes
Notification will be provided to the fishing licence holders prior to commencement of activities	Good practice	Yes
MODU will be equipped with suitable navigation aids, automatic identification system (AIS) and competent crew maintaining 24-hour visual, and radio and	Standard practice. Reduces likelihood of impact.	Yes

electronic surveillance confirmed through the Marine OVID Assurance process.		
A ‘no fishing’ policy will be implemented for the Bratwurst-1 drilling campaign.	Good practice	Yes
Summary of ALARP		
The expected impact magnitude of the Bratwurst-1 drilling campaign on other marine users is expected to be slight because of the very low fishing effort in the region and the limited activity around the well location in relation to the area available for fishing. Overall the environmental sensitivity is considered low and the residual impact of interference with other users is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.		

Demonstration of Acceptability	
Principles of ESD	The impacts from the physical presence of the Bratwurt-1 drilling campaign are consistent with the principles of ESD based on: • the socio-economic values/sensitivities within the Operational Area are not expected to be significantly impacted; • the health, diversity and productivity of the environment is not expected to decrease; and • the drilling campaign does not significantly impinge upon the rights of other parties to access environmental resources (e.g. commercial fishers).
Relevant Requirements	OPGGS Act, Navigation Act, Marine Orders 30, Marine Orders 21, COLREGS
Internal and External Context	• Shell’s consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context. Shell’s environmental policy and HSSE & SP Control Framework and the OVID process are applicable to this planned activity. • The environmental performance outcomes (EPOs), and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell’s internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • the minimal disruption posed by the physical presence of MODU and AHTs; • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell’s global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the physical presence of the MODU and AHTs have been undertaken; and • stakeholder concerns have been considered. The residual impact associated with physical presence of the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.1.2 *Physical Presence of the MODU and AHTs – Disturbance of Conservation Significant Fauna*

Activity

The MODU and AHTs present at the drilling location could potentially disturb fauna of conservation significance by changing normal fauna behaviour (e.g. if animals are attracted to or move away from the MODU or AHTs).

Assessment

With regards to BIAs, the Bratwurst-1 drilling campaign overlaps a whale shark BIA. Whale sharks may also migrate through the area during migration between Ningaloo Reef and International waters. Whale sharks are expected to travel through the Operational Area while the MODU and AHTs are present however they are not expected to occur in significant numbers, given the main foraging aggregations are recorded in coastal waters, particularly near Ningaloo Reef (Department of Conservation and Land Management 2005). Impacts to the behaviour of whale sharks that encounter the MODU and/or AHTs are expected to be short-term due to the short duration of the drilling campaign and the mobile nature of whale sharks. Potential impacts are considered slight as impacts will be limited to individual animals; no impacts are expected at a population level.

No other BIAs, critical fauna habitat or significant habitat features are within or close to the Operational Area (**Sections 4.4.3** and **4.4.4**). The MODU and AHTs within the Operational Area are not expected to affect the BIAs for other fauna of conservation significance due to their distance from the drilling campaign. Habitat modification, and in some cases specifically the presence of offshore rigs and platforms, is a key threat to a number of threatened and migratory marine mammals, marine turtles and sharks in Australia (Commonwealth of Australia 2017a, DEH 2005a, DEWHA 2009a, DoE 2015a, DoE 2015l, DoE 2015m, DSEWPaC 2012d, DSEWPaC 2013b). No significant impacts are expected to occur to any threatened/migratory species or population from the physical presence of the MODU, given its distance away from sensitive receptors and within an open offshore environment. Although a whale shark BIA overlaps the Operational Area, impacts to this species are not expected due to the small number of individuals expected to transit the area (mainly between July and November).

Individual animals (particularly whales, turtles, seabirds, rays and offshore dolphins) may transit through the area, and these may be disturbed by the MODU or AHTs if they travel close enough to or through the Operational Area. However, given the Operational Area is in an open ocean environment which is predicted to be relatively featureless aside from a small number of isolated sensitivities (e.g. shoals, banks and offshore islands and reefs), fauna is not expected to travel through the Operational Area in large numbers. The nearest sensitive feature is Goeree Shoal, with it's 20 m depth plateau located approximately 1.4 km northwest of the Operational Area and 8 km from the Bratwurst-1 well location (see **Section 4.3.2** for additional distances to other depth contours). Any avoidance or attraction behaviour is expected to be very localised and temporary, therefore impacts to fauna of conservation significance are considered slight.

Table 5 - 9: Risk Assessment for Physical Presence of MODU – Disturbance of Conservation Significant Fauna

Project Component/ Activity	Environmental Value/Sensitivity				Evaluation – Planned		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Physical presence of MODU and AHTs – disturbance of conservation significant fauna species	-	X	-	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Comply with EPBC Regulations 2000 – Part 8 Division 1 *Interacting with cetaceans*, including: • AHTs will not travel greater than 6 knots within 150 m of a dolphin and 300 m of a whale (caution zone); and • AHTs will not approach closer than 50 m to a dolphin or 100 m to a whale. These regulations will apply to whale sharks as well as cetaceans.	Standard practice. Compliance with legislation.	Yes
Elimination		
None identified - The physical presence of the MODU and AHTS is vital to the drilling campaign and cannot be eliminated.	-	-
Substitution		
None identified – Substitution of the MODU with another type of drilling rig does not alter physical presence.	-	-
Reduction		
None identified – AHTs numbers and drilling campaign are optimised for safe operations and adequate operational support of MODU.	-	-
Mitigation		
Use of dedicated Marine Mammal Observers on board the AHTs.	No reduction in impact expected due to low numbers of fauna in open ocean.	No
Use of bird deterrents	No reduction in impact expected due to distance from seabird and shorebird BIAs and expected low numbers of birds in open ocean.	No
Use of Passive Acoustic Monitoring (PAM) Systems to detect whales.	No reduction in impact expected due to distance from whale BIAs and expected low numbers of fauna in open ocean.	No
Summary of ALARP		
The expected magnitude of impact of the Bratwurst-1 drilling campaign in terms of changing the behaviour of conservation significant fauna (including whale sharks) is considered slight because of the low numbers of fauna in the region, the lack of habitat critical to the survival of fauna of conservation significance, the open ocean location of the well and the short-term nature of the drilling campaign. Overall the sensitivity is considered low and the residual impact of disturbance to marine fauna of conservation significance is assessed as slight. The residual impact is considered managed to ALARP with the implementation of the identified controls.		

Demonstration of Acceptability	
Principles of ESD	The risks and impacts to fauna of conservation significance from the physical presence of the Bratwurt-1 drilling campaign are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted. • the health, diversity and productivity of the environment is not expected to decrease; and

	• physical presence is not expected to reduce biological diversity and ecological integrity.
Relevant Requirements	EPBC Regulations 2000
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for whale sharks, marine mammals and turtles and considered key threats to these species in the management of impacts and risks as relevant to physical presence of the MODU and AHTs. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign, external requirements and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • expected low numbers of fauna of conservation significance; • the minimal, short-term disruption posed by the physical presence of MODU and AHTs • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the physical presence of the MODU and AHTs have been undertaken; and • no stakeholder concerns have been raised. The residual impact on fauna of conservation significance associated with physical presence of the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.1.3 *Physical Presence – Disturbance of Seabed from Anchoring of MODU and AHTs*

Activity

Up to 12 anchors are planned to be deployed and set by AHTs to secure the MODU prior to drilling and retrieved by the AHTs at the end of the drilling campaign. Anchors are not expected to be pre-laid unless drilling occurs during cyclone season in which case up to 4 storm lines may be prelaid. The anchors are planned to be spread out in an even radial pattern extending up to 2,000 m from the MODU.

Placing the anchors takes approximately 48 hours, and during this process, there will likely be temporary seabed disturbance at each anchor location prior to the anchor being settled into place. Each anchor has the potential to disturb approximately 25 m^2 of seabed (up to 300 m^2 in total). Mooring chains and lines also cause temporary seabed disturbance and it has been estimated that this will cause up to 25 ha of disturbance (comprising approximately a 1 km drag with an allowance of approximately 25 m breadth).

Assessment

Anchoring of the MODU has a physical impact on the seafloor and the associated benthic communities and causes movement of sediments. The significance of the impact depends on the sensitivity of the seafloor habitat being affected. The seabed at the well location is expected to be relatively flat with mainly soft sediment, devoid of any significant seabed features and with little, if any, available hard substrate (**Section 4.2.3**).

Seabed features such as pockmarks, sand waves and megaripples are likely to occur based on surveys undertaken near the Operational Area **(Section 4.2.3)**. The closest seabed feature is Goeree Shoal, with it's 20 m depth plateau located approximately 1.4 km northwest of the Operational Area and 8 km from the Bratwurst-1 well location. Given these distances (see **Section 4.3.2** for additional distances to other depth contours), this feature will not be impacted by anchoring. Benthic surveys undertaken near the Operational Area showed low abundance of epibenthic communities, and in some areas surveyed the benthic habitats had little to no visible fauna (**Section 4.3.1**). The likely impacts to the seabed and epibenthic communities are smothering and temporary disturbance but impacts are expected to be slight and short lived.

Table 5 - 10: Risk Assessment for Physical Presence – Disturbance of Seabed from Anchoring of MODU and AHTs

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Anchoring of MODU	X	-	X	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
None identified	-	-
Elimination		
AHTs will not anchor within the Operational Area during drilling operations (except in emergency situations).	Reduces likelihood and magnitude of impact.	Yes
Substitution		
Using a DP drilling rig (i.e. no anchoring) rather than a MODU	Using a DP rig introduces operational risks (delay due to lack of rig availability, drilling delays or slowing down of drill operations due to DP rig shifting off-position); additional costs (DP rigs are less economic than moored rigs); additional waste generation (DP rigs require larger crews); and additional atmospheric emissions (DP engines need to be run 24 hours a day to maintain rig position).	No
Reduction		
None identified – The number of anchors is optimised for safe operations and to provide a stable platform for operational requirements.	-	-
Mitigation		
Conduct pre-drilling surveys, including bathometric side scan sonar, to detect benthic habitat at the well location.	Standard practice. Reduces likelihood and magnitude of impact.	Yes
A mooring analysis will be undertaken specific to the Bratwurst-1 well location to inform the MODU's anchoring plan.	Standard practice. Reduces likelihood and magnitude of impact.	Yes

Anchors locations are as per the planned locations outlined in MODU's anchoring plan.	Standard practice.	Yes
Summary of ALARP		
Given the widespread extent of similar benthic habitat (soft sand sediments with limited hard substrate) in the region, low abundance and sensitivity of benthic communities and the high likelihood that affected areas will recover in a short time, the environmental effects from setting and retrieving anchors are of minimal ecological significance and the magnitude of the impacts are slight. Overall the sensitivity is assessed as low, the residual impact level is considered slight and managed to ALARP. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.		

Demonstration of Acceptability	
Principles of ESD	The risks and impacts from anchoring of the MODU are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; • anchoring is not expected to decrease biological diversity and ecological integrity; and • the precautionary principle has been applied, and studies (pre-drilling surveys) will be undertaken where knowledge gaps were identified.
Relevant Requirements	N/A
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context, including Shell's environmental policy and HSSE and SP Control Framework (Maritime assurance standards). • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with anchoring will be implemented; and • no stakeholder concerns have been raised. The residual impact associated with physical presence of the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.1.4 *Physical Presence – Well Suspension and / or Abandonment*

Activity

In the event of well suspension, sufficient permanent subsurface barriers (e.g. cement plugs) will be installed inside the well to plug the well and form permanent barriers to the drilled formations. The well casings and wellhead will be left in situ. Well plugging and suspension will take approximately 5 days and may involve the use of a ROV.

Well abandonment involves installing permanent subsurface barriers (e.g. cement plugs) (if well suspension has not already undertaken), cutting the wellhead/casing strings below the level of the sea floor and recovering the wellhead to surface. Well abandonment activities will take approximately 7 days and may involve the use of a ROV for operations such as visual monitoring during installation of subsurface barriers and cutting and removal of the wellhead and casings.

ROV activities during well suspension and well abandonment may result in negligible, temporary seabed disturbance and suspension of sediment as a result of working close to, or occasionally on, the seabed. The footprint of a typical ROV is approximately 2.5 m x 1.7 m.

Assessment

Physical disturbance to the seabed and benthic communities can occur due to ROV activities associated with well plugging and suspension / abandonment. Physical disturbance includes movement of sediments, localised sediment deposition on the seabed and epibenthic communities and short-term, localised water turbidity.

The seabed and benthic communities at the Bratwurst-1 well location are expected to be broadly the same as areas surveyed within <1 and 5 km of the Operational Area that are relatively flat, with predominately sandy sediment and low benthic fauna abundance (**Section 4.3.1**). Given the widespread extent of similar habitat, the low sensitivity of the well location, and the high likelihood that temporarily localised affected areas recover in a short time, the environmental effects are considered of minimal ecological significance and the overall impact is considered slight.

Table 5 - 11: Risk Assessment for Physical Presence – Well Suspension and / or Abandonment

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Well suspension	X	-	X	-	Slight	Low	Slight
Well abandonment	X	-	X	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
None identified	-	-
Elimination		
None identified – the exploration well must be safely plugged and either suspended or abandoned to prevent loss of well containment.	-	-
Reduction		
None identified – the exploration well must be safely plugged and either suspended or abandoned to prevent loss of well containment.	-	-
Mitigation		
Installation of sufficient permanent subsurface barriers during well suspension and / or abandonment to maintain well integrity.	Standard practice. Compliance with industry standards. Reduces likelihood of impact.	Yes
Well plugging and suspension/abandonment will be undertaken in accordance with the WOMP	Standard practice. Reduces likelihood of impact.	Yes
Well abandonment will be undertaken as per the Shell Well Abandonment Manual and Guide (WS 38.80.31.35-Gen).	Standard practice. Reduces likelihood of impact.	Yes
Summary of ALARP		
Given the widespread extent of similar habitat, low abundance of benthic habitats and communities at the well location, low sensitivity of the well location, and the high likelihood that affected areas will		

recover in a short time, the magnitude of impacts from well plugging, suspension and abandonment are considered slight. Overall the environmental sensitivity is low. The residual impact is slight and is deemed to be managed to ALARP with implementation of the identified controls.	
Demonstration of Acceptability	
Principles of ESD	The environmental impacts from well plugging, suspension and abandonment are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted; • the health, diversity and productivity of the environment is not expected to decrease; and • biological diversity and ecological integrity within the Operational Area is not expected to be significantly impacted.
Relevant Requirements	N/A
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context, including Shell's environmental policy, HSSE & SP Control Framework (Maritime Standards) and Shell Well Abandonment Manual and Guide. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impacts are slight given the application of the controls outlined above and the following points: • pre-planning of this activity will consider all relevant well information obtained during the drilling campaign; • the proposed wellhead removal approach for well abandonment is considered to have the highest probability of success with the lowest environmental impact; • the low sensitivity and widespread nature of the seabed habitat; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with well plugging, suspension and abandonment have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with well plugging, suspension and abandonment is considered acceptable.	

5.5.2 Liquid Discharges

5.5.2.1 *Discharge of Deck Drainage and Bilge Water*

Activity

Deck drainage and bilge water will be generated on board the MODU and AHTs. Deck drainage includes wash down water, seawater spray and rainwater and may contain small quantities of oil, grease and biodegradable detergents present on the deck, Bilge water can contain oil, solid particles and chemicals such as solvents and detergents.

The MODU and AHTs each have open and closed drain systems to manage deck drainage and bilge water.

Open drainage systems are expected to discharge wash water directly to sea. Wash water will comprise low toxicity cleaning chemicals (Offshore Chemical Notification

Scheme (OCNS) category D or E/Gold or Silver) and trace amounts of hydrocarbons or other chemicals. Rainfall will also be partially diverted through open drain systems.

Closed drain systems on the MODU and AHTs include the pump, mud/pit room and engine rooms. Liquids entering closed drain systems are diverted to oily water separation tanks. Following separation, water with oil in water content of less than 15 parts per million (ppm) is planned to be discharged overboard in accordance with MARPOL 73/78 Annex I. Oily waste material produced by this process is diverted to a dedicated holding tank. Oily waste from the MODU holding tank is transferred to an AHT to be disposed of onshore, in accordance with the Shell HSSE &SP Control Framework.

Only small volumes of deck drainage runoff and bilge water are expected during the Bratwurst-1 drilling campaign. Due to these low expected volumes, any discharged run-off is likely to rapidly dilute and disperse.

Assessment

Deck drainage and bilge water have the potential to impact the marine environment through acute or chronic toxicity, oxygen depletion or salinity stress. The water quality in the immediate vicinity of the MODU and AHTs will be impacted during deck drainage and bilge water discharge, which has the potential to create surface sheens and localised reduction in water quality if it enters the marine environment. Impacts will be short-term because discharge volumes will be relatively small and will be diluted and dispersed in the open ocean environment.

There are no protected marine areas within the Operational Zone, therefore deck drainage and bilge water will not impact on protected marine areas.

The only BIA within the Operational Area is the whale shark BIA. It is possible that individual whale sharks may transit past the MODU and/or AHTs as deck drainage or treated bilge water is discharged, however no potential impacts to whale sharks are considered due to the small volumes of discharge, low concentration of contaminants, the rapid dilution and dispersion of the discharges in the open ocean environment and the treatment standard for bilge water.

No other BIAs are within or close to the Operational Area, and there are no significant ecosystems, habitats or communities near the well location. Therefore, deck drainage and bilge water are not expected to affect any other BIAs, ecosystems, communities or habitats.

Pollution and chemical discharge are key threats to threatened and migratory marine mammals, marine turtles, birds and sharks in Australia (Commonwealth of Australia 2017a; DEH 2005a; DEWHA 2008b; DEWHA 2009a; DEWHA 2009b; DoE 2014c; DoE 2014d; DoE 2015c; DoE 2015c; DoE 2015e; DoE 2015l; DoE 2015m; DoE 2016a; DoE 2016b; DoE 2016c; DoE 2016d; DoE 2016e; DSEWPaC 2011a; DSEWPaC 2013b). Individual animals (particularly whales, turtles, seabirds, rays and offshore dolphins) may transit through the area. However, no adverse ecological effects are anticipated because of the low volumes and concentration of contaminants, the lack of fauna critical habitats, low abundance of fauna in the Operational Area and rapid dilution rates in an open ocean environment.

Table 5 - 12: Risk Assessment for Discharge of Deck Drainage and Bilge Water

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Discharge of deck drainage and bilge water	X	-	-	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
The MODU and AHTs will comply with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 91 (Marine Pollution Prevention – Oil) which enacts MARPOL 73/78 Annex 1, including the requirement for IMO-compliant oil-water separation systems such that discharge overboard will not exceed 15 ppm.	Standard practice. Compliance with legislation. Reduces likelihood and magnitude of impact.	Yes
Compliance with Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Reduces likelihood and magnitude of impact.	Yes
The MODU and AHTs have appropriate Shipboard Oil Pollution Emergency Plans (SOPEPs).	Standard practice. Compliance with legislation. Reduces likelihood and magnitude of impact.	Yes
Elimination		
Collection and storage of deck drainage and bilge water onboard the MODU and AHTs for subsequent transport to mainland and disposal onshore.	Onshore disposal is not practical given the lack of storage capacity on the MODU / AHTs, lack of suitable facilities onshore for disposal, the increased costs and increased atmospheric emissions due to transport to shore, and the lack of environmental benefit. Significantly, onshore disposal does not reduce the net environment risk associated with offshore discharges in non-sensitive locations.	-
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
Spill Kits will be available on the MODU and AHTs.	Standard practice. Reduces likelihood of impact.	Yes
OVID-style inspections will be undertaken of the MODU and AHTs, including a check for valid International Oil Pollution Prevention (IOPP) Certificates, as part of the contracting process	Good practice. Reduces likelihood of impact.	Yes

Summary of ALARP	
No adverse ecological effects are anticipated because of the small volumes and low concentration of contaminants, the lack of nearby sensitive habitats, low abundance of receptors in the Operational Area and rapid dilution and dispersion rates in an open ocean environment. Overall, the magnitude of environmental impact from the discharge of deck drainage and bilge water is considered slight, with low sensitivity and slight residual impact. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.	
Demonstration of Acceptability	
Principles of ESD	The risks and impacts from deck drainage and bilge water are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; • the health, diversity and productivity of the environment is not expected to decrease; and • biological diversity and ecological integrity is not expected to be significantly impacted.
Relevant Requirements	Navigation Act and Marine Orders 91 (Marine Pollution Prevention - Oil), Marine Orders 93 (NLS)
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for whale sharks, marine mammals and turtles and considered key threats to these species in the management of impacts and risks as relevant to discharge of deck drainage and bilge water. • Shell has also considered the internal context, including Shell's environmental policy and HSSE and SP Control Framework, specifically 'Water in the Environment' and Maritime Standards. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with deck drainage and bilge water will be implemented; and • no stakeholder concerns have been raised. The residual impact associated with deck drainage and bilge water discharge from the MODU and AHTs for the Bratwurst-1 drilling campaign is considered to be acceptable.	

5.5.2.2 *Discharge of Treated Sewage, Grey-water and Putrescible Waste from MODU and AHTs*

Activity

The MODU and AHTs will generate sewage, grey-water and putrescible waste (i.e. food scraps). A MODU with a maximum crew capacity of 200 persons discharges approximately 40 m3 of treated domestic wastewater (sewage and grey-water) per day during drilling operations. AHTVs are typically manned by 10 to 20 crew and only generate small volumes of domestic waste.

Domestic wastewater will be treated prior to discharge. The MODU and AHTs will have sewage treatments plants, a sewage communiting and disinfecting system and sewage holding tanks as required by vessel class in accordance with *The Protection of the Sea*

(Prevention of Pollution from Ships) Act 1983, which enacts Marine Order 96 (Marine Pollution Prevention – Sewage).

Putrescible waste will be macerated before discharge in accordance with Marine Order 95 (Marine Pollution Prevention – Garbage) such that the waste can pass through a screen with no opening wider than 25 mm.

Assessment

Disposal of domestic wastewater and putrescible wastes to the ocean may cause some temporary, localised nutrient enrichment of the surface waters surrounding the discharge point. Due to the rapid dilution in an open ocean environment and the high biodegradability/ low persistence of the wastes, any potential impacts to water quality are expected to be highly localised, temporary and slight.

Discharge of domestic wastewater and putrescible wastes will not impact marine protected areas or sensitive habitats because there are none within the Operational Area and the discharges are highly localised.

The only BIA within the Operational Area is the whale shark BIA. Whale sharks may transit through the Operation Area. Individual animals of other fauna of conservation species (particularly whales, turtles, seabirds, rays and offshore dolphins) may also transit through the area. However, no adverse ecological effects are anticipated on the whale shark BIA, whale sharks or other fauna of conservation significance because of the short duration of the Bratwurst-1 drilling campaign, low volumes and localised nature of discharge, and the solubility and dispersion properties of the treated wastes which will rapidly dilute and naturally attenuate, nutrient levels away from the MODU and AHTs will return to normal, therefore no impacts on whale sharks are expected.

Table 5 - 13: Risk Assessment for Discharge of Treated Sewage, Grey-water and Putrescible Waste from MODU and AHTs

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Discharge of sewage, grey-water and putrescibles from MODU and AHTs	X	-	-	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
All sewage, grey-water and putrescibles from the MODU and AHTVs will, as a minimum, comply with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, including: • Marine Order 95 (Marine Pollution Prevention – Garbage), which enacts Annex V of the MARPOL Convention; and • Marine Order 96 (Marine Pollution Prevention – Sewage), which implements Annex IV of the MARPOL Convention.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Elimination		
Collection and storage of sewage, grey-water and putrescibles onboard the MODU and AHTs for	Onshore disposal is not practical given the lack of	-

subsequent transport to mainland and disposal onshore.	storage capacity on the MODU / AHTs, lack of suitable facilities onshore for disposal, the increased costs and increased health and safety exposures associated with handling, transport to shore, and onshore disposal, and the lack of environmental benefit. Significantly, onshore disposal does not reduce the net environment risk associated with offshore discharges in non-sensitive locations.	
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
All waste disposal is managed to the Shell HSSE and SP Control Framework 'Water in the Environment', 'Waste', and Maritime Standards.	Good practice. Reduces likelihood of impact.	Yes
OVID-style inspections will be undertaken of the MODU and AHTs, including a check for valid International Sewage Pollution Prevention (ISPP) Certificate, garbage management plans and garbage record books, as part of the contracting process	Good practice. Reduces likelihood of impact.	Yes
Summary of ALARP		
Given waste treatment, the temporary nature of the drilling campaign, small quantities involved, the chemical properties of the discharged materials which are highly biodegradable and low persistence, the rapid dilution in the open ocean environment and highly localised impact area, the magnitude of impacts from sewage, greywater and putrescible waste is assessed as slight. Overall the sensitivity of the surrounding environment is considered low and the residual impact is considered slight. The residual impact is deemed to be managed to ALARP with implementation of the identified controls.		

Demonstration of Acceptability	
Principles of ESD	The impacts from discharge of treated sewage, greywater and putrescible waste from the MODU and AHTs are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; • the health, diversity and productivity of the environment is not expected to be significantly impacted; and • discharges are not expected to decrease biological diversity and ecological integrity.
Relevant Requirements	Protection of the Sea (Prevention of Pollution from Ships) Act 1983, Marine Order 95, Marine Order 96, Marine Order 93 (NLS)
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for whale sharks, marine mammals and turtles and considered key threats to these species in the management of impacts and risks as relevant to discharge of treated sewage, greywater and putrescible waste. • Shell has also considered the internal context, including Shell's environmental policy and HSSE and SP Control Framework, specifically 'Water in the Environment', 'Waste', and Maritime Standards. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.

Summary of Acceptability
The residual impact is slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the discharge of treated sewage, greywater and putrescible waste have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with discharge of treated sewage, greywater and putrescible waste from the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.

5.5.2.3 *Discharge of Cooling Water and RO Brine*

Activity

The MODU uses cooling water to cool down systems such as the main air-conditioning system, the main generators, air compressors and brake coolers. There are likely two main discharges from the MODU:

- The engine cooling water pump, which runs continually, discharging approximately 130 tonne/hr of cooling water from the starboard forward discharge point at approximately 3 degrees above sea water temperature.
- The air-conditioning cooling pump which also runs continually, discharging approximately 100 tonne/hr from the port column 2 at approximately 2 degrees above sea water temperature.

A reverse osmosis plant will be used to generate fresh water on the MODU and AHTS vessels for domestic purposes. The reverse osmosis (RO) plant takes in seawater, removes the minerals to make potable water, and discharges brine. Brine is unsuitable for consumption and will be diluted with seawater prior to discharge to sea. Approximately 30 m^3 per day of brine will be discharged to sea from the MODU, with smaller volumes discharged from the AHTs which are smaller and have less crew, AHT's will utilise potable water where possible.

Assessment

The discharge of cooling water results in a decrease in water quality if the temperature of the discharge is higher than seawater. The temperature threshold used for discharged cooling water is the World Bank guideline which requires cooling water to be within 3°C of the background temperature within a distance of 100 m from the discharge point (International Finance Corporation (IFC), 2007). As can be seen above, discharge waters are likely to achieve World Bank requirements at the end of the discharge pipe or within a few metres of the discharge point. Given the very localised temperature changes compared to the size of the receiving environment, any potential impacts to water quality are expected to be highly localised, temporary and slight.

Potential impacts from brine discharge are decreased water quality due to an increase in salinity. Relatively small volumes of brine will be released in an open ocean environment; therefore, water quality impacts are considered temporary and highly localised.

Discharge of cooling water and brine will not impact marine protected areas or sensitive habitats due to the highly localised nature of the discharges and the distance to sensitive receptors.

The only BIA within the Operational Area is the whale shark BIA. Fauna of conservation species (particularly whale sharks, whales, turtles, seabirds, rays and offshore dolphins) may transit through the area. However, no adverse ecological effects are anticipated on the whale shark BIA, whale sharks or other fauna of conservation significance because of the short duration of the Bratwurst-1 drilling campaign, low volumes and localised nature of discharges, and the dispersion and dilution that occurs in open ocean environments.

Table 5 - 14: Risk Assessment for Discharge of Cooling Water and RO Brine

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Discharge of cooling water and RO brine	X	-	-	-	Slight	Low	Slight
Key Management Controls Identified							
Control				*Demonstration of ALARP*			*Control Adopted*
Standards, Legislation, Best Practice							
None identified				-			-
Elimination							
Collection and storage of cooling water and brine onboard the MODU and AHTs for subsequent transport to mainland and disposal onshore.				Onshore disposal is not practical given the lack of storage capacity on the MODU/AHTs, lack of suitable facilities onshore for disposal, the increased costs and increased health and safety exposures associated with handling, transport to shore, and onshore disposal, and the lack of environmental benefit. Significantly, onshore disposal does not reduce the net environment risk associated with offshore discharges in non-sensitive locations.			No
Substitution							
None identified				-			-
Reduction							
None identified				-			-
Mitigation							
Cooling water systems and RO plants will be maintained in accordance with the manufacturer's specifications.				Standard practice. Reduces likelihood of impact.			Yes
Summary of ALARP							
Given the small volumes of cooling water and brine discharges, the temporary nature of the operations, the rapid dilution in the open ocean environment and highly localised impact area, the magnitude of impact from the discharge of cooling water and brine is assessed as slight. Overall the sensitivity of the surrounding environment is considered low. The residual impact is slight and is deemed to be managed to ALARP with implementation of the identified controls.							
Demonstration of Acceptability							

Principles of ESD	The impacts from cooling water and brine discharge are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted; • the health, diversity and productivity of the environment is not expected to decrease; and • discharges are not expected to decrease biological diversity and ecological integrity.
Relevant Requirements	N/A
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context, including Shell's environmental policy and HSSE and SP Control Framework, specifically 'Water in the Environment', Waste, and Maritime Standards. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impacts are slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with cooling water and brine discharges have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with discharge of cooling water and brine from the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.2.4 *Disposal of Drilling Fluids and Cuttings*

Activity

Drilling fluids are used to carry out the following functions during drilling operations (Allen 1981; cited in Hinwood et al. 1994):

- transport of cuttings to the surface;
- supply of hydraulic power to the drill bit;
- cool and lubricate the drill bit;
- cover permeable formations of the borehole with a thin, tough filter cake;
- exert a hydrostatic head against the borehole walls to help prevent caving or sloughing of the formation;
- suspend cuttings and weight material such as barite when circulation is interrupted – as when adding a new stand of drill pipe;
- release cuttings readily at the surface;
- support part of the weight of the drill string through buoyancy;
- prevent flow of formation fluids into the borehole and to prevent blow-outs; and
- permit securing all the information necessary for evaluating the formations penetrated.

Drill cuttings are the rock particles removed from the well (bore hole) during the drilling operation.

Section 7.1.1 outlines the guiding principles for chemical selection, which is applied to the selection of drilling fluids. Several muds are available for drilling. These include oil-based mud (OBM), SBM and WBM. Of these muds, the WBM is considered the most environmentally benign. Thus, Shell uses WBM as the default drilling fluid selection as long as the mud technical design requirements are met. Overall the WBM is considered environmentally benign. As described below, the more technically challenging sections of the well may require SBM; where this is the case, the SBM selected will be the lowest toxicity possible whilst still providing the technical requirements needed for well stability.

Drilling of the riserless 42" section is planned to be undertaken with seawater and prehydrated bentonite sweeps with the cuttings deposited directly on the sea floor.

Drilling of the 17 ½" section is also planned to be riserless using either seawater and prehydrated bentonite sweeps, or a simple WBM may be used which comprises seawater, prehydrated bentonite and polymer mud system. If WBM is used, a RMR system may be used to circulate the returns (cuttings and fluids) back to the MODU. Cuttings are then separated from drilling fluid using SCE. If the RMR is in place, The WBM is recirculated and the separated cuttings are discharged to ocean. Drill cuttings are discharged above the water line. The drilling fluid volumes outlined in **Table 2 – 3** have been estimated for the Bratwurst-1 well using interval sizes and depths outlined in **Section 2** of this document

The 42" and 17 ½" sections do not require additional operational performance enhancement, as they do not pose technical challenges that require synthetic or oil-based muds. Seawater, sweeps and WBM have the most acceptable environmental footprint, which satisfies technical requirements.

The bottom sections of the well may be drilled using a closed SBM system. When SBMs are used, the riser will be in place and the returns will be circulated back to the surface where cuttings will be separated from muds on the MODU using SCE. This system allows the recovery and re-use of SBM and/or storage and onshore disposal of SBM. The SCE will reduce concentration of SBM on cuttings to an average of <6.9% (wet) over the sections where SBM fluids are used (as per Shell HSSE &SP Control Framework, 'Water in the Environment'). Muds will be sent onshore for disposal and are planned to be sold /reused by the contractor. The separated drill cuttings with residual coating of fluids are then discharged overboard after meeting the discharge criteria.

The SBM base fluid to be used is Saraline 185V, LAO, EDC Diamond or a combination of the three. EDC Diamond is currently being used in Western Australia by other operators. EDC Diamond is currently ranked as a D on the OCNS Rankings with no substitution warnings. LAO has previously been used in Western Australia, due to its acceptable environmental performance and low toxicity. SBM volumes outlined in **Table 2 – 3** have been estimated using interval sizes and depths outlined in **Section 2** of this EP.

Generally, a drilling mud mix consists of approximately 60% synthetic base fluid and 40% other additives. Like the base fluid, the additives selected for use have been selected using the criteria outlined in **Section 7.1.1**. In addition to the base fluid the components of the SBM are likely to include water, organophilic clay, lime, calcium chloride, calcium carbonate, proprietary emulsifiers and barite. In total, approximately 735 m^3 of drill cuttings is expected to be produced, excluding cuttings from contingent activities (i.e. base case total).

Respudding and sidetracking are contingent activities which may be required if the well hole becomes unstable and the well is lost before a 13 5/8" casing can be installed, or if operational challenges arise or a section of the hole is redrilled for the purposes of subsurface evaluation (**Section 2.2.5.3** and **2.2.5.5**). If a respud is required, up to approximately 500 m^3 of additional cuttings could be produced. If a sidetrack well is required, up to approximately 235 m^3 of additional cuttings could be produced. This results in a total worst-case discharge of drill cuttings to the seabed of up to 1,470 m^3.

Only one major SBM pit cleaning exercise may be required at the completion of the well. SBM pit cleaning is a process that generates waste fluids requiring disposal. Note that only residue SBM will be discharged from the pit during cleaning. If the non-aqueous fluid content of the residues is <1% v/v oil, the waste water from the pit (industrial water) will be discharged overboard. By limiting the pit clean ups and monitoring prior to discharge, the waste fluid stream is greatly reduced.

For the duration of the activity, daily reports outlining routine drilling activities, volumes of cuttings discharged, volumes of drilling fluid and environmental incidents, are collated by the offshore mud engineers:

- weight and volume of cuttings discharged (Mt / m^3);
- volume of WBM used (bbl.);
- volume of WBM discharged (bbl.);
- volume of SBM used (bbl.);
- volume of SBM cuttings discharged (bbl.); and
- volume of industrial water.

At the end of the drilling campaign, a Drilling Fluids End of Well Report will be completed. This report will include the final mud reconciliation.

Assessment

The main environmental concerns associated with the discharge of drilling fluids and cuttings to the marine environment are:

- increased turbidity and increase in total suspended solids (TSS) in the water column;
- temporary water discolouration;
- decrease of light penetration in the water column due to increased TSS and sedimentation;
- sediment deposition and alteration of sediment characteristics;
- smothering of benthic communities;
- contamination of sediments and associated toxicity to marine biota; and
- bioaccumulation and biomagnification.

The following receptors that may potentially be impacted by drilling discharges have been identified: water quality and plankton communities; benthic habitats and associated fauna; fauna of conservation significance (including whale sharks, cetaceans and turtles); and fish. However, as described in **Section 4**, none of these receptors are abundant in or considered to be restricted to the well location.

WBM coated cuttings and bulk mud

The environmental impact associated with the disposal of drill cuttings has been the subject of much scientific research globally across the oil and gas industry. This section is based on a comprehensive understanding of cuttings disposal issues published by industry organisations including Australian Petroleum Production & Exploration Association (APPEA) (APPEA, 2011), Oil and Gas UK (Oil and Gas UK [OGUK], 2005), and International Association of Oil and Gas Producers (International Association of Oil and Gas Producers (IOGP), 2003).

During drilling of the riserless 42” section, cuttings will be deposited directly on the sea floor which will lead to sediment deposition, alteration of sediment characteristics and smothering of benthic communities in the vicinity of the well location.

The discharge of WBM and cuttings overboard from the MODU will result in a temporary discolouration and increased turbidity and TSS which impacts water quality and can impact plankton communities. The nature of the change in turbidity is dependent on the characteristics of the cuttings, primarily size and density. The particle size distribution of cuttings will vary based on the geology of the formations being drilled, the characteristics of the drilling equipment, and the design of the well. Cuttings typically range from coarse gravel (> 32 mm) to silt (< 63 µm). Coarse particles will typically settle rapidly and have little potential to impact water quality (IOGP, 2016). As cuttings particle size decreases, the settling velocity will typically decrease, and the ratio of residual drilling fluids to cutting size increases. This will result in a turbid plume that will decrease as the plume is diluted and the suspended particles are deposited.

Results from modelling commissioned by Shell Australia of drill cuttings and fluids discharges for the Crux wells, which are approximately 8 km from the Bratwurst-1 well location, however, in a similar open ocean environment and similar water depth (170 m for Crux wells compared to approximately 155 m for the Bratwurst-1 well), indicated dilution is expected to occur rapidly due to the currents in the open ocean environment (RPS 2018a). The modelling predicted deposition thicknesses of ≤ 1 mm (considered to represent a low ecological threshold) and > 10 mm (high ecological threshold) within approximately 326 m and 68 m, respectively, for a single well resulting in approximately 891 m^3 of cuttings (i.e. well below the predicted base case volume – refer **Table 2 – 3**). Modelling of drill cuttings and drilling mud deposition from drilling five Crux wells around one well centre (approximately 4,455 m^3 of cuttings, approximately three times the predicted total for the Bratwurst-1 well, including contingent activities – refer **Table 2 – 3**) over 167.5 days predicted drill cuttings and drilling muds would not extend beyond 658 m (low exposure threshold) and 248 m (high exposure threshold) and were not likely to impact any sensitive receptors (RPS 2018a). Given this, no impacts to other marine users (e.g. commercial fishermen) are expected from the discharge of drill cuttings due to the 500 m petroleum exclusion zone that will be implemented, the short-term duration of the increased turbidity and TSS, and the distance to nearest receptor (Goeree Shoal, whose 50-100 m depth contour is approximately 6.4 km from the Bratwurst-1 well).

According to Hinwood et al. (1994), in the Independent Scientific Review of the Environmental Implications of Offshore Oil and Gas Development in Australia by Swan et al. (ed.) 1994 stated that the plume created by the discharge of drill cuttings can be expected to dilute by a factor of at least 10,000 within a 100 m of its point of discharge; at which point most of the particulates derived from cuttings will have settled out. Given the generally limited turbidity of the expected plume, the limited area impacted and the short-lived period of impact, the plume is not expected to impact photosynthetic activity measurably in the water column.

As the cutting particles fall through the water column they will be dispersed by currents. Minor alteration of benthic habitat characteristics (sediment particle size, element composition) may occur on the seafloor near the MODU from cuttings deposited directly on the seafloor or disposed overboard of the rig. Mineralisation of cuttings is expected to be low and any metals present are unlikely to be in a bioavailable or in a soluble form. Bottom-feeding organisms would be most susceptible to bioaccumulation of metals from cuttings. Benthic fauna are sparsely distributed in the Operational Area and community types are likely to be widely spread in the region (**Section 4.3.1**). Given the current and depth of water at the well location (140-200 m) it is unlikely that a noticeable cuttings pile will develop on the seabed. No significant benthic environmental effect resulting from disposal of cuttings is anticipated as the area likely to be affected is localised, the benthic biota are sparsely distributed (**Section 4.3.1**) and extensive studies have demonstrated that recovery is rapid.

SBM coated cuttings

The discharge of cuttings coated in SBM will result in localised burial of benthic organisms, alteration of the benthic substrate and increased turbidity in the water column, though plumes generated from SBM coated cuttings are generally less than those generated from WBM coated cuttings.

Acute ecotoxicity testing is commonly used to predict the toxicity of drilling fluids in the marine environment. SBMs currently used in drilling operations in Australia range from slightly toxic to non-toxic (LC50 value of 1,000 to >100,000 mg/l), depending on the test organisms used (APPEA, 2008). This low toxicity can be attributed to two factors; the low solubility of SBMs in the water column and their negligible concentrations of aromatic hydrocarbons. The Polycyclic Aromatic Hydrocarbons (PAH)s, which are primarily responsible for the toxicity of OBMs, are below detectable levels in the SBMs selected for the Bratwurst-1 drilling campaign. SBMs currently in use in Australia are generally considered to have limited potential to bio-accumulate in aquatic organisms (APPEA, 2008).

A compilation and review of the findings of 75 studies relating to the discharge of nonaqueous drilling fluids (NADFs) by the IOGP (IOGP, 2003) concluded that the numerous field studies conducted to measure the initial impacts and recovery from NADF discharge showed that benthic community disturbance is in general very localised and temporary. The term NADF refers to both OBMs and SBMs.

Contaminant levels would reach background levels within a short distance from discharge area and be undetectable beyond 3,000 m (9,843 ft) from the site, according to some studies of surface discharges (Neff et al., 2000). Biodegradation of modern NADF can be relatively rapid, particularly when NADF concentrations are low to moderate, and where newer NADFs were used field studies show that recovery was underway within one year of cessation of discharges.

The rate of biodegradation is controlled by factors including temperature, hydrostatic pressure, and the availability of oxygen. Initially, the dispersed SBM would aerobically biodegrade. At the seafloor, where DO is limited, the sediments would likely become anaerobic as bacteria use the available oxygen to metabolise the SBM; biodegradation would then proceed anaerobically at a slower rate. Anoxia is caused by the rapid biodegradation of the SBM. The various components of the benthic community would be directly impacted relative to the thickness of the drilling mud on top of the initial sediment-water interface.

Studies specifically into the environmental effects of Saraline 185V across a range of depths (70 m to 1,500 m) in Malaysia have shown that Saraline 185V does no more harm to the environment than internal olefins (e.g. LAO) (Dorn, 2007). Testing undertaken in Australia at the Prelude Concerto well site showed that Saraline 185V degradation was as extensive as demonstrated offshore in Shell's Malaysian studies (Dorn, 2007, American Chemistry Council, 2006).

A description of the key features of Saraline 185V base fluid is given below:

- Saraline 185V is rated as a category E with no substitution warnings on the OCNS rankings list.
- Saraline 185V is a synthetic gas to liquid (GTL) linear paraffin, which is virtually free of aromatics and contaminants, such as sulphur and amine. It is synthesized from clean natural gas via a proprietary catalytic Fischer-Tropsch process.
- Shell Saraline 185V is a mixture of alkanes of carbon chain length of predominantly C10 to C20.

- Saraline 185V is classified as a 'synthetic drilling base fluid' as it is produced from the reaction of a purified feedstock, as opposed to highly refined/processed mineral oils which are produced directly from the fractional distillation of crude oil (OGP 2003).
- Invert emulsion drilling fluids containing Saraline 185V are technically suitable for use in high temperature applications, such as Auriga.
- Saraline 185V readily biodegrades, is considered non-toxic in the water column and has low sediment toxicity. It has a low viscosity, a low pour point and relatively high flash point making it ideal for offshore drilling in the Browse Basin.
- It is widely used as a non-aqueous base fluid in an invert emulsion drilling mud in the upstream oil and gas industry throughout the Asia Pacific region. Saraline 185V has been used extensively on the NWS, WA. It has also been used extensively in Malaysia, Thailand, Vietnam, Philippines, Bangladesh, India, New Zealand, China and the Caspian Sea since 1997.

The discharge of SBM coated drill cuttings is not expected to impact on fauna in the water column, such as whale sharks, marine mammals or turtles. Both Saraline and LAO are considered non-toxic in the water column. Also, the discharge of drill cuttings does not result in the very high concentrations of suspended sediments (>1830 mg/L) needed to cause fauna mortality. Fish (including whale sharks), marine mammals are turtles are likely to move away from increased turbidity and TSS caused by drill cuttings discharge.
Assessment

The discharge of WBMs and WBM/SBM-coated drill cuttings decreases water quality, alters benthic habitat characteristics and impacts benthic fauna through smothering. Water quality impacts are expected to be short-lived and slight. Impacts to benthic habitats and benthic fauna are considered slight and localised.

Table 5 - 15: Risk Assessment for Disposal of Drilling Fluids and Cuttings

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Discharge of WBMs, WBM coated drill cuttings and SBM coated drill cuttings	X	-	X	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Compliance with legislation. Reduces magnitude of impact.	Yes
Compliance with Shell Control Framework 'Water in Environment: Specifications for Water Discharge" for SBM cuttings discharges	Good practice. Reduces magnitude of impact.	Yes
Use of SCE to reduce SBM on cuttings to <6.9% (wet) averaged over the well sections drilled with SBM.	Good practice. Reduces magnitude of impact.	Yes
Elimination		
Reinjection of drill cuttings into a geological formation below the seabed.	The cost and technical risks associated with reinjection of	No

	cuttings (including potential well integrity risks) outweighs any potential environmental benefits.	
Substitution		
None identified – Drilling fluids are integral to the drilling process.	-	-
Reduction		
Reduce cuttings produced at seabed by reducing the diameter of the well.	The well diameter has been optimised for safety, technical and operational requirements. Reducing the well diameter introduces drilling risks and increases the potential need for respudding or side tracking	No
Storage of WBMs, WBM cuttings and SBM cuttings on board the MODU for transport to the mainland and onshore disposal.	Onshore disposal is not practical given the lack of storage capacity on the MODU, risk of muds settling inside tanks, lack of suitable facilities onshore for disposal, the increased costs and increased health and safety exposures associated with handling, transport to shore, and onshore disposal. Significantly, onshore disposal does not reduce the net environment risk associated with offshore discharges in non-sensitive locations.	No
Mitigation		
No bulk SBM discharged during the Bratwurst-1 drilling campaign.	Standard practice. Reduces magnitude of impact	Yes
Part 1: Start-up Rig Specific SBM checklists completed prior to SBM transfer to the MODU and into the hole.	Standard practice. Reduces magnitude of impact	Yes
Part 2: Specific SBM checklist for completed prior to displacement and use of SBM.	Standard practice. Reduces magnitude of impact	Yes
Monitoring of drilling fluids storage, transfer facilities and equipment, including regular testing of SBM oil-on-cuttings.	Standard practice. Reduces magnitude of impact.	Yes
Use of SCE to reduce concentration of SBM on cuttings discharged to sea to an average over SBM sections of <6.9% (wet)	Standard practice. Reduces magnitude of impact.	Yes
The SCE is planned to be maintained in accordance with the vendor Preventative Maintenance Schedule.	Standard practice. Reduces magnitude of impact.	Yes
One Major SBM Pit cleaning at the end of the well campaign will minimise industrial water discharge to the environment.	Standard practice. Reduces magnitude of impact.	Yes
Summary of ALARP		
The expected impact magnitude of the Bratwurst-1 drilling campaign from discharges of WBMs and drill cuttings on water quality, benthic communities and benthic fauna is expected to be slight because of: • open ocean location of the well which assists with dispersion and dilution of WBMs; • the low sensitivity of the benthic habitats; • low abundance and diversity of benthic communities at the well location; • the lack of habitat critical to the survival of fauna of conservation significance;		

• low toxicity and high degradability of selected WBM and SBMs; • the short-term nature of the drilling campaign; and • the high likelihood that affected areas will recover in a short time. Overall the environmental sensitivity is considered low and the residual impact of WBM and drill cuttings discharge is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.	
Demonstration of Acceptability	
Principles of ESD	The impacts from discharge of WBM coated cuttings and bulk mud are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted. • the health, diversity and productivity of the environment is not expected to decrease in the long-term; and • significant impacts to the conservation of biological diversity and ecological integrity are not expected.
Relevant Requirements	N/A
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Management of impacts to fauna are consistent with conservation advice and recovery plans for threatened species. • Shell has also considered the internal context, including Shell's environmental policy, Chemical Selection process and Shell Control Framework – Specification for Discharge to Water for SBM cuttings discharges. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impacts are slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the discharge of WBM coated cuttings and bulk mud have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with WBM cuttings and bulk mud discharges from the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.2.5 *Discharge of Cement and Additives*

Activity

Cement is used to create a physical and hydraulic bond between a conductor or casing string and the formation and is essential for well integrity. Cement is also used to provide permanent barriers when abandoning wells. Cementing fluids consist of cement and various additives including inorganic salts, lignins, bentonite, barite, defoamers and surfactants.

While cementing fluids are not routinely discharged to the environment, cement slurry will be released during cementing of the 36" conductor to ensure there is sufficient cement around the conductor to form a structural base to support the weight of subsequent casing strings and the BOP. Cement may remain liquid for several hours, during which time there may be some release of chemicals into ambient waters. After the cement has hardened, chemical components of the cement are locked in the inert cement matrix. Cement is only circulated to seabed for the conductor – the cement for bottom hole casing strings is not circulated to surface and remains down hole. It is estimated that up to 60 m^3 of cement slurry will be released to the seabed.

Cement slurry may also be released to the seafloor during well plugging. It is not possible to have zero cement excess due to the increased risk of insufficient cement and the potential for loss of conductor structural integrity (during casing installation) or well integrity (during well plugging). Pressurized air is used when transferring dry bulk cement from the AHTs to the MODU and when preparing the bulk silo tanks “fluffing” prior to mixing cement. During these operations, small amounts of dry cement may blow onto the sea surface resulting in minor surface discharges.

Cement is mixed and pumped ‘on the fly’ from a small mixing tank (approximately 3 m^3) on the cement unit. This limits the volume of excess or contaminated cement that could potentially require discharge into the ocean. Excess or contaminated liquid cement cannot be used down hole and cannot be returned to shore for disposal, as it would solidify in storage tanks. Therefore, any excess volumes of cement will be mixed with sea water and discharged overboard from the MODU. All unused cement additives are planned to be returned to shore for reuse or disposal. Excess dry bulk cement remaining at the end of well will be slurrified for discharge overboard.

Contamination can happen in various ways. If the mixed fluid is prepared in mud pit and there is a leak in the line, mud can come into contact with mixed fluid (used to mix cement slurry) and cause a contamination issue. This risk is mitigated by changing all solid chemicals to liquid chemicals and using an automated liquid additive system (LAS). An automated LAS adds the required amount of chemical additives directly to the displacement tubs, removing the need to premix cement mix water in a mud pit and then to dispose of excess after the job is completed.

If incorrect chemicals are used to prepared mixed fluids, this can also cause contamination. Cement designs will be submitted by the Vendor and reviewed by a Shell Cementing Technical SME. Over displacement volume may potentially lead to damaging the cement quality at the shoe. In this case sometimes cement slurry needs to be circulated all out and the job is required to be repeated.

Down time is prevented during execution by ensuring equipment is maintained as required. Avoiding downtime is important as downtime may cause an interruption during a cementing job; if mixed cement slurry is left unpumped over an extended period, it may alter the cement properties, which may lead to a contamination event. The cementing contractor has a proactive maintenance system for all cement pump unit and ancillary equipment.

The typical components of cement are outlined below in **Table 5 - 16** below and are considered representative of the types of additives that may be used for the Bratwurst-1 drilling campaign. Cement and cement additives will be selected using the Shell chemical selection process outlined in **Section 7.1.1** and will typically have low toxicity ratings of OCNS E, CHARM Gold or equivalent.

Table 5 - 16: Typical Cement Components

Type of Component	Use
Cement – Class G: Cements used in well	Mostly used in Australia with proved results as the most suitable cement for Australian well conditions. Class G cement can resist better to sulphurous compounds, commonly present down hole, which can detrimentally affect some cement hydration products. For well construction at temperatures of 110°C and higher, addition of 35% or 45% silica flour reduces the likelihood of cement degradation. Silica flour is not added for well construction at temperatures less than 110°C
Antifoam	To prevent foaming during mixing. Antifoam additive has been used in Australia for many years with proven technical results at low concentrations.
Extender	Added in low density to maintain slurry stability. Liquid extender comes in liquid or solid form. Liquid form is preferred as it can be mixed directly into the cement mixing system, rather than solids which require a mud pit, creating dead volumes.
Retarder	Retarder is used to slow the setting rate of cement.
Fluid loss additive.	Used for fluid loss and control of gas migration into cement.
Spacer	Additive used to for mud removal
Dispersant	Enhances the fluidity of the slurry so that it can be mixed on surface and pumped to the well. Either liquid dispersant or non-retarding dispersant is used.
Cement set enhancer	Used to assist with cement setting in low temperature water.
Gas control agent	Creates an impermeable barrier to prevent gas in the well annulus from migrating into the cement slurry.
Surfactant	Used to remove SBM from the well annulus
Solvent	Used to remove SBM from the well annulus.

Assessment

The discharge of cement to the marine environment around the 36” conductor will cover the seabed around the well, resulting in localised burial of benthic organisms and alteration of the benthic substrate. The cement will solidify, potentially providing a hard substrate for epifaunal organisms to occupy. However, it is likely that the cement will ultimately be covered by drill cuttings circulated to seabed from the well during riserless drilling operations. It is very difficult to isolate any impact on the environment from cement from the broader impacts associated with drill cuttings.

The loss of dry cement during dry bulk cement transfer will result in localised water quality impacts, however the impacts will be temporary and highly localised as only minor discharges are expected.

The discharge volume of surplus or contaminated cement requiring disposal is kept relatively low because the cement for the Bratwurst-1 well is designed to be ‘mixed on the fly’. Surplus or contaminated cement requiring discharge into the ocean would result in increased local turbidity in the water column as the liquid cement plume dilutes and disperses though the water column. The cement will be dispersed by currents, potentially resulting in minor alteration of benthic habitat characteristics (sediment particle size, element composition). However, given the depth of water at the well location (140-200 m) and the local currents it is unlikely that detectable concentrations will accumulate on the seabed. Again, it is very difficult to isolate any impact on the environment from cement from the broader impacts associated with drill cuttings discharge, especially given comparatively small volumes.

The guiding principle for the selection of cement additives is to select the solution with the most acceptable environmental footprint that meets technical requirements as outlined in the chemical selection process described in **Section 7.1.1**.

Cement discharged during the Bratwurst-1 drilling campaign will have a localised distribution. There are no sensitive or protected marine areas within the Operational Area, and the seabed habitat is comprised of soft sediments with low benthic community abundance and diversity (**Section 4**). The release of cement during casing installation and well plugging, loss of dry cement during transfers and the discharge of excess or contaminated cement is not expected to have a significant impact on the benthic environment or water quality.

Table 5 - 17: Risk Assessment for Discharge of Cement and Additives

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Discharge of cement, cementing fluids and additives	X	-	X	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Reduces magnitude of impact.	Yes
NOHSC: 1008 (2004) – Approved Criteria for Classifying Hazardous Substances) – MSDS available on-board for hazardous substances.	Standard practice. Compliance with industry standards. Reduces magnitude of impact.	Yes
Elimination		
None identified – cement is fundamental to installing conductor / casing strings and providing well integrity.	-	-
Substitution		
None identified	-	-
Reduction		
Reduce cement discharge by using inner string cementing (only applicable to conductor)	Good practice. Reduces magnitude of impact.	Yes
Mitigation		
Cement designs will be peer reviewed by the Shell Cementing Technical SME.	Standard practice. Reduces magnitude of impact.	Yes
The cementing returns will be monitored at the mudline during conductor installation with an ROV.	Standard practice. Reduces magnitude of impact.	Yes
The cement system will be maintained in accordance with the manufacturer's specifications.	Standard practice. Reduces magnitude of impact.	Yes

The pressure and volumes of cement pumped during conductor / casing string installation will be accurately tracked.	Standard practice. Reduces magnitude of impact.	Yes
Unused cement additives will be returned to shore for disposal.	Standard practice. Reduces magnitude of impact.	Yes
Unused excess bulk dry cement will be returned to shore for resale, reuse or disposal	Backloading bulk dry cement (which is loaded onto supply vessels via tankers onshore and not in packaging which is easily trsnported) onshore disposal is not practical given the: • The HSE risk associated with Vessel to Tanker(onshore) Transfers due to the risk explosion caused by over-pressurisation. • Everytime cement is blown to move it from one storage vessel to another, the likliehood of contamination from moisture in the air (being used to transport the cement) can result in solidification of cement in the receiving vessel, resulting in solidification in the vessel tank which can render tanks unusable for period of time and /or high risk safety concerns due to vessel entry. • lack of potential customers for resale/reuse (i.e. sourced from Adelaide), • rigorous QA/QC process the bulk dry cement would need to pass to be deemed suitable for resale/reuse, • transportation emissions and costs associated with returning excess cement onshore and to a suitable resale or disposal facility, and • increased health and safety exposures associated with offloading dry cement from the MODU. Significantly, onshore disposal is not considered to reduce the net environment impact associated with offshore discharges in the non-sensitive well location. The additional transport environmental and safety impacts and costs associated with returning the excess bulk cement to shore for reuse or disposal outweigh the minor environmental impacts associated with the discharged the excess cement offshore.	No

Summary of ALARP	
The expected impact magnitude of the Bratwurst-1 drilling campaign on commercial fishing is expected to be slight because of: • open ocean location of the well; • the low sensitivity of the benthic habitats; • low abundance and diversity of benthic communities at the well location; • the lack of habitat critical to the survival of fauna of conservation significance; • low volumes of cement to be discharged; • low toxicity of selected cement components; • the short-term nature of the drilling campaign; and • the high likelihood that affected areas will recover in a short time. Overall the environmental sensitivity is considered low and the residual impact is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.	
Demonstration of Acceptability	
Principles of ESD	The impacts from discharge of cement, cementing fluids and additives are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted; • significant impacts to the health, diversity and productivity of the environment are not expected; and • discharges are not expected to decrease biological diversity and ecological integrity.
Relevant Requirements	N/A
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Management of impacts to fauna are consistent with conservation advice and recovery plans for threatened species. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impacts are slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the discharge of cement, cementing fluids and additives have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with cement, cementing fluids and additives for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.2.6 *Subsurface Discharges (BOP control fluid discharge, well annular fluids from abandoned wells)*

Activity

Approximately 50 m^3 of BOP control fluid is planned to be discharged to the sea during BOP installation, functioning testing and pressure-testing. The BOP will be regularly function tested whilst the BOP is on the seabed to ensure the BOP is operating to the required standards and to test functionality of the BOP for emergency situations. The most likely BOP fluid used will be Stack Magic Eco or Erifon HD603 HP.

Once drilling of the well is complete, small volumes of well fluids are trapped in the annular spaces between casing. During well abandonment, when the wellhead is removed, these well annular fluids may be released to the ocean. The release will occur at the seabed and will be slow (i.e. not instantaneous) because the fluids are typically heavier than seawater and trapped in small spaces.

Assessment

Stack Magic Eco, which is classified as D within the UK OCNS.

Erifon HD603 HP (no dye) is a field proven, dilutable, water-based hydraulic fluid specifically formulated for use in high-pressure open/ vent to sea BOP control systems. The fluid prevents valves from sticking even after long static periods and improves system life under slow moving high load conditions. Erifon HD603 HP is diluted at 3% v/v in water in the BOP fluid. The chemical is readily biodegradable (results of >60% biodegradation in 28 days to an OSPAR HOCNF accepted ready biodegradation protocol) and does not bioaccumulate. Erifon HD603 HP does not contain ingredients on the list of the US Clean Water Act Priority Pollutants. It is rated red under the scheme in Norway and is currently rated C with substitution warnings under the UK OCNS scheme. The current C rating is driven by the tracing dye contained within Erifon HD603 HP.

Given the low toxicity, low concentration and small volumes of BOP control fluid which will be further diluted upon subsea discharge in the open ocean environment at the Bratwurst-1 well location, significant environmental impacts are not anticipated.

Table 5 - 18: Risk Assessment for Subsurface Discharges (BOP control fluid discharge, well annular fluids from abandoned wells)

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Subsurface discharge of BOP control fluid and well annulus fluids	X	-	-	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Reduces magnitude of impact	Yes
NOHSC: 1008 (2004) – Approved Criteria for Classifying Hazardous Substances) – MSDS available on-board for hazardous substances.	Standard practice. Reduces magnitude of impact	Yes
Elimination		
None identified – testing of BOP functionality is required for safety and technical reasons	-	-
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		

Quantities of BOP control fluid used and discharged is monitored using flow meters and recorded by stock level balance check.	Standard practice. Reduces magnitude of impact	Yes
Summary of ALARP		
The expected impact magnitude of the Bratwurst-1 drilling campaign from subsea discharge of BOP control fluid and well annular fluid is expected to be slight because of: • the low sensitivity of the benthic habitats; • low abundance and diversity of benthic communities at the well location; and • low toxicity of selected BOP control fluids and well annular fluids. Overall the environmental sensitivity is considered low and the residual impact of interference with other users is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.		
Demonstration of Acceptability		
Principles of ESD	The risks and impacts from deck drainage and bilge water are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted. • the health, diversity and productivity of the environment is not expected to decrease; and • biological diversity and ecological integrity is not expected to be significantly impacted.	
Relevant Requirements	NOHSC: 1008 (2004), Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.	
Summary of Acceptability		
The residual impact from discharge of BOP control fluids and well annular fluids is slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with deck drainage and bilge water will be implemented; and • no stakeholder concerns have been raised. The residual impact is considered to be acceptable.		

5.5.3 Light emissions

5.5.3.1 *Physical Presence of MODU and AHTs – Light Emissions*

Activity

The MODU and vessels will be lit on a 24-hour basis to maintain operational safety and navigation requirements as outlined in the *OPGGS Act* and *Navigation Act 2012*. Artificial light from activities associated with the Bratwurst-1 drilling campaign will result in light spill to the surrounding marine environment. Existing sources of light near the Operational Area are limited to vessel movements and oil and gas development activities, with these resulting in temporary illumination. Therefore, the baseline illumination of the Operational Area is predominantly from starlight and the lunar phase and cycle. Artificial light emissions will be generated from two primary sources:

- navigational and operational lighting required for functional operation; and

- flaring activities.

As project activities are conducted 24 hours a day, lighting is required for safety and navigational purposes. Therefore, the MODU and project vessels will be constantly lit. The amount of light spill generated in the Operational Area will be dependent on the number of light sources, the wavelength and intensity of the light sources, the location and/or placement of light fittings and the method of light switching.

Flaring would also occur during well testing, should this contingent activity be required.

Impact Assessment

Threatened Species and Ecological Communities

The presence of artificial lighting associated with activities during all phases of the Bratwurst-1 drilling campaign has the potential to impact marine fauna and birds, particularly those that use visual cues for orientation, navigation, or other purposes. Potential impacts from artificial lighting may include:

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

<u>Marine Reptiles</u>

The Operational Area does not contain any emergent land or shallow features that may be of importance to nesting or foraging turtles, as the primary marine reptile group that may be influenced by light emissions. Therefore, turtles are unlikely to be present in the area in significant numbers. However, it is reasonably assumed that turtles may transit the Operational Area as they move from nesting beaches and offshore areas.

Light pollution on nesting beaches can alter nocturnal behaviours in adult and hatchling turtles. Artificial lighting can disrupt or affect the choice of nesting location by female turtles, particularly light visible on the landward side of nesting beaches (Salmon 1992). Turtle hatchlings leaving nesting beaches are particularly sensitive to artificial lighting as they use celestial cues to orientate (Limpus 1997, Salmon et al. 1992). Once in the water, marine turtle hatchlings may still use celestial lights as navigational markers during oceanic migrations and are known to be attracted towards bright lights. Hatchlings can become disorientated and trapped within light spill around platforms and vessels, resulting in increased energy expenditure, increased predation and decreased survival rates.

Extensive light attraction studies have been conducted on turtle hatchlings, including at Barrow Island (Pendoley 2005). These studies demonstrated that hatchlings crawl away from tall, dark horizons (sand dunes and vegetation) towards lower and lighter horizons (the sea and stars), and that artificial lighting can alter this response. Studies have demonstrated that when on land, hatchlings are not significantly affected by artificial light at a distance of 800 m (Pendoley 2005). Once in the water, hatchling navigation is understood to be influenced predominantly by wave motion, currents and the earth's magnetic field.

Artificial lighting is a key threat to threatened and migratory marine turtles in Australia (Commonwealth of Australia 2017a, DEWHA 2009a). Given the distance to the nearest emergent land is 86 km (Cartier Island) light is not expected to reach any turtle nesting beaches. Therefore, there is no potential for adverse disturbance to hatchling turtles arising from the Bratwurst-1 drilling campaign. Adult turtles passing through the

Operational Area may temporarily alter their normal behaviour whilst attracted to the light spill from infrastructure. Given the wide migratory distribution (i.e. several hundred kilometres) of adult turtles outside of nesting season and their low-density presence within the Operational Area and EMBA, the subsequent attraction from direct lighting is expected to be minor and a temporary disruption to a small portion of the adult turtle population.

Birds

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

Migratory birds are thought to use the Earth's magnetic field as a reference when undertaking migrations (Archer 2017, Chernetsov 2016, Chernetsov et al. 2017, Heyers et al. 2017), although may rely on other cues such as visual cues for shorter-range movements. Light from offshore platforms in the North Sea have been shown to attract migrating birds and birds that migrate during the night are especially affected (Verheijen 1985). Light from the Bratwurst-1 drilling campaign may potentially attract migratory birds, however given the Earth's magnetic field is the primary navigation cue, the campaign is not expected to have any influence on large-scale bird migrations.

Given the location of the Operational Area in a remote offshore location, distant from known migratory aggregation areas for birds, and that only a small number of individuals are expected to pass through the area whilst in transit, any behavioural disturbances such as disorientation, attraction and/or exhaustion are considered to be slight. Impacts may potentially affect a small proportion of individual birds, however, are not expected to result in any population level effects on even a local scale.

Other Fauna

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

Shaw et al. (2002), in a similar light trap study, noted that juvenile tunas (*Scombridae*) and jacks (*Carangidae*), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. Any impacts arising from light emissions to marine fauna are considered to be slight.

Table 5 - 19: Risk Assessment for Physical Presence of MODU and AHTs – Light Emissions

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Magnitude*	*Sensitivity*	*Residual Impact*
Light emissions from MODU and AHTs	-	X	-	-	Slight	Low	Slight
Key Management Controls Identified							

Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
None identified	Lighting is required under legislation including: • International Regulations for preventing Collisions at Sea 1972 (COLREGs); • Safety of Life at Sea (SOLAS) – Chapter 5; • The Navigation Act 2012; • Marine Order 21(Safety of Navigational and Emergency Procedures); and • Marine Order 30 (Prevention of Collisions) (as appropriate to vessel class). • Marine Orders 32, cargo handling equipment (50 LUX is required by Law in any working area).	-
Elimination		
None identified	Lighting is a requirement for safety and navigation and cannot be eliminated.	-
Substitution		
Shrouding MODU lights to prevent light spill or directional lighting	Well location far away from turtle and birds BIAs, therefore, costs outweigh benefits.	No
Reduction		
Restricting/avoiding night works	Control not credible as drilling requires 24-hour operation and lighting is required for safe.	No
Reduce duration of drilling operations	Control not credible as drilling operations are based on engineering and safety requirements and reduced as much as practicably possible from a cost perspective.	No
Mitigation		
Inspection and maintenance of flaring system for efficiency during well test.	Standard practice. Reduces likelihood of impact.	Yes
Summary of ALARP		

The expected magnitude of light emissions from the MODU and AHTs on marine turtles, birds and other marine fauna is expected to be slight due to: • the Operational Area being in a remote offshore location away from emergent land; and • the lack of habitat critical to the survival of fauna of conservation significance. Overall the environmental sensitivity is considered low and the residual impact of light emissions is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.	
Demonstration of Acceptability	
Principles of ESD	The risks and impacts from light emissions from the Bratwurst-1 drilling campaign are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; and • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur.
Relevant Requirements	COLREGs, SOLAS, The *Navigation Act* 2012, Marine Order 21, Marine Order 30, and Marine Order 32
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for marine turtles and considered key threats to these species in the management of impacts and risks as relevant to artificial lighting emissions. • Shell has also considered the internal context, including Shell's environmental policy, Adherence to Maritime Standards. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • the minimal disruption posed by light emissions from the MODU and AHTs; • regulatory requirements and Shell standards are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the physical presence of the MODU and AHTs have been undertaken; and • no stakeholder concerns have been raised. The residual impact on fauna of conservation significance associated with light emissions from the MODU and AHTs for the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.4 Underwater noise

5.5.4.1 *Noise Emissions during Drilling Operations, MODU/Vessel Movements and VSP*

Activity

Aspects of the Bratwurst-1 drilling campaign will generate underwater noise above ambient levels. This noise may result in impacts and risks to environmental receptors. The relevant noise sources are described below and include:

- normal operations of the MODU (i.e. machinery) and drilling operations;
- vessels-related noise, particularly while using dynamic positioning (DP); and
- VSP during drilling activities.

The main source of noise from the MODU will be from operation of drilling machinery and use of VSP. Noise produced from the MODU is likely to be predominantly low frequency, below 2 kHz with peak frequencies below 0.5 kHz. The noise generated by drilling operations, excluding the use of thrusters for dynamic positioning, is relatively low intensity continuous noise. Extrapolation from measurements of underwater noise from a semi-submersible drilling rig by McCauley (1998) indicates noise source levels for non-drilling and drilling noise from a rig range from 160 to 164 dB re 1 µPa at 1 m (SVT Engineering Consultants 2018).

Vessel noise varies with the size, speed, engine type of the vessel and the activities being undertaken. Smaller, faster vessels typically produce higher-frequency sound at lower source levels than large, relatively slow-moving ships. AHTs typically produce sound levels around 160-180 dB re 1 µPa at 1 m during transit and these levels drop with reduced speed. As a ship's speed increases, broad band noise such as propeller cavitation and hull vibration noise become dominant over machinery related tones (National Research Council [NRC], 2003). When the vessels using DP are holding station, frequencies increase considerably with the use of thrusters to maintain position. McCauley (1998) measured noise from AHTs 'holding station' with an estimated source volume of 182 dB re 1 µPa at 1 m, with levels decreasing by around 34 dB within 50 m. During the activity 2-4 AHTs will occur within the Operational Area at a time. Support vessel sound emissions are generally dominated by low frequencies below 1 kHz.

During VSP operations, four to five receivers are positioned in a section of the wellbore and the airgun array is discharged approximately five times at 20 second intervals. The generated sound pulses are reflected through the seabed and are recorded by the receivers. VSP typically involves the use of a seismic energy source (e.g. a single air gun or a small air gun array) suspended in the water column and a receiver (e.g. hydrophone or geophone) suspended within the well bore. The seismic source may be suspended directly below the drilling rig or may be offset (e.g. suspended behind a vessel). Vertical seismic profiling typically required noise emissions between 8 and 24 hours per well.

VSP noise is not continuous. Each discharge of the seismic source generates a short, discrete, low frequency sound impulse. Seismic impulses during VSP are typically much lower than those generated during typical marine seismic surveys. Source levels for typical VSP seismic energy sources is estimated at 193.5 dB re 1 µPa2.s, with the majority of the noise energy occurring at low frequencies (< 100 Hz) (SVT Engineering Consultants 2018).

The aspects that may generate noise, and the characteristics of the noise, are discussed further below in reference to potential impacts to marine fauna.

The propagation of noise in the marine environment is influenced by many factors, such as:

- the characteristics of the noise (e.g. frequency, intensity, location);
- the characteristics of the water column (e.g. density interfaces, water depth, sea surface state); and
- the characteristics of the sediment (e.g. capacity to reflect and absorb noise).

The characteristics of the water column (e.g. density) and seabed will affect the transmission of underwater noise in the marine environment. As the majority of underwater noise associated with the Bratwurst-1 drilling campaign will be generated within the Operational Area, the water column and seabed characteristics at this location have been used for the basis of the impact assessment.

Thresholds for Noise Impacts to Marine Fauna

Impacts to marine fauna can be grouped as follows in decreasing order of effect:

- Mortality or potential mortal injury – physical injury that may result in the death of an animal.
- Impairment:
- Recoverable injury – physical injury from which an animal is expected to recover.
- Permanent threshold shift (PTS) – a permanent reduction in the ability of an animal to perceive sound. Recovery is not expected to occur,
- Temporary threshold shift (TTS) – a temporary reduction in the ability of an animal to perceive sound. Recovery to a pre-exposure levels is expected to occur.
- Masking – no change in the ability for an animal to perceive sound, but biologically meaningful sounds may be "drowned out" by anthropogenic noise.
- Behavioural impacts – typically short-term behavioural responses such as avoidance, surfacing etc. Behaviour will return to normal following cessation of the anthropogenic noise.

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

- sound exposure guidelines for fishes and sea turtles: a technical report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI (Popper et al. 2014); and
- technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NOAA 2018).

Fish, Larvae and Sea Turtles

Impact thresholds for fish, fish larvae and marine turtles for impulsive and non-impulsive underwater noise are summarised in **Table 5 - 20** and **Table 5 - 21** respectively. These are derived primarily from the extensive review and recommendations of Popper et al. (2014).

Table 5 - 20: Fish, Larvae and Marine Turtle Noise Criteria for Impulsive Noise Sources (e.g. VSP) (SVT Engineering Consultants 2018)

Type of Animal	**Mortality and Potential Mortal Injury**	**Impairment**			**Behaviour**
		Recoverable Injury	**TTS**	**Masking**	
VSP					
Fish: No swim bladder (particle motion detection)	> 219 dB $L_{E,p}$ or > 213 dB L_{pk}	> 216 dB $L_{E,p}$ or > 213 dB L_{pk}	> 186 dB $L_{E,p}$	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder is not involved in hearing (particle motion detection)	210 dB $L_{E,p}$ or > 207 dB L_{pk}	203 dB $L_{E,p}$ or > 207 dB L_{pk}	> 186 dB $L_{E,p}$	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	207 dB $L_{E,p}$ or > 207 dB L_{pk}	203 dB $L_{E,p}$ or > 207 dB L_{pk}	186 dB $L_{E,p}$	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate

Eggs and larvae	210 dB $L_{E,p}$ or > 207 dB L_{pk}	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Marine turtles	> 210 dB $L_{E,p}$ or > 207 dB L_{pk}	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	175 dB L_p 164 dB $L_{E,p}$

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

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

Table 5 - 21: Fish, Larvae and Marine Turtle Noise Criteria for Continuous Noise Sources (Operations and Vessels) (SVT Engineering Consultants 2018)

Type of Animal	**Mortality and Potential Mortal Injury**	**Impairment**			**Behaviour**
		Recoverable Injury	**TTS**	**Masking**	
Fish: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder is not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB L_p for 48 h	158 dB L_p for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low
Marine turtles	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

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

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

Marine Mammals

The vulnerability of marine mammals to underwater noise is linked to their ability to perceive sound. Cetaceans can be grouped based on similarities in their hearing. Underwater noise exposure thresholds can then be weighted for each cetacean group to emphasise noise frequencies that a group may be particularly vulnerable to. This approach is described in Southall et al. (2007) and has been applied to a range of underwater noise guidelines and impact assessments on cetaceans. The South Australian government Underwater noise piling guidelines (Department of Planning, Transport and Infrastructure 2012) applied in this assessment use this approach.

The impact thresholds applied during the noise modelling assessment for marine mammals for impulsive and non-impulsive underwater noise are summarised in **Table 5 - 22**. These are derived primarily from technical guidelines published by the National Oceanic and Atmospheric Administration (2018).

Table 5 - 22: Mammal Sound Exposure Criteria

Type of Animal	PTS – Permanent Injury		TTS – Impairment		Behaviour	
	Impulsive	Non-impulsive	Impulsive	Non-impulsive	Impulsive	Non-impulsive
Low-frequency cetaceans	219 dB L_{pk} 183 dB $L_{E,p}$	199 dB $L_{E,p}$	213 dB L_{pk} 168 dB $L_{E,p}$	179 dB $L_{E,p}$	160 dB L_p	120 dB L_p
Mid-frequency cetaceans	230 dB L_{pk} 185 dB $L_{E,p}$	198 dB $L_{E,p}$	224 dB L_{pk} 170 dB $L_{E,p}$	178 dB $L_{E,p}$	160 dB L_p	120 dB L_p
High-frequency cetaceans	202 dB L_{pk} 155 dB $L_{E,p}$	173 dB $L_{E,p}$	196 dB L_{pk} 140 dB $L_{E,p}$	153 dB $L_{E,p}$	160 dB L_p	120 dB L_p

<u>Other Fauna</u>

Sharks and rays do not typically have gas-filled cavities such as swim bladders and are considered less vulnerable to underwater noise related injuries. As such, sharks and rays were grouped with fish without a swim bladder (**Table 5 - 20** and **Table 5 - 21**) for this assessment of impacts and risks. This includes whale sharks which are expected to potentially occur within the Operational Area, mainly from July to November (DEWHA 2015c).

No suitable published guidelines were identified for sea snakes. Sea snakes were grouped with fish without a swim bladder (**Table 5 - 20** and **Table 5 - 21**) for this assessment of impacts and risks.

While there are reputable published studies indicating the potential for underwater noise to impact upon invertebrates, no suitable published guidelines were identified. Invertebrates have been considered in the assessment of risks and impacts from underwater noise, although no threshold values have been applied.

Impact Assessment

Threatened Species and Ecological Communities

Activities conducted during the Bratwurst-1 drilling campaign which emit underwater noise have the potential to cause localised and temporary impacts on marine fauna, including fish, marine turtles and cetaceans. Based on modelling conducted for the Shell Australia Crux Offshore Project Proposal, underwater noise levels from drilling and temporary VSP activities will fall below all relevant threshold criteria for marine fauna within 35 m from the noise source (SVT, 2018).

For vessels using DP, there is a potential for permanent injury to low-frequency cetaceans within a range of up to 350 m based on the daily exposure criterion, if the animal remains with this range for the duration of the event (i.e. cumulative impact) (SVT, 2018). Behavioural impacts from DP noise to low-frequency cetaceans may extend to a range of 1.6 km. These exposure zones are dependent on the class and type of vessel, and are considered the worst-case scenario. Thresholds for fish, larvae, marine turtles and mid-frequency cetaceans are not expected to be exceeded at any distance from noise emitted from DP. Given this, the potential impacts to marine fauna from the Bratwurst drilling campaign are expected to be restricted to temporary behavioural impacts to marine mammals, marine reptiles and fish within the Operational Area.

Marine Mammals

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

Low frequency cetaceans are expected to be most vulnerable to underwater noise from VSP due to the frequency spectra of these noise sources overlapping the functional hearing range of these species (approximately 7 Hz to 30kHz), and the relatively high intensity of the noise sources. Several low frequency cetaceans (blue, humpback, Sei, fin and Bryde's whales) were identified as potentially occurring within the Operational Area. Noise monitoring in the Timor Sea for the Barossa development indicated pygmy blue and Bryde's[1] whales are the most likely to occur (McPherson et al. 2016). Detection of calling low-frequency cetaceans calls were not constant, but occurred sporadically, often in groups or sets of calls.

The low frequency cetacean instantaneous peak thresholds for PTS and TTS will not be exceeded at any range from any noise source. Modelling found the cumulative (i.e. 24 hour) PTS and TTS thresholds for low frequency cetaceans to be exceeded at 350 m for vessel noise related to DP (SVT, 2018). These thresholds are highly conservative, as they rely on the cetacean remaining within the threshold radius for the duration of the entire 24-hour period. This is considered very unlikely, as low frequency cetaceans in the area are typically migrating and would be expected to move away from uncomfortable stimuli (i.e. high noise levels).

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

Mid frequency cetacean's instantaneous peak and cumulative (i.e. 24 h) thresholds for PTS and TTS will not be exceeded at any range. As with the low frequency cumulative thresholds, these PTS and TTS thresholds are highly conservative, and mid frequency cetaceans in the area are highly mobile and would be expected to move away from uncomfortable stimuli (i.e. high noise levels).

Anthropogenic noise is a key threat to threatened and migratory marine mammal species identified as potentially occurring within the Operational Area (DoE 2015a; DoE 2015b;

[1] McPherson et al. (2016) distinguish Omura's whale (*Balaenoptera omurai*) as a distinct species from Bryde's whale (*B. edeni*), however the taxonomy of Omura's whale is unclear. *B. omurai* is a recent description. Many authorities (including the DoEE) do not make any distinction between *B. omurai* and *B. edeni* and retain *B. edeni* as this species name has priority. As such, this EP refers only to *B. edeni*, with this classification including *B. omurai*.

(DoE 2015c; DoE 2015d). Based on the controls Shell will implement, potential impacts are expected to consist of behavioural disturbance to cetaceans occurring within the Operational Area only. This behavioural disturbance is likely to consist of avoidance of areas of high noise intensity, which may inhibit other behaviours such as feeding. Behavioural disturbance will be restricted in time to relatively short periods when high noise intensity activities are occurring (i.e. VSP). Following cessation of noise generation, animal behaviour is expected to return to normal. Therefore, potential impacts such as mortality, injury, PTS and TTS are considered very unlikely to occur.

Marine Reptiles

Marine reptiles such as turtles and sea snakes are not known to be particularly sensitive to underwater noise. Research on marine turtles suggests that functional hearing is concentrated at frequencies between 100 and 600 Hz (which is a subset of the low frequency cetacean range). Several turtle species were identified as likely to occur within the Operational, although no critical habitat or BIAs overlap of occur near the Operational Area. The water depth and benthic habitat within the Operational Area is typically too deep for turtle foraging for several species (e.g. Hays et al. 2001, Polovina et al. 2003), although species that eat primarily pelagic prey (e.g. leatherback and juvenile green turtles) may forage for pelagic prey. As such, turtles are expected to occur only at low densities within the Operational Area and are likely to be transiting the area rather than foraging, breeding or nesting (although foraging at the relatively shallow shoals within the operational area may occur).

Anthropogenic noise is a key threat to threatened and migratory marine turtles in Australia (Commonwealth of Australia 2017a, DEWHA 2009a). Noise sources that may arise from the Bratwurst-1 drilling campaign are not expected to exceed the instantaneous threshold for permanent injury or fatality, nor the behavioural impact threshold, for marine turtles or sea snakes at any range. Potential impacts to marine reptiles will be restricted to short term behavioural disturbance to animals in close proximity to high intensity noise sources (i.e. VSP). Given the expected low density of turtles within the Operational Area this potential impact would only affect a relatively small portion of turtle populations in the region. Recovery from behavioural disturbance is expected to occur immediately once the noise emission is ceased.

Fish, Sharks and Rays

The Operational Area is not expected to host highly abundant or diverse assemblages of fishes, including sharks and rays, however a BIA for whale sharks does overlap the Operational Area. Whale sharks may transit through the Operational Area in small numbers, most likely between July and November, during their northern migration.

Whale sharks are reported to have hearing frequencies ranging between 0.001 – 0.8 kHz (Martin 2004), which is within the ranges of noise which will be discharged from vessels, the MODU and from VSP. Noise from VSP, as well as from drilling and use of DP was not found to exceed any threshold for fish with no swim bladders (considered most relevant to whale sharks) or for any other category of fish species (SVT, 2018). Given whale sharks are highly mobile and that only small numbers are expected to occur within the Operational Area during even peak periods, any impacts are expected to be restricted to temporary avoidance of the area.

Research assessing behavioural responses of whale sharks to the presense of tourism vessels within the Ningaloo Marine Park found that, although whale sharks were observed changing direction more frequently in the presence of tourism vessels, individuals were also observed to maintain neutral behaviours including surface swimming, resurfacing and no reaction to the presence of tourism vessels and/or tourists swimming within 250 m of the shark (Raudino et al., 2016). It is likely that noise from these vessels would be one of the key causes of observed impacts. Given these vessels specifically target and approach whale sharks, it's reasonable to assume behavioural responses from whale sharks to support vessels and the MODU would be less directed, and restricted to general avoidance of the Operational Area.

Anthropogenic noise is not listed as a key threat to whale sharks or any other identified threatened or migratory fish species (DEH, 2005a; DoE 2015l). However, the Whale Shark (Rhincodon typus) Recovery Plan Issues Paper suggests that high intensity anthropogenic noise could potentially disrupt normal behaviours of whale sharks such as feeding, mating and migration (DEH, 2005b), and later developed conservation advice for whale sharks lists assessing the impacts of chronic noise as a research priority for this species (DEH, 2005a). Based on the controls Shell will implement, potential impacts to whale sharks and other fish species are expected to consist of slight behavioural disturbance to individuals occurring within the Operational Area only. This behavioural disturbance is likely to consist of avoidance of areas of high noise intensity, which may inhibit other behaviours such as feeding within a localised area. Behavioural disturbance will also be restricted in time to relatively short periods when high noise intensity activities are occurring (i.e. VSP). Following cessation of noise generation, animal behaviour is expected to return to normal.

Table 5 - 23: Risk Assessment for Noise Emissions during Drilling Operations, MODU/Vessel Movements and VSP

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Magnitude*	*Sensitivity*	*Residual Impact*
Noise emissions during drilling and operations and MODU/vessel movements	-	X	-	-	Slight	Medium	Slight
Noise emissions during VSP	-	X	-	-	Slight	Medium	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Support vessels will comply with EPBC Regulations 2000 – Part 8, Division 8.1 Interacting with cetaceans (Reg 8.04 Other craft). Regulations will be applied to whale sharks identified during the drilling campaign.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
VSP activities will comply with 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines (DEWHA 2008), including: A.3.1 Pre-Start-up-Visual Observation: • During daylight hours, visual observations (using binoculars and the naked eye from a high vantage point on the MODU) for the presence of whales should be undertaken by a suitably	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes

trained crew member for at least 30 minutes before the commencement of VSP activities. A.3.2 Soft Start Procedure (also known as ramp-up): • VSP acoustic source will be initiated at the lowest power setting, with a gradual ramp-up over a 30 minute period until the full operating power level is reached. A.3.4 Operations Procedure: • During daylight hours, trained crew should undertake visual observations continuously during survey operations. • Operators should power down the acoustic source to the lowest possible setting when not collecting data. A.3.5 Stop Work Procedure: • If a whale is sighted within the 3km observation zone an additional trained crew member or marine mammal observer should also be brought to the bridge to continuously monitor the whale whilst in sight. • If a whale is sighted within or is about to enter the Low power zone (1 km), the acoustic source should be powered down to the lowest possible setting. If a whale is sighted or is about to enter the Shut-down zone (500 m), the acoustic source should be shut down completely. • Power-up of the acoustic source with soft-start procedures should only occur after the whale has been observed to move outside the Low power zone, or when 30 minutes have lapsed since the last whale sighting. A.3.6 Night-time and Low Visibility Procedures: • Operations may proceed provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24 hour period. Regulations will be applied to whale sharks identified during the drilling campaign.		
Key noise-generating equipment will be maintained in accordance with the maintenance management system and/or regulatory requirements.	Standard practice. Reduces likelihood of impact.	Yes
Code on noise levels on board ships (resolution A.468(XII).	Standard practice. Reduces likelihood of impact.	Yes
Elimination		
Do no conduct VSP.	Avoidance of VSP use is not credible as VSP is needed for technical data	No
Substitution		
None identified - MODU, AHTs and VSP are a requirement for the successful completion of the Bratwurst-1 drilling campaign and no suitable lower noise source substitutions have been credibly identified.	-	-
Reduction		
None identified– reduction controls are included in legislative requirements listed above.	-	-
Mitigation		
None identified – mitigation controls are included in legislative requirements listed above.	-	-

Summary of ALARP	
The expected magnitude of noise emissions from the MODU, AHTs and during VSP on marine mammals, marine reptiles and fish, sharks and rays is expected to be slight due to: • the Operational Area being in a remote offshore location away from emergent land and whale/turtle BIAs/critical habitat; • the short-term nature of the drilling campaign; • the lack of BIAs/ habitat critical to the survival of fauna of conservation significance and high mobility of fauna which do have overlapping sensitivities; and • predicted source levels not exceeding any referenced PTS or higher threshold for impacts marine fauna. Overall the environmental sensitivity is considered low and the residual impact of light emissions is assessed to be slight. The residual impact is slight and is deemed to be managed to ALARP with implementation of the identified controls.	
Demonstration of Acceptability	
Principles of ESD	The risks and impacts from underwater noise associated with the Bratwurst-1 drilling campaign are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; and • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur.
Relevant Requirements	• EPBC Policy Statement – Interaction between offshore seismic exploration and whales (DEWHA 2008c); • Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NOAA 2018); and • Sound exposure guidelines for fishes and sea turtle (Popper et al. 2014).
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for marine mammals, whale sharks and turtles and considered key threats to these species in the management of impacts and risks as relevant to anthropogenic noise emissions. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • the minimal behavioural impacts posed by noise emissions from the Bratwurst-1 drilling campaign, particularly given the short duration of the most significant noise emitting activity (VSP); • regulatory requirements and Shell standards are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the physical presence of the MODU and AHTs have been undertaken; and • no stakeholder concerns have been raised. The residual impact on marine fauna of conservation significance associated with noise emissions from the Bratwurst-1 drilling campaign is considered acceptable.	

5.5.5 Atmospheric Emissions

5.5.5.1 *Fuel Combustion, Flaring (during well testing) and Ozone Depleting Substances (ODS)*

Activity

The main source of atmospheric emissions from the MODU and AHTs is the combustion of liquid fuel in the energy units (diesel-powered generators and pumps, emergency generator, vessel engines etc.). Atmospheric emissions from fuel combustion may include sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), carbon monoxide (CO), volatile organic compounds (VOC) and particulates.

If well testing is undertaken, hydrocarbons produced will need to be flared. Flaring is unlikely to exceed 7 days over approximately 2 weeks.

ODS may be found onboard the MODU and AHT in old air-conditioning and refrigeration systems.

Assessment

The release of emissions to the atmosphere temporarily decreases local air quality and contributes to greenhouse gas (GHG) emissions. While emissions of GHG will add to global GHG concentrations, the volumes from the Bratwurst-1 campaign are very small and are not considered to have a determinable local-scale impact. Due to the short duration and small scale of the drilling campaign, low sensitivity of the receiving environment subject to local and regional air quality changes (absence of receptors in the open offshore context) and the open ocean environment in which air emissions are quickly dispersed, the impact of the additional pollutants is slight.

Table 5 - 24: Risk Assessment for Fuel Combustion, Flaring (during well testing) and Ozone Depleting Substances (ODS)

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Planned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Magnitude*	*Sensitivity*	*Residual Impact*
Atmospheric emissions from fuel combustion, flaring and ozone depletion substances	X	-	-	-	Slight	Low	Slight

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
MODU and AHTs (as appropriate to vessel class) will comply with Marine Order 97 (Marine pollution prevention – air pollution) which requires vessels to have a valid IAPP Certificate (for vessels > 400 tonnage) and use of low sulphur diesel fuel, when possible.	Standard practice. Compliance with legislation.	Yes
The sulphur content of fuel used by project vessels will comply with Regulation 14 of MARPOL Annex VI (as appropriate to vessel class) in order to control Sox and particulate matter emissions.	Standard practice. Compliance with legislation.	Yes

As part of the OVID, MODU/vessels are checked for compliance with Marine Orders 97, for compliance with the Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 and Regulations 1995	Standard practice. Compliance with legislation.	Yes
Maintenance of an ODS Record Book, as required by MARPOL Annex VI (Regulation 12) – Ozone-Depleting Substances from refrigerating plants and firefighting equipment.	Standard practice. Compliance with legislation.	Yes
Elimination		
Do not combust fuel	The MODU and AHTs need fuel to generate power. There are no feasible alternatives to fuel.	No
Do not undertake well testing	Well testing may be needed if formation evaluation results indicate presence of hydrocarbons. Well testing is the only technically feasible method to assess the reservoir for production suitability.	No
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
A preventative maintenance system will be implemented, which includes regular inspections and maintenance of engines and flaring system.	Good practice	Yes

Summary of ALARP

The expected impact magnitude of the Bratwurst-1 drilling campaign from atmospheric emissions is expected to be slight because of:

- the open ocean location of the well;
- the short duration and small scale of the drilling campaign,
- low sensitivity of the receiving environment subject to local and regional air quality changes (absence of receptors in the open offshore context); and
- the open ocean environment in which air emissions are quickly dispersed.

Overall the environmental sensitivity is considered low and the residual impact of atmospheric emissions is assessed to be slight. Given the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.

Demonstration of Acceptability

Principles of ESD	The risks and impacts from atmospheric emissions from the drilling campaign are consistent with the principles of ESD based on: • the environmental resources within the operational area are not expected to be significantly impacted; and • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur.
Relevant Requirements	International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI: Regulations for the prevention of air pollution from ships AMSA Marine Order 97 (Marine Pollution Prevention – Air Pollution) Relevant requirements of the National Pollutant Inventory (NPI) NEPM, National Greenhouse and Energy Reporting Act 2007, and National Greenhouse and Energy Reporting (NGER) (Safeguarding Mechanism) Rule 2015 (or contemporary requirements at the time
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Management of impacts to fauna are consistent with conservation advice and recovery plans for threatened species.

	• Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework and compliance with the OVID. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign, external requirements and Shell's internal requirements.
Summary of Acceptability	
The residual impact is slight given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk will be implemented; and • no stakeholder concerns have been raised. The residual impact associated with atmospheric emissions for the Bratwurst-1 drilling campaign is considered acceptable.	

5.6 Unplanned Impacts

5.6.1 Invasive Marine Species

5.6.1.1 *Unplanned Introduction of Invasive Marine Species*

Activity

Invasive marine species (IMS) are marine plants or animals that have been introduced into a region beyond their natural range and can survive, reproduce and establish populations.

The three primary mechanisms causing the inadvertent introduction and spread of these unwanted species are hull fouling, ballast water discharges and aquaculture activities. Most of these introductions are confined to coastal waters with a significantly greater occurrence in temperate waters than tropical waters. The published 'Proposed Australian Biofouling Management Requirements' reports that there are approximately 450 marine species of non-indigenous or unknown origins in Australia (Hewitt 2011; cited in DAFF 2011). It also states that studies show that up to 69 per cent of these are associated with biofouling (Hewitt et al. 2010, 2004, 1999; cited in DAFF 2011). It predicts that 3 to 4 new non-indigenous marine species (NIMS) continue to establish in Australian waters each year (Hewitt 2011; cited in DAFF 2011a).

Biofouling management is assessed and controlled through pre-mobilisation IMS risk assessment and screening as per the Shell Australia Marine Biosecurity Management Manual (HSE_GEN_005791). The Manual is in accordance with the International Maritime Organization (IMO) 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species. This is outlined in the Shell Australia Marine Biosecurity Management Manual that was developed in line with the *Biosecurity Act 2015 (Cwlth)*, with reference to the WA *Fish Resources Management Act 1994*. The Guidelines incorporated into the Shell Australia Biosecurity Management Manual are the:

- National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), e.g. offshore support vessels, seismic vessels, rigs, pipelay vessels, anchor handle tug vessels;
- National Biofouling Management Guidance for Non-Trading Vessels (2009), e.g. dredges, barges, research vessels;
- National Biofouling Management Guidelines for Commercial Vessels (e.g. Liquified natural gas (LNG) tankers, condensate carriers etc.); and
- Western Australia Department of Fisheries Good Vessel Maintenance Guide.

The measures presented in the guidelines (for the petroleum sector, non-trading vessels and commercial vessels) have been adopted in the Manual to provide a consistent, codified framework in which to demonstrate to regulatory authorities the effective management of biofouling risks. Australia's guidelines for marine biosecurity are consistent with those of the International Maritime Organization (IMO) 2011 *Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species*.

The MODU and AHTs will come from Australian waters where possible. It is unlikely that the MODU or AHTs' 'last port of call' is overseas, however if the MODU or any AHTs are coming from an overseas location all required quarantine clearances prior to entering Australian waters will be obtained. Marine Orders 98 and biosecurity legislative requirements are all adhered to. If the MODU comes from interstate waters, Shell will assess the risk at the time as to whether quarantine restrictions will be imposed (this is commonly done between NT and WA and within WA waters).

In the unlikely event that the MODU or AHTs are carrying high risk ballast water (e.g. from overseas), ballast water exchange will only occur outside of the 12 Nm limit in water depths greater than 200 m deep and comply with the Australian Ballast Water Management Requirements (DAWR, 2016).

Assessment

All known and potential marine pests listed by Australian agencies are nuisance foulers, predators, invasive seaweeds or noxious dinoflagellates that inhabit harbours, embayment's, estuaries, shorelines and/ or shallow coastal waters less than 200 m deep (Hayes et al. 2004, Barry et al. 2006).

The water depth at the Bratwurst-1 well location is approximately 155 m. The open ocean environment provides minimal larval retention times or suitable habitat for coastal adapted exotic species. Hence, the likelihood of the introduction of exotic or introduced marine species is extremely remote. The impact of potentially introducing exotic marine species at the wellhead location is considered minor.

Table 5 - 25: Risk Assessment for Unplanned Introduction of Invasive Marine Species

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – unplanned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Significance*	*Likelihood*	*Residual Risk*
Introduction of IMS	-	-	X	-	Slight	Unlikely	Minor

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Compliance with the requirements of the *Biosecurity Act 2015*.	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes
If the MODU has an overseas 'last port of call', a Pre-Arrival Report will confirm that the MODU meets ballast and quarantine requirements.	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes

Adherence to the International Convention for the Control and Management of Ship's Ballast Water and Sediments 2004 and the Australian Ballast Water Management Requirements (DAWR, June 2016), including: • ballast water and sediment management plan • Ballast Water Record Book. • ballast water exchange must be done in open waters.	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes
In the event of weather, service vessels will not shelter closer than 100m to shore (not including ports)	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes
Adherence to Shell Australia Marine Biosecurity Management Manual (HSE_GEN_005791)	Standard practice. Reduces significance and likelihood of impact.	Yes
Elimination		
None identified	-	-
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
IMS risk assessments for AHTs used for the activity. The assessment identifies the pre-voyage actions that are required per vessel (e.g. dry-docking, antifouling, hull cleaning).	Good practice.	Yes
Summary of ALARP		
In the unplanned event that IMS are introduced to the Operational Area, the expected significance of impact to marine fauna and benthic communities is considered slight because of - open ocean location of the well. Overall the environmental risk is considered unlikely and with the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.		

Demonstration of Acceptability	
Principles of ESD	The risks and impacts from introduction of IMS are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; and • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur.
Relevant Requirements	*Biosecurity Act 2015*, International Convention for the Control and Management of Ship's Ballast Water and Sediments 2004, Australian Ballast Water Management Requirements 2016
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has also considered the internal context, including Shell's environmental policy and Shell Australia Marine Biosecurity Management Manual (HSE_GEN_005791). • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign, external requirements and Shell's internal requirements.
Summary of Acceptability	
The residual risk is minor given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture;	

• good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with IMS will be implemented; and • no stakeholder concerns have been raised. The residual risk is considered acceptable.

5.6.2 Improper Waste / Equipment Management

5.6.2.1 *Unplanned Loss of Solid Waste (hazardous/non-hazardous) or Dropped Objects Overboard*

Activity

The MODU and AHTs will generate non-hazardous and hazardous waste during daily operations. The volumes of solid waste generated as part of the drilling campaign are likely to be small.

Non-hazardous waste from the MODU and AHTs (such as packaging, bottles and cans, electrical/electronic waste, paper and cardboard, scrap metal, wood) will be collected, stored and transferred to shore for disposal.

Hazardous waste (including waste chemicals/oil, empty chemical containers, batteries and medical waste) will be appropriately stored and transferred onshore for disposal at a Shell approved licensed facility as per the HSSE and SP Control Framework, Waste requirements.

No solid wastes will be disposed of at sea. All wastes will be stored and transported back to shore for correct management according to the vessel Garbage Management Plan.

Food waste will either be macerated as per Marine Order 95 or brought to shore (**Section 5.5.2.2**). All ships/vessels coming into Australian waters from international ports and used on the campaign are required to report to a gazetted port (in this case Broome Port) and be cleared by the Customs and the Commonwealth Department of Agriculture and Water Resources (DAWR). All food and waste is removed at the port and disposed of utilising regulated Port quartine processes, vessel kitchens and galleys and crew areas are cleaned in order to obtain a DAWR low-risk status in the form of a letter. This enables service vessels to interact in Australian Waters without further biosecurity concerns. Shell requires all vessels to obtain and maintain low-risk status.

Various equipment, including small items such as tools and Personal Protective Equipment, will be needed by personnel to undertake daily work tasks and maintenance on the MODU. There is the potential for equipment to be accidently dropped overboard from the MODU during the drilling campaign.

Assessment

Loss of solid waste or equipment overboard may reduce water quality, with subsequent impacts on nearby environmental sensitivities.

Benthic habitats may be temporarily polluted or smothered by dropped solid waste or equipment if the item is heavy enough to sink to the seabed. As described in **Section 4**, there are no significant benthic habitats or protected marine areas around the well location. Impacts to benthic habitats from dropped waste or equipment are possible however impacts are expected to be highly localised.

Marine fauna within the Operational Area (including species of conservation significance such as whale sharks, cetaceans, marine turtles and seabird as described in **Section**

4.4) may become entangled or ingest discarded waste. Pollution is a key threat to threatened and migratory marine mammals, marine turtles, birds and sharks in Australia (Commonwealth of Australia 2017a; DEH 2005a; DEWHA 2008b; DEWHA 2009a; DEWHA 2009b; DoE 2014c; DoE 2014d; DoE 2015c; DoE 2015c; DoE 2015e; DoE 2015l; DoE 2015m; DoE 2016a; DoE 2016b; DoE 2016c; DoE 2016d; DoE 2016e; DSEWPaC 2011a; DSEWPaC 2013b). Whale sharks are surface filter feeders, and the Operational Area occurs within a BIA for whale sharks, however large numbers of whale sharks are not expected at the well location. Impacts are expected to be unlikely as they are limited to individual fauna that encounter dropped items.

Table 5 - 26: Risk Assessment for Unplanned Loss of Solid Waste (hazardous/non-hazardous) or Dropped Objects Overboard

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – unplanned**		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Significance*	*Likelihood*	*Residual Risk*
Unplanned loss of solid waste (hazardous/non-hazardous) or dropped objects overboard	X	X	X	-	Slight	Unlikely	Minor

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
The MODU and AHTs will comply with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 95 which enacts MARPOL 73/78 Annex V, including requirement for a Garbage Management Plan. GOMO – Guidelines for Marine Operations will be followed, as transfer for hazardous waste. Compliance with DAFWA and DAWR biosecurity requirements.	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes
NOHSC: 1008 (2004) – Approved Criteria for Classifying Hazardous Substances) – MSDS available on-board for hazardous substances.	Standard practice. Compliance with legislation. Reduces significance and likelihood of impact.	Yes
Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Reduces significance and likelihood of impact.	Yes
Elimination		
Recovery of dropped waste / equipment by using AHTs or ROV	Not considered feasible due to safety risks	No
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
Any dropped objects into the sea shall be reported, recorded and investigated via the Shell incident management system.	Good practice.	Yes

Summary of ALARP	
In the unplanned event that solid waste or equipment is accidently dropped overboard, the expected significance of impact to water quality, benthic communities and conservation significant species is expected to be slight because of: • The highly localised impact to water quality; • the low sensitivity of the benthic habitats; • low abundance and diversity of benthic communities at the well location; and • the low numbers of fauna in the region. Overall the environmental risk is considered unlikely and with the implementation of the identified controls, the residual impact is deemed to be managed to ALARP.	
Demonstration of Acceptability	
Principles of ESD	The risks and impacts from accidental loss of solid waste or equipment overboard are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted; and • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur.
Relevant Requirements	*Protection of the Sea (Prevention of Pollution from Ships) Act 1983,* Marine Order 95, MARPOL 73/78 Annex V,
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Management of impacts to fauna are consistent with conservation advice and recovery plans for threatened species. • Compliance with relevant DAFWA and DAWR requirements. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework, Waste. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign, external requirements and Shell's internal requirements.
Summary of Acceptability	
The residual risk is minor given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the accidental loss of solid waste or equipment overboard will be implemented; and • no stakeholder concerns have been raised. The residual risk is considered acceptable.	

5.6.2.2 *Unplanned Discharge of Chemicals or Hazardous Liquid Waste*

Activity

The MODU and AHTs will have a range of chemicals and hydrocarbons stored in small quantities (e.g. cleaning products, hydraulic fluid, etc.). Accidental spills of these chemicals may occur, potentially leading to unintentional discharge to the marine environment (i.e. small spills and leaks). Smalls spills may occur during bulk chemical transfer, during operations when the chemical is in use, or from leaks in chemical storage areas and/or equipment. Spills may result in localised impacts on water quality and toxicity effects on marine fauna and flora.

Hazardous wastes and chemicals generated/produced by the activity may include:

- acetylene from welding equipment;
- water treatment chemicals;

- cleaning agents (e.g. degreasers used in workshops for maintenance and rig wash, electric contact cleaner, solvents);
- adhesives/sealants (e.g. small quantities of isocyanates used in superglues, threadlock);
- refrigerants;
- paint and thinners; and
- other liquid additives/chemicals.

Impact Assessment

Physical Environment and Threatened Species and Ecological Communities

Hydrocarbon based, or chemical spills may result in localised impacts on water quality and toxicity effects on marine fauna, with a potential to impact conservation significant species which may be passing through the Operational Area. Pollution and chemical discharge are key threats to threatened and migratory marine mammals, marine turtles, birds and sharks in Australia (Commonwealth of Australia 2017a; DEH 2005a; DEWHA 2008b; DEWHA 2009a; DEWHA 2009b; DoE 2014c; DoE 2014d; DoE 2015c; DoE 2015c; DoE 2015e; DoE 2015l; DoE 2015m; DoE 2016a; DoE 2016b; DoE 2016c; DoE 2016d; DoE 2016e; DSEWPaC 2011a; DSEWPaC 2013b). Specific effects on individual receptors would depend upon the type and volume of chemical released, but they are broadly similar to the receptors discussed in relation to hydrocarbon spills (**Section 5.6.4**).

Depending on the volume released, the impact of hazardous wastes/chemicals to the marine environment at the location from incorrect disposal/spill is considered negligible to minor. Given the controls in place to manage this risk, smaller negligible spills are more likely than those that may cause minor impacts. Impacts are expected to be restricted to the deep-water environment of the Operational Area and will impact any sensitive habitat (e.g. shoals/banks or offshore reefs or islands).

Table 5 - 27: Risk Assessment for Unplanned Discharge of Chemicals or Hazardous Liquid Waste

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Unplanned**		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Significance*	*Likelihood*	*Residual Risk*
Unplanned discharge of chemicals or hazardous liquid waste	X	X	-	-	Slight	Unlikely	Minor

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Storage, labelling, transfer and disposal of hazardous waste will be in compliance with MARPOL 73/78 and MSDS, as appropriate to vessel class	Standard practice. Compliance with legislation.	Yes
NOHSCL 1008 (2004) – Approved Criteria for Classifying Hazardous Substances: • MSDS available on-board for all hazardous substances	Standard practice. Compliance with legislation.	Yes

Chemical Management Process (HSE_GEN_007879) for chemical selection and assessment of effects on the environment.	Standard practice. Compliance with legislation.	Yes
For SBM, pre-start checklist completed prior to first use of SBM to check that drains are closed	Standard practice. Reduces likelihood of impact.	Yes
Elimination		
None identified	Use of chemicals and some hazardous liquids is essential to the safe operation of the MODU and vessels during drilling operations.	-
Substitution		
None identified	Chemical management process outlined above ensure lowest toxicity chemicals are utilised.	-
Reduction		
Relevant waste management procedures will be included in inductions for all site personnel	Standard practice. Reduces likelihood of impact.	Yes
Mitigation		
Spill Kits will be available on the MODU and AHTs	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Regular inspection and inventory of spill kits	Standard practice. Reduces likelihood of impact.	Yes
Bulk chemical and hazardous waste storage areas will be appropriately bunded	Standard practice. Reduces likelihood of impact.	Yes

Summary of ALARP

The expected impact significance of an unplanned discharge of chemicals or hazardous liquid waste on water quality and conservation significant species during the Bratwurst-1 drilling campaign is expected to be slight due to:

- the offshore remote location of the Operational Area away from sensitive receptors;
- low sensitivity of environment with a potential to be impacted;
- expected low numbers of fauna of conservation significance;
- the small predicted spill volumes; and
- the standard controls in place to manage this risk.

Overall the environmental risk is considered unlikely. The residual risk is minor and is deemed to be managed to ALARP with implementation of the identified controls.

Demonstration of Acceptability	
Principles of ESD	The impacts from an unplanned discharge of chemicals or hazardous liquid waste during the Bratwurst-1 drilling campaign are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted.
Relevant Requirements	NOHSCL 1008 (2004)
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for marine mammals, marine turtles, birds and sharks and considered key threats to these species in the management of impacts and risks as relevant to unplanned chemical and liquid hazardous waste discharges. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. Shell's Chemical Management Process (HSE_GEN_007879) is applicable to this planned activity.

	• The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual risk is minor given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with the unplanned discharge of chemicals or hazardous liquid waste will be implemented; and • no stakeholder concerns have been raised. The residual risk on water quality and fauna of conservation significance associated with an unplanned chemical and/or hazardous liquid waste discharged to the marine environment during the Bratwurst-1 drilling campaign is considered acceptable.	

5.6.3 Accidental Collision between Vessels and Conservation Significant Species

5.6.3.1 *Injury/mortality of conservation significant fauna*

Activity

The MODU will be towed into position prior to drilling and will be anchored (therefore stationary) during the Bratwurst-1 drilling campaign, therefore the MODU does not pose a collision risk for species of conservation significance. The AHTs in the Operational Area pose a potential collision risk to whale sharks, turtles and cetaceans that may frequent the area.

Assessment

The Operational Area overlaps with a BIA for whale shark, and whale sharks may travel through the area during the Bratwurst-1 drilling campaign but are not expected in significant numbers. It is not close to known cetacean or turtle BIAs and is distant to the humpback whale migration routes; therefore, the abundance of cetaceans and marine turtles within the Operational Area is expected to be very low. Vessel collisions are key threats to threatened and migratory marine mammals, marine turtles and whale sharks in Australia (Commonwealth of Australia 2017a; DEH 2005a; DEWHA 2009a; DoE 2015c; DoE 2015d; DoE 2015l). Animals are expected to alter course away from AHTs and the likelihood of accidental collision between AHTs and fauna of conservation significance is unlikely.

Table 5 - 28: Risk Assessment for Injury/mortality of conservation significant fauna

Project Component/ Activity	Environmental Value/Sensitivity				Evaluation – Unplanned		
	Physical Environment	*Threatened species and ecological*	*Ecosystems, communities and habitats*	*Socio-economic and cultural*	*Significance*	*Likelihood*	*Residual Risk*
Accidental collision between vessels and threatened species	-	X	-	-	Minor	Unlikely	Minor
Key Management Controls Identified							
Control				*Demonstration of ALARP*			*Control Adopted*
Standards, Legislation, Best Practice							

Compliance with Marine Order 21 (Safety of Navigational and Emergency Procedures) and Marine Order 30 (Prevention of Collisions) (as appropriate to vessel class)	Standard practice. Compliance with legislation.	Yes
Compliance with EPBC Regulations 2000 – Interacting with cetaceans (Division 8.1), including: • vessels will not travel greater than 6 knots within 300 m of a whale (caution zone) and not approach closer than 100 m from a whale; • vessels will not approach closer than 50 m for a dolphin and/or 100 m for a whale (with the exception of animals bow riding).	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Elimination		
None identified	-	-
Substitution		
Vary timing of the drilling campaign to avoid peak cetacean migration and turtle nesting periods	No reduction in impact expected due to distance from cetacean BIAs, turtle BIAs and low numbers of fauna expected in open ocean location.	No
Reduction		
None identified	-	-
Mitigation		
Compliance with EPBC Regulations 2000 – Interacting with cetaceans (Division 8.1), including: • vessels will not travel greater than 6 knots within 300 m of a whale (caution zone) and not approach closer than 100 m from a whale; • vessels will not approach closer than 50 m for a dolphin and/or 100 m for a whale (with the exception of animals bow riding).	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Dedicated Marine Mammal Observers on board AHTs.	No reduction in impact expected due to low numbers of fauna in open ocean.	No

Summary of ALARP
The expected significance of impact from vessel collisions with conservation significant fauna (including whale sharks) is considered slight because of the: • low numbers of fauna in the region; • the lack of habitat critical to the survival of fauna of conservation significance; • relatively slow vessel speeds within the Operational Area; and • the short-term nature of the drilling campaign. Overall the likelihood of vessel – fauna collisions is considered unlikely. The residual risk is assessed as minor and, with implementation of the identified controls, is deemed to be managed to ALARP.

Demonstration of Acceptability	
Principles of ESD	The risks and impacts to fauna of conservation significance from the physical presence of the Bratwurt-1 drilling campaign are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted. • the health, diversity and productivity of the environment is not expected to decrease; and • no significant impacts are expected in terms of biological diversity and ecological integrity.
Relevant Requirements	EPBC Act

Internal and External Context	• Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for whale sharks, marine mammals and turtles and considered key threats to these species in the management of impacts and risks as relevant to vessel collisions. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework, Maritime Assurance OVID. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation and Shell's internal requirements.
Summary of Acceptability	
The residual risk associated with vessel-fauna collisions during the Bratwaurst-1 drilling campaign is minor given the application of the controls outlined above and the following points: • regulatory requirements are incorporated; • the drilling campaign is consistent with Shell policy, standards and culture; • good practice from industry guidelines and practical mitigations to reduce the risk associated with vessel-fauna collisions will be implemented; and • no stakeholder concerns have been raised. The residual risk for the Bratwurst-1 drilling campaign is considered acceptable.	

5.6.4 Accidental Hydrocarbon Release

Four credible accidental hydrocarbon release scenarios have been identified for the Bratwurst-1 drilling campaign. Worst-cases for these identified scenarios have been considered in the environmental risk assessment and include:

- Long-term uncontrolled loss of well containment during drilling operations (an 80-day subsea release of 453,342 m^3 (2,853,000 bbl) of condensate). No mitigation measures applied.
- Uncontrolled loss of fuel due to vessel to vessel collision (instantaneous release of 250 m^3 marine diesel. No mitigation measures applied.
- Loss of fuel during bunkering (10 m^3 of marine diesel). No mitigation measures applied.
- Hydrocarbons dropping out from flaring during well testing.

Each of these scenarios is discussed in detail below. As each scenario has been defined as the worst-case, or largest credible volume and duration, these unplanned events can also result in smaller spills. The potential consequences of these spills are much smaller than the large volume hydrocarbon releases considered below.

5.6.4.1 *Overview of Unplanned Spill Modelling*

For the two larger unplanned releases, loss of well containment and vessel to vessel collision, stochastic spill modelling was conducted. Modelling provides an indication of potential trajectories which allows an assessment of potential impacts to the environment in the event of a spill. This impact assessment then informs the development of adequate controls and response measures to ensure the risk associated with these events is considered ALARP and Acceptable. The characteristics of each modelled scenario are provided in Table 5 - 29. Justification of these model parameters is provided below.

Table 5 - 29: Summary of Modelled Hydrocarbon Spill Scenarios

Parameters	Loss of well containment	Loss of fuel from vessel*
Release Location	Seabed release	Surface release
Latitude†	12° 54' 21.86" S	12° 54' 21.86" S
Longitude†	124 24' 35.88" E	124 24' 35.88" E
Depth	157 m (below mean sea level)	0 m (below mean sea level)
Hydrocarbon Type	Crux condensate	Marine Diesel
Duration	80 days	Instantaneous
Total Volume	453,342 m^3 (2,853,000 bbl.)	250 m^3

** Stochastic modelling was completed for two similar vessel tank rupture release scenarios (i.e. same release volume, hydrocarbon type and other spill parameters) within proximity to the Operational Area. This modelling has been used as a surrogate to determine potential floating entrained and dissolved hydrocarbon spill extents and inform assessment of impacts resulting from a spill originating from the Operational Area as part of the Bratwurst-1 drilling campaign. See specific risk section for 250 m^3 MDO spill due to vessel to vessel collision below for full explanation of modelling.*

*† Given the location of the well was not confirmed when spill modelling was commissioned, release location for a well loss of containment and loss of fuel from vessel lies within the approximate well location area and within the Operational Area (as defined in **Section 2.1.3**), however, is located slightly south of the confirmed well location (**Section 2.1.2**).*

Each of the two spill scenarios was modelled using a stochastic modelling approach, where the release was repeatedly simulated using different metocean conditions. A total of 300 deterministic model runs were undertaken for each worst-case credible spill scenario (100 during summer, 100 during winter and 100 during transitional season). The aggregated deterministic results (300 deterministic runs for each release scenario) constitute the stochastic data set, from which probabilities of contact above thresholds are determined. Shell considers environmental receptors identified as potentially being contacted with a probability of one or higher (≥1%). This will identify more receptors than would be impacted by a given release, and hence it is environmentally conservative.

Hydrocarbon Characteristics

Crux Condensate

Crux condensate has been used as a nearest exploration analogue for the Bratwurst-1 drilling campaign. Given it targets the same Jurassic aged Plover Formation gas reservoirs that form part of the Crux Gas Field, approximately 8 km away from the Bratwurst-1 well. Plover Formation reservoir targets at the Bratwurst-1 prospect location are anticipated to be at similar depths, thus also at similar pressures and temperatures, to the gas reservoirs at Crux Field, approximately 4,300 to 4,500 m below the sea floor. The Bratwurst-1 prospect reservoirs are not expected to be directly connected to the Crux Field reservoirs, though they both form part of the same Jurassic aged petroleum system and are therefore anticipated to have very similar hydrocarbon fluid properties, hence Crux condensate being an appropriate analogue. Given the exploration well Circinus-1 was drilled in 1999 adjacent to the Bratwurst prospect, to depths just above the Plover Formation (TD at 4, 206 m KB), but did not intersect any shallow hydrocarbons, the possibility of encountering other hydrocarbons while drilling to target depth is considered highly unlikely.

Crux condensate is a relatively volatile (>90% volatile hydrocarbons by mass), non-viscous hydrocarbon mixture. Soluble aromatic hydrocarbons contribute approximately 12.3% by mass of the whole condensate, with a large proportion (9.8%) in the C4-C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water.

Crux Condensate (API 49.0) contains a low proportion (approximately 7.8% by mass) of hydrocarbon compounds (mostly non-toxic inert waxes) that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered hydrocarbon has a dynamic viscosity of 1.052 cP. The pour point of the whole condensate (9 °C) ensures that the unweathered hydrocarbon will remain in a liquid state over the annual temperature range observed in northern Australian waters.

The condensate 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 54.8% of the hydrocarbon mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.8% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 14.6% should evaporate over several days (265 °C < BP < 380 °C).

Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining Crux condensate, including an increase in the viscosity and pour point. Although removal of the most volatile compounds through evaporation and dissolution will result in an increase in density of the remaining Crux condensate, the mixture will not solidify or sink as it weathers.

The whole condensate has low asphaltene content (<0.05%), indicating a low tendency for the hydrocarbon to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 12.3% by mass of the whole condensate. Around 9.8% by mass is highly soluble and highly volatile. The fate of this component, which include the BTEX compounds, will vary depending on the release conditions and subsequent setting.

Subsea discharge will favour the process of dissolution but if the dissolved plume rises to the surface waters, the compounds will tend to evaporate from the water into the atmosphere. A further 2.5% by mass consists of moderately volatile and soluble di-aromatic hydrocarbons. These compounds dissolve more slowly but tend to persist in soluble form for longer.

The physical properties and boiling points of Crux condensate are presented in **Table 5 - 30** and **Table 5 - 31** respectively.

Marine Diesel Oil

Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%. If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first two days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil tend 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. (APASA, 2018)

The physical properties and boiling points of MDO are presented in **Table 5 - 30** and **Table 5 - 31** respectively. The boiling points are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate.

The aromatic components within the volatile to low-volatility range are also soluble (with decreasing solubility following decreasing volatility) and will dissolve across the oil-water interface. The rate of dissolution will increase with increase in surface area. Hence, dissolution rates will be higher under discharge conditions that generate smaller oil droplets.

Atmospheric weathering will commence if and when oil droplets float to the water surface. Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C4 to C10 compounds (or less than 180 °C BP);
- Up to 24 hours for the C11 to C15 compounds (180-265 °C BP);
- Several days for the C16 to C20 compounds (265-380 °C BP); and
- Not applicable for the residual compounds (BP > 380 °C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

The actual fate of released hydrocarbons in the marine environment will depend greatly on the amount of oil that reaches the surface, either through the initial release or by rising after discharge in the water column.

Table 5 - 30: Physical Properties of the Hydrocarbons used in the Modelling

Physical Properties	Crux Condensate	Marine Diesel
Density (kg/m3)	783.6 (at 15 °C)	829.1 (at 25 °C)
API	49.0	37.6
Dynamic viscosity (cP)	1.052 (at 20 °C)	4.0 (at 25 °C)
Pour point (°C)	9.0	-14.0
Hydrocarbon property category	Group I	Group II
Hydrocarbon persistence classification	Non-persistent	Non-persistent

Table 5 - 31: Boiling-point Breakdown of the Hydrocarbons used in the Modelling

Oil Type	Volatiles (%)	Semi-Volatiles (%)	Low Volatiles (%)	Residual (%)	Aromatics (%)
Boiling point (°C)	<180 C4 to C10	180 – 265 C11 to C15	265 – 380 C16 to C20	>380 >C20	Of whole oil <380 BP
	Non-persistent			Persistent	-
Crux condensate	54.8	22.8	14.6	7.8	12.3
Marine Diesel	6.0	34.6	54.4	5.0	3.0

Hydrocarbon Impact Thresholds

Spilled hydrocarbons can exist as a range of fates, or phases, in the marine environment. These are floating, entrained, dissolved and accumulated (i.e. stranded onshore) hydrocarbons. Each of these fates, or phases, can interact with the environment in diverse ways due to different pathways to receptors and impact mechanisms.

A series of impact thresholds for floating, entrained, dissolved and shoreline accumulated hydrocarbons were determined. These thresholds were applied to the hydrocarbon spill modelling studies and used to inform the assessment of potential impacts and risks. Three thresholds were applied to each fate, or phase, (low exposure, moderate exposure and high exposure); these are described in **Table 5 - 32**.

Table 5 - 32 also outlines thresholds used to derive the EMBA (see **Section 4.1**). The EMBA defines the outer boundary of the existing environment that may be affected from unplanned events. The EMBA includes all areas where hydrocarbon levels exceed thresholds concentrations where an ecological impact may occur. Where relevant, a lower threshold was defined to determine impacts to socio-economic receptors (i.e. floating oil). This approach has facilitated the assessment of all environmental values and sensitivities that could potentially be affected by the project and has formed the basis of the EPBC Protected Matters search (**Section 4.4.1**).

Table 5 - 32: Summary of the Zones of Exposure and Thresholds (RPS 2018d)

Exposure Zone	Threshold	Justification
Floating Hydrocarbon Threshold		
Exposure zone *Low exposure* *(1 g/m^2-10 g/m^2)*	1 g/m^2	**This threshold is considered to provide a conservative extent of potential impacts to socio-economic receptors associated with visual amenity.** The 1 g/m^2 threshold represents the practical limit of observing hydrocarbon sheens in the marine environment and therefore has been used to define the outer boundary of the low exposure zone. This threshold is considered below levels which would cause environmental harm and is more indicative of the areas perceived to be affected due to its visibility on the sea-surface. This exposure zone is not considered to be of significant biological impact but may be visible to the human eye. This exposure zone represents the area contacted by the spill and defines the conservative outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone *Moderate exposure* *(>10 g/m^2-25 g/m^2)*	10 g/m^2	**This threshold has been used to define the EMBA, given it is the level at which ecological impacts may occur.** Ecological impact has been estimated to occur at 10 g/m^2 as this level of oiling has been observed to mortally impact birds and other wildlife associated with the water surface (French et al. 1996, French 2000). The 10 g/m^2 threshold has been selected to define the moderate exposure zone. Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone *High exposure* *(>25 g/m^2)*	25 g/m^2	The 25 g/m^2 threshold is above the minimum threshold observed to cause ecological impact. Studies have indicated that a concentration of surface oil 25 g/m^2 or greater would be harmful for the majority of birds that contact the hydrocarbon at this concentration (Koops et al. 2004, Scholten et al. 1996). Exposure above this threshold is used to define the high exposure zone.
Shoreline Hydrocarbon Threshold		
Exposure zone Low exposure (10 g/m^2-100 g/m^2)	10 g/m^2	In previous risk assessment studies by French-McCay *et al.* (McCay et al. 2005a, 2005b), a threshold of 1 g/m^2 was used to assess the potential for shoreline contact (by oil stranding on shorelines/beaches). It is a conservative threshold used to define regions of socio-economic impact, such as the need for shore clean-up on man-made concrete/stone walls or on amenity beaches. A less conservative threshold of 10 g/m^2 has been defined as the zone of potential 'low' exposure. This exposure zone represents the area visibly contacted by the spill and defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate exposure	100 g/m^2	French *et al.* (1996) and French-McCay (2009) have defined an oil exposure threshold of 100 g/m^2 for shorebirds and wildlife (furbearing aquatic mammals and marine reptiles) on

(>100 g/m^2-1,000 g/m^2)		or along the shore, which is based on studies for sub-lethal and lethal impacts. The 100 g/m^2 threshold has been used in previous environmental risk assessment studies (French et al. 2011, French McCay 2004, French-McCay 2003, French-McCay et al. 2012, National Oceanic and Atmospheric Administration 2013). This threshold is also recommended in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone (AMSA 2015). Thresholds of 100 g/m^2 and 1,000 g/m^2 will define the zones of potential 'moderate' and 'high' exposure on shorelines, respectively. Contact within these exposure zones may result in impacts to the marine environment.
Adverse exposure zone High exposure (>1,000 g/m^2)	1,000 g/m^2	
Entrained Hydrocarbon Threshold		
Exposure zone Low exposure (10 ppb-100 ppb)	10 ppb	The 10 ppb threshold represents the lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the Australian and New Zealand Environment and Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand (2000) (ANZECC & ARMCANZ) water quality guidelines. Due to the requirement for relatively long exposure times (>24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or is trapped against a shoreline for periods of several days or more. This exposure zone is not considered to be of significant biological impact. This exposure zone represents the area contacted by the spill and conservatively defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate exposure (>100 ppb-500 ppb)	100 ppb	**This threshold has been used to define the EMBA, given it is the level at which ecological impacts may occur.** The 100 ppb threshold is considered conservative in terms of potential for toxic effects leading to mortality for sensitive mature individuals and early life stages of species. This threshold has been defined to indicate a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 100 ppb threshold has been selected to define the moderate exposure zone. Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High exposure (>500 ppb)	500 ppb	The 500 ppb threshold is considered conservative high exposure level in terms of potential for toxic effects leading to mortality for more tolerant species or habitats. This threshold has been defined to indicate a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 500 ppb threshold has been selected to define the high exposure zone.
Dissolved Aromatic Hydrocarbon Threshold		
Exposure zone Low exposure (6 ppb-50 ppb)	6 ppb	The threshold value for species toxicity in the water column is based on global data from French *et al.* (1999) and French-McCay (2003, 2002), which showed that species sensitivity (fish and invertebrates) to dissolved aromatics exposure > 4 days (96-hour LC_{50}) under different environmental conditions varied from 6 ppb-400 ppb, with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae). Based on scientific literature, a minimum threshold of 6 ppb used to define the low exposure zones (Clark 1984,

		Engelhardt 1983, Geraci and St Aubin 1988, Jenssen 1994, Tsvetnenko 1998). This exposure zone is not considered to be of significant biological impact. This exposure zone represents the area contacted by the spill and conservatively defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate exposure (>50 ppb-400 ppb)	50 ppb	**This threshold has been used to define the EMBA, given it is the level at which ecological impacts may occur.** A conservative threshold of 50 ppb was chosen as it is more likely to be indicative of potentially harmful exposure to fixed habitats over short exposure durations (French-McCay 2002). French-McCay (2002) indicates that an average 96-hour LC_{50} of 50 ppb could serve as an acute lethal threshold to 5% of biota. The 50 ppb threshold has been selected to define the moderate exposure zone. Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High exposure (>400 ppb)	400 ppb	A conservative threshold of 400 ppb was chosen as it is more likely to be indicative of potentially harmful exposure to fixed habitats over short exposure durations (French-McCay 2002). French-McCay (2002) indicates that an average 96-hour LC_{50} of 400 ppb could serve as an acute lethal threshold to 50% of biota. The 400 ppb threshold has been selected to define the high exposure zone.

5.6.4.2 *Loss of Well Containment*

Activity

The Bratwurst-1 drilling campaign involves drilling and suspension/abandonment of a single subsea well. Shell engineering standards require a range of features which manage the risk of a loss of well control to very low levels. However, there is a possibility that a loss of well containment may occur. While the likelihood is very small, a complete loss of well containment (a well blowout) has the potential to release significant volumes of condensate into the environment. Such a release could result in significant environmental damage.

Industry statistics from wells using similar controls that will be applied during exploration drilling of the well indicates the likelihood of a well blowout is $2.5 \times 10^{-5} Q^{-0.3}$, where Q is the mass of spilled hydrocarbons in tonnes (Det Norske Veritas 2011). These functions are consistent with observed well blowout data observations in Australia and similar jurisdictions around the world. Most loss of well containment incidents do not result in a worst-case well blowout scenario, and typically release relatively small masses of hydrocarbons.

Shell has determined the worst-case credible spill scenario that could occur from Bratwurst-1 drilling campaign. This scenario is a complete well blowout of the exploration well. This scenario consists of an 80-day uncontrolled release of 453,342 m^3 (2,853,000 bbl) of condensate. The duration is based on the credible worst-case time required to control the well (either by capping or drilling of a relief well) and the volume is based on the maximum credible rate of release derived from the proposed well design and reservoir characteristics (refer **Section 2.2.1**). The release location is at the seabed at the approximate well location (refer **Section 2.1.3**).

While this scenario is very unlikely, using the worst-case credible spill as the basis for the risk assessment provides an environmentally conservative assessment of the potential impacts and risks posed by the Bratwurst-1 drilling campaign.

Modelling Results

Stochastic oil spill modelling indicates that subsurface spills at the Bratwurst-1 well location are expected to remain offshore, away from sensitive marine receptors. Key results from the stochastic modelling studies for a worst-case loss of well containment showed (RPS, 2018a):

- Crux Condensate contains a large proportion of volatile compounds, and relatively low proportions of residual hydrocarbons that will not evaporate at atmospheric temperatures. If exposed to the atmosphere, around 78% of the mass will be expected to evaporate in around 24 hours, another 14% within a few days, and the remaining 8% will be expected to persist in the marine environment until decayed due to photochemical and biological degradation.
- During a subsurface release, relatively small oil droplets initially entrained in the water column will rise to the surface quickly (within 20 seconds). These droplets will re-entrain rapidly into the surface mixed layer of the water column (upper 3-10 m, depending on the conditions), with floating slicks only likely to form under calm wind conditions. Evaporation rates will be high, given the large proportion of volatile to semi-volatile compounds within the oil, and the residual fraction will persist in the environment until degradation processes occur. Considering the spill volume and the relatively high likelihood of entrainment occurring, there is a high potential for dissolution of soluble aromatic compounds.

Floating oil:

- Floating oil concentrations equal to or greater than the low (1 g/m^2 – i.e. socio-economic threshold) threshold could potentially be found, in the form of slicks, up to 556 km from the release location. Floating oil concentrations are not predicted to exceed the moderate (10 g/m^2 – i.e. ecological threshold) and high (25 g/m^2) thresholds at probabilities greater than 1% (refer **Table 5 - 32**).

Shoreline accumulation:

The following table summarises the oil spill modelling results for shoreline accumulation.

Worst Case - Oil Ashore Criterion (>1m^3 – >100g/m^2 – Annualised)

Worst-Affected Receptors	Max Volume Ashore (m3)	Highest Probability Contact (%)	Shortest Time to Contact (days)	Longest Shoreline Contact (km)
Ashmore Reef	19	13	32	1
Kakadu Coast Djukbinj NP	19	1	88	5
Joesph Bonaparte Gulf Northern Territory	15	1	81	2
Bathurst Island	11	1	87	2
Browse Island Turtle BIA	11	5	14	2

Darwin Coast	10	1	90	1
Timor Leste	10	1	104	1
Cartier Island	9	13	28	3
Croker Island	8	1	106	2
Indonesia	5	1	86	1
Mermaid Reef	5	1	24	1
Melville Island	2	<1	93	3

Entrained oil:

- Entrained oil concentrations at the low (10 ppb), moderate (100 ppb) and high (500 ppb) thresholds could potentially be found up to 3,308 km, 3,304 km and 3,256 km from the release location, respectively.
- The Goeree Shoal, Vulcan Shoals, North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, and Whale Shark BIA receptors are predicted to be contacted by entrained oil at the high threshold with 100% probability across all seasons.
- The minimum time to contact with any receptor by entrained oil at the low, moderate and high thresholds across all seasons is forecast at the Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, and Whale Shark BIA receptors as approximately 1 hour. These receptors are also predicted to have the maximum entrained hydrocarbon concentration of 383,180 ppb in summer.

Dissolved oil:

- Dissolved aromatic hydrocarbon concentrations at the low (6 ppb), moderate (50 ppb) and high (400 ppb) thresholds could potentially be found up to 3,294 km, 3,265 km and 3,086 km from the release location, respectively.
- The Vulcan Shoals, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, and Whale Shark BIA receptors are predicted to be contacted by dissolved aromatic hydrocarbons at the high concentration threshold with 100% probability across all seasons.
- The Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, and Whale Shark BIA receptors are forecast to have the maximum dissolved aromatic hydrocarbon concentration of 43,473 ppb in summer.

Impact Assessment

Table 5 - 33 summarises all sensitive receptors identified as being potentially impacted during a loss of well containment at a probability of 1% or higher for outlined ecological thresholds (i.e. thresholds developed to define the EMBA). Where a large receptor is associated with a number of smaller overlapping receptors, the highest probability range has been provided using the colour scheme outlined within the table. For a full list of sensitive receptors that may be impacted in the event of a loss of containment see **Appendix B**. Seasonality has been given as S = summer months, W = winter months and T = transitional months. Potential impacts to these receptors in the unlikely event of a loss of containment are outlined in the following sections.

Table 5 - 33: Summary of Modelling Results for Loss of Well Control Scenario for Receptors Above Identified Thresholds

Receptor Category *Probability of being impacted* <1% - 1% / >25-50% >1-10% / >50-75% >10-25% / >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	**Shoreline accumulation ≥100 g/m²**	**Entrained ≥500 ppb**	**Dissolved ≥400 ppb**
Shoals and Banks				
Barracouta Shoals	-	N/A	S, W, T	S, W, T
Barton Shoal	-	N/A	S, W, T	S, W, T
Britomart Shoal	-	N/A	S	-
Dillon Shoal	-	N/A	S, W, T	S, T
Echo Shoals	-	N/A	S, T	S, T
Eugene McDermott Shoal	-	N/A	S, W, T	S, W, T
Fantome Shoal	-	N/A	S, W, T	W, T
Goeree Shoal	-	N/A	S, W, T	S, W, T
Heywood Shoal	-	N/A	S, W, T	S, W, T
Jabiru Shoals	-	N/A	S, W, T	S, W, T
Jones Shoal	-	N/A	S	-
Karmt Shoal	-	N/A	S, T	S, T
Loxton Shoal	-	N/A	S, T	-
Martin Shoal	-	N/A	S, T	-
Newby Shoal	-	N/A	S, W, T	S, T
Pee Shoal	-	N/A	S, W, T	S, T
Penguin Shoal	-	N/A	S, W, T	S, W, T
Shepparton Shoal	-	N/A	S, T	S, T
Troubadour Shoals	-	N/A	S, T	S, T
Vee Shoal	-	N/A	S, W, T	S, W, T
Vulcan Shoal	W	N/A	S, W, T	S, W, T
Bellona Bank	-	N/A	S, T	S, T
Flat Top Bank	-	N/A	S, W, T	S, T
Sahul Bank	-	N/A	S, W, T	S, W, T
Reefs and Offshore Islands				
Browse Island	-	W, T	S, W, T	S, W, T
Hibernia Reef	-	N/A	S, W, T	S, T
Mainland Coast-lines				
Cobourg Peninsula*	-	-	S, T	-
Darwin Coast*	-	T	S, T	-
Indonesia	-	T	S, W, T	S, W, T
Joseph Bonaparte Gulf Northern Territory (NT)*	-	S	S, T	-
Kakadu Coast*	-	S	S, T	-
Kimberley Coast*	-	-	S, W, T	S, W, T
North Broome Coast*	-	-	T	-

Receptor Category *Probability of being impacted* <1% - ; 1% ; >1-10% ; >10-25% ; >25-50% ; >50-75% ; >75%	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Port Hedland-Eighty Mile Beach*	-	-	T	-
Timor Leste	-	S	S, T	S, T
West Arnhem Land*	-	-	S	-
Key Ecological Features				
Ancient Coastline at 125 m depth contour*	-	N/A	S, W, T	S, W, T
Ashmore Reef and Cartier Island and surrounding Commonwealth waters*	-	W, T	S, W, T	S, W
Canyons linking the Argo Abyssal Plain with the Scott Plateau*	-	N/A	S, T	S, W, T
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	N/A	S, W, T	-
Carbonate banks & Terrace System of Van Diemen Rise	-	N/A	S, W, T	S, W, T
Carbonate bank and terrace system of Sahul Shelf*	-	N/A	S, W, T	S, T
Continental Slope Demersal Fish Communities	-	N/A	S, W, T	S, W, T
Exmouth Plateau	-	N/A	S, W, T	T
Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals	-	T	S, W, T	S, W, T
Pinnacles of the Bonaparte Basin	-	N/A	S, W, T	S, W, T
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex*	-	N/A	S, W, T	S, W, T
Shelf break and slope of the Arafura Shelf	-	N/A	S, T	S, T
Tributary Canyons of the Arafura Depression	-	N/A	S, T	-
BIAs				
Turtle BIA	-	N/A	S, W, T	S, W, T
Seabirds BIA	-	N/A	S, W, T	S, W, T
Whales BIA	-	N/A	S, W, T	S, W, T
Dolphins BIA	-	N/A	S, T	S, T
Dugong BIA	-	N/A	S, W, T	S, W, T
River Shark BIA	-	N/A	S, T	T
Whale Shark BIA	-	N/A	S, W, T	S, W, T
Marine Parks, Heritage Places and Ramsar Wetlands				
Lalang-garram / Camden Sound Marine Park	-	-	T	-
Lalang-garram / Horizontal Falls Marine Park	-	-	T	T
North Kimberley Marine Park	-	-	T	S, T

Receptor Category *Probability of being impacted* <1%: - 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
North Lalang-garram Marine Park	-	-	T	-
Charles Darwin NP	-	-	S, T	-
Garig Gunak Barlu NP	-	-	S, T	-
Kakadu NP*	-	-	S, T	-
Mary River NP	-	-	S, T	-
Mitchell River NP Coast	-	-	S, T	-
Prince Regent NP Coast	-	-	S	-
Djukbinj NP	-	S	S, T	-
Kimberley AMP*	-	N/A	S, W, T	S, W, T
Oceanic Shoals AMP*	-	N/A	S, W, T	S, W, T
Ashmore Reef AMP*	-	S,W	S, W, T	S, W, T
Carnarvon Canyon AMP	-	N/A	T	-
Cartier Island AMP	-	S, W, T	S, W, T	S, W, T
Arafura AMP*	-	N/A	S, T	-
Argo-Rowley Terrace AMP	-	N/A	S, W, T	S, W, T
Arnhem AMP*	-	N/A	S, T	-
Clerke Reef AMP	-	-	S, W, T	S, W, T
Gascoyne AMP	-	N/A	S, W, T	T
Imperieuse Reef AMP	-	-	S, W, T	S, T
Joseph Bonaparte Gulf AMP	-	N/A	S, T	-
Mermaid Reef AMP	-	T	S, W, T	S, W, T
Fisheries				
NPF	T	N/A	S, W, T	S, W, T
North-west Slope Trawl Fishery	-	N/A	S, W, T	S, W, T
Southern Bluefin Tuna Fishery	W, T	N/A	S, W, T	S, W, T
Timor Reef Fishery (NT Managed)	-	N/A	S, T	S, T
Western Skipjack Fishery	W, T	N/A	S, W, T	S, W, T
Western Tuna and Billfish Fishery	W, T	N/A	S, W, T	S, W, T

** Includes associated islands, reefs, banks, and shoals*

Physical Environment

Water Quality

In the event of a loss of well containment during the Bratwurst-1 drilling campaign, large volume releases of Crux condensate have the potential to result in increased concentrations of dissolved hydrocarbons, which include Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and PAHs. There low molecular weight compounds are known to be toxic to marine biota (refer to Ecosystems, Communities and Habitats and Threatened Species and Ecological Communities below for a discussion of these effects). BTEX compounds do not persist in the environment due to their volatility and will diminish once released into the environment. The concentration of BTEX is expected to be highest near the release location and will decline as the spilled hydrocarbon weathers. PAHs are less volatile than BTEX and are expected to persist for longer in the environment.

The concentrations of hydrocarbons in the water column will decrease over time once the release has stopped due to processes such as dispersion, dilution, physical and biological degradation, and evaporation. For short duration release scenarios, these processes will begin to reduce the total amount of hydrocarbons in the water column shortly after the release. The worst-case loss of well containment will continue to release fresh hydrocarbons for the duration of the release, and the volume of hydrocarbons will increase until the release is stopped.

A loss of well containment is predicted to have minor long-term and/or short-term impacts to water quality. There is a potential for areas of significant value or with higher sensitivity to contamination (e.g. submerged shoals/banks, offshore islands and coastal areas) to be impacted in the event of a long-term release. See **Table 5 - 33** for a summary of sensitive receptors that could be impacted in the event of a loss of containment spill, and relevant sections below for potential impacts to these receptors.

<u>Sediment Quality</u>

Hydrocarbon contaminants from a subsea release during a loss of well containment may impact sediments by advective transport of the plume that will be formed during the release and will expand throughout the release duration (Romero et al. 2015). Any resulting contamination will be concentrated around, and down-current from, the wellhead. Due to the low density and volatile nature of the hydrocarbon, weathered condensate is unlikely to be deposited to the seabed.

A loss of well containment would have minor impacts to sediment quality, which would likely be focused in a small area within the immediate release site during a long-term hydrocarbon release. There is a potential for a reduction in sediment quality at some areas of significant value or higher sensitivity to contamination (e.g. submerged shoals/banks, offshore islands and coastal areas) due to contact and adherence of entrained hydrocarbons. This would result in minor reductions to sediment quality in localised areas of these sensitive receptors. See **Table 5 - 33** for a summary of sensitive receptors that could be impacted in the event of a loss of containment spill, and relevant sections below for potential impacts to these receptors.

<u>Air Quality</u>

The gas plume from the worst-case loss of well containment scenario will result in a gas cloud upon reaching the surface. The formation of a gas cloud poses a significant health and safety risk from the formation of explosive mixtures and asphyxiation. This potentially large gas cloud is expected to disperse rapidly in the open, offshore environment. Given the highly localised extent and expected short duration of the gas cloud, this risk is considered very low.

Ecosystems, Communities and Habitats

<u>Benthic Communities</u>

A seabed release of Crux condensate during the Bratwurst-1 drilling campaign may result in impacts to water quality and sediments near the release location (refer to sections Water Quality and Sediment Quality above). The seabed near these potential release locations (i.e. the Operational Area) are characterised by unconsolidated sediments which host spare assemblages of filter- and deposit-feeding organisms. These fauna may be subject to acute and chronic toxic effects from exposure to hydrocarbons, however the extent of the affected habitat is expected to be localised to the vicinity of the release location. Bare sediment habitat is very widely represented in the Timor Sea, and the associated fauna assemblages are not considered to be particularly sensitive of or high conservation value.

Filter feeding benthic communities may be vulnerable to entrained and dissolved hydrocarbons. Entrained hydrocarbons can be ingested by filter feeders, leading to increased exposure due to accumulation of ingested oil droplets (Payne and Driskell 2003). While typically less toxic than dissolved hydrocarbons, entrained oil may still cause toxic effects; entrained oil may also result in physical impacts such as clogging of filter feeding organs, potentially resulting in reduced feeding efficiency. Filter feeder, and sessile organisms in general, may be exposed to concentrations of dissolved hydrocarbons that result in acute and chronic toxic effects.

Results from modelling studies of the worst-case loss of well containment indicated that several offshore reefs and islands, and banks and shoals, may be contacted by hydrocarbons above impact thresholds. See **Table 5 - 33** for a summary of sensitive receptors that could be impacted in the event of a loss of containment spill, and relevant sections below for a discussion of potential impacts to these receptors.

Nearshore benthic communities are typically more diverse than those found in the deep-water habitat of the Operational Area, often due to the presence of primary producers, such as seagrasses, macroalgae, zooxanthellate corals and mangroves.

Most seagrasses within the area that may be affected by the worst-case hydrocarbon spill scenarios are subtidal, although there may be relatively small areas of intertidal seagrasses along the WA and NT coastlines, as well as at international coastlines of Indonesia and Timor-Leste. Seagrass in the subtidal and intertidal zones have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is unlikely to be exposed to spilled hydrocarbons, as most hydrocarbons in subtidal environments will be concentrated at the surface. Intertidal seagrasses are vulnerable to smothering by floating oil slicks, which can lead to mortality if it coats their flowers, leaves and stems (Dean et al. 1998, Taylor and Rasheed 2011). Long-term impacts to seagrass are unlikely unless hydrocarbons are retained within the seagrass meadow for a sustained duration (Wilson and Ralph 2011). Toxicity effects can also occur due to absorption of soluble fractions of hydrocarbons into tissues (Runcie et al. 2010). The potential for toxicity effects of entrained hydrocarbons may be reduced by weathering processes that should serve to lower the content of soluble aromatic components before contact occurs.

Like seagrasses, the potential impacts to macroalgae depend on the exposure pathway; most macroalgae in the region are subtidal, although intertidal macroalgae may be present. Studies of subtidal macroalgal assemblages exposed to fuel oil spills have shown that impacts from exposure is slight (Edgar et al. 2002, Lobón et al. 2008). Effects of exposure to oil on intertidal macroalgae are more variable; some studies reported little evidence of impacts (Díez et al. 2009), while others show significant impacts (De Vogelaere and Foster 1994). Recovery of intertidal macroalgae has been shown to occur faster in areas where oil has been left to degrade naturally compared to areas subject to intensive clean-up operations (De Vogelaere and Foster 1994). Given the potential for shoreline contact is very low for even the worst-case spill scenario, impacts to macroalgae are considered to be highly unlikely.

Subtidal and intertidal zooxanthellate corals occur widely throughout the Timor Sea, including around offshore reefs and islands, bank and shoals, and the mainland coast. Shallow subtidal and intertidal corals may be coated by stranded floating hydrocarbons during low tides, which may subsequently be re-floated by subsequent incoming tides. Impacts from physical coating of corals appears to also depend on coral morphology. Coral species more likely to retain oil coatings (e.g. due to polyp morphology, or gross morphology with high surface area to volume ratios such as branching corals) have been shown to be more susceptible to impacts (Shigenaka 2001). Exposure to dissolved and entrained hydrocarbons may result in acute and chronic toxic effects, with longer exposure durations typically leading to greater potential for mortality (Shigenaka 2001). Corals may also ingest entrained oil particles, potentially leading to an accumulation of hydrocarbons into coral tissue (Loya and Rinkevich 1980).

Intertidal mangrove habitats occur throughout much of Kimberley and NT coastlines and Indonesia and Timor-Leste and are highly susceptible to oil pollution (National Oceanic and Atmospheric Administration (NOAA) 2014). Given the distance between potential release locations and the nearest mangroves, any spilled hydrocarbons reaching mangroves will be highly weathered. Mangroves are vulnerable to contact with floating hydrocarbons, which may coat prop roots and pneumatophores (aerial roots that support oxygen uptake) (Duke and Archibald 2016). Exposure can result in direct effects such as yellowed leaves, defoliation and mortality, and indirect effects such as reduced recruitment and increased sensitivity to other stressors (NOAA 2014). Like seagrasses, mangroves can also be impacted by entrained and dissolved aromatic hydrocarbons either in the water or sediment.

A loss of well containment is predicted to have minor long-term localised and/or short-term widespread impacts to benthic communities. There is a potential for benthic habitats of significant value or with higher sensitivity (e.g. submerged shoals/banks, offshore islands and coastal areas) to be impacted in the event of a long-term release. See **Table 5 - 33** for a summary of sensitive benthic habitat receptors that could be impacted in the event of a loss of containment spill, and relevant sections below for potential impacts to these receptors.

Shoals and Banks

The Timor Sea region hosts numerous named banks and shoals, a number of which were identified by the stochastic modelling as being contacted by hydrocarbons from worst-case credible spill scenarios. Modelling results indicated shoals relatively close to the release locations are at greatest likelihood of being impacted (i.e. >75% - refer **Table 5 - 33**). These include Goeree Shoal, Eugene McDermott Shoals, Vulcan Shoal, Barracouta Shoals, Heywood Shoals, Jabiru Shoal, Pee Shoal, three shoals/banks within the Oceanic Shoals AMP, and two banks within the Ashmore Reef AMP. In the unlikely event of a significant hydrocarbon spill, these benthic features may be contacted by entrained and dissolved hydrocarbons above impact thresholds. There is a 1% chance that Vulcan shoal will be contacted by floating oil; no other shoals or banks are predicted to be reached by floating oil. The shortest modelled time to contact was 1 hr (Vulcan Shoal) for entrained hydrocarbons during winter months, providing relatively little time for hydrocarbons to weather.

Studies of the banks and shoals in the region show these areas host biological communities distinct from the surrounding relatively deep bare sediment habitat, however indicated the banks were broadly similar to each other (e.g. Heyward et al. 2017, 2012, 1997). Each bank hosted a range of light-dependent ecosystems characterised by benthic primary producers, such as coral and macroalgae. Surveys of shoals near the Operational Area following the Montara oil spill indicated these communities did not exhibit obvious impacts as a result of the spill (Heyward et al. 2013, 2012, 2010). However, considerable natural variation both over time and between locations was observed (Heyward et al. 2013). Reviews of the ecological function of the banks and shoals in the Timor Sea east of the Operational Area concluded there is a relatively high degree of connectivity between banks and shoals, with the banks acting as a series of “stepping stones” (Heyward et al. 2017, 2013 p. 20). In the event of a disturbance to benthic communities as the result of a hydrocarbon spill, the upstream banks and shoals may act as a source of propagules or larvae, which may enhance recovery.

Contact with dissolved and entrained hydrocarbons above adverse exposure thresholds may result in mortality of benthic biota. The loss of habitat-forming biota such as corals, macroalgae or sponges could result in changes to habitats, with consequent changes to fauna assemblages. As described above in Benthic Communities, impacts to corals, seagrasses and macroalgae include acute and chronic toxicity which may result in non-lethal impacts (e.g. reduced feeding) and mortality.

The time required for recovery following disturbance will depend on the nature and scale of the impact. Banks and shoals in the region have been exposed to significant intermittent disturbance for long periods of time, such as damage from cyclones and changes in water temperature associated with the El Niño-Southern Oscillation. Differences in benthic communities over time within and between banks and shoals (such as those observed by Heyward et al. 2013) may represent different phases of ecological succession.

A loss of well containment is predicted to have potentially major impacts to shoals and banks identified by stochastic modelling (see **Table 5 - 33** for a summary of shoals and banks impacted, and **Appendix B** for a full list of contacted receptors**)**. Impacts to shoals/banks nearest to the release location are more likely to exhibit widespread degradation requiring long-term restoration, while receptors further from the release location will see minor, more short-term impacts.

Offshore Reefs and Islands

Offshore islands and reefs often host biological communities that are distinct from coastal islands and the mainland. Like the Shoals and Banks described above, offshore reefs and islands typically host light-dependent ecosystems characterised by benthic primary producers. Potential impacts to submerged receptors associated with offshore reefs and islands will be similar to those described in Shoals and Banks above. Unlike shoals and banks, offshore reefs and islands may be impacted by floating hydrocarbons and shoreline accumulation (in addition to entrained and dissolved hydrocarbons).

Several offshore reefs and islands were identified by stochastic modelling as potentially being contacted by entrained and dissolved hydrocarbons above adverse exposure thresholds, with shoreline accumulation predicted at four of these receptors. For entrained hydrocarbons, Scott Reef and Seringapatam Reef, Ashmore Reef and and Cartier Island have a >75% probability of being contacted, while Hibernia Reef, Browse Island have a >50-75% probability of being contacted. Results were similar, however with slightly lower probabilities, for dissolved hydrocarbons.

While floating hydrocarbons were not predicted to contact any offshore reef or island, there is low probability (>1 – 13%) for shoreline accumulation to occur at Browse Island, Cartier Island, Ashmore Reef and Mermaid Reef (see **Table 5 - 33** for a summary of offshore reefs and islands impacted, and **Appendix B** for a full list of contacted receptors). As described above, shoreline accumulation can occur where floating hydrocarbons have not reached due to contact and adherence of entrained hydrocarbons. Minimum time to contact to these shoreline receptors was Browse Island (14 days), indicating the hydrocarbons have considerable weathering time in which degradation will occur prior to reaching any coastline. In addition, given the expected worstcase shoreline impact (upto 19 m^3) at these receptors, shoreline impacts are considered to be potentially moderate risk for those shorelines impacted.

A loss of well containment is predicted to have potentially major impacts to offshore islands and reefs identified by stochastic modelling. Impacts to the identified receptors nearest to the release location are more likely to exhibit widespread degradation requiring long-term restoration, while receptors further from the release location will see minor, more short-term impacts.

WA and NT Mainland Coastline

Stochastic modelling identified upto a 1% probability of shoreline contact along any individual mainland Australian shores above the shoreline ecological exposure threshold. No individual shoreline contact was predicted on mainland coasts above a 1% probability. Entrained and dissolved hydrocarbons have a less than 10% probability of contacting any WA or NT shoreline.

Minimum time to contact to these shoreline receptors was the NT coastline (81 days), indicating the hydrocarbons have considerable weathering time in which degradation will occur prior to reaching any coastline. Weathering reduces the soluble aromatic hydrocarbon fractions within the environment, leaving relatively low toxicity residual hydrocarbons such as paraffins.The maximum volumes ashore along any single WA mainland or NT coastline was upto 19 m^3. Given this, impacts to any effected shoreline would be expected to be upto moderate, short-term and localised impacts to Australian mainland coastlines, the risk to these shorelines is considered minor.

Indonesian and Timor-Leste Coastlines

Stochastic modelling results indicated there is the potential for contact with the Indonesian and Timor-Leste coastlines above the ecological adverse exposure thresholds. Probability of contact with these coastlines is 1%, <10% and <25% for shoreline, dissolved, and entrained hydrocarbons, respectively. This indicates a very low likelihood of contact and, coupled with the remote likelihood of a loss of well containment, indicates impacts will at most be slight, short-term and localised.

As for Australian mainland coastlines, Indonesian and Timor-Leste coastlines are also not predicted to be contacted by the conservative 1 g/m^2 socio-economic impact threshold for floating oil (see **Table 5 - 32**). Minimum time to contact for these two receptors was to the Indonesian coastline (86 days) by upto a maxmimum of 10 m^3, indicating the hydrocarbons have considerable weathering time in which degradation will occur prior to reaching any coastline. Potential impacts may include smothering of coastal infrastructure (e.g. aquaculture, fishing equipment), which may result in moderate localised economic and environmental impacts.

Key Ecological Features

Several KEFs may be exposed to hydrocarbons above adverse impact thresholds in the event of a loss of containment release of hydrocarbons. KEFs with relatively high (>50%) likelihoods of contact above entrained and dissolved impact thresholds include:

- Ancient coastline at 125 m depth contour;
- Carbonate bank and terrace system of the Sahul Shelf;

- Continental slope demersal fish communities;
- Ashmore Reef and Cartier Islands and surrounding Commonwealth waters;
- Seringapatam Reef and Commonwealth waters in the Scott Reef complex; and
- Pinnacles of the Bonaparte Basin.

All but two of these KEFs are entirely sub-tidal; discussion of potential impacts in this section is limited to sub-tidal features of the KEFs listed above. The exceptions of Ashmore Reef and Cartier Islands and surrounding Commonwealth waters and Seringapatam Reef and Commonwealth waters in the Scott Reef complex are considered above in Offshore Reefs and Islands and Shoals and Banks. Oil pollution is considered a potential pressure on these two KEFs (refer Section 4.3.6) (DSEWPaC 2012a; 2012b).

The sub-tidal KEFs may be exposed to entrained and dissolved above the adverse exposure thresholds. The environmental values of these sub-tidal KEFs are a function of their geomorphology and depth. A worst-case loss of well containment will not alter the geomorphology or depth characteristics of the sub-tidal KEFs. Given the nature of these KEFs (i.e. potentially more rugose and complex benthic habitats), there may be relatively diverse benthic communities associated with these habitats, such as filter feeding communities and demersal fish assemblages. These biological receptors may be impacted by dissolved and entrained hydrocarbon above adverse exposure thresholds, which may result in acute a or chronic toxic effects.

The identified sub-tidal KEFs are spatially large environmental features. Modelling results indicated that no single deterministic run affected the entirety of a sub-tidal KEF; most runs typically affected a minor portion of these sensitive receptors. Given the nature of the KEFs and the scale of potential impacts, recovery of impacted parts of a KEF are expected to be facilitated by movement and recruitment of biota from the unaffected areas. Therefore, a loss of well containment has a remote potential for resulting in moderate impacts to sub-tidal KEFs, including the potential for persistent environmental damage and/or widespread change in habitats or species beyond natural variability

Threatened Species and Ecological Communities

<u>Marine Mammals</u>

A range of cetaceans potentially occur within the EMBA for the worst-case credible loss of containment spill scenario. These are described in **Section 4.4.5**. Although hydrocarbon spills are not specifically mentioned as a key threat for a number of cetaceans expected to occur or transit within the EMBA, chemical discharge and pollution are a key threat (DoE 2015a, DoE 2015c, DoE 2015d, DSEWPaC 2012d).

Cetaceans exposed to hydrocarbons may exhibit avoidance behaviour. Geraci (1988) documented apparent avoidance of floating by bottlenose dolphins, suggesting that cetaceans can detect and avoid surface slicks. However, observations during spills have recorded whales and dolphins traveling through and feeding in hydrocarbon slicks. During the Deepwater Horizon spill cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al. 2017). Cetaceans observed during the spill response for the Montara oil spill Included oceanic species such as false killer whales, bottlenose dolphins, spotted dolphins and spinner dolphins (Watson et al. 2009).

Cetaceans exposed to surface, entrained or dissolved aromatic hydrocarbons above adverse exposure thresholds may suffer external oiling, ingestion of hydrocarbons and inhalation of toxic vapours (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Cetaceans in coastal waters (e.g. coastal dolphin species and humpback whales at the northern limit of their migration) are at lower risk of impacts than cetaceans in offshore water due to the hydrocarbon weathering before reaching coastal waters. Impacts from direct oiling from a spill of Crux condensate are considered unlikely due to the non-persistent nature of the hydrocarbon and the thick layer of skin and blubber of cetaceans. Impacts from direct exposure are expected to be irritation of eyes and mucous membranes. Entrained hydrocarbons may be ingested by cetaceans during feeding, particularly by baleen whales. Some species of baleen whale, such as blue whales, may be seasonally present during their migrations. However, significant feeding during migration is not expected (although opportunistic feeding may occur).

Dugongs are known to occur in coastal waters and around offshore islands within the adverse exposure zones identified by the stochastic spill modelling. There is a paucity of studies examining the effects of hydrocarbon spills on dugongs, although the direct impacts of exposure to hydrocarbons may be similar to cetaceans. Like cetaceans, dugongs are expected to be resilient to direct impacts due to their thick skin and blubber. Suitable dugong habitat is associated with seagrass meadows, which are typically restricted to shallow waters around the mainland coast and islands. The distance of dugong habitat from the worst-case credible spill release locations means that oil reaching dugong habitat will be highly weathered.

Given this and the remote likelihood of a loss of containment event occurring, moderate impacts to conservation significant and other marine mammals may occur.

<u>Marine Reptiles</u>

Stochastic modelling results indicated adverse exposure zones overlap the known distribution of several species of marine turtles and sea snakes. Saltwater crocodiles were also identified as potentially occurring within the EMBA; given the preferred habitat for salt water crocodiles are freshwater rivers and estuaries, impacts to this species from the worst-case hydrocarbon spill are not considered credible.

Chemical discharge is listed as a key threat to marine reptiles expected to occur within the EMBA (Commonwealth of Australia 2017a, DEWHA 2009a). Marine turtles may be exposed to floating hydrocarbons when at the sea surface (e.g. breathing, basking etc.), and are not expected to avoid floating hydrocarbon slicks (National Oceanic and Atmospheric Administration 2010). Exposure to floating or entrained hydrocarbons may result in external oiling, which could result in impacts such as inflammation or infection (Gagnon and Rawson 2010, Lutcavage et al. 1995, National Oceanic and Atmospheric Administration 2010). Given the large portion of non-persistent hydrocarbons in Crux condensate, there is a much lower risk of direct oiling of marine turtles and other fauna than would be possible with a heavier hydrocarbon type. Dissolved hydrocarbons may result in toxic effects on marine turtles, however their relatively impermeable skin reduces the potential for these impacts.

Several banks and shoals occur in the vicinity of the operational area, which may be used as foraging areas by marine turtles (although none are recognised as BIAs). Impacts to benthic habitats and biota at these banks and shoals may result in a reduction of prey for marine turtles. Refer to Shoals and Banks above for further information on potential impacts to these sensitive receptors.

Stochastic modelling identified a number of shoreline habitats (sandy beaches and inter-nesting habitat) that may be exposed to hydrocarbons above adverse exposure thresholds. Many of these are classified as habitat critical for the survival of marine turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a). Significant breeding and nesting activity occurs at these locations throughout the EMBA and wider northwest and north regions. Given the distance of these locations from the Operational Area, worst-case credible spills of Crux condensate reaching these areas will be highly weathered and unlikely to result in impacts. A spill reaching coastal waters during peak periods to turtle nesting may have increased potential to cause impacts.

Sea snakes have similar exposure pathways to spilled hydrocarbons as marine turtles (although sea snakes will not be exposed to shoreline hydrocarbon accumulation). Potential impacts are expected to be comparable and may include irritation of eyes and mucous membranes. Sea snake mortality has been linked to exposure to hydrocarbon spills, with dead sea snakes recovered from the region of the Montara oil spill showing high levels of petroleum hydrocarbons (including PAHs) in the trachea, lungs and stomach (Gagnon 2009). These results are consistent with exposure through ingestion and respiration of hydrocarbons. Ashmore Reef and Hibernia Reef are noted as being one of the few sites where the critically endangered leaf-scaled sea snake and short-nosed sea snake have been recorded, along with other species of sea snake. Both the leaf-scaled and snort-nosed sea snakes have not been detected at Ashmore Reef since 2001, despite increased biological survey effort. Both locations were identified by the stochastic modelling as potentially being exposed to hydrocarbon above adverse exposure limits.

Considering the remote likelihood of a loss of containment event occurring in addition to the widespread nature of marine reptiles as well as the number of BIAs and Critical Habitat present within the EMBA for protected marine reptile species (refer **Section 4.4.5**), moderate impacts to conservation significant and other marine reptiles may occur.

<u>Birds</u>

A number of seabird and migratory shorebird species have been identified as potentially occurring within the EMBA. Oil/chemical spills, pollution and habitat loss from pollution are listed as keys threats to many of these species (DoE 2015e; DoE 2016a; DoE 2016b; DoE 2016c; DoE 2016d; DoE 2016e; DSEWPaC 2011a; DSEWPaC 2011b). Additionally, several BIAs for seabird and migratory shorebird species occur throughout the EMBA, centred around offshore and coastal islands and mainland shorelines (refer **Section 4.4.5**).

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). However, given the non-persistent nature of Crux condensate resulting in high rates of evaporation and low volumes of floating oil, a spill is unlikely to pose a significant risk to birds.

Seabirds may encounter floating oil when foraging for food. Seabird foraging is typically concentrated around roosting locations, such as offshore and coastal islands. Potential roosting locations lie considerable distances from the Operational Area; the nearest significant roosting location is Cartier Island (approximately 86 km northwest). Ashmore Reef is a Ramsar-listed wetland and hosts significant seabird colonies and is an important stopping area for migratory shorebirds. Ashmore Reef lies approximately 135 km from the Operational Area. Floating hydrocarbons are not expected to reach these receptors, or any BIA for birds.

Migratory shorebirds are seasonally abundant during summer months, and a spill during this period would have greater potential to impact migratory shorebirds. Migratory shorebirds are not likely to encounter floating oil at sea, but may be affected by shoreline accumulation of oil, or oil and shallow foraging habitats such as intertidal mudflats. There is a very low probability of any shoreline accumulation at any sensitive receptor where shorebirds may aggregate and/or forage (see sections above for Offshore Reefs and Islands, WA and NT Mainland Coastline and Indonesian and Timor-Leste Coastlines). Unlike seabirds, shorebird mortality due to hypothermia from matted feathers is relatively uncommon (Henkel et al. 2012).

Indirect impacts, such as reduced prey availability and bioaccumulations of PAHs, may occur (Henkel et al. 2012).

Given the absence of floating oil and very low probability of shoreline accumulation at areas utilised by seabird and shorebird species, in addition to the remote likelihood of a loss of containment event occurring, minor impacts to conservation significant and other bird species may occur.

<u>Fish</u>

Fish respire through gills, which may make them more vulnerable to dissolved hydrocarbon fraction than fauna with less permeable skins, such as cetaceans, marine reptiles and birds. Despite this apparent vulnerability, fish mortalities are rarely observed to occur as a result of hydrocarbon spills (Fodrie and Heck 2011, International Tanker Owners Pollution Federation 2011b), although instances of fish mortality from spills in confined areas (e.g. bays) have been recorded. These observations are consistent with fish moving away from hydrocarbons in the water (Hjermann et al. 2007).

Exposure of fish to hydrocarbons may result in acute and chronic effects and may vary depending on a range of factors such as exposure duration and concentration, life history stage, inter-species differences and other environmental stressors (Westera and Babcock 2016). Environmental monitoring of pelagic and demersal fishes immediately following the Montara oil spill indicated that fish were exposed to hydrocarbons, although no adverse effects were detected (Gagnon and Rawson 2012, 2011). Further sampling and testing over time indicated that fish captured in close proximity to the Montara wellhead were comparable to those collected from reference sites (Gagnon and Rawson 2012, 2011).

Most marine fish species produce very high numbers of eggs, which then undergo a planktonic larval development phase. Early life history stages of fish (planktonic eggs and larvae) may be more vulnerable to hydrocarbon pollution than juvenile and adults, as these early life history phases cannot actively avoid water with high concentrations of hydrocarbons. Fish embryos and larvae may exhibit genetic and developmental abnormalities from long-term exposure to low concentrations of hydrocarbons (Fodrie and Heck 2011), although such long exposures may not be representative of real world conditions. PAHs have also been linked to increased mortality and stunted growth rates of early life history (pre-settlement) of reef fishes, as well as behavioural impacts that may increase predation of post-settlement larvae (Johansen et al. 2017). Given the temporal and spatial scale of the worst-case credible spill scenario (as shown by a single deterministic run rather than the combination of 300 deterministic runs which make up the full EMBA), and the typically high supply of eggs and larvae, it is unlikely that any of the worst-case credible spill scenarios will result in significantly reduced recruitment of fish due to impacts during early life history phases. This conclusion is supported by studies of fish stocks following large-scale hydrocarbon spills, which have shown relatively little evidence of reduced recruitment at the scale of fish stocks/populations (Fodrie and Heck 2011). Potential impacts to fish species are expected to be minor, with no lasting effects.

<u>Shark and Rays</u>

Transitory and resident sharks may occur within the EMBA identified by the stochastic spill modelling. Pollution is listed as a key threat to whale sharks (DEH 2005a; DoE 2015l); this species was identified as potentially occurring within the Operational Area (e.g. traversing the area during migration from aggregation off Ningaloo Reef between July and November) and a BIA for whale sharks overlaps with the Operational Area. Tagging studies by Meekan and Radford (2010) have shown whale sharks traversing the Timor Sea following the seasonal aggregation off the Ningaloo Coast. Whale sharks may be exposed to entrained and dissolved hydrocarbons by contact with their gills and ingestion during feeding. The large volume filter feeding behaviour of whale sharks may result in a relatively high potential for exposure to entrained hydrocarbons compared to many other marine species (Campagna et al. 2011).

Tagging studies off Ningaloo Reef have shown that whale sharks disperse broadly and largely outside of the defined BIA (Meekan and Radford 2010, Wilson et al. 2006). Whales sharks are also not known to travel in groups like some shark species and other marine fauna do. Genetic studies of whale sharks have shown low genetic diversity, which suggests flow of genetic material through the movement of individual sharks over large spatial scales (Schmidt et al. 2009). On this basis, only few individuals would be within the EMBA above the adverse exposure threshold at any one time and impacts such as toxic effects leading to mortality are highly unlikely.

Other oceanic (e.g. mako) and resident (e.g. reef) sharks and manta rays will occur throughout the EMBA, although Heyward et al. (2017) noted that shark numbers were lower than expected, potentially due to fishing pressure. Potential impacts to other oceanic shark species are likely to be minor, and similar to fish (see Fish above). Any reduction of shark numbers may take longer to recover due to the relatively long lifespans and low reproductive output compared to finfish species.

Socio-economic and Cultural Environment

World Heritage

A small portion of the Kakadu World Heritage Area, approximately 800 km from the Operational Area, has a 1-10% probability of being impacted by entrained hydrocarbons in the event of a loss of well containment. The Area was not predicted to be impacted by dissolved or floating hydrocarbons. On the basis of the nature and scale of the contact predicted by the modelling, no impacts to the world heritage values of the Kakadu World Heritage Area will occur.

National Heritage Places

The Kakadu National Heritage Place has the same extent at the Kakadu World Heritage Area discussed above in World Heritage; no impacts to the heritage values of this Place will occur as a results of a worst-case credible hydrocarbon spill.

Spill modelling results indicated that the West Kimberley National Heritage Place may be contacted by entrained and dissolved hydrocarbons above ecological impact thresholds, at 1-10% and 1% probabilities for contact, respectively. No shoreline or floating hydrocarbons are predicted to occur across the entire Kimberly coast, including at the West Kimberley Heritage Place. The West Kimberley National Heritage Place contains a range of shoreline types, including rocky shores, sandy beaches and mangroves. Potential impacts to these are discussed above in WA and NT Mainland Coastline. Many of the heritage values of the area (refer to **Section 4.5.5**) lie inland and will not be impacted by a hydrocarbon spill.

Given the low likelihood of hydrocarbons contacting these areas and given a majority of these areas lie inland and would not be reached in the event of a loss of well containment, impacts would be slight at most to these receptors.

Commonwealth Heritage Places

Several offshore islands and reefs listed as Commonwealth Heritage Places were identified by the spill modelling results as potentially being contacted by hydrocarbons. These include:

- Ashmore Reef National Nature Reserve;
- Scott Reef and Surrounds;
- Mermaid Reef – Rowley Shoals;
- North Keeling Island; and
- Christmas Island Natural Areas.

The heritage values of these areas are primarily associated with their outstanding natural values (**Section 4.5**). Ashmore Reef National Nature Reserve is the closest Commonwealth Heritage Place to the Operational Area (approximately 135 km at the closest point), and the only likely to be contacted or impacted by hydrocarbons in the event of a spill (entrained and dissolved only). Given the distances from these receptors to the Operational Area, there is a low to negligible probability any hydrocarbons would contact these areas, and if contact was to occur impacts would be no effect to slight. See Offshore Reefs and Islands above for a discussion of potential impacts to these values.

Ramsar Wetlands

Several Ramsar Wetland sites were identified by the stochastic modelling as potentially being impacted in the event of a loss of well containment. As for heritage places and areas, most Ramsar Wetland sites are in the far-field of the model and defined EMBA and are highly unlikely to be contacted by hydrocarbons above the ecological adverse exposure thresholds. Similarly, the exception is Ashmore Reef, which is the closest Ramsar site to the Operational Area (approximately 135 km).

The migratory bird species associated with Ramsar sites are most vulnerable to floating oil, and oil accumulations along the shoreline. However, no floating or shoreline accumulation is expected at these receptors. Given the distances from these receptors to the Operational Area, there is a low to very low probability any hydrocarbons would contact these areas, and if contact was to occur impacts would be minor to slight. Note the PMST report identified several Ramsar wetlands at Christmas Island, however given the distance to these receptors these Ramsar wetlands will not credibly be impacted.

Australian Marine Parks

Modelling results indicated a range of AMPs that may be contacted above adverse exposure thresholds. These parks contain a range of environmental values such as marine biota, representative marine habitats and unique sea scapes (e.g. KEFs). Environmental values for these AMPs are described in **Section 4.5.8** and discussed above in Physical Environment, Ecosystems, Communities and Habitats, and Threatened Species and Ecological Communities. Refer to these sections for discussion of potential impacts to these environmental values within AMPs.

Marine Archaeology

Marine archaeological artefacts relevant to impacts from a loss of well containment during the Bratwurst drilling campaign are historic shipwrecks. No impacts to historic shipwrecks are expected to occur due to the depth of these artefacts and their distance from the Operational Area. The nearest historic shipwreck, the Anne Millicent, lies approximately 95 km from the Operational Area.

Cultural Heritage

Aboriginal people have a long history of inhabitation across northern Australia, particularly coastal regions. As outlined above in WA and NT Mainland Coastline, potential shoreline contact above the ecological adverse exposure threshold has a 1% probability of occurring in the event of a loss of containment hydrocarbon release. Hydrocarbon pollution and shoreline clean-up activities may result in disturbance to culturally significant sites. Given the very low likelihood of shoreline contact, the potential for shoreline accumulation above which clean-up activities would be effective is very low. Potential impacts to cultural heritage are considered to be no effect to slight.

Commercial Fisheries

A number of WA State, NT and Commonwealth commercial fisheries operate within the EMBA. The worst-case credible loss of containment hydrocarbon spill scenario may result in a range of impacts to commercial fishing activities, such as (International Tanker Owners Pollution Federation 2011b):

- displacement of fishing effort from areas affected by a spill or spill response activities;
- damage to fish stocks due to mortality;
- closure of fisheries by management agencies;
- inability to sell catch due to perceived or actual fish tainting or contamination; and
- oiling of fishing gear, particularly by floating oil.

A significant hydrocarbon spill would likely result in the temporary closure of areas of fisheries within the EMBA. The spatial extent and duration of the closure would depend on the nature and scale of the pollution resulting from the hydrocarbon spill. Given the large spatial extent of managed fisheries in the area potentially contacted above adverse exposure thresholds, a spill is unlikely to result in complete closure of a fishery. Rather, the closure of areas to fishing is more likely to result in the displacement of fishing effort. Displacement from productive fishing areas may result in impacts to fishers such as increased costs and reduced catch per unit effort.

Exposure of fish to hydrocarbons may result in tainting, which may render landings unsuitable for human consumption. Tainting may occur even a low levels of hydrocarbon exposure. Monitoring of fish for taint immediately following capping of the Montara well detected differences between fish likely to have been exposed to hydrocarbons, however these differences were not conclusively linked to oil contamination and fell within the range of “normal” fish odours (Rawson et al. 2011). Samples collected at the same monitoring locations two and four months after were not distinguishable (Rawson et al. 2011). These results are consistent with other studies of fisheries resources exposed to hydrocarbon pollution, which acknowledge the potential for impacts to fisheries resources and have shown little potential risk for consumers if suitable fisheries management actions are undertaken (Law and Hellou 1999, Law and Kelly 2004).

Fish caught in areas affected by a significant hydrocarbon spill may be perceived as being of poorer quality, even if no decrease in quality is evident. This may result in lower prices at the time of sale and subsequently lead to reduced income for commercial fishers. Potential impacts to commercial fishers are predicted to be moderate, including a short-term decrease in the availability or quality of a resource.

Traditional Indonesian Fishing

Traditional Indonesian fishing activity occurs within the MoU box, which overlaps the EMBA and associated adverse exposure zones identified by the spill modelling results. Traditional fishing is concentrated around banks, shoals, island and reefs; refer to Shoals and Banks and Offshore Reefs and Islands for discussion of potential impacts to these receptors. The worst-case credible loss of containment spill scenario may impact upon the biological resources exploited by traditional Indonesian fishers, such as fish and benthic invertebrates (e.g. sea cucumbers and trochus shells). Impacts to these biological resources may result in effects on traditional fishers, such as reduced catch rates and displacement of fishing effort. Given the distance between the Operational Area and the reefs exploited by traditional Indonesian fishers, impacts to traditional Indonesian fishing activities are considered to be unlikely and would be minor.

Tourism and Recreation

There are currently no known tourism activities in the Operational Area, or surrounding areas, due to its remoteness. Some tourism activity may occur at remote offshore islands and reefs within the EMBA. These activities are expected to be exclusively nature-based tourism and impacts to the environmental values associated with these islands and reefs may impact upon tourism activities. Refer to Offshore Reefs and Islands for discussion on the potential impacts to these receptors.

Mainland coastline and islands will typically host more nature-based tourist activities than offshore islands. This activity is expected to be seasonal, with increased visitation during the winter dry season months. No floating hydrocarbons are expected to reach these coastlines, at either the ecological or socio-economic thresholds. Refer to WA and NT Mainland Coastline above for a discussion of potential impacts to the natural receptors along these coastlines.

Impacts to tourism activities are expected to be minor, based on the likelihood and nature of contact to environmental values that support tourism activities. Impacts to these values may result in displacement of tourism activity, and potentially minor loss of revenue for tourist operators (e.g. charter fishing cancellations due to fishery closures).

Military/Defence

Defence activities within the offshore NAXA are unlikely to be affected by a loss of containment hydrocarbon spill hydrocarbon release. Activities may be temporary displaced from areas where spill response operations are underway. This would result in minor impacts which are highly localised and temporary in nature.

Ports and Commercial Shipping

Potential impacts to ports and commercial shipping from a loss of containment hydrocarbon spill hydrocarbon release are expected to be very minor and consist of temporary displacement of other users from areas where spill response activities are underway. These are expected to be concentrated around the release location.

Offshore Petroleum Exploration and Operations

Petroleum activities in the region include the Shell-operated Prelude floating liquefied natural gas (FLNG) facility, the INPEX-operated Ichthys facility and the Montara development (previously operated by the Petroleum Authority of Thailand Exploration and Production (PTTEP) Australia, now Jadestone Energy). Other exploration activities may occur in the Timor Sea throughout the Bratwurst-1 drilling campaign. Reduction in water quality as a result of a worst-case credible spill may affect the operation of these facilities if seawater at the facility is no longer suitable for intake (e.g. for use as cooling water or feed water for reverse osmosis water generation). This may result in impacts to routine operations such as decreased production. A worst-case hydrocarbon spill response may result in competition for vessels and potentially MODUs (if well intervention or a relief well is required). Impacts to other petroleum activities from a loss of well containment are expected to be minor.

Table 5 - 34: Risk Assessment for Loss of Well Containment

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Unplanned**		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Significance*	*Likelihood*	*Residual Risk*
Loss of well containment resulting in long-term hydrocarbon release	X	X	X	X	Massive (unplanned events only)	Remote	Major

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
A bow-tie for the well blow out MODU safety case will be adopted and reviewed prior to submitting the Safety Case to NOPSEMA.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with NOPSEMA accepted Bratwurst-1 drilling campaign WOMP.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with NOPSEMA accepted MODU Safety Case Revision.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with NOPSEMA accepted OPEP.	Standard practice. Compliance with legislation.	Yes
Elimination		
None identified	-	-
Substitution		
None identified	-	-
Reduction		
Compliance with Shell's global standard for well design integrity to assure mechanical and functional integrity for all anticipated loads throughout the life of the well. These standards meet or exceed current International and Australian standards.	Standard practice. Reduces likelihood of impact.	Yes
Compliance with Shell MODU Operator Well Control Bridging document that clarifies and documents clear agreement on any conflicts between processes described in the MODU Contractor and Shell well control manuals.	Standard practice. Reduces likelihood of impact.	Yes
Installation and regular function and pressure testing of well control equipment (including BOP, choke and kill lines and manifold, etc)	Standard practice. Reduces likelihood of impact.	Yes

Maintenance and inspection system for BOP control equipment, as per rig contractor's preventative maintenance system.	Standard practice. Reduces likelihood of impact.	Yes
Regular well integrity checks as defined in the drilling program.	Standard practice. Reduces likelihood of impact.	Yes
Well relief locations will be planned at the well design stage and documented in the Well Control Contingency Plan.	Standard practice. Reduces likelihood of impact.	Yes
Tertiary well control for the Bratwurst-1 drilling campaign is outlined in the Bratwurst-1 Well Control Contingency Plan which will include the Well Capping and Containment Plan (these documents will be developed prior to execution) that documents Bratwurst-1 specific well capping mobilisation and deployment options and relief well locations, rigs and drilling strings.	Standard practice. Reduces likelihood of impact.	Yes
Mitigation		
Implement the Cyclone Contingency Plan, if required, for severe weather events that includes a timeline to secure the well and down man the MODU	Standard practice. Reduces likelihood of impact.	Yes
Shell shall have access to a well capping system that is deployable globally, available in Australia within 35-42 days. Details of this arrangement are outlined with the OPEP. As part of the OSRL consortium, Shell have access to the 15Kpsi capping stack and offset deployment equipment. Modelling has shown that the offset deployment system is suitable for wells up to 1.3Bcf/day blow out rate (which is far higher than the expected blow out rate for this well). A relief well design and associated readiness shall be pre-planned and documented in the Bratwurst-1 Well Control Contingency Plan.	Standard practice. Mitigates and reduces impact severity.	Yes
Evaluation of existing capping stacks located closer to well site for quicker deployment (eg. Singapore): Shell has access to four capping stacks via OSRL. The nearest two are located in Singapore and South Africa. However, these are both 10k stacks and are not compatible for use with the Offset Installation Equipment (OIE) required to be used for the well. The two 15k stacks which can be used with the Offset Installation Equipment (OIE) are located in Norway and Brazil. The 15k stack located in Norway may be air freighted without being first broken down into sub-components which is optimal as it reduces required dismantling, construction and testing requirements which offset any benefit of air freighting. A 15k capping stack is available in Singapore through Wildwell Control. However, the potential benefit in mobilisation time of this system is discounted currently due to the need for an OIE to enable the successful installation of a cappingstack on the Bratwurst well. Since the only OIE in the world currently is located in Trieste, Italy, and this piece of equipment is on the critical path to successfully install the capping stack there is currently no benefit in pursuring a capping stack which is closer to the well site than our current arrangements enable. Due to the shallow water depth of Bratwurst and high potential gas rate, a capping stack deployment method requiring manned vertical access to the well is not considered to be feasible. The OIE	Not feasible	No

deployment method is designed to allow capping stack deployment without requiring manned vertical well access. As a blowout preventer (BOP) will have been installed on the well prior to drilling into reservoir, the design of the OIE also includes the capability to lift to the lower marine riser package (LMRP) from the main BOP. This will allow the capping stack to be latched onto the LMRP connector. If there is no BOP installed, the capping stack may be installed directly onto the wellhead. The difference between the 10k and 15k capping stacks which prevents the use of a 10k capping stack from deployed using the OIE is a function of their respective shut in methods and resultant top geometry. The 15k capping stacks shut in the well by means for two set of blind rams. These rams as analogous to those used on BOP stacks, have a 18-3/4" full bore and have a 18-3/4" H4 connector installed on top of them. The OIE latches onto this H4 connector when deploying the capping stack onto the well. The 10k capping stacks shut in the well by means of two gate valves with a 7-1/16" inner diameter and do not have the 18-3/4" H4 top connection required for interfacing with the OIE. Furthermore, at the potential blow out rates at Bratwurst, even if vertical access can be achieved, the resultant uplift forces on the 10k capping stacks exceed the weight of the capping stack and will precluding their installation on Bratwurst.		
Airfreight mobilisation options for capping stacks and OIE: The OIE is 14m tall, 10.5m x 13.5m laterally and weights 240 metric ton, far exceeding the capability of even the largest freighters for air transport such as an Antonov. The OIE is stored fully assembled in Trieste, Italy in preparation for mobilisation by vessel. While it is possible to disassemble the OIE, advice from the Shell capping stack subject matter experts in Houston is that due to the time required to disassemble, reassemble and test and commission, vessel mobilisation of the OIE in its fully assembled state is recommended and considered to be a more timely option. While the 15k capping stack in Norway may be air freighted, the critical path for capping stack deployment is driven by the mobilisation time for the OIE. The base case therefore, is not to air freight the capping stack, but this will be revaluated should the capping stack become the critical path item.	Air freight of the OIE, considering all the implications of disassembly, reassembly, commisioning and testing is not currently considered to be as timely as vessel transportation.	No
Minimise well control response deployment times – Evaluation of Vessel requirements: Shell has evaluated vessel requirements and equipment needs and associated options to minimise the deployment times as far as possible for capping stacks and OIE to the well location. This detail is outlined in section 7.2.4 of the OPEP. Shell appropriately evaluated mobilisation times for the capping stack and OIE and these have been reduced as far as is reasonably practicable.	Standard practice. Reduces likelihood of impact.	Yes
Minimise well control response deployment times – Evaluation of Safety case approval requirements for well control response:	Standard practice. Mitigates and reduces impact severity.	Yes

In the event of a well blowout, approved safety cases will be required to be accepted by NOPSEMA for the MODU drilling the relief well and heavy lift vessels involved in the capping stack and OIE installation. Details of options to be considered for these are outlined within the OPEP section 7.2.4. As apart of preparing this EP, the Wells HSE Advisor reviewed all the steps required to develop a suitable safety case revision for well control response activities and this concluded that the Bratwurst MODU facility safety case revision would form the basis for any required safety case revision required for well control response activities. Alternate options to allow an expitited safety cases approval which have been considered but currently discounted as the benefit appears to be grossly disproportionate to the benefit gained. Namely because there does not appear to be any clear overally benefits in implemented any of the below options over the current base case which is to use the Bratwurst-1 safety case revision which will be approved by NOPSEMA as the basis/template for any revisions required for a relief well or capping stack/OIE vessels. Considered options includes: • Seeking a NOPSEMA pre-approved draft safety case • Partly drafting a safety case revision (this is considered to have already been compelted, once the Bratwurst safety case revision is approved)		
Before the Bratwurst well is spudded, Shell will lead an integrated Source Control Workshop with expert assistance from Shell's Virtual Source Control Team. The workshop is seeking the following key outcomes: • a complete logistics evaluation of the processes required to deliver all the 3 key pieces of well control equipment, the SFRT, the capping stack, and the OIE from their peacetime locations to a port of disembarkation. • offload from delivery transport to staging areas • reassembly (where required) and testing • crossload onto technical deployment vessels • all contractual issues associated with multiple contractors equipment and vessels • The technical aspect of deloyment onto appropriate operating vessels The intent of the workshop is to identify and cloes out gaps identified in the above areas and produce a 2 phase process: • The logistics movement from peacetime locations • The technical deployment to well site of all 3 major components	Standard practice. Mitigates and reduces impact severity.	Yes
Shell will have agreements in place with oil spill response service providers, notably OSRL and Australian Marine Oil Spill Centre (AMOSC).	Standard practice. Mitigates and reduces impact severity.	Yes
Maintain Shell's Global Response Support Network (GRSN)	Standard practice. Mitigates and reduces impact severity.	Yes
Membership with SSFRT	Standard practice.	Yes

	Mitigates and reduces impact severity.	
Hydrocarbon spill response personnel will be trained and competent in spill response.	Standard practice. Reduces likelihood of impact.	Yes
Undertake regular hydrocarbon spill response drills to test the NOPSEMA accepted OPEP and competency of spill response personnel.	Standard practice. Reduces likelihood of impact.	Yes
Compliance with NOPSEMA accepted Operational and Scientific Monitoring Plan (HSE_PRE_000496).	Standard practice. Reduces likelihood of impact.	Yes

Summary of ALARP

The highest expected impact significance on environmental values/sensitivities from a loss of well containment resulting in a long-term condensate release to the marine environment is massive due to:

- the number of environmental (i.e. shoals/banks, offshore reefs and islands, coastlines, KEFs, AMPs and conservation significant species) and socio-economic values/sensitivities (i.e. commercial and indigenous fisheries, tourism, communities and industry) with a potential to be impacted; and
- the potential severity of impact to these receptors.

Overall the likelihood of the event occurring is remote and the residual risk ranking of a loss of well containment is assessed to be major.

Demonstration of Acceptability

Principles of ESD	The risks and impacts from the worst-case credible hydrocarbon release resulting from loss of well containment are inherently inconsistent with some of the principles of ESD based on the following: • environmental resources may be significantly impacted in the event a worst-case credible spill occurs, and • a worst-case credible spill may prevent others exercising their right to access environmental resources. Shell will apply a range of controls to ensure that a worst-case credible spill from the Bratwurst-1 drilling campaign does not occur. These include a range of industry best practices that have been developed through extensive industry experience, including the lessons learned from significant unplanned releases such as the Macondo and Montara well blowouts. Following successful application of these controls, Shell considers the residual risk to be consistent with the principles of ESD. This consistency is achieved by: • developing natural resources in an environmental responsible manner, resulting in income for government, generation of Australian jobs, and developing an increased understanding of the Timor Sea environment. • applying the precautionary principle in the assessment of hydrocarbon spill scenarios by: • using worst-case credible spill scenarios. Industry statistics indicate most unplanned spills are significantly smaller than the worst-case credible spills. • using a stochastic modelling approach for numerical modelling of the worst-case credible spill scenarios that includes a large number of deterministic runs covering a range of metocean conditions, and • using environmentally conservative adverse exposure zone thresholds.
Relevant Requirements	OPGGS(E) Regulations
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks; • Shell has reviewed conservation advices and recovery plans for marine mammals, marine turtles, birds and fish and considered key threats to these species in the management of impacts and risks as relevant to a potential loss of well containment; • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • Shell has, and will continue to maintain, an appropriate spill response framework, which includes regular testing of the response arrangements.

	This response framework will be applied to all stages of the Bratwurst-1 drilling campaign; and • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is Major given the application of the controls outlined above and the following points: • the remote likelihood of risk; • regulatory requirements and Shell standards are incorporated; • good practice developed from Shell's global drilling operations, industry guidelines and practical mitigations to reduce the risk associated with a loss of well containment have been undertaken; • Shell has undertaken an extensive, conservative risk assessment and will apply a range of additional controls consistent with relevant requirements and industry best practice; and • stakeholder concerns have been adequately addressed in this EP and the Bratwurst-1 OPEP. The residual impact associated with a loss of containment during the Bratwurst-1 drilling campaign is considered acceptable.	

5.6.4.3 *Marine Diesel Spill Due to Vessel to Vessel Collision*

Activity

At least two vessels will support the MODU during the Bratwurst-1 drilling campaign. Vessels will be used to deploy and accurately position the MODU's anchors prior to drilling operations and to supply the MODU during operations. Vessels will remove waste from the MODU and supply the MODU with fresh water, food, fuel, cement, drilling fluid materials (including fluids and bulk products) and drilling equipment. All AHTs will use marine diesel, with a maximum single tank capacity of approximately 250 m^3.

During operations, there is a very low likelihood of two vessels within the Operational Area to be involved in a vessel to vessel collision. Of the 111 spills greater than 1 tonne in Australian waters between 1982 and 2010, six were caused by vessel to vessel collisions. This spill frequency is low, compared to the 26,235 commercial vessel visits to Australian ports in 2010 alone (DNV, 2011). The risk of a spill from vessel to vessel collision will depend on the severity, i.e. speed and aspect of the vessels during the event.

Shell has determined the worst-case credible release from a loss of fuel from a vessel is an instantaneous release of 250 m^3 of marine diesel. This scenario involves a support vessel being impacted by another vessel moving at near full speed, resulting in a puncture of the diesel tanks below the waterline. During the collision it is credible that one tank could be punctured, resulting in the worst-case scenario of 250 m^3. It is not considered credible that multiple tanks would rupture, given the design of vessels, standard maritime practices and additional controls restricting speed and vessel movements within the Operational Area. This scenario also conservatively assumes the entire tank at full capacity would be lost to the marine environment, however, it is more likely that a portion of the contents of the tank would be released resulting in a significantly smaller spill.

Marine diesel is a low viscosity distillate fuel. Diesel contains a high proportion of lighter hydrocarbons, such that evaporation is an important process contributing to the removal of spilt diesel from the sea surface. Evaporation will be enhanced by higher wind speeds and warmer sea and air temperatures. The general behaviour of diesel at sea can be summarised as follows:

- a slick of diesel will elongate rapidly in the direction of the prevailing wind and waves;

- very rapid spreading of the low viscosity diesel will take place;
- some diesel fuel oils may form an unstable emulsion at the thicker, leading edges of the slick;
- speed of physical dispersion of the surface slick increases with wind speed. Up to 95% of a slick may disperse within about 4 hours of the spill in 15 knot winds, warm air and sea conditions; and
- evaporation of diesel is likely to be enhanced due to the warmer prevailing air and sea temperatures of the Operational Area.

To inform the potential impacts from a marine diesel spill resulting from a vessel to vessel collision, stochastic numerical modelling commissioned by Shell in 2018 has been reviewed. Modelling was conducted for two adjacent, but comparable release points, located 84 km northwest and 88 km southwest from the Operational Area, respectively. Each scenario modelled a short-term (instantaneous) surface release of 250 m^3 of marine diesel from a vessel, representing a fuel tank rupture after a collision. Modelling results are considered comparable to a vessel diesel spill scenario for the Bratwurst drilling campaign given the proximity to the Operational Area and, therefore, likely similar metocean influences and given these locations are closer to the nearest potential shoreline receptors, Cartier and Browse Islands.

Results from modelling were used to estimate the potential extents of floating, dissolved and entrained hydrocarbons at the defined thresholds outlined in **Table 5 - 32**. These extents were then used to identify potential receptors within these extents that may be affected by a vessel to vessel collision within the Operational Area. Results from this assessment are provided below.

Modelling Results

Key results from the stochastic modelling studies for a diesel spill from a vessel to vessel collision showed (RPS, 2018b):

- Considering the discharge characteristics, the properties of the oil and its expected weathering behaviour, floating oil will be susceptible to entrainment into the wave-mixed layer under typical wind conditions. Evaporation rates will be significant, given the moderate proportion of volatile compounds in the oil (41%). The low-volatility fraction of the oil (54%) will take longer durations of the order of days to evaporate, and the residual fraction of 5% is expected to persist in the environment until degradation processes occur (over periods of weeks to months). Considering the spill volume, there is a low potential for dissolution of soluble aromatic compounds.
- Floating oil concentrations equal to or greater than the low (1 g/m^2 – i.e. socio-economic threshold), moderate (10 g/m^2 – i.e. ecological threshold) and high (25 g/m^2) thresholds could potentially be found, in the form of slicks, up to 291 km, 75 km and 42 km from the release location, respectively.
- Entrained oil concentrations at the low (10 ppb), moderate (100 ppb) and high (500 ppb) thresholds could potentially be found up to 1,732 km, 1,726 km and 275 km from the release location, respectively.
- Dissolved aromatic hydrocarbon concentrations at the low (6 ppb) and moderate (50 ppb) thresholds could potentially be found up to 1,126 km and 23 km from the release location, respectively. No dissolved hydrocarbons are expected above the 40 ppb ecological threshold.

Impact Assessment

Physical Environment, Threatened Species and Ecological Communities and Socio-Economic and Cultural Environment

Table 5 - 35 summarises all sensitive receptors identified as being potentially impacted during a vessel to vessel collision for outlined ecological thresholds (refer **Table 5 - 32**). Potential impacts to these receptors in the unlikely event of vessel to vessel collision resulting in a fuel tank rupture are described in the National Energy Resources Australia (NERA) Consequence Analysis of an Accidental Release of Diesel Reference Case (NERA, 2018). This Reference Case is considered relevant to the risk described for the Bratwurst-1 drilling campaign given that:

- Water depths within the Operational Area are greater than 10 m (i.e. 155 m).
- Accidental release volume is <700 m^3 (i.e. 250 m^3).
- Fuel type is marine diesel (i.e. consistent with hydrocarbon characteristics within the Reference Case).
- Other variables, including air temperature, release duration and consequence thresholds are consistent within those used in the Reference Case's impact analysis.

Impacts not explicitly described within the Reference Case (e.g. for protected areas) are described above in the Impact Assessment for a loss of well containment scenario.

Table 5 - 35: Summary of Modelling Results for Vessel to Vessel Collision Scenario for Receptors Above Identified Thresholds.

Receptor Category	**Hydrocarbon Phase Above Adverse Exposure Threshold**			
	Floating ≥10 g/m²	**Shoreline accumulation ≥100 g/m²**	**Entrained ≥500 ppb**	**Dissolved ≥400 ppb**
Shoals and Banks				
Barracouta Shoals	Y	N/A	Y	-
Eugene McDermott Shoal	Y	N/A	Y	-
Fantome Shoal	-	N/A	Y	-
Goeree Shoal	Y	N/A	Y	-
Heywood Shoal	Y	N/A	Y	-
Jabiru Shoals	-	N/A	Y	-
Pee Shoal	-	N/A	Y	-
Vulcan Shoal	Y	N/A	Y	-
Reefs and Offshore Islands				
Browse Island	-	-†	Y	-
Hibernia Reef	-	-†	Y	-
Mainland Coast-lines				
Kimberly	-	-	Y	-
Key Ecological Features				
Ancient Coastline at 125 m depth contour	Y	N/A	Y	-
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	-	N/A	Y	-
Carbonate bank and terrace system of Sahul Shelf	Y	N/A	Y	-
Continental Slope Demersal Fish Communities	Y	N/A	Y	-
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	-	N/A	Y	-

Receptor Category	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
BIAs				
Turtle BIA	Y	N/A	Y	-
Seabirds BIA	Y	N/A	Y	-
Whales BIA	-	N/A	Y	-
Whale Shark BIA	Y	N/A	Y	-
Marine Parks, Heritage Places and Ramsar Wetlands				
Kimberley AMP*	-	N/A	Y	-
Oceanic Shoals AMP	-	N/A	Y	-
Ashmore Reef AMP	-	N/A	Y	-
Cartier Island AMP	-	N/A	Y	-
Fisheries				
Northern Prawn Fishery	-	N/A	-	-
North-west Slope Trawl Fishery	Y	N/A	Y	-
Southern Bluefin Tuna Fishery	Y	N/A	Y	-
Timor Reef Fishery (NT Managed)	-	N/A	-	-
Western Skipjack Fishery	Y	N/A	Y	-
Western Tuna and Billfish Fishery	Y	N/A	Y	-

** Includes associated islands, reefs, banks, and shoals*

† From release locations used in stochastic modelling, shoreline oil for the coastlines of Browse Island and Cartier Island was predicted to be low, with maximum accumulated volumes of 80 and 37 m^3, respectively, in transitional months only. Given the release locations are significantly closer to these receptors than the Operational Area (15 km versus 86 km to Cartier Island and 67 versus 152 km to Browse Island) no shoreline oil is expected to occur from a diesel spill of 250 m^3 within the Operational Area.

Table 5 - 36: Risk Assessment for Marine Diesel Spill Due to Vessel to Vessel Collision

Project Component/ Activity	Environmental Value/Sensitivity				Evaluation – Unplanned		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Significance*	*Likelihood*	*Residual Risk*
250m^3 MDO spill due to vessel to vessel collision	X	X	-	X	Major	Unlikely	Moderate

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Compliance with MARPOL 73/78, the Navigation Act 2012, the Protection of the Sea (Prevention of	Standard practice. Compliance with legislation.	Yes

Pollution from Ships Act 1983 and subsequent Marine Orders (as appropriate to vessel class): • All vessels involved in the project will have a valid SOPEP or SMPEP (as appropriate for vessel classification).	Reduces likelihood of impact.	
Compliance with Marine Orders 30: Prevention of Collisions and Marine Orders 21: Safety of Navigation and emergency procedures (as appropriate to vessel class).	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Offshore Vessel Inspection Database (OVID) or equivalent reviewed prior to mobilisation of project vessels	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with petroleum safety zone as per Section 6161 of the OPGGS Act.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Compliance with NOPSEMA accepted OPEP and First Strike Response Plan.	Standard practice. Compliance with legislation.	Yes
Elimination		
None identified	AHTs are vital to the drilling campaign and cannot be eliminated.	-
Substitution		
None identified	A minimum vessel size is required to conduct support activities including anchoring of MODU.	-
Reduction		
All AHTs will be equipped with at least DP2 systems	Standard practice. Reduces likelihood of impact.	Yes
AHT DP systems will be serviceable and operational within the 500 m petroleum safety zone at all times, as required by Shell Activity Specific Operating Guideline (ASOG)	Standard practice. Reduces likelihood of impact.	Yes
Mitigation		
Consultation with relevant and interested stakeholders	Standard practice. Reduces likelihood of impact.	Yes
Communication with AMSA (including AMSA JRCC) and AFMA to ensure the location of the MODU is known by vessels that may be operating in the region.	Standard practice. Reduces likelihood of impact.	Yes
MODU will be equipped with suitable navigation aids, automatic identification system (AIS) and competent crew maintaining 24-hour visual, and radio and electronic surveillance as per the OVID process.	Standard practice. Reduces likelihood of impact.	Yes
Shell will have agreements in place with oil spill response service providers, notably OSRL and Australian Marine Oil Spill Centre (AMOSC).	Standard practice. Reduces likelihood of impact.	Yes
Maintain Shell's Global Response Support Network (GRSN)	Standard practice. Reduces likelihood of impact.	Yes
Hydrocarbon spill response personnel will be trained and competent in spill response.	Standard practice. Reduces likelihood of impact.	Yes
Undertake regular hydrocarbon spill response drills to test the NOPSEMA accepted OPEP and competency of spill response personnel.	Standard practice. Reduces likelihood of impact.	Yes
Summary of ALARP		

The highest expected impact significance on environmental values/sensitivities from a vessel to vessel collision resulting in a full capacity tank rupture and release to the marine environment is major due to the number of environmental (i.e. shoals/banks, offshore reefs and islands and conservation significant species) and socio-economic values/sensitivities (i.e. fisheries) with a potential to be impacted. Overall the likelihood of the event occurring is remote and the residual risk ranking of a 250 m^3 vessel tank rupture is assessed to be moderate.	
Demonstration of Acceptability	
Principles of ESD	The risks and impacts from the worst-case credible MDO release resulting from a vessel to vessel collision are inherently inconsistent with some of the principles of ESD based on the following: • environmental resources may be significantly impacted in the event a worst-case credible spill occurs, and • a worst-case credible spill may prevent others exercising their right to access environmental resources. Shell will apply a range of controls to ensure that a worst-case credible spill from the Bratwurst-1 drilling campaign does not occur. These include a range of industry best practices that have been developed through extensive industry experience. Following successful application of these controls, Shell considers the residual risk to be consistent with the principles of ESD. This consistency is achieved by: • applying the precautionary principle in the assessment of hydrocarbon spill scenarios by: • using worst-case credible spill scenarios. Industry statistics indicate most unplanned spills are significantly smaller than the worst-case credible spills. • using a stochastic modelling approach for numerical modelling of the worst-case credible spill scenarios that includes a large number of deterministic runs covering a range of metocean conditions, and • using environmentally conservative adverse exposure zone thresholds.
Relevant Requirements	OPGGS Act, Navigation Act, Marine Orders 30, Marine Orders 21, COLREGS
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks; • Shell has reviewed conservation advices and recovery plans for marine mammals, marine turtles, birds and fish and considered key threats to these species in the management of impacts and risks as relevant to a diesel spill resulting from a vessel to vessel collision; • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework. • Shell has, and will continue to maintain, an appropriate spill response framework, which includes regular testing of the response arrangements. This response framework will be applied to all stages of the Bratwurst-1 drilling campaign; and • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is moderate given the application of the controls outlined above and the following points: • the remote likelihood of risk; • regulatory requirements and Shell standards are incorporated; • all good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with vessel collisions have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with a vessel to vessel collision during the Bratwurst-1 drilling campaign is considered acceptable.	

5.6.4.4 *Diesel Spill During Refuelling at Sea*

Activity

Refuelling of the MODU from vessels may occur weekly. Diesel transfer is planned to take a minimum of 3-4 hours. The probability of a spill occurring during fuel transfer operations is low, however, this probability is inherently increased given the frequency of operations. Causes include hose rupture, coupling failures or tank overflow. Spillage volume is generally less than 160 litres (0.15 m^3), and potential quantities are reduced by visual observations, shutdown of pumps and automatic closure of safety valves. The maximum credible spill amount is considered to be 10 m^3, however, there is a very low likelihood of this volume being spilled should an incident occur during refuelling.

Impact Assessment

Previous modelling for similar surface spills of marine diesel have found surface hydrocarbons to be contained with approximately 1 km of the release location and is unlikely to be found entrained or dissolved at significant depths. The closest sensitive receptor to the Operational Area is Goeree Shoal, with it's 20 m depth plateau located approximately 1.4 km northwest of the Operational Area and 8 km from the Bratwurst-1 well location. With consideration of the added 2,500 m buffer that the Operational Area provides from the potential release site during bunkering operations at the MODU, this receptor is not expected to be impacted in the event of a spill. Furthermore, Goeree Shoal is a submerged shoal, and therefore would not be affected by a small surface spill of marine diesel.

Given this, impacts to water quality and to conservation significant or other species (as described in the NERA Reference Case – see above in vessel to vessel collision) are considered negligible.

Table 5 - 37: Risk Assessment for Diesel Spill During Refuelling at Sea

Project Component/ Activity	Environmental Value/Sensitivity				Evaluation – Unplanned		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Significance*	*Likelihood*	*Residual Risk*
10m³ hydrocarbon spill during bunkering	X	X	-	-	Slight	Remote	Negligible

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Compliance with MARPOL 73/78, the Navigation Act 2012, the Protection of the Sea (Prevention of Pollution from Ships Act 1983 and subsequent Marine Orders: • All vessels involved in the project will have a valid SOPEP or SMPEP (as appropriate for vessel classification). • GOMO.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Offshore Vessel Inspection Database (OVID) or equivalent reviewed prior to mobilisation of project vessels	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes

MODU/vessel bunkering procedures will include as a minimum: • use of dry break coupling; • inspection and certification/testing of bulk transfer hoses; • bunkering start during daylight hours where practicable (e.g. suitable sea conditions); • continual visual monitoring of hoses connections and tank levels; and • preventative maintenance of equipment to ensure integrity.	Standard practice. Reduces likelihood of impact.	Yes
No offshore refuelling	Offshore refuelling is required as the MODU must remain on station during drilling operations.	No
Elimination		
None identified	-	-
Substitution		
None identified	-	-
Reduction		
None identified	-	-
Mitigation		
None identified	-	-

Summary of ALARP
The expected impact significance to water quality and species from an up to 10 m^3 surface spill of diesel during refuelling operations is slight due to there being no sensitive receptors expected to be impacted and due to the localised nature of the spill. Overall the likelihood of the event occurring is remote and the residual risk ranking is assessed to be negligible.

Demonstration of Acceptability	
Principles of ESD	The impacts from a fuel spill during offshore refuelling are consistent with the principles of ESD based on: • the environmental values/sensitivities within the Operational Area are not expected to be significantly impacted.
Relevant Requirements	OPGGS Act, Navigation Act, Marine Orders, COLREGS
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks; • Shell has reviewed conservation advices and recovery plans for marine mammals, marine turtles, birds and fish and considered key threats to these species in the management of impacts and risks as relevant to a potential loss of well containment; • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework, and OVID processes are applicable to this planned activity; • Shell has, and will continue to maintain, an appropriate spill response framework, which includes regular testing of the response arrangements. This response framework will be applied to all stages of the Bratwurst-1 drilling campaign; and • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.

Summary of Acceptability
The residual impact is negligible given the application of the controls outlined above and the following points: • the remote likelihood of risk;

- regulatory requirements and Shell standards are incorporated;
- all good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with vessel collisions have been undertaken; and
- no stakeholder concerns have been raised.

The residual impact associated with a fuel spill during offshore refuelling at part of the Bratwurst-1 drilling campaign is considered acceptable.

5.6.4.5 *Hydrocarbons Dropping Out from Flaring During Well Testing*

Activity

During well testing there is a potential for hydrocarbons to drop out whilst flaring. See **Section 5.5.5** for a description on flaring during well testing. Although flaring is optimised to reduce incomplete combustion, there is a potential for some uncombusted liquid hydrocarbons to drop out during flaring operations. As it is not possible to recover these fluids, they will be released to the marine environment. Well testing is a contingent activity. Should well testing take place it would occur over approximately one week.

Impact Assessment

Physical Environment

Small volumes of hydrocarbons released to the marine environment during flaring may result in localised impacts on water quality. Impacts are considered to be negligible and highly localised. Given the short duration of well testing, small volumes of hydrocarbons will rapidly dilute to non-toxic levels that will not have any impact on threatened/migratory or other marine fauna or any sensitive habitat (e.g. shoals/banks or offshore reefs or islands).

Table 5 - 38: Risk Assessment for Hydrocarbons Dropping Out from Flaring During Well Testing

Project Component/ Activity	**Environmental Value/Sensitivity**				**Evaluation – Unplanned**		
	Physical Environment	*Threatened species and ecological communities*	*Ecosystems, communities and habitats*	*Socio-economic and cultural environment*	*Significance*	*Likelihood*	*Residual Risk*
Liquid hydrocarbons dropping out whilst flaring	X	-	-	-	Slight	Remote	Negligible

Key Management Controls Identified		
Control	*Demonstration of ALARP*	*Control Adopted*
Standards, Legislation, Best Practice		
Inspect and maintain well testing equipment in accordance with MODU Safety Case Revision.	Standard practice. Compliance with legislation. Reduces likelihood of impact.	Yes
Elimination		
None identified	Flaring during well testing is a safety requirement and cannot be eliminated.	-
Substitution		
None identified	-	-
Reduction		

High efficiency burners will be used in accordance with MODU procedures/well testing specifications	High efficiency burners optimise combustion and reduce hydrocarbon drop out	Yes
Mitigation		
Undertake visual monitoring of the flare during well testing	Burner efficiency can be adjusted when liquid drop out is identified to mitigate hydrocarbon dropout	Yes

Summary of ALARP	
The expected impact significance to water quality from hydrocarbon drop out from flaring during well testing is slight due to there being no sensitive receptors expected to be impacted and due to the short-term localised nature of the hydrocarbon release. Overall the likelihood of the event occurring is remote and the residual risk ranking is assessed to be negligible.	
Demonstration of Acceptability	
Principles of ESD	The impacts from hydrocarbon drop out from flaring during well testing are consistent with the principles of ESD based on: • the environmental receptors are not expected to be significantly impacted. • significant impacts on the health, diversity, productivity and ecological integrity of the environment are not expected to occur. • the socio-economic values/sensitivities within the Operational Area are not expected to be impacted.
Relevant Requirements	OPGGS Act, Navigation Act, Marine Orders, COLREGS
Internal and External Context	• Shell's consultation program has considered statements and claims made by stakeholders when undertaking the assessment of impacts and risks. • Shell has reviewed conservation advices and recovery plans for whale sharks, marine mammals and turtles and considered key threats to these species in the management of impacts and risks as relevant to the risk of hydrocarbons dropping out during well testing. • Shell has also considered the internal context, including Shell's environmental policy and HSSE & SP Control Framework and the OVID process, is applicable to this planned activity. • The EPOs, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Bratwurst-1 drilling campaign and Shell's internal requirements.
Summary of Acceptability	
The residual impact is negligible given the application of the controls outlined above and the following points: • the remote likelihood of risk; • regulatory requirements and Shell standards are incorporated; • good practice developed from Shell's global vessel operations, industry guidelines and practical mitigations to reduce the risk associated with vessel collisions have been undertaken; and • no stakeholder concerns have been raised. The residual impact associated with a fuel spill during offshore refuelling at part of the Bratwurst-1 drilling campaign is considered acceptable.	

6 Oil Pollution Emergancy Plan (OPEP)

The Bratwurst-1 Drilling Campaign Oil Pollution Emergency Plan (OPEP) supports the drilling of the Bratwurst-1 exploration well in the unlikely event of an oil pollution emergency during this activity. Operations are planned to take place after 1 July 2019, with a nominal spud date of 1 August 2019.

This OPEP outlines preparedness and response arrangement for worst credible spill scenarios that may occur as a result of the Bratwurst-1 drilling campaign. It describes the environmental sensitivities within the environment that may be affected (EMBA) priorities for protection and appropriateness of available response strategies for each scenario. The plan also describes response arrangements, preparedness and capability and roles and responsibilities associated with the response. Information on training and competency of oil spill response personnel is outlined within the Bratwurst Environment Plan (EP).

Shell Australia has significant operational presence in the Browse Basin due to its Prelude FLNG project, approximately 55km to the southwest of the well location, which provides a high level of existing Emergency Response preparedness in the region which can be leveraged for this exploration activity. A majority of the Emergency Response capability presented in this OPEP, including trained personnel, IMT and Command, support, and plans are provided by these existing Prelude FLNG arrangements.

Table A & B has been developed to guide response personnel through the key steps of this OPEP during a level 1(Tier1) Level 2 (Tier 2) or Level 3 (Tier 3) spill.

An overview of initial (first strike) actions for **vessel spills** are in **Table A**. **Table B** contains initial (first strike) actions for **loss of well containment**.

Vessels Spills: Australian Maritime Safety Authority (AMSA) is the control agency; Shell undertake first strike actions and support AMSA in accordance with the MOU. Seek early engagement with AMSA liaison officer.

Loss of well containment: Shell is the Control Agency except for any part of the spill which enters state waters, in a level 2 (Tier 2) DoT becomes the Control Agency for the response in WA state jurisdiction (coordinated command). Seek early engagement with DoT liaison officer, as per the latest DOT Inductry Guidance Note (September 2018).

Information to support the initial (first strike) response requirements is included in the rest of this Oil Pollution Emergency Plan (OPEP).

Unidentified spill sources, including for level 1 (Tier 1) (minor) spills, ensure samples are taken for onshore fingerprint analysis as soon as possible. Sample bottles and analysis arrangements are coordinated through the Mobile Offshore Drilling Unit (MODU).

Definitions for ‘Responsible role’ persons in Tables A & B are as follows;

- ERT – Emergency Response Team (MODU Based)
- IMT (W) – Incident Management Team (West) (Perth Based)
- OIM- Offshore Installation Manager (MODU based)
- VM – Vessel Master

6.1 Table A Vessel Spill - Initial (First Strick) Action

	Responsible Role		Spill from Vessel (AMSA Control Agency)		
Item	IMT (IMT Leader)	VM	Initial (First Strike) Actions	Information Resources/ Contact Information	Comments
1.		✓	Stop the spill	Vessel shipboard oil pollution emergency plan (SOPEP)	
2.		✓	Vessel Master alert the OIM (ERT)		
3.		✓	Initiate Monitor and Evaluate: Gain and maintain situational awareness. Deploy satellite tracking buoy as close to spill source as possible	Visual observations, deploy tracking buoy.	
4.		✓	Classify the Level of spill	Appendix F	
5.		✓	Verbally notify AMSA Rescue Coordination Centre (RCC)	24 hr AMSA Ph: 1800 641 792 Notification to AMSA RCC. AMSA is the Control Agency and will respond in accordance with its Marine Pollution Response Plan (National Plan 2017). ERT and IMT (W) will provide support as directed by AMSA.	
6.		✓	Activate IMT (W)	IMT Leader to liaise closely with AMSA Incident Commander regarding response.	
7.		✓	Prepare Pollution Report (POLREP), submit it to AMSA and give copy to IMT (W)		
8.	✓		Verbally notify NOPSEMA of Level (Tier) 2 or Level (Tier) 3 spill **within 2 hours.**	Complete verbal notification within 2 hours of spill occurrence	
9.	✓		Immediate notification to Shell STASCo in the event of; • a spill to water from maritime transportation operations; or • any Shell related marine incident	IMT Leader	
10	✓		IMT Leader to Engage with appropriate Business Executive who will in turn liaise with (This action should also be in the Vessel First strike plan above) Crisis Management Team CMT		
11	✓		Initiate further Monitor and Evaluate actions: aerial, vessel, modelling, satellite, weather forecasts	Shell IMT (W) has modelling resources. To contact RPS APASA contact Australian Marine Oil Spill Centre (AMOSC) Shell IMT (W) to contact support vessels in the vicinity to be on stand-by	
12	✓		Mobilise Oil Spill Monitoring Plan (OSMP) contractor	Environment Unit to contact contractor (AIMS)	
13	✓		Initiate incident planning for next operational period.	IMT Leader to seek input and agreement from AMSA Incident Controller (IC) as the Control Agency.	

6.2 Table B Well Operations Oil Spill – Initial (First Strick) Actions

	Responsible Role		Spill from Rig (Shell Control Agency*)		
Item	**ERT**	**IMT (IMT Leader)**	**Initial (First Strike) Actions**	**Information/ Resources/ Contact**	**Comments**
1.	✓		Isolate the Source of the Spill	Drilling Emergency Response Plan Note: As per Contractor SOPEP for drill campaign.	
2.	✓		Alert the IMT (W)	Rig Operator activate their IMT and SOPEP	
3.	✓		Classify the Level of spill		
4.	✓		Initiate Monitor and Evaluate: Gain and maintain situational awareness (visual observations). Deploy satellite tracking buoy as close to spill source as possible	Visual observations, deploy tracking buoy.	
5.	✓		Activate IMT		
6.	✓		Prepare POLREP for AMSA, submit it to IMT.	External notifications/forms	
7.		✓	Verbally notify NOPSEMA of Level (Tier) 2 or Level (Tier) 3 spill **within 2 hours**	Contact made within 2 hours of spill occurrence	
8.		✓	Immediate notification to Shell STASCo in the event of; • a spill from an Asset that could result in a Tier 3 (level 3) response. • any Shell related marine incident	IMT Leader Request GRSN mobilisation if required (Level (Tier) 3).	
9.		✓	IMT (L) to Engage with appropriate Business Executive who will in turn liaise with (This action should also be in the Vessel First strike plan above) Crisis Management Team CMT		
10		✓	Notify and Mobilise AMOSC, DoT and Department of Biodiversity, Conservation and Attractions (DBCA) (and AMSA, STASCo (GRSN), OSRL as required)	Support Team Activation and External Notification and Reporting. AMOSC: IMT Leader call DoT: IMT Leader call Duty Officer DBCA (oiled wildlife): IMT Leader As Require AMSA: IMT Leader OSRL: IMT Leader request through STASCo	
11		✓	Notify Key Stakeholders, request liaison officers (DoT/AMSA etc.) imbedded in IMT and keep informed as appropriate	Support Team Activation and External Notification and Reporting	
12		✓	Initiate further Monitor and Evaluate actions: aerial, vessel, modelling, satellite, weather forecasts	Shell IMT has modelling resources. To contact RPS APASA contact AMOSC	
13		✓	Initiate source control oil spill response strategy		
14		✓	Mobilise Oil Spill Monitoring Plan (OSMP) contractor	Environment Unit to contact contractor (AIMS)	
15		✓	Identify Protection Priorities		

	Responsible Role		Spill from Rig (Shell Control Agency*)		
Item	**ERT**	**IMT (IMT Leader)**	**Initial (First Strike) Actions**	**Information/ Resources/ Contact**	**Comments**
16		✓	Validate strategic spill impact mitigation assessment (SIMA) to generate the initial operational SIMA	Strategic SIM Section 6.3.	
17		✓	Initiate incident planning for next operational period.		
18		✓	Implement incident plan.		
19		✓	Use monitor and evaluate data to update spill modelling outputs		

*In line with SHP-MEE, WA DoT is the Control Agency within state waters (including Browse Is.) for any Offshore Facility Spills which enter WA state waters. In this instance, Shell would remain in the Control Agency within Commonwealth (Australian Government) waters. Remember theat WA DoT are on;y thr Control Agency when it is greater than Level 1 incident.

6.3 Incident Managemetn System

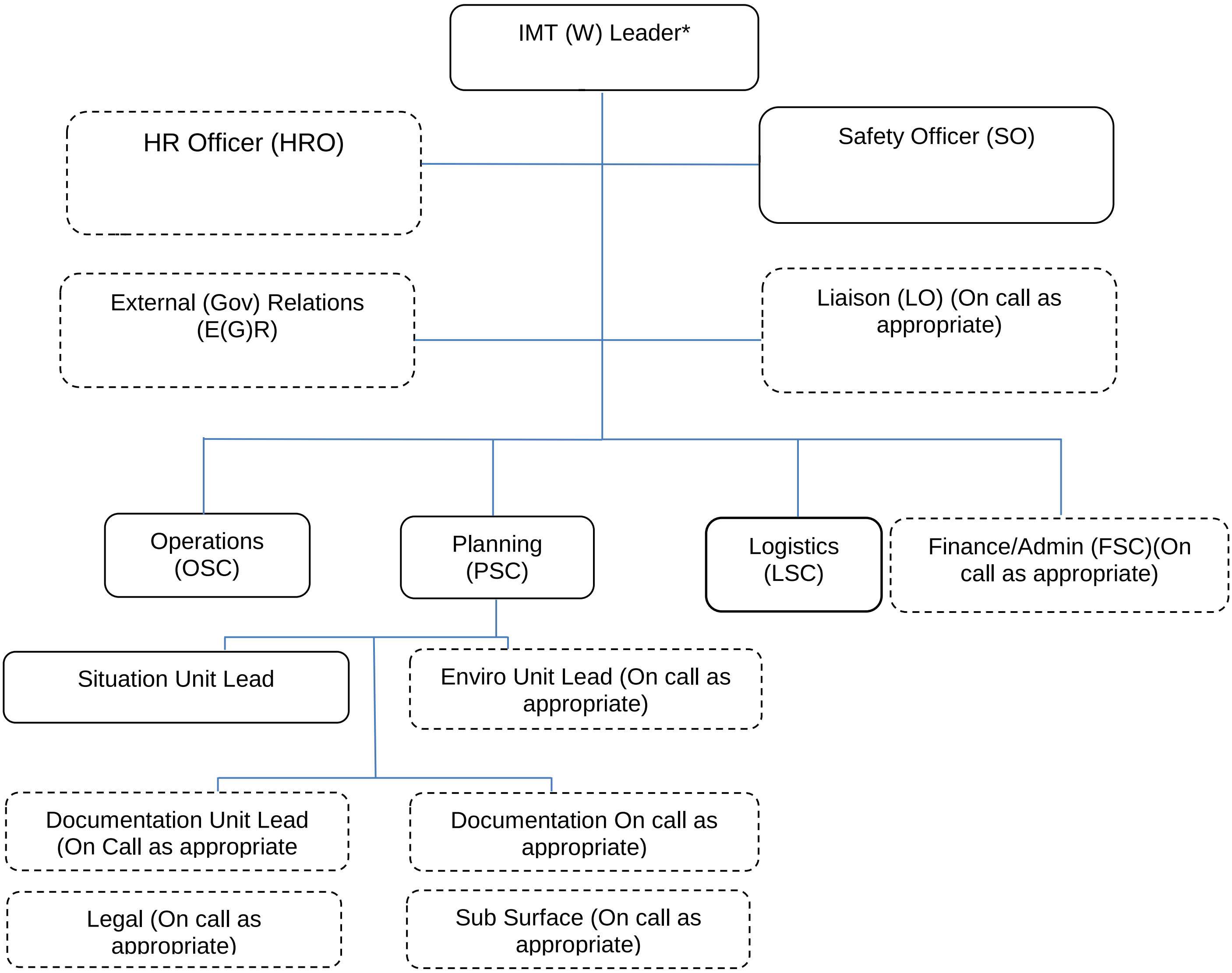
Shell utilise the Incident Command System (ICS) IMS framework. This enables Shell to conduct a more effective response through use of a broad range of personnel resources by using globally consistent terminology

6.4 Command Structure

Shell Australia Incident Management Team (IMT) (West) Emergency Response Plan describes roles and responsibilities of the level 2 IMT(W) in response to an all hazards emergency.

There are various key roles and responsibilities in the initial (first strike) actions stage of a spill response that are key to an effective and efficient response (Figure – Command Structure). The IMT(W) Leader determines the size and nature of the activated response organisation in consideration of the Level of the incident, nature of the incident (i.e. MEDEVAC vs Hydrocarbon Release), scale of response, and utilising the principle of 'prudent over-reaction'.

Figure: Incident Management Team (West) (IMT (W)) Structure



6.5 Spill Impact Mitigation Assessment (SIMA)

The strategic SIMA was developed based on the risk evaluation, ALARP and acceptability assessments for all the emergency events outlined in **Section 5**.

An Operational SIMA will be conducted in an extended response using the strategic SIMA as the initial basis. If required, a more detailed SIMA will be conducted following the SIMA process outlined within the IMT (W) ERP. As always documented justificaitons for decisions made is important as this process forms the basis for what spill response strategies will be implemented through each operational period of an IAP. The SIMA will consider relevant receptors when conducting the SIMA. This will include consideration of relevant information outlined in Marine Park Management Plans or Threatened Species Recovery Plans as relevant to the spill. These plans will help inform the proposed response options for implementation and that any impacts from these are acceptable in the context of the impacts to the specific values and sensitivities.

Following implementation of the initial (first strike) response, it is always important to provide documented justification of reasoning for decisions being made in a response, hence the table below outlines reasons why or why not they planned to be used during the Initial (First Strike) Actions.

Table C: Strategic SIMA: Strategy applicability to credible worst case scenarios used for planning initial (First Strike) response

Strategy Applicability	Vessel collision – diesel (~up to 250 m^3)	Well Blow-out – Crux condensate (~up to 453,342 m^3)
1. Monitor and Evaluate	**Planned (First Strike)** - Monitor and Evaluate is applicable and helpful in all spill events. This strategy has several sub strategies (personnel surveillance through to aerial surveillance) and is scalable according to spill nature and scale. SIMA will always support the implementation 'Monitor and Evaluate' given the clear benefits in maintaining situational awareness throughout the duration of a spill event and little or no environmental impact associated with its implementation. This strategy intentionally duplicates some tools outlined in the Oil Spill Monitoring Strategy.	
2. Source Control	**Planned –** Source control as per Vessel SOPEP.	**Planned** – Subsea Source Control will be implemented using an OSRL capping stack located in Stavanger, Norway. Additionally, there is a requirement for supplementary equipment specifically to facilitate the safe deployment of the capping stack onto a hi flow gas well in shallow water, known as the Offset Installation Equipment (OIE), owned and operated by Saipem and is located in Trieste, Italy. Shell will mobilise the AMOSC SFRT and Dispersant stockpile to Broome for transhipment to a suitable vessel for transport and deployment at the incident location. AMOSC SFRT equipment is located in Perth - mobilisation and transport interval of approximately five days (from the point of initial callout to the point of departure from the port of Broome). Capping stack and OIE being located in separate locations in Europe will represent a shipping interval of between 35 – 42 days, with the proposed destination of Darwin.
3. Natural Recovery	**Planned (First Strike)** - Natural recovery is the most effective response to reduce the spill volume through natural weathering and fate processes.	**Planned (First Strike)** - Natural recovery is the most effective response to reduce the spill volume through natural weathering and fate processes. Natural recovery is often the most effective response technique for light oils (Group 1-3).

4. Chemical Dispersant	**Not planned** - Diesel evaporates and spreads rapidly and will likely be too thin to enable effective use of chemical dispersants.	**Not planned (Surface)** - Chemical dispersant testing was carried out on Prelude condensate. The testing was shown to be relatively effective. However, condensate is a rapidly spreading oil and, by the time it is safe to approach the slick, it is likely to be too thin to be amenable to chemical dispersant. Oiling does not reach or contact any environmental sensitivities before degrading below threshold concentrations, therefore there is no mitigation supporting the strategy as dispersant application acts to drive hydrocarbons into the water column thereby reducing any natural recovery on the surface. **Not planned (Subsea)** - The application of subsea dispersant at the well head using the Subsea First Response Toolkit (SFRT) would not be beneficial in the blow-out scenario for Bratwurst. The expected high pressures, flow rates and ratio of gas to condensate would produce a highly turbulent environment that would result in extremely small oil droplets. The addition of subsea dispersant would not be expected to act to reduce the droplet size any further and the oil produced from the blowout could be considered 'dispersed' and is predicted to remain largely (80%) entrained without dispersant application. The biodegradation rate of the released hydrocarbons would not be expected to be increased as a result of the addition of dispersant subsea and therefore no mitigation would be expected from employing this strategy.
5. Contain and Recover	**Not planned** - Diesel spreads too quickly and it will be too thin to corral, it will mostly degrade naturally. There is no net environmental benefit.	**Not planned** - Condensate is a rapidly spreading oil and by the time it is safe to approach the slick, it is likely to be too thin to be amenable to the contain and recover strategy.
6. In-situ Burning	**Not planned -** diesel spreads too quickly and it will be too thin to corral to enable in-situ burning.	**Not planned -** condensate is a rapidly spreading oil and, by the time it is safe to approach the slick, it is likely to be too thin to be amenable to in-situ burning. Given the waxy nature of persistent fractions, it is unlikely that burning will be able to be initiated.

7. Protect and Deflect	**Not planned -** The ‘Protect and Deflect’ strategy is unlikely to work in the deep water, open ocean environment immediately surrounding the emergent sensitivities (reefs). Access to the shallow intertidal area on top of emergent sensitivities is likely to be very difficult/not safe. Potential boats are too small to be safely able to use set up booms and anchors to protect the island. Even if the boats could carry the anchors, anchor and boom placement in the shallow intertidal area is likely to cause more direct damage reefs. Strong tides and currents are also a limiting factor for any shoreline deflection boom deployment along coastlines or islands.
8. Shoreline clean up	**Planned -** In the event of shoreline contact, shoreline clean up could be carried out at contacted shorelines such as Cartier Island and Browse Island (Key Ecological Receptors). Preparations for shoreline response should be made as soon as predictions indicate a possible shoreline impact. DoT IC (as control agency) approval is required before commencing shoreline clean-up in state waters, and liaison with DoEE for spills involving Protected Matters (i.e. Ashmore Reef).
9. Oiled Wildlife	**Planned -** In the event oiled wildlife are detected during a response, oil wildlife response will be carried out.
10. Oil Spill Monitoring Plan	**Planned (first strike) –** In the event of a level 2 or level 3 spill, the oil spill monitoring plan will be enacted. Some key operational monitoring techniques are also covered under the monitor and evaluation strategy (OM1, OM3 and OM8) as well.

Table D: Shoreline Clean-up Commencement and Termination and Capability Summary

Sub strategy/ Tools	Level 1 Use?	Level 2 Use?	Level 3 Use?	Commencement Criteria	Termination Criteria	Resources
Shoreline Clean-up	No	Yes	Yes	Level (Tier) 2 Level 3 spills which are predicted to impact a shoreline. Within WA jurisdiction, as agreed with WA DOT.	For WA state jurisdiction as agreed with WA DoT; For Commonwealth jurisdiction in consultation with the relevant government agencies (e.g. AMSA and DOEE); For international locations (East Timor and Indonesia) in consultation with the relevant international agencies and DFAT.	For offshore islands and remote shorelines: • Prelude FLNG (or other vessel) will act as a staging and accommodation facility. • Approximately 10 personnel with handheld equipment such as shovels and bulk bags. • Helicopter call-off contract in place to mobilise people, equipment and waste to remote shorelines from staging/accommodation facilities. Given the maximum volumes ashore are small (19 m^3) and the maximum length affected is also small (upto 5 km) compared to overall legth of shorelines in the area substantial personnel and equipment resources would not be expected to be required to respond to such an incident. Therefore, for accessible WA mainland or NT coastlines, in addition to above, the following resources are expected to be required but could be scaled up if required; • Upto 50 people with handheld equipment such as shovels and bulk bags.

Table E: Oiled Wildlife Resources and Application

Resource Equipment	Number required	Specification	Primary Resource location	Agreement in Place	Mobilisation time
Vessel	1	Storage capacity for 50 oiled fauna and potentially oiled wildlife kit and auxiliaries.	Vessels will be accessed from support vessels already on contract, or Shell's marine broker arrangements (vessels of opportunity).	Shell has arrangements in place with marine broker to identify available vessels quickly. Shell is a participating member of AMOSC with access to Mutual aid arrangements.	Marine broker and Mutual Aid vessels availability and mobilisation time dependent.
Personnel	77 (expected worst case as level 4 per WA OWRP)	People with training and skills are deployed.	AMOSC, Core Group (Australia Wide). OSRL and International expertise. DBCA to be notified in relation to impacts within state waters (and adjacent commonwealth waters with DoEE as well) and assistance requested.key personnel.	Shell is a participating member of AMOSC with access to Mutual aid arrangements. AMSA MoU and OSRL contracts.	Core Group members can be available within 3 days. DBCA personnel response expected within 3 days. Other personnel will likely take around 7-10 days to mobilise. Personnel is not expected to be a bottleneck in OWR implementation.
Equipment	1	Depending on kit size, anticipate sizing for 50 oiled fauna units would be more than adequate.	Fremantle.	Shell is a participating member of AMOSC with access Mutual aid arrangements.	34 hours from Fremantle to Broome + 30 hours by vessel (+ mobilisation times).

7 Implementation Strategy

The OPGGS(E) Regulations requires that an EP contains an implementation strategy that includes the following information:

- reporting requirements to the Regulator;
- description of the environmental management system used to manage the activity,
- a clear chain of command;
- measures to communicate employee and contractor responsibilities;
- sufficient monitoring, recording, auditing, management of non-conformance and review of environmental performance and the implementation strategy;
- sufficient monitoring and recording of emissions and discharges;
- an OPEP; and
- appropriate consultation of authorities and other relevant persons/organisations.

7.1 Management Systems

All Shell's operations are conducted in accordance with Shell's HSSE and SP Control Framework (**Section 3**).

Shell's Wells Global Management System operates within the HSSE and SP Control Framework and provides for a consistent approach across Shell's well activities globally. It sets out the principles, policies, standards, and processes that must be adhered to for risk management, technical assurance and standards, competency as well as HSE management. The WOMP for the Bratwurst-1 drilling campaign describes the application of the Shell Global Well Management System specifically to the activities covered in this EP.

The MODU contractor operates under a safety case which identifies major accident events and the associated controls and mitigation measures for the MODU. The safety case also describes MODU operation; explains the risk identification and assessment processes; demonstrates how the contractor's HSE systems manage those risks to ALARP, and details recovery measures.

The MODU contractor also implements a Safety Case Revision Document that identifies any additional risks specifically associated with the Bratwurst-1 drilling campaign that are not already covered in the safety case. It demonstrates how Shell's Management Systems are planned to be bridged to the contractor's HSE Management Systems to maintain a consistent management approach between the two companies, including linkages to Shell's Emergency Response Plan (Guidance Document) (GEN_GEN_000014).

7.1.1 Chemical Selection Process

The following is a summary of the chemical environmental discharge assessment process outlined in the Shell Chemical Management Process (HSE_GEN_007879) which assesses chemicals planned or likely to be discharged to the ocean, which may cause a credible risk to the marine environment, based on different criteria. Where the below criteria are met, this demonstrates impacts associated with the chemicals use are acceptable.

At the heart of the process are the guidelines from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS). CEFAS assigns product ratings for the petroleum industry based on the Offshore Chemical Notification Scheme (OCNS), on behalf of the UK government. These ratings are based on the physical, chemical and ecotoxicological properties of products. Chemicals are assessed in one of two ways:

1) Using the Chemical Hazard and Risk Management (CHARM) model which takes into account exposure of the chemical(s) to the environment and allows a risk assessment to be performed. The CHARM model calculates the ratio of Predicted Environmental Concentration (PEC) against the Predicted No Effect Concentration (PEC:PNEC). This is expressed as a Hazard Quotient (HQ), which is then used to rank the product from purple (most hazardous), through orange, blue, white, and silver, to gold (least hazardous).

2) Non-CHARM products not applicable to the CHARM model (e.g. inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A (most hazardous) through to E (least hazardous) based on their intrinsic environmental hazard (effect) and fate properties.

Where proposed substances do not have an OCNS ranking, other sources of information and assessment criteria will be used as detailed further below. The chemical environmental discharge assessment process is depicted in Figure 62 below. The Chemical Selection Process will be led by the Production Chemist with inputs from the HSSE Team, Chemical user/proponent, and subject matter experts as required and ensures impacts and risks associated with chemical discharge are reduced to levels that are ALARP and acceptable, while meeting operational performance requirements.

<u>For Chemicals with OCNS Ranking:</u>

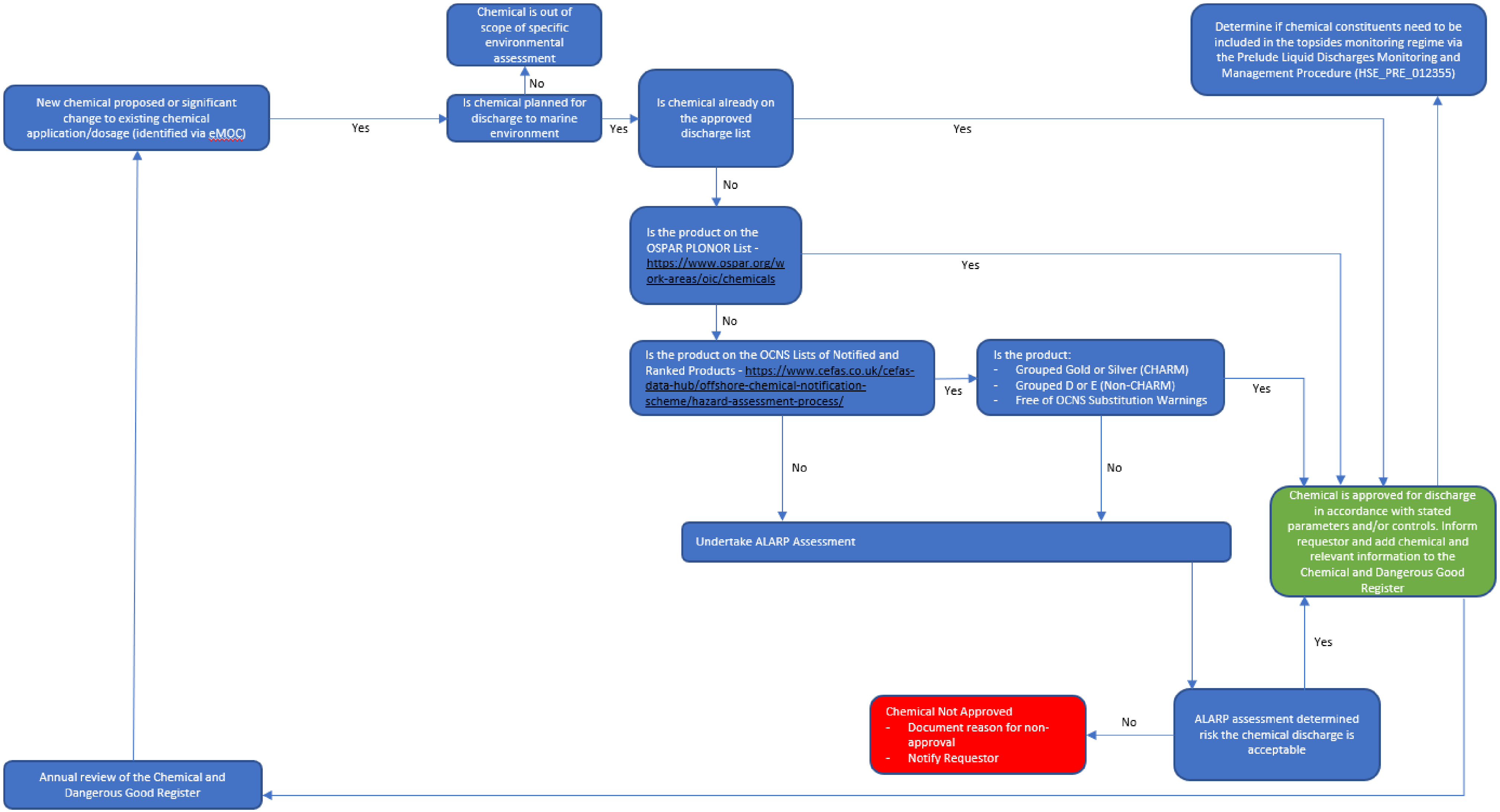
Chemicals that are grouped Gold, Silver, E or D under the OCNS Lists of Notified and Ranked Products and have no substitution warning do not require further assessment, as they do not represent a significant risk to the environment.

The foremost objective for Shell is to use chemicals that meet the above criteria. If the proposed chemical does not meet this criteria, an alternative chemical which will meet the desired criteria will be sourced where practicable.

However, if no other technically acceptable available chemicals meet the criteria and the proposed chemical has an OCNS grouping of white, blue, orange, purple, A, B, C or has a product/substitution warning, an ALARP assessment is required to determine acceptability prior to approval and use (Figure 62).

<u>For Chemicals without OCNS Ranking:</u>

If basic criteria (OCNS ranking) information is not available for the proposed chemical, an ALARP assessment in accordance with the method outlined in this EP will be undertaken to determine acceptability prior to approval and use (Figure 62 below).


Chemical is out of scope of specific environmental assessment
No
New chemical proposed or significant change to existing chemical application/dosage (identified via eMOC)
Yes
Is chemical planned for discharge to marine environment
Yes
Is chemical already on the approved discharge list
Yes
Determine if chemical constituents need to be included in the topsides monitoring regime via the Prelude Liquid Discharges Monitoring and Management Procedure (HSE_PRE_012355)
No
Is the product on the OSPAR PLONOR List - https://www.ospar.org/work-areas/oic/chemicals
Yes
No
Is the product on the OCNS Lists of Notified and Ranked Products - https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment-process/
Yes
Is the product:
- Grouped Gold or Silver (CHARM)
- Grouped D or E (Non-CHARM)
- Free of OCNS Substitution Warnings
Yes
No
No
Undertake ALARP Assessment
Chemical is approved for discharge in accordance with stated parameters and/or controls. Inform requestor and add chemical and relevant information to the Chemical and Dangerous Good Register
Yes
Chemical Not Approved
- Document reason for non-approval
- Notify Requestor
No
ALARP assessment determined risk the chemical discharge is acceptable
Annual review of the Chemical and Dangerous Good Register

7.1.2 Management of Change (MOC)

Management of change (MOC) is a compulsory Shell requirement to avoid incidents resulting from unforeseen consequences of Process Changes, Procedural Changes or Organisational Changes. Changes must be fully documented and reviewed by senior project management, prior to decision and communication of the change to all relevant parties, and execution as per Wells Management of Change and Deviation manual (WS 38.80.31.11-Gen). This defines the requirements for managing changes within a well project and deviations to requirements specified in Wells Manuals. This manual applies to projects, activities and operations that are under Wells operational control.

All changes presented under the MOC process require Health, Safety, Security, Environment & Social Performance (HSSE&SP) screening and endorsement. If a change is considered significant as per Regulation 17 (5) or (6) then a revised or new EP will be submitted to NOPSEMA for acceptance.

If the MOC is related to a change in location from what was described in the accepted EP after OPEP response arrangements have been tested, and before the next test is conducted, the testing shall be in relation to the new location as soon as practicable after it has been added to the plan, in accordance with Regulation 14 (8C).

7.1.3 Oil Pollution Emergency Plan (OPEP) and Oil Spill Monitoring Plan (OSMP)

The Bratwurst-1 Drilling Campaign OPEP (HSE_GEN_015415) is presented in a standalone document. It contains all response related information on the roles and responsibilities of key personnel in the event of an oil spill response.

The Shell Australia Oil Spill Monitoring Plan (OSMP) (HSE_PRE_000496) and supporting Operational and Scientific Monitoring Plans (OM's and SM's) form the basis of the OSMP implementation strategy. Shell has previously submitted the OM's and SM's to NOPSEMA for assessment and refers to these as information previously given to NOPSEMA. Maintenance and testing arrangements for the OSMP are outlined within the OSMP (HSE_PRE_000496) itself.

7.2 Environmental Management and Mitigation Measures

The management measures for each aspect of the operations are presented and discussed in **Section 5**.

7.3 Roles and Responsibilities

Roles and responsibilities associated with this EP for key personnel are summarised in **Table 7 - 1**. Key roles and responsibilities related to the management and implementation of oil spill response arrangements in the event of an emergency event are outlined within the OPEP.

Table 7 - 1: Acceptability Categories

Position	Responsibilities

Well Operations Team Lead	• Overall accountability for the activity. • Responsible for assigning resources and planning. • Responsible for the competence of the crews and contractors. • Responsible for auditing and verification. • Responsible for external reporting. • Accountable for Emergency and Oil Spill Response preparedness and readiness.[3] • Responsible for Environmental Performance and compliance with the EP.
SA Senior Well Engineer Operations (SWEO) [Rig Superintendent role]	• Reports to Well Operations Team Lead. • Responsible for the implementation of the EP. • Responsible for monitoring compliance (including contractor performance). • Responsible for the drilling unit compliance with Shell standards and any additional requirements laid out in this EP. • Responsible for the operational obligations outlined in this EP are communicated to the well site and is understood by the Senior Shell well site representative (SA Drilling Supervisor).
MODU Offshore Installation Manager (OIM)	• Responsible for carrying out all operations aboard the MODU in a manner consistent with EP. • Responsible for training and competency of all personnel so that they can carry out duties as required in this EP. • Responsible for notifying the SA Drilling Supervisor of any incidents arising from operations that may have an adverse impact on the performance objectives identified in this EP. • Manage deck spills per SOPEP.
AHT Master	• Responsible for acting immediately to rectify any environmental incident from the AHT • Ensure all crew members comply with the EP. • Manage deck spills per SOPEP. • Responsible for ensuring cetacean sighting recording is undertaken.
SA Drilling Supervisor(s) (DSV) (Company Site Representative)	• Infield implementation and monitoring including implementation of maintenance plan, waste management plan, operational procedures, maintaining logs. • Responsible for the operational obligations of this EP, communicating these obligations to the rig crew and enforcing compliance. • Prepare the well site operations plan and communicate this to the rig crew. • Daily reporting to the SWEO. • Responsible for ensuring FIM reports and reporting incidents to Shell.
MODU Crew	• Responsible for immediate reporting of any environmental incident to the OIM. • Responsible for waste materials disposal such that no waste materials are disposed of to the sea (other than waste from the vessel's ablutions). • Follow any directive issues by the OIM with respect to environmental protection.
Wells and Logistics HSSE advisor	• Support and provide advice to the SWEO on HSE for the activity. • Compile monthly reporting and end of activity reports. • Manages HSSE incident investigations and closeout of actions and reporting.
Logistics Manager	• Accountable for provision of logistics resources for the activity including aviation, marine and compliance with this EP.

[3] Note, this does not include any responsibilities specifically around executing emergency or oil spill response activities. These are all outlined within the OPEP.

MM Lead Wells	• Accountable for the provision of logistics resources including supply base, warehouse, road transport, airfreight and waste services and compliance with this EP.
Onshore Supply Chain Coordinator	• Responsible for execution of supply base, warehouse, road transport, airfreight and waste services and compliance with this EP.
Offshore Supply Chain Coordinator	• Responsible for execution of cargo management to and from the MODU in coordination with the Onshore Supply Chain Coordinator and compliance with this EP.
Aviation Service Coordinator	• Responsible for implementation of aviation logistics in compliance with this EP.
Rig Maintenance Supervisor	• Maintains a list of environmentally sensitive hoses as well as other critical maintenance items.

7.4 Competence and Inductions

7.4.1 Competency

All personnel required to work on the Bratwurst-1 drilling campaign shall be employed on the basis they are competent to do their job.

Within Shell, the HSSE and SP Control Framework requires people in HSSE Critical Positions to have their HSSE-MS competence assured. These people must attain a set proficiency level in three competences: HSSE Lead; HSSE Prepare; and HSSE Apply. People in HSSE Critical Positions are responsible for the development and maintenance of effective barriers to prevent incidents.

SA maintains a HSSE Critical Positions Register and HSSE Critical Positions have been identified and positional competency requirements have been defined according to the Group HSSE Competence Framework Critical Leaders.

The minimum standard of competency in the Wells department staff is detailed in the Global Wells Management System Manual. HSSE professionals, including the Wells and Logistics HSSE advisor, have competency requirements established in the Global HSSE and SP Management System Manual.

Shell Drilling Supervisors must have attended a W320 Advanced Well Control course in the past 4 years (an internally run Shell course) or have sat a Shell Trade Test (for contractors) and hold a valid International Well Control Forum (IWCF) / International Association of Drilling Contractors (IADC) certification.

In terms of the MODU and vessel contractors, only prequalified companies with whom Shell has a service agreement are qualified to bid for the activity. A HSE pre-qualification questionnaire is included in the tender package, which is evaluated by the HSE department in parallel to the technical and commercial evaluations. The provisions of the OVID assurance program apply to all contractor vessel activities associated with Shell. Shell stakeholders required to assure a positive vetting include Marine Subject Matter Expert, Aviation Subject Matter Expert and country security manager, Global Maritime Marine Warranty Surveyor and the project workstreams responsible for the activity to be conducted. Contractors have their own Competence requirements in place.

7.4.2 MFO Training for VSP Operations

A suitable number of crew will be trained by an experienced MFO and be onboard the MODU before any VSP will occur such that at least one trained MFO will be on watch during the VSP. The objective of the training will be to ensure the following requirements are understood by the trained MFO's:

Policy Statement 2.1 key requirements:

- A.3.1 Pre-Start-up-Visual Observation:
  - During daylight hours, visual observations (using binoculars and the naked eye from a high vantage point on the MODU) for the presence of whales will be undertaken by a suitably trained4 crew member for at least 30 minutes before the commencement of VSP activities.
- A.3.2 Soft Start Procedure (also known as ramp-up):
  - VSP acoustic source will be initiated at the lowest power setting, with a gradual ramp-up over a 30 minute period until the full operating power level is reached.
- A.3.4 Operations Procedure:
  - During daylight hours, trained crew should undertake visual observations continuously during survey operations.
  - Operators should power down the acoustic source to the lowest possible setting when not collecting data.
- A.3.5 Stop Work Procedure:
  - If a whale is sighted within the 3km observation zone an additional trained crew member or marine mammal observer should also be brought to the bridge to continuously monitor the whale whilst in sight.
  - If a whale is sighted within or is about to enter the Low power zone (1 km), the acoustic source should be powered down to the lowest possible setting. If a whale is sighted or is about to enter the Shut-down zone (500 m), the acoustic source should be shut down completely.
  - Power-up of the acoustic source with soft-start procedures should only occur after the whale has been observed to move outside the Low power zone, or when 30 minutes have lapsed since the last whale sighting.
- A.3.6 Night-time and Low Visibility Procedures:
  - Operations may proceed provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24 hour period.
- Regulations will be applied to whale sharks identified during the drilling campaign.
- Whale identification requirements needed to distinguish species which are covered under EPBC policy statement 2.1[5].
- Distance estimation requirements and methods.
- Reporting requirements.

[4] Suitably trained: Means observers will be trained using a standard training and awareness pack developed by a Shell Biodiversity subject matter expert with experience in MFO activities. This training will be carried out before observers carry out any observation activities for VSP. The objective is that personnel will understand the observation requirements and be able to identify broad categories of cetacean (e.g. whale/dolphin/ Whale shark) suitable for MFO activities.

5 ‘Whales’ includes baleen whales and larger toothed whales, such as, sperm whales, killer whales, false killer whales, pilot whales and beaked whales.

7.4.3 Induction

All personnel will be given an HSSE induction prior to the commencement of work on the Bratwurst-1 drilling campaign so that they are aware of their obligations and commitments. The HSSE inductions shall cover:

- Shell Australia HSSE & SP Policy and Commitment;
- legislative requirements – including key MARPOL requirements;
- key environmental aspects, impacts and risks associated with the Bratwurst-1 drilling campaign; and
- Shell's key EP commitments and environmental management requirements.

7.4.4 Emergency Response Competencies

Shell Australia follows the approved ICS and IMO emergency management training requirement for ICS command and general staff. Specific competencies for IMT members are defined in the Shell Operational HSSE Competence Framework and are tracked in the Shell Open University. Relevant IMT personnel[6] trained in Oil Spill response to at least IMO2 level.

ER Exercise Attendance

To maintain competency of IMT personnel it is required that 80% of personnel will participate in an IMT exercise annually and 100% every 2 years. Participation in exercises is tracked in the SA Exercises & Training Schedule and is reviewed monthly or following significant personnel or policy change by the Shell Australia Emergency Response Coordinator.

ER Training

Only persons that have completed all mandatory training requirements can be placed on the IMT roster. Training status of IMT personnel are to be reviewed monthly (or following significant personnel or policy change by the SA ERC) and notifications issued in advance to personnel requiring re-validation by training and/or ER exercise participation.

AMOSC Core Group

As a Participating Member of AMOSC, Shell Australia contributes staff towards the AMOSC Core Group. AMOSC Core Group members require a higher level of oil spill training, including attendance at AMOSC Core Group workshops and exercises. Shell Australia has 9 Core Group members as of Feb 2019, all of whom are also members of the Shell Australia IMT, resulting in a deeper level of training and competency within the IMT(W) group.

7.5 Monitoring, Audits and Incident Investigation

This section of the EP outlines the measures undertaken by Shell to regularly monitor the management of environmental risks and impacts of the activity against the performance outcomes, standards and measurement criteria, with a view to continuous improvement of environmental performance.

[6] Relevant IMT persons: refers to the IMT lead – trained in IMO3 (or equivalent), planning, logistics and operations section chiefs and environment unit leads being trained in IMO2 (or equivalent).

Monitoring and review of environmental performance of the activity is done to meet the requirements of the following:

- Shell Australia Environmental Reporting Manual (HSE_GEN_003179); and
- Shell Australia Environmental Compliance Procedure (HSE_GEN_003177).

Emissions and discharges parameters which will be monitored during the Bratwurst-1 drilling campaign are detailed in relevant parts of Section 5 and Section 6; and are summarised in **Table 7 - 2**. Relevant data may be used for annual NGERS and NPI reporting.

Table 7 - 2: Sources of Emissions and Discharges for Monitoring

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/ Methodology*	Records	EP Reference
Discharge from bilge system	Oil Content Volume As per IOPP Certificate	Per discharge	As per IOPP Certificate	Maintenance records of oily water separator Oil Record Book	Section 5.5.2
Discharge from the sewage and greywater	Quality Volume As per ISPP Certificate	As per ISPP Certificate	As per ISPP Certificate	Maintenance records of sewage treatment system	Section 5.5.2
Drill Cutting Fluids (including pit cleaning in the event of SBM being used)	Volume of Oil in Water	End of campaign	Oil on Cuttings test	Daily Mud Report	Section 5.5.2
Ballast Water	Volume Location	As required / per exchange	Ballast Water log	Ballast Water log	Section 5.6.1
Atmospheric Emissions	Diesel sulfur content	As required (every delivery)	Delivery certificates	Delivery certificates	Section 5.5.5
	Diesel volume used	As required (every delivery)	Delivery certificates	Delivery certificates	
Non-hazardous wastes generated and disposed	Volume of wastes	As required (every delivery)	Garbage Record Book	Garbage Record Book	Section 5.5.2 and Section 5.6.2
Hazardous wastes generated and disposed	Volume of wastes	As required (every delivery)	Garbage Record Book	Garbage Record Book	Section 5.5.2 and Section 5.6.2
Accidental releases of hydrocarbons or chemicals	Type, volume and concentrations of release Incidents reported in accordance with Shell and	Per incident	Monthly incident reports and analysis. Volumes will be estimated based on technical data	Incident reports in FIM Monthly Environmental Incident Reports	Section 5.6.4

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/ Methodology*	Records	EP Reference
	regulatory requirements.		and evaluations (e.g. duration of release and known inventory)		

7.5.1 Audits and Inspections

7.5.1.1 *Planned Audits*

A series of audits and inspections are undertaken prior to commencing drilling activities as part of the MODU and AHTs pre-qualification and premobilisation assurance process, including:

- Shell's Global Rig Start-up Team inspect the MODU prior to acceptance for compliance with applicable Shell Standards and the drilling contract.
- Shell Aviation International shall conduct an audit of the MODU helideck and aircraft refueling facilities prior to rig acceptance.
- Offshore Vessel Inspection Database (OVID) style audit is conducted by the SA Marine department (results will not be published to the database) to confirm the marine integrity of the MODU and the AHTs.

No other audits are planned given the short duration and low nature and scale of the wellhead removal activity.

7.5.1.2 *Regular Inspections*

The SA Drilling Supervisor (DSV) is Shell's representatives aboard the MODU. They are responsible for ensuring the operational requirements of the EP are communicated to the MODU crew and implemented on a daily basis. The DSV may attend tool box talks as required and described in the Safety Case Revision Document (as created in conjunction with the Rig Operators) including pre-phase meetings and after action (this is reviews for the different aspects of the drilling operations e.g. fuel transfers).

The DSV also conduct's regular informal HSE checks of the MODU activities to ensure that the EP commitments are implemented, attend the daily MODU operations meetings and prepare the daily report to the SA SWEO, which details any environmental incidents that have occurred in the previous 24 hours.

The MODU contractor also conduct's checks in line with contractor requirements.

These regular checks work to make sure that the specified controls are in place to manage environmental risks, and that they remain working, and contribute to continually reducing the risks to ALARP.

The SA Marine Department communicates the operational requirements of the EP to the vessel crew, conduct regular informal HSE checks of the vessel activities to ensure that the EP commitments are implemented.

Any hazards or areas of concern identified during formal or informal inspections, or during normal working operations, will be rectified immediately where possible. Any specific worksite environmental issues identified are discussed with site management and highlighted to supervisors to brief their teams during toolbox talks and shift handovers.

Critical Monitoring and measuring equipment to be identified and inspected to ensure calibration and operation is correct. It is the responsibility of the Well Operations Team Lead to ensure this occurs.

7.6 Management and Review of Environment Plan

The only planned review of this EP will be if the well is suspended and is planned to be re-entered. The results of the review will be incorporated into planning future operations.

However, if any new or increased impacts risks are identified during the Bratwurst-1 drilling campaign, an assessment of the risk and review of the EP is undertaken and, if determined to be a significant new or significantly increased risk, the activity leading to the new risk will not continue until acceptance of the management approach to the new/ changed risks has been provided by NOPSEMA. A significant increase in risk would mean a change in the colour to a higher risk in the risk matrices (**Table 5 – 4**) for planned impacts and (**Table 5 – 6**) for unplanned events).

This review process will work to make sure that the specified controls and the EP are adequate to reduce the risks to ALARP and if the risk has changed, additional controls will be put in place, so that the risks can be continually reduced to ALARP.

7.7 Management of Incidents and Non-Conformances

All Health, Safety, Security and Environmental incidents and non-conformances are managed in accordance with the SA HSSE Incident Reporting, Investigation and Follow Up Procedure (HSE_GEN_000027) that describes the process of reporting, classification, investigation, follow-up and close out. Non-conformances are treated in the same way as incidents and for the purposes of this document will be referred to as incidents.

All incidents records are managed in an online electronic system FIM. Below is the overview of the incident management process:

- The system allows for incidents to be raised by any employee of the company including offshore personnel.
- The incident is then assigned to a Responsible Supervisor (Incident Owner) who then retains the ownership of the incident until closeout.
- The Responsible Supervisor initiates the Incident Investigation the depth of which depends on the actual and potential risk ranking of the incident.
- The recommendations of the investigation team are reviewed by the Incident Owner who then assigns the corrective and preventative actions to appropriate action party. Actions are tracked to closeout where the Incident Owner accepts that the remedial action is successfully completed based on the evidence recorded and logged in FIM.
- FIM provides functionality for automatic reminders for Incident Owner and Action Parties about the actions due. However, in addition reviews of outstanding actions are carried out both at asset/department level, and at the SA Business Assurance Committee level at regular intervals to ensure timely closeout of actions.

In addition to the Incident Management Process outlined above, SA also reports the number of non-compliances to the Shell Group on a quarterly basis, along with other HSE data in accordance with Shell Group Performance Monitoring and Reporting (PMR) standard. This information is reviewed in a dedicated HSE Business Performance Review where SA performance is reviewed by the Shell Group.

All employees or contracted staff are encouraged to submit incident reports to alert the organisation about the occurrence of an incident or non-conformance. The SA Drilling Supervisor is responsible for making sure these reports are raised in the FIM system. Incidents will be reported to Shell by the SA DSV or SA Marine Superintendent for marine vessels.

The incident investigation process works to understand the cause of an incident and the reason why a control / mitigation measure has failed and to rectify the fault to prevent recurrence and the reporting process works to track performance and allows sharing of learnings. This process contributes to reducing the risks to ALARP.

7.8 Reportable and Recordable Incidents – External

7.8.1 Reportable Incidents

NOPSEMA will be notified of all reportable incidents under Regulation 26 of the OPGGS(E)Regulation within 2 hours of the incident and in writing with 3 days. Under the OPGGS(E) Regulations, **Reportable Incidents** are defined as '*an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage*'. The Shell Group RAM (**Appendix E**) uses severity levels 0 to 5 to define environmental consequences (no effect, slight effect, minor effect, moderate effect, major effect and massive effect'). All environmental effects with a severity 3 or greater (i.e. moderate to massive) are considered Reportable Incidents. Based on the risk assessment (**Table 5 – 6**), three events are considered moderate consequence or higher:

- death of threatened, migratory or cetacean species from collision with a vessel;
- diesel spill resulting from a vessel to vessel collision; and
- a hydrocarbon spill resulting from a well control incident.

Additional reportable incidents are also captured in

Table 7 - 3. The reportable incident report will contain all material facts and circumstances concerning the reportable incident, actions taken to avoid or mitigate any adverse impacts and corrective action taken. This report will be made to NOPSEMA (phone: +61 8646 17090, submissions@nopsema.gov.au). The NOPSEMA incident reporting guidance, plus the Incident Response Form (FORM FM0831 – Reportable Environmental Incident) can be located at:

http://www.nopsema.gov.au/environmental-management/notification-and-reporting/

Table 7 - 3: Externally Reportable Incidents

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
Uncontrolled release of petroleum liquids > 80 L.	OPGGS (Safety) Regulations (Chapter 2, Part 4, Subregulation 2.41 (2)	ASAP and in writing within 3 days afterward.	NOPSEMA Incident Notification: (08) 6461 7090 Incident Reports submissions@nopsema .gov.au

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
Any spill to water	Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (2015).	ASAP once pollution has been confirmed	AMSA via Australian Search and Rescue (AusSAR) Phone: 1800 641 792 or +61 2 6230 6811 Incident Reporting Requirements: https://www.amsa.gov.au/forms/incident-report AMSA POLREP: https://amsa-forms.nogginoca.com/public/polrep.htmlhttps://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/Contingency/Oil/documents/Appendix7.pdf
Any breach in biosecurity, including exchange of ballast water within the 12 nm limit.	OPGGS(E) Regulations 2009 Reg 26. Biosecurity Act 2015; Australian Ballast Water Management Requirements 2011.	ASAP once the breach is confirmed.	NOPSEMA Incident Notification Phone: +61 8 6461 7090 Incident Reports submissions@nopsema.gov.au DAWR Phone: **1800 798 636**. Or online at: http://www.agriculture.gov.au/pests-diseases-weeds/report
Death or injury of threatened, migratory or cetacean species from collision with a vessel.	EPBC Act 1999, Chapter 5, Part 13, Division 3, subdivision C, 232 (2).	Within 7 days include the time, place, circumstances, species affected and the consequences of the action.	The Secretary, DOE Phone: +61 2 6274 1111 Fax: +61 2 6274 1666 protected.species@environment.gov.au
Reportable incidents for this EP:	OPGGS(E) Regulations 2009 Reg 26.	Verbally within 2hrs of the incident occurring.	NOPSEMA Incident Notification: (08) 6461 7090

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
• Death of threatened, migratory or cetacean species from collision with a vessel • Any spill originating from vessels. • Spill resulting from well blow-out. A reportable environmental incident means an incident relating to the activity that has caused or has the potential to cause moderate to significant environmental damage (by Shell standards this is considered a severity of 3 or greater on the Shell RAM).	OPGGS(E) Regulations 2009 Reg 26(6).	Written record of the verbal notification as soon as practical post the verbal notification.	NOPSEMA Incident Reports submissions@nopsema.gov.au DMP Email: webmaster@dmp.wa.gov.au Ph: +61 (08) 9222 3333 National Offshore Petroleum Titles Administrator (NOPTA) Email: titles@nopta.gov.au Ph: +61 8 6424 5300
	OPGGS(E) Regulations 2009 Reg 26A.	Written incident report within 3 days. Form: N-03000-FM0831**.	NOPSEMA submissions@nopsema.gov.au Or via secure file transfer at: https://securefile.nopsema.gov.au/filedrop/submissions
	OPGGS(E) Regulations 2009 Reg 26A(5).	Copy of the written incident report within 7 days of giving the written report to NOPSEMA.	DMP Email: webmaster@dmp.wa.gov.au Ph: +61 (08) 9222 3333 NOPTA Email: titles@nopta.gov.au Ph: +61 8 6424 5300

* If in state waters, contact DoT (08 9480 9924), and DMP Petroleum Environment Duty Phone within 2hrs.

** Incident Response Form (FORM FM0831 – Reportable Environmental Incident) can be located at: http://www.nopsema.gov.au/environmental-management/notification-and-reporting.

7.8.2 Recordable Incidents

Recordable incidents in the OPGGS(E) Regulations are defined as '*an incident arising from the activity that breaches a performance objective or standard in the Environment Plan that applies to the activity and is not a reportable incident*'. Performance objectives and standards for the program are detailed in **Section 5**.

NOPSEMA will be notified of all **Recordable Incidents**, according to the requirements of Regulation 26B of the OPGGS(E) Regulations. A report of Recordable Incidents must be given to NOPSEMA '*as soon as practicable after the end of each calendar month, and in any case not later than 15 days after the end of the calendar month*'.

As per the OPGGS(E) Regulations, the report will comprise:

- a record of all Recordable Incidents that occurred during the calendar month;

- all material facts and circumstances concerning the Recordable Incidents that the titleholder knows or is able, by reasonable search or enquiry, to find out;
- any action taken to avoid or mitigate any adverse environment impacts of the Recordable Incidents; and
- the corrective action that has been taken, or is proposed to be taken, to prevent similar Recordable Incidents.

Shell will email the report monthly to the NOPSEMA. Recordable incidents are captured in **Table 7 - 4**.

Table 7 - 4: Externally Recordable Incidents

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
Breach of any performance standard or objective (Table 6.1) in this EP.	OPGGS(E) Regulations 2009 Reg 26B And Part 1 (4) Definition of "recordable incident".	As soon as practicable after the end of each calendar month and in any case not later than 15 days after the end of the calendar month. Form: N-03000-FM0928	Send completed form to: NOPSEMA submissions@nopsema.gov.au Or via secure file transfer at: https://securefile.nopsema.gov.au/filedrop/submissions

7.9 Reporting

Shell also has internal reporting requirements against environment parameters identified in the Shell Group Performance Monitoring and Reporting (PMR) standard. This data is used as the basis for an annual Shell Group external HSE report (Shell Sustainability Report), which is publicly and externally reported.

7.9.1 Notifications

Titleholders need to complete Forms 1405 and Form 1408 per outline below and submit them to NOPSEMA in any of the following ways:

- hard copy to: NOPSEMA, Level 8, 58 Mounts Bay Road, PERTH 6000, Western Australia;
- post to: Submissions, NOPSEMA, GPO Box 2568, PERTH 6001, Western Australia;
- secure file transfer: https://securefile@nopsema.gov.au/filedrop/submissions ; and
- email to: submissions@nopsema.gov.au.

Start and end of an activity

Regulation 29 of the OPGGS(E) Regulations 2009 requires that a titleholder must notify NOPSEMA using Form 1405 (located at: http://www.nopsema.gov.au/environmental-management/environmental-resources/ on NOPSEMA's website) that an activity:

- is to commence at least 10 days before the activity commences; and
- is completed within 10 days after the completion.

Notification of the end of the Environment Plan

Regulation 25A of the OPGGS(E) Regulations 2009 requires the title holder to notify NOPSEMA using Form 1408 (located at: http://www.nopsema.gov.au/environmental-management/environmental-resources/ on NOPSEMA's website) that:

- the activity or activities to which the plan relates have ended; and
- all the obligations under the environment plan have been completed.

7.9.2 Compliance Reporting

Regulation 26C requires that an Environmental Performance report will be submitted to NOPSEMA in writing. This report will be submitted to NOPSEMA within 12 months of the activity commencement and every 12 months thereafter

7.10 Records & Storage

The OPGGS(E) Regulations requires that the titleholder of an activity must store and maintain a document or other record for the period of 5 years from the making of the document or other record; and in a way that makes retrieval of the document or other record reasonably practicable.

The documents or other records stipulated by the regulation are listed below:

- the environment plan in force for the activity;
- revisions of the environment plan;
- written reports (including monitoring, audit and review reports) about environmental performance, or about the implementation strategy, under the environment plan;
- records of emissions and discharges into the environment made in accordance with the environment plan;
- records of calibration and maintenance of monitoring devices used in accordance with the environment plan;
- records and copies of reports mentioned in regulations 26 and 26A, relating to reportable incidents; and
- records and copies of reports mentioned in regulation 26B, relating to recordable incidents.

7.10.1 Records of Discharges and Emissions

In accordance with Regulation 14(7) a record of all discharges and emissions with be maintained via the means specified in each relevant measurement criterion cited in and as per **Table 7 - 2**. At the end of the Bratwurst-1 drilling campaign, an End of Well Report will be prepared including a record of all discharges and emissions.

7.11 Maintenance and Testing of Emergency Response and Oil Pollution Emergency Plan

The Bratwurst-1 Drilling Campaign OPEP (HSE_GEN_015415) is presented in a standalone document. It links to the MODU contractor's Emergency Response Plan, which will be bridged to the MODU Safety Case Revision Document. The Emergency Response Plan and OPEP is planned to be tested prior to the Bratwurst-1 BOP installation, to make sure that all relevant personnel are aware of their personal responsibilities in these plans.

Exercises are critical to ensure there is appropriate level of response readiness should there be an incident and are an important part of continually managing the risks associated with an oil spill to ALARP from a response readiness perspective. The oil spill response exercises are outlined in the SA Drilling Exercise Plan.

The following exercises will either be run as a combined or a 2 separate excercises:

- one level 1 (tier 1) exercise: At the beginning of the drilling activity, a desktop exercise will be held to test communications and first strike response plan in the OPEP, and to ensure that the Emergency Response Team members are aware of their roles and responsibilities in the event of an incident.
- one level 2 (tier 2) exercise: prior to spud, there will be a desktop exercise which will involve the role play of the rig (using rig contrators and test the capability of the rigs IMT and ability to respond), which in turn will stand up Shell IMT for support. A third party independent Oil Spill Response qualified facilitor (section 7.11.1) will be utilized to co-ordinate and assess the exercise. The objectives will be to test:
    - exercising interface between ERT and IMT.
    - exercising the logistics functioning and capacity against that described within the OPEP
    - exercise oil spill monitor and evaluation tactics
    - First Strike Response Plan
    - Third party response arrangements (Internal: Aircraft, Marine, Shell Health, HR, External Government Relations, Legal, wells, ; External role play notifications to include: AMOSC; AMSA and NOPSEMA).

SA has a Drilling Exercise Plan which outlined minimum annual exercises planned for the following 3 years. It tests key elements of an OPEP's capability, preparedness , readiness and associated supporting arrangments. Below are examples listed of elements to be tested in annual level (tier) 2/3 exercises:

- exercising interface between ERT and IMT
- exercising the logistics functioning and capacity against that described within the OPEP
- exercise stand-up of relevant OSMP sections implementation (annually)
- exercise oil spill monitor and evaluation tactics
- SA participation in national plan or state exercises coordinated by AMSA or AMOSC or WA DOT (annually where opportunity exists)
- participation in the Shell GRSN annual Tier 3 exercise which aims to test the functionality of Shell Group's Tier 3 oil spill response capabilities (annually).

Before the Bratwurst well is spudded, Shell will lead an integrated Source Control Workshop with expert assistance from Shell's Virtual Source Control Team which is seeking the following key outcomes:

- a complete logistics evaluation of the processes required to deliver all the 3 key pieces of well control equipment, the SFRT, the capping stack, and the OIE from their peacetime locations to a port of disembarkation.
- offload from delivery transport to staging areas
- reassembly (where required) and testing
- crossload onto technical deployment vessels
- all contractual issues associated with multiple contractors equipment and vessels
- The technical aspect of deloyment onto appropriate operating vessels

The intent of the workshop is to identify and cloes out gaps identified in the above areas and produce a 2 phase process:

- The logistics movement from peacetime locations

- The technical deployment to well site of all 3 major components

Actions falling out of this test will be captured and tracked to closure.

7.11.1 Mechanism to examine the effectiveness of the response arrangements against the objectives of testing

Objectives for spill exercises will be SMART for Level 1, 2 or 3. This will enable the objectives to be clearly evaluated as being met or not. For level 2 or 3 exercises, an independent assessor (either internal or external to Shell) will examine the effectiveness of the response arrangements during a spill exercise to determine the outcome of the objectives. The assessor will make written findings and recommendations from the test for consideration by Shell to assist in identifying deficiencies with response arrangements and continually improve the overall response readiness of Shell.

Recommendations from the tests will have SMART actions put against them where appropriate and they will be tracked to closure in Shell's (or Contractors) action tracking system as appropriate.

7.12 Continuous Improvement

Shell's HSSE Management System (HSSE MS) is continually improving due to incorporation of increasing legislative requirements, increasing community expectations, improved available technology, learning from incidents industry wide and within Shell, and regular review cycle. Assurance that the HSSE MS is working, continually improving and new Shell standards are applied occurs via Shell Australia internal audits and Shell Global auditing process. Company standards are at least equal to, but in many cases more stringent than legislation. Both legislation and company standards are continually being updated and requiring a higher level of performance over time. Concurrently, new technologies are becoming available and making improved performance possible and more affordable. This continual improvement is reflected in more challenging ALARP and tolerable benchmarks, leading to better environmental outcomes over time.

7.13 Consultation

As operator, Shell Australia has consulted with relevant persons in accordance with the NOPSEMA Decision-making guideline – Criterion-10A(g) Consultation Requirements (N-04750-GL1629) under the OPGGS (Environment) Regulations 2009 for the Bratwurst-1 drilling campaign.

Shell has ensured that all relevant persons have been provided with sufficient information and had the opportunity to raise any objections or claims.

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

7.13.1 Shell General Business Principles and Stakeholder Engagement

Shell Australia's consultation is undertaken in line with the Shell General Business Principles and relevant legislative requirements. Key to these principles is that Shell employees share a set of core values - honesty, integrity and respect for people. Key principles:

- Local Communities: Shell aims to be a good neighbour by continuously improving the ways in which we contribute directly or indirectly to the general wellbeing of the communities within which we work. We manage the social impacts of our business activities carefully and work with others to enhance the benefits to local communities and mitigate any negative impacts from our activities. In addition, Shell companies take a constructive interest in societal matters, directly or indirectly related to our business.

- Communication and Engagement: Shell recognises that regular dialogue and engagement with our stakeholders is essential. In our interactions with local communities, we seek to listen and respond to them honestly and responsibly. Part of this commitment is ensuring those people and organisations that are impacted by our activities are engaged, and that their concerns are heard and responded to.

7.13.2 Shell Australia's Stakeholder Engagement Process

In supporting Shell's adherence to the Shell Business Principles, from the initial discovery of the resource, is a comprehensive stakeholder strategy which ensures that:

- The external context is monitored and understood;
- Stakeholder needs, interests, concerns and expectations are understood, and shared outcomes are defined;
- There is a clear and direct link between risks/opportunities and stakeholders;
- Stakeholder engagement protocols are established and consistent, coordinated external engagements;
- Scenario planning is undertaken for potential stakeholder responses; and
- Explicit inclusion of external perspectives in business decisions.

7.13.3 The Team

Shell Australia has a Perth based External and Government Relations team, which includes Social Performance, who facilitate stakeholder and community engagement in Australia on behalf of the business with support teams in Canberra, Melbourne and Queensland (QGC). This team manages the interface for the business with external stakeholders such as, communities, NGOs, Government(s) and the media. Working as an integrated team allows a 'whole of Shell view' to be provided in stakeholder engagements and ensure stakeholders receive consistent and coordinated information. This is important where, for example, exploration activities have similar stakeholders to other Shell activities in the region (e.g. Prelude FLNG) and therefore require an aligned approach.

7.13.4 Stakeholder Engagement Plans

The External Relations team maintain an Exploration Stakeholder Engagement plan for the portfolio which includes a stakeholder matrix, engagement strategy for each activity and a feedback mechanism via SA_exploration@shell.com. This engagement plan is a 'live' document that is updated as the exploration portfolio changes.

7.13.5 EP Consultation Strategy

The consultation strategy (**Figure 7 - 1**) for this EP reflects the short-term nature of the activity.

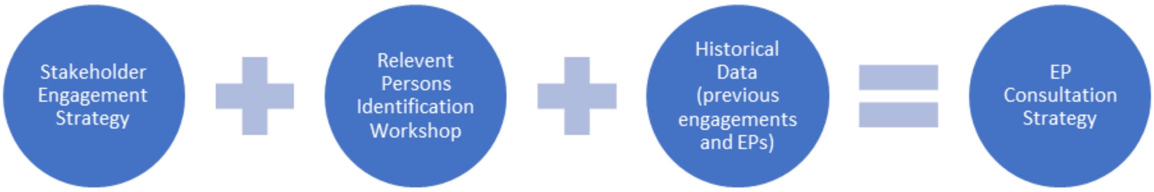


Figure 7 - 1: Development of Consultation Strategy

7.13.6 Relevant Persons

Shell has a robust internal process to identify, prioritise and understand stakeholders as outlined below.

Table 7 - 5: Process to identify, prioritise and understand stakeholders

1.	**Identify Stakeholders against specific business objectives**
2.	**Prioritise stakeholders based on impact, influence and stakeholder views/concerns**
3.	**Analyse value drivers and views on our activities**
4.	**Define desired shared outcomes**
5.	**Early engagements with stakeholders to validate/confirm risks and opportunities**

This process was used to develop the Bratwurst-1 drilling campaign Stakeholder Matrix and formed the foundation for the Relevant Persons Identification process.

Shell Australia identified key stakeholders who were potentially impacted by or had an interest in Bratwurst-1 drilling campaign based on well location and the environmental impacts and risks associated with planned activities and unplanned events.

Shell Australia reviewed its internal database of stakeholders which was used for consulting on Prelude FLNG. Feedback was sought from the Prelude FLNG consultation team to assist in designing the stakeholder engagement approach.

A draft stakeholder list of relevant and interested persons was circulated internally and to Shell Australia's environmental consultants for review. Following feedback from the team, a workshop was held with representatives from Shell's exploration, environmental and external relations teams to review the stakeholder list.

Shell Australia also sought updated extracts from AFMA and the Department of Primary Industries and Regional Development to assist in finalising the stakeholder list.

Shell Australia also met with NOPSEMA to gain insights into effective consultation.

A review of the stakeholder groups identified that the fishing industry needed to be provided a specific letter which offered a one-on-one meeting with each stakeholder if the stakeholder required further information.

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

- functions, interests and activities of the relevant persons;

- prior feedback and information from relevant persons on their perspectives and how they prefer to be engaged; and
- information gathered during the Environment Plan process.

The result was a list of all relevant persons who require formal consultation and their specific information requirements.

Key stakeholders identified include the fishing industry including licence holders, Federal and State governments and agencies, local governments, industry/business, community groups, non-government organisations (NGO)s and others as detailed in **Table 7 - 4**.

7.13.7 Reasonable Period

Shell Australia has determined that a minimum 30 days is reasonable period for formal consultation. This is a common duration specified for matters that are open to public comment and Shell's historic engagements supports that it is enough time to allow for a relevant person to assess the information provided by Shell Australia in a letter containing all the risks as outlined in the EP and respond detailing any objections or claims.

The 30-day period acts as a minimum period in Shell's consultation planning processes, and relevant persons are explicitly asked to respond within that time. However, Shell acts on a case by case basis depending on the response received from relevant persons and will allow for requests to extend this period if requested.

7.13.8 Sufficient Information

Shell Australia chose to commence consultation in November 2018. From 2 November 2018 to 14 December 2018, relevant stakeholders were engaged via letter, face-to-face meetings, email and phone conversations. The following consultation summary covers the consultation activities undertaken for the Bratwurst-1 drilling campaign:

- In November, Stakeholders were sent an activity-specific letter detailing the Bratwurst-1 drilling campaign. Shell Australia provided relevant persons with letter outlining all the risks and mitigations extracted directly from the EP. This approach ensured that recipients had access to the risks outlined in the EP and the associated mitigations and could make their own assessment on the impact of the activity, thus removing potential for Shell to make any assumptions about what relevant persons would be interested or concerned about. The letter also contained contact details, location specifics, details of the activity and the response period of 30 days.
- Shell Australia held a face-to-face meeting with the Western Australian Fishing Industry Council as they were the only respondent who raised an issue with the well exploration.
- Follow up phone calls and emails were made to stakeholders that had expressed an interest or concern about the activity in the past. Shell Australia received 2 requests for additional information, which were responded to via email.
- Shell Australia also sought to contact by telephone fishing licence holders where a phone number could be legally obtained.

The results of stakeholder consultation are recorded in a log and summarised in **Table 7 - 7**. Shell is confident that stakeholders were given a good overview of the drilling and completions program and have had adequate time to raise questions or concerns as demonstrated in **Table 7 - 7**.

7.13.9 Assessment of merits of claims and objections

Shell Australia has a claims process managed by the Social Performance Team which guides our actions in response to complaints received from stakeholders, see **Appendix D** Complaints Management process. Shell Australia adapted this process for the EP to ensure it allowed for the efficient assessment of the merits of the claims and objections received.

Shell Australia uses relevant subject matter expertise to assess the merits of any claims and objections and to determine a response to the relevant person.

7.14 Ongoing Consultation

Upon acceptance of this EP, Shell Australia will uphold its commitments to ensuring relevant persons continue to be consulted if there are changes in the scope of the activity or stakeholders have requested to be updated during the campaign.

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

Shell Australia will ensure that all relevant stakeholders are kept informed of the progress of the Bratwurst-1 drilling campaign. The process for ongoing consultation for the Bratwurst-1 drilling campaign involves notifying relevant fishing licence holders and regulatory authorities prior to activity commencing and providing a contact point that Stakeholders can continue to raise their concerns. This is available via the following the telephone number (08) 9338 6600.

Table 7 - 6: Relevant Persons and Consultation Process Table

Category	Relevant Persons	Functions, Interests or Activities	Consultation Approach	Ongoing Consultation
Commonwealth Government	Australian Border Force Department of Immigration and Border Protection	The Department of Immigration and Border Protection is responsible for immigration and customs border policy.	Letter	Not required
Commonwealth Government	Department of Agriculture and Water Resources	Biosecurity regulator	Letter	Not required
Commonwealth Government	Department of Foreign Affairs and Trade (DFAT)	DFAT provides foreign, trade and development policy advice to the government. Manages and provides advice to government on Australia's International obligations for marine protection	Letter	Not required
Commonwealth Government	Department of the Environment and Energy (DoEE)	DoEE designs and implements the Australian Government's policies and programmes to protect and conserve the environment, water and heritage and promote climate action. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the Act as matters of national environmental significance.	Letter	Not required
Commonwealth Government	Federal Member for Kimberley - Melissa Price	Member for Kimberley – interested in major activities occurring in the Kimberley region.	Letter	Not required
Commonwealth Government	The RAN Australian Hydrographic Service	The RAN Australian Hydrographic Service is the Commonwealth Government agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating in Australian waters. They operate under the Navigation Act.	Letter	Contact 3 weeks prior to commencement of activity so they can issue notice to mariners.
Commonwealth Government	Director of National Parks	The Director of National Parks' responsibilities include: • Managing Commonwealth reserves and conservation zones • Protecting biodiversity and heritage in Commonwealth reserves and conservation zones • Carrying out research relevant to Commonwealth reserves • Cooperating with other countries to establish and manage national parks and nature reserves in those countries	Letter and follow up emails	Not required

		• Making recommendations to the Australian Government Minister for the Environment		
Environmental NGO's	Australian Conservation Foundation (ACF)	The ACF stands for ecological sustainability. We get to the heart of environmental problems by tackling the underlying social and economic causes. We work across society to influence urgent, transformative action to deliver lasting change on the scale required to secure a sustainable environment. We bring people together to champion the true value of our environment and its critical role in sustaining all other systems and in achieving human wellbeing.	Letter and follow up email	Not required
Environmental NGO's	Australian Marine Conservation Society (AMCS)	The AMCS is the voice for Australia's ocean wildlife. We are an independent charity, staffed by a committed group of professional and passionate scientists, educators and advocates who have defended Australia's oceans for 50 years. Our paid and volunteer staff work every day on behalf of the community to protect our ocean wildlife.	Letter and follow up email	Not required
Environmental NGO's	Conservation Council of Western Australia	For over 45 years, the Conservation Council has been WA's outspoken and independent voice for the environment and communities. As WA's peak environmental group, we represent tens of thousands of individual supporters and over 100 Member Groups with diverse interests across the state.	Letter and follow up email	Not required
Environmental NGO's	Greenpeace	Greenpeace is an independent campaigning organisation that uses non-violent direct action to expose global environmental problems and to force solutions which are essential to a green and peaceful future. Greenpeace's goal is to ensure the ability of the earth to nurture life in all its diversity.	Letter and follow up email	Not required
Environmental NGO's	WWF	WWF has long recognised that the planet's species, people, habitats, governments and global markets are directly and often delicately inter-related. We also know that meaningful conservation cannot take place without addressing the complex relationships that exist between these elements.	Letter - no email address available	Not required
Fisheries	Commonwealth Fishing Association (CFA)	The CFA is the peak body representing the collective rights, responsibilities and interests of a diverse commercial fishing industry in Commonwealth regulated fisheries. The CFA was formed in April 2002 as a non-profit organisation.	Letter and follow up email	Not required
Fisheries	Kimberley Professional Fisherman's Association	There are about 20 different PFAs operating around Western Australia, from the Kimberley in the State's far north to Esperance in the south.	Letter and phone call	Not required
Fisheries	Mackerel Managed Fishery	The Mackerel Managed Fishery uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel.	Letter	Not required

Fisheries	North Coast Shark Fishery	Commercial shark fishing in WA takes place in the north and south of the State. The northern and southern shark fisheries have a State and joint-authority management component due to the distribution of several shark stocks across state boundaries. Both fisheries also operate under Commonwealth approvals. The Northern Shark Fishery comprises the State-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery in the eastern Kimberley.	Letter	Not required
Fisheries	North West Slope Trawl Fishery	The North West Slope Trawl Fishery is in deep water from the coast of the Prince Regent National Park to Exmouth between the 200m depth contour to the outer limit of the Australian Fishing Zone.	Letter	Not required
Fisheries	Northern Demersal Scalefish Fishery	The boundaries of the NDSF are all waters of the Indian Ocean and Timor Sea off the north coast of Western Australia east of 120° 00.079' east longitude and north of 19°59.917' south latitude	Letter and phone calls to licence holders where a phone number could be located	Notification of prior to commencement of activity.
Fisheries	Pearl Oyster Fishery	The WA Pearl Oyster Fishery is the only remaining significant wild stock fishery for pearl oysters in the world. It is a quota based, dive fishery, operating in shallow coastal waters along the north west shelf.	Letter	Not required
Fisheries	Pearl Producers Association	The Pearl Producers Association (PPA) is the peak industry representative body for licensees in WA and the Northern Territory.	Letter and follow up email	Not required
Fisheries	RecFishWest	RecfishWest is the peak body representing 740,000 recreational fishers in WA. We are a not-for-profit community organisation that strives to ensure high quality fishing experiences are maintained and enjoyed, as an integral part of the WA lifestyle.	Letter and follow up email	Not required
Fisheries	Southern Bluefin Tuna Fishery	The Southern Bluefin Tuna Fishery covers the entire sea area around Australia, out to 200 nm from the coast	Letter	Not Required
Fisheries	Western Australian Fishing Industry Council	The peak commercial fishing industry body to represent the industry in WA.	Letter and follow up emails and meeting	Not required
Fisheries	West Coast Deep Sea Crustacean Managed Fishery	The West Coast Deep Sea Crustacean Managed Fishery targets Crystal (Snow) Crabs, Giant (King) Crabs and Champagne (Spiny) Crabs. Using baited pots in waters deeper than 150m (and mostly at depths of between 500m – 800m) along the continental shelf of the West Coast and Gascoyne Bioregions, this fishery is quota-based.	Letter	Not required

Fisheries	Western Tuna & Billfish Fishery	The Western Tuna and Billfish Fishery covers the sea area west from the tip of Cape York in Queensland, around WA, to the border between Victoria and South Australia. Fishing occurs in both the Australian Fishing Zone and adjacent high seas.	Letter	Not required
Government Agency	AMSA Rescue Coordination Centre (RCC)	Provide 24 hour emergency service for marine issue and coordinate marine rescues	Letter	Not required
Government Agency	Australian Fishery Management Authority (AFMA)	Section 7 of the Fisheries Administration Act 1991. In relation to fishing activities by Australian-flagged boats on the high seas to devise and implement management regimes in relation to those activities that are consistent with Australia's international obligations for the management of Fisheries. Commonwealth managed fisheries only.	Letter	Not required
Government Agency	Australian Marine Safety Authority (AMSA)	AMSA is a statutory authority established under the Australian Maritime Safety Authority Act 1990 (the AMSA Act). It is Australia's national regulatory body, who promote the safety and protection of our marine environment and combat ship-sourced pollution. They provide the infrastructure for safety of navigation in Australian waters, and maintain a national search and rescue service for the maritime and aviation sectors	Letter	Not required
Marine Organisations	Australian Institute of Marine Science	Shell's current operational and scientific monitoring program contractor	Letter	Not required
Marine Organisations	Australian Marine Oil Spill Centre (AMOSC)	AMOSC operates the Australian oil industry's major oil spill response facility. AMOSC's stockpile of oil spill response equipment includes oil spill dispersant and containment, recovery, cleaning, absorbent and communications equipment. Equally important is AMOSC's role in training and coordinating industry personnel ready to provide immediate emergency oil spill response.	Letter	Not required
State Government	Department of Water and Environment Regulation (WA) (DWER)	DWER's purpose is to advise on and implement strategies for a healthy environment, for all Western Australians. EPA 1986 Section 72 EP Act, reporting of Environmental Pollution	Letter	Not required
State Government	Department of Mines, Industry Regulation and Safety (DMIRS)	The DMIRS is responsible for ensuring the State's resources sector is developed and managed responsibly and sustainably for the benefit of all Western Australians. Responsible department for offshore petroleum in adjacent state territory	Letter	Not required
State Government	NT Department of Fisheries	Boating, fishing and marine - Commercial fishing. Commercial fisheries and licences, fishing tour operator licences, logbooks. Management of biosecurity risks to NT fisheries	Letter	Not required
State Government	State Member for Kimberley	Advocate for the people of the Kimberley region and will ensure that the region continues to have a strong voice in the Parliament	Letter	Not required

State Government	WA Department of Primary Industry and Regional Development (DPIRD)	The DPIRD manage WA licensed / recreational fisheries Fish Resources Management Act 1984	Letter	Not required
State Government	WA Department of Biodiversity, Conservation and Attractions (DBCA)	DBCA manages wildlife within WA land and waters. Management of WA state marine parks and reserves.	Letter	Not required
State Government	WA Department of Transport (DOT)	DOT's focus is on operational transport functions and strategic transport planning and policy across the range of public and commercial transport systems that service WA. With more than 1000 employees, we have the expertise to deliver and connect a complex, inter-related economic and social network. Responsible for managing oil spills in state waters	Letter	OPEP has been submitted and will be finalised with DOT.

Table 7 - 7: Consultation carried out specifically for the proposed drilling program

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Western Australian Fishing Industry Council (WAFIC)	Letter sent on 2 November 2018. Telephone call with on 5 November 2018 Emails correspondence on key issues and to organize a meeting Meeting on Friday 14th December 2018	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	• WAFIC were pleased that Shell will place fishing restrictions on all vessels during the Bratwurst-1 drilling campaign. • WAFIC suggested that should the wellhead remain post the drilling operations, they would ask for the exclusion zone to be lifted and a cautionary zone to placed over the area instead, as wellheads often make great reefs for congregation areas for fishing. • WAFIC were clear that the Bratwurst-1 drilling campaign is standard operations and that they have no further comments on the activity other than ensuring appropriate notification are issued to fishing licence holders in the area. • WAFIC provided fishery specific information to allow Shell to identify fisheries which are currently operating within the Operational Area and, therefore, have the potential to be impacted by planned activities from the Bratwurst-1 drilling campaign. WAFIC's responses are detailed below in the relevant fishery's Summary of Stakeholder Response. WAFIC advised that only one fishery (the NDSF. including 2 permit holders) currently is known to operate within the Operational Area.	Shell have considered WAFIC's requests and: • will implement a no fishing policy for vessels involved in the Bratwurst-1 drilling campaign; • will provide Notification to the fishing licence holders prior to commencement of activities; and • will advise the Hydrographic office of the well position. Provided we see no risk to navigation the well will be marked on navigational charts, but no cautionary or exclusion zone will be applied (no elevated risk has been identified for this campaign).

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
The RAN Australian Hydrographic Service (AHS)	Letter sent on 2 November 2018	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email response from the Manager Nautical Assessment and Maintenance which said they have no issues with any of the proposed works. They would like to be informed when firmer dates are available for each activity.	No issues raised. Shell will provide notification of dates for the activity once they have been confirmed.
Department of Transport	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email response from DOT on 8 November asking for 6 weeks' timeframe to consult and compliance with the Industry Guidance note "Oil Spill Management in Australia".	No issues raised. Consultation with DOT on the OPEP is occurring.
Yennett Pty Ltd/ Western Deep Sea Crustacean Fishery	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email saying thank you for the information and currently fishing in other locations.	No issues raised. No response required.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Deepsea Water Services/ Western Deep Sea Crustacean Fishery	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email saying thank you for the information and currently fishing in other locations.	No issues raised. No response required.
Australian Fishery Management Authority (AFMA)	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Initial email response from AMFA stated that the organisation does not have resources available to review or provide detailed comment and provided links to sources of relevant information including which fisheries are relavant to the area.	No issues raised. No response required.
Department of Biosecurity, Conservation and Attractions	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email from DBCA saying thank you for notifying the department, they have no comments to make given the activities are in Commonwealth waters.	No issues raised. No response required.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Mareterram Fisheries Pty Ltd	Letter on 2 November	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email from the Manager– Policy and Environment, Mareterram Fisheries Pty Ltd. Asked to be kept informed of activities as required.	No issues raised. Notification will be provided to the fishing licence holders prior to commencement of activities.
Department of Agriculture and Water Resources	Letter and follow up email and phone call.	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Two email responses outlining that the environmental plan needs to articulate how Shell intends to conduct operations in relation to biosecurity. The key consideration for your development of the Environmental Plan for Biosecurity (Vessel aircraft and personnel) is subject to how you intend to conduct operations in relation to biosecurity, the 'biosecurity status' of the offshore rig/seismic vessel and operation of domestic service/tender vessels in their ability to access the *Biosecurity (Exposed Conveyances-Exceptions from Biosecurity Control) Determination 2016.* *During a phone call with Department of Agriculature and Water Resources, they suggested that this activity needs to consult with the Prelude activity for biosecurity and to consult with DAWR in this regard.*	Shell Australia (Customs advisor) often meets with DAWR representatives (Fremantle Office) to discuss biosecurity requirements across all SA activities which will have discussion about Bratwurst, vessel and rigs closer to the operational time. SA Bratwurst and Prelude biosecurity/customs are all run via the SME customs advisor to ensure consistency.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Department of Mines, Industry Regulation and Safety	Letter	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email from DMIRS stated that they have reviewed the information package and that no further information is required at this stage.	No issues raised. No response required.
Parks Australia	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email from the Senior Marine Parks Officer at Parks Australia asking for further time to provide a response. Email back from them saying not in commonwealth marine park and therefore they have no issue. Advised that notification is required should there be any oil leak which could threaten a marine park.	No issues raised. No response required. Notification will be provided should a hydrocarbon release be expected to reach any AMP.

Department of Primary Industries and Regional Development (DPIRD)	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	• Department recommends that Shell Australia initiate and maintain ongoing consultation with the Western Australian Fishing Industry Council, RecFishWest and directly with fishers (contact details of licensed fishers can be obtained through the Department's public register). • The Department therefore requests that risks to seabed disturbance and underwater noise are identified and mitigation strategies are developed and implemented during the survey to reduce the associated impacts. • The Department recommends that all vessel managers minimise the risk of translocating marine pests into or within WA waters. This can be achieved by accurately assessing and then reducing the level of risk and Vessel Check is recommended for this purpose. • The Department also recommends that the suspected or confirmed presence of any marine pest or disease be reported within 24 hours by email or telephone. • With respect to developing an Oil Pollution Emergency Plan (OPEP), the Department requests that specific strategies are developed in the EP and/or OPEP to mitigate risks/potential impacts on spawning grounds and nursery areas for key fish species in the area. • The Department requests that all potential impacts to fisheries, fish and fish habitat described in this letter are specifically identified in the final Environment Plans and strategies to be undertaken by Shell Australia to mitigate or minimise these impacts are described. Should there be any objections or claims raised during the	Shell have considered DPIRD's requests and: • Shell Australia has met with WAFIC to discuss the well exploration activity. RecFishWest responded that unlikely to affect recreational fishers given the location. Licence holders have been contacted and active licence holders will be notified of activity prior to commencement. • An OPEP has been developed and was submitted to the Department of Transport for comment. DOT had 11 comments which Shell addressed and resubmitted to the DOT for further comment. DOT acknowledged that Shell have provided much information to them in recent OPEP reviews. • See above for biosecurity comments. Shell sits on two external biosecurity boards, one with DPIRD, DAWR and industry and MIAL • This EP document outlines the mitigation of risks to the fishery.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
			consultation process, the Department requests that these conflicts are resolved to the satisfaction of the regulator i.e. the National Offshore Petroleum Safety and Environment Management Authority.	
Australian Conservation Foundation	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No issues raised. No response required.
Australian Marine Conservation Society	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No issues raised. No response required.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Conservation Council of Western Australia	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No issues raised. No response required.
Greenpeace	Letter and follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No issues raised. No response required.
WWF	Letter (no email address could be located)	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No issues raised. No response required.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Commonwealth Fishing Association	Letter, follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Letter was returned to sender and email to CEO was returned undelivered. It appears association is no longer active.	No response required.
Kimberley Professional Fisherman's Association (KPFA)	Letter, follow up email and phone call	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Letter was returned to sender, Called and spoke to the past president of the organisation, who informed that the association did not exist anymore and gave contact information of the existing licence holder.	No response required.
Northern Demersal Scalefish Fishery (NDSF) *WA managed fishery*	Letters, only two active licence holders, spoke to one licence holder whose phone number was provided by KPFA	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Contacted one of two licence holders by phone. The licence holder asked that Shell engage with WAFIC to consult on exploration activities as they don't have time to meet.	No response required. Shell have met with WAFIC and no issues were raised.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Mackerel Managed Fishery *WA managed fishery*	Letters to licence holders	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response from licence holders. WAFIC indicated no licence holders currently active in the area of the Bratwurst-1 drilling campaign.	No response required. Shell have met with WAFIC and no issues were raised.
Northern Shark Fishery *WA managed fishery*	Letters to licence holders	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response from licence holders. WAFIC indicated no licence holders currently active in the area of the Bratwurst-1 drilling campaign.	No response required. Shell have met with WAFIC and no issues were raised.
North West Slope Trawl Fishery *Commonwealth managed fishery*	No current active licence holders in the area of the exploration so no letters sent. While the fishery overlaps the permit area it does not overlap the operational area.	Not applicable.	Not applicable.	No response required. Shell have met with WAFIC and no issues were raised.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
Pearl Producers Association (PPA).	Letter, Follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	No response.	No response required. Shell have met with WAFIC and no issues were raised.
RecFishWest	Letter, Follow up email	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	Email response received at RecFishWest on 14 November indicating given location of exploration activity unlikely to affect recreational fishing industry.	No issues raised. No response required.
Southern Bluefin Tuna Fishery *Commonwealth managed fishery*	Currently no active licence holders in the area so no letters sent	Not applicable.	Not applicable.	No response required. Shell have met with WAFIC confirmed there are no active vessels operating within the Operational Area.
Western Skipjack Fishery (WSF) *Commonwealth managed fishery*	Currently no active licence holders in the area so no letters sent	Not applicable.	Not applicable.	No response required. Shell have met with WAFIC confirmed there are no active vessels operating within the Operational Area.

Organisation	Summary of Engagement Methods	Summary of items discussed	Summary of Stakeholder Response	Assessment of Merit/Issues Raised and Summary of SA Response
West Coast Deep Sea Crustacean Fishery *WA managed fishery*	Letters to licence holders	The letter sent outlined the Bratwurst-1 drilling campaign including the location of the drilling and permit areas, scope of the activity and the risk and proposed mitigations of the drilling activity including risks associated with: • Physical presence of vessels in the area • Liquid discharges • Drilling operations	One licence holders responded and asked to be kept informed of activity. WAFIC advised this fishery mostly operates in water depths of 500-800 m along the continental shelf of the West Coast and Gascoyne Bioregions.	Shell Australia will contact all licence holders prior to commencement of the exploration activity
Western Tuna & Billfish Fishery *Commonwealth managed fishery*	Currently no active licence holders in the area so no letters sent.	Not applicable.	Not applicable.	No response required. Shell have met with AFMA and confirmed that there are only a few active permit holders in the fishery and that they do not currently operate within the Operational Area.
Northern Prawn Fishery (NPF) *WA managed fishery*	Currently no active licence holders in the area so no letters sent, this was confirmed by WAFIC in the face-to face meeting.	Not applicable.	Not applicable.	No response required. Shell have met with WAFIC and no issues were raised.

7.14.1 Conclusion

Shell Australia’s approach to consultation on the Bratwurst-1 drilling campaign is one which is appropriate to the scale, risk and short-term nature of the activity. It has resulted in transparent and collaborative discussions between Shell Australia and the identified relevant persons during the preparation of this EP.

Shell Australia is confident that the processes outlined in this EP have adequately afforded relevant persons a detailed understanding of the Bratwurst-1 drilling campaign risks and potential impacts, as well as the opportunity to communicate claims or objections for Shell Australia to address as appropriate.

Shell Australia does not intend to provide further updates on the drilling campaign unless there are major changes in the scope and associated risks or the stakeholder has requested progress updates.

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8.2 List of Acronyms

Acronym	Definition
ABS	Australian Bureau of Statistics
ADB	Asian Development Bank
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHT	Anchor Handling Tug
AHS	Australian Hydrographic Service
ALARP	As Low as Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AMSA JRCC	Australian Maritime Safety Authority Joint Rescue Coordination Centre
ANSD	Australian National Shipwrecks Database
ANZECC & ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand
APPEA	Australian Petroleum Production and Exploration Association
BIA	Biologically Important Area
BoM	Bureau of Meteorology
Bonn Convention	Convention of the Conservation of Migratory Species of Wild Animals 1979
BOP	Blowout Preventer
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAMBA	The China Australia Migratory Birds Agreement
CO_2	Carbon Dioxide
COLREGS	International Regulations for Preventing Collisions at Sea 1972
DAWR	Department of Agriculture and Water Resources
DEC	Department of Environment and Conservation
DEH	Department of Environment and Heritage
DEWHA	Department of Environment, Water, Heritage and the Arts
DHA	Department of Home Affairs
DMP	Department of Mines and Petroleum
DO	Dissolved Oxygen
DoEE	Department of the Environment and Energy
DoF	Department of Fisheries
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSV	Drilling Supervisor
EAA	East Asian-Australasian
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPs	Environmental Plans
EPOs	Environmental Performance Outcomes
EPS	Environmental Performance Standards

Acronym	Definition
ESD	Ecologically Sustainable Development
ESHIA	Environment, Social, and Health Impact Assessment
FIM	Fountain Incident Management
FLNG	Floating Liquefied Natural Gas
GHG	Greenhouse Gas
HEMP	Hazards and Effects Management Process
HSE	Health Safety and Environment
HSSE	Health, Security, Safety, the Environment
HSSE & SP	Health, Security, Safety, the Environment and Social Performance
HSSE & SP-MS	Health, Security, Safety, the Environment and Social Performance Management System
IADC	International Association of Drilling Contractors
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention
IFC	International Finance Corporation
IMO	International Maritime Organisation
IMS	Invasive Marine Species
ITF	Indonesian Throughflow
IUCN	International Union for Conservation of Nature
IWCF	International Well Control Forum
JAMBA	The Japan Australia Migratory Birds Agreement
KEF	Key Ecological Features
LNG	Liquified Natural Gas
LP	Low Pressure
MAFMF	Marine Aquarium Fish Managed Fishery
MARPOL	International Convention for the Prevention of Pollution from Ships
MDRT	Measured Depth Rotary Table
MNES	Matters of National Environmental Significance
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MoU	Memorandum of Understanding
MSL	Mean Sea Level
NADF	Nonaqueous drilling fluids
NAXA	North Australian Exercise Area
NDSF	Northern Demersal Scalefish Fishery
NERA	National Energy Resources Australia
NGER	National Greenhouse and Energy Reporting
NGOs	Non-Government Organisations
NIMS	Non-indigenous Marine Species
NMR	North Marine Region
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NO_X	Oxides of Nitrogen

Acronym	Definition
NPF	Northern Prawn Fishery
NPI	National Pollutant Inventory
NT	Northern Territory
NWMR	North-west Marine Region
NWS	North West Shelf
NWSTF	North West Slope Trawl Fishery
OBM	Oil-based Mud
OCNS	Offshore Chemical Notification Sheme
ODS	Ozone Depleting Substance
OIM	Offshore Installation Manager
OPEP	Oil Pollution Emergency Plan
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations, 2009
OSMP	Operational and Scientific Monitoring Program
PAH	Polycyclic Aromatic Hydrocarbon
PFW	Produced Formation Water
ppm	Parts Per Million
PSD	Particle Size Distribution
PSU	Practical Salinity Unit
PTS	Permanent Threshold Shift
PTTEP	Petroleum Authority of Thailand Exploration and Production
PWSNT	Parks and Wildlife Service Northern Territory
RAM	Risk Assessment Matrix
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
SBM	Synthetic Based Mud
SCE	Solid Control Equipment
SOLAS convention	The International Convention for the Safety of Life at Sea, 1974
SO_X	Sulphur Oxides
SWEO	Senior Well Engineer Operations
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WAM	Western Australian Museum
WAMSI	Western Australian Marine Science Institution
WB	World Bank
WBM	Water Based Mud
WDTF	Western Deepwater Trawl Fishery
WOMP	Well Operations Management Plan
WSF	Western Skipjack Fishery
WTBF	Western Tuna and Billfish Fishery

Acronym	Definition
UNEP IP	United Nations Environment Program Industry and Environment
VOC	Volatile Organic Compounds
VSP	Vertical Seismic Profiling

Appendix A: EPBC Protected Matters Search (PMST) Results

PMST for Operational Area (24 October 2018)

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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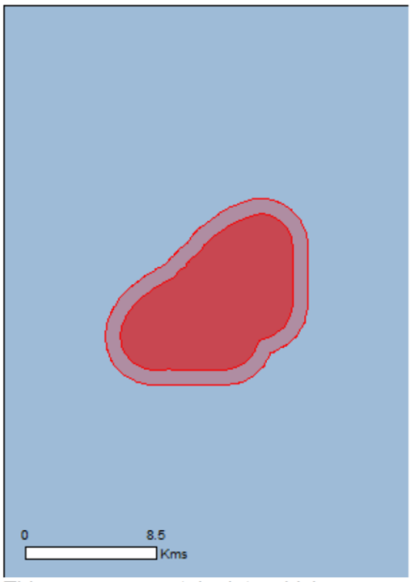

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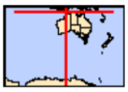

Summary

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:	20
Listed Migratory Species:	33

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:	59
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)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside 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		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
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

Name	Status	Type of Presence
		habitat likely to occur within area
Reptiles		
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 known 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
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	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
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may 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

Name	Threatened	Type of Presence
		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
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 known 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
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 may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely 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

Name	Threatened	Type of Presence
		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
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* 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
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	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

Name	Threatened	Type of Presence
		area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may 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
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
		area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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 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 known 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
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		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
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	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
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely 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

Name	Status	Type of Presence
		habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

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

-12.91753 124.33661,-12.91545 124.33607,-12.90879 124.3369,-12.9076 124.33755,-12.90464 124.33864,-12.9047 124.33877,-12.90413 124.33895,-12.90386 124.3391,-12.90391 124.3392,-12.90232 124.33986,-12.89872 124.34223,-12.89621 124.34435,-12.89243 124.34853,-12.89088 124.35078,-12.89008 124.35235,-12.88745 124.35506,-12.88417 124.36058,-12.88288 124.36326,-12.8811 124.36646,-12.87981 124.36797,-12.87696 124.37063,-12.87415 124.37409,-12.87404 124.37401,-12.8731 124.37472,-12.872 124.37592,-12.871 124.37668,-12.86925 124.37869,-12.86895 124.37911,-12.86906 124.37919,-12.86778 124.38099,-12.86556 124.38291,-12.86547 124.38276,-12.86529 124.38288,-12.86272 124.38479,-12.86248 124.385,-12.86258 124.38513,-12.862 124.38573,-12.8619 124.38562,-12.86142 124.38605,-12.86069 124.38697,-12.85918 124.38834,-12.85778 124.39049,-12.85629 124.39232,-12.85543 124.39378,-12.85282 124.39747,-12.85231 124.39795,-12.84893 124.40341,-12.84514 124.41424,-12.84486 124.41965,-12.84614 124.42491,-12.84886 124.42957,-12.8528 124.43322,-12.8576 124.43554,-12.86286 124.43634,-12.89669 124.43634,-12.90316 124.43512,-12.90878 124.43162,-12.91225 124.42739,-12.91275 124.42618,-12.91418 124.42401,-12.91551 124.42145,-12.91684 124.41718,-12.9187 124.41592,-12.92071 124.41509,-12.92178 124.41486,-12.92298 124.41427,-12.92616 124.4123,-12.93003 124.40823,-12.9325 124.40317,-12.93335 124.39759,-12.93335 124.36647,-12.93301 124.36442,-12.93335 124.36219,-12.93335 124.35471,-12.93229 124.34851,-12.92926 124.34304,-12.9246 124.33892,-12.91956 124.33684,-12.91869 124.33661,-12.91753 124.33661

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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PSMT for EMBA (7 November 2018)

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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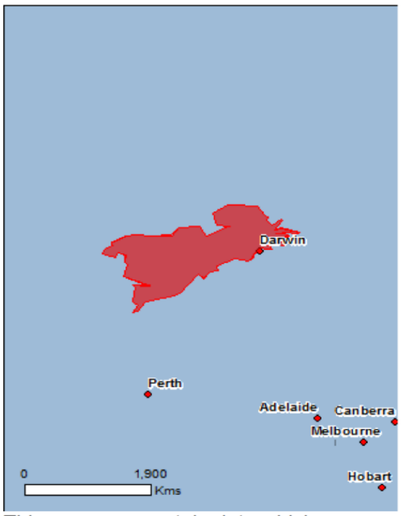

Coordinates
Buffer: 1.0Km

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:	None
National Heritage Places:	1
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	68
Listed Migratory Species:	73

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:	3
Commonwealth Heritage Places:	3
Listed Marine Species:	134
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	20

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	12
Regional Forest Agreements:	None
Invasive Species:	25
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	13

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Cobourg peninsula	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North
North-west

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat known to occur within area
Mirafra javanica melvillensis Horsfield's Bushlark (Tiwi Islands) [81011]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat likely to occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Mesembriomys macrurus Golden-backed Tree-rat, Koorrawal [119]	Vulnerable	Species or species habitat known to occur within area
Notomys aquilo Northern Hopping-mouse, Woorrentinta [123]	Vulnerable	Species or species habitat may occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat may occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Plants		
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	Endangered	Species or species habitat likely to occur within area
Hoya australis subsp. oramicola a vine [55436]	Vulnerable	Species or species habitat known to occur within area
Mitrella tiwiensis a vine [82029]	Vulnerable	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat known to occur within area
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat known to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat known to occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus gurrmul Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
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 may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat may 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
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area

Name	Threatened	Type of Presence
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation 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
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area

Name	Threatened	Type of Presence
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	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
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		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 melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		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
Numenius phaeopus Whimbrel [849]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area

Name	Threatened	Type of Presence
Pluvialis squatarola Grey Plover [865]		Species or species habitat likely to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Government Solicitor
Defence - QUAIL ISLAND BOMBING RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		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 melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur

Name	Threatened	Type of Presence
		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
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish		Species or species

Name	Threatened	Type of Presence
[66202]		habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species 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

Name	Threatened	Type of Presence
		habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke 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

Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
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

Name	Status	Type of Presence
		within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Arnhem	Special Purpose Zone (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Gascoyne	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Adele Island	WA
Browse Island	WA
Dambimangari	WA
Garig Gunak Barlu	NT
Low Rocks	WA
Prince Regent	WA
Unnamed WA28968	WA
Unnamed WA41775	WA
Unnamed WA44673	WA
Unnamed WA44674	WA
Uunguu	WA
Vernon Islands	NT

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus		
Gamba Grass [66895]		Species or species habitat likely to occur within area
Brachiaria mutica		
Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana		
Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Hymenachne amplexicaulis		
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra		
Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon		
Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Ashmore Reef	EXT
Cobourg Peninsula System	NT
Mermaid Reef	EXT

Key Ecological Features (Marine)

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-11.11861 110.91316,-10.17504 112.77798,-9.98115 114.23788,-10.21893 116.26739,-10.07238 118.93981,-8.98382 119.96197,-8.68512 122.80161,-10.12062 123.67036,-8.69115 126.69621,-8.65528 125.13436,-6.86357 124.50289,-5.56294 126.48041,-5.64735 128.00612,-5.72515 129.71865,-5.83407 130.50281,-7.14425 131.59042,-7.30296 131.94897,-7.89661 131.84273,-8.63671 132.54826,-7.64035 133.72959,-7.84646 133.94718,-9.26484 132.89749,-9.02768 133.76793,-9.60099 136.19449,-9.84048 136.03929,-9.69484 134.23908,-9.81553 133.41279,-9.88343 134.2218,-10.24206 134.70854,-10.39122 133.81212,-10.84701 133.56635,-11.19782 134.27013,-11.50384 134.25847,-11.35711 133.13108,-10.92657 132.59058,-11.16549 131.73625,-11.30883 131.69262,-11.62577 132.15848,-11.99491 132.43502,-12.11687 131.59779,-11.91404 131.25446,-12.13848 130.87574,-12.38039 130.714,-12.6331 130.16539,-13.23402 129.9158,-13.67025 129.61225,-13.7267 129.27311,-13.45597 127.46396,-14.49164 125.05641,-14.68271 125.08275,-15.08753 125.25891,-15.26318 124.17682,-16.27095 123.24155,-15.6964 122.52466,-18.42433 120.01299,-18.67603 119.38207,-19.58414 115.54148,-20.88654 114.44324,-21.08419 113.69974,-19.98797 114.49318,-19.59093 113.66454,-17.62202 114.0685,-17.2237 113.64468,-17.29077 115.8382,-15.96319 112.48528,-14.31181 113.00288,-13.94207 112.63267,-13.00346 112.74562,-12.66031 111.84823,-13.22547 111.34295,-12.67474 109.65192,-12.03423 109.9222,-11.59059 110.98808,-11.11861 110.91316

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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Appendix B: Modelling Results for Loss of Well Control Scenario for Receptors Above Identified Thresholds

Receptor Category *Probability of being impacted* <1% - 1% / >25-50% >1-10% / >50-75% >10-25% / >75%	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Shoals and Banks				
Abbott Shoal	-	N/A	S, T	-
Afghan Shoal	-	N/A	S, T	S, T
Ann Shoals	-	N/A	S, T	-
Barbara Shoal	-	N/A	S, T	-
Barracouta Shoals*	-	N/A	S, W, T	S, W, T
Barton Shoal	-	N/A	S, W, T	S, W, T
Bassett-Smith Shoal	-	N/A	S, W, T	S, T
Beagle Shoals	-	N/A	S, T	-
Big Bank Shoals	-	N/A	S, T	S, T
Bill Shoal	-	N/A	S, T	-
Britomart Shoal	-	N/A	S	-
Calder Shoal	-	N/A	S, T	S, T
Cootamundra Shoal	-	N/A	S, T	S, T
Deep Shoal 1	-	N/A	S, W, T	S, T
Deep Shoal 2*	-	N/A	S, T	S, T
Dillon Shoal	-	N/A	S, W, T	S, T
Echo Shoals*	-	N/A	S, T	S, T
Echuca Shoal*	-	N/A	S, W, T	S, W, T
Eugene McDermott Shoal*	-	N/A	S, W, T	S, W, T
Evans Shoal	-	N/A	S, T	T
Fantome Shoal*	-	N/A	S, W, T	W, T
Fitzpatrick Shoal	-	N/A	S, T	-
Flinders Shoal	-	N/A	S, T	T
Franklin Shoal	-	N/A	S, T	T
Giles Shoal	-	N/A	S, T	-
Goeree Shoal	-	N/A	S, W, T	S, W, T
Hancox Shoal	-	N/A	S, T	-
Heywood Shoal	-	N/A	S, W, T	S, W, T
Jabiru Shoals	-	N/A	S, W, T	S, W, T
Jones Shoal	-	N/A	S	-

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Karmt Shoal	-	N/A	S, T	S, T
Lowry Shoal	-	N/A	S, T	-
Loxton Shoal	-	N/A	S, T	-
Mangola Shoal	-	N/A	S, W, T	S, W, T
Margaret Shoal	-	N/A	S	-
Marie Shoal	-	N/A	S, T	S, T
Marsh Shoal	--	N/A	S, T	-
Martin Shoal	-	N/A	S, T	-
Mataram Shoal	-	N/A	S, T	-
Mermaid Shoal	-	N/A	S, T	S
Money Shoal	-	N/A	S	-
Moresby Shoal	-	N/A	S, T	T
Moss Shoal	-	N/A	S, T	T
Newby Shoal	-	N/A	S, W, T	S, T
Ommaney Shoals	-	N/A	S,T	-
Parry Shoal	-	N/A	S, T	S, T
Pee Shoal	-	N/A	S, W, T	S, T
Penguin Shoal	-	N/A	S, W, T	S, W, T
Penguin Shoal	-	N/A	S, W, T	S, W, T
Renard Shoals	-	N/A	S, T	-
Shepparton Shoal	-	N/A	S, T	S, T
Skottowe Shoal	-	N/A	S, T	T
Sunset Shoal	-	N/A	S, T	S
Taiyun Shoal	-	N/A	S, T	-
Tassie Shoal	-	N/A	S,T	S, T
Troubadour Shoals	-	N/A	S, T	S, T
Van Cloon Shoal	-	N/A	S, W, T	S, W, T
Vee Shoal	-	N/A	S, W, T	S, W, T
Victoria Shoal	-	N/A	S, T	-
Vulcan Shoals*	W	N/A	S, W, T	S, W, T
Wells Shoal	-	N/A	S, T	-
Baldwin Bank	-	N/A	S, W, T	S, W, T

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Bellona Bank	-	N/A	S, T	S, T
Branch Banks	-	N/A	S, T	S, T
Favell Bank	-	N/A	S, W, T	S, W, T
Flat Top Bank*	-	N/A	S, W, T	S, T
Foelsche Bank	-	N/A	S, T	-
Gale Bank	-	N/A	S, W, T	S, W, T
Goodrich Bank	-	N/A	S, T	T
Holothuria Banks	-	N/A	S, W, T	S, W, T
Johnson Bank	-	N/A	S, W, T	S, W, T
Lynedoch Bank	-	N/A	S, T	-
Margaret Harries Bank*	-	N/A	S, T	S, T
Otway Bank	-	N/A	S, T	S, T
Parsons Bank	-	N/A	S, T	T
Sahul Bank*	-	N/A	S, W, T	S, W, T
Sunrise Bank*	-	N/A	S, T	S, T
Tait Bank	-	N/A	S, T	S
Woodbine Bank	-	N/A	S, W, T	S, W, T
Reefs and Offshore Islands				
Baxendell Reef	-	N/A	S, T	-
Beagle and Dingo Reefs	-	N/A	T	T
Beatrice Reef	-	N/A	S	-
Christine Reef	-	N/A	S, T	-
Draytons Reef	-	N/A	S, T	-
East Holothuria Reef	-	N/A	S, T	S, T
Elizabeth Reef	-	N/A	S, T	-
Elphinstone Reef	-	N/A	S, T	-
Fish Reef	-	N/A	S, T	-
Harris Reef	-	N/A	S, T	S
Heritage Reef	-	N/A	S, T	-
Hibernia Reef	-	N/A	S, W, T	S, T
Hinkler Patches	-	N/A	S, T	-
Hunt Patch	-	N/A	S, T	-

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold: Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Ingram Reef	-	NA	S, T	-
Jamieson Reef	-	N/A	S, T	S
Knight Reef	-	N/A	S, T	
Long Reef	-	-	S, T	S, T
Lyne Reef	-	N/A	S, T	-
Mavis Reef	-	N/A	T	-
Middle Reef	-	N/A	S, T	T
Oliver Reef	-	N/A	S	-
Oliver Rock	-	N/A	S, T	S
Orontes Reef	-	N/A	S, T	-
Rothery Reef	-	N/A	S, T	S, T
Sandy Islet	-	-	S, W, T	S, W, T
Scott Reef North	-	N/A	S, W, T	S, W, T
Scott Reef South	-	N/A	S, W, T	S, W, T
Seringapatam Reef	-	N/A	S, W, T	S, W, T
Taylor Patches	-	N/A	S, T	-
The Boxers	-	N/A	S, T	S, T
The Boxers Area*	-	N/A	S, T	S, T
Tregenna Reef	-	N/A	S, T	-
West Holothuria Reef	-	N/A	S	S, T
Adele Island	-	-	W, T	T
Admiralty Gulf Islands	-	-	S, T	S
Advance Island	-	-	T	-
Bathurst Island	-	T	S, T	S, T
Bigge Island	-	-	S, T	S, T
Bonaparte Archipelago	-	-	S, T	S, T
Browse Island	-	W, T	S, W, T	S, W, T
Buccaneer Archipelago	-	-	S, T	-
Burford Island	-	-	S, T	-
Cape Londonderry Islands	-	-	S, T	-
Cassini Island	-	-	S, T	S
Coronation Island Group	-	-	S, T	-

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Croker Island	-	T	S, T	-
Darch Island	-	-	S	-
East Vernon Island	-	-	S, T	-
Eclipse Archipelago	-	-	S, T	-
Field Island	-	N/A	S	-
Grant Island	-	-	S, T	-
Greenhill Island	-	-	S, T	-
Jones Island	-	-	S, T	S
Kingfisher Island	-	-	T	
Lawson Island	-	-	S, T	-
Long Island Kimberley	-	-	S, T	S, T
McCluer Island	-	-	S, T	-
Melville Island	-	-	S, T	T
Mogogout Island	-	-	S	-
Montalivet Island	-	-	S, T	S, T
Montgomery Islands	-	-	T	-
Montgomery Islands and Reef	-	-	T	-
Morse Island	-	-	S, T	-
Napier Broome Bay Islands	-	-	S,	-
New Year Island	-	-	S, T	-
North West Vernon Island	-	-	S, T	T
Oxley Island	-	-	S, T	-
Peron Islands	-	-	T	-
Roche Islands and Reefs	-	-	S, T	-
South West Vernon Island	-	-	S, T	-
Troughton Island	-	-	S, T	S, T
White Island	-	-	S, T	-
Wunmiyi Island	-	-	S, T	-
Mainland Coast-lines				
Cobourg Peninsula	-	-	S, T	-
Darwin Coast	-	T	S, T	-
Indonesia	-	T	S, W, T	S, W, T

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Joseph Bonaparte Gulf Northern Territory	-	S	S, T	-
Kakadu Coast	-	S	S, T	-
Kakadu National Park	-	-	S, T	-
Kimberley Coast	-	-	S, T	S, T
North Broome Coast	-	-	T	-
Port Hedland-Eighty Mile Beach	-	-	T	-
Timor Leste	-	S	S, T	S, T
West Arnhem Land	-	-	S	-
Key Ecological Features				
Ancient Coastline at 125 m depth contour	-	N/A	S, W, T	S, W, T
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	-	W,T	S, W, T	S, W
Canyons linking the Argo Abyssal Plain with the Scott Plateau	-	N/A	S, T	S, W, T
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	N/A	S, W, T	-
Carbonate banks & Terrace System of Van Diemen Rise	-	N/A	S, W, T	S, W, T
Carbonate bank and terrace system of Sahul Shelf	-	N/A	S, W, T	S, T
Continental Slope Demersal Fish Communities	-	N/A	S, W, T	S, W, T
Demersal Fish Community	-	N/A	S, W, T	S, W, T
Exmouth Plateau	-	N/A	S, W, T	T
Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals	-	T	S, W, T	S, W, T
Pinnacles of the Bonaparte Basin	-	N/A	S, W, T	S, W, T
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	-	N/A	S, W, T	S, W, T
Shelf break and slope of the Arafura Shelf	-	N/A	S, T	S, T
Tributary Canyons of the Arafura Depression	-	N/A	S, T	-
BIAs				
Turtle BIA	-	N/A	S, W, T	S, W, T
Seabirds BIA	-	N/A	S, W, T	S, W, T
Whales BIA	-	N/A	S, W, T	S, W, T

Receptor Category	Hydrocarbon Phase Above Adverse Exposure Threshold			
Probability of being impacted: <1% (-); 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Floating ≥10 g/m²	Shoreline accumulation ≥100 g/m²	Entrained ≥500 ppb	Dissolved ≥400 ppb
Dolphins BIA	-	N/A	S, T	S, T
Dugong BIA	-	N/A	S, W, T	S, W, T
Rivershark BIA	-	N/A	S, T	T
Whale Shark BIA	W, T	N/A	S, W, T	S, W, T
Marine Parks and Heritage Areas				
Lalang-garram / Camden Sound Marine Park	-	-	T	-
Lalang-garram / Horizontal Falls Marine Park	-	-	T	T
North Kimberley Marine Park	-	-	T	S, T
North Lalang-garram Marine Park	-	-	T	-
Charles Darwin NP	-	-	S, T	-
Garig Gunak Barlu NP	-	-	S, T	-
Kakadu NP	-	-	S, T	-
Mary River NP	-	-	S, T	-
Mitchell River NP Coast	-	-	S, T	-
Prince Regent NP Coast	-	-	S	-
Djukbinj NP	-	S	S, T	-
Kimberley AMP	-	N/A	S, W, T	S, W, T
Oceanic Shoals AMP	-	S, W	S, W, T	S, W, T
Ashmore Reef AMP	-	N/A	S, W, T	S, W, T
Carnarvon Canyon AMP	-	N/A	T	-
Cartier Island AMP	-	S, W,T	S, W, T	S, W, T
Arafura AMP	-	N/A	S, T	-
Argo-Rowley Terrace AMP	-	N/A	S, W, T	S, W, T
Arnhem AMP	-	N/A	S, T	-
Clerke Reef AMP	-	-	S, W, T	S, W, T
Gascoyne AMP	-	N/A	S, W, T	T
Imperieuse Reef AMP	-	-	S, W, T	S, T
Joseph Bonaparte Gulf AMP	-	N/A	S, T	-
Mermaid Reef AMP	-	T	S, W, T	S, W, T
Fisheries				
Northern Prawn Fishery	T	N/A	S, W, T	S, W, T

Receptor Category *Probability of being impacted* <1% -; 1%; >1-10%; >10-25%; >25-50%; >50-75%; >75%	Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating ≥10 g/m^2	Shoreline accumulation ≥100 g/m^2	Entrained ≥500 ppb	Dissolved ≥400 ppb
North-west Slope Trawl Fishery	-	N/A	S, W, T	S, W, T
Southern Bluefin Tuna Fishery	W, T	N/A	S, W, T	S, W, T
Timor Reef Fishery (NT Managed)	-	N/A	S, T	S, T
Western Skipjack Fishery	W, T	N/A	S, W, T	S, W, T
Western Tuna and Billfish Fishery	W, T	N/A	S, W, T	S, W, T

Appendix C: Shell HSSE & SP Policy

Shell Commitment and Policy on Health, Security, Safety, the Environment and Social Performance.

Commitment

In Shell we are all committed to:

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

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

Policy

Every Shell Company:

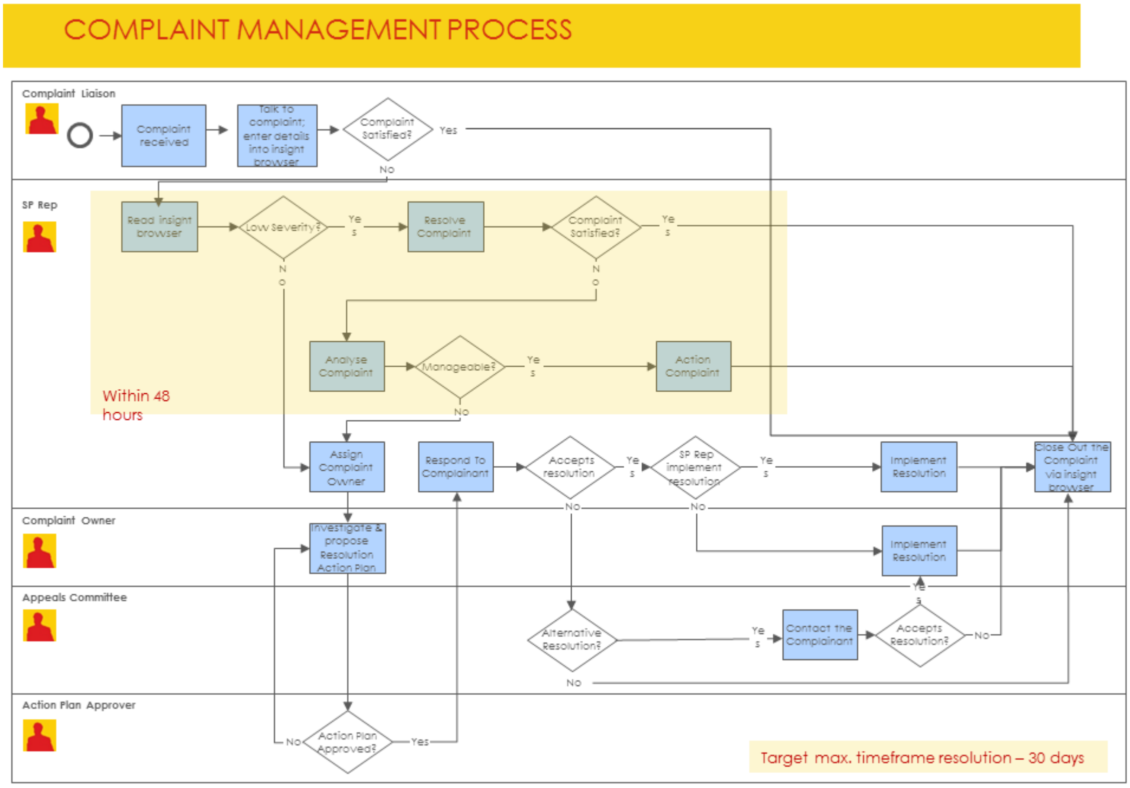
- Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires Contractors to manage HSSE & SP in line with this policy;
- Requires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

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

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

Terms in green are included in the HSSE & SP Control Framework Glossary.
Terms in blue reference manuals and manual sections in the HSSE & SP Control Framework.
This document is not controlled when printed. See the Change Log for version control information.

Appendix D: Complaints Management process



Appendix E: RAM

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Community	Environment	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect					
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect					

Appendix F: Spill level Classification

Characteristic	Level 1	Level 2	Level 3
Management			
Jurisdiction	Single jurisdiction (Commonwealth Waters)	Multiple jurisdictions (State/Commonwealth Waters)	Multiple jurisdictions, including international
Resources	Resourced from within one area	Requires intra-state resources	Requires national or international resources
Type of Incident			
Type of response	First-strike	Escalated	Campaign
Duration of response	Single shift	Multiple shifts Days to weeks	Extended response Weeks to months
Resources at Risk			
Environment	Isolated impacts or with natural recovery expected within weeks	Significant impacts and recovery may take months. Remediation required	Significant area and recovery may take months. Remediation required
Public Affairs	Local and regional media coverage	National media coverage	International media coverage