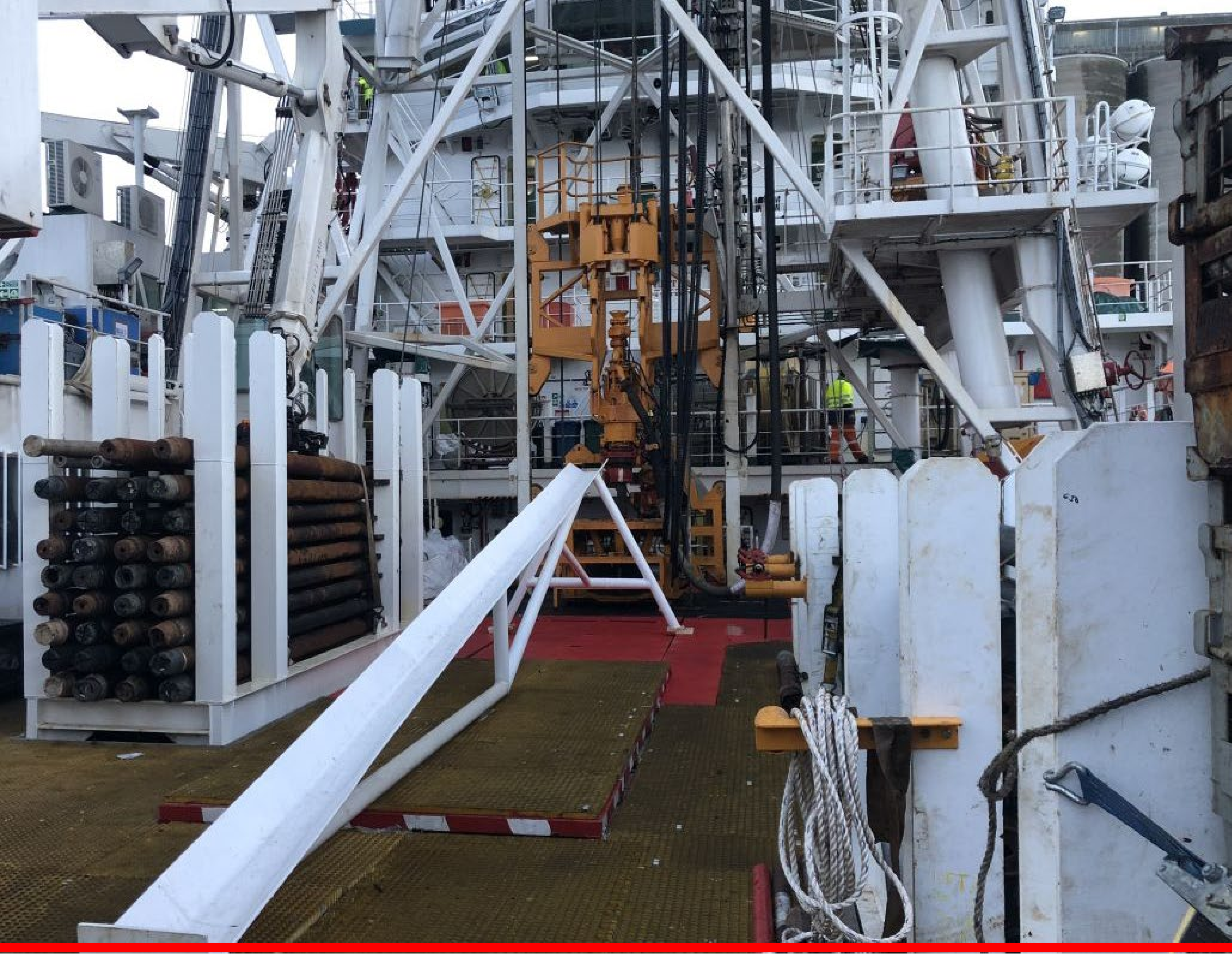

ENVIRONMENT PLAN

Beehive Pre-Drill Geotechnical Assessment

WA-488-P

3 August 2022

Rev 0

Prepared for:

EOG Resources Australia Block WA-488 Pty Ltd
ACN: 648 224 293
Suite 406, Level 4, 20 Bond Street, Sydney, NSW, 2000, Australia
www.eogresources.com

Prepared by:

Aventus Consulting Pty Ltd
ABN: 68 100 174 202
Suite 307, 75 Tulip Street, Cheltenham, VIC 3192
www.aventusconsulting.com.au

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Project Team

Name	Title	Project role
Giulio Pinzone	Principal Environmental Consultant	Quality assurance
Chris Ryan	Principal Environmental Consultant	Lead author
Siena Adorno	Environmental Consultant	Co-author

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Acronyms/Abbreviations

Acronym	Definition
2D	Two-dimensional
3D	Three-dimensional
AAR	Air to Air Refuelling
ACMA	Australian Communications and Media Authority
AEST	Australian Eastern Standard Time
AEW&C	Airborne Early Warning and Control
AFANT	Amateur Fishermen’s Association of the Northern Territory
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHIS	Aboriginal Heritage Inquiry System
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
AS	Australian Standard
ASBTIA	Australian Southern Bluefin Tuna Industry Association
AST	Aspartate Transaminase
BACI	Before-After-Control-Impact
BAT	Best Available Techniques
BIA	Biologically Important Area
BOM	Bureau of Meteorology
BPEM	Best Practice Environmental Management
BRAHSS	Behavioural Response of Australian Humpback whales to Seismic Surveys
BRUVS	Baited Remote Underwater Video Systems
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BWMC	Ballast Water Management Certificate
BWMP	Ballast Water Management Plan
BWR	Ballast Water Report
BWRS	Ballast Water Record System
CAMBA	People’s Republic of China for the Protection of Migratory Birds and their Environment 1986
CEFAS	Centres for Environment, Fisheries and Aquaculture Science (UK)
CFA	Commonwealth Fisheries Authority
CHARM	Chemical Hazard and Risk Management
CHIRP	Compressed High-Intensity Radar Pulse
CMST	Centre of Marine Science and Technology

Acronym	Definition
CoEP	Code of Environmental Practice
CPUE	Catch Per Unit Effort
CTD	Conductivity, Temperature and Depth
Cth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water and the Environment (Cth) (*former*)
DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DEPWS	Department of Environment, Parks and Water Security (NT)
DITT	Department of Industry, Tourism and Trade (NT)
DMIRS	Department of Mines, Industry Regulation and Safety (WA)
DNP	Director of National Parks
DoD	Department of Defence
DoF	Department of Fisheries (WA)
DoT	Department of Transport
DP	Dynamic Positioning
DPIRD	Department of Primary Industries and Region Development (WA)
DPLH	Department of Planning, Lands and Heritage (WA)
EB	Environmental Benefit
EIA	Environmental Impact Assessment
EIAPP	Engine international air pollution prevention
EMBA	Environment That May Be Affected
EP	Environment Plan
ePAR	Electronic Pre-Arrival Report
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999 (Cth)
EPO	Environmental Performance Objective
EPS	Environmental Performance Standard
ERA	Environmental Risk Assessment
ERC	Emergency Response Coordinator
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
Ev	Evaluation
FPSO	Floating Production Storage and Offloading
FRDC	Fisheries Research Development Corporation
GEP	Gas Export Pipeline
GHG	Greenhouse Gas
GMP	Garbage Management Plan
GNSS	Global Navigation Satellite System
HFC	High Frequency Cetacean
HFO	Heavy Fuel Oil

Acronym	Definition
HMCS	Harmonised Mandatory Control Scheme
HQ	Hazard Quotient
HSE	Health , Safety and Environment
HVAC	Heating, Ventilation and Air Conditioning
IAFS	International Anti-fouling System
IAPP	International Air Pollution Prevention
IEE	International Energy Efficiency
IMAS	Institute for Marine and Antarctic Studies
IMCA	International Marine Contractors Association
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMDG	International Marine Dangerous Goods
IMO	International Maritime Organisation
IMP	Impact
IMS	Invasive Marine Species
IMT	Incident Management Team
IOGP	International Association of Oil & Gas Producers
IOPP	International Oil Pollution Prevention
IPIECA	International Petroleum Industry Environmental Conservation Association
IPP	International Pollution Prevention
IR	Infra-red
ISPP	International Sewage Pollution Prevention
ISPS	International Ship and Port Facility Security
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for the Conservation of Nature
JAMBA	Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment
JBG	Joseph Bonaparte Gulf
JSA	Job Safety Analysis
KCMF	Kimberley Crab Managed Fishery (also referred as the North Coast Crab Fishery).
KEF	Key Ecological Feature
KGBF	Kimberley Gillnet and Barramundi Fishery
KLC	Kimberley Land Council
KPMF	Kimberley Prawn Managed Fishery
LAT	Lowest Astronomical Tide
LFC	Low Frequency Cetacean
LP	Low Pressure
LPG	Liquified Petroleum Gas
Ltd	Limited
LWD	Logging While Drilling
MARPOL	International Convention for the Prevention of Pollution from Ships
MBC	Maritime Border Command

Acronym	Definition
MBES	Multi-beam echo sounder
MDO	Marine Diesel Oil
MFC	Mid Frequency Cetacean
MMF	Mackerel Managed Fishery
MMO	Marine Mammal Observer
MNES	Matters of National Environmental Significance
MoC	Management of Change
MODU	Mobile Offshore Drilling Unit
MP	Marine Park
MSS	Marine Seismic Survey
NatPlan	National Plan for Maritime Environmental Emergencies
NCVA	National Conservation Values Atlas
NDSMF	Northern Demersal Scalefish Managed Fishery
NEBA	Net Environmental Benefit Analysis
NIW	Nationally Important Wetlands
NLC	Northern Land Council
NMFS	National Marine Fisheries Service
NMR	North Marine Region
NNTT	National Native Title Tribunal
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NPF	Northern Prawn Fishery
NPFI	Northern Prawn Fishing Industry Pty Ltd
NRT	National Response Team
NSW	New South Wales
NT	Northern Territory
NT Plan	Northern Territory Oil Spill Contingency Plan 2014
NTSC	Northern Territory Seafood Council
NWMR	Northwest Marine Region
NWSA	North Wildcatch Seafood Australia
NZS	New Zealand Standard
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone Depleting Substances
OIW	Oil In Water
OPEP	Oil Pollution Emergency Plans
OPGGS	*Offshore Petroleum and Greenhouse Gas Storage Act* 2006 (Cth)
OPGGS(E)	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPIC	Offshore Petroleum Incident Coordination
OSMP	Operational and Scientific Monitoring Programs
OSPAR	Oslo-Paris Convention 1992
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response

Acronym	Definition
OWS	Oily Water Separator
P&ID	Piping and Instrumentation Diagrams
PAH	Polyaromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCPT	Piezo Cone Penetrometer Test
PDSA	Pre-drilling Seabed Assessment
PLONOR	Pose Little or No Risk
PMS	Planned Maintenance System
PMST	Protected Matters Search Tool
POB	Persons On Board
POLREP	Pollution Report
PPA	Pearl Producers Association
PPE	Personal Protective Equipment
PTS	Permanent Threshold Shift
PTW	Permit To Work
PVC	Polyvinyl Chlorides
PWC	Parks and Wildlife Commission
PWS	Parks and Wildlife Service (WA)
RCC	Response Coordination Centre
REACH	Registration, Evaluation and Authorisation of Chemicals
RO	Reverse Osmosis
ROKAMBA	Republic of Korea Migratory Birds Agreement 2006
ROV	Remotely Operated Vehicle
RQ	Risk Quotient
SBM	Synthetic-based mud
SBP	Sub-bottom profiling
SBTF	Southern Bluefin Tuna Fishery
SDS	Safety Data Sheet
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SIMOPS	Simultaneous Operations
SITREP	Situation Report
SMPEP	Shipboard Marine Pollution Emergency Plan
SPL	Sound Pressure Level
SPRAT	Species Profile and Threats
SRL	Southern Rock Lobster
SSS	Side scan sonar
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
STP	Sewage Treatment Plant
TECS	Threatened Ecological Communities
TTS	Temporary Threshold Shift

Acronym	Definition
UNEP IE	United Nations Environment Programme Industry and Environment
USA	United States of America
USBL	Ultrashort Base Line
UXO	Unexploded Ordnance
VHF	Very High Frequency
VoO	Vessels of Opportunity
WA	Western Australia
WAF	Water-Accommodated Fraction
WAFIC	Western Australian Fishing Industry Council
WBM	Water-based mud
WEL	Woodside Energy Limited
WestPlan	Western Australian Oil Spill Contingency Plan
WHP	Wellhead Platform
WSTF	Western Skipjack Tuna Fishery
WTBF	Western Tuna and Billfish Fishery

1 Introduction

1.1 Background to the Beehive Project

EOG Resources Australia Block WA-488 Pty Ltd (hereafter referred to as EOG) is the titleholder of exploration permit WA-488-P and is planning for drilling to commence on the Beehive-1 exploration well in 2023. The drilling will be undertaken using a jack-up Mobile Offshore Drilling Unit (MODU) and is scheduled to take approximately 55 days. Further information on the drilling activities can be found in the Beehive-1 Exploration Drilling Environment Plan (EP) (link) which is currently under assessment with the National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA).

Prior to drilling, a number of geophysical and geotechnical investigations need to be carried out to assess and characterise the seabed for risk mitigation and geohazard identification and to evaluate the sub-seabed conditions to support a jack-up MODU. The Beehive Pre-Drill Seabed Assessment (PDSA) EP was accepted on 2 March 2022 by NOPSEMA and allowed for the geophysical and geotechnical activities to be completed by August 2022 (link).

The geophysical investigations were completed in July 2022, however the geotechnical investigations are now scheduled to commence sometime between October 2022 and June 2023. As such, this EP has been prepared for the geotechnical investigations because the time window in the PDSA EP has elapsed.

1.2 The Geotechnical Activity

EOG proposes to undertake geotechnical investigations (the activity) within Commonwealth marine waters approximately 71 kilometres (km) north of the Western Australian (WA) coastline in the Joseph Bonaparte Gulf (JBG) (Figure 2.1). The activity (as defined in Regulation 6 of the OPGGS(E)) is defined as:

> *The physical collection of geotechnical data, from the time that the vessel first enters the activity area and deploys equipment, until the time the vessel retrieves the equipment and departs the activity area.*

The activity area is defined in Section 2.1. A full description of the activity is provided in Chapter 2.

1.3 Titleholder and Liaison Person

EOG Resources, Inc. (as the parent company of EOG) was established in 1985 and is listed on the New York Stock Exchange. It is one of the largest independent crude oil and natural gas exploration and production companies in the United States of America (USA) with hydrocarbon reserves in the USA and Trinidad & Tobago. The company has a market cap of approximately USD$63 billion (AUD$90 billion) as of 28 July 2022, and employs around 2,800 people.

The Titleholder for this activity is:

EOG Resources Australia Block WA-488 Pty Ltd
Suite 406, Level 4, 20 Bond Street,
Sydney, NSW, 2000, Australia

The nominated liaison person for this EP is:

Jonathan Chung

Director, Business Development International

1111 Bagby Street, Sky Lobby 2

Houston, TX 77007 USA

Phone: +1 713-651-7000

Email: australia@eogresources.com

EOG will notify NOPSEMA of any change in 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 including changes to the activity or the EP in accordance with the details provided in Table 1.1.

Table 1.1 OPGGS(E) notification requirements – change of contact details and end of activity

Regulation requirements	OPGGS(E)
A change of Titleholder, change in the Titleholder's nominated liaison person or a change in the contact details for either the Titleholder or the liaison person. Notification to be provided within 7 days of the change.	Regulation 15(3)
The end of operation of the EP (i.e., at completion of the activity). *To be reported using proforma (FM1408) on the NOPSEMA website.	Regulation 25A*
The end of an activity (i.e., within 10 days of completion of the activity). *To be reported using proforma (FM1405) on the NOPSEMA website.	Regulation 29*

1.4 Scope of this Plan

This EP has been prepared in accordance with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act 2006) and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)). It aims to secure acceptance from NOPSEMA by demonstrating that EOG will manage the environmental impacts and risks of the activity to As Low As Reasonably Practicable (ALARP) and to an acceptable level. In brief, this EP includes a description of:

- The nature of the activity (location, layout, operational details);
- Stakeholder consultation activities;
- The environment affected by the activity;
- Environmental impacts and risks (including emergency incidents);
- Mitigation and management measures;
- Environmental performance outcomes, standards and measurement criteria;
- How impacts and risks are demonstrated to be ALARP and acceptable;
- The implementation strategy to ensure that the environmental impacts and risks are managed in a systematic manner; and
- Reporting arrangements.

1.5 Environment Plan Summary

Table 1.2 provides a summary of this EP as required by Regulation 11(4) of the OPGGS(E).

Table 1.2 EP Summary of material requirements

EP Summary requirement	EP section
The location of the activity	Section 2.1
A description of the receiving environment	Chapter 5
A description of the activity	Chapter 2
Details of the environmental impacts and risks	Chapter 7
The control measures for the activity	Chapter 7
The arrangements for ongoing monitoring of the titleholder's environmental performance	Chapter 8
Response arrangements in the oil pollution emergency plan (OPEP)	Chapter 9
Consultation already undertaken and plans for ongoing consultation	Chapter 4
Details of the titleholder's nominated liaison person for the activity	Section 1.3

2 Activity Description

This chapter provides a description of the proposed activity in accordance with the requirements of Regulation 13(1) of the OPGGS(E).

2.1 Activity Location

The geotechnical activity area lies entirely within WA-488-P (which covers an area of 4,100 km^2) in water depths from approximately 35 metres (m) to 50 m Lowest Astronomical Tide (LAT). It is defined as the polygon bounded by the coordinates in Table 2.1 and shown in Figure 2.1. This polygon has an area of approximately 50.4 km^2.

At its closest point, the activity area is located approximately 163 km offshore from nearest WA coastline and 73 km from the Northern Territory (NT) coastline. The distances from the activity area to nearby features are provided in Table 2.2.

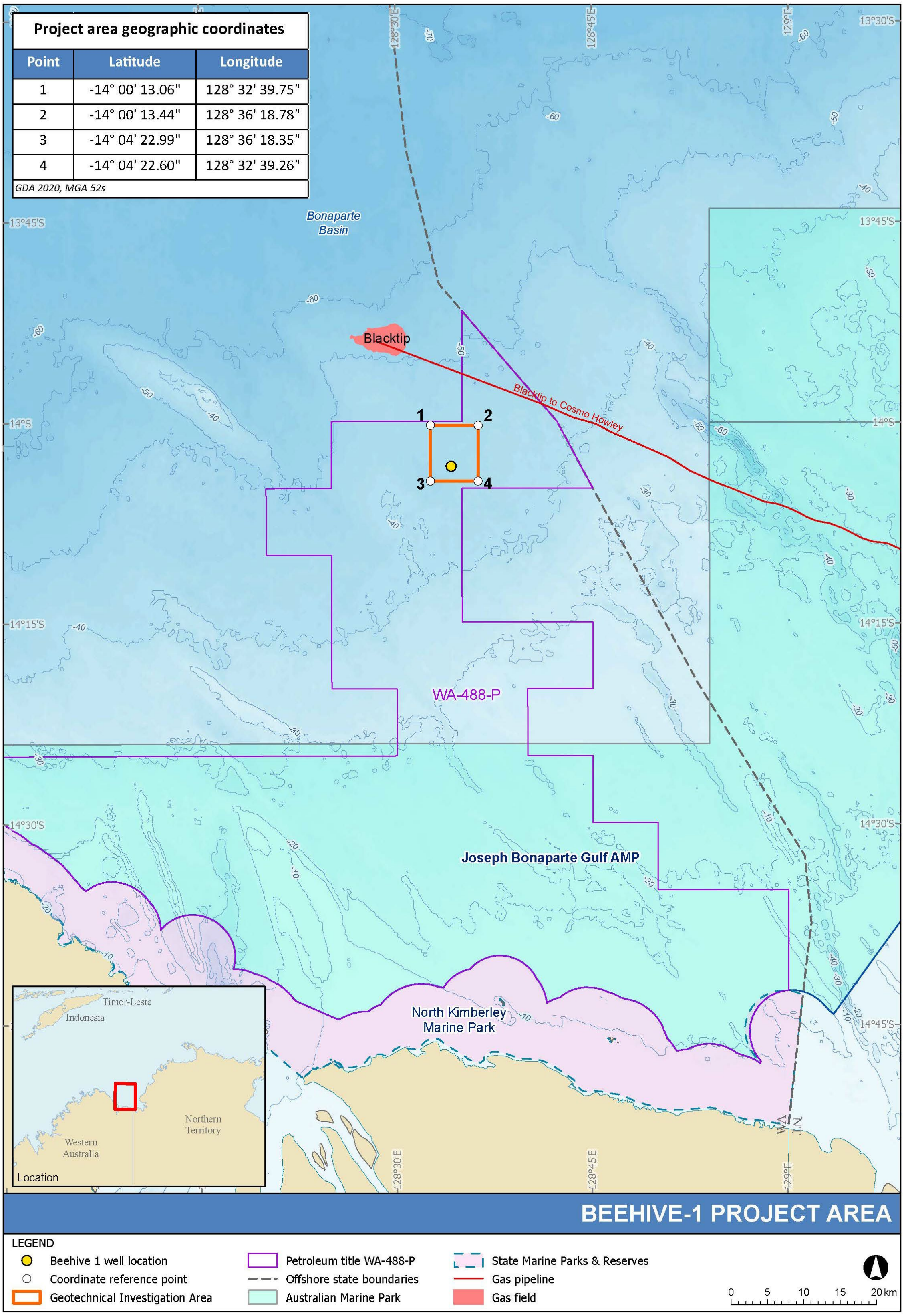
Table 2.1 Geographic coordinates of the activity area

Point	Latitude	Longitude
1	14° 00' 13.06"	128° 32' 39.75"
2	14° 00' 13.44"	128° 36' 18.78"
3	14° 04' 22.99"	128° 36' 18.35"
4	14° 04' 22.60"	128° 32' 39.26"

Source: GDA 2020, MGA 52S.

Table 2.2 Distance to key features from the activity area

Feature	Distance and direction from the nearest point of the activity area to the nearest point of the feature
Towns	
Port Keats (Wadeye) (NT)	100 km ENE
Wyndham (WA)	163 km SSE
Kununurra (WA)	189 km SSW
Kalumbaru (WA)	206 km WSW
Darwin (NT)	295 km NE
Marine Protected Areas	
Joseph Bonaparte Gulf Australian Marine Park (AMP)	32 km E
Oceanic Shoals AMP	152 km NNE
North Kimberley Marine Park (WA)	65 km S
Petroleum Infrastructure	
Blacktip gas export pipeline	5.5 km NE
Blacktip unmanned wellhead platform	15 km NW



Point	Latitude	Longitude
1	-14° 00' 13.06"	128° 32' 39.75"
2	-14° 00' 13.44"	128° 36' 18.78"
3	-14° 04' 22.99"	128° 36' 18.35"
4	-14° 04' 22.60"	128° 32' 39.26"

Figure 2.1 Location of the geotechnical investigation area in WA-488-P

2.2 Timing and Duration

The activity is scheduled to commence between October 2022 and June 2023. The exact timing of the activity within this time window is contingent on the receipt of environmental approvals, vessel/equipment availability and fair sea state conditions suitable for the activity.

The activity is estimated to take up to 2 weeks in total to complete, although this is dependent on the exact methods and technologies used as well as weather conditions during the activity execution phase.

2.3 Objective of the Activity

The objective of the activity is to identify constraints and hazards that may affect the drilling of a well, specifically:

- Acquire and assess geotechnical data and soil samples to support the safe placement of the MODU's jack-up legs and conduct riserless drilling;
- Identify sub-seabed features and hazards that may impact on the exact positioning of the MODU;
- To define any potential hazards or factors of operational significance for drilling rig emplacement.
- To identify geohazards and geological conditions relating to drilling of the top-holes.
- To assist with future wellsite planning.

The risk to a MODU's integrity through loss of seabed support makes intrusive geotechnical investigations critical (IOGP, 2017). Investigations must take place in the Beehive drilling area and in the case of a jack-up MODU, must also cover the area of approach to the location (i.e., the commencement of leg pinning activity) (IOGP, 2017). As the proposed drilling location(s) are not finalised, the activity area has been designed to consider the full positional uncertainty of the final surface location of any well(s).

2.4 Geotechnical Investigations

Geotechnical investigation methods collect detailed information on the physical properties of the seabed and the underlying shallow sediments to build up a picture of the local geology of the activity area. One of the methods includes collecting sediments that are photographed, described and tested to determine the load bearing properties of the seabed sediments at potential MODU spud can locations.

The objective of the geotechnical investigations is to assess and characterise the seabed and sub-seabed conditions at each MODU location, including calibrating and interpreting geophysical results, as well as provide the necessary data for risk mitigation, geohazard identification and clearance, exploration drilling operations and engineering analysis. The proposed techniques will include:

- Borehole (BH) sampling to acquire high quality soils for laboratory testing to inform the detailed engineering design in the field; and

- Piezo cone penetrometer testing (PCPT) to determine seabed strength and general ground stratigraphy.

The scope of work is ISO 19905-1: 2016 compliant, the exact work will depend on the soil conditions encountered with a combination of BHs and PCPT measurements acquired near the

MODU location, to characterise the sub-seabed to safely set the MODU. The exact locations for sampling and testing will depend on the geophysical data interpretation and preliminary engineering analysis. A simplified pictorial representation of geotechnical investigation techniques is provided in Figure 2.2.

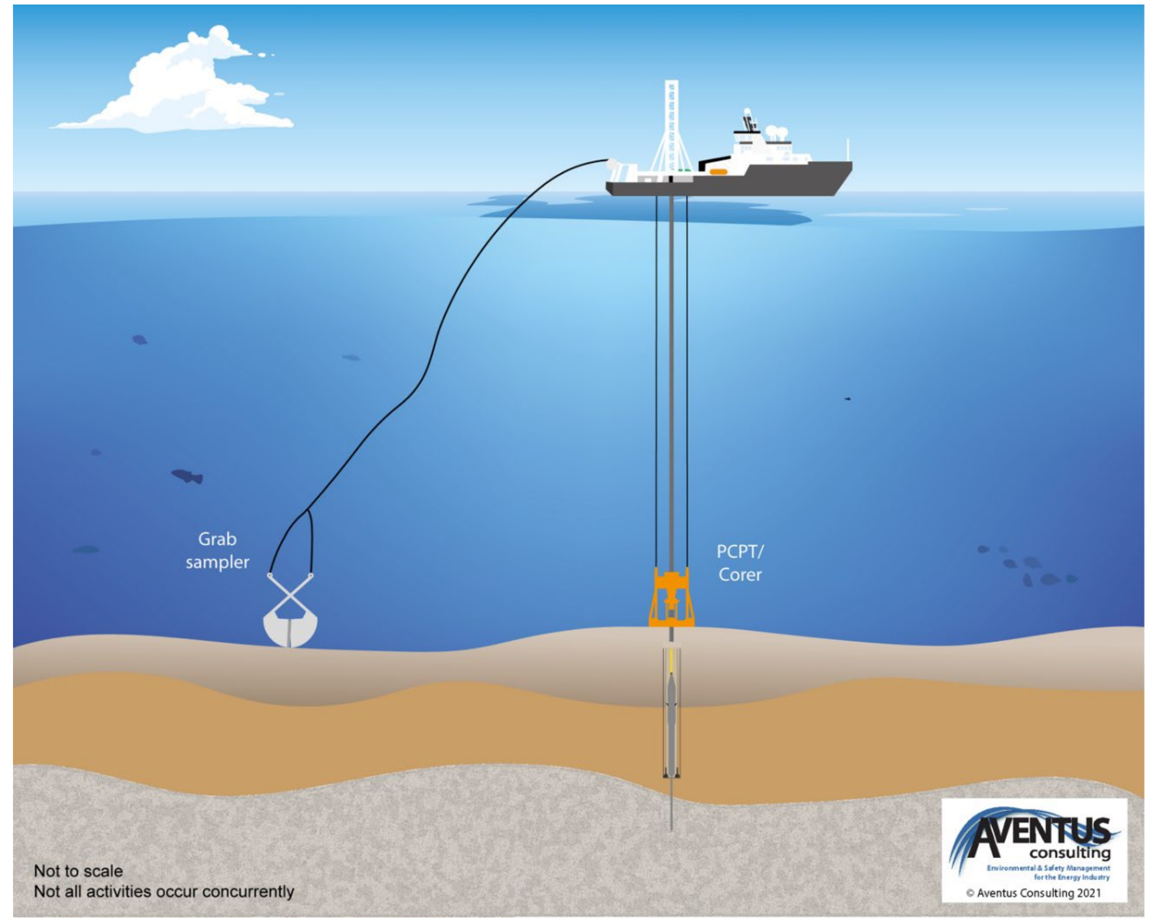


Figure 2.2 Simplified representation of geotechnical investigation techniques

2.4.1 Borehole Sampling

Borehole sampling gathers geotechnical soil data to a minimum depth of the jack-up MODU spud can penetration plus 1.5 x the spud can diameter. The maximum depth of the boreholes ranges between 40 and 80 m below the seabed, depending on soil conditions encountered during operations.

Typically, one borehole sample is collected from the centre of the MODU location and one sample at each MODU spud can location (i.e., four in total). For conservatism, it is assumed that up to 15 samples may be taken across the activity area. The samples are used to ground truth the geophysical data and provides soil strength data that can be used for geotechnical analysis.

Downhole sampling would be undertaken at predetermined intervals. Sampling will typically consist of rotary cores/push cores for the full length of one of the boreholes. For borehole coring, hydraulically operated push or piston samplers may be used to recover high quality samples as a result of the piston being fixed in one position while the sample tubes penetrate the soil downhole.

If the PCPT is unable to penetrate the seabed to the desired depth, rotary cored samples may be collected in lieu of PCPT until ground conditions permit the PCPT to be redeployed downhole.

A seabed frame is lowered to the seabed with the PCPT unit integrated into it and operated remotely. A typical PCPT is shown in Figure 2.3. The type of sample tube used will depend on the soil type expected and for piston/push would typically be 76 mm (outside diameter), 72 mm (internal diameter), and nominal 1 m length, for a footprint of 0.45 m^2.

Figure 2.3 Typical PCPT

Alternatively, a robotic seabed system (Figure 2.4) may be used with a Hydraulically Tethered Piston Sampler of 54 mm (outside diameter), 44 mm (internal diameter). The seabed drilling and PCPT system has a maximum estimated footprint of approximately 4.5 m^2 on the seabed. For 15 sampling locations, this equates to a total disturbance area of 67.5 m^2 across the activity area.

Drilling fluids will be used in the borehole sampling process, as described below.

Figure 2.4 Robotic seabed system

Drill Cuttings

Cuttings are discharged directly to the seabed during borehole sampling. Drill cuttings are inert pieces of rock, sand and other particles removed from the borehole during the sampling process. Cuttings range in size from very coarse to very fine particles.

The coring for this activity will generate a very small volume of cuttings at a few locations, as outlined in Table 2.3.

Table 2.3 Approximate cutting discharge volumes for borehole sampling

Total depth	Borehole diameter	Number of holes across the activity area	Total drill cuttings volume
Up to 80 m (more likely <50)	Variable, usually about 40-80 mm	Up to 15, expecting 6	π x 0.08 m^2 x 80 m = 0.402m^3 per borehole. A maximum of 6.03 m^3 total for 15 boreholes across the activity area

Drill Fluids

Drilling fluid will be used during the borehole sampling and PCPT process to lubricate the drill bit, transport cuttings out of the borehole to keep the borehole clean and to prevent the borehole from collapsing during the coring process. For a borehole 80 m deep, the volume of drilling fluid would be in the order of 30 m^3.

Seawater is the primary constituent of geotechnical drilling fluids. Inert drilling fluid additives may be added to the seawater to form a water-based mud (WBM) if challenging boring conditions are encountered. Common WBM additives that may be used during the coring process are listed in Table 2.4.

Table 2.4 Potential drill fluid additives and discharge volumes

Additive	Function	Indicative total volume	OCNS rating*	
			CHARM	Non-CHARM
Guar	Viscosifier. A high-yield organic xanthan gum polymer used to impart viscosity to the drilling fluid. It is readily biodegraded via bacterial activity.	~2 kg/m³ of drilling fluid (~60 kg for an 80 m deep borehole)	-	E
Bentonite	Viscosifier. A naturally-occurring high-density mineral milled to a uniform particle size and used to increase fluid density. It is inert in the environment.	~25 kg/m³ of drilling fluid (~2,000 kg for an 80 m deep borehole)	-	E
Barite	Weighting agent. A naturally-occurring high density mineral milled to uniform particle size and used to increase the fluid density. It is inert in the environment.	15 kg/m³ of drilling fluids (450 kg for an 80 m deep borehole)	-	E

** Ratings current at July 2022.*

The exact types and composition of the WBM will not be known until after the geotechnical contractor has been engaged. EOG will specify that all drilling fluid additives are of low eco-toxicity, with only 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM) OCNS-rated chemicals to be used (see following section) in accordance with the Offshore Chemical Notification Scheme (OCNS).

The preferred drilling fluid at the time of writing is *Pure-Bore® Liquid* which has a Gold CHARM rating.

OSPAR Convention

In the absence of Australian standards regarding the suitability of drilling mud chemical additives, the Offshore Chemical Notification Scheme (OCNS) is generally used as a basis for selecting environmentally acceptable chemicals in the Australian offshore upstream petroleum industry. The OCNS manages chemical use and discharge by the UK and Netherlands offshore petroleum industries. The scheme is regulated in the UK by the Department of Energy and Climate Change using scientific and environmental advice from the UK's Centres for Environment, Fisheries and Aquaculture Science (CEFAS) and Marine Scotland.

The OCNS uses the Harmonised Mandatory Control Scheme (HMCS) developed through the Oslo-Paris (OSPAR) Convention 1992. This ranks chemical products according to Hazard Quotient (HQ), calculated using the Chemical Hazard and Risk Management (CHARM) model. The CHARM model requires the biodegradation, bioaccumulation and toxicity data of the product to be provided.

Under the OSPAR Convention, organic-based compounds used in production, completion and workovers, drilling and cementing are subject to the CHARM model. The CHARM model calculates the ratio of the 'Predicted Effect Concentration' against the 'No Effect Concentration' expressed as a HQ, which is then used to rank the product. The HQ is converted to a colour banding to denote its environmental hazard, which is then published on the Definitive Ranked Lists of Approved Products (link). Gold has the lowest hazard, followed by silver, white, blue, orange and purple (having the highest hazard).

Products not applicable to the CHARM model (i.e., inorganic substances, synthetic-based muds (SBM), hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with 'A' having the greatest potential environmental hazard and 'E' having the least. Products that only contain substances termed PLONORs (Pose Little or No Risk to the environment) are given the OCNS 'E' grouping (Figure 2.5). Data used for the assessment includes toxicity, biodegradation and bioaccumulation.

OCNS Hazard Groupings for CHARM and Non-CHARM Chemical Products						
CHARM	Gold	Silver	White	Blue	Orange	Purple
Non-CHARM	E	D	C	B	A	
	Lowest Hazard				*Highest Haza*	

Source: NOPSEMA (2015).

Figure 2.5 Illustration of hazard ranking bands for chemical products classified under the OCNS

Chemical substitution

Chemicals that are hazardous to the marine environment are subject to substitution warnings under the HMCS. The UK follows and applies the OSPAR harmonised pre-screening scheme and complies with the Registration, Evaluation and Authorisation of Chemicals (REACH) recommendation to replace chemical substances identified as candidates for substitution. These substances are flagged with a substitution warning on the product template.

CEFAS recommends that during the selection of chemical products, operators consider the magnitude of their Risk Quotient (RQ) and the presence of hazardous substances, and encourages operators to select products without a substitution warning.

Chemical review process

EOG will review all chemicals nominated by the drilling fluids contractor against the Definitive Ranked Lists of Approved Products (current at the time) to ensure that only 'Gold' or 'Silver' (CHARM) and 'E' or 'D' (non-CHARM) rated chemicals are nominated and that none of the chemicals nominated have a substitution warning.

Where, for technical reasons an additive is required that has not been registered with CEFAS (and therefore does not have a rating), EOG will apply the CHARM or, in the case of non-CHARMable products, the OCNS process (link) to calculate the CHARM rating or OCNS grouping. Only additives with a hazard quotient of <30 (gold/silver) or an OCNS grouping of D/E will be used. This will be managed in line with EOG Resource's MoC process (described in Section 8.8).

2.4.2 Piezo Cone Penetrometer Testing (PCPT)

PCPT measurements yield soil strength and helps to delineate soil stratigraphy. Typically, one sample is collected from the centre of the MODU location (with a contingency for one sample at each MODU spud can location [i.e., four in total]). This ground-truths the geophysical data and provides soil strength data that can be used for geotechnical analysis.

PCPT involves the in-situ measurement of the resistance of ground to continuous penetration. This process involves lowering a frame to the seabed and pushing the PCPT unit into the sediment at a steady penetration rate (usually 2 cm per second). The PCPT measures resistance to the push and these measurements allow high quality interpretation of ground conditions and pore pressure dissipation testing. The resolution of the PCPT in delineating stratigraphic layers is related to the size of the cone tip.

When the required penetration depth is reached, all equipment is withdrawn from the seabed. A small hole will remain in the seabed, which will eventually collapse and infill with the movement of seabed sediments. The PCPT unit consists of rods up to 25 m long (or smaller discrete rod sections) with a small cone at its base (typical cone tip cross-sectional area of 2, 5, 10 or 15 cm^2). This activity is mostly likely to use 10 cm^2. Penetration may occur to 40 m deep. The actual penetration is dependent on the soil conditions. A PCPT typically takes 2-2.5 hours to complete, depending on water depth. Given the small activity area, PCPT sampling may only take a few hours in total.

2.4.3 Laboratory Testing

Laboratory analysis of the nature and composition of seabed sediments will be undertaken onboard the geotechnical vessel and, if necessary in onshore laboratories. Offshore laboratory testing has the benefit of informing the need for additional testing while the vessel is on location if results indicate variable seabed profiles. Offshore laboratory testing will be completed on acquired samples, including:

- Water content, bulk density, and dry density;
- Photography of all samples including gradated scale and colour chart;
- For cohesive soils, strength testing including torvane, miniature lab vane, unconsolidated undrained triaxial, pocket penetrometer; and
- Secure storage of samples and delivery to the onshore laboratory for further testing, if necessary.

Seabed samples will be measured for visual classification, wet and dry density, moisture content, Torvane and shear strength. Also mobilised to the geotechnical vessel will be the necessary equipment for extrusion, cutting, handling and securing the samples. All tests will be performed according to relevant Australian, British or ASTM standards, or other recognised procedures.

2.5 Associated Non-invasive Investigations

A conductivity, temperature and depth (CTD) probe and drop camera may be deployed within the water column to provide visual and physico-chemical information about the activity area. These devices are static non-invasive survey techniques that do not interact with the seabed and do not generate acoustic sound or other emissions. As such, they are not considered in the activity environmental impact and risk assessment (Section 7).

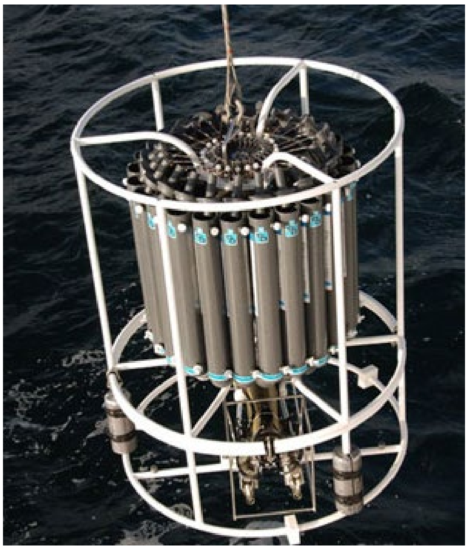
2.5.1 Conductivity, Temperature and Depth

A conductivity, temperature and depth (CTD) device (Figure 2.6) measures physical properties, specifically conductivity and temperature, of the seawater relative to depth. Conductivity is a measure of how well a solution conducts electricity and is directly related to salinity, which is the concentration of salt and other inorganic compounds in seawater. When combined with temperature data, salinity measurements are used to determine seawater density. In the context of G&G investigations, such measurements are required for sound velocity in order to calibrate the acoustic equipment as the speed of sound through the water column is integral to the calculations.

The CTD rosette (the metal device holding water sampling bottles) is lowered on a cable from the vessel and takes water samples using a Niskin sampler at designated intervals in the water column (usually from three sample depths – near-surface, mid-water and above the seabed). The data is then processed and available onboard. The CTD rosette may also contain other sensors that can measure additional physical or chemical properties.

2.5.2 Drop Camera

A 'drop camera' (i.e., camera housed in water-proof casing and mounted in a stainless-steel frame) may be deployed from the vessel to take representative photos of the seabed types encountered in the activity area (Figure 2.6). The camera is simply lowered to the seabed and the camera triggered. Additionally, if video images are required, a similar frame may be towed behind the vessel close to the seabed using a weighted towfish and communications cable.



(a)

(b)

Figure 2.6 CTD (a) and drop camera on frame (b)

2.6 Contractors

The geotechnical vessel contractor is yet to be appointed. Only contractors with a proven history of safe and successful operations will be considered.

2.7 Vessel

The vessel is yet to be selected to undertake the activity. A specialised vessel with a large deck area and drilling derrick will be necessary for the geotechnical activities. Such a vessel may be mobilised from elsewhere in Australia or from a global pool of suitable vessels.

Table 2.5 presents the estimated maximum vessel dimensions and tank capacities for vessels that could be used for this activity. This provides an indication of the likely size of the vessels required. Figure 2.7 provides images of typical geotechnical vessels.

Table 2.5 Typical geotechnical vessel specifications

Parameter	Specification (max)
Vessel type	Multi-purpose supply, platform supply
Crew accommodation	Up to 60 people
Tonnage (gross)	Up to 4,258 t
Dimensions	
Length	Up to 87 m
Breadth	Up to 20 m
Draught	Up to 8 m
Deck area	Up to 600 m^2
Tank capacities	
Potable water	Up to 1,021 m^3
Mud (liquid)	Up to 1,050 m^3
Brine	Up to 1,050 m^3
Fuel oil	Up to 1,357 m^3

Initial mobilisation of crew to the vessel will be via port call, which will be selected post-contract award. Given the short duration of the activity, crew changes are not anticipated while on site. No helicopter transfers are planned (although they may be required in the event of medical emergencies).

During the geotechnical investigations, the vessel will hold station using dynamic positioning (DP) or propellers; anchoring will not be necessary, unless in the event of an emergency. The use of support vessels will not be required.

Given the short duration of the activity, the vessel will not require refuelling on location in order to complete the activity. The vessel will bunker with marine diesel only while in port.

In the event of bad weather during the investigations, the vessel will seek safe shelter or return to port. A weather forecasting service (which provides a look-ahead several days out) will be used to ensure that the vessels are not mobilised immediately prior to forecasted poor weather, thus minimising the need to seek safe shelter and arrange crew transfers.

	The *Fugro Mariner*
	Solstad Nor Spring
	The *TEK Ocean Spirit*
	The *MMA Valour*

Figure 2.7 Vessels typically used to undertake geotechnical investigations

2.8 Simultaneous Activities

Eni may be drilling production wells at the nearby Blacktip unmanned production platform (link), scheduled to occur during November and December 2022, and possibly extending into February 2023. EOG continues to consult with Eni (see Chapter 4).

2.9 Activity Summary

Table 2.6 summarises the proposed activity parameters.

Table 2.6 Summary of the activity parameters

Parameter	Details		
Timing	October 2022 to June 2023		
Duration of the activity	2 weeks in total		
Water depths	30 – 50 m LAT		
Activity area (overall)	~50 km^2		
Geotechnical investigation	Duration (estimate)	Depth of penetration (m)	Number of investigation sites
PCPT	1-2 weeks	Up to 40	Up to 15 across the activity area
Borehole sampling		Up to 80	

3 Environmental Regulatory Framework

In accordance with Regulation 13(4) of the OPGGS(E), this chapter describes the legislative requirements that apply to the activities described in this EP.

In line with OPGGS(E) Regulation 31 and Section 2.6 of NOPSEMA's *Environment Plan content requirement guidance note* (September 2020), EOG refers the reader to Chapter 3 of its accepted PDSA EP (996161-2022-Beehive#1-PDSA-EP-Rev2, available here) that provides the environmental regulatory framework for the activity.

3.1 EOG Environmental Policy

In accordance with Regulation 16(a) of the OPGGS(E), EOG's Safety and Environmental Policy is provided in Figure 3.1. The policy provides a public statement of the company's commitment to minimise adverse effects on the environment and to improve environmental performance.

3.2 Commonwealth Legislation

A summary of the key Commonwealth legislation and regulations relevant to the environmental management of the activity is provided below. Details of the most pertinent legislation and regulations are provided in **Appendix 1**.

3.3 State and Territory Legislation

The relevant WA and NT territory legislation is provided in **Appendix 1.** Legislation for these jurisdictions is only likely to be triggered in the event of an emergency situation, such as an oil spill, that requires response activities to be conducted in state or territory waters. Incident reporting requirements under state and territory legislation and regulations is provided in Section 8.7of this EP.

Safety & Environmental Policy

Our Goal

Conduct our operations in a responsible manner to avoid harm to people and the environment.

Our Commitment

EOG Resources, Inc. will conduct its business with a commitment to safeguard people and to protect the environment. Good safety and environmental performance is critical to the success of our business and is the responsibility of every EOG Resources, Inc. employee and contractor.

Our Focus Areas

- **Planning** – Make safety and environmental matters an integral part of our business planning, training, development, and decision-making.
- **Compliance** – Conduct our business in a manner designed to comply with all applicable safety and environmental laws and regulations and apply responsible standards where such laws or regulations do not exist.
- **Continuous Improvement** – Strive to continuously drive safety and environmental performance improvement through setting goals, training, monitoring progress and utilizing data-driven decision making and adaptive management.
- **Communication** – Communicate openly with our customers, employees, contractors, neighbors, appropriate officials, public interest groups, shareholders and other stakeholders, regarding significant safety and environmental matters.
- **Leadership** – Provide leadership, professional staff, training, support, and other resources necessary for the implementation of safety and environmental programs that are designed to ensure each individual knows their responsibilities and feels empowered to speak up and take appropriate action.
- **Engagement** – Engage with regulators, industry groups, and others to develop sound, effective laws and regulations, policies and procedures to protect the environment, employees, contractors and the general public and to raise the standards of our industry.
- **Transparency** – Make consistent, informed decisions by promoting knowledge sharing, data stewardship and collaboration within the organization, and with stakeholders.

Rev. May 2021

Figure 3.1 EOG Safety and Environmental Policy

4 Stakeholder Consultation

In keeping with EOG's Safety and Environmental Policy (Figure 3.1), EOG is committed to open communication and engagement with communities and other stakeholders as part of its operations. EOG welcomes feedback and is continuously endeavouring to learn from experience in order to manage its environmental and social impacts and risks.

4.1 Stakeholder Consultation Objectives

The objectives of EOG's stakeholder consultation are to:

- Engage with stakeholders in an open, transparent, timely and responsive manner;
- Design the activity to address and minimise stakeholder concerns;
- Build and maintain trust with stakeholders; and
- Demonstrate that stakeholders have been appropriately consulted.

The objectives are achieved by:

- Identifying and confirming stakeholders ('relevant persons' whose functions, interests or activities may be affected by the activity);
- Ensuring stakeholders are informed about the activity and its environmental and social impacts and risks;
- Providing informative, accurate and timely information;
- Ensuring stakeholders are informed about the process for consultation and that their feedback is considered in the EP; and
- Ensuring that issues raised by stakeholders are adequately assessed, and where requested or relevant, responses to feedback are communicated back to them.

4.2 Regulatory Requirements and Guidelines

EOG incorporated the requirements and guidance of the following documents into its stakeholder consultation:

- The OPGGS(E);
- NOPSEMA policies, guidance and information papers, including:
  - PL1347 - Environment plan assessment policy – 19 May 2020;
  - GL1721 - Environment plan decision making – 10 June 2021;
  - GL1887 - Consultation with Commonwealth agencies with responsibilities in the marine area – 3 July 2020;
  - GN1344 - Environment plan content requirements - 11 September 2020;
  - GN1488 - Oil pollution risk management - 7 July 2021;
  - GN1785 - Petroleum activities and Australian marine parks - 3 June 2020;
  - GN1847 - Responding to public comment on environment plans – 11 September 2020;
  - IP1411 - Consultation requirements under the OPGGS (E) Regulations 2009 - Rev 2 – 2014;

- Other relevant guidance, including:
  - AFMA: Petroleum industry consultation with the commercial fishing industry (available at https://www.afma.gov.au/sustainability-environment/petroleum-industry-consultation);
  - WA DPIRD: Guidance statement for oil and gas industry consultation with the Department of Fisheries (July 2013);
  - WA DoT: Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020); and
  - WA DMIRS: Consultation Guidance Note (For the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009) (April 2012).

4.3 Relevant Persons and Other Stakeholders Identification

EOG has consulted widely with a range of relevant persons and other stakeholders in the course of developing their plans for the activity and in the preparation of the EP. This has included consultation on the activities to be carried out under the EP (as described in Chapter 2) along with consultation to prepare for unplanned emergency events, such as responding to a MDO release (as assessed in Section 7.15).

In this EP, EOG has distinguished between relevant persons and other stakeholders. Relevant persons are those meeting the definition provided in Regulation 11A(1) of the OPGGS(E) (see Section 4.3.1), while other stakeholders are considered to be a broader set of people or organisations that EOG has consulted with during the planning for the activity and in preparing the EP.

4.3.1 Relevant Persons

In identifying relevant persons for the activity, EOG applied Regulation 11A(1) of the OPGGS(E) which defines a ‘relevant person’ as:

(a) Each Department or agency of the Commonwealth to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;

(b) Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;

(c) The Department of the responsible State Minister, or the responsible Northern Territory Minister.

(d) A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP, or the revision of the EP; and

(e) Any other person or organisation that the titleholder considers relevant.

The activities to be carried out under the EP (Chapter 2) were reviewed and relevant persons identified under clauses 11A(1)(a), (b), (c) and (d) of the OPGGS(E). EOG used maps of existing petroleum permits and infrastructure, commercial fisheries maps, marine sensitivity mapping, online heritage and native title searches and the guidelines listed above (Section 4.2) to develop this list of relevant persons. Table 4.1 identifies the relevant persons.

EOG believes it has appropriately identified and consulted with all reasonably identifiable relevant persons. If additional relevant persons are identified by EOG, or made known to them, they will be included in all future consultation activities.

4.3.2 Other Stakeholders

Consultation has been undertaken with a wide variety of stakeholders during the preparation of the Exploration Drilling EP (and its OPEP and OSMIP) to ensure that EOG has adequate arrangements for responding to and monitoring oil pollution as required under Regulation (8AA) of the OPGGS(E). Some of the stakeholders consulted are relevant persons for this EP under Regulation 11A(1) of the OPGGS(E), however many of those consulted do not meet the definition of a relevant person for this EP.

There are many other stakeholders whose functions, interests or activities may overlap the socio-economic EMBA (see Section 5.6). EOG recognises that the relevance of stakeholders identified in this EP may change in the event of a non-routine event or emergency. EOG maintains lists of these stakeholders and may engage with them in the event of a non-routine event or emergency. EOG acknowledges that unidentified stakeholders may be affected and may only become known in such an event.

Table 4.1 Relevant persons consulted for the Beehive-1 geotechnical activity

Category 1 – Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
1. Australian Hydrographic Office (AHO)	2. Australian Maritime Safety Authority (AMSA)
3. Australian Communications and Media Authority (ACMA)	4. Department of Defence (DoD)
5. Australian Fisheries Management Authority (AFMA)	6. Department of Agriculture, Water and the Environment (DAWE) (recently changed name to Department of Climate Change, Energy, the Environment and Water [DCCEEW])
7. Director of National Parks (DNP)	8. National Native Title Tribunal (NNTT)
9. Maritime Border Command (MBC)	10. Department of Foreign Affairs (DFAT)
Category 2 – Each Department or agency of a State to which the activities to be carried out under the EP may be relevant	
Western Australian	
11. Department of Primary Industries and Region Development (DPIRD) - Fisheries	12. Department of Biodiversity, Conservation and Attractions (DBCA)
13. Department of Transport (DoT) – oil spill response coordination	14. Department of Fisheries (DoF) – under DPIRD
15. Department of Planning, Lands and Heritage (DPLH)	16. Pilbara Ports Authority
Northern Territory	
17. Department of Industry, Tourism and Trade (DITT)	18. Department of Environment, Parks and Water Security (DEPWS)
19. DITT – Fisheries Division	20. Department of Transport (DoT) – marine safety branch.
21. Environmental Protection Agency (EPA)	

Category 3 – The Department of the responsible State Minister	
Western Australian	
22. WA Department of Mines, Industry Regulation and Safety (DMIRS)	
Northern Territory	
NT DITT (number 17 listed under Category 2)	
Category 4 – A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
Commercial Fisheries (Licence Holders)	
23. Northern Prawn Fishery (NPF) (Cth)	24. Southern Bluefin Tuna Fishery (SBTF)
25. Western Skipjack Tuna Fishery (WSTF)	26. Western Tuna and Billfish Fishery (WTBF)
27. Northern Prawn Fishing Industry Pty Ltd (NPFI)	28. Northern Demersal Scalefish Managed Fishery (NDSMF) (WA)
29. Mackerel Managed Fishery (MMF) – Area 2 (WA)	30. Kimberley Prawn Managed Fishery
31. Kimberley Crab Fishery (WA)	32. Kimberley Gillnet and Barramundi Fishery (WA)
33. A Raptis & Sons Pty Ltd	34. Northern Wildcatch Seafood Australia (NWSA)
35. Demersal Fishery (NT)	36. Offshore Net & Line Fishery (NT)
37. Spanish Mackerel Fishery (NT)	38. Coastal Line Fishery (NT)
Fisheries Associations	
39. Commonwealth Fisheries Authority (CFA)	40. Australian Southern Bluefin Tuna Industry Association (ASBTIA)
41. Western Australian Fishing Industry Council (WAFIC)	42. Pearl Producers Association (PPA)
43. Recfish West	44. Northern Territory Seafood Council (NTSC)
45. Amateur Fishermen's Association of the Northern Territory (AFANT)	
Cultural Heritage	
46. Kimberley Land Council (KLC)	47. Miriuwong and Gajerrong Aboriginal Corporation
48. Balanggarra Aboriginal Corporation	49. Northern Land Council (NLC)
Tourism	
50. Marine Tourism Western Australia (MTWA)	
Other	
51. Darwin Port Corporation	52. NT Regional Harbourmaster

53. WA Cambridge Gulf Limited (CGLTD) - Wyndham Port	54. Seafarms Group Limited
Petroleum	
55. Eni Australia B.V.	56. Woodside Energy Ltd (WEL)
57. Melbana Energy Limited	58. Neptune Energy Bonaparte Pty Ltd
59. Santos Ltd	60. BP Developments Australia Pty Ltd
61. Chevron Australia Pty Ltd	62. Kuwait Foreign Petroleum Exploration Company (Kufpec)
Category 5 – Any other person or organisation that the Titleholder considered relevant	
None identified.	

4.4 Consultation for the Beehive Project

4.4.1 Engagement Approach

Consultation has been broadly undertaken in line with the International Association for Public Participation (IAP2) spectrum, which is considered best practice for stakeholder engagement. In order of increasing level of public impact, the elements of the spectrum and their goals are:

- Inform – to provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.
- Consult – to obtain public feedback on analysis, alternatives and/or decisions.
- Involve – to work directly with stakeholders throughout the process to ensure that public concerns and aspirations are consistently understood, considered and addressed.
- Collaborate – to partner with the public in each aspect of the decisions, including the development of alternatives and the identification of the preferred solution.
- Empower – to place final decision-making in the hands of the stakeholders.

The manner in which EOG has informed, consulted and involved relevant persons with the activity are outlined through this section. Collaboration (partnering on decision-making with relevant persons) has not been required to date.

Under the regulatory regime for the approval of EPs, the decision maker is the regulator. This being the case, the final step in the IAP2 spectrum, 'Empower', has not been adopted.

4.4.2 Engagement Methodology

The tools and methods that have been and will continue to be used for engagement with relevant persons are:

- Project Information Flyers (available in **Appendix 2**), which are all available on EOG Australia's website:
    - First information flyer – was focused on the PDSA and broadly introduced the drilling program and was issued to relevant persons on the 17th September 2021 (10 weeks prior to the public exhibition of the EP), and provided information on the location and

timing of the activity (see the Beehive PDSA EP (996161-2022-Beehive#1_PDSA-EP-Rev2, available here). Some information sheets were sent several days later as a result of email bounce-backs. The information sheet included a high-level impact and risk assessment for the PDSA and contact details to provide the opportunity to provide feedback.

- Second information flyer – was issued on the 2nd December 2021 to inform relevant persons that the EP was available on the NOPSEMA website for public exhibition, along with providing an update on the timing of the PDSA and advising that the title transfer was completed.
- Third information flyer – was issued on 28th February 2022, 14th March 2022, 15th March 2022, 25th March 2022 and 4th April 2022 to inform relevant persons and additional stakeholders (as they became known) about the drilling activity.
- Fourth information flyer – was issued on 12th and 13th May 2022 to inform relevant persons and additional stakeholders (as they became known) about the upcoming mobilisation of the vessel to undertake the geophysical survey. In addition, the information sheet advised that the Drilling EP was available on NOPSEMA's website for public exhibition for 30 days, until 8th June 2022.
- Fifth information flyer – was issued on 27th June 2022 to inform relevant persons and additional stakeholders (as they became known) about EOG's plans to prepare a separate EP for geotechnical activities in the activity area (this EP). An update was also provided about the drilling activity. Comments were invited.

- Project phone number and email – A telephone number and email address is provided in the project information flyers. The phone number is monitored by the Environmental Consultant and the email address is monitored by the nominated liaison person.
- One-on-one briefings – where relevant persons have expressed concerns, one-on-one briefings (via phone) with the project's environmental consultants have been offered. Several such phone calls have taken place.
- One-on-one meetings – where assessed as appropriate.

4.4.3 Consultation for the PDSA EP and the Exploration Drilling EP

The Beehive PDSA EP (link) included consultation for the both the geophysical and geotechnical activities (which are the same as the activities described in Chapter 2 of this EP). As the PDSA EP included geophysical investigations (considered an exploration activity for the purposes of Regulation 11B of the OPGGS(E)), it was published on NOPSEMA's website for 30 days, along with an invitation for public comment on the EP. There was one public comment related to the shallow seismic component of the geophysical investigations and claimed impacts on marine fauna. NOPSEMA assessed EOG's response to the comment and published a key matters report (link) upon acceptance of the Beehive PDSA EP. The PDSA EP was accepted by NOPSEMA on 2nd March 2022 and includes summaries of the consultation and EOG's responses, along with a full report of the consultation undertaken between 17th September and 6th December 2021.

Since then, further consultation on the implementation and completion of the geophysical activities has occurred, along with consultation on the Beehive-1 Exploration Drilling EP and consultation for this EP. The geophysical investigations have been completed; however the geotechnical investigations are now scheduled to commence sometime between October 2022 and June 2023. Significant consultation has been undertaken for the Beehive-1 Drilling EP related to potential risks and responses in the event of a loss of well control (LoWC) leading to a major oil spill. Summaries of the consultation and EOG's responses, along with a report of the consultation undertaken for the Beehive-1 Exploration Drilling EP can be found in Table 4.2 of the Beehive-1 Drilling EP (996161-2022-Beehive#1-Drilling-EP-Rev2, see the link here).

4.4.4 Consultation for this EP

The nature and scale of the geotechnical activity means it has no risk of a LoWC event and there is a very low probability of MDO contacting shorelines (at the lowest threshold) in the event of worst-case MDO spill from the vessel (see Section 7.15). As such, consultation for the geotechnical activity has focussed on the activities to be carried out under the EP (as described in Chapter 2). Consultation related to the geophysical or exploration drilling activities is not included in this EP.

4.5 Assessment of Matters Raised During Consultation

A summary of the stakeholder consultation undertaken for this EP, including responses received, EOG's assessment of comments received and how each response has been addressed in the EP, is provided in Table 4.2. All correspondence between EOG and relevant persons are provided to NOPSEMA as sensitive information in accordance with Regulation 9(8) of the OPGGS(E).

Relevant persons have been, and will be, provided with feedback as to whether their objection or claim was substantiated, how it was assessed, any controls put in place to manage the impact or risk, and any changes to the EP to further reduce the impact or risk to ALARP and an acceptable level.

4.6 Ongoing Consultation

Regulation 14(9) of the OPGGS(E) requires ongoing consultation to be incorporated into the Implementation Strategy of the EP (see Chapter 8). EOG will continue to consult with relevant persons and other stakeholders for the Beehive Project and for this EP. Records will be kept of all consultations along with EOG's assessment of comments received and how each response has been addressed. Activity notification requirements are provided in Section 8.9.

4.7 Summary of Stakeholder Consultation

All consultation undertaken with relevant persons for the geotechnical activity, including EOG's responses and assessment of merit, is detailed in:

- The Beehive PDSA EP (link) (17th September to 6th December 2021). This includes consultation for geophysical and geotechnical activities.
- The Beehive Exploration Drilling EP (link) (17th September 2021 to 12th July 2022). This includes consultation for the PDSA EP and for the Exploration Drilling EP.
- Table 4.2 (27th June to 2nd August 2022). This also includes some consultations from the PDSA and Exploration Drilling EPs where relevant to the geotechnical activity.

A complete copy of original communications between EOG and relevant persons is provided in **Appendix 3** as a sensitive information report to NOPSEMA. The reference number provided with the date of communication in Table 4.2 links to each record of correspondence in **Appendix 3**.

Table 4.2 Summary of consultation undertaken with relevant persons

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
Category 1. Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant				
1. AHO Responsible for the publication and distribution of nautical products, maritime safety information and NTM.	EOG will continue to consult with the AHO and make the necessary notifications throughout the activities. Notification requirements are included in Section 8.9 of the EP.			
2. AMSA Responsible for maritime safety.	EOG will continue to consult with AMSA and provide the necessary notifications for the activity. Notification requirements are included in Section 8.9 of the EP.			
3. ACMA Administrator of submarine cable protection zones.	The location of the cable protection zones is not in the vicinity of the activity area. Consultation with cable owners is therefore not required. No further consultation required with ACMA.			
4. DoD Responsible for Australian defence activities.	12/05/2022 (DoD-13) 02/06/2022 (DoD-14)	Directorate of Property Interests and Acquisition of DoD thanked EOG for the project information and advised that certain activity location coordinates as identified in the information flyer are within the NAXA and during 12 – 25 September 2022, the NAXA has a multi-nation naval exercise programmed and industry activities may become mutually incompatible with Defence operations. DoD requested EOG confirm that they will not be present in the NAXA during the specified exercise period.		EOG confirmed with DoD will not have any activities in the area during 12 – 25 September 2022.
5. AFMA Manager of fisheries in Commonwealth waters.	No assessment of merit required. No further consultation required with AFMA.			
6. DCCEEW - Biosecurity Responsible for managing biosecurity for marine pests.	DCCEEW has not provided any comments to date. EOG is familiar with marine biosecurity requirements and does not need to consult with this stakeholder in the immediate future. Vessel biosecurity controls are provided in the EP. Biosecurity notification requirements are provided in Section 8.9 of the EP.			
7. DNP Manages the AMP network.	No assessment of merit required. Further consultation will be undertaken if required.			

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
8. NNTT Administration of the *Native Title Act 1993*.	No further consultation required with NNTT in line with their advice.			
9. MBC Key agency for border protection.	No assessment of merit required. Further consultation will be undertaken if required.			
10. DFAT Manages relationships with neighbouring countries.	No assessment of merit required. Further consultation will be undertaken if required.			
Category 2. Each Department or agency of a State to which the activities to be carried out under the EP may be relevant				
11. WA DPIRD Manages WA commercial fisheries.	WA-managed fisheries in the activity area and EMBA are described in Section 5.6.1. Further consultation will be undertaken if required.			
12. WA DBCA Manages WA marine parks and reserves and protected marine fauna and flora.	The DBCA responded saying that they have no comments on the activity but asked that future notifications continue to be provided. No assessment of merit required.			
13. WA DoT Manages oil pollution preparedness for and response in WA state waters.	No assessment of merit required. Spill notification requirements for state waters are included in Section 9.3 of the PDSA EP (link). Consultation is ongoing with the WA DoT in relation to the development of the drilling OPEP.			
14. WA DoF – Refer to WA DPIRD (see entry #10).				
15. WA DPLH Manages the *Aboriginal Heritage Act* 1972.	The DPLH asked that the DMIRS be consulted about the activity, which has been done. No further consultation is required with this relevant person.			
16. Pilbara Ports Authority Manages the Dampier Port	No assessment of merit required.			

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
17. NT DITT Manages NT commercial fisheries.	13/05/2022 Phone call	The DITT Officer called EOG to discuss concerns regarding the number of holes being drilled, impacts to fisheries stock that straddle the WA/NT border and impacts of drill cuttings on benthic fauna. EOG talked through the concerns, pointing to where the issues are addressed in the publicly available drilling EP and clarifying the difference between boreholes drilled for geotechnical investigations and the wellbore for Beehive-1.	The DITT Officer stated he was satisfied with the outcomes of the discussion but that he would nevertheless forward through his concerns in writing (see following row).	EOG has addressed this relevant person's concerns regarding potential impacts to fisheries resources and biota (Section 7.3).
	13/05/2022 (DITT-11)	DITT expressed concerns about shared fisheries resources and cumulative effects on biota and higher trophic organisms		
18. NT DEPWS Protects the environment and natural resources in the NT, including marine fauna management.	No assessment of merit required. EOG will continue to provide flyers but believes no further consultation is warranted.			
19. NT DITT - Fisheries Manages NT fisheries and aquatic ecosystems.	No assessment of merit required. EOG believes it is not necessary to follow up with the Fisheries department given EOG is consulting directly with the NT DITT (17).			
20. NT DoT Manages oil pollution preparedness for and response in NT waters.	No assessment of merit required. Further consultation will be undertaken if required.			
21. NT EPA Independent authority under the NT EPA Act to prevent and respond to pollution.	No assessment of merit required. Further consultation will be undertaken if required.			

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
Category 3 – The Department of the responsible State Minister				
22. WA DMIRS Manages offshore petroleum approvals in WA State waters.	No assessment of merit required. Notification requirements are included in Section 8.9.2 and spill notifications are provided in Section 9.3 of the PDSA EP (link). Further consultation will be undertaken if required.			
	27/07/2022 (DMIRS-08)	Responded to Flyer#5 advising that: DMIRS has reviewed the notification and does not require any further information at this stage. Please provide pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMP upon completion of the activity to petroleum.environment@dmirs.wa.gov.au. Please see the Consultation Guidance Note for information pertaining to the reporting of incidents that could potentially impact on any land or water under State jurisdiction.		
NT DITT – As per entry #17.				
Category 4 – A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP				
23. NPF (Cth) Peak body representing the Northern Prawn Fishery.	Consultation with this fishery is undertaken via the NPFI. See NPFI entry (#27).			
24. SBTF (Cth) Peak body representing the Southern Bluefin Tuna (SBT) Fishery.	EOG has made contact with the fishery, and they do not appear to have any concerns. Further consultation is not required.			
25. WSTF (Cth) Peak body representing the WSTF.	WSTF confirmed there is no known tuna fishing effort or catch in the activity area. Further consultation is not required.			
26. WTBF (Cth) Peak body representing the WTBF.	Consultation results as per WSTF (see entry #22).			
27. Northern Prawn Fishing Industry (NPFI) Pty Ltd Peak body for NPF.	EOG committed to continuing consultation with the NPFI as planning for the drilling campaign progresses.			
28.NDSMF (WA)	Consultation with this fishery is undertaken via WAFIC.			

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
Peak body for Northern Demersal Scalefish Fishery.	See WAFIC entry (#41).			
29. MMF (WA) Peak body for Mackerel Managed Fishery.	Consultation with this fishery is undertaken via WAFIC. See WAFIC entry (#41).			
30. Kimberley Prawn Managed Fishery (WA) Peak body for Fishery.	Consultation with this fishery is undertaken via WAFIC. See WAFIC entry (#41).			
31. Kimberley Crab Fishery (WA) Peak body for Fishery.	Consultation with this fishery is undertaken via WAFIC. See WAFIC entry (#41).			
32. Kimberley Gillnet and Barramundi Fishery (WA) Peak body for Fisheries.	Consultation with this fishery is undertaken via WA DPIRD. See WA DPIRD entry (#11).			
33. A Raptis & Sons Pty Ltd Owns and operates vessels in the NPF and NT demersal fishery zones.	No assessment of merit required. All relevant fisheries managers and associations have been contacted.			
34. NWSA NWSA operates its fleet from Darwin.	NWSA advised the PDSA will not have an impact on the fishery. No further consultation is required.			
35. Demersal Fishery (NT) Peak body representing Demersal fishing	No concerns raised with the geotechnical activity. No assessment of merit required. Further consultation will be undertaken if required.			
36. Offshore Net & Line Fishery (NT)	Consultation with this fishery is undertaken via the NT Demersal Fishery. See NT Demersal Fishery entry (#32).			
37. Spanish Mackeral Fishery (NT)	Consultation with this fishery is undertaken via the NT Demersal Fishery. See NT Demersal Fishery entry (#32).			
38. Coastal Line Fishery (NT).	Consultation with this fishery is undertaken via the NT Seafood Council. See NTSC entry (#44).			
39. CFA Peak body for Commonwealth-regulated fisheries	CFA confirmed they have no involvement in projects outside of the south-east Australian region. EOG has consulted with WAFIC as advised by CFA. They requested no further consultation.			

<table>
<tr><th>Relevant person</th><th>Date (email reference)</th><th>Consultation conducted</th><th>Issues, objections and claims</th><th>EOG’s assessment of merit</th></tr>
<tr><td>40. ASBTIA (Cth)
Peak body for SBT Fishery.</td><td colspan="4">ASBTIA confirmed the fishery does not actively fish in the activity area and it is highly unlikely to have any impact on SBT spawning.
They requested no further consultation.</td></tr>
<tr><td>41. WAFIC
Peak body for the WA commercial fishing, pearling and aquaculture sectors.</td><td colspan="4">WAFIC replied saying they have no specific concerns in relation to the geotechnical activity.
Consultation will be ongoing as required.</td></tr>
<tr><td>42. PPA
Peak body for the Australian South Sea Pearling Industry.</td><td colspan="4">The PPA is no longer performing a consultative role for the fishery. Consultation with this fishery is undertaken via WA DPIRD.
See WA DPIRD entry (#10).</td></tr>
<tr><td>43. RecFish West
Peak body representing recreational fishers in WA.</td><td colspan="4">RecFish West has raised no concerns despite multiple contact attempts.
EOG will continue to provide project information flyers as a courtesy.</td></tr>
<tr><td>44. NTSC
Represents the seafood industry in NT.</td><td colspan="4">Has raised no concerns despite multiple contact attempts.
EOG will continue to provide project information flyers as a courtesy.</td></tr>
<tr><td>45. AFANT
Represents the interests of recreational fishing in the NT.</td><td colspan="4">AFANT has raised no concerns despite multiple contact attempts.
No further consultation is considered necessary.</td></tr>
<tr><td>46. KLC
Peak indigenous body in the Kimberley region.</td><td colspan="4">EOG continues to provide information to the KLC and will further engage and consult in respect of any feedback received.</td></tr>
<tr><td>47. Miriuwong and Gajerrong Aboriginal Corporation
Native title holders of large areas in the north of the East Kimberley region.</td><td colspan="4">EOG continues to provide information to the MGAC and will further engage and consult in respect of any feedback received.</td></tr>
<tr><td>48. Balanggarra Aboriginal Corporation (BAC)
Registered native title body corporate. Administers land on behalf of the Barangaroo People.</td><td colspan="4">EOG continues to provide information to the BAC and is engaging directly in response to feedback received.</td></tr>
<tr><td>49. Northern Land Council
Considered Peak indigenous body.</td><td colspan="4">No concerns raised.
EOG followed up with NLC who stated they did not have any comments to provide at this stage (phone call: 05/05/2022).</td></tr>
</table>

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
50. MTWA Represents the tourism industry in WA	Attempts to elicit concerns from this relevant person have been made and no response provided. EOG will continue to provide flyers but believes no further consultation is warranted.			
51. Darwin Port Corporation management of Darwin Port.	Flyer provided as a courtesy. No further consultation required at this stage.			
52. NT Regional Harbourmaster Pollution response	Flyer provided as a courtesy. No further consultation required at this stage.			
53. WA Cambridge Gulf Limited (CGLTD) - Wyndham Port	Flyer provided as a courtesy. No further consultation required at this stage.			
54. Seafarms Group Limited Developer of aquaculture project.	No concerns raised with the geotechnical activity. No assessment of merit required. Further consultation will be undertaken if required.			
55. Eni Australia Titleholder of adjacent petroleum permit WA-33-L.	The geotechnical activity area is more than 5.5 km to the southeast of the Blacktip pipeline. Further consultation will be undertaken as required.			
56. Woodside Titleholder of permits WA-522-P & WA-279-P.	Given the operational area does not overlap any of Woodside's operating assets, EOG considers there is no immediate need to chase them up for feedback.			
57. Melbana Energy Titleholder of permits NT/P87 & WA-544-P.	This relevant person has confirmed they have no concerns or issues with the project. No additional consultation if required.			
58. Neptune Energy Titleholder of permit WA-27-R.	Given the operational area does not overlap any of Neptune Energy's operating assets, EOG considers there is no immediate need to chase them up for feedback.			
59. Santos Nearby titleholder permit WA-454-P, WA-545-P and NT/P84.	Given the activity area and EMBA do not overlap any of Santos' operating assets, EOG considers there is no immediate need to chase up Santos for feedback.			
60. BP Developments Australia Pty Ltd Operator of permit WA-359-P.	BP stated the activity is not relevant to them and requested to be removed from the distribution list. EOG has done so.			
61. Chevron Australia Pty Ltd Operator of permit WA-37-L.	Given the activity area and EMBA do not overlap any of Chevron's operating assets, EOG considers there is no immediate need to chase them up for feedback.			

Relevant person	Date (email reference)	Consultation conducted	Issues, objections and claims	EOG's assessment of merit
62. Kufpec Operator of permit WA-538-P.	Given the activity area and EMBA do not overlap any of Kufpec's operating assets, EOG considers there is no immediate need to chase them up for feedback.			
Category 5 – Any person or organisation that the Titleholder considered relevant				
None identified.				

5 Description of the Existing Environment

In accordance with OPGGS(E) Regulation 13(2), the 'environment that may be affected' (EMBA) by the activity is described in this section, together with its values and sensitivities. While each hazard associated with the activity has its own unique EMBA, the largest one has been chosen for this chapter so as to describe all possible values and sensitivities, which is a full loss of MDO from the largest tank of the activity vessel from within the activity area. Spill modelling of this event used the NOPSEMA Bulletin #1 Oil Spill Modelling (NOPSEMA, 2019) hydrocarbon contact values of four oil phases (surface, dissolved, entrained and accumulated shoreline) that pose differing environmental risks to define the outer extent of the EMBA (Table 5.1).

The low contact values used to inform the extent of the EMBA are useful for establishing scientific monitoring parameters and identifying potential socio-economic impacts (the socio-economic EMBA); however, they may not be at concentrations that are ecologically significant (NOPSEMA, 2019). Therefore, in addition to the socio-economic EMBA, an ecological EMBA has also been derived from the stochastic spill modelling using hydrocarbon thresholds that are identified by NOPSEMA Bulletin #1 (NOPSEMA, 2019) as having the potential to cause impacts to ecological receptors (Table 5.1). The ecological EMBA considers the four phases of oil previously mentioned (noting that the stochastic spill modelling does not predict shoreline accumulation at concentrations that would cause ecological harm) (RPS, 2021).

The socio-economic EMBA and the ecological EMBA are presented in Figure 5.1 and are referred collectively as the 'spill EMBA'.

Table 5.1 Oil spill thresholds used to define the socio-economic EMBA and the ecological EMBA

Hydrocarbon phase	Exposure values	
	Socio-economic EMBA	Ecological EMBA
Shoreline	10 g/m^2 Potential for some socio-economic impact	100 g/m^2 Area likely to cause environmental impacts and to require clean-up effort (not reached in the modelling)
Sea surface	1 g/m^2 Approximates socio-economic effects and planning area for scientific monitoring	10 g/m^2 Lower limit for harmful contact to birds and marine mammals
Dissolved	10 ppb Planning area for scientific monitoring as potential water quality trigger exceedance	50 ppb Potential toxic effects, particularly sub-lethal effects to sensitive species
Entrained	10 ppb Planning area for scientific monitoring as potential water quality trigger exceedance	100 ppb To inform risk evaluation

Source: NOPSEMA (2019)

This spill EMBA has been established through hydrocarbon spill modelling (see Section 7.15). The EMBA is generated from stochastic modelling and therefore does not represent the possible outcome from a single spill scenario. The EMBA represents the compilation of possible outcomes and encompasses the area predicted to be affected from 100 simulations of the scenario per season (summer, winter, transition). Because of this, the EMBA is large, covering areas that may not be affected by any single spill event.

Where appropriate, descriptions of the JBG environment (beyond the spill EMBA) are provided for context. The 'environment' is defined in the OPGGS(E) regulations as:

- Ecosystems and their constituent parts, including people and communities;
- Natural and physical resources;
- The qualities and characteristics of locations, places and areas;
- The heritage value of places; and
- The social, economic and cultural features of these matters.

The key sources of information used in developing this chapter include the:

- EPBC Act Protected Matters Search Tool (PMST) database (link) searches conducted for the activity area, the ecological EMBA and the socio-economic EMBA (**Appendix 4**);
- Species Profile and Threats (SPRAT) Database (link);
- The Northwest Marine Bioregional Plan Bioregional Profile (DEWHA, 2008b);
- Marine bioregional plan for the North Marine Region (DSEWPC, 2012);
- National Conservation Values Atlas (NCVA) (link); and
- Seabed Habitats and Hazards of the JBG and Timor Sea, Northern Australia (Przeslawski *et al*., 2011).

The relevant values and sensitivities considered in this chapter are inclusive of but not limited to the matters protected under Part 3 of the EPBC Act.

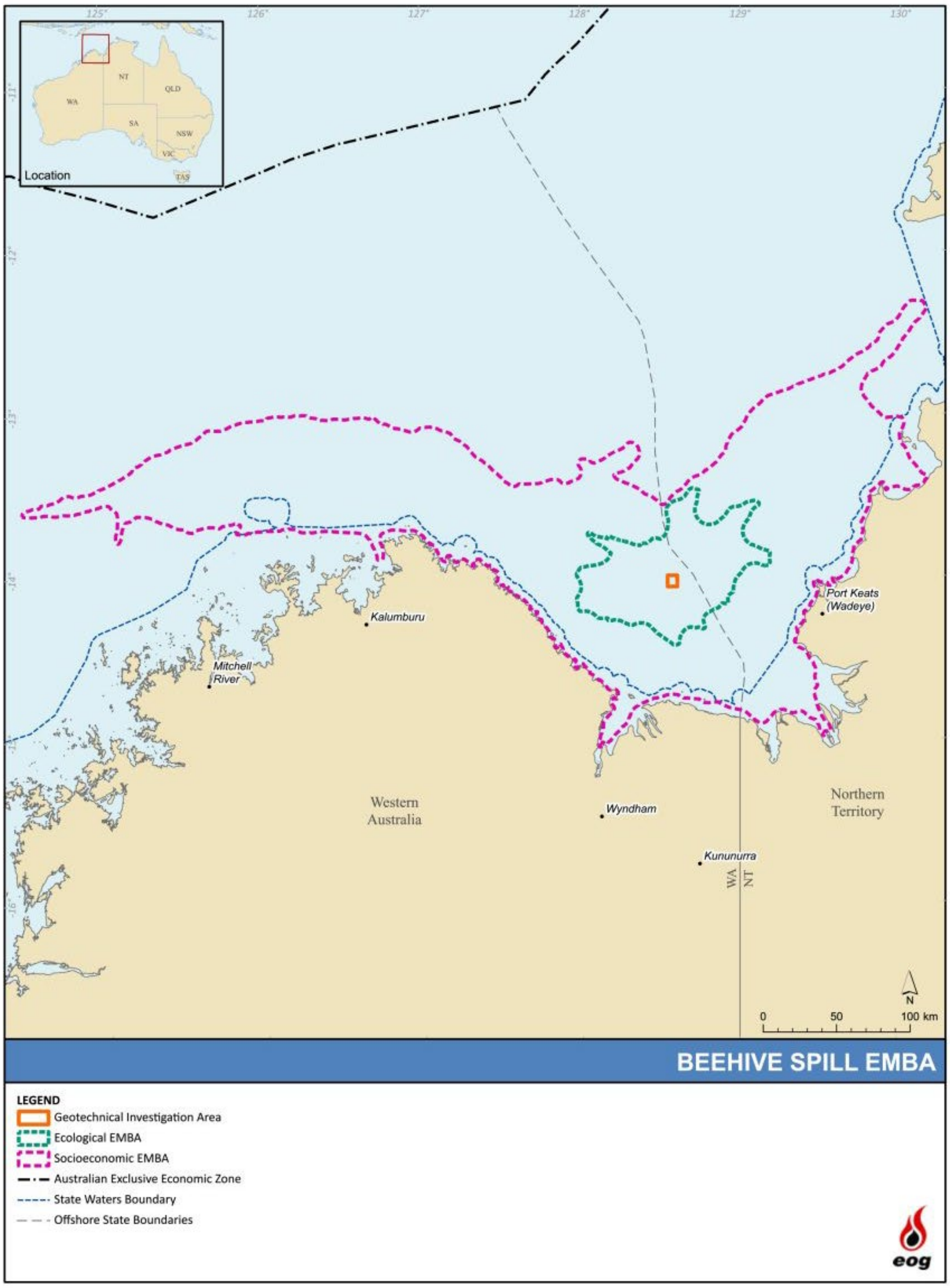


Figure 5.1 The spill EMBA

5.1 Regional Context

The activity area is located within the Northwest Marine Region (NWMR), while the spill EMBA occurs within both the NWMR and the North Marine Region (NMR). The NWMR comprises Commonwealth waters from the Western Australia-Northern Territory (WA-NT) border to Kalbarri, south of Shark Bay, WA (DEWHA, 2008b). The NMR comprises Commonwealth waters from west Cape York Peninsular (Queensland) to the WA-NT border (DSEWPC, 2012).

The NWMR is characterised by the large area of continental shelf and continental slope, highly variable tidal regions and very high cyclone incidence (DEWHA, 2008b). The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions. This region is highly influenced by tidal flows and less by ocean currents (DEWHA, 2008b).

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, the activity area and ecological EMBA are situated completely within the Northwest IMCRA Transition bioregion while the socio-economic EMBA also intersects the Northwest IMCRA province and the Timor province (CoA, 2006), which is illustrated in Figure 5.2.

The following mesoscale bioregions are intersected by the spill EMBA and are presented in Figure 5.3:

- Cambridge-Bonaparte;
- Bonaparte Gulf;
- Anson Beagle;
- Oceanic Shoals;
- Kimberley; and
- North West Shelf.

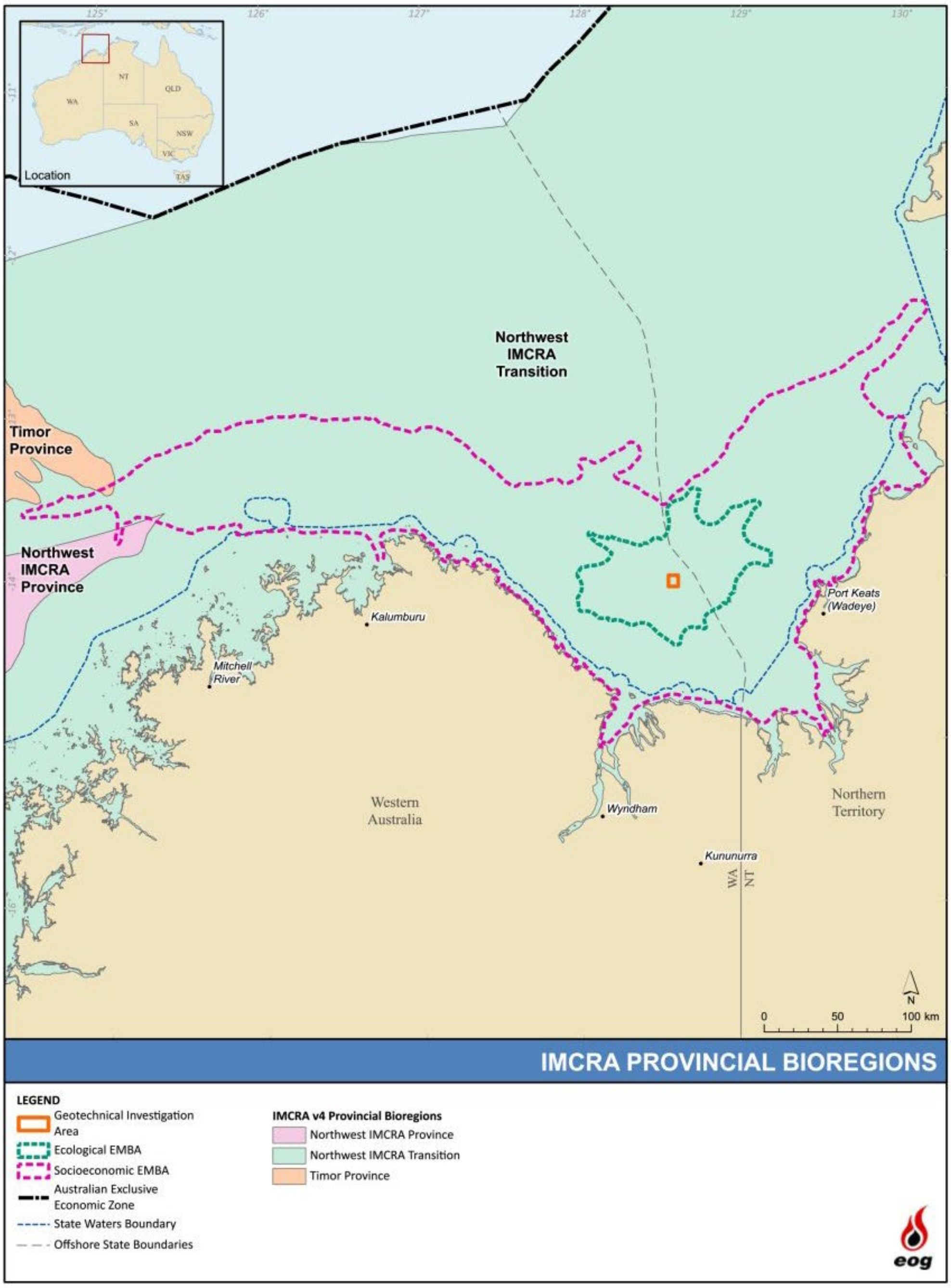


Figure 5.2 Provincial bioregions intersected by the EMBA

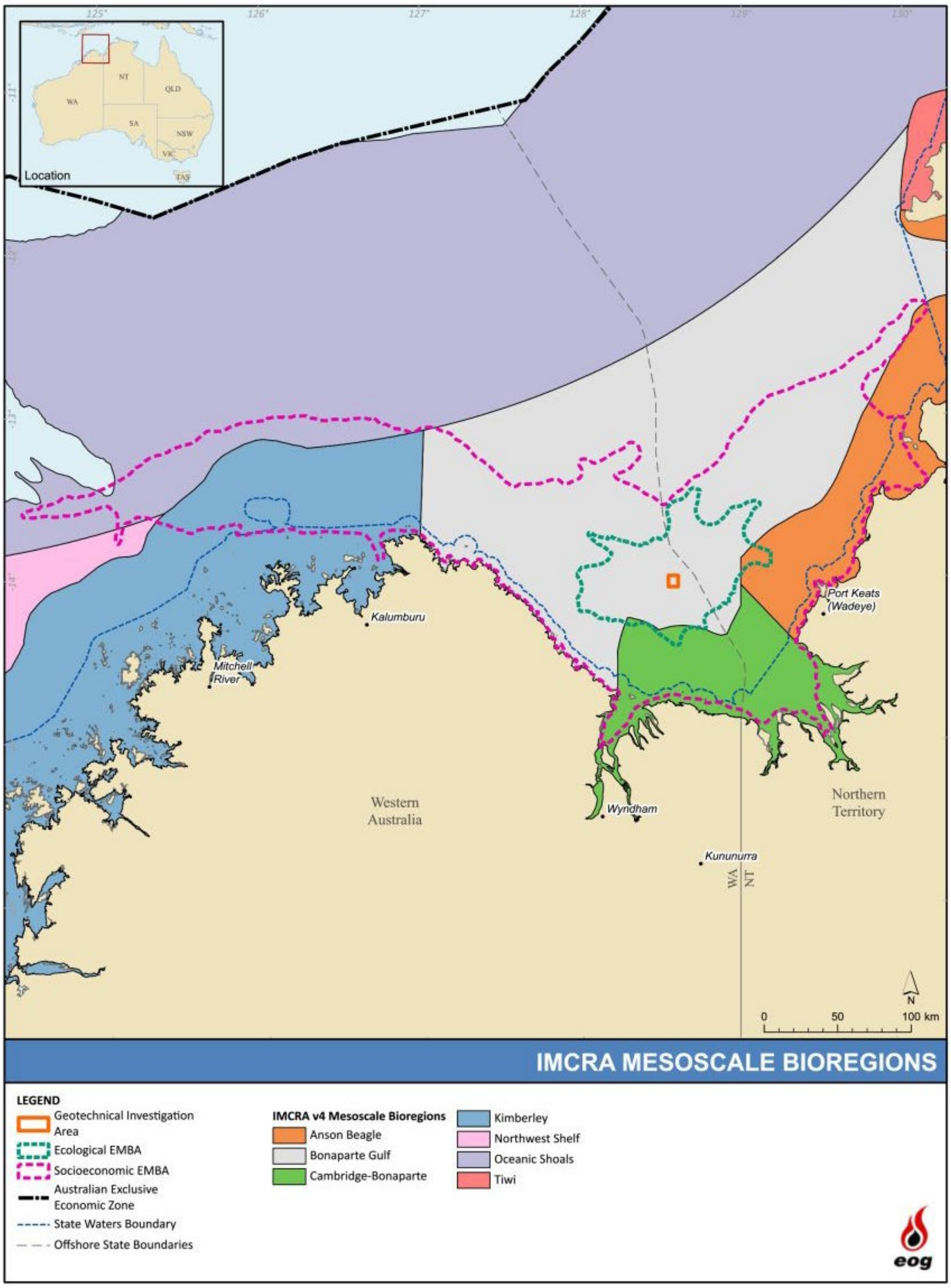


Figure 5.3 Mesoscale bioregions intersected by the EMBA

5.1.1 Climate

The region has a tropical monsoonal climate with two distinct seasons known as the northwest monsoon, which occurs from late October to mid-March ("wet season"); and the southeast monsoon, which occurs from May to mid-October ("dry season"). Regular and high rainfall is a characteristic of the northwest monsoon, mainly over coastal areas and during cyclones. This is caused by large amounts of moisture being gathered as the monsoon crosses the sea from the Asian high-pressure belt on its way to the intertropical convergence zone, which drifts southward close to, or over, northern Australia. On the contrary, the southeast monsoon originates from the southern hemisphere high-pressure belt and is relatively dry and cool.

Cyclones are common in the region, and they occur typically between December and April (BoM, 2021a). Cyclones result in severe storms with gale force winds and a rapid rise in water levels.

Temperature and Rainfall

Wadeye Airport (Port Keats), located on the NT mainland approximately 85 km east of the activity area, is the location of the nearest meteorological station to the activity area. Data collected from 1997 to 2019 show that the highest maximum temperature (mean of 34.4°C) occurs in April, October and November, whilst the lowest maximum temperature (mean of 16.8°C) occurs in July (BoM, 2021b).

Data collected from 1997 to 2019 at the Wadeye Airport weather station show that the mean annual rainfall is 1,317.8 mm, with the highest rainfall in January (312.2 mm) and the least in August (0.7 mm) (BoM, 2021b). Typically, the majority of rain occurs from December to March (mean of 1,025 mm).

Winds

Wind patterns in the region are controlled by the seasonal migration of high-pressure cells from latitudes 25-30°S in winter to 35-40°S in summer (Pearce *et al*., 2003). Sea surface wind data spanning five years sourced from the NCEP/NCAR global reanalysis project shows two predominant (general) directions:

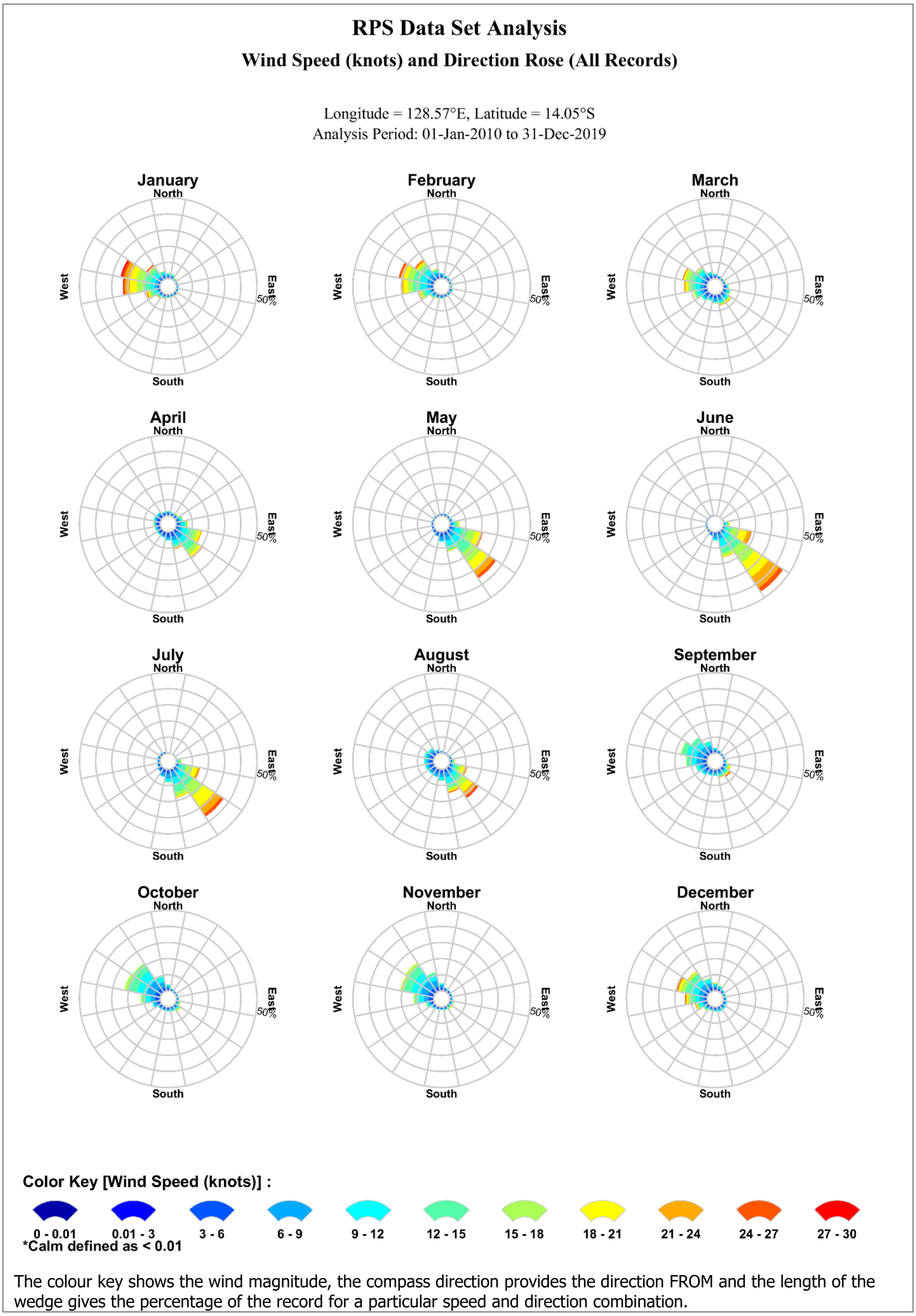
1. West to northwest winds prevail during the months of September to February; and
2. Easterly to south-easterly winds prevail from April to July (Kalnay *et al*., 1996; Kistler *et al*., 2001).

March and August are transitional periods with a higher variability in wind directions. Wind speed and direction used in the stochastic spill modelling are provided in Table 5.2 and presented in Figure 5.4 (RPS, 2021).

Table 5.2 Predicted average and maximum winds for the wind station nearest the activity area for 2010-2019 (inclusive)

Season	Month	Avg. wind speed (knots)	Maximum wind speed (knots)	General direction (from)
Summer	January	13.2	44.9	West-northwest
	February	11.4	35.2	
Transitional	March	9.7	46.2	Variable
Winter	April	9.3	32.7	Southeast
	May	11.7	28.8	
	June	14.1	27.4	
	July	12.3	30.9	
	August	10.4	29.5	
Transitional	September	8.7	29.3	Variable
Summer	October	8.8	24.7	West-northwest
	November	8.8	24.1	
	December	9.9	35.9	
Minimum		8.7	24.1	
Maximum		14.1	46.2	

Source: RPS (2021).



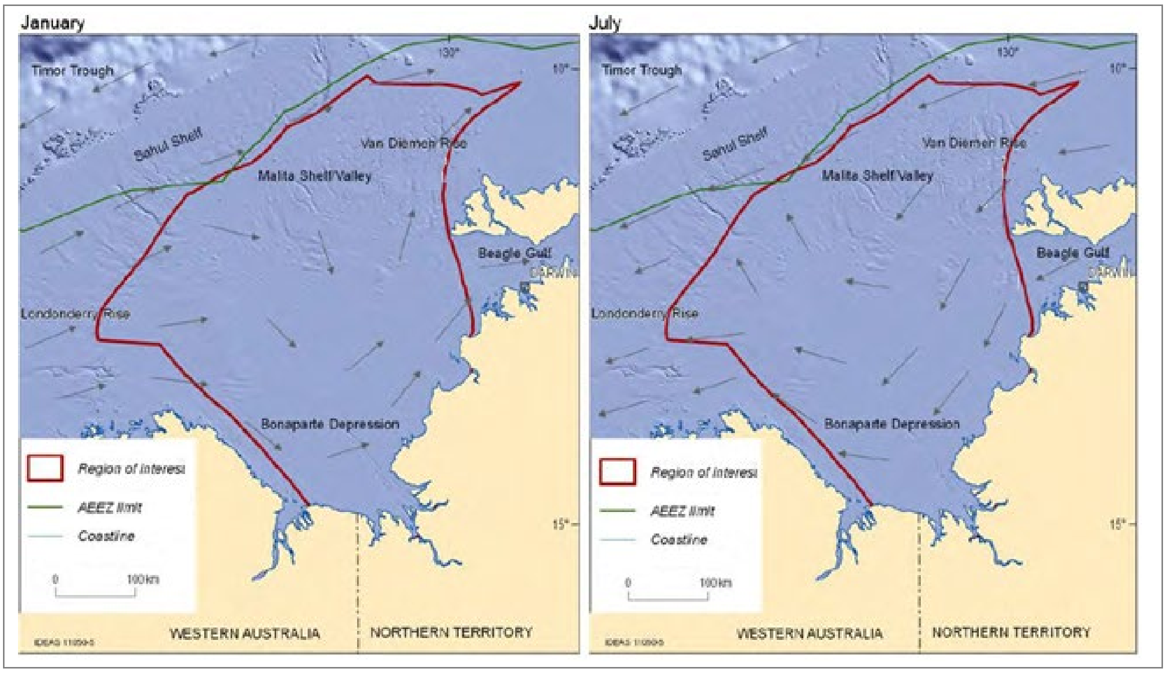
Source: RPS (2021).

Figure 5.4 Modelled monthly wind rose distributions from 2010-2019 (inclusive) for the wind station closest to the activity area

5.1.2 Oceanography

Water Currents

Broad-scale ocean circulation of the North Australian Shelf is dominated by the Indonesian Throughflow current system. Circulation in the JBG is dominated by tidal and wind driven currents according to the season (Figure 5.5) (Przeslawski *et al.*, 2011).



Source: Przeslawski et al 2011.

Figure 5.5 Currents of the JBG

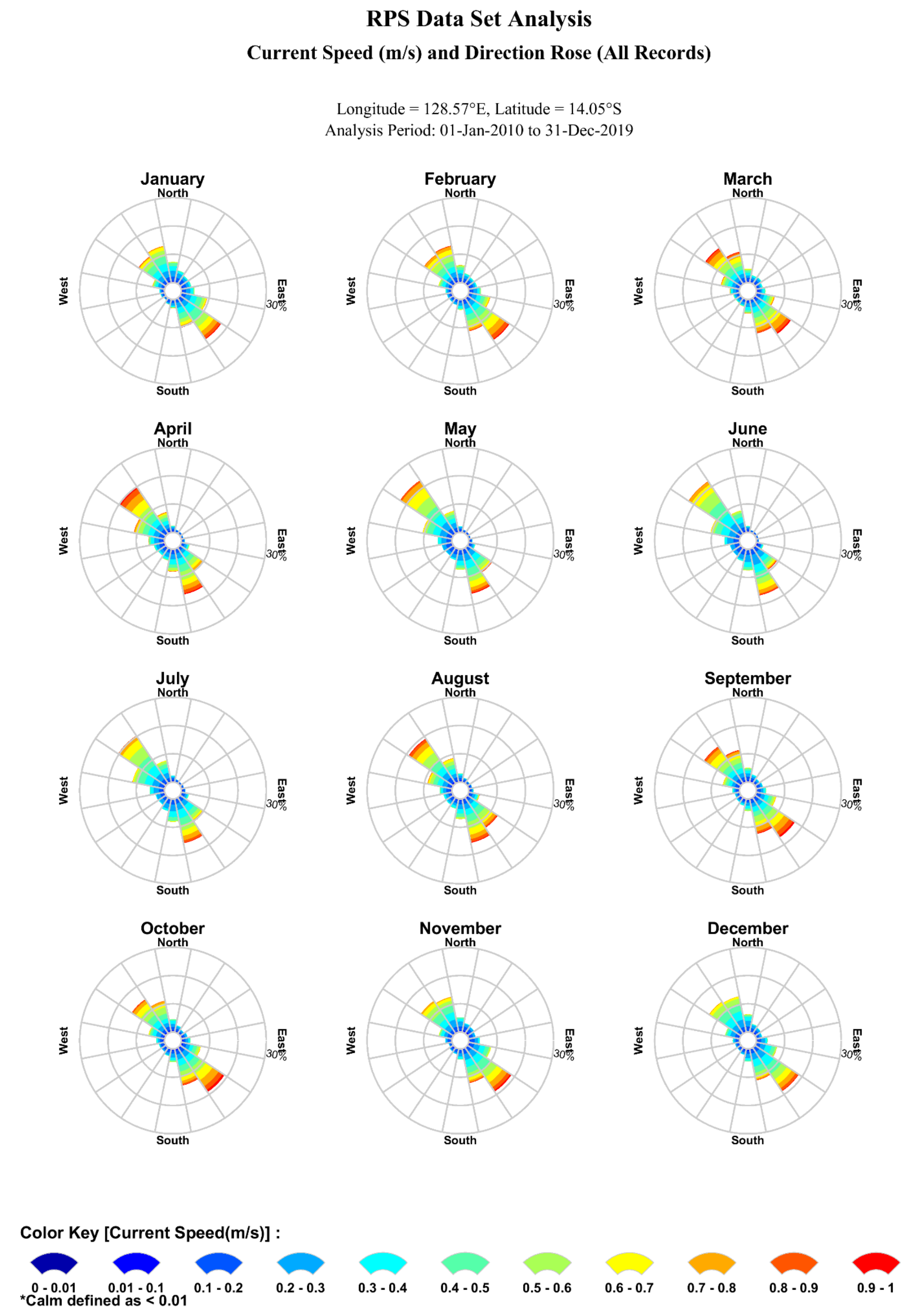
Table 5.3 provides the average and maximum combined surface current speeds (ocean plus tides) located within the activity area. This data indicates that surface currents flow predominantly along the northwest to southeast axis. The monthly current speeds averaged between 0.33 to 0.40 m/s and reached a peak of 0.96 to 1.17 m/s.

Figure 5.6 illustrates the monthly surface current rose plots located in the activity area from 2010 to 2019 (inclusive). Figure 5.7 represents the major ocean currents in north-western Australian waters.

Table 5.3 Predicted average and maximum surface current speeds within the activity area from 2010-2019 (inclusive)

Season	Month	Avg. current speed (m/s)	Maximum current speed (m/s)	General direction (towards)
Summer	January	0.35	1.10	Northwest and southeast
	February	0.37	1.12	
Transitional	March	0.40	1.05	
Winter	April	0.39	1.06	
	May	0.35	1.17	
	June	0.34	1.07	
	July	0.35	0.96	
	August	0.37	1.15	
Transitional	September	0.39	1.10	
Summer	October	0.37	1.09	
	November	0.34	1.06	
	December	0.33	0.98	
Minimum		0.33	0.96	
Maximum		0.40	1.17	

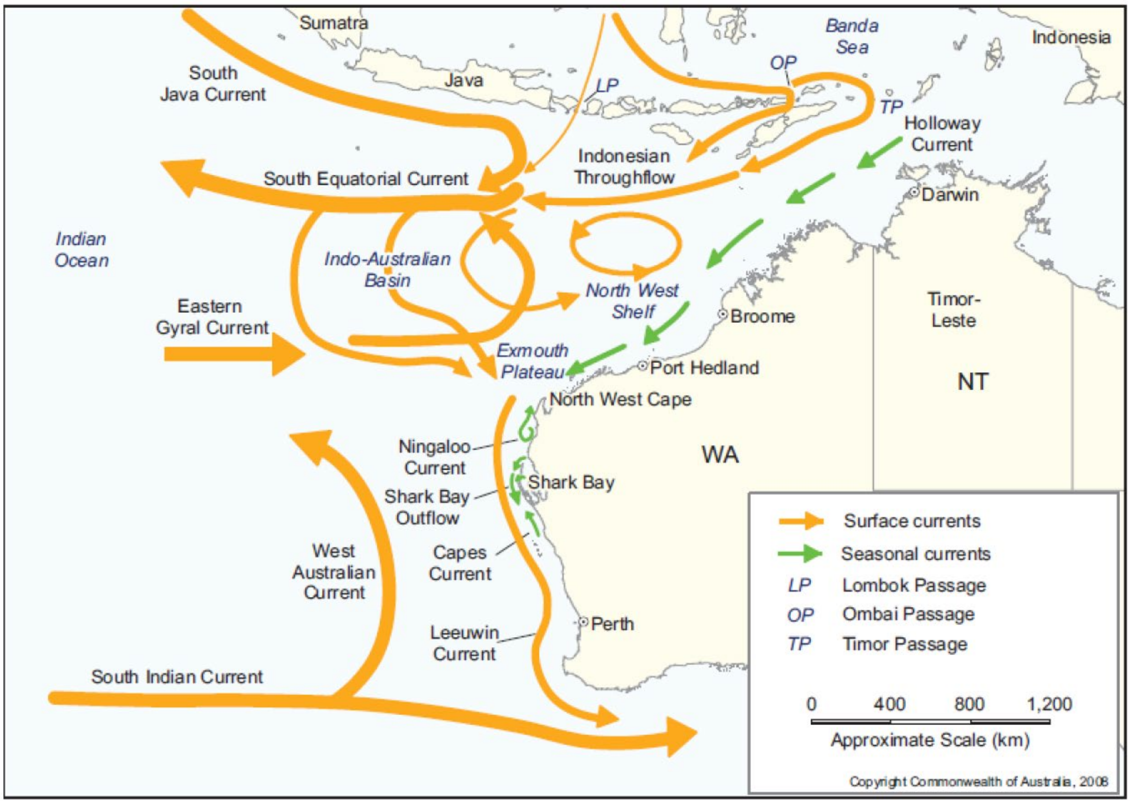
Source: RPS (2021).



The colour key shows the current magnitude (m/s), the compass direction provides the current direction flowing TOWARDS and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

Source: RPS (2021).

Figure 5.6 Monthly surface current rose plots nearby the activity area (2010-2019 inclusive)



Source: DEWHA, 2008b.

Figure 5.7 Ocean currents along the Northwest Australian continental shelf

Sea Temperature and Salinity

Surface water temperatures and salinities vary seasonally and are influenced by the Indonesian Throughflow. During the northwest monsoon, a thermocline flow of relatively cool water dominates resulting in the tropical Indian Ocean being cooled rather than warmed. The region typically has average sea surface temperatures of 28-30°C and salinities of 34-35 psu.

Tides

The JBG is subject to semi-diurnal tides with two high and low tides per day, and has the largest tidal energy observed anywhere in the world (>7 m) (Rothlisberg *et al.*, 2005). Within the JBG mesoscale bioregion, tides range from 2-3 m offshore (microtidal) rising to 3-4 m inshore (mesotidal).

Waves

In the JBG, the Southern Ocean swell is higher in winter than in summer as a result of northerly migration of swell-generating storms. The wave period and significant wave height generated by this swell is highly dependent on the exact location within the basin. For example, the JBG is protected from the Southern Ocean swell; therefore, swells affecting the area are limited to those generated by cyclones or prolonged storm winds (Maxwell *et al.*, 2004). The region is considered a moderate-energy environment except when influenced by tropical cyclones which generate short-term but major fluctuations in sea levels. Swells generated may have periods of 6-18 seconds and wave heights of 0.5-9 m and are dependent on the size, intensity, speed and relative location of the cyclone.

Water Quality

The Indonesian Throughflow brings in oligotrophic waters (low in nutrients) from the western Pacific Ocean through to the Indian Ocean (DEWHA, 2008b). Exceptions in the region occur in the event of local or regional upwelling activity at the shelf break, where deeper, cooler nutrient-rich water is brought to the surface (DEWHA, 2008b). These upwelling activities include, but are not limited to, internal wave and tide regimes, horizontal shear due to strong tidal currents and tropical cyclones. However, understanding of the nature and spatial distribution of biological productivity in the region is limited (DEWHA, 2008b).

Major inputs of fine silt sediments from the Ord, Victoria and Keep River systems occur during the wet season, creating vast areas of high turbidity, particularly in the southern part of the Gulf. The sediments are deposited to form sand bars and mud flats which are themselves the source of high turbidity throughout the year as sediments are resuspended by tidal movements. Though there is only limited marine and nearshore water quality data available, as there are no major developments or population centres near the activity area, the potential for existing pollution is limited.

Ambient Ocean Sound

Physical and biological processes contribute to natural background sound. Physical processes include that of wind, waves, rain and earthquakes, whilst biological noise sources include vocalisations of marine mammals and other marine species.

Wind is a major contributor to noise between 100 Hz and 30 kHz and can reach 85-95 dB re $1\mu Pa^2/Hz$ under extreme conditions (WDCS, 2004). Rain may produce short periods of high underwater sound with a flat frequency spectra to levels of 80 dB re $1\mu Pa^2/Hz$ and magnitude 4 earthquakes have been reported to have spectral levels reaching 119 dB re $1\mu Pa^2/Hz$ at frequency ranges of 5-15 Hz.

Turnpenny and Nedwell (1994) found that in sensitive species such as the cod, continuous ambient sound alone resulted in auditory masking, and that sound had to be 20 dB above ambient sound to be audible. Table 5.4 presents a comparison of biological and anthropological sounds in the marine environment.

Table 5.4 Sound intensity and pressure (dB re 1µPa @ 1 m from source) for some common marine sources

Source	Sound intensity (dB re 1 µPa)	Frequency (Hz)	Reference
Natural sound			
Ambient sea sound	80-120	Varied	2
Undersea earthquake	272	50	2
Seafloor volcanic eruption	255+	Varied	2
Lightning strike on sea surface	250	Varied	2
Iceberg calving, shoaling and disintegration	220-245	Varied	4
Bottlenose dolphin click	Up to 229	Up to 120,000	2
Breaching whale	200	20	2
Blue whale vocalisations	190	12 – 400 (16 – 25 dominant)	2
Blue whale moans	188	12 – 390 (16 - 25 dominant)	1
Southern right whale vocalisations	172-186	30 – 2,200 (50 – 500 dominant)	1

Source	Sound intensity (dB re 1 µPa)	Frequency (Hz)	Reference
Humpback whale vocalisations	144-174	30 – 8,000 (song) (120 – 4,000 dominant) 50 – 10,000 (social calls)	1, 3
Sperm whale clicks	Up to 235	100 – 30,000	2
Anthropogenic sound			
Seismic acoustic source (32 guns)	178-210	Most energy 5 to 200 Hz	1
Ship sound (close to hull)	200	10 – 100	2
Fishing trawler	158	100	3
7 m outboard motorboat	156	630	3
Tanker (179 m)	180	60	3
Supertanker (340 m)	190	7	3
Containership (274 m)	181	8	3
Navigation transponders	180 – 200	7,000 – 60,000	3
SSS	220 – 230	50,000 – 500,000	3
Bottom profilers	200 – 230	400 – 30,000	3
Helicopter flyover (Bell 212)	142 – 155	162	1, 3
Drill rig (Ocean Bounty semi-submersible)	145 maximum (>120 for 1% of time at 5.1 km)	20 – 1,000 (15-30 dominant)	5
Floating Production Storage and Offloading (FPSO) (maximum at Griffin Venture)	176	10 – 500 (up to 2,000)	6
References			
1 – Richardson et al (1995).	2 – APPEA (2004).	3 – WDCS (2004).	
4 – Matsumoto et al (2014).	5 – Woodside (2003).	6 – Apache Energy (2008).	

5.1.3 Physical Environment

Bathymetry

The benthic environment of the JBG is linked to its geomorphic features, with the majority of the area characterised by infaunal plains, with some localised reefs and outcrops supporting sponge gardens. Water depths in the activity area is approximately 40-45 m, while water depths in the spill EMBA range from ~100 m (offshore) to <10 m (inshore).

Bathymetry in parts of the south of the JBG is strongly influenced by the strong tidal movement and channels of the Ord, Keep, Victoria and Fitzmaurice rivers. A series of extensive sandbars, known as the King Shoals and Medusa Banks, have been generated in the southwest by the strong outflows of sediment-laden water from the Cambridge Gulf. Similar sandbars can be found in the southeast of the JBG. Bathymetry of the JBG and the activity area is presented in Figure 5.8.

Sedimentology

The sedimentology of the NWMR is varied due to the diversity of physical features from coral reefs to major canyons that act as conduits for sediment and nutrient transport (DSEWPC, 2012). Sedimentology in the NMR is also varied, with physical features including shallow canyons, which mainly consist of calcium carbonate, based sediments, as well as limestone pinnacles and reefs (DEWHA, 2008b).

The continental shelf in the JBG is the widest in Australia, extending up to 400 km from the shore. The sedimentology of the JBG is unique, with most of the inner shelf being characterised by relatively flat expanses of soft sediment seabed with localised rocky outcrops, gravel deposits and sands banks. The soft sediments in the region typically consist of sandy and muddy substrate, occasionally made up of patches of coarser sediments (Baker *et al*., 2008). The inner shelf section of the JBG receives significant loads of sediments from several large rivers including the Daly and Victoria rivers (Przeslawski *et al*., 2011).

The distribution of seabed sediments in the JBG, and in particular within the Sahul Shelf, reflects the present-day oceanographic condition and displays a distinct seaward fining pattern (Lees 1992, in Baker *et al*., 2008). Sediment sampling undertaken by Environmental Resource Management Australia Pty Ltd (ERM) in 2010 and 2011 (within WA-6-R and NT/RL1, 96 km north of the activity area) confirms that the area is mainly dominated by sand, with similar proportions of smaller gravel, silt and clay (ERM, 2011).

The top layer of sediment in the JBG from ~3 km to 35 km offshore is expected to be greater than 1 m in depth and consists of sand and gravel with variable proportions of clay. This material is primarily alluvium, derived from sedimentary sandstones and basal conglomerate. Sonar images indicate some minor paleochannels in this area containing mega-ripple or sand waves. These sediments are generally unconsolidated coarse sand, fine gravel interspersed with areas of flat and featureless seabed containing very soft to firm gravelly clays (Woodside, 2004).

The main drainage channels for the Victoria River System occur from approximately 35 km to 58 km offshore. This area is dynamic as currents and tidal influence are constantly changing the seabed features in the area. Due to the dynamic nature of the channels, the thickness of the top layer of sediment is expected to be variable. A top layer greater than one metre in depth and consisting of sands and gravels with variable proportions of clay is expected from 59 km to 65 km offshore, with some minor paleochannels occurring. The influence of alluvial inputs diminishes from around 60 km offshore to the Blacktip Wellhead Platform (WHP), which is located ~10 km north and west of the activity area (depending on the exact point of reference). This top layer increases to greater than two metres in depth from 66 km offshore and the sediments range from loose silty/clayey sands from 66 km to 75 km and very soft clayey silt and silty clay from 75 km offshore to the Blacktip WHP location (Woodside, 2004). Again, the seabed alternates between flat and featureless seabed containing very soft to firm silty clay and an area of hummocky seabed containing mega-ripple or sand waves, though the seabed is generally flat to gently sloping from about 66 km offshore to the Blacktip WHP location (Woodside, 2004).

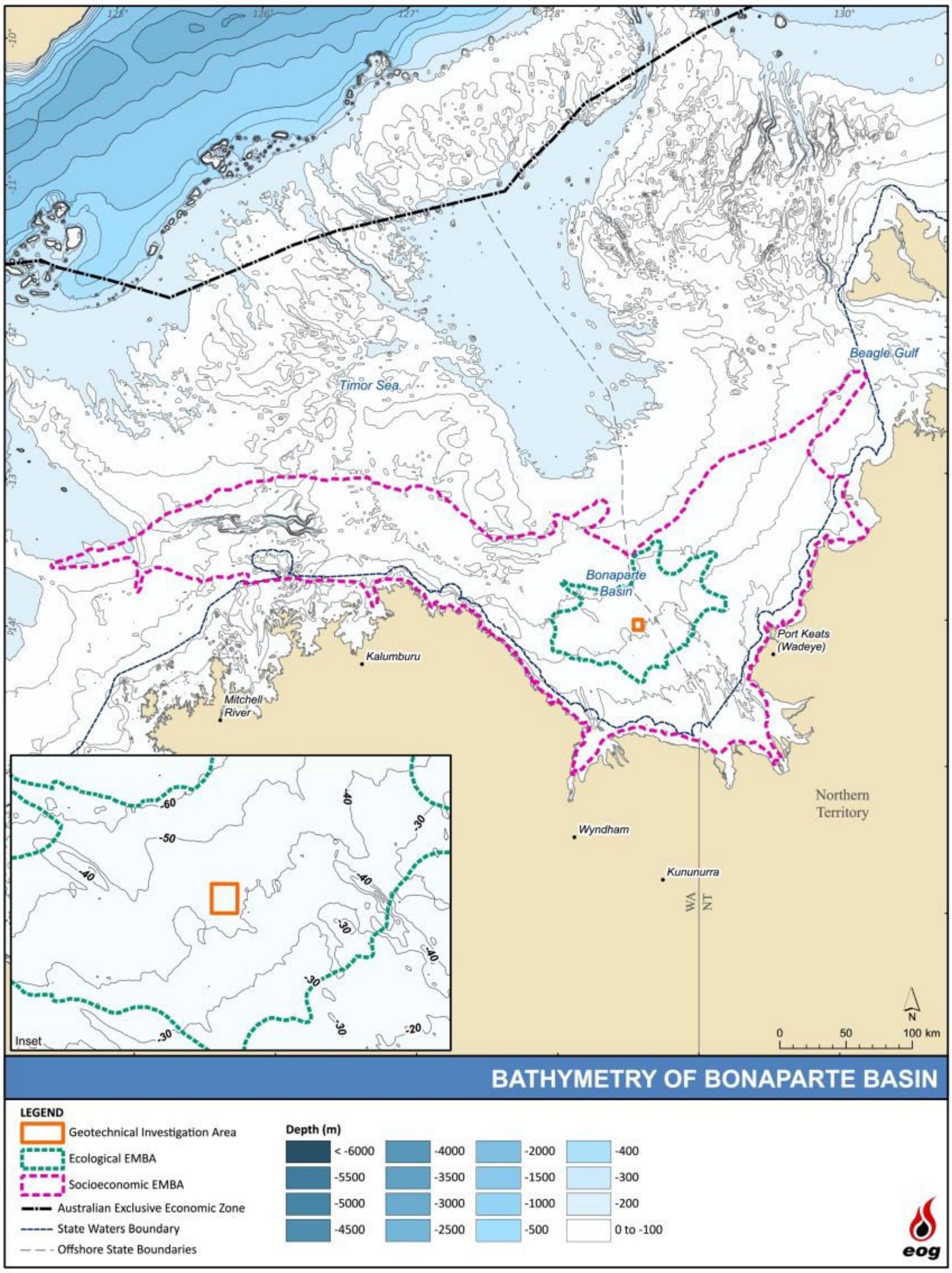


Figure 5.8 Bathymetry of the JBG

Seabed

Seabed morphology in parts of the JBG is influenced by the strong tidal movement and channels of the Ord, Keep, Victoria and Fitzmaurice rivers. A series of extensive sandbars, known as the King Shoals and Medusa Banks (approximately 50 km south of the activity area), have been generated by the strong outflows of sediment-laden water from Cambridge Gulf. Similar sandbars can be found in the south-east of the JBG. The activity area is located entirely within the 'shelf' geomorphic feature, which is typically characterised by extensive sediment plains and high sediment deposition from the coastal rivers to the south (Figure 5.9).

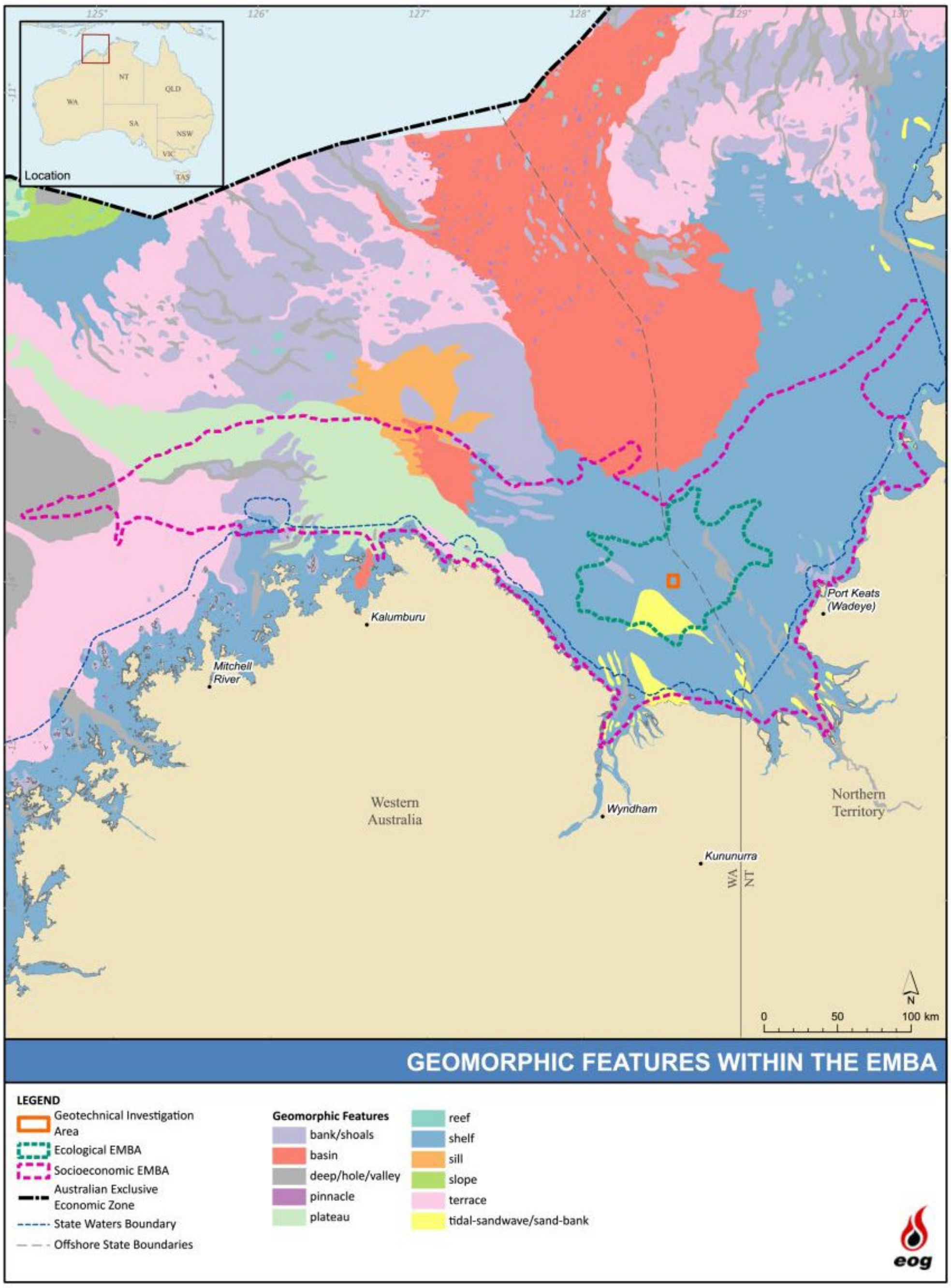


Figure 5.9 Geomorphic features of the activity area and EMBA

5.2 Coastal Environment

The physical coastal environment described in this section is defined by the potential extent of dispersion of low threshold entrained hydrocarbons predicted under the MDO spill scenario (the socio-economic EMBA), which stretches from the northern Kimberley coast in WA to the Daly River estuary in the NT (noting that the ecological EMBA does not intersect the shoreline and there is no accumulation of hydrocarbons on the shoreline at concentrations that may cause ecological harm).

5.2.1 Shoreline Habitats

Shoreline habitats are defined as those habitats that are adjacent to the water along the mainland and islands that occur above the Lowest Astronomical Tide (LAT), and most often in the intertidal zone. The following section broadly categorises shoreline habitats as the following biological communities that were identified to occur within the socio-economic EMBA: mangroves, sandy beaches, intertidal mud flats, rocky shores and islands.

Intertidal mud and sand flats

The socio-economic EMBA intersects intertidal mud and sand flats on the southern coastline of the JBG, approximately 127 km southeast of the activity area. Mudflats are comprised of layers of fine mud due to the ongoing deposition of estuarine silts, which combines with deposition of fine sands by tidal movements. These areas provide important habitat for mud and sand-dwelling invertebrates such as crabs, prawns, shells and worms and sheltered habitat for larval and juvenile fishes. Due to the diversity of infauna, they are also an important foraging habitat for various shorebird species including egrets, plovers and oystercatchers.

Sandy beaches

Using satellite imagery, sand beaches are the dominant shoreline type on the eastern coast of the JBG with only occasional rocky headlands and river estuaries leading to the ocean. These environments are highly remote and are unlikely to have any significant anthropogenic presence. The beaches may provide roosting and nesting habitat for sand nesting bird species, such as plovers.

Rocky shores

Using satellite imagery, rocky shorelines are the dominant shoreline type on the western coast of the JBG that is intersected by the socio-economic EMBA. While there are some stretches of sand beaches on the western coast, they are confined to the sheltered bays and inlets. The exposed rocky shores would be exposed to wave action from the JBG and as such are likely to provide habitat for intertidal algae and shell species.

Mangroves

Mangroves commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes (Kathiresan and Bingham, 2001). Mangroves are found wherever suitable conditions are present including wave-dominated settings of deltas, beach/dune coasts, limestone barrier islands and ria/archipelago shores (Semeniuk, 1993).

Mangroves are important primary producers and have a number of ecological and economic values, including reducing coastal erosion and providing habitat for a variety of epibenthic, infaunal and meiofaunal invertebrates (Kathiresan and Bingham, 2001). Crustaceans known to inhabit the mud in mangrove systems include fiddler crabs, mud crabs, shrimps and barnacles, while water channels of the system support various finfish. Mangroves and their associated invertebrate-rich mudflats are also an important habitat for migratory shorebirds from the northern hemisphere, as well as some avifauna that are restricted to mangroves as their sole habitat (Garnet and Crowley, 2000).

Using satellite imagery, mangrove habitat intersected by the socio-economic EMBA typically occur along the banks of the major rivers and estuarine environments of the southern JBG including at Quoin Island (119 km southeast) and Clump Island (126 km southeast) and along the southern coastline of Dorcherty Island (80 km east).

Islands

No islands or emergent reef systems are located within the activity area or the ecological EMBA. However, several rocky and sandy islands are located within the socio-economic EMBA that provide intertidal and shoreline habitats for a variety of marine fauna and ecological communities, including many small islands along the north Kimberley coast. The most significant islands to the activity area are Pelican Island (76 km south), Kanggurryu Island (70 km south), Dorcherty Island (80 km east) and Lacrosse Island (71 km southwest).

5.3 Biological Environment

The sources listed at the start of this chapter have been used in the preparation of this section. Additionally, biologically important areas (BIAs) are identified for those species that may occur within the activity area and spill EMBA. BIAs are spatially defined areas, defined by the DCCEEW based on expert scientific knowledge, where aggregations of individuals of a species are known, or likely, to display biologically important behaviour such as breeding, foraging, resting or migration (DAWE, 2021a). The BIAs do not represent a species' full distribution range.

5.3.1 Benthic Assemblages

The benthic environment of the JBG is linked to its geomorphic features, with the majority of the area characterised by infaunal plains, with some localised reefs and outcrops supporting sponge gardens. Przeslawski et al (2011) provides an overview of the benthic environment associated with the different geomorphic features within the EMBA, which are presented in Figure 5.10:

- Shelf – sediment plains that are swept by strong tidal currents and are subject to large influxes of suspended sediment and freshwater, particularly during the wet season. Support diverse infaunal communities that play a key ecological role by contributing to nutrient cycling and sediment turnover (bioturbation) at the local scale. Low abundance of crustaceans, echinoderms and sessile epifauna are expected.
- Banks/shoals - elevated features with a relatively high proportion of hard substrate that support patches of moderately dense octocoral and sponge gardens which in turn provide habitat for other epifauna and cryptofauna. Banks support high numbers of epifaunal species. Infaunal species richness is moderately high in bank sediments. Very few macroalgae (including *Halimeda*) or reef-forming hard corals were recorded.
- Basin - low-relief expanses of unconsolidated sediment, and the available biological data suggests that these habitats are dominated by infauna with limited epifauna.
- Deep/hole/valley - dominated by flat soft sediment expanses. Support low-moderate numbers of epifaunal species and include many debris-swept channels, which in places expose small patches of underlying rock that support moderate densities of sessile animals.
- Tidal-sandwave/sand bank – high disturbance, soft substrate, limited biota.

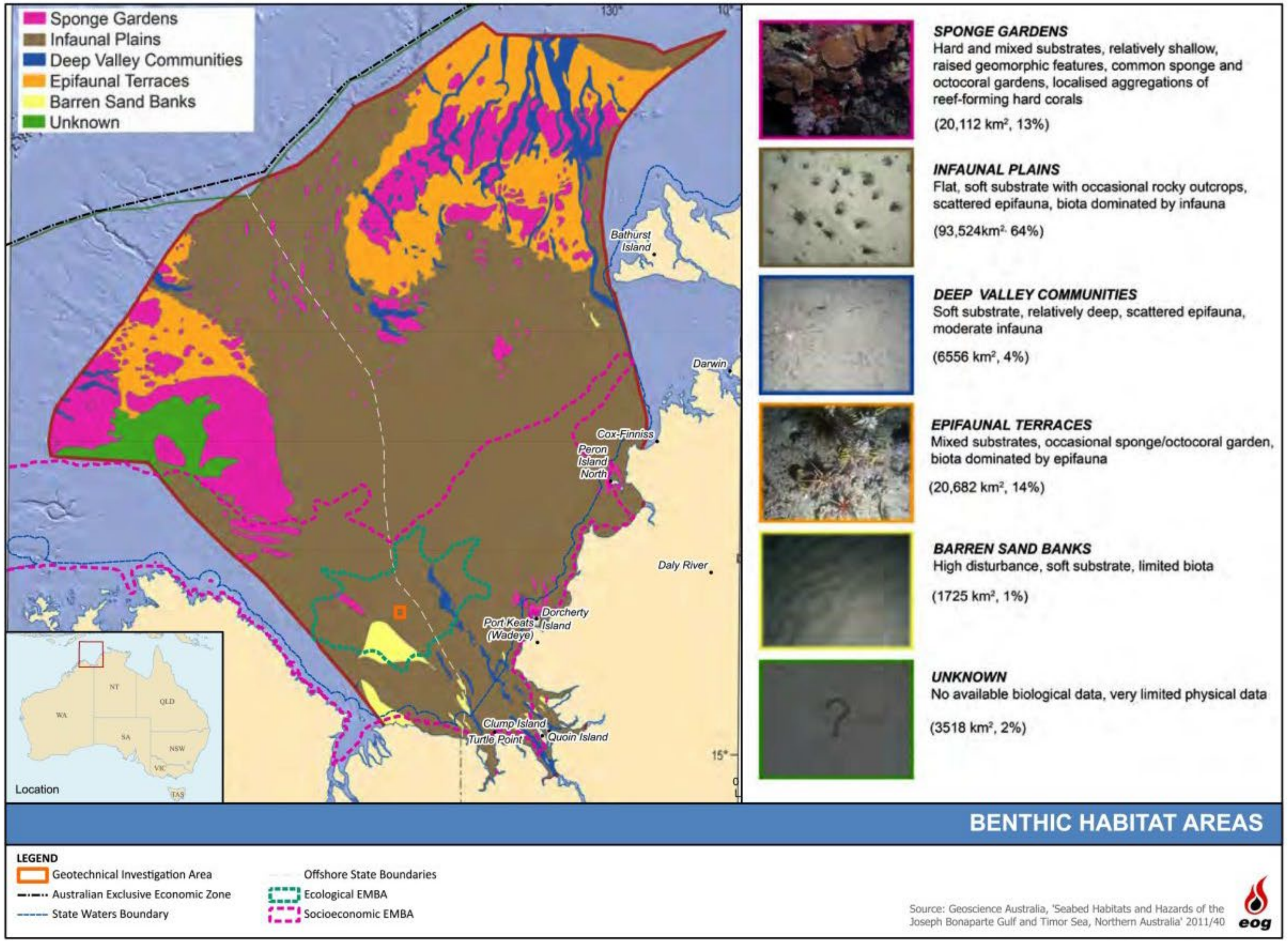


Figure 5.10 Generalised habitat map showing likely distribution of habitats and biological communities in the activity area and EMBA

Based on Figure 5.10, the main habitat type in the activity area and EMBA is infaunal plains, which are primarily characterised by flat soft substrate with occasional rocky outcrops, scattered epifauna and biota dominated by infauna (Przeslawski *et al*., 2011).

Infaunal communities

Studies conducted on the infauna within the Blacktip Project area (the closest sampling station, located approximately 10 km northwest from the activity area) found infauna to be diverse and abundant, with two major phyla, Arthropoda (crustaceans) and Annelida (polychaete worms), contributing over 80% of the total number of individuals (Woodside, 2004). Recorded Arthropoda species include tanaids (shrimps), brachyurans (crabs) and grammarid amphipods. The Annelida were diverse comprising of 36 families, with the most abundant families being Terebellidae, Spionidae, Onphidae, Maldanidae and Ampharetidae. Members of these families are mainly tube-dwelling worms that feed on detrital material on the surface or in the surface sediments. Other abundant infauna are Cnidaria (hydroids, soft corals), Mollusca (mainly bivalves) and Echinodermata (brittle stars, sea urchins).

The Blacktip baseline studies found that infauna species richness and abundance in the JBG was related to sediment particle size. Richness and species abundance increased with distance from the mouth of the Victoria River (approximately 125 km southeast of the activity area), which coincided with an increasing proportion of fine particles in the sediment (Woodside, 2004). Sites near the Victoria River mouth generally had coarser sediments and lower species richness and abundance. The Blacktip sampling sites supported a richer assemblage than sites closer to the Victoria River mouth (Woodside, 2004).

During this survey, 135 nominal species were identified. However, faunal abundance was low with only 528 individuals recorded and only 14 species recording more than 10 individuals across all the offshore samples. The composition of the infaunal community was somewhat unusual. Continental shelf infauna is generally dominated by polychaete worms. However, nearly three times as many crustaceans were collected as polychaetes. Bryozoans and hydroids were the next most abundant group after the crustaceans, and nearly as many molluscs and echinoderms were collected as polychaetes. The most abundant species was a porcelain crab followed by a brittle star (Woodside, 2004).

The study also observed that sites near the Victoria River mouth, which generally had coarser sediments, had a greater proportional abundance of crustaceans and cnidarians (hydroids and soft corals) compared to sites further offshore, which supported a predominantly detritus feeding infauna (Woodside, 2004).

Crustaceans

In a study of prawn trawl bycatch in the JBG, which included sampling locations within the EMBA and approximately 10 km from the activity area, Tonks et al (2008) found that four crustacean species dominated the invertebrate component of the bycatch: *Charybdis callianassa* (Portunidae); *Trachypenaeus gonospinifer* (Penaeidae); *Metapenaeopsis novaeguineae* (Penaeidae); and *Solenocera australiana* (Solenoceridae).

The dominant prawn species of the JBG are the penaeid species, namely tiger prawn (*Penaeus esculentus*), banana prawn (*P. merguiensis*) and red-legged banana prawn (*P. indicus*). These species occur in coastal waters to depths of approximately 200 m and are widely distributed through sub-tropical and tropical waters from Western Australia to New South Wales (Jones and Morgan, 1994). Shallower inshore waters act as nursery grounds for juveniles, such as the river and tidal creek systems of the JBG. Small numbers of prawns can also be found in mangrove habitats. More is known about the distribution and abundance of prawns in the JBG compared to other crustaceans due to their commercial significance.

As discussed in detail in Section 5.6.1, prawns are commercially caught in areas of the JBG, mainly in the west of the gulf and in Fog Bay, NT to the northeast of the activity area. The juvenile prawns that migrate offshore to the fishery come from mangrove nursery habitats from the Victoria River in the east of the Gulf, to the Ord River and Cambridge Gulf in the west, forming a very extensive migration throughout the lower region of the JBG. This migration is likely to be from February to April and October to December. Migration of the juveniles is thought to be triggered by rainfall and river discharge. The areas most intensely fished for prawns are located in the Gulf of Carpentaria (outside the EMBA).

Prawns

There are several prawn species present in the JBG that occupy benthic habitats and prey on micro-organisms, small shellfish, worms and decaying organic matter. Several of the species develop their juveniles in nearshore estuarine and mangrove habitat before moving further offshore in adulthood. Based on information from the NPFI, commercial prawn species such as banana, tiger and endeavour prawns may spawn within the activity area during the warmer months of the year. The habitat, distribution and reproduction of these species is presented in Table 5.5 based on several sources of literature.

Table 5.5 Key prawn species habitat, distribution, and reproduction in the JBG

Species	Habitat	Stock structure & distribution	Spawning
Banana prawns Redleg banana prawn (*Penaeus indicus)* White banana prawn (*P. merguiensis*)	Banana prawns live in tropical and sub-tropical coastal waters and are found over muddy and sandy bottoms in coastal waters and estuaries (AFMA, 2021). White banana prawns can generally be found at depths of 16-25 m but can occur to depths of 45 m, while red-legged banana prawns are found at depths of 35-90 m (AFMA, 2021). Juvenile redleg banana prawns are found in estuarine habitats up to 120 km south and 240 km east-southeast of the southern and eastern limits of the *P. indicus* fishery in the JBG. Although mangrove habitats are the closest inshore habitats to the fishery, they are not used by *P. indicus.* Given the habitat preference for *P. indicus*, the larvae resulting from spawning in the fishing grounds rely on tides and currents. move large distances to the south and east to their nursery habitats (Loneragan *et al.,* 2002). This implies that the emigrating juveniles and sub-adults migrate from the mangrove nursery habitats, north and west, across shallower sand substrates (30-40 m deep) to the deep-water fishery (on mud substrates about 50-80 m deep). Juvenile white banana prawns are found in estuarine habitats in the western part of JBG, about 50 km to the southwest of the *P. indicus* fishery.	Banana prawn species are mainly found in tropical and sub-tropical waters around Australia from Shark Bay in WA to the NT and Queensland coastlines (including waters in Torres Strait between Australia and Papua New Guinea) (AFMA, 2021). The biological stock structure of banana prawn is uncertain. Redleg banana prawns are widely distributed across the Indo-West Pacific Ocean. In the JBG, a single separate stock is assumed for stock assessment and management purposes (ABARES, 2021). In the NPF, there is some evidence of white banana prawn sub-stock structuring associated with significant river catchments and their annual flow regimes; however, there is an absence of clear evidence on biological stock structure, status is determined for a single fishery-level stock (ABARES, 2021).	Banana prawns reach reproductive maturity at approximately 6 months of age (AFMA, 2021). They spawn offshore throughout the year with two spawning peaks: the late dry season (September - November) and the late wet season (March – May) (AFMA, 2021) (see Figure 5.11). Banana prawns are serial spawners. Each female lays several egg batches each year. Females produce 100,000 to 450,000 eggs per year. Eggs hatch within 24 hours of fertilisation (AFMA, 2021). Less than 1% of larvae survive the 2-4 week planktonic larval phase to reach suitable coastal nursery habitats where they settle, however there are no written records to verify these statistics other than postlarval and juvenile mortality are known to be high (Rob Kenyon CSIRO Division of Marine Research, pers.comm. February 2022). After 1-3 months in the nursery grounds, the young prawns migrate offshore. Migration of the main cohort occurs November-March. A possible second cohort migrates April-June (Neil Loneragan, CSIRO Division of Marine Research, pers.comm., April 2000). Migration is thought to be triggered by rainfall and river discharge. Juveniles reach sexual maturity at 6 months and have a lifespan of 1-2 years (Yearsley *et al.,* 1999).

Species	Habitat	Stock structure & distribution	Spawning
Tiger prawns Brown tiger prawn (*Penaeus esculentus*) Grooved tiger prawn (*P. semisulcatus*).	Tiger prawns live in coastal waters to depths of 200 m (AFMA, 2021). Adult brown tiger prawns are found over coarse sediments and adult grooved tiger prawns are found in fine mud sediments (AFMA, 2021). Juvenile tiger prawns are found in shallow waters, often where seagrass beds are present, and sometimes on top of coral reef platforms (AFMA, 2021).	Brown tiger prawns are endemic to tropical and subtropical waters of Australia, while grooved tiger prawns have a wider Indo–West Pacific distribution. There is some genetic evidence of separation of brown tiger prawn stocks from the east and west coasts of Australia (Ward *et.al.*, 2006). Assessment of stock status for the brown tiger and grooved tiger is undertaken at the management unit level – NPF (Commonwealth) (Butler *et al*., 2021b).	For brown tiger prawns, spawning occurs throughout the year, in both inshore and offshore areas, while grooved tiger prawns spawn in offshore areas (AFMA, 2021). Brown tiger prawns have a spawning peak between July and October (Figure 5.11) (AFMA, 2021). Grooved tiger prawns have a spawning peak in August-September, with a secondary peak in February (Figure 5.11) (AFMA, 2021). Females produce about 186,000 eggs (brown tiger prawns) and 365,000 eggs (grooved tiger prawns) per year depending on their body size. Eggs hatch within 24 hours of fertilisation (AFMA, 2021). There is little to no information available on the spawning locations of tiger prawns (Rob Kenyon CSIRO Division of Marine Research, pers.comm. February 2022). Juveniles reach sexual maturity at about 6 months and have a lifespan of 2 years (Yearsley *et al.,* 1999).

Species	Habitat	Stock structure & distribution	Spawning
Endeavour prawns Blue endeavour prawn (*Metapenaeus endeavouri*) Red endeavour prawn (*M. ensis*).	Endeavour prawns live in tropical coastal waters (AFMA, 2021). Blue endeavour prawns are found over sandy or mud-sand substrates to depths of about 60 m, while red endeavour prawns prefer muddy substrates and have been found to depths of 95 m (AFMA, 2021). Juvenile blue endeavour prawns are commonly associated with seagrass beds in shallow estuaries, while juvenile red endeavour prawns are more widely distributed across seagrass beds, mangrove banks, mud flats and open channels (AFMA, 2021).	Endeavour prawn fisheries are located in Shark Bay, Exmouth Gulf, the north coast of WA, the Gulf of Carpentaria, the Torres Strait and the east coast of Queensland. Little is known about the biological stock structure of the populations of blue and red endeavour prawns. Assessment of stock status for each species is undertaken at the NPF (Commonwealth) management level (Roelofs et al., 2021).	Spawning occurs throughout the year (AFMA, 2021). Blue endeavour prawns have spawning peaks in March and September, while red endeavour prawns have a spawning peak in September to December (Figure 5.11) (AFMA, 2021). There is little to no information available on the spawning locations of endeavour prawns (Rob Kenyon CSIRO Division of Marine Research, pers.comm. February 2022). Females produce about 296,000 eggs per year (AFMA, 2021). Juveniles reach sexual maturity at 6 months and have a lifespan of 1-2 years (Yearsley *et al.,* 1999).

Note: AFMA and CSIRO were contacted by EOG in February 2022 to verify gaps in information specifically spawning locations for banana prawns, tiger prawns and endeavour prawns. Where available, data is referenced within the table.

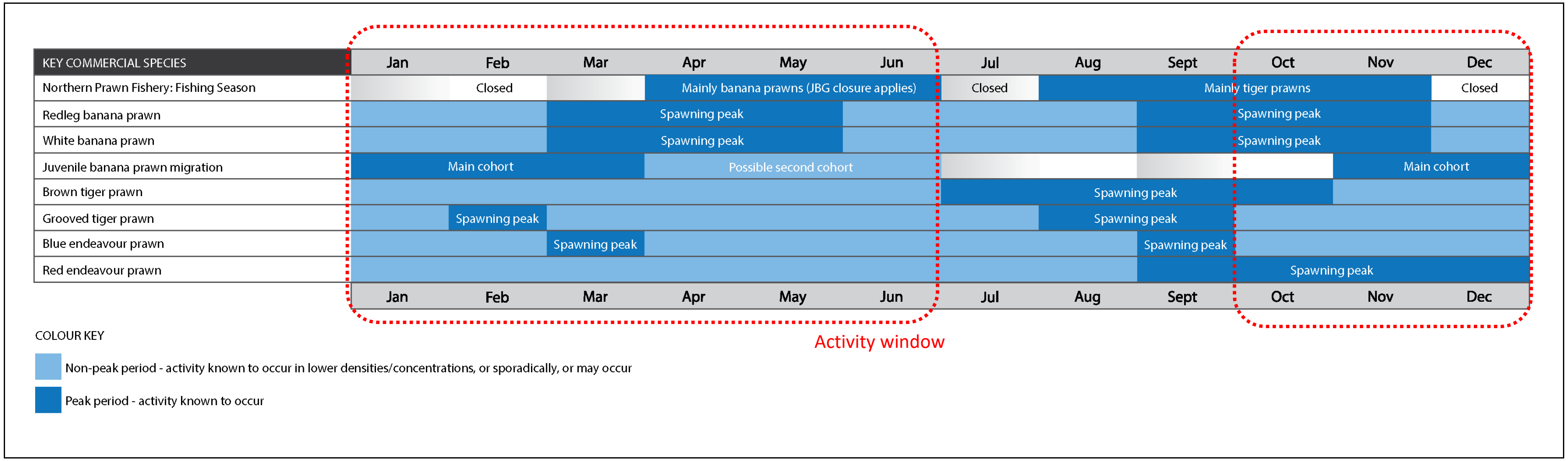


Figure 5.11 Commercial prawn species spawning periods

Molluscs

The JBG has relatively low mollusc species diversity due to the restricted number of habitats available and silty conditions, with less than 100 species (mainly bivalves) recorded in the region (Walker *et al*., 1996). Many different types of molluscs are found in the mangroves, including clams (Walker *et al*., 1996). The soft sediment infaunal plains habitat that dominates the activity area does not provide extensive hard substrate for bivalve molluscs or other fixed invertebrates to attach and reproduce (Przeslawski *et al*., 2011).

During stakeholder engagement for the Santos Fishburn 3D MSS, the PPA noted that there would most likely be a variable distribution of silver lipped pearl oyster (*Pinctada maxima*) at the proposed depths where that survey took place within the JBG. Silver lipped pearl oysters are known to be sparsely distributed in the JBG out to the 100 m isobath. Primary spawning occurs from the middle of October to December, with a smaller secondary spawning occurring in February and March (Hart *et al*., 2015).

Reefs, Shoals and Banks

Coral reefs are habitats with high diversity of corals, associated fish and other species of both commercial and conservation importance. No reef habitats have been identified within the activity area or the ecological EMBA; however, the socioeconomic EMBA does overlap with areas of coral reef habitats. The closest identified coral reef habitat is located within the Joseph Bonaparte Gulf Australian Marine Park (JBG AMP). Emu Reefs (located 85 km northeast of the activity area) was recently surveyed by traditional owners of the Thamarrur region in partnership with the Australian Institute of Marine Science (AIMS), Eni and Parks Australia. The survey deployed Baited Remote Underwater Video Systems (BRUVS) and captured a diversity of fish, sharks and crabs as well as the protected and culturally significant eyebrow wedgefish (*Rhynchobatus palpebratus*) (Parks Australia, 2021a).

King Shoals Sanctuary Zone is located within the North Kimberley Marine Park (see Table 5.13), approximately 68 km SSW of the activity area. It supports a wide diversity of organisms including corals and other reef dwelling species. The area is likely to be foraging grounds for flatback turtles and sawfish.

Oceanic shoals and banks are abrupt geological features that rise from the deep continental shelf to within 15-20 m of the sea surface. These unique habitats contain submerged reefs that support a very high diversity of coral reef ecosystems (Heyward *et al*., 2017). It is likely that the open oceanic environment that the northwest banks and shoals are situated in contributes to their high species diversity and abundance as their exposure to oceanic influences may enhance productivity and in turn the diversity of species inhabiting them (Parks Australia, 2021a). There are no identified oceanic shoals or banks located within the activity area or the ecological EMBA, however, there are several identified shoals and banks in the western extent of the socio-economic EMBA including Holothuria Banks, Tait Bank, Penguin Shoal and Bassett-Smith Shoal (RPS, 2021). Though there is a paucity of information relevant to these specific features, studies of similar nearby shoals not located in the EMBA have found a high diversity of free-living corals, sponges, gorgonian soft corals, hard corals, rhodoliths, tropical fish, rays and sharks (Heyward *et al*., 2017; Moore *et al*., 2017; Heyward *et al*., 2010). It is expected that the shoals and banks located in the western extent of the socio-economic EMBA may include a similar assemblage of species. Identified banks, reefs and shoals in relation to the activity area and EMBA are presented in Figure 5.12.

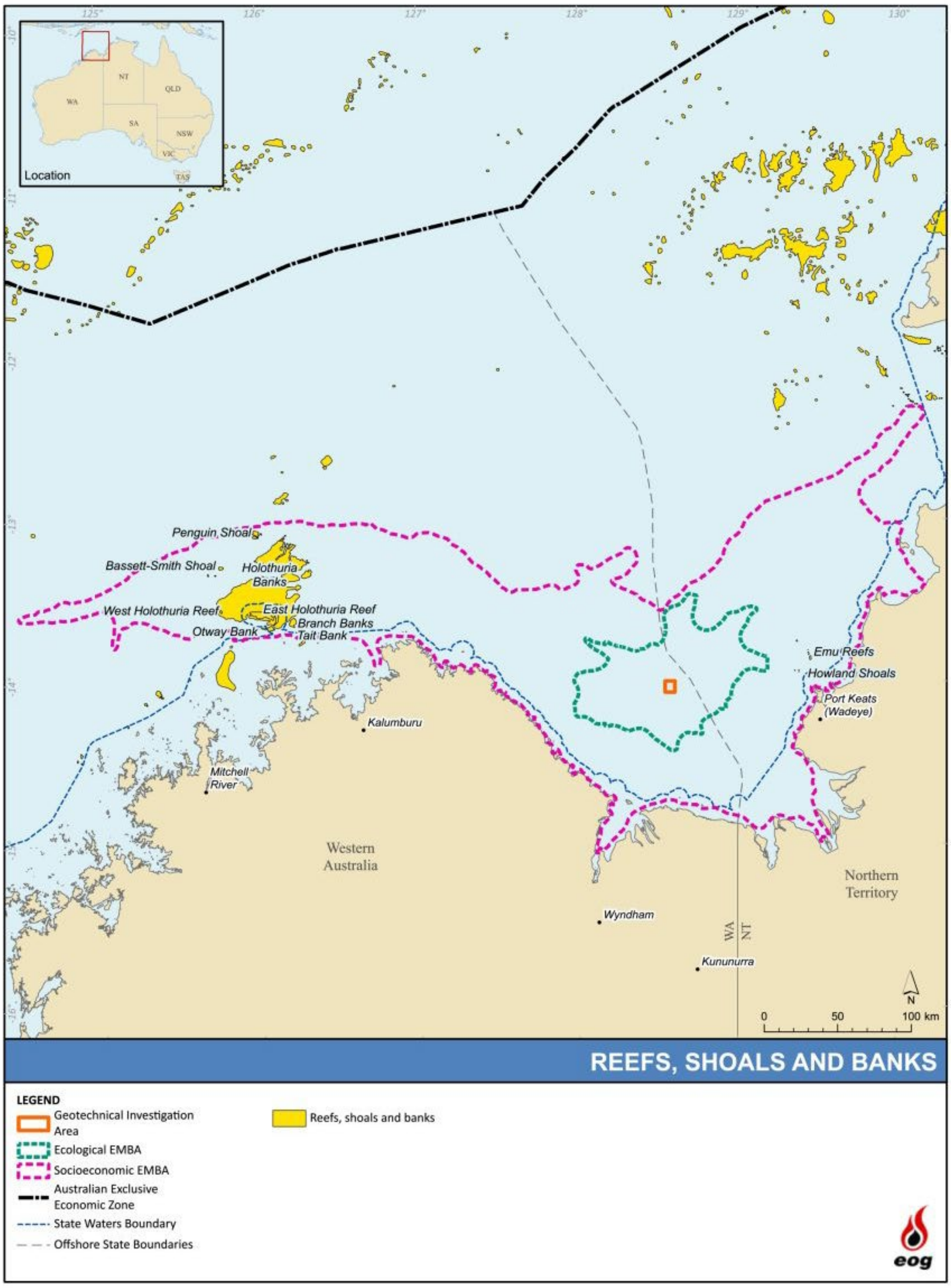


Figure 5.12 Reefs, shoals and banks in the EMBA

5.3.2 Flora

Mangroves

Mangroves provide nutrient to surrounding waters and are also important habitat and nursery areas for fish and invertebrates. The north Kimberley region contains some of the most species rich systems of mangroves in the world (DPaW, 2016). The mangroves and estuarine habitats of the north Kimberley support a range of threatened, protected and culturally important species including estuarine crocodiles, turtles, dolphins, sawfish, mud crabs, fish and specialist mangrove birds (DPaW, 2016).

In the JBG, mangroves occur in river estuaries. The mangroves surrounding the Ord River are notable in terms of their structural complexity and diversity. Fourteen species of mangroves have been identified within the Ord River alone (Pedretti & Paling, 2001). This diverse area is known to support significant habitats for saltwater crocodiles, migratory birds and supports populations of the commercially exploited species of red-legged banana prawn (*Penaeus indicus*) (Kenyon *et al*., 2004).

Seagrass Beds and Macroalgae

Seagrass beds and macroalgae communities are the primary food source for many marine species and provide important habitats and nursery grounds (Heck *et al*., 2003; Wilson *et al*., 2010). Within the north Kimberley marine region, seagrass and macroalgae communities are an important source of primary productivity. They provide vital habitat for juvenile fish, turtles and dugongs and can be found around Cape Londonderry, which is 165 km west of the activity area and within the socio-economic EMBA but outside of the ecological EMBA (DPAW, 2016).

5.3.3 Plankton

Plankton is a key component in oceanic food chains and comprises two elements; phytoplankton and zooplankton, as described herein.

Phytoplankton (photosynthetic microalgae) comprise 13 divisions of mainly microscopic algae, including diatoms, dinoflagellates, gold-brown flagellates, green flagellates and cyanobacteria and prochlorophytes (McLeay *et al*., 2003). Phytoplankton drift with the currents, although some species have the ability to migrate short distances through the water column using ciliary hairs. Phytoplankton has the capacity to multiply rapidly in response to bursts of nutrient availability and are subsequently consumed by zooplankton that in turn are consumed by other marine fauna species.

Zooplankton is the faunal component of plankton, comprising small crustaceans (such as krill), fish eggs and fish larvae. Zooplankton includes species that drift with the currents and also those that are motile. Nutrients and planktonic organisms (including many species of larval recruits) are transported to and from the JBG by the southerly movement of the Indonesian Throughflow and the southeast and northwest monsoonal wind-driven currents (Brewer *et al*., 2007).

5.3.4 Finfish, Sharks and Rays

Table 5.6 lists the fish, sharks and rays which are listed under the EPBC Act with potential to occur in the spill EMBA (**Appendix 4**). The listed marine species are all Sygnathiformes (seahorses, pipefishes and their relatives). Figure 5.13 illustrates the likely temporal presence and absence of these fish species in the activity area and EMBA. The species listed as threatened or migratory are described in this section.

Table 5.6 EPBC Act-listed finfish, sharks and rays that may occur in the activity area and EMBA

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Anoxypristis cuspidate	Narrow sawfish	-	Yes	-	✓	✓	✓	No	No	-
Carcharodon carcharias	Great white shark	V	Yes	-	✓	✓	✓	No	No	RP
Carcharhinus longimanus	Oceanic whitetip shark	-	Yes		✓	✓	✓	No	No	-
Glyphis garricki	Northern river shark	E	-	-	✓	✓	✓	No	No	CA, RP
Isurus oxyrinchus	Shortfin mako	-	Yes	-	✓	✓	✓	No	No	-
Isurus paucus	Longfin mako	-	Yes	-	✓	✓	✓	No	No	-
Manta alfredi	Reef manta ray	-	Yes	-	✓	✓	✓	No	No	-
Manta birostris	Giant manta ray	-	Yes	-	✓	✓	✓	No	No	-
Pristis clavata	Dwarf sawfish	V	Yes	-	✓	✓	✓	No	No	CA, RP
Pristis pristis	Largetooth sawfish	V	Yes	-	✓	✓	✓	No	No	CA, RP
Pristis zijsron	Green sawfish	V	Yes	-	✓	✓	✓	No	No	CA, RP
Rhincodon typus	Whale shark	V	Yes	-	✓	✓	✓	No	No	CA
Sphyrna lewini	Scalloped hammerhead	CD	-	-	✓	✓	✓	No		-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Thunnus maccoyii	Southern bluefin tuna	CD	-	-	-	-	✓	No		-
Seahorses, pipefish and pipehorses										
Bhanotia fasciolata	Corrugated pipefish	-	-	Yes	-	-	✓	No	No	-
Campichthys tricarinatus	Three-keel pipefish	-	-	Yes	✓	✓	✓	No	No	-
Choeroichthys brachysoma	Pacific short-bodied pipefish	-	-	Yes	✓	✓	✓	No	No	-
Choeroichthys suillus	Pig-snouted pipefish	-	-	Yes	✓	✓	✓	No	No	-
Corythoichthys amplexus	Fijian banded pipefish	-	-	Yes	✓	✓	✓	No	No	-
Corythoichthys flavofasciatus	Reticulate pipefish	-	-	Yes	✓	✓	✓	No	No	-
Corythoichthys haematopterus	Reef-top pipefish	-	-	Yes	-	✓	✓	No	No	-
Corythoichthys intestinalis	Australian messmate pipefish	-	-	Yes	-	-	✓	No	No	-
Corythoichthys schultzi	Schultz's pipefish	-	-	Yes	✓	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Cosmocampus banneri	Roughridge pipefish	-	-	Yes	-	-	✓	No	No	-
Doryrhamphus dactyliophorus	Banded pipefish	-	-	Yes	-	-	✓	No	No	-
Doryrhamphus excisus	Bluestripe pipefish	-	-	Yes	✓	✓	✓	No	No	-
Doryrhamphus janssi	Cleaner pipefish	-	-	Yes	✓	✓	✓	No	No	-
Festucalex cinctus	Girdled pipefish	-	-	Yes	-	✓	✓	No	No	-
Filicampus tigris	Tiger pipefish	-	-	Yes	-	-	✓	No	No	-
Halicampus brocki	Brock's pipefish	-	-	Yes	✓	✓	✓	No	No	-
Halicampus dunckeri	Red-hair pipefish	-	-	Yes	-	-	✓	No	No	-
Halicampus grayi	Mud pipefish	-	-	Yes	✓	✓	✓	No	No	-
Halicampus spinirostris	Spiny-snout pipefish	-	-	Yes	✓	✓	✓	No	No	-
Haliichthys taeniophorus	Ribboned pipehorse	-	-	Yes	✓	✓	✓	No	No	-
Hippichthys cyanospilos	Blue-speckled pipefish	-	-	Yes	-	✓	✓	No	No	-
Hippichthys parvicarinatus	Short-keel pipefish	-	-	Yes	-	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Hippichthys penicillus	Beady pipefish	-	-	Yes	✓	✓	✓	No	No	-
Hippocampus angustus	Western spiny seahorse	-	-	Yes	-	-	✓	No	No	-
Hippocampus histrix	Spiny seahorse	-	-	Yes	✓	✓	✓	No	No	-
Hippocampus kuda	Spotted seahorse	-	-	Yes	✓	✓	✓	No	No	-
Hippocampus planifrons	Flat-face seahorse	-	-	Yes	✓	✓	✓	No	No	-
Hippocampus spinosissimus	Hedgehog seahorse	-	-	Yes	✓	✓	✓	No	No	-
Micrognathus micronotopterus	Tidepool pipefish	-	-	Yes	✓	✓	✓	No	No	-
Solegnathus hardwickii	Pallid pipehorse	-	-	Yes	✓	✓	✓	No	No	-
Solegnathus lettiensis	Gunther's pipehorse	-	-	Yes	✓	✓	✓	No	No	-
Solenostomus cyanopterus	Robust ghost pipefish	-	-	Yes	✓	✓	✓	No	No	-
Syngnathoides biaculeatus	Double-end pipehorse	-	-	Yes	✓	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Trachyrhamphus bicoarctatus	Bentstick pipefish	-	-	Yes	✓	✓	✓	No	No	-
Trachyrhamphus longirostris	Straightstick pipefish	-	-	Yes	✓	✓	✓	No	No	-

<u>Definitions</u>

EPBC Act	Description
Listed threatened species	A native species listed in Section 178 of the EPBC Act as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
Listed migratory species	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the EPBC Act.
Listed marine species	As listed in Section 248 of the EPBC Act.

<u>Key</u>

EPBC status	V	Vulnerable
	E	Endangered
	CE	Critically endangered
	CD	Conservation Dependent
BIA	A	Aggregation
	D	Distribution (i.e., presence only)
	F	Foraging
	M	Migration

Recovery plans (under the EPBC Act)	CA	Conservation Advice
	CMP	Conservation Management Plan
	RP	Recovery Plan

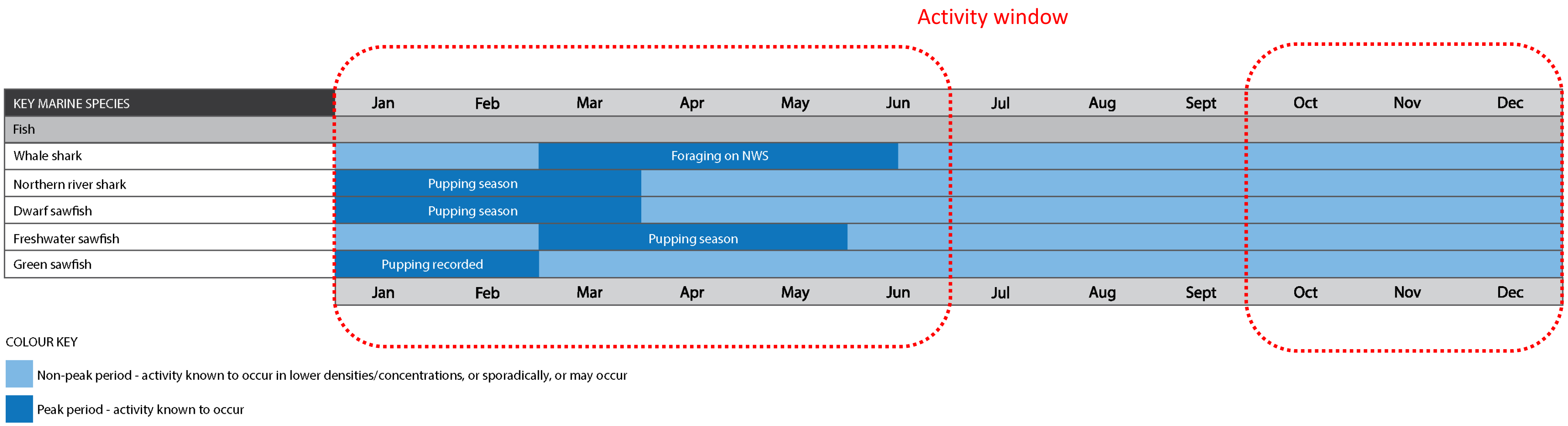


Figure 5.13 Likely temporal presence and absence of EPBC Act-listed fish species in the activity area and spill EMBA

The exact locations and timing of spawning and/or aggregations of fish and shark species are unknown, but the DPIRD provide an indication of species that may spawn within the North Coast bioregion, which includes the JBG (DoF, 2013a) (Table 5.7).

Table 5.7 Peak spawning/aggregation times for key commercial fish species in the North Coast Bioregion

Common name	Species name	Spawning / Aggregation times
Blacktip shark	*Carcharhinus tilstoni & C.limbatus*	November – December
Goldband snapper	*Pristipomoides multidens*	January – April
Pink snapper	*Pagrus auratus*	May – July
Rankin cod	*Epinephelus multiinotatus*	August – October
Red emperor	*Lutjanus sebae*	October, January, March
Sandbar shark	*Carcharhinus plumbeus*	October – January
Spanish mackerel	*Scomberomorus commerson*	August – November

Great white shark (EPBC Act: Vulnerable, Listed migratory)

The great white shark (*Carcharodon carcharias*) is widely distributed and located throughout temperate and sub-tropical waters with their known range in Australian waters including all coastal areas except the NT (DAWE, 2021b). Studies of the great white shark indicates that they appear to be largely transient, with a few longer-term residents; however, individuals are known to return to feeding grounds on a seasonal basis (Klimey and Anderson, 1996). Observations of adult white sharks are more frequent around fur-seal and sea lion colonies whilst juveniles are known to congregate in certain key areas.

There are no biologically important aggregation, breeding or foraging areas intersected by the activity area or spill EMBA; however, it is likely that individuals may transit through the spill EMBA.

Shortfin mako shark (EPBC Act: Listed migratory)

The shortfin mako (*Isurus oxyrinchus*) is a pelagic species with a circumglobal, wide ranging oceanic distribution in tropical and temperate seas (Mollet *et al*., 2000). It is widespread in Australian waters, recorded in offshore waters all around the continent's coastline with exception of the Arafura Sea, the Gulf of Carpentaria and Torres Strait (DAWE, 2021b). Shortfin makos are also highly migratory and travel large distances (DAWE, 2021b).

Due to their widespread distribution in Australian waters, their presence in the activity area and spill EMBA is likely to be limited to transiting individuals.

Longfin mako shark (EPBC Act: Listed migratory)

The longfin mako is widely distributed; however, it is rarely encountered and can be found along the WA coastline as a far south as Geraldton (Last and Stevens, 2009). There is limited research into the species within Australian waters; however, Sepulveda et al (2004) recorded southern Californian juveniles favoured surface waters, while larger adults were frequently observed at depths of up to 250 m. Whilst assumed to be a deep-dwelling shark, sightings on the ocean surface, and the species' diet, suggest a greater depth range (Reardon *et al*., 2006).

Though there is limited information about the longfin mako, their presence in the activity area and spill EMBA is likely to be limited to transiting individuals.

Whale shark (EPBC Act: Vulnerable, listed migratory)

The whale shark (*Rhincodon typus*) is a filter-feeding shark and is the largest known species of fish in the world (DAWE, 2021b). It is considered to be an oceanic and coastal species, commonly seen far offshore but also closer inshore near coral atolls (DAWE, 2021b). Whale sharks generally prefer tropical to warm temperate waters where surface sea temperature ranges from 21° to 25 °C (DAWE, 2021b). In Australian waters the whale shark is commonly seen in waters off northern WA, NT and Queensland with only very occasional sightings off Victoria and South Australia (Last and Stevens, 1994). The movements of whale sharks are not well documented; however, they are known to seasonally aggregate (March and April) in shallow tropical waters off the North West Cape in WA (DAWE, 2021b).

Whale sharks may occur within the activity area and spill EMBA. A foraging BIA is intersected by the socio-economic EMBA (Figure 5.14) and hence, individuals may forage in the far western extent of the EMBA.

Northern river shark (EPBC Act: Endangered)

The northern river shark (*Glyphis garricki*) is an elasmobranch capable of living and moving between freshwater and seawater. The species utilises rivers, tidal sections of large tropical estuarine systems, macro tidal embayments, inshore and offshore marine habitats. The species is listed as endangered under the EPBC Act, based partly on its limited geographic distribution (TSSC, 2014a). Within Australia, the northern river shark is known to occur in WA and the NT, occupying both marine and freshwater environments including the JBG, Daly River, Adelaide River and the South and East Alligator Rivers (TSSC, 2014a) (Figure 5.15). Whilst northern river sharks have been observed well offshore, the extent to which this occurs is unknown (TSSC, 2014a).

Individuals may be present within the activity area or nearshore areas of the spill EMBA.

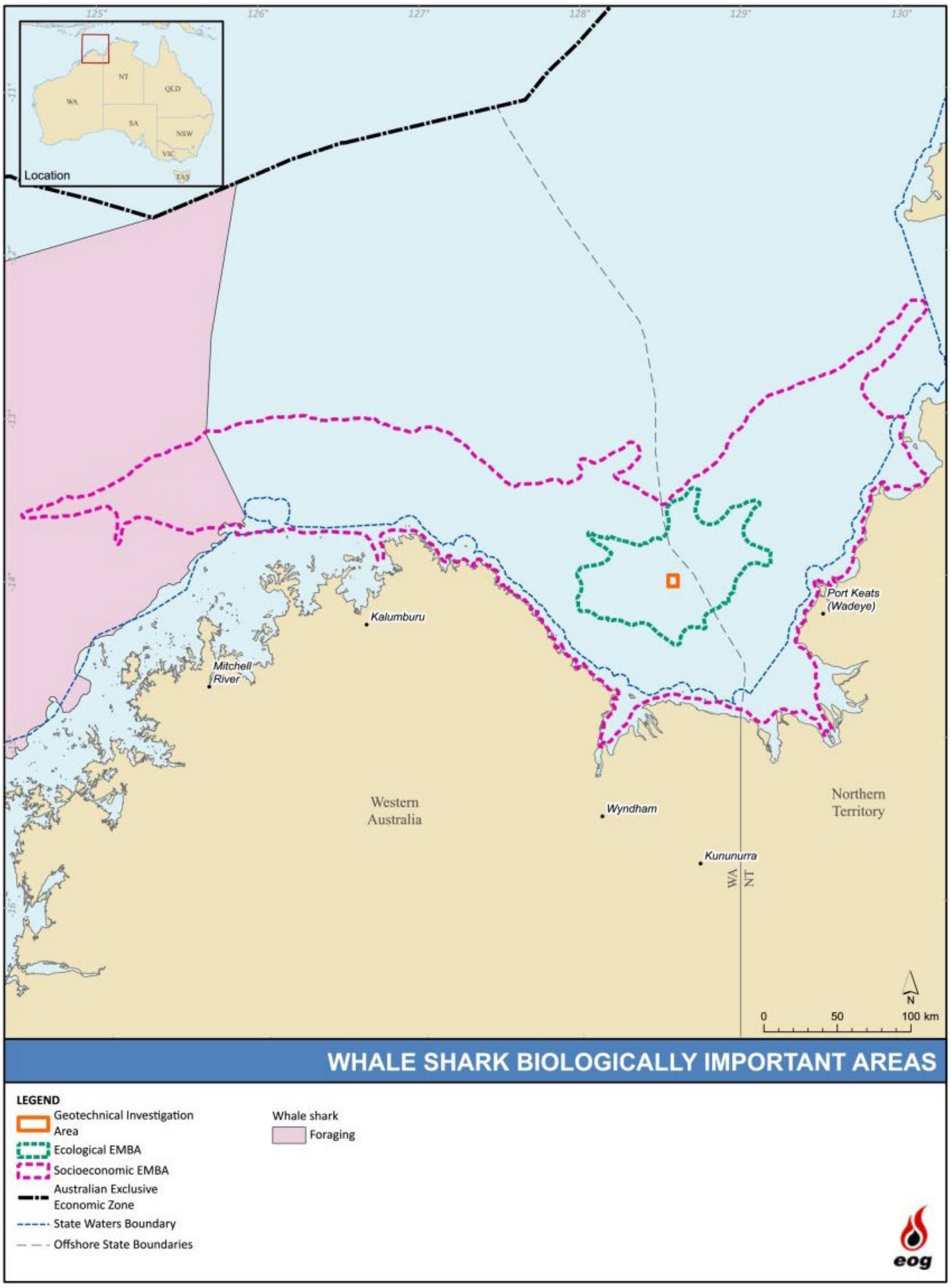


Figure 5.14 Whale shark BIA intersected by the spill EMBA

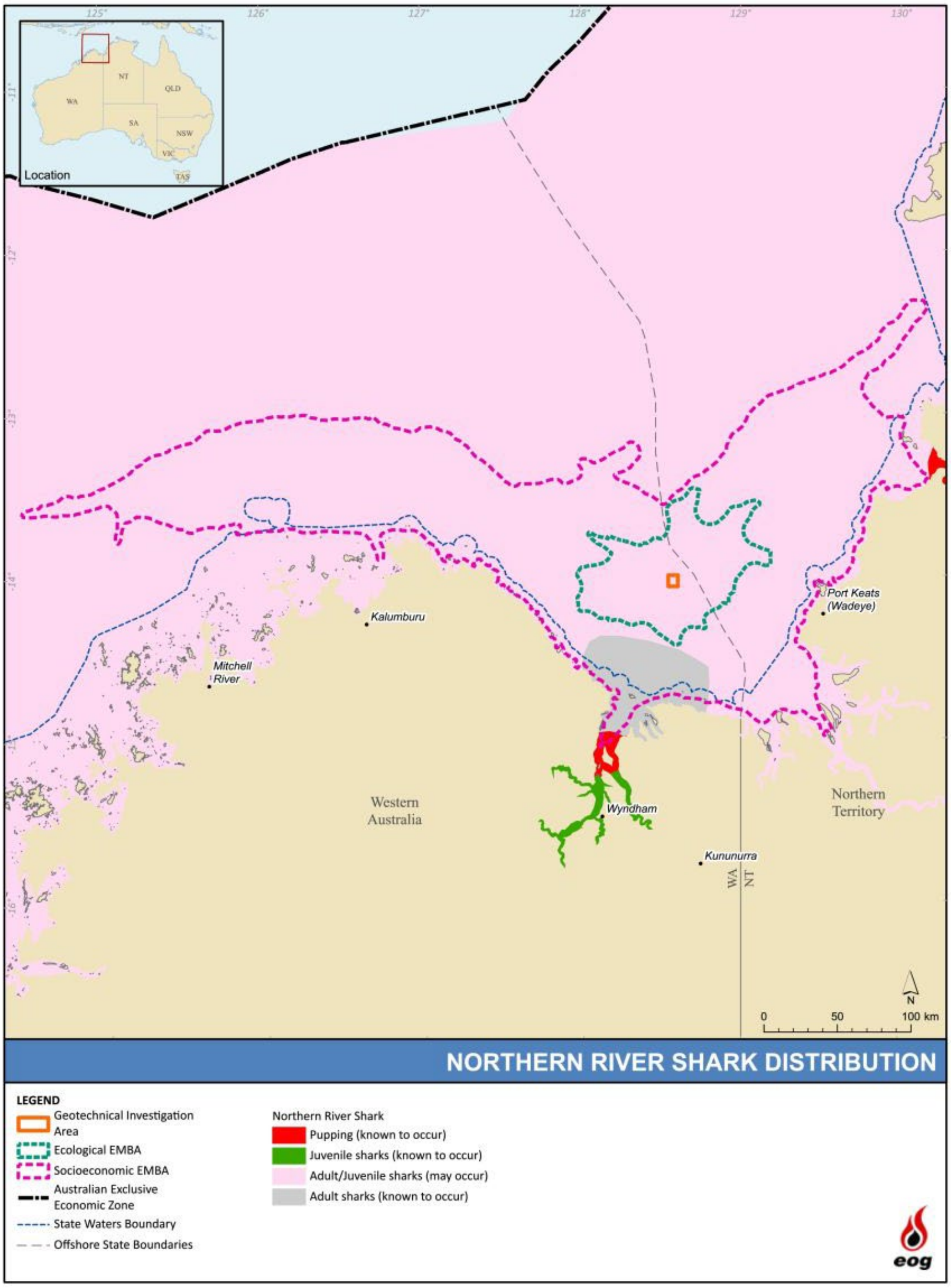


Figure 5.15 Northern river shark presence in the activity area and spill EMBA

Oceanic whitetip shark (EPBC Act: Listed migratory)

Within Australian waters, the oceanic whitetip shark (*Carcharhinus longimanus*) is found from Cape Leeuwin, WA, through parts of the NT and down the east coast of Queensland and New South Wales (NSW) to Sydney (Last and Stevens, 2009). It has not been recorded within the Gulf of Carpentaria or the Arafura Sea. The oceanic whitetip shark is a circumglobal deep-water pelagic species inhabiting tropical to warm-temperate waters (Compagno, 1984). Oceanic whitetip sharks prefer water temperatures above 20°C and can reach depths of >180 m (Castro *et al*., 1999).

Given the species distribution in deep offshore waters, the presence of the species within the activity area and EMBA is expected to be low.

Reef manta ray (EPBC Act: Listed migratory)

The reef manta ray (*Manta alfredi*) has a circum-global range in tropical and sub-tropical waters with sightings between waters off Perth, all along the northern coastline of Australia to the waters off the Solitary Islands, NSW (Marshall *et al*., 2011a). While this species tends to inhabit nearshore environments, it is known to occurs in waters as deep as 300 m and has been sighted around offshore coral reefs, rocky reefs and seamounts. In addition, it makes seasonal migrations of several hundred kilometres (Marshall *et al*., 2011a).

Despite there being no known aggregation sites within close proximity to the EMBA, reef manta rays may be present in the activity area and EMBA as transiting individuals.

Giant manta ray (EPBC Act: Listed migratory)

The giant manta ray (*Manta birostris*) has a widespread distribution along the coast of Australia and is known to seasonally migrate between aggregation sites. The giant manta ray is commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts (Marshall *et al*., 2011b).

This species has also been recorded within the Oceanic Shoals Marine Park, which is located 143 km north of the activity area and outside the EMBA (Nichol *et al*., 2013). Despite there being no known aggregation sites within close proximity to the activity area, giant manta rays may be present in the activity area and EMBA as transiting individuals.

Narrow sawfish (EPBC Act: Listed migratory)

The narrow sawfish lives in coastal and estuarine habitats across northern Australia and is generally restricted to shallow waters (less than 40 m) (D'Anastasi *et al*., 2013). The species is known to occur in the Gulf of Carpentaria but its distribution and migration is largely unknown. The narrow sawfish has the potential to occur within the activity area and spill EMBA because it has been caught as bycatch by the NPF in these areas (Tonks *et al*., 2008).

Dwarf sawfish (EPBC Act: Vulnerable, Listed migratory)

The dwarf sawfish (*Pristis clavata*) usually inhabits shallow (2–3 m deep) coastal waters and estuarine habitats. Its distribution is considered to extend north from Cairns around the Cape York Peninsula in Queensland, across northern Australian waters to the Pilbara coast in WA (DAWE, 2021b). The dwarf sawfish uses its rostrum to stun schooling fish by sideswiping or threshing while swimming through a school. The main prey species is popeye mullet (*Rhinomugil nasutus*). The main threats to dwarf sawfish are habitat loss and entanglement in fishing nets.

Adult dwarf sawfish are known to occur in the activity area and the nearshore areas of the spill EMBA (Figure 5.16).

Largetooth sawfish (EPBC Act: Vulnerable, Listed migratory)

Largetooth sawfish (*Pristis pristis*) utilise both freshwater (juvenile) and marine (adult) environments during the different stages of its lifecycle (TSSC, 2014b). Within Australia, largetooth sawfish have been recorded in numerous drainage systems across northern WA, NT and northern Queensland (TSSC, 2014b). The freshwater sawfish feeds on fishes and benthic invertebrates. The saw is used to stun schooling fish, such as mullet, and for extracting molluscs and small crustaceans from the benthic sediment.

The activity area and the spill EMBA overlap areas where adult largetooth sawfish are known to occur (Figure 5.17).

Green sawfish (EPBC Act: Vulnerable, Listed migratory)

The green sawfish (*Pristis zijsron*) occurs in both inshore and offshore marine coastal waters of northern Australia. Its current known distribution stretches from Broome, WA around northern Australia and down the east coast as far as Jervis Bay, NSW (DAWE, 2021b). The main threats to green sawfish are habitat loss and entanglement in fishing nets. The EMBA overlaps areas where both adult and juvenile sawfish are known to occur and is adjacent to the inner waters of the southern JBG where pupping of this species is likely to occur (Figure 5.18). It has also been caught as bycatch from the NPF in the area overlapped by the activity area and spill EMBA and therefore is likely to be present in both (Tonks *et al*., 2008).

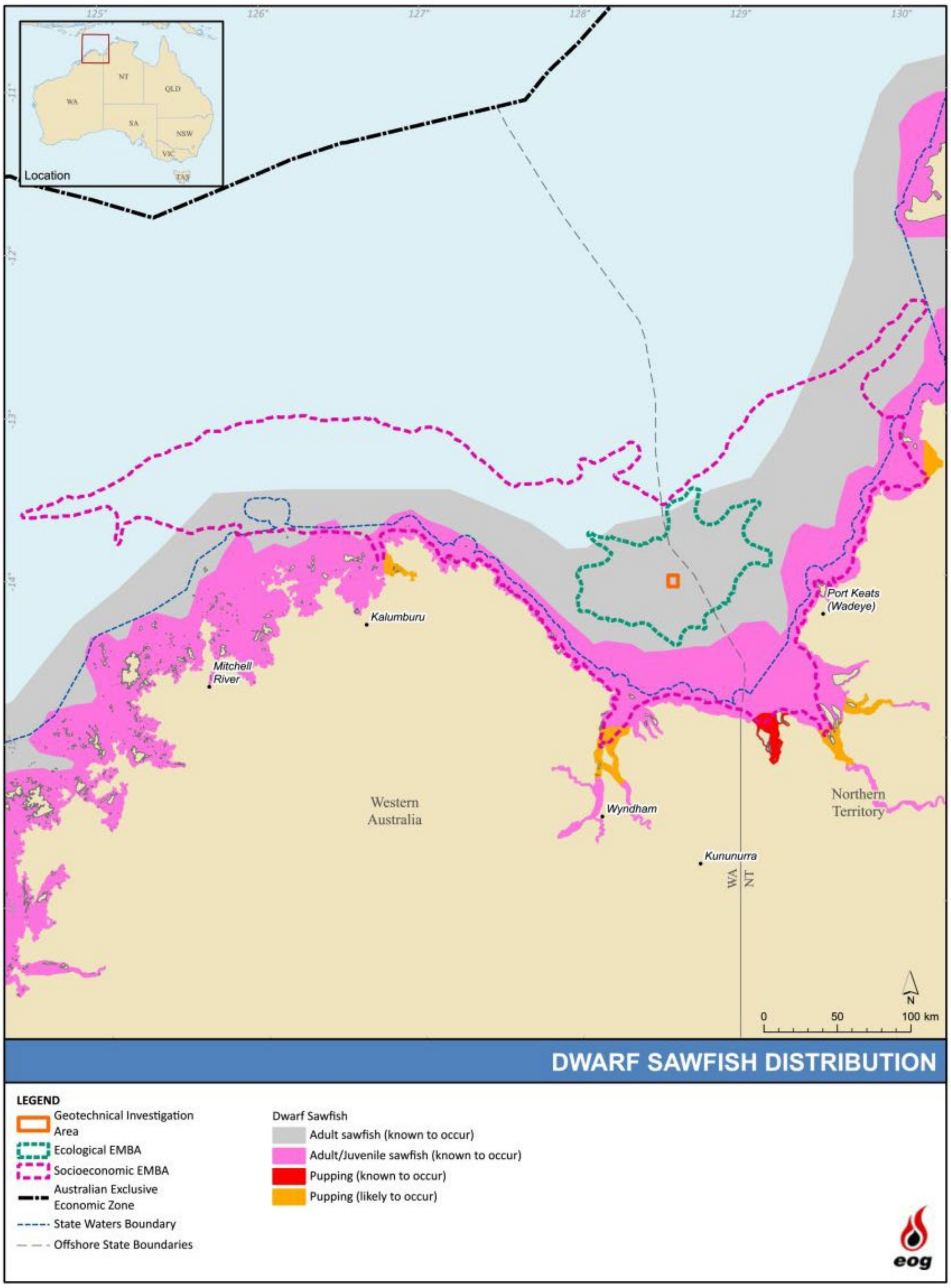


Figure 5.16 Dwarf sawfish presence in the activity area and spill EMBA

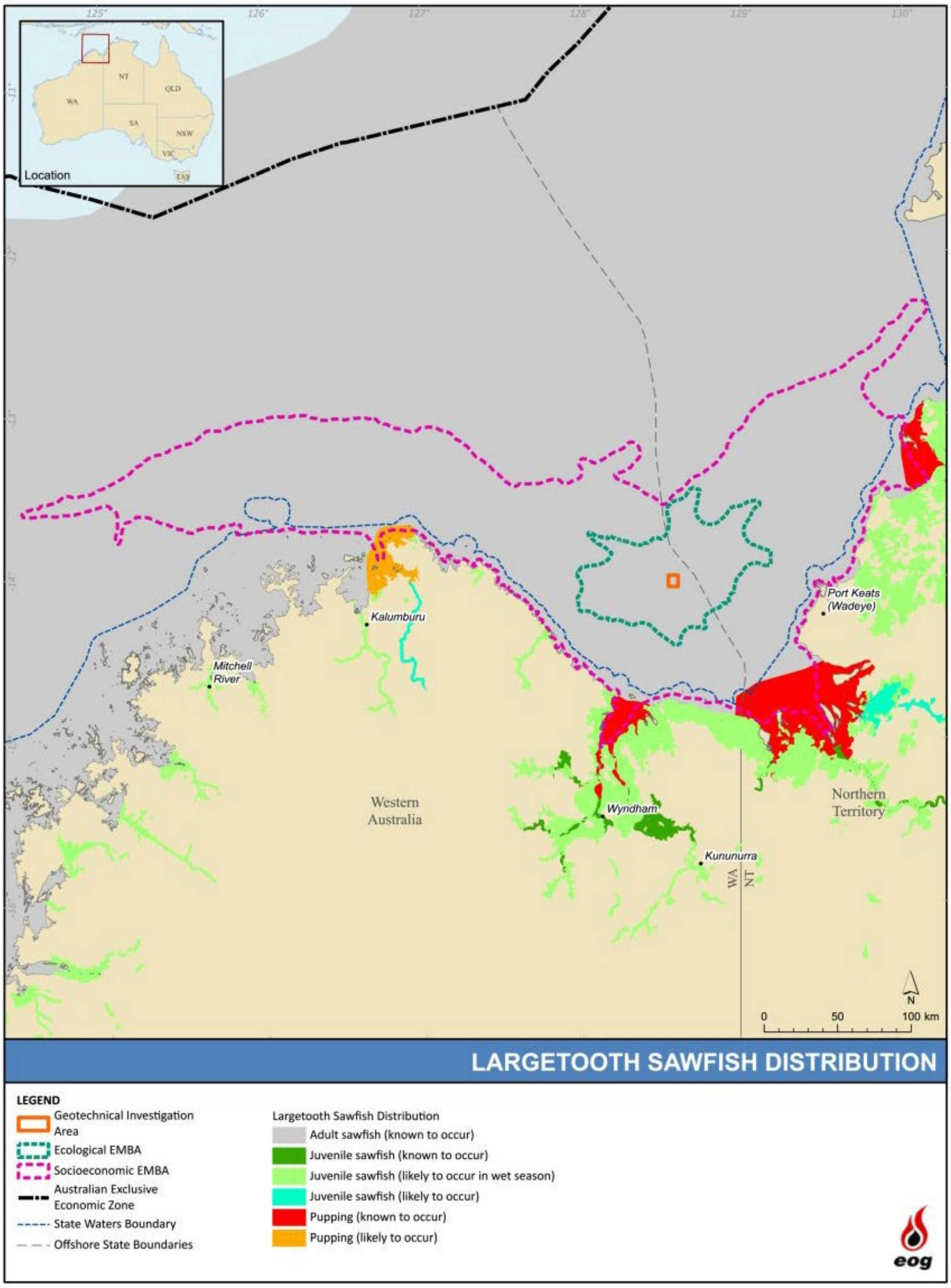


Figure 5.17 Largetooth sawfish presence in the activity area and spill EMBA

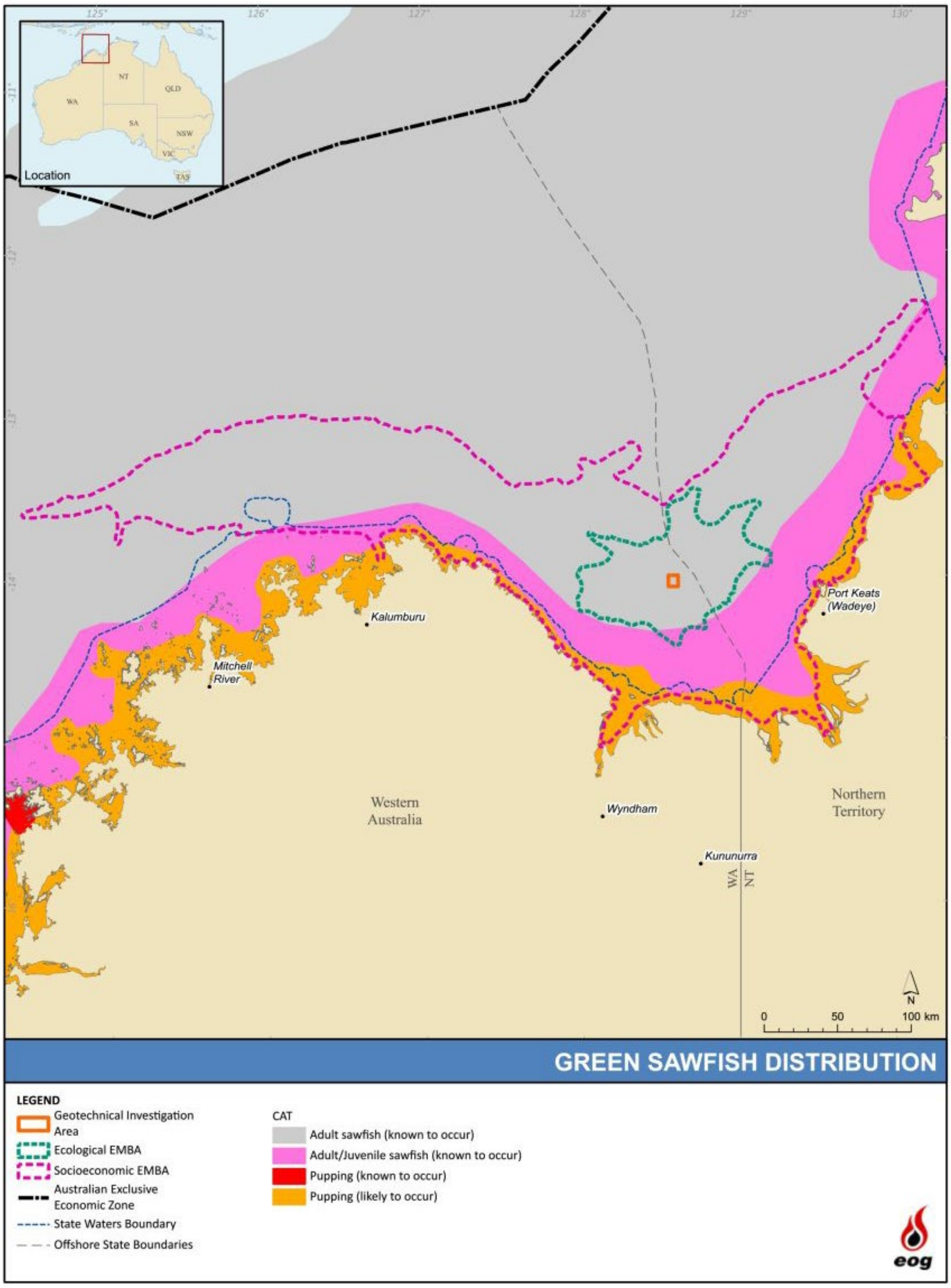


Figure 5.18 Green sawfish presence in the activity area and spill EMBA

Sygnathids (EPBC Act: Listed marine species, FFG Act: Not listed)

All of the listed marine fish species identified in the EPBC Act PMST are sygnathiformes, which includes seahorses, seadragon, pipehorse and pipefish. The majority of these fish species are associated with seagrass meadows, macroalgal seabed habitats, reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep. They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as *Sargassum*. It is unlikely that sygnathid species in the deeper waters of the activity area though they are likely to occur in the inshore areas of the spill EMBA.

The PMST species profile and threats profiles indicate that the sygnathiforme species listed for the EMBA are widely distributed throughout northern and north-western Australian waters. The diverse range of ecological niches afforded by reef sites would be expected to provide suitable habitat for these listed species. The likely absence of reef and seagrass habitat within the activity area would suggest the diversity and abundance of these species would be far less in the activity area.

5.3.5 Marine Mammals

The PMST search results for marine mammals which may reside within or migrate through the activity area and spill EMBA (**Appendix 4**) are presented in Table 5.8 and a description focused on threatened species follows. Figure 5.19 illustrates the likely temporal presence and absence of cetaceans in the activity area and EMBA. The species listed as threatened or migratory are described in this section.

Table 5.8 EPBC Act-listed cetaceans that may occur in the activity area and EMBA

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Whales										
Balaenoptera borealis	Sei whale	V	Yes	Yes	✓	✓	✓	No	No	CA
Balaenoptera edeni	Bryde’s whale	-	Yes	Yes	✓	✓	✓	No	No	-
Balaenoptera musculus	Blue whale	E	Yes	Yes	✓	✓	✓	No	No	CMP
Balaenoptera physalus	Fin whale	V	Yes	Yes	✓	✓	✓	No	No	CA
Kogia breviceps	Pygmy sperm whale	-	-	Yes	-	-	✓	No	No	-
Kogia simus	Dwarf Sperm Whale	-	-	Yes	-	-	✓	No	No	-
Megaptera novaeangliae	Humpback whale	-	Yes	Yes	✓	✓	✓	No	No	-
Physeter macrocephalus	Sperm whale	-	Yes	Yes	-	-	✓	No	No	-
Ziphius cavirostris	Cuvier’s beaked whale	-	-	Yes	-	-	✓	No	No	-
Dolphins										
Delphinus delphis	Common dolphin	-	-	Yes	✓	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Feresa attenuata	Pygmy killer whale	-	-	Yes	-	-	✓	No	No	-
Globicephala macrorhynchus	Short-finned pilot whale	-	-	Yes	-	-	✓	No	No	-
Grampus griseus	Risso's dolphin	-	-	Yes	✓	✓	✓	No	No	-
Orcaella brevirostris	Australian snubfin dolphin	-	Yes	Yes	-	-	✓	No	No	-
Orcinus orca	Killer whale	-	Yes	Yes	✓	✓	✓	No	No	-
Peponocephala electra	Melon-headed whale	-	-	Yes	-	-	✓	No	No	-
Pseudorca crassidens	False killer whale	-	-	Yes	✓	✓	✓	No	No	-
Sousa sahulensis	Australian humpback dolphin	-	Yes	Yes	✓	✓	✓	No	No	-
Stenella attenuata	Spotted dolphin	-	-	Yes	✓	✓	✓	No	No	-
Stenella coeruleoalba	Striped dolphin	-	-	Yes	-	-	✓	No	No	-
Stenella longirostris	Long-snouted spinner dolphin	-	-	Yes	-	-	✓	No	No	-
Steno bredanensis	Rough-toothed dolphin	-	-	Yes	-	-	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Tursiops aduncus	Indian Ocean bottlenose dolphin	-	-	Yes	✓	✓	✓	No	No	-
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	-	Yes	Yes	✓	✓	✓	No		-
Tursiops truncatus	Bottlenose dolphin	-	-	Yes	✓	✓	✓	No	No	-
Dugong										
Dugong dugon	Dugong	-	Yes	Yes	✓	✓	✓	No	No	-

Same key as per Table 5.6.

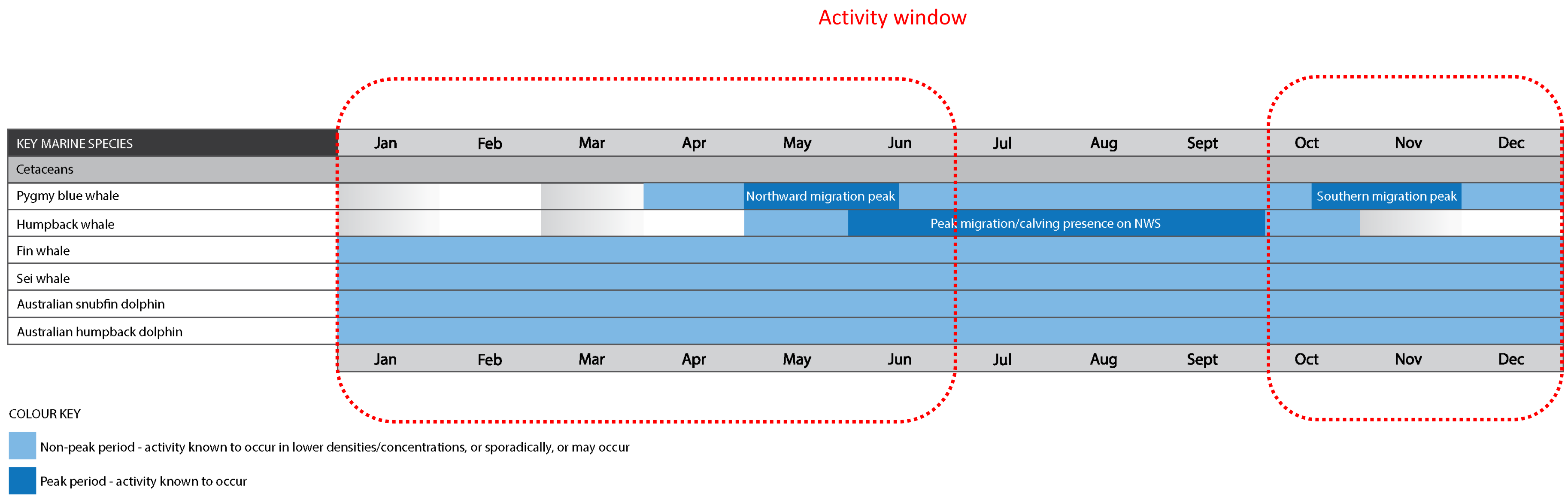


Figure 5.19 Likely temporal presence and absence of EPBC Act-listed cetacean species in the activity area and EMBA

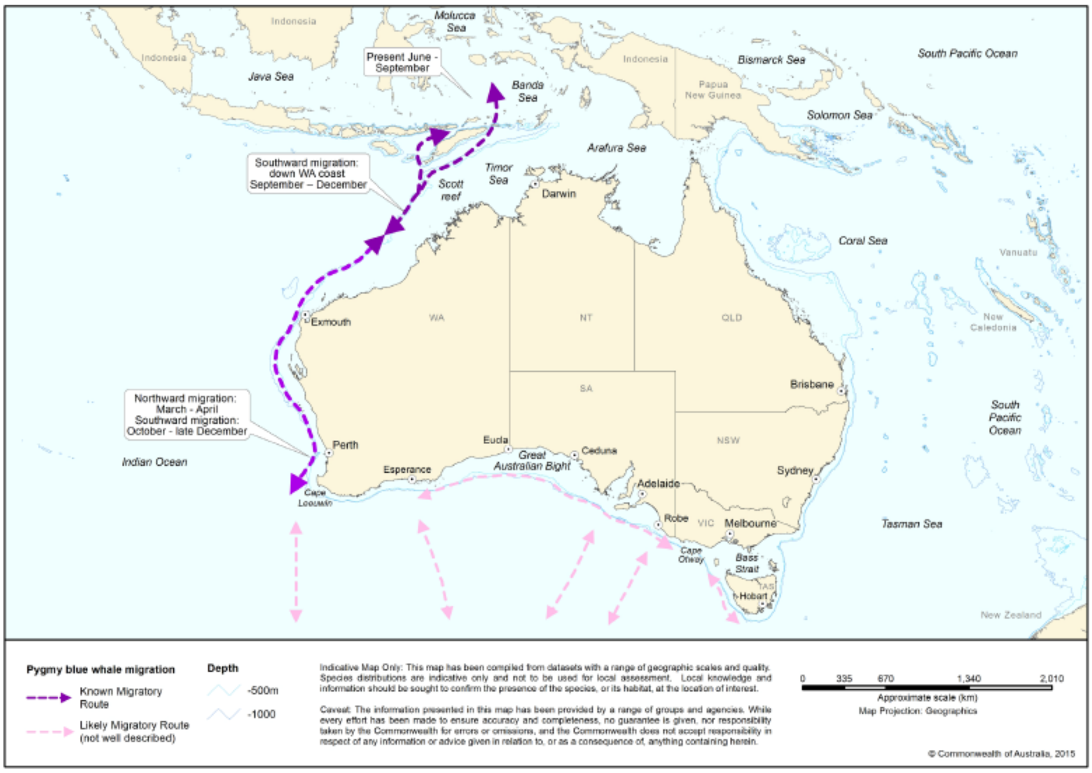
Pygmy blue whale (EPBC Act: Endangered, Listed migratory)

Blue whales (*Balaenoptera musculus*) are the largest living animals, growing to a length of over 30 m and weighing up to 180 tonnes (DoE, 2015a). In Australia, there are two recognised sub-species of blue whale; the Antarctic blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*B. m. brevicauda*).

Blue whales have a worldwide distribution but tend to move between warm water (low latitudes) for breeding and cold water (high latitudes) for feeding. Pygmy blue whales are thought to migrate from Australian feeding areas to breeding grounds that include Indonesia (based on sightings in Indonesia in the austral winter), while Antarctic blue whale winter migratory destinations include lower latitudes of the Pacific and Indian Oceans (DoE, 2015a). Thus, the pygmy blue whale is more likely to be encountered in tropical waters and hence the information provided herein is based on the pygmy blue whale.

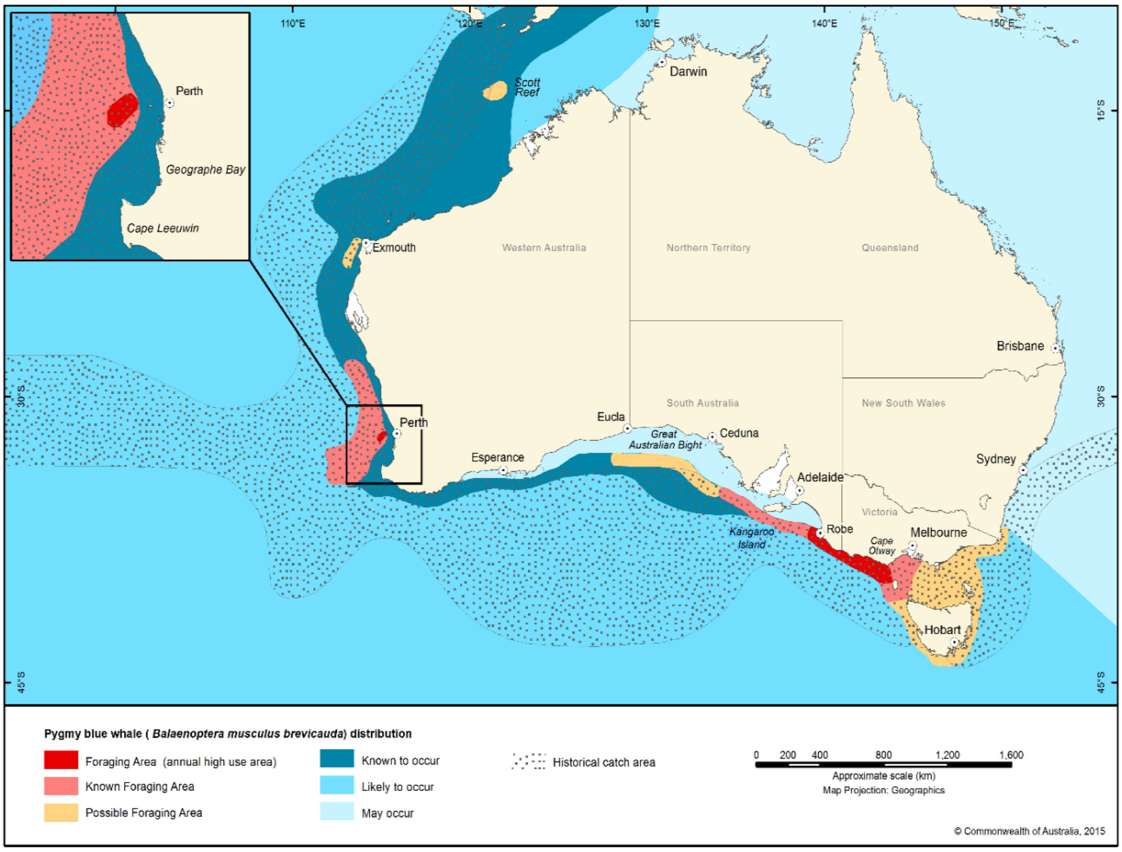
Tracking of pygmy blue whales identified that they migrate north from the Perth Canyon (known feeding area) in March/April reaching Indonesia by June where they remain until at least September (DoE, 2015a). Southern migration from Indonesia may occur from September and finish by December after which the animals may make their way slowly northwards towards the Perth Canyon by March/April (Double *et al*., 2014). Blue whale migration is thought to follow deep oceanic routes, and a tagging study by Double et al (2014) identified that the shallowest waters occupied was ~1,300 m. Figure 5.20 shows the distribution of pygmy blue whale around Australia. There is a foraging, migration and distribution BIA located off the Northwest Shelf (Figure 5.21), which is not intersected by the spill EMBA or the activity area.

Though there are no BIAs that are intersected by the activity area or EMBA, the activity area and EMBA are considered within the 'likely' distribution of the species and therefore pygmy blue whales may be present in the region (DoE, 2015a).



Source: DoE (2015a).

Figure 5.20 Pygmy blue whale migration routes



Source: DoE (2015a).

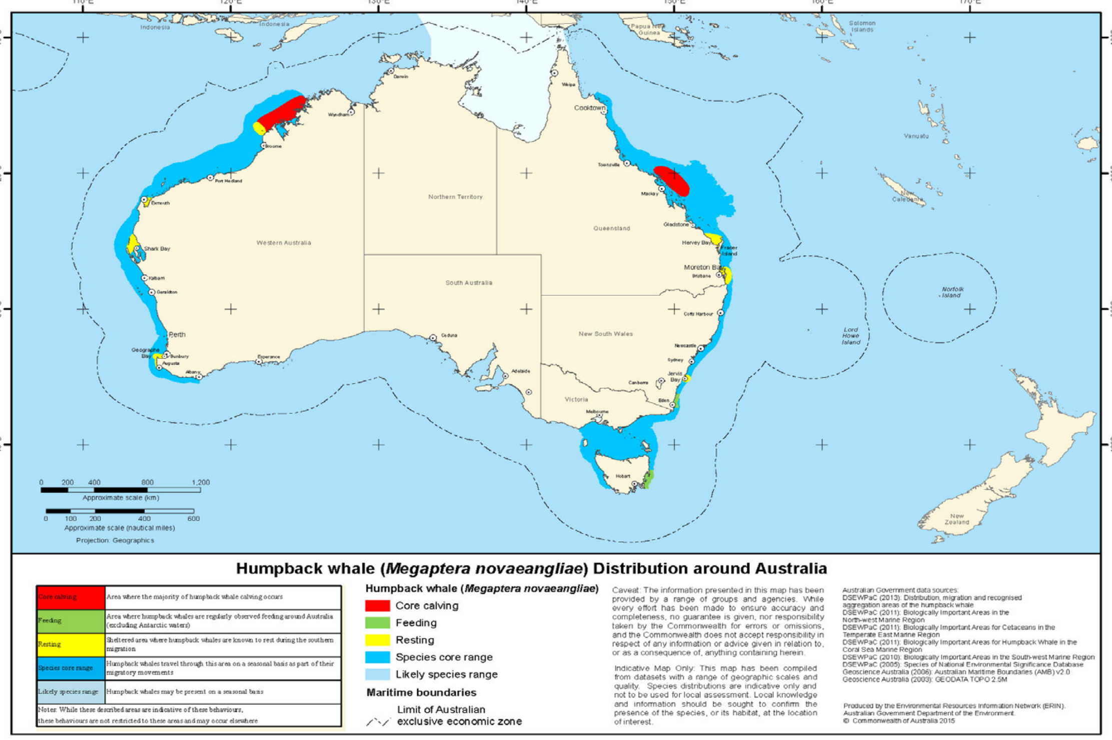
Figure 5.21 Pygmy blue whale BIAs

Humpback whale (EPBC Act: Listed migratory)

Humpback whales (*Megaptera novaeangliae*) in the southern hemisphere undertake an annual migration during the austral winter from Antarctic feeding areas to tropical calving grounds (DAWE, 2021b). Figure 5.22 shows the distribution of humpback whales around Australia.

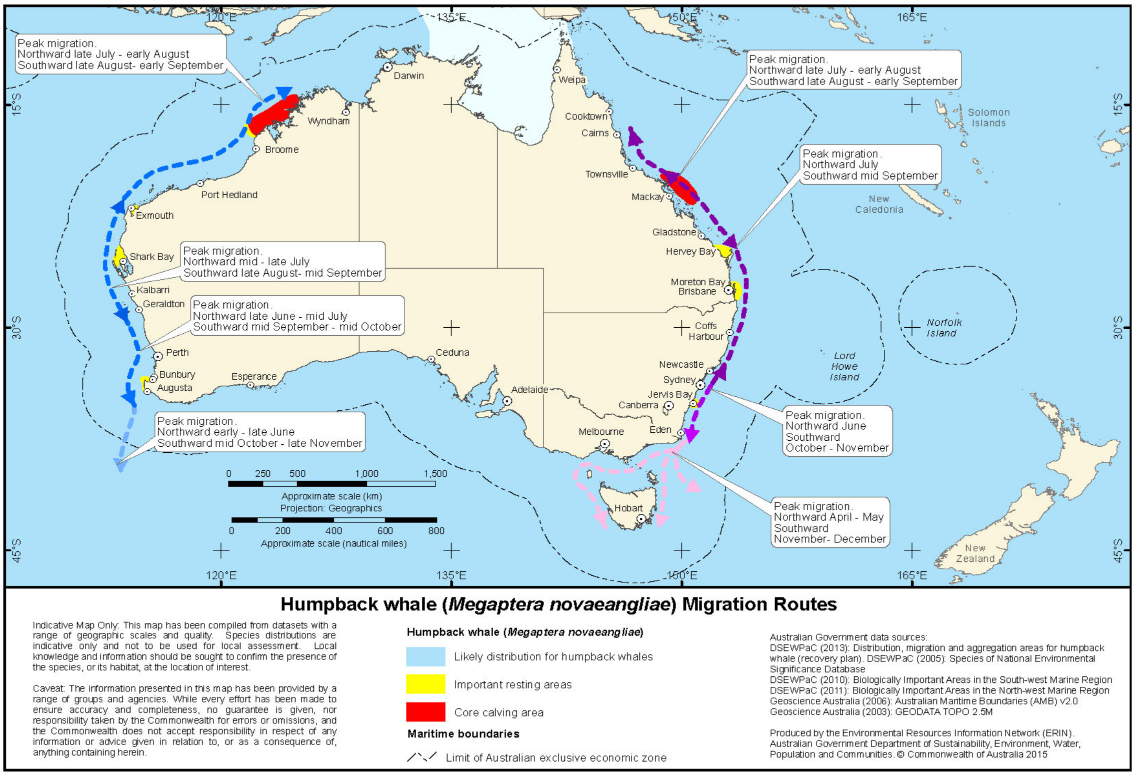
In the NWMR, humpback whales are known to have breeding and foraging grounds between Broome and the northern end of Camden Sound (460 km southwest of the activity area and over 195 km south from the closest extent of the EMBA), with the highest concentrations occurring between June and September (DEWHA, 2008b). Camden Sound appears to be the northern most limit for the majority of the west coast whales (Figure 5.23) (Jenner *et al*., 2001).

The breeding and calving BIA for humpbacks off the west Kimberley coastline extends as far as Bigge Island (107 km south of the EMBA). Therefore, humpback whales are unlikely to be present in the activity area though may be present in the spill EMBA during the period of peak presence in northwestern Australia (June – September).



Source: TSSC (2015a).

Figure 5.22 Distribution of the humpback whale around Australia



Source: TSSC (2015a).

Figure 5.23 Migration routes of humpback whales around Australia

Sei whale (EPBC Act: Vulnerable, Listed migratory)

Sei whales (*B. borealis*) are primarily found in deep water oceanic habitats and their distribution, abundance and latitudinal migrations are largely determined by seasonal feeding and breeding cycles (TSSC, 2015b).

Sei whale global population is estimated to have declined by 80% over the previous three generation period (TSSC, 2015b). Sei whales were the most commonly observed whales during Australian National Antarctic Research Expedition voyages in the 1960s and 1970s, with the majority recorded south of 60°S in the Southern Ocean (TSSC, 2015b).

These whales are thought to complete long annual seasonal migrations from subpolar summer feeding grounds to lower latitude winter breeding grounds (TSSC, 2015b); details of this migration and whether it involves the entire population are unknown. There are no defined foraging and feeding areas nor are there known mating or calving areas in Australian waters.

In the Australian region, sei whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, New South Wales, Queensland, the Great Australian Bight, NT and WA (TSSC, 2015b).

Based upon the species preference for deep offshore waters, and the small number of sei whale sightings in Australia, it is considered unlikely that this species occurs within the activity area or EMBA.

Fin whale (EPBC Act: Vulnerable, Listed migratory)

The fin whale (*B. physalus*) is the second largest whale species after the blue whale, growing up to 27 m long and weighing up to 70 tonnes (TSSC, 2015c). Fin whales are considered a cosmopolitan species and occur from polar to tropical waters, and rarely in inshore waters. The full extent of their distribution in Australian waters is uncertain but they occur within Commonwealth waters and have been recorded in most state waters and from Australian Antarctic Territory waters (TSSC, 2015c).

Fin whales are generally thought to undertake long annual migrations from higher latitude summer feeding grounds to lower latitude winter breeding grounds (TSSC, 2015c). It is likely they migrate in November - May between Australian waters and Antarctic feeding areas (the Southern Ocean), sub-Antarctic feeding areas (the Southern Subtropical Front) and tropical breeding areas (Indonesia, the northern Indian Ocean and south-west South Pacific Ocean waters) (TSSC, 2015c). Migration patterns are not well understood. It is thought the species may breed in deeper waters of the Indonesian Archipelago, using north western Australia as a migration route.

The conservation advice (TSSC, 2015c) identifies vessel strike and anthropogenic noise as threats to the species. Based on the fin whale preference for deep offshore waters, and the minimal sightings in the JBG, it is considered unlikely that this species occurs within the activity area or the spill EMBA.

Sperm whale (EPBC Act: Vulnerable, listed migratory)

Sperm whales (*Physeter macrocephalus*) are the largest of the toothed whales and are generally found in pods of up to 50 individuals (DAWE, 2021b). Sperm whales have a global distribution. They generally inhabit deeper oceanic waters, although they have been located closer to coastlines at depths of approximately 200 m.

The PMST indicates that the species is not predicted to occur within the activity area, but is known to occur within the EMBA. No BIAs for the species are recorded in the activity area or spill EMBA.

It is possible that sperm whales may transit through the activity area and spill EMBA, but they are not expected to be present in significant numbers.

Bryde's whale (EPBC Act: Listed migratory)

The Bryde's whale (*Balaenoptera edeni*) is restricted to tropical and temperate waters and has been recorded off all Australian states with exception of the NT (Bannister *et al.*, 1996). Bryde's whales can be found in both oceanic (500 to 1,000 m isobath) and inshore waters (<200 m isobath) (DAWE, 2021b). Population estimates are not available for Bryde's whales, globally or in Australia, and no migration patterns have been documented in Australian waters (DAWE, 2021b). Bryde's whale is considered to be a fairly opportunistic feeder and it appears that the coastal and offshore forms may be distinguished by their prey preferences, with the smaller coastal form feeding on schooling fishes, such as pilchard, anchovy, sardine, mackerel, herring and others. In contrast, the larger offshore form appears to feed on small crustaceans, such as euphausids, copepods, pelagic red crabs and cephalopods.

The PMST indicates that the species may occur within the activity area and the EMBA. There are no BIAs within the activity area or EMBA.

Omura's whale (EPBC Act: not listed)

Omura's whale (*Balaenoptera omurai*) may occur in and around the activity area and EMBA but is not listed under the EPBC Act. It is understood that DAWE is considering listing this species and as such, it is described briefly here. It is listed under the IUCN Red list as 'data deficient.'

Omura's whale was first described in 2003 and is morphologically similar to but genetically distinct from the Bryde's and sei whales (Cerchio *et al.*, 2019). This species is widely distributed in tropical and warm-temperate locations in all ocean basins except the central and eastern Pacific Ocean. Field research indicates Omura's whale has a strong preference for shallow water, on-shelf habitat, with only short ventures into adjacent deep waters (Cerchio *et al.*, 2019).

Cerchio et al (2019) report that there have been several accounts of Omura's whale along Australia's northwest coast, from Exmouth (WA) into the Timor Sea. McPherson et al (2016) recorded Omura's whale calls around the Barossa and Caldita gas fields (460-490 km northeast of the activity area) in 2014-15 as part of the monitoring undertaken for ConocoPhillips Australia's Barossa Development proposal. The calls were primarily observed from May to August, with no detection of the species' calls from November to late December.

Given the limited information available for this species, it is assumed that it may migrate through the operational area.

Killer whale (EPBC Act: Listed migratory)

The killer whale (*Orcinus orca*) (the largest member of the dolphin family) is thought to be the most cosmopolitan of all cetaceans and appear to be more common in cold, deep waters, though they have often been observed along the continental slope and shelf particularly near seal colonies (Bannister *et al.*, 1996). The killer whale is widely distributed from polar to equatorial regions and has been recorded in all Australian waters with concentrations around Tasmania. The only recognised key locality in Australia is Macquarie Island and Heard Island in the Southern Ocean (outside the EMBA) (Bannister *et al.*, 1996).

The habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters (DAWE, 2021b). The breeding season is variable, and the species moves seasonally to areas of food supply (Bannister *et al.*, 1996; Morrice *et al*., 2004). The activity area and EMBA are unlikely to represent important habitat for this species. Therefore, killer whales are unlikely to be present in the activity area or EMBA.

Australian humpback dolphin (EPBC Act: Listed migratory)

Australian humpback dolphins (*Sousa sahulensis*) are found primarily in coastal waters and feed mainly on fish associated with coastal-estuarine waters (DAWE, 2021b). In Queensland and the NT, Australian humpback dolphins are mainly found in water less than 20 km from the nearest river mouth, and in water less than 15–20 m deep (DAWE, 2021b). They are generally found in river mouths, mangroves, seagrass beds, tidal channels and inshore reefs. They are known to have resident groups that forage, feed, breed and calve in state and territory waters. Calves may be born throughout the year, but peaks in summer and spring have been reported.

The PMST indicates that the species is not predicted to occur within the activity area, but is known to occur within the EMBA. The coastal area of the socio-economic EMBA comes within 10 km of intersecting the significant habitat BIA for this species but does not overlap (Figure 5.24). Therefore, the species is unlikely to be present in the activity area and likely to be present in the western extent of the spill EMBA.

Australian snubfin dolphin (EPBC Act: Listed migratory)

Australian snubfin dolphins (*Orcaella brevirostris*) occur mostly in protected shallow waters close to the coast, and close to river and creek mouths, including the shallow coastal waters and estuaries along the Kimberley coast and Cambridge Gulf (DAWE, 2021b). Within Australian waters, Australian snubfin dolphins have been recorded almost exclusively in coastal and estuarine waters (DAWE, 2021b). All available data on the distribution and habitat preferences of Australian snubfin dolphins indicate that they mainly occur in one location: shallow coastal and estuarine waters of Queensland, NT and northern WA (DAWE, 2021b). Australian snubfin dolphins share similar habitat preference with Australian humpback dolphins, with these two species potentially occurring in the same area through most of their Australian range (DAWE, 2021b).

Feeding primarily occurs in shallow waters (less than 20 m) close to river mouths and creeks (DAWE, 2021b). This includes a variety of habitats, from mangroves to sandy bottom estuaries and embayments, to rock and/or coral reefs. Prey for this species includes fish of the families Engraulidae, Clupeidae, Chirocentridae, Anguillidae, Hemirhampidae, Leiognathidae, Apogonidae, Pomadasydae, Terapontidae and Sillaginidae, typically associated with shallow coastal waters and estuaries in tropical regions (DAWE, 2021b).

Off the WA Kimberley coast, the development of infrastructure, mostly associated with the petroleum industry and iron ore activities, and seismic surveys and petroleum explorations are of concern and are suspected to have an impact at the local level at all affected sites. This threat to Australian snubfin dolphins is considered likely to continue into the future, with the potential to increase its impact as habitat degradation and loss increase with increased human population requirements (DAWE, 2021b).

The PMST indicates that the species is not predicted to occur within the activity area, but is known to occur within the EMBA. The EMBA overlaps with the resting, foraging, calving and breeding BIA for this species (Figure 5.25).

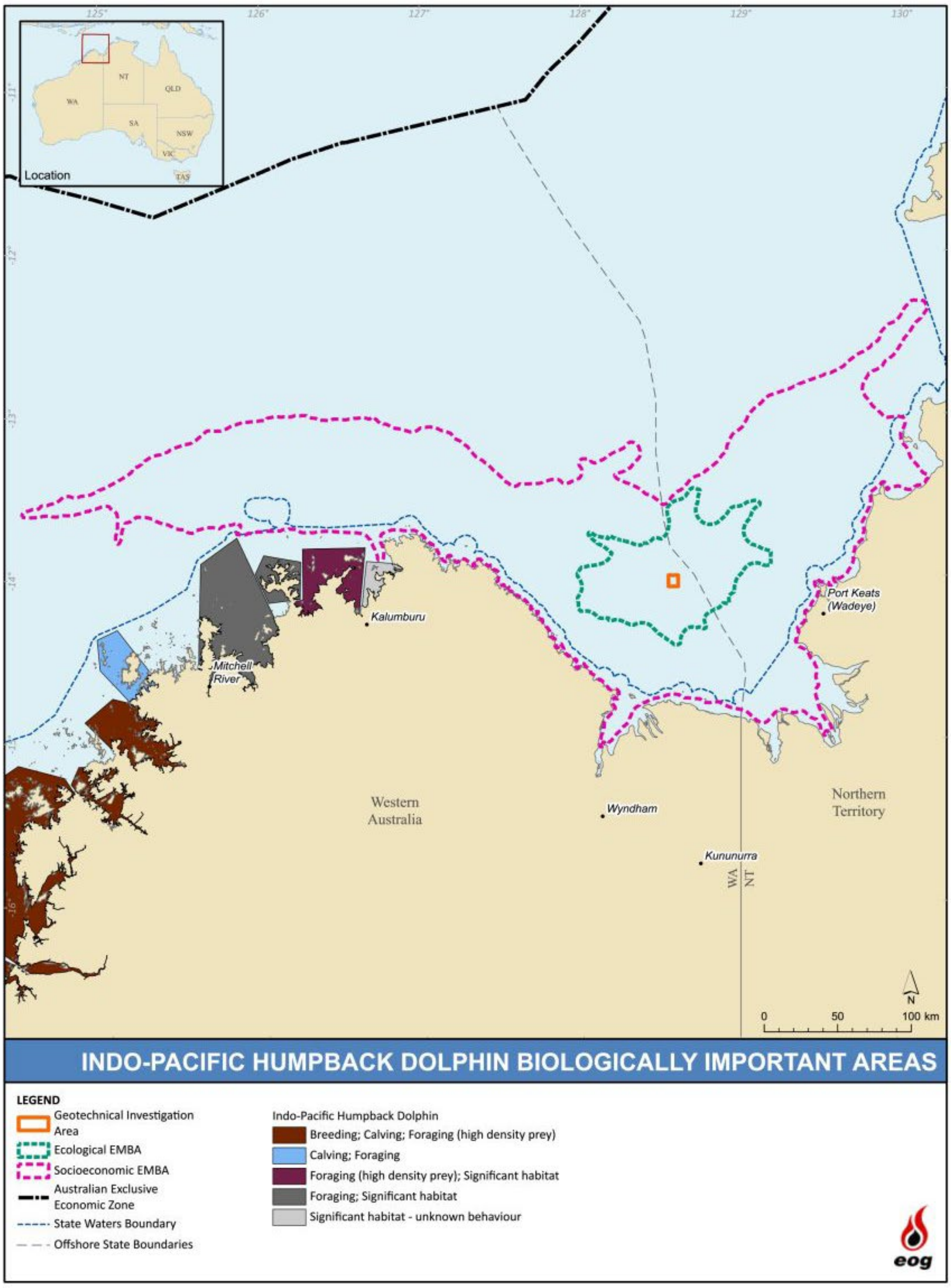


Figure 5.24 Australian humpback dolphin BIA intersected by the spill EMBA

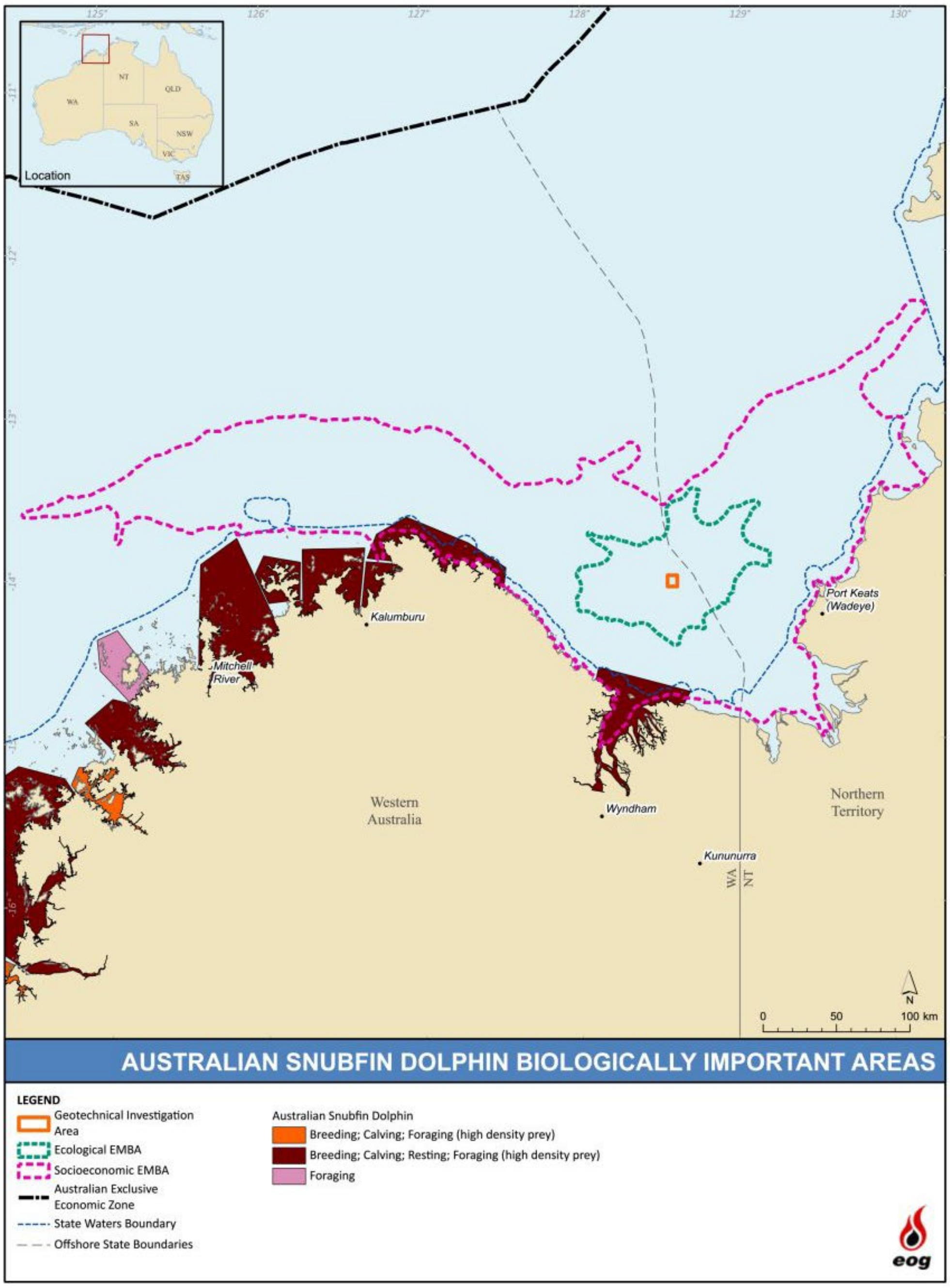


Figure 5.25 Australian snubfin dolphin BIA intersected by the spill EMBA

Dugong (EPBC Act: Listed marine, migratory)

Dugongs (*Dugong dugon*) inhabit protected shallow coastal areas, such as wide shallow bays and mangrove channels. They feed on seagrass, and major concentrations of dugongs tend to coincide with sizeable seagrass beds. Research undertaken in the NT, including aerial surveys, has focused on dugong populations in the Gulf of Carpentaria and in the northern parts of the NT, such as the Tiwi Islands and Coburg Peninsula. No surveys have been undertaken in the JBG, therefore little is known about the distribution of dugongs in the Gulf. However, as high turbidity in the JBG limits the development of seagrass beds, dugongs are not expected to be abundant (Woodside, 2004).

Though not abundant in the JBG, dugongs have been reported to occur along the coastline from Cape Hay (83 km east of the activity area) to Pearce Point (290 km northeast of the activity area), with the main populations concentrated around Dorcherty Island (80 km east of the activity area) (Woodside, 2004). Therefore, dugongs are unlikely to be present in the activity area but may be present in the nearshore areas of the spill EMBA.

5.3.6 Reptiles

The PMST search found six species of marine turtle are listed under the EPBC Act as potentially occurring in the EMBA, as listed in Table 5.9 (**Appendix 4**). Three of the turtle species are listed as endangered with the other three listed as vulnerable. Additionally, 22 species of sea snake were identified as potentially occurring in the EMBA (two of which are listed as critically endangered). Two species of crocodile were also identified.

Ecological stages and temporal occupation of the turtle species is presented in Figure 5.26.

Table 5.9 EPBC Act-listed marine reptiles that may occur in the activity area and EMBA

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Turtles										
Caretta caretta	Loggerhead turtle	E	Yes	Yes	✓	✓	✓	No	No	F
Chelonia mydas	Green turtle	V	Yes	Yes	✓	✓	✓	Yes	Yes	I, F
Dermochelys coriacea	Leatherback turtle	E	Yes	Yes	✓	✓	✓	No	No	-
Eretmochelys imbricate	Hawksbill turtle	V	Yes	Yes	✓	✓	✓	No	No	-
Lepidochelys olivacea	Olive ridley turtle	E	Yes	Yes	✓	✓	✓	Yes	Yes	I, F
Natator depressus	Flatback turtle	V	Yes	Yes	✓	✓	✓	Yes	Yes	I, F
Sea snakes										
Acalyptophis peronii	Horned sea snake	-	-	Yes	✓	✓	✓	No	No	-
Aipysurus apraefrontalis	Short-nosed sea snake	CE	-	Yes	-	-	✓	No	No	CA
Aipysurus duboisii	Dubois' sea snake	-	-	Yes	✓	✓	✓	No	No	-
Aipysurus eydouxii	Spine-tailed sea snake	-	-	Yes	✓	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Aipysurus foliosquama	Leaf-scaled sea snake	CE	-	Yes	✓	✓	✓	No	No	CA
Aipysurus laevis	Olive sea snake	-	-	Yes	✓	✓	✓	No	No	-
Astrotia stokesii	Stokes' sea snake	-	-	Yes	✓	✓	✓	No	No	-
Disteira kingii	Spectacled sea snake	-	-	Yes	✓	✓	✓	No	No	-
Disteira major	Olive-headed sea snake	-	-	Yes	✓	✓	✓	No	No	-
Emydocephalus annulatus	Turtle-headed sea snake	-	-	Yes	-	✓	✓	No	No	-
Enhydrina schistosa	Beaked sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrelaps darwiniensis	Black-ringed sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrophis atriceps	Black-headed sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrophis coggeri	Slender-necked sea snake	-	-	Yes	-	-	✓	No	No	-
Hydrophis elegans	Elegant sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrophis inornatus	Plain sea snake	-	-	Yes	-	✓	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Hydrophis mcdowelli	Small-headed sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrophis ornatus	Spotted sea snake	-	-	Yes	✓	✓	✓	No	No	-
Hydrophis pacificus	Large-headed sea snake	-	-	Yes	-	✓	✓	No	No	-
Lapemis hardwickii	Spine-bellied sea snake	-	-	Yes	✓	✓	✓	No	No	-
Parahydrophis mertoni	Northern mangrove sea snake	-	-	Yes	-	-	✓	No	No	-
Pelamis platurus	Yellow-bellied sea snake	-	-	Yes	✓	✓	✓	No	No	-
Crocodiles										
Crocodylus johnstoni	Freshwater crocodile	-	-	Yes	-	-	✓	No	No	-
Crocodylus porosus	Salt-water crocodile	-	Yes	Yes	✓	✓	✓	No	No	-

Same key as per Table 5.6.

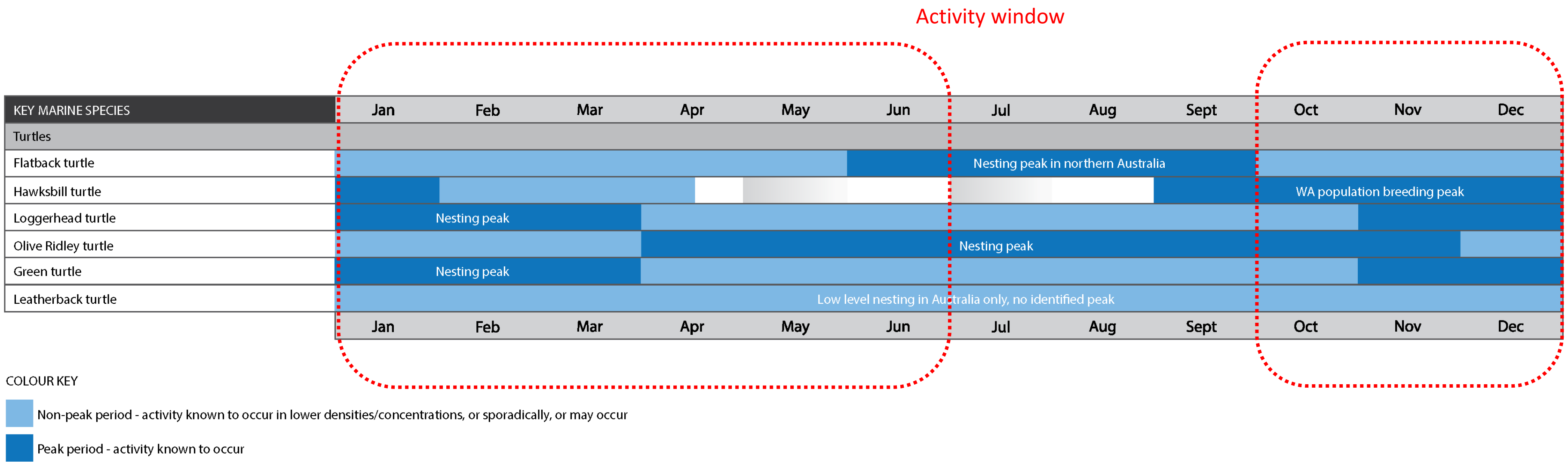


Figure 5.26 Likely temporal presence and absence of EPBC Act-listed turtle species in the activity area and EMBA

Loggerhead turtle (EPBC Act: Endangered, listed migratory)

The loggerhead turtle (*Caretta caretta*) has a global distribution throughout tropical, sub-tropical and temperate waters. In Australia, the loggerhead turtle occurs in waters of coral and rocky reefs, seagrass beds, and muddy bays throughout eastern, northern and western Australia (DAWE, 2021b).

While nesting is mainly concentrated on sub-tropical beaches in southern Queensland and from Shark Bay to the North West Cape in WA between November and March, foraging is more widespread. Loggerhead turtles show fidelity to both their foraging and breeding areas and can migrate over 2,600 km between the two (DAWE, 2021b). The WA stock forage from Shark Bay through to Arnhem Land, NT (DAWE, 2021b).

Juveniles feed on algae, pelagic crustaceans, molluscs and flotsam, whilst as an adult the species feeds on gastropod molluscs, clams, jellyfish, starfish, coral, crabs and fish (DAWE, 2021b). Loggerhead turtles are known to forage around the pinnacles of the Bonaparte Basin and the carbonate bank and terrace system of the Sahul Shelf KEFs. The foraging BIA for the loggerhead turtle is intersected by the socio-economic EMBA and is presented in Figure 5.27. Given the proximity of the foraging BIA to the activity area (~89.6 km north), it is likely that loggerhead turtles are present in the activity area and EMBA.

Green turtle (EPBC Act: Vulnerable, listed migratory)

Green turtles (*Chelonia mydas*) nest, forage and migrate across tropical northern Australia (DAWE, 2021b) and are commonly found foraging and nesting in the Gulf of Carpentaria (DSEWPaC, 2012). In WA, nesting is between November and March and green turtles can migrate over 2,600 km between their feeding and nesting grounds (DAWE, 2021b). The pinnacles of the Bonaparte Basin are thought to be a key ecological feature where green turtles move between foraging and nesting grounds (DSEWPaC, 2012). The species primarily forages in shallow benthic habitats (<10 m) such as tropical tidal and subtidal coral and rocky reef habitat or inshore seagrass beds, feeding on seagrass beds or algae mats (Hazel *et al*., 2009; DAWE, 2021b). Large feeding aggregations of green turtles are present at Ashmore Reef (located outside the EMBA) and is the only reef recorded on the Sahul Shelf, where such large numbers of green turtles gather to feed.

The NCVA identifies that the activity area and EMBA overlap with a foraging BIA for this species (Figure 5.28). As such, green turtles are likely to occur in the activity area and EMBA. The closest nesting and inter-nesting BIAs are located at Cassini Island 286 km west of the activity area and are not intersected by the EMBA. Within foraging areas, adult green turtles feed on seagrass, sponges and algae (DAWE, 2021b).

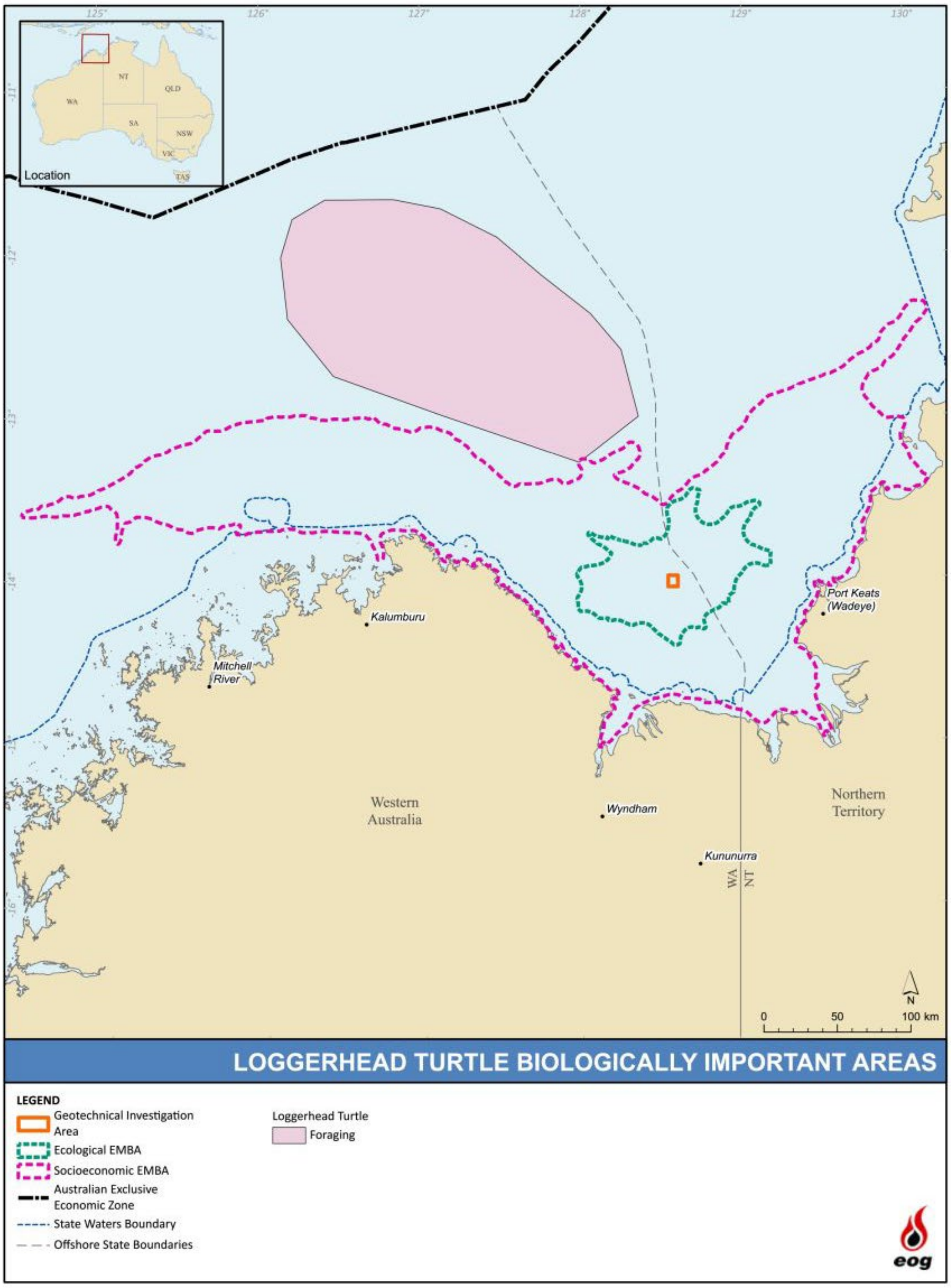


Figure 5.27 Loggerhead turtle BIA intersected by the spill EMBA

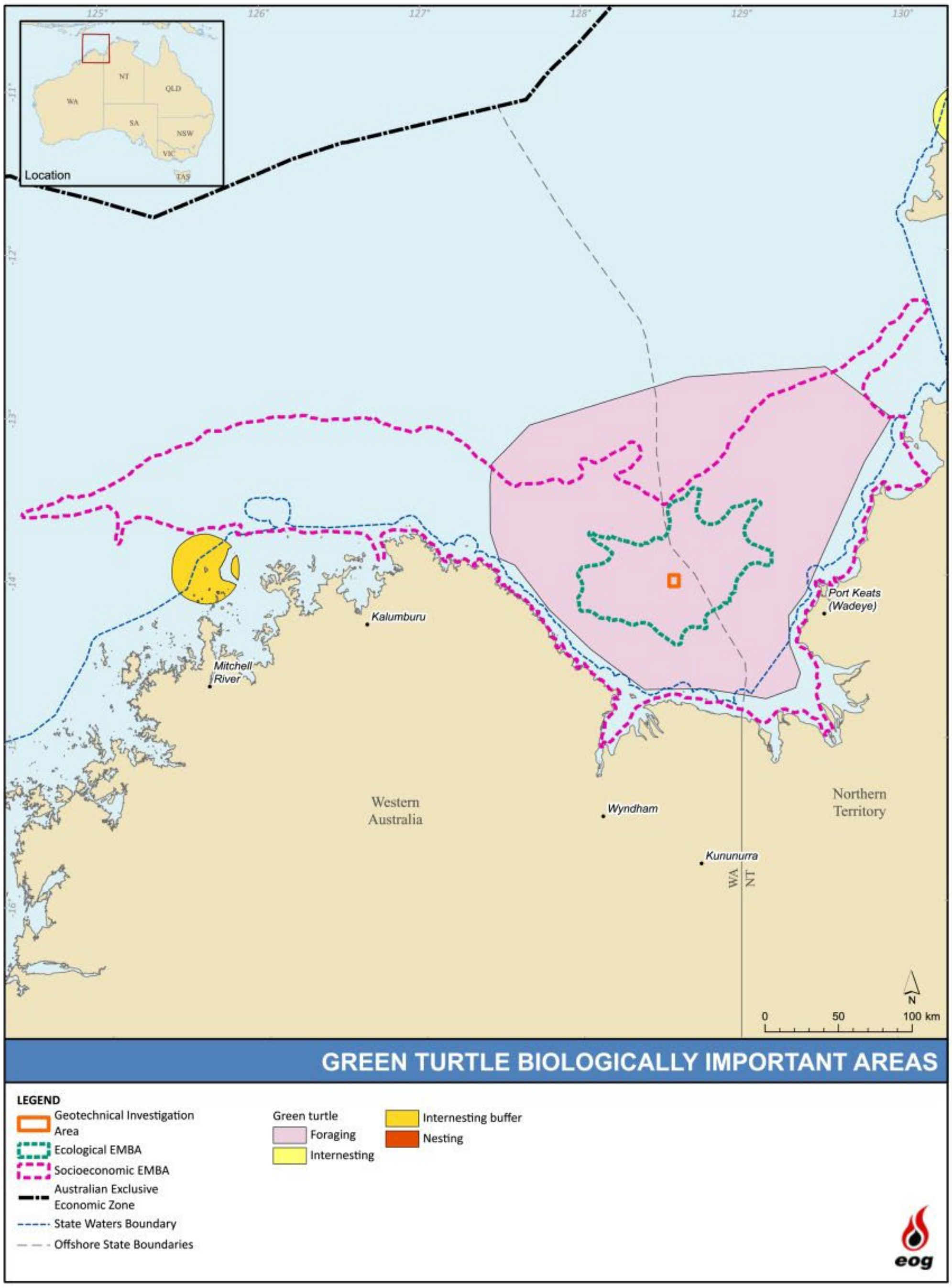


Figure 5.28 Green turtle BIA intersected by the activity area and spill EMBA

Flatback turtle (EPBC Act: Vulnerable, listed migratory)

The flatback turtle (*Natador depressus*) is only found in Australian waters and some nearby waters in Indonesia and Papua New Guinea. It is commonly found in the NWMR and NMR, nesting in northern Australia and foraging in the region.

Breeding occurs all year round; however, in northern Australia most nesting occurs between June and August (DAWE, 2021b). Flatback turtle nesting is widespread across the islands and mainland beaches east of Dampier Peninsula in winter, with Cape Domett (in Cambridge Gulf, 77 km south of the activity area) reported to support the highest density (Whiting *et al*., 2008). Flatback turtles nest at Cape Domett throughout the year. The Recovery Plan for Marine Turtles in Australia 2017

-2027 (DoEE, 2017c) notes that the peak nesting period at Cape Domett is July to September. The Cape Domett nesting population appears to be one of the largest known nesting populations of this species, with an estimated yearly population in the order of several thousand turtles (Whiting *et al*., 2008).

The 60 km inter-nesting buffer for flatback turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) is based primarily on the movements of tagged inter-nesting flatback turtles along the Northwest Shelf reported by Whittock et al (2014), which found that flatback turtles may demonstrate inter-nesting displacement distances up to 62 km from nesting beaches. However, these movements were confined to longshore movements in nearshore coastal waters or travel between island rookeries and the adjacent mainland (Whittock *et al*., 2014). There is no evidence to date to indicate flatback turtles move into deep offshore waters during the inter-nesting period. Flatback turtle hatchlings do not have an offshore pelagic phase. Instead, hatchlings grow to maturity in shallow coastal waters thought to be close to their natal beaches (DoEE, 2017c). Flatback turtle hatchlings do not undertake oceanic migrations like the juveniles of other turtle species do, but spend their juvenile life phase within continental shelf waters. The activity area intersects an extremely small area (1.68%) of the inter-nesting buffer BIA and the EMBA intersects the inter-nesting BIA, as illustrated in Figure 5.29.

Adult flatback turtles are primarily carnivorous, feeding on soft-bodied invertebrates. Juveniles eat gastropod molluscs, squid, siphonophores, and limited data indicate that cuttlefish, hydroids, soft corals, crinoids, molluscs and jellyfish are also eaten (DAWE, 2021b). The species has been recorded foraging in depths less than 10 m to over 40 m on the carbonate bank and terrace system of the Sahul Shelf KEF and around the pinnacles of the Bonaparte Basin KEF. The EMBA intersects a foraging BIA located in the Bonaparte Basin, as illustrated in Figure 5.29.

The NCVA identifies the area out to 60 km offshore from Cape Domett and Lacrosse Island in the Cambridge Gulf as an inter-nesting BIA for flatback turtles, which is intersected by the EMBA and part of the activity area. Hence, it is likely that flatback turtles will be present in the activity area and EMBA.

Olive Ridley turtle (EPBC Act: Endangered, listed migratory)

The olive ridley turtle (*Lepidochelys olivacea*) has a worldwide tropical and sub-tropical distribution and is known to occur in both WA and the NT (DSEWPC, 2012c). While nesting has been recorded in WA, it is far more common in the NT (DSEWPC, 2012).

Although olive ridley turtles nest all year round, nesting activity peaks around April to November, with the majority of nesting occurring from the Arnhem Land coast (including Bathurst Island, outside the EMBA) to the northwest coast of Cape York Peninsula (outside of the EMBA) (DSEWPC, 2012). After nesting, Olive Ridley turtles are known to migrate up to 1,050 km to various foraging areas (DAWE, 2021b), including the pinnacles of the Bonaparte Basin and the carbonate bank and terrace system of the Sahul Shelf KEF (DSEWPC, 2012).

The olive ridley turtle is known to primarily forage in soft-bottom habitats ranging in depths from 6 – 35 m, though they are also known to forage in pelagic waters (DEWHA 2008a). Adult turtles forage for crabs, shrimp, tunicates, jellyfish, salps and algae in depths ranging from several metres to over 100 m (DAWE, 2021b). The NCVA identifies that the activity area and EMBA overlap with a foraging BIA for this species (Figure 5.30); hence it is possible that individuals could be encountered in the activity area or EMBA, though nesting is unlikely to occur in the coastal sections of the EMBA.

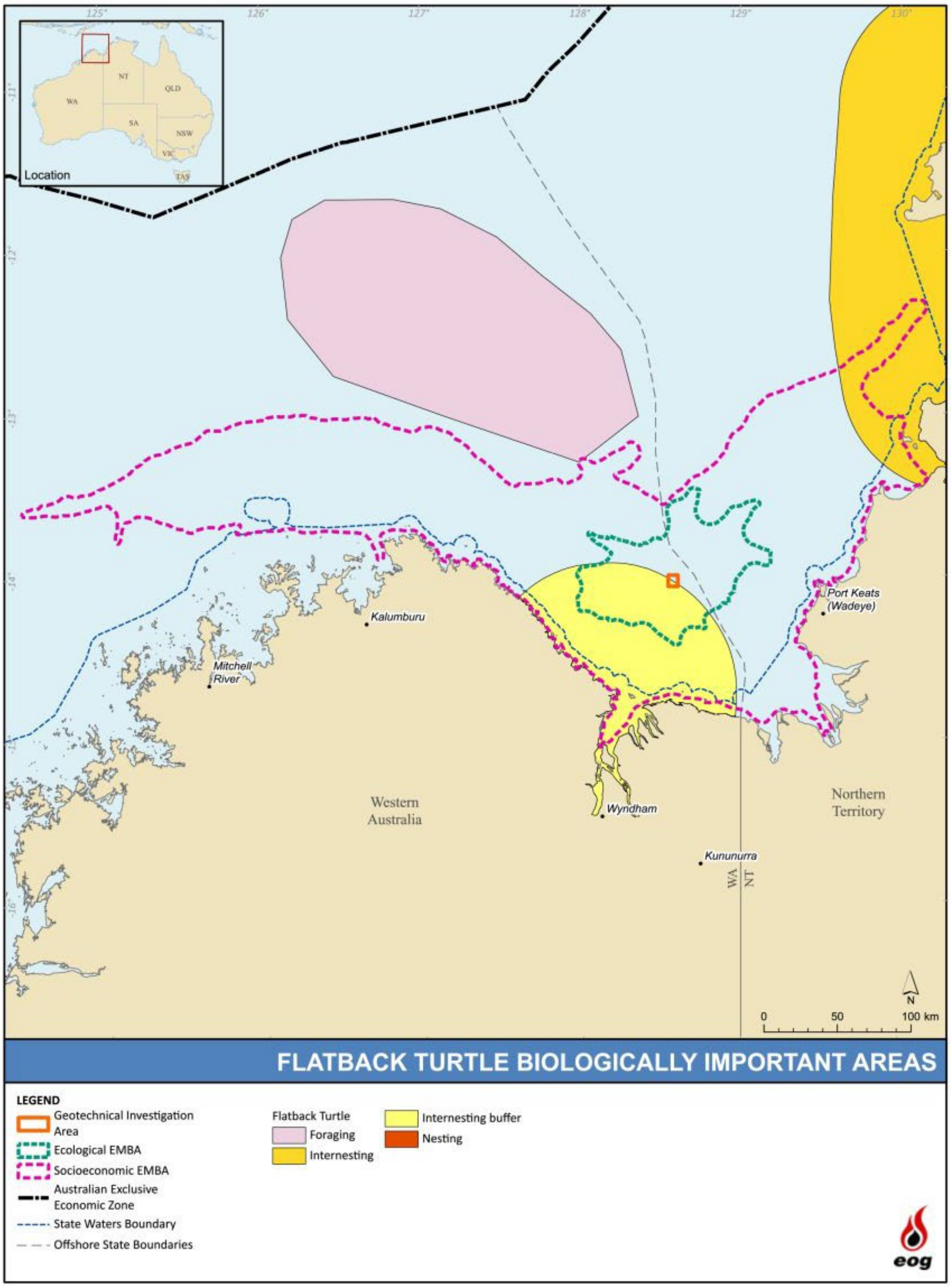


Figure 5.29 Flatback turtle BIA intersected by the activity area and spill EMBA

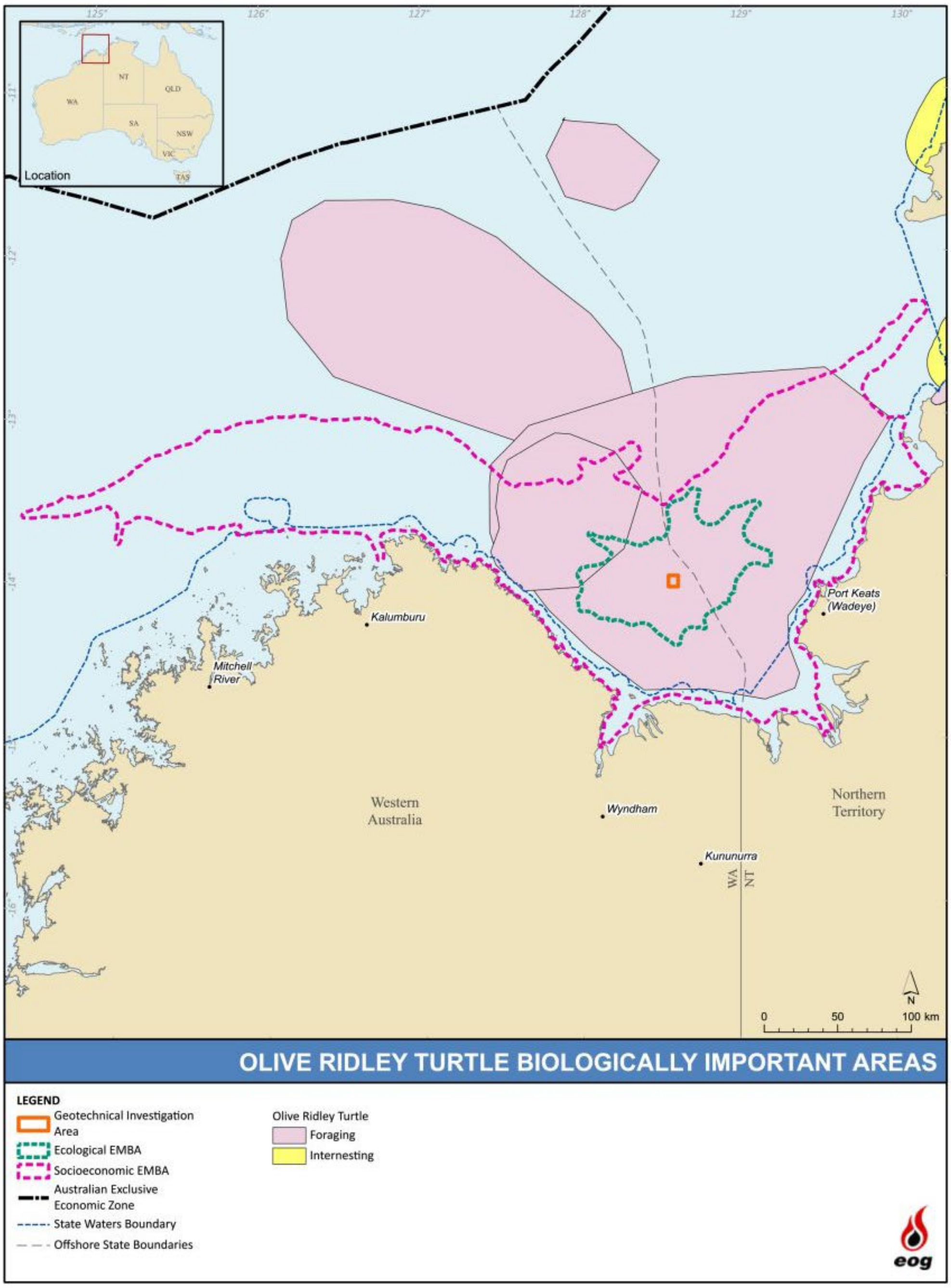


Figure 5.30 Olive Ridley turtle BIA intersected by the activity area and spill EMBA

Hawksbill turtle (EPBC Act: Vulnerable, listed migratory)

Hawksbill turtles (*Eretmochelys imbricate*) are found in tropical, sub-tropical and temperate waters in all the oceans of the world (DoEE, 2019e). The hawksbill turtle is commonly found in the NWMR and NMR, nesting extensively along the coasts and foraging in the region.

As a juvenile, the hawksbill turtle feeds on plankton in the open ocean and then feeds on sponges, hydroids, cephalopods, gastropods, jellyfish, seagrass and algae as an adult (DAWE, 2021b). The species is also highly migratory, moving up to 2,400 km between foraging and breeding areas (DSEWPC, 2012). Due to genetic variability, Australia's population is considered to comprise of two distinct stocks; one in WA and the other in the northeast of Australia (DSEWPC, 2012). These distinct populations are also known to have significantly different breeding seasons.

Hawksbill turtles forage in waters ranging from 1.5 m to 84 m deep, and Fossette et al (2021) report that 17% of satellite tagged turtles (total n=42) foraged in waters greater than 20 m. Fossette et al (2021) reported less than a quarter of foraging area overlapped with designated foraging BIAs for hawksbill turtles (none of which are intersected by the activity area or EMBA) and/or Commonwealth and State-managed protected areas.

The northeast sub-population breeds throughout the year with a peak nesting period during July to October (DSEWPaC, 2012), while in the WA population breeding peaks around October to January. There are no BIAs for the species located within the activity area or spill EMBA. The species may be encountered in the activity area and EMBA as transient individuals.

Leatherback turtle (EPBC Act; Endangered, listed migratory)

The leatherback turtle (*Dermochelys coriacea*) is a pelagic feeder found in tropical, sub-tropical, and temperate waters throughout the world. While it is less abundant off the northern Australian continental shelf, it is occasionally sighted in the Gulf of Carpentaria and near the Cobourg Peninsula (460 km northeast of the activity area and outside the EMBA) (DSEWPaC, 2012).

No major nesting has been recorded in Australia, with isolated nesting recorded in Queensland and the NT (DSEWPaC, 2012). The closest confirmed inter-nesting site for the leatherback turtle is at Cobourg Peninsula (outside the EMBA) (DAWE, 2021b).

Leatherback turtles forage on pelagic soft bodied creatures (such as jellyfish, squid, salps, siphonophores and tunicates) all year round in Australian waters (DAWE, 2021b). The species may be present in the activity area and EMBA, though is unlikely to nest within the coastal areas of the EMBA.

Short-nosed sea snake (EPBC Act: Critically Endangered)

The short-nosed sea snake (*Aipysurus apraefrontalis*) is endemic to WA and occurs throughout the Northwest Shelf and eastern Indian Ocean. This fully aquatic species can grow up to 90 cm in length and prefers shallow coastal reef habitats.

Given the shallow water distribution of the species it is unlikely the species will occur within the activity area, however the species and species habitat may occur in the spill EMBA. Cartier Island and Ashmore Reef (530 km west of activity area) are internationally significant sites for their abundance and diversity of sea snakes, both of which are located outside the EMBA.

Leaf-scaled sea snake (EPBC Act: Critically Endangered)

The only known populations of the leaf-scaled sea snake (*Aipysurus foliosquama*) species inhabit the shallow reef habitats of the Sahul Shelf and Ashmore Reef (Minton and Heatwole, 1975), which are both located outside the activity area and EMBA.

Given the shallow water distribution, it is unlikely the species will occur within the activity area, but the species and species habitat is known to occur in the EMBA.

Saltwater crocodile (EPBC Act: Listed migratory)

The saltwater crocodile (*Crocodylus porosus*) is distributed from King Sound, WA throughout coastal NT to Rockhampton in Queensland, where it can be found in coastal waters, estuaries, lakes, inland swamps and marshes up to 150 km inland from the coast (DAWE, 2021b).

Preferred nesting habitat of the saltwater crocodile includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements. Floating rafts of vegetation also provide important nesting habitat. In the NT, most nest sites are found on the north-west banks of rivers

(DAWE, 2021b). The species nest during the wet season with peak nesting during January and February. Whilst sightings of saltwater crocodiles far out to sea have been recorded, it is more likely to be encountered in the coastal areas of the socio-economic EMBA than in the activity area.

5.3.7 Avifauna

The PMST search (**Appendix 4**) identified seabirds and shorebirds listed under the EPBC Act with potential to occur in the spill EMBA (Table 5.10). The PMST results also includes terrestrial species of birds that are protected under the EPBC Act which are not included in Table 5.10. Figure 5.31 illustrates the likely temporal presence and absence and ecological stages of these bird species in the activity area and EMBA. The species listed as threatened or with a BIA intersected by the activity area or EMBA are described in this section.

Many of the birds listed in Table 5.10 are listed in the following international conventions that aim to protect the birds themselves and their habitat:

- Republic of Korea Migratory Birds Agreement 2006 (ROKAMBA);
- Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979;
- Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment 1974 (JAMBA); and
- Convention on Wetlands of International Important especially as Waterfowl Habitat 1971 ('Ramsar Convention', see also Section 5.4.5).

Table 5.10 EPBC Act-listed bird species that may occur in the activity area and EMBA

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Seabirds										
Anous stolidus	Common noddy	-	Yes	Yes	✓	✓	✓	No	No	-
Anous tenuirostris melanops	Australian lesser noddy	V	-	Yes	-	-	✓	No	No	CA
Calonectris leucomelas	Streaked shearwater	-	Yes	Yes	✓	✓	✓	No	No	-
Fregata ariel	Lesser frigatebird	-	Yes	Yes	✓	✓	✓	No	No	-
Fregata minor	Greater frigatebird	-	Yes	Yes	✓	✓	✓	No	No	-
Haliaeetus leucogaster	White-bellied sea-eagle	-	-	Yes	-	-	✓	No	No	-
Onychoprion anaethetus	Bridled tern	-	Yes	Yes	-	-	✓	No	No	-
Pandion haliaetus	Osprey	-	Yes	Yes	-	-	✓	No	No	-
Papasula abbotti	Abbott's booby	E	-	Yes	-	-	✓	No	No	CA
Phaethon lepturus	White-tailed tropicbird	-	Yes	Yes	✓	✓	✓	No	No	-
Sterna bengalensis	Lesser crested tern	-	-	Yes	-	✓	✓	No	Yes	-
Sterna dougallii	Roseate tern	-	Yes	Yes	-	-	✓	No	No	-
Sternula albifrons	Little tern	-	Yes	Yes	-	-	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Shorebirds										
Acrocephalus orientalis	Oriental reed-warbler	-	Yes	Yes	-	-	✓	No	No	-
Actitis hypoleucos	Common sandpiper	-	Yes	Yes	✓	✓	✓	No	No	-
Apus pacificus	Fork-tailed swift	-	Yes	Yes	-	-	✓	No	No	-
Arenaria interpres	Ruddy turnstone	-	Yes	Yes	-	-	✓	No	No	-
Calidris acuminata	Sharp-tailed sandpiper	-	Yes	Yes	✓	✓	✓	No	No	-
Calidris alba	Sanderling	-	Yes	Yes	-	-	✓	No	No	-
Calidris canutus	Red knot	E	Yes	Yes	✓	✓	✓	No	No	CA
Calidris ferruginea	Curlew sandpiper	CE	Yes	Yes	✓	✓	✓	No	No	CA
Calidris melanotos	Pectoral sandpiper	-	Yes	Yes	✓	✓	✓	No	No	-
Calidris tenuirostris	Great knot	CE	Yes	Yes	-	-	✓	No	No	CA
Charadrius leschenaultia	Greater sand plover	V	Yes	Yes	-	-	✓	No	No	CA
Charadrius mongolus	Lesser sand plover	E	Yes	Yes	-	-	✓	No	No	CA
Charadrius veredus	Oriental plover	-	Yes	Yes	-	-	✓	No	No	-

Scientific name	Common name	EPBC Act Status			Presence			BIA intersected by activity area?	BIA intersected by ecological EMBA?	Recovery Plan in place?
		Threatened	Migratory	Marine	Activity area	Ecological EMBA	Socio-economic EMBA			
Larus novaehollandiae	Silver gull	-	-	Yes	-	-	✓	No	No	-
Limnodromus semipalmatus	Asian dowitcher	-	Yes	Yes	-	-	✓	No	No	-
Limosa lapponica	Bar-tailed godwit	-	Yes	Yes	-	-	✓	No	No	-
Limosa lapponica baueri	Nunivak bar-tailed godwit	V	-	-	-	-	✓	No	No	CA
Limosa limosa	Black-tailed godwit	-	Yes	Yes	-	-	✓	No	No	-
Numenius madagascariensis	Eastern curlew	CE	Yes	Yes	✓	✓	✓	No	No	CA
Numenius phaeopus	Whimbrel	-	Yes	Yes	-	-	✓	No	No	-
Pluvialis squatarola	Grey plover	-	Yes	Yes	-	-	✓	No	No	-
Rostratula australis	Australian painted snipe	E	-	Yes	-	-	✓	No	No	CA

Same key as per Table 5.6.

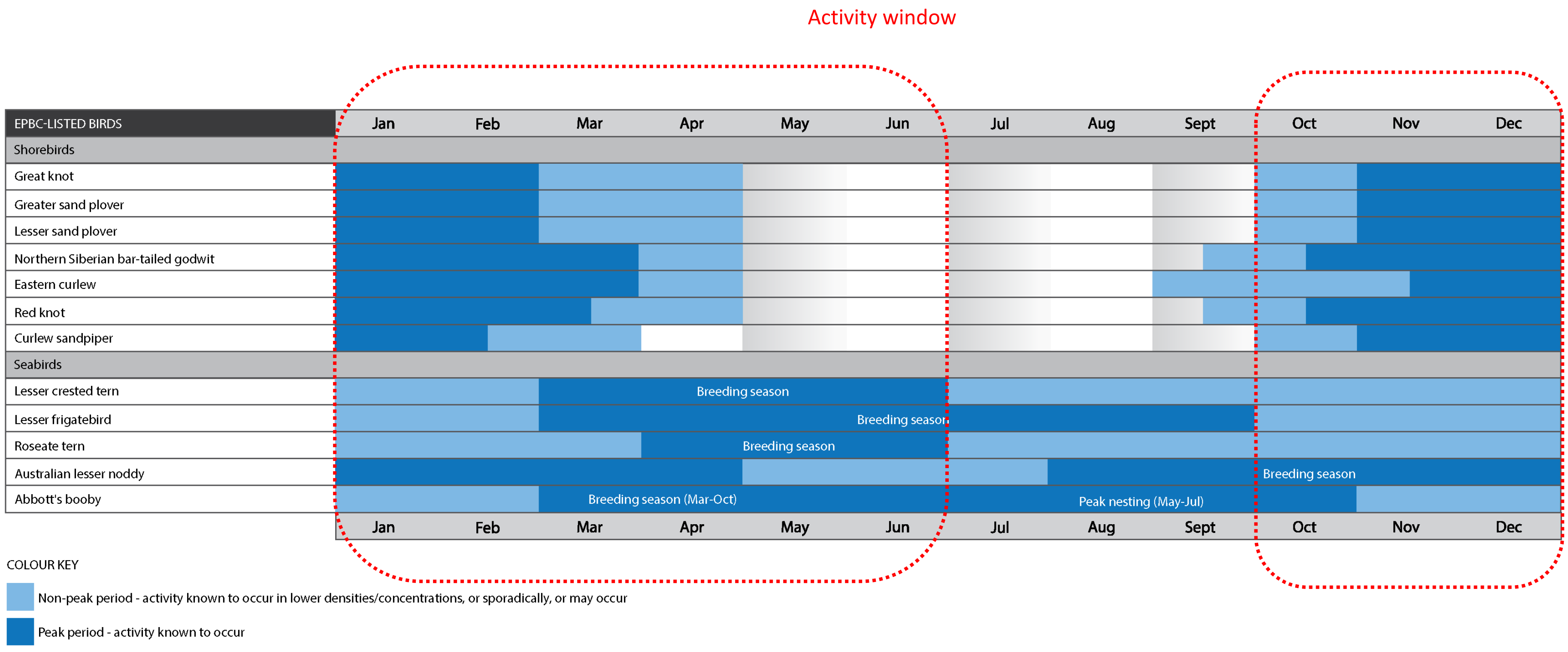


Figure 5.31 Likely temporal presence and absence of EPBC Act-listed seabird species in the activity area and EMBA

Seabirds

Roseate tern (EPBC Act: Listed Migratory)

The roseate tern (*Sterna dougallii*) occurs throughout various coastal habitats including beaches, reefs and sandy/coral islands. It is a specialist forager for small pelagic fish (DAWE, 2021b). The terns prefer nesting sites adjacent to clear shallow hunting areas. Nests are generally a bare scrape in sand, shingle or coral rubble. The species breeds in large mixed-species colonies from April to June, with breeding populations located around Ashmore Reef, Cartier Island and Scott Reef (none of which are located in the EMBA) (DEWHA, 2008). Little information is available about migratory movements or timing through the northwest of Australia.

A breeding BIA for the species is intersected by the EMBA at coastal islands off the north Kimberley coast (Figure 5.32). Foraging, feeding or related behaviours are likely to occur within the offshore and coastal areas of the EMBA but unlikely in the activity area due to its distance from the nearest breeding BIA (166 km west from the activity area). Therefore, the species is unlikely to be present in the activity area and likely to be present in the western extent of the EMBA.

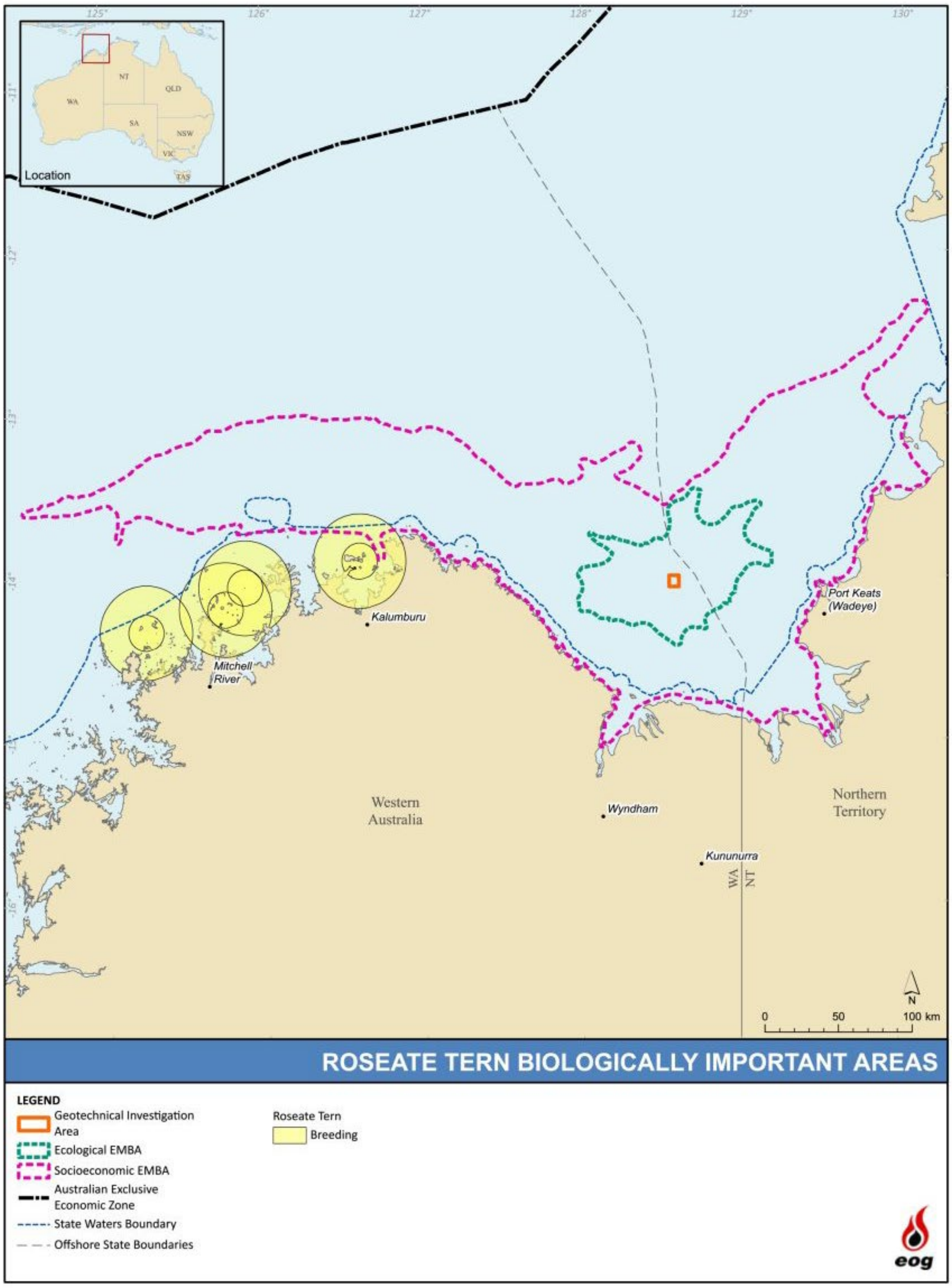


Figure 5.32 Roseate tern BIA intersected by the spill EMBA

Lesser frigatebird (EPBC Act: Listed Migratory)

Lesser frigatebirds (*Fregata ariel*) are usually observed in tropical waters around the coast of northern WA, NT, Queensland and NSW (DSEWPC, 2012d). They are often found foraging far offshore, especially during the non-breeding season where some large movements have been recorded (DSEWPC, 2012). During the breeding season (March - September), the lesser frigatebird's range remains close to the breeding colonies (DSEWPC, 2012).

The EMBA overlaps a breeding BIA for this species but the activity area does not (Figure 5.33). Hence, this species is unlikely to be in the activity area due to its distance from the breeding BIA (172 km west of the activity area) and may be present within the EMBA.

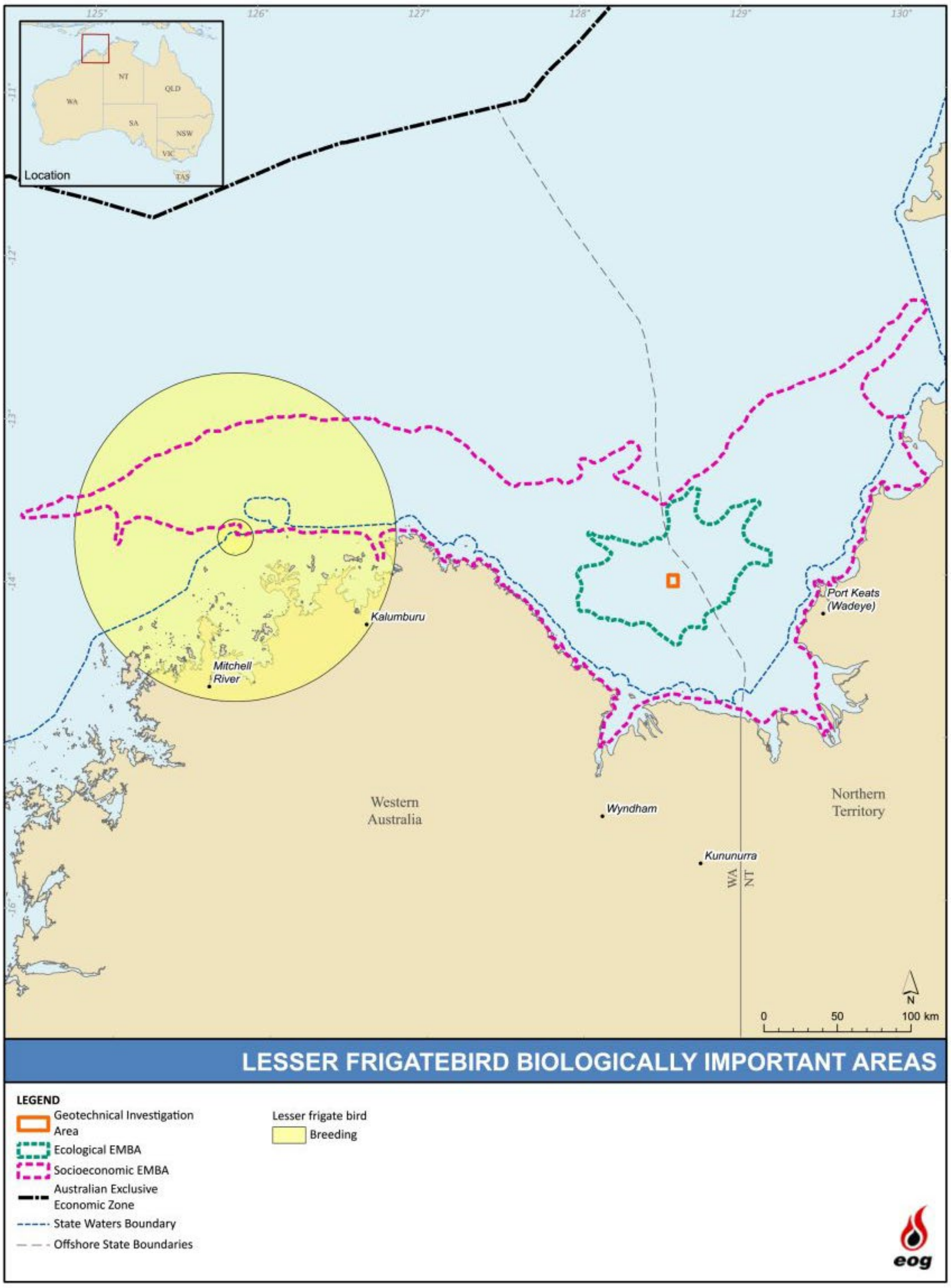


Figure 5.33 Lesser frigatebird BIA intersected by the spill EMBA

Lesser crested tern (EPBC Act: Listed Migratory)

The lesser crested tern (*Sterna bengalensis*) inhabits tropical and sub-tropical sandy and coral coasts and estuaries (DSEWPC 2012). In Australia, lesser crested terns are found on coasts and in coastal waters, primarily in northern Australia. The species occurs around most of the NT, with the highest density of confirmed sightings along the coast to the south-west of Darwin (DSEWPC 2012).

The species breeds on low-lying islands, coral flats, sandbanks and flat sandy beaches, and may move nesting sites from one year to the next (DSEWPC 2012). Lesser crested terns forage for small pelagic fish and shrimp in the surf and over offshore waters in areas of reef and deeper shelf waters

(DSEWPC 2012). The spill EMBA partially overlaps with a lesser crested tern breeding BIA (Figure 5.34). There is no overlap between the activity area and the lesser crested tern breeding BIA.

Given these breeding areas are 44 km west from the activity area, there is a low likelihood of this species occurring in the activity area. Given the location of breeding grounds within the spill EMBA, this species is likely to be present in the spill EMBA.

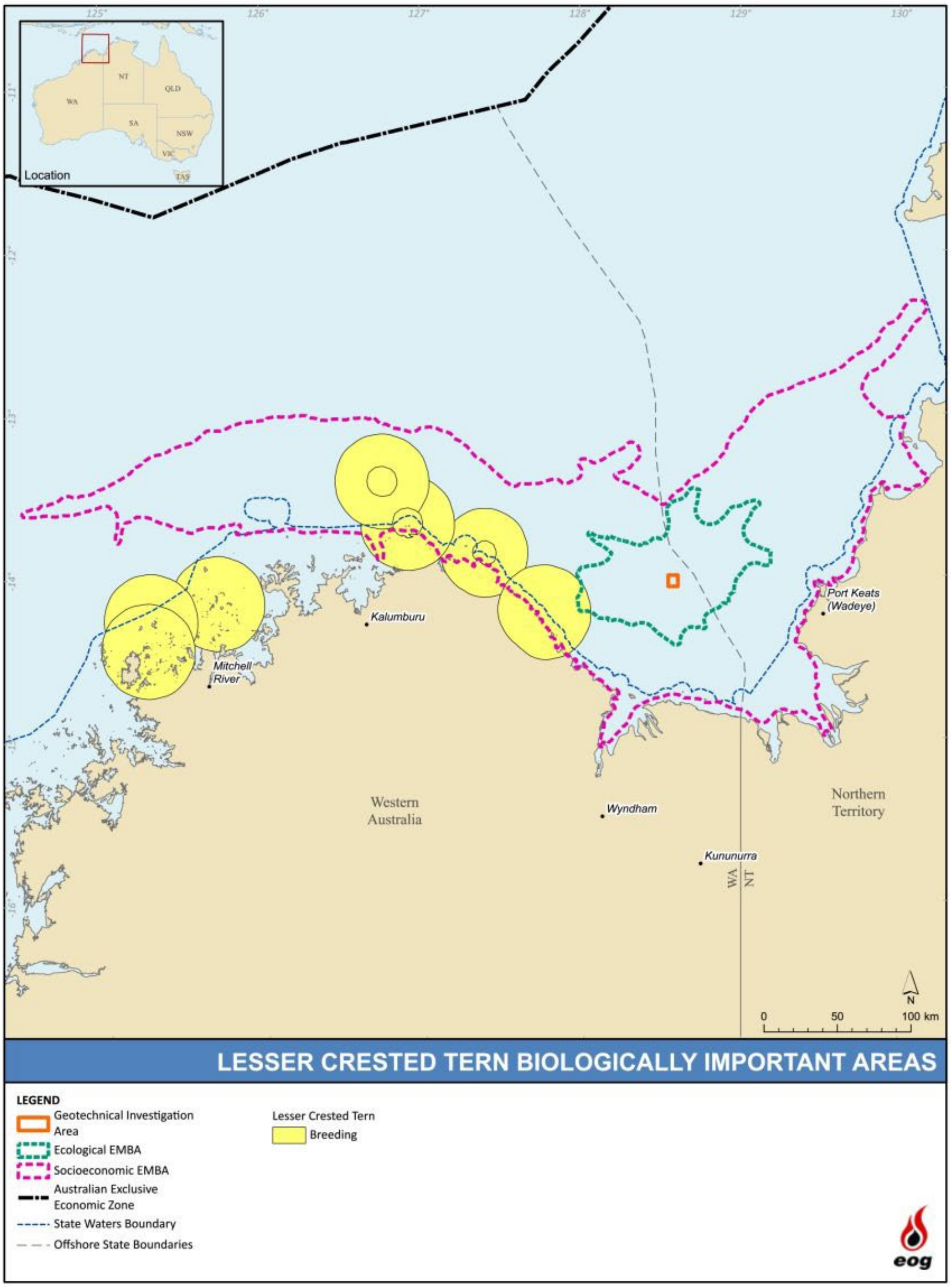


Figure 5.34 Lesser crested tern BIA intersected by the spill EMBA

Australian lesser noddy (EPBC Act: Vulnerable)

The Australian lesser noddy (*Anous tenuirostris melanops*) is endemic to Australia and nests on the Abrolhos Islands, Ashmore Reef and various other islands throughout tropical and sub-tropical northwest Australia (DAWE, 2021b). They may forage out to sea or close inshore to breeding islands, including outside fringing reefs, feeding on small squid and fish (DoEH, 2005). They roost mainly in mangroves, and sometimes rest on the beaches (DoEH, 2005).

The Australian lesser noddy is not predicted to occur in the activity area but may occur within the coastal areas of the EMBA.

Abbott's booby (EPBC Act: Endangered)

Abbott's booby (*Papasula abbotti*) spend much of their time at sea, but need to come ashore to breed (DAWE, 2021b). It is currently known to only breed on Christmas Island (outside the EMBA) during the months of March to October, with peak nesting May-July (DAWE, 2021b). The species nests in tall rainforest trees, laying a single egg clutch (DAWE, 2021b). Birds are known to travel up to 400 km from nesting locations to forage for fish and squid (DAWE, 2021b).

The species is not predicted to occur in the activity area but may occur in the EMBA.

Shorebirds

Curlew sandpiper (EPBC Act: Critically Endangered, Listed Migratory)

In Australia, the curlew sandpiper (*Calidris ferruginea*) occurs around the coasts and is also quite widespread inland, though in smaller numbers (DAWE, 2021b). They are rarely recorded in the northwest Kimberley, around Wyndham and Lake Argyle (DAWE, 2021b).

This species is unlikely to be present in the activity area due to its location offshore but given that the EMBA is adjacent to (without intersecting) critical habitat for this species (e.g., wetlands), it is possible that this species would be present in the coastal sections of the EMBA during the summer months.

Lesser sand plover (EPBC Act: Endangered, Listed Migratory)

The lesser sand plover (*Charadrius mongolus*) spends non-breeding periods in Australia. The species is widespread in coastal regions and has been recorded in all states within Australia but mainly occurs in northern and eastern Australia (DAWE, 2021b).

The species feeds mostly on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks (DAWE, 2021b). They also occasionally forage on coral reefs and on sandy or muddy river margins (DAWE, 2021b). The lesser sand plover roost near foraging areas, on beaches, banks and spits, banks of sand and shells, and occasionally on rocky spits, isles or reefs (DAWE, 2021b).

This species is not predicted to occur in the activity area due to its distance from shore but may occur within the coastal areas of the EMBA and in the Cambridge Gulf.

Eastern curlew (EPBC Act: Critically Endangered, Listed Migratory)

The eastern curlew (*Numenius madagascariensis*) has a primarily coastal distribution within Australia (DotE, 2015c). It does not breed in Australia and is found foraging on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline (DoE, 2015b).

This species is unlikely to be present in the activity area due to its location offshore but given that the EMBA is adjacent to (without overlapping) critical habitat for this species (e.g., wetlands), it is possible that this species occurs in the EMBA during the summer.

Nunivak bar-tailed godwit (EPBC Act: Vulnerable)

The Nunivak bar-tailed godwit (*Limosa lapponica baueri*) is a large wader recorded in coastal areas of all states and territories of Australia (DAWE, 2021b). The species is found in coastal habitats such as large intertidal sand and mudflats, banks, estuaries, harbours, bays and coastal lagoons where it forages when the tide is out (DAWE, 2021b). Their diet consists of worms, molluscs, crustaceans, insects and some plant material (DAWE, 2021b). This species breeds in the northern hemisphere and migrates south for the winter, arriving in northwest Australia from August and departs before the end of April (DAWE, 2021b).

This species is not predicted to occur in the activity area due to its offshore location but may be present in the coastal sections of the EMBA between August and April.

Great knot (EPBC Act: Critically Endangered, Listed Migratory)

The great knot (*Calidris tenuirostris*) has been recorded around the entire Australian coast and spends non-breeding periods in Australia (DAWE, 2021b). The greatest numbers of this species are found in northern Australia, and most commonly on the coast of the Pilbara and Kimberley, from the Dampier Archipelago to the NT border, and in the NT from Darwin and Melville Island, through Arnhem Land to the southeast Gulf of Carpentaria (DAWE, 2021b). This species typically prefers sheltered coastal habitats with large intertidal mudflats or sandflats (DAWE, 2021b). The great knot feeds on snails, worms and crustaceans, and forages on intertidal mudflats, estuaries, and in mangroves.

This species is not predicted to be encountered in the activity area due to its habitat preferences, although it is expected in parts of the coastal areas of the EMBA where its preferred habitat is available.

Red knot (EPBC Act: Endangered, Listed Migratory)

The red knot (*Calidris canutus*) is common in all the main suitable habitats around the coast of Australia (DAWE, 2021b), and very large numbers are regularly recorded in northwest Australia, with Eighty Mile Beach and Roebuck Bay being particular strongholds (both outside the EMBA). In WA, it is widespread on the coast from Ningaloo Reef and Barrow Island to the southwest Kimberley coastline. In the NT it is mainly recorded in Darwin.

The red knot is not predicted to occur within the activity area due to its habitat preferences, but is likely to be present in parts of the coastal areas of the EMBA.

Australian painted snipe (EPBC Act: Endangered)

The Australian painted snipe (*Rostratula australis*) is a wader and is found in wetlands throughout all Australian states and territories (DAWE, 2021b). The species generally inhabits freshwater wetlands, although can inhabit brackish water, saltmarshes and claypans (DAWE, 2021b). It feeds on vegetation, seeds, insects, worms, molluscs, crustaceans and other invertebrates (DAWE, 2021b). The Australian painted-snipe is not predicted to occur within the activity area, but is likely to be present in the EMBA.

Greater sand plover (EPBC Act: Vulnerable, Listed Migratory)

The greater sand plover (*Charadrius leschenaultia*) occurs in coastal areas throughout Australia with the greatest populations between the NW Cape and Roebuck Bay (DAWE, 2021b) (both outside the EMBA). The plover spends almost all its time in coastal habitats. Their diet consists mainly of molluscs, worms, crustaceans and insects (DAWE, 2021b). The species breeds in the northern hemisphere and migrates south for the boreal winter (DAWE, 2021b). The greater sand plover is one of the first migratory waders to return to northwest Australia, usually arriving in late July and departing in mid to late April (DAWE, 2021b).

The species is not predicted to occur in the activity area due to its habitat preferences, but may occur within the coastal areas of the EMBA from July to April.

5.3.8 Marine Pests

It is widely recognised that marine pests can become invasive and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati and Grosholz, 2007).

The Marine Pests Interactive Map (DAFF, 2021) indicates that the major port likely to be used to support the activity (e.g., Darwin) is not known to harbour any marine pests. However, Department of Agriculture, Fisheries and Forestry (DAFF) (2021) notes that the following species are listed to keep watch for in the Port of Darwin due to their high potential for accidental introduction:

- Asian green mussel (*Perna viridis*) – typically inhabits soft sediment bottoms from the low tide mark to shallow waters up to 42 m deep. Juveniles are bright green than turn brown in adults.
- American slipper limpet (*Crepidula fornicate*) – competes with native species for food and space and may alter sediment characteristics by removing suspended sediments from the water column. Its likely habitat includes mud, rocks and sand within shores and shall waters.
- Black striped false mussel (*Mytilopsis sallei*) – affects the productivity of commercial fisheries and aquaculture by competing with native species for food and space. The species usually inhabits shallow waters up to a few metres deep.
- Charru mussel (*Mytella charruana*) – successful invasive species globally due to its great dispersal ability and tolerance for a wide variety of habitats. Typically found on rocky or hard substrates in shallow waters.

5.4 Conservation Values and Sensitivities

The conservation values and sensitivities within the EMBA are described in this section, with Table 5.11 providing an outline of the conservation categories described.

Table 5.11 Conservation values in the EMBA

Category	Conservation classification	Section
MNES under the EPBC Act	Australian Marine Parks (AMP)	Section 5.4.1
	World Heritage-listed properties	Section 5.4.2
	National Heritage-listed places	Section 5.4.3
	Wetlands of international importance	Section 5.4.5
	Nationally threatened species and threatened ecological communities	Throughout Section 5.3 and Section 5.4.6
	Migratory species	Throughout Section 5.3
	Great Barrier Reef Marine Park	Not applicable.
	Nuclear actions	Not applicable.
	A water resource, in relation to coal seam gas development and large coal mining development	Not applicable.
Other areas of national importance	Commonwealth heritage-listed places	Section 5.4.7
	Key Ecological Features (KEF)	Section 5.4.8
	Nationally important wetlands (NIW)	Section 5.4.4
State protected areas	State/territory protected areas	Section 5.4.9

5.4.1 Australian Marine Parks

The activity area does not intersect any AMPs. The closest AMPs to the activity area that are intersected by the EMBA are the JBG AMP (located 30 km south of the activity area) and the Kimberley AMP (located 219 km west of the activity area), described herein. AMPs in the EMBA are illustrated in Figure 5.35.

Joseph Bonaparte Gulf AMP

The JBG AMP covers an area of 8,597 km^2 and water depths within the AMP range from less than 15 m to 75 m (Galaiduk *et al*., 2018). The JBG AMP is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition provincial bioregion and the Oceanic Shoals meso-scale bioregion (Galaiduk *et al*., 2018). The AMP contains a number of prominent shallow seafloor features including an emergent reef system, shoals and sand banks (Galaiduk *et al*., 2018). It also includes one key ecological feature, the Carbonate Bank and Terrace System of the Sahul Shelf, which is valued as a unique seafloor feature with ecological properties of regional significance (AMP, 2019a). The Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija and Balangarra people have responsibilities for sea country in this AMP (DNP, 2018a).

Kimberley AMP

The Kimberley AMP is located approximately 100 km north of Broome, WA and the central part of the Kimberley AMP is adjacent to the WA Camden Sound State Marine Park. It covers 74,469 km^2, with depths from less than 15 m to 800 m.

The Kimberley AMP is characterised by:

- High numbers of marine mammals such as dolphins, whales and dugong. The humpback whale breeds and calves in the Kimberley AMP annually after undertaking an extensive migration from Antarctica. Three dolphin species (Australian snubfin dolphin, Australian humpback dolphin and spotted bottlenose dolphin) use the Kimberley AMP to forage within and travel to coastal waters to calve and raise their young in inshore, protected waters.
- Important foraging rounds for seabirds and shorebirds known to breed on Adele Island (outside of the EMBA), including critically endangered eastern curlews and curlew sandpipers.
- Sea country within the AMP is valued for Indigenous cultural identity, health and wellbeing.
- Tourism, commercial fishing, mining, recreation (including fishing) and traditional use are important activities in the AMP.

There are no KEFs within the Kimberley AMP.

Section 2.4 of the North Marine Parks Network Management Plan 2018 (DNP, 2018a) and Section 2.4 of the North-west Marine Parks Network Management Plan 2018 (DNP, 2018b) identify pressures relevant to the marine park networks. Pressures are defined as human-driven processes, events and activities that may detrimentally affect the values of the reserves network. Table 5.12 summarises the pressures and sources of pressure on the conservation values of the of the NMR and NWMR Reserves Network.

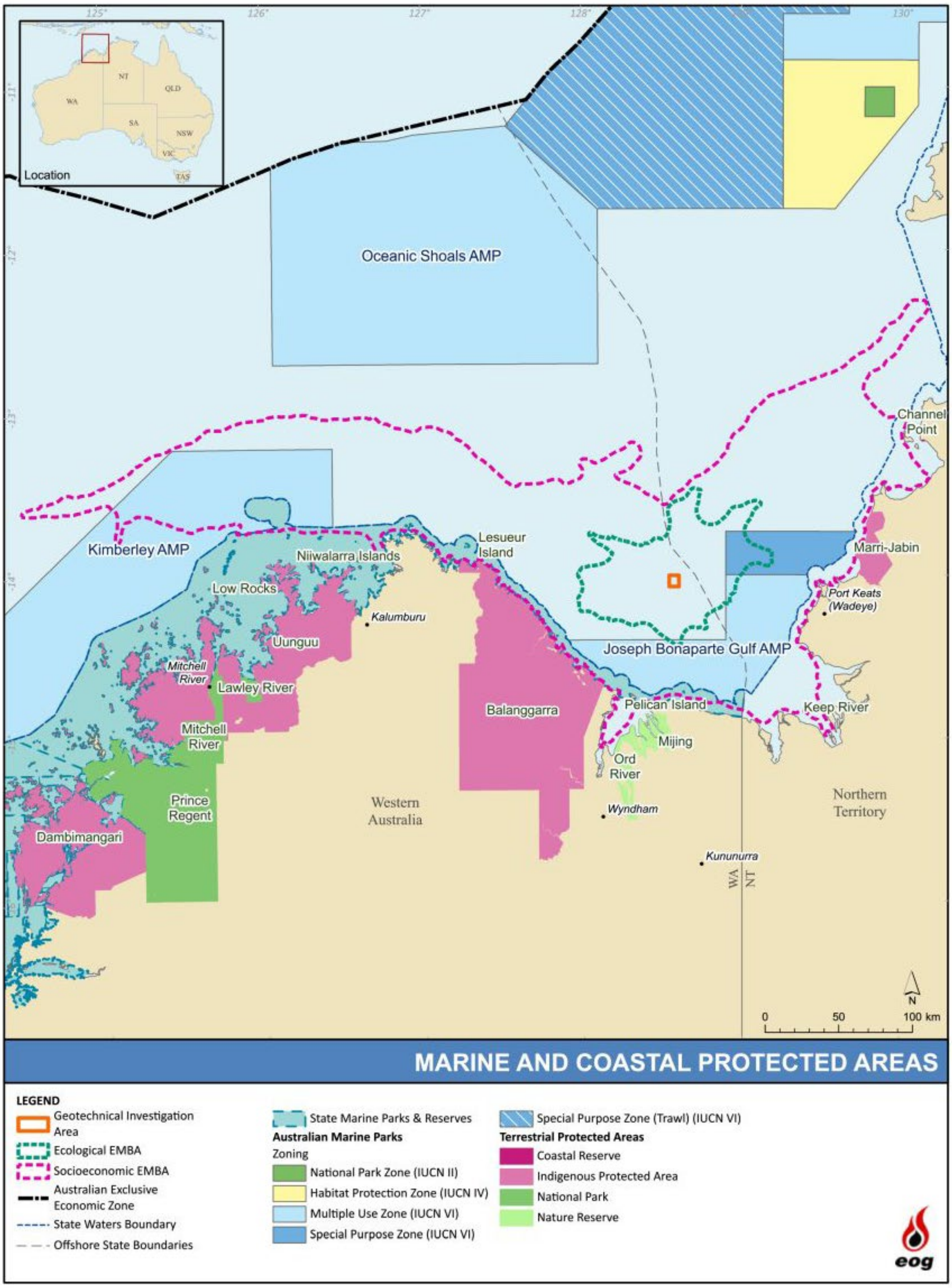


Figure 5.35 Protected areas intersected by the spill EMBA

Table 5.12 Summary of environmental pressures in the NWMR and NMR

Pressure	Description
Climate change	Climate change impacts on marine environments are complex and interrelated and may include changes in sea temperature, sea level, ocean acidification, sea currents, increased storm frequency and intensity and species range extension or local extinction. Examples of features and species vulnerable to climate change impacts include submerged coral reefs, sawfish, sharks, dolphins, seabirds and marine turtles.
Changes in hydrology	Coastal developments and agriculture have the potential to discharge increased sediment loads and pollutants to rivers, estuaries and nearshore coastal environments. This can result in increased turbidity and siltation, which in turn impacts species that spawn or inhabit coastal, nearshore or offshore waters. Habitats and species vulnerable to changes in hydrology include seagrass meadows, reefs, sawfish, shark and dugong.
Extraction of living resources	Sustainable fishing as well as illegal or unregulated fishing can modify natural populations and disproportionately target select valuable species. Species vulnerable to extraction include shark, sawfish, turtles, sea snakes, fish and dugong.
Habitat modification	Offshore infrastructure developments can impact habitat within marine parks through physical disturbance and indirectly through the physical presence of infrastructure. Benthic habitats may be impacted by direct discharges to the seabed resulting in smothering or a reduction in the quantity of light reaching the seabed. Habitats and species vulnerable to habitat modification include reefs, shoals and pinnacle habitats, turtles, fish, sea snakes, dolphins and dugong.
Human presence	Wildlife watching, camping, boating, diving and snorkelling are drawcard activities for people to the region and have the potential to impact natural wildlife behaviour or result in damage to fragile marine environments. Habitats and species vulnerable to these impacts include reefs, turtles and seabirds.
Invasive species	Accidental introduction and establishment of invasive species can have potentially debilitating impacts on island, reef or shallow-water marine ecosystems. Direct impacts from predation or damage to important habitat and indirect impacts from competition for food resources can affect native populations. Habitats and species vulnerable to invasive species include reefs, turtles, seabirds and saltwater crocodiles.
Marine pollution	Land-based and marine activities that result in pollution have the potential to impact marine park values. Discharges of emissions including light, marine debris, noise, oil and chemicals can be detrimental to marine life and cause contamination of ecosystems and entanglement of marine fauna. Habitats and species vulnerable to marine pollution include islands, reefs, shallow-water habitats, dolphins, whales, turtles, sawfish, sharks and seabirds.

5.4.2 World Heritage Properties

World Heritage listed properties are examples of sites that represent the best examples of the world’s cultural and heritage values, of which Australia has 19 properties (DAWE, 2021d). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

There are no World Heritage Properties within or adjacent to the activity area or the EMBA. The closest World Heritage Property is Kakadu National Park (onshore), which is located over 400 km northeast of the activity area.

5.4.3 National Heritage-Listed Properties

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation (DAWE, 2021e). These places are protected under Chapter 5, Part 15 of the EPBC Act. There are no National Heritage-listed places intersected by the activity area. The socio-economic EMBA intersects the West Kimberley National Heritage Place. This National Heritage-listed place is described below and presented in Figure 5.36.

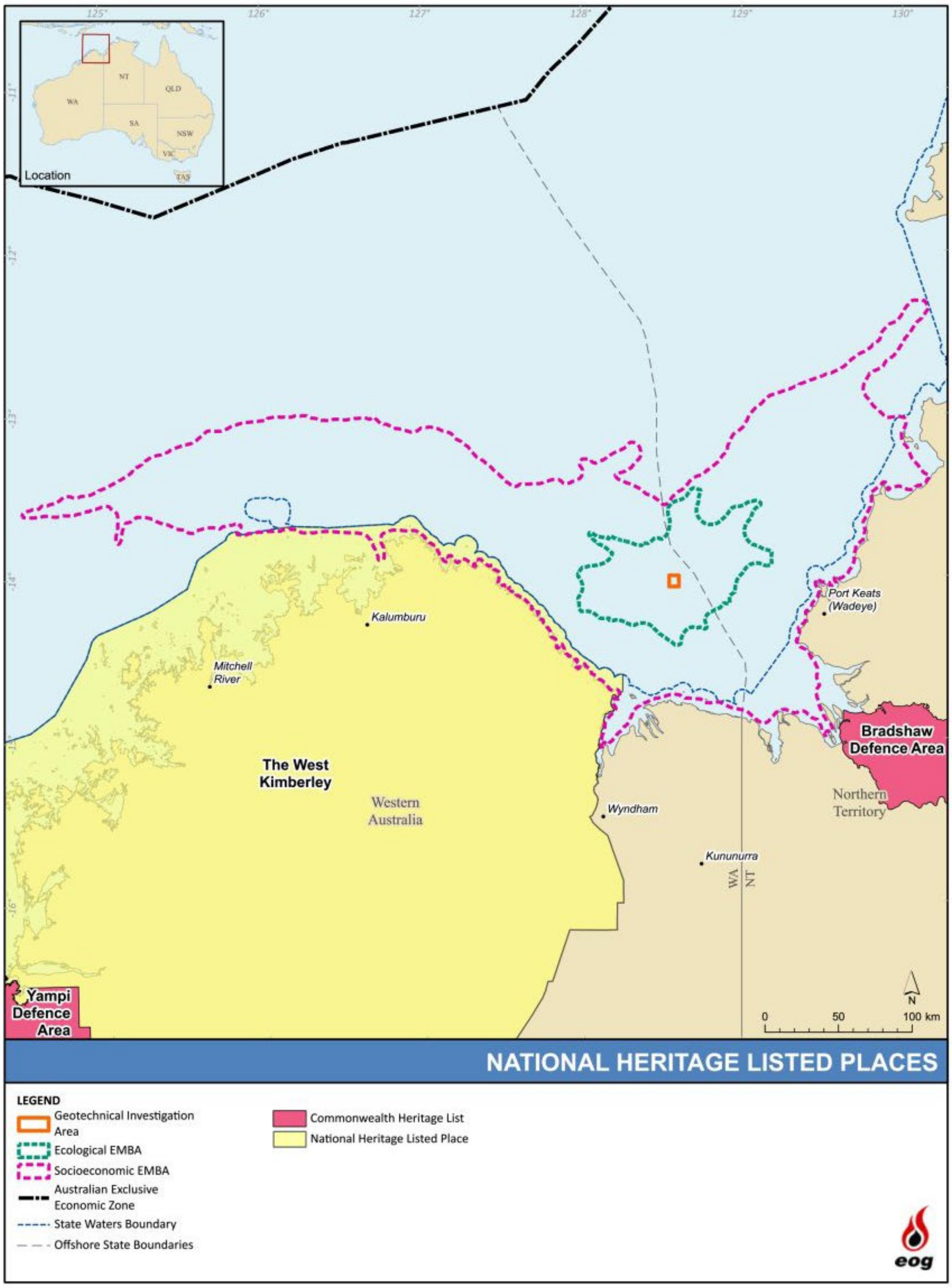


Figure 5.36 National Heritage-Listed Places intersected by the spill EMBA

West Kimberley National Heritage Place

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DAWE, 2021b). The West Kimberley National Heritage place covers a vast area that is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands. The values most relevant to the marine environment is Roebuck Bay as a migratory hub for shorebirds (Roebuck Bay does not fall within the EMBA).

5.4.4 Nationally Important Wetlands

NIWs are considered significant for a variety of reasons, including their importance for maintaining ecological and hydrological roles in wetland systems, providing important habitat for animals at a vulnerable or particular stage in their life cycle, supporting 1% or more of the national population of any native plant or animal taxa or for its outstanding historical or cultural significance (DAWE, 2021h). The Ord Estuary System is intersected by the socioeconomic EMBA (see Figure 5.37).

5.4.5 Wetlands of International Importance

Australia has 66 wetlands of international importance (‘Ramsar wetlands’) that cover more than 8.3 million hectares (as of September 2021) (DAWE, 2021f). Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity, and are included on the List of Wetlands of International Importance developed under the Ramsar Convention. These wetlands are protected under Chapter 5, Part 15 of the EPBC Act.

There are no Ramsar wetlands intersected by the activity area or the EMBA (Figure 5.37). However, the Ord River Floodplain Ramsar wetland is within 10 km of the boundary of the EMBA and so is described here.

Ord River Floodplain

The Ord River Floodplain Ramsar site is a floodplain and estuarine wetland system. North of the lagoons, the site includes the Ord River Estuary leading into the Cambridge Gulf while the northeast end of the site heads around the coast to include a series of extensive intertidal creeks and flats known as the False Mouths of the Ord. The upstream portion of the floodplain and river tends to be freshwater and becomes more saline as the river approaches the Cambridge Gulf and falls under tidal influence (DAWE, 2021b).

Mangroves are the most common vegetation in the site, extending from the False Mouths of the Ord to the upstream sections of the estuary. The mangroves form narrow fringes along the intertidal areas, with saltmarsh on higher ground. The intertidal mangroves support many species of birds and bats and are a breeding area for banana prawns (DAWE, 2021b).

Over 200 species of birds have been recorded within the site including waterfowl, migratory shorebirds, mangrove birds and terrestrial species. The site supports the nationally threatened Australian painted snipe. The wetlands are habitat for many fish species that require migration between marine and more freshwater environments during their life, including the nationally threatened species largetooth sawfish, green sawfish and northern river shark. Reptiles that use the site include the freshwater crocodile and saltwater crocodile (DAWE, 2021b).

The Ord River Floodplain Ramsar site lies within the boundaries of six Indigenous language groups: Miriuwung, Gajerrong, Dulbung, Guluwaring, Djangade and Biambarr. The site contains Indigenous burial sites, artefact scatters, quarries, paintings and ceremonial sites (DAWE, 2021b). The Ord River Nature Reserve is gazetted for the conservation of flora and fauna. The Lower Ord River and the False Mouths of the Ord are popular destinations for locals and visitors for recreational fishing, crabbing and boating (DAWE, 2021b).

The *Ord River and Parry Lagoons nature reserves management plan 77 2012* (DEC 2012) is the approved management plan for the Ord River Floodplain Ramsar Site.

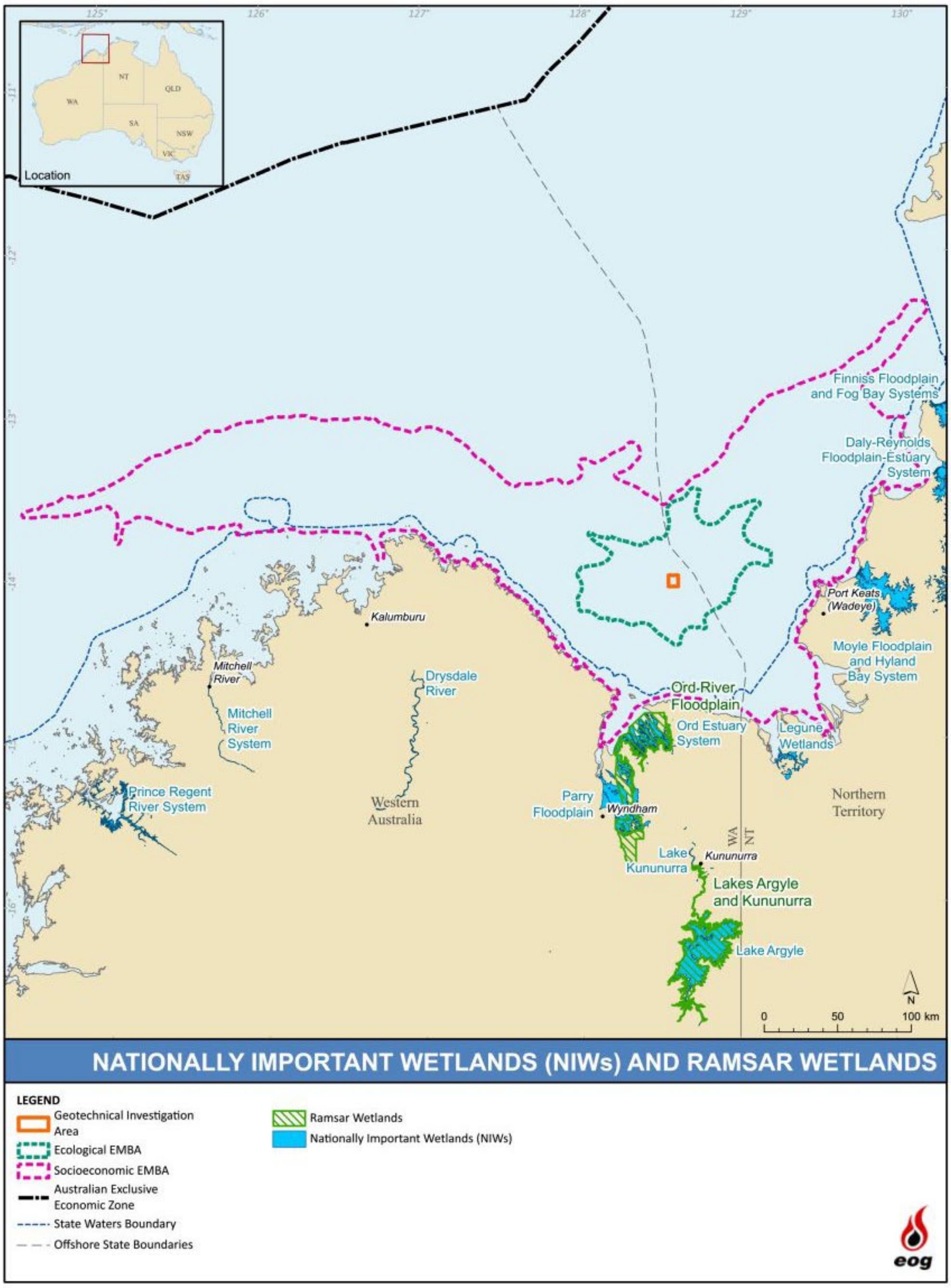


Figure 5.37 Ramsar wetlands and NIWs intersected by the spill EMBA

5.4.6 Threatened Ecological Communities

The Australian Government is responsible for identifying and protecting MNES through the EPBC Act. Threatened Ecological Communities (TECs) are a MNES under the EPBC Act. TECs provide wildlife corridors and/or habitat refuges for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species).

There are no TECs identified in the spill EMBA or activity area.

5.4.7 Commonwealth Heritage-listed Places

Commonwealth Heritage-listed places are natural, indigenous and historic heritage places owned or controlled by the Commonwealth (DAWE, 2021g). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the Commonwealth Heritage List occur within the activity area. The EMBA is located within 10 km of the Bradshaw Defence Area, which is described below.

Bradshaw Defence Area

The Bradshaw Defence Area is bounded by the Fitzmaurice and Victoria Rivers on the shores of the JBG. The Bradshaw Defence Field Training Area comprises a vast and rugged habitat endowed with a diverse array of plants and animals. The place demonstrates to a high degree the interplay of erosional terrains associated with coastal and fluvial environments. Coastal mudflats, associated tidal creek networks and mangal stands are prominent along the coastal margins. In places, the mudflats are 'interrupted' by bedrock outcrop, while in other locations, bedrock forms small islands rimmed by mudflats and associated mangrove belts. There is a substantial rainfall gradient within the place, so that species characteristic of both the wetter coastal forests and drier inland woodlands of north western Australia are represented (DAWE, 2021b).

5.4.8 Key Ecological Features

KEFs are components of the marine ecosystem that are considered to be important for biodiversity or ecosystem function and integrity of the Commonwealth Marine Area.

The activity area does not overlap with any KEFs, however the EMBA overlaps with the ‘Carbonate bank and terrace system of the Sahul Shelf’ KEF. At its closest point, the activity area is located 12 km east of this KEF (Figure 5.38). This KEF is described below.

Carbonate bank and terrace system of the Sahul Shelf

The carbonate bank and terrace system of the Sahul Shelf KEF is located in the western JBG and to the north of Cape Bougainville and Cape Londonderry. The carbonate banks and terrace system of the Sahul Shelf is defined as a KEF for its role in enhancing biodiversity and local productivity relative to its surrounds as it is a unique seafloor feature supporting relatively high species diversity, making it regionally significant.

The KEF provides areas of hard substrate in an otherwise soft sediment environment, which is important for sessile species. Banks rise from depths of approximately 80 m to within 30 m of the surface. Banks that rise to within 45 m water depth support more biodiversity, such as communities of sessile benthic invertebrates including hard and soft corals, sponges, whips, fans and bryozoans (Brewer *et al*., 2007; Nichol *et al*., 2013). Brewer et al (2007) also noted that banks within the KEF support aggregations of demersal fish species such as snappers, emperors and groupers.

The banks are recognised as a biodiversity hotspot for sponges with more species and different communities than the surrounding seafloor (NERP MBH, 2014). The KEF is also known as a foraging area for flatback, olive ridley and loggerhead turtles (DSEWPC, 2012).

Threats to the KEF include changes in sea temperature and ocean acidification, both resulting from climate change, as well as extraction of living sources from illegal, unreported and unregulated fishing (Brewer *et al*., 2007; Nichol *et al*., 2013).

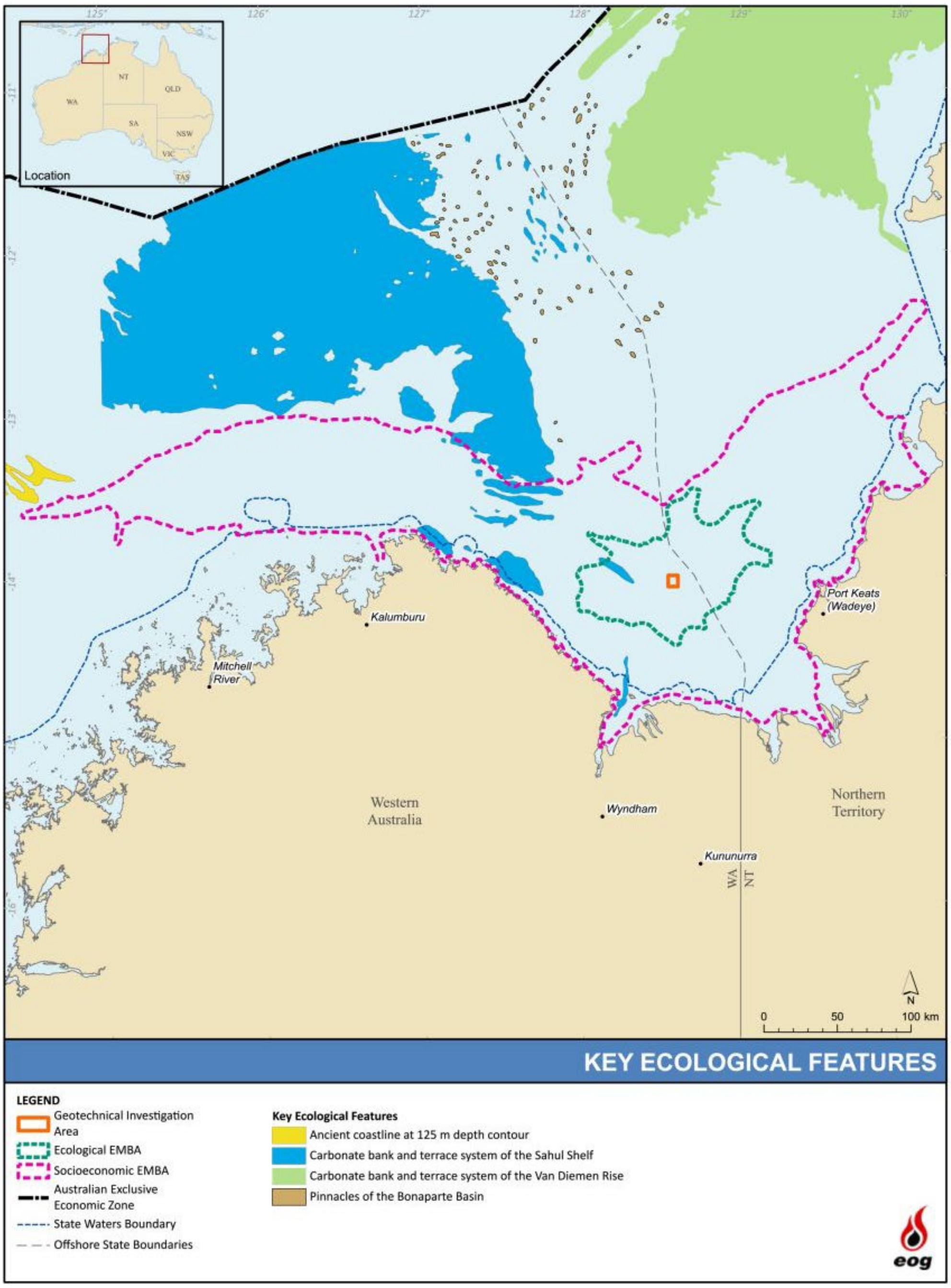


Figure 5.38 KEFs intersected by the spill EMBA

5.4.9 State/Territory Protected Areas

The activity area does not intersect any State- or Territory-managed protected areas.

There is one WA-managed marine protected area intersected by the EMBA (see Figure 5.35) and described in Table 5.13. There are no NT-managed marine protected areas intersected by the EMBA.

Table 5.13 WA marine protected areas in the spill EMBA

Name	Distance and direction from activity area	Description
North Kimberley Marine Park	59 km southwest of the activity area	The North Kimberley Marine Park is the largest state marine park in WA, covering an area of approximately 18,450 km^2. The park is located in state waters and extends from York Sound to Cape Londonderry, to the JBG and up to the WA/NT border (DPW, 2016). The park is part of a joint management plan between the Department of Parks and Wildlife and the Uunguu, Balangarra, Miriuwung Gajerrong and Wilinggin traditional owners (DPW, 2016). The North Kimberley Marine Park covers a large variety of marine habitats including coral reefs, seagrass, mangroves and macroalgal communities. More than 1,000 islands and associated intertidal and subtidal habitats are contained within its boundaries. Seagrass beds found around Cape Londonderry (164 km west of the activity area) provide foraging areas for dugong and marine turtles (DPW, 2016). The marine park surrounds thousands of islands with diverse and rich habitats. Marine turtle nesting sites and breeding sites for seabirds and migratory shorebirds have been identified within the marine park, and fringing reefs line the shores of almost all of the islands (DPAW, 2016). The productive deep waters that surround the islands and open sea reefs provide foraging habitat for marine mammals and pelagic fish, such as mackerel (DPW, 2016). The complex coastline of the mainland also creates a variety of habitats and communities, including important areas for dugongs, Australian snubfin dolphins and Australian humpback dolphins (DPW, 2016). The marine park also contains many places of cultural and spiritual importance to traditional owners (DPW, 2016). Environmentally significant areas with the marine park include: • King Shoals Sanctuary Zone – supports a wide diversity of organisms including corals and other reef dwelling species. The area is likely to be foraging grounds for flatback turtles and sawfish. • Cape Domett Special Purpose Zone – is a globally significant nesting area for flatback turtles, and the surrounding waters provide habitat for sawfish, Australian snubfin dolphins and include mangroves.

5.5 Heritage Values

5.5.1 Aboriginal Heritage

A search of the WA Department of Aboriginal Affairs' Aboriginal Heritage Inquiry System (AHIS) does not identify any registered Aboriginal heritage sites, other heritage sites or Aboriginal heritage survey areas within the activity area. The existence of any unknown sites or artefacts of significance within the offshore waters of northern Australia is considered highly unlikely.

There are seven Registered Aboriginal Sites (Burrunungu, Ganggarryu, Ngarrmu/Ngarrmiyu, Balu-Gunanjarr Complex, Pelican Islet 1, Reveley Island Midden and Berkeley River Dunes) listed along the coast offshore Wyndham and the east Kimberley that fall within the EMBA.

5.5.2 Native Title

A search of the NNTT Register did not identify any Native Title areas or any pending titles within the activity area. There are four Native Title areas within the EMBA:

- Miriuwung Gajerrong - represented by the Miriuwung and Gajerrong Aboriginal Corporation (MG Corporation). The determination area extends to intertidal areas and sea country intersected by the EMBA in the Cambridge Gulf and eastern Kimberley region (Figure 5.39).
- Balanggarra - represented by the Balanggarra Aboriginal Corporation. The northern boundary of the area runs through sea country and encompasses a number of islands near the coast, including the Sir Graham Moore Islands, Adolphus Island and Reveley Island (Figure 5.40).
- Spirit Hills Pastoral Lease No.2 – located in the NT near the Keep River National Park and is held by the Miriuwung-Bindjen, Miriuwung-Nyawam Nyawam, Gajerrong-Gurrbjim, Gajerrong-Djarradjarranay, Gajerrong-Djandumi and Gajerrong-Wadanybang groups.
- Legune Pastoral Lease – located in the NT near the Keep River National Park Extension and is held by the Gajerrong-Wadanybang, Gajerrong-Gurrbjim and Gajerrong-Djarrajarrany groups.

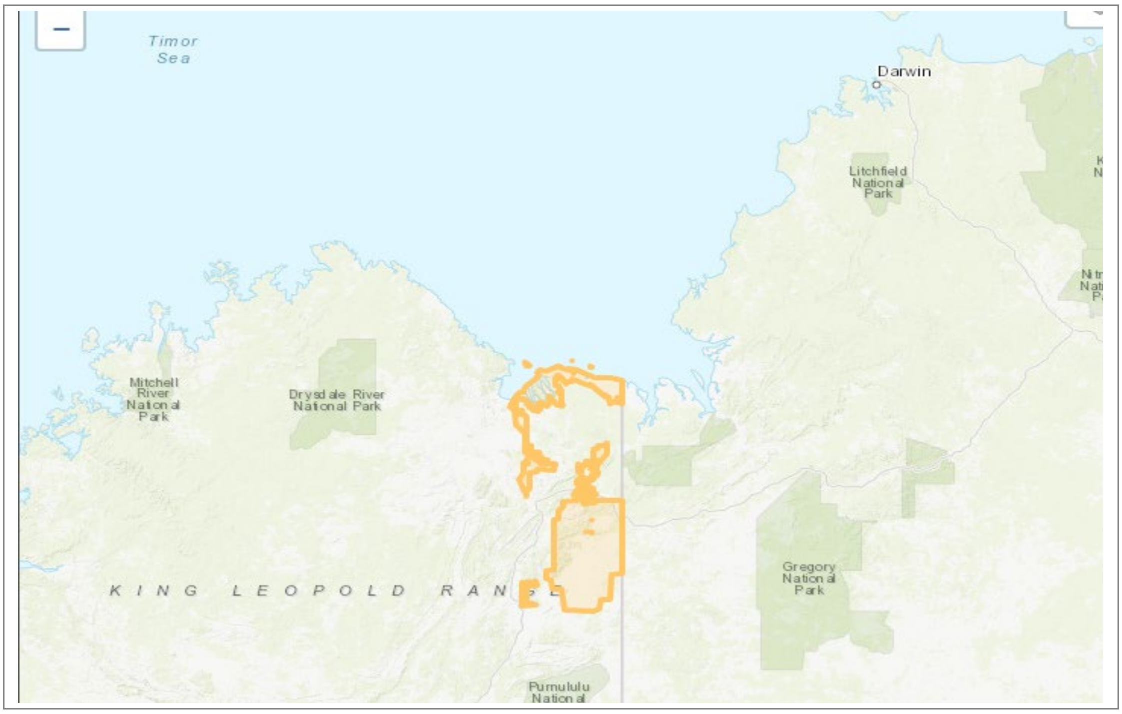


Figure 5.39 Miriuwung Gajerrong Native Title Determination Area

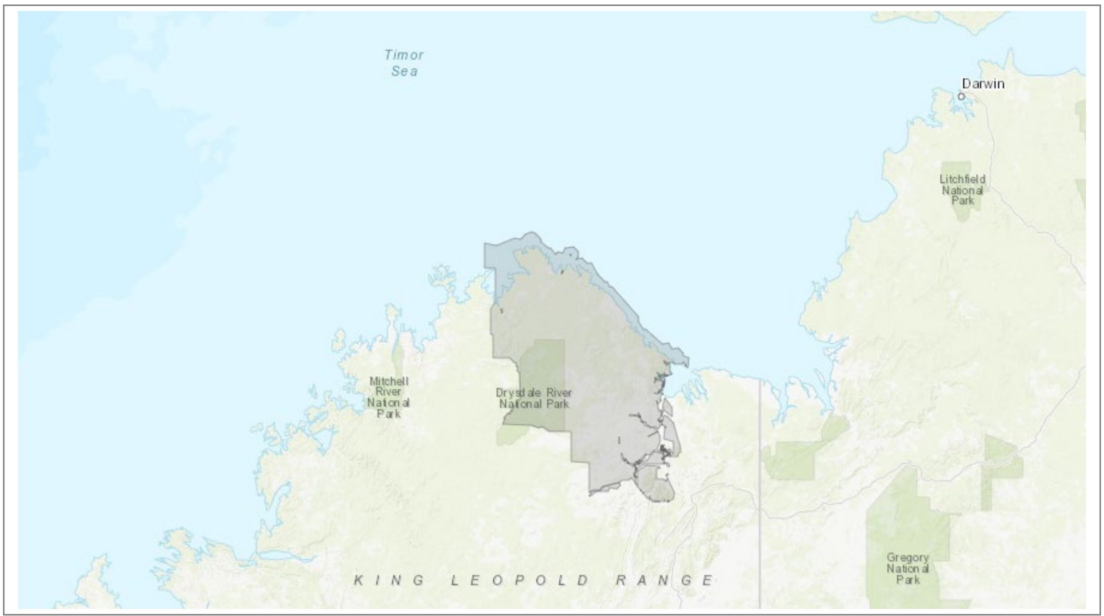


Figure 5.40 Balanggarra Native Title Determination Area

5.5.3 Maritime Archaeological Heritage

Historic shipwrecks are recognised and protected under the *Underwater Cultural Heritage Act 2018*, which aims to protect historic wrecks and associated relics. Under the Act, all wrecks more than 75 years old are protected, together with their associated relics regardless of whether their actual locations are known.

A search of the National Shipwreck and Relic database identified no shipwrecks within the activity area. Five shipwrecks are identified in the coastal parts of the EMBA (Figure 5.41) and are briefly described below.

- Phoenix (Shipwreck ID 8241): Wrecked in 1950 but was never found. This is very little information regarding the vessel or wreck.
- Polype (Shipwreck ID 4673): Wrecked in 1913 but was never found. This is very little information regarding the vessel or wreck.
- Loellen (Shipwreck ID 3486): Wrecked in 1965 by heavy seas after unloading cargo on Tchindy Beach. No wreck has been found.
- Margaret Mary (Shipwreck ID 4450): Wrecked in 1965 but was never found. This is very little information regarding the vessel or wreck.
- Editha (Shipwreck ID 3996): Wrecked in 1963 and was originally constructed in 1903. Wrecked off Cape Hay, NT but was not found.

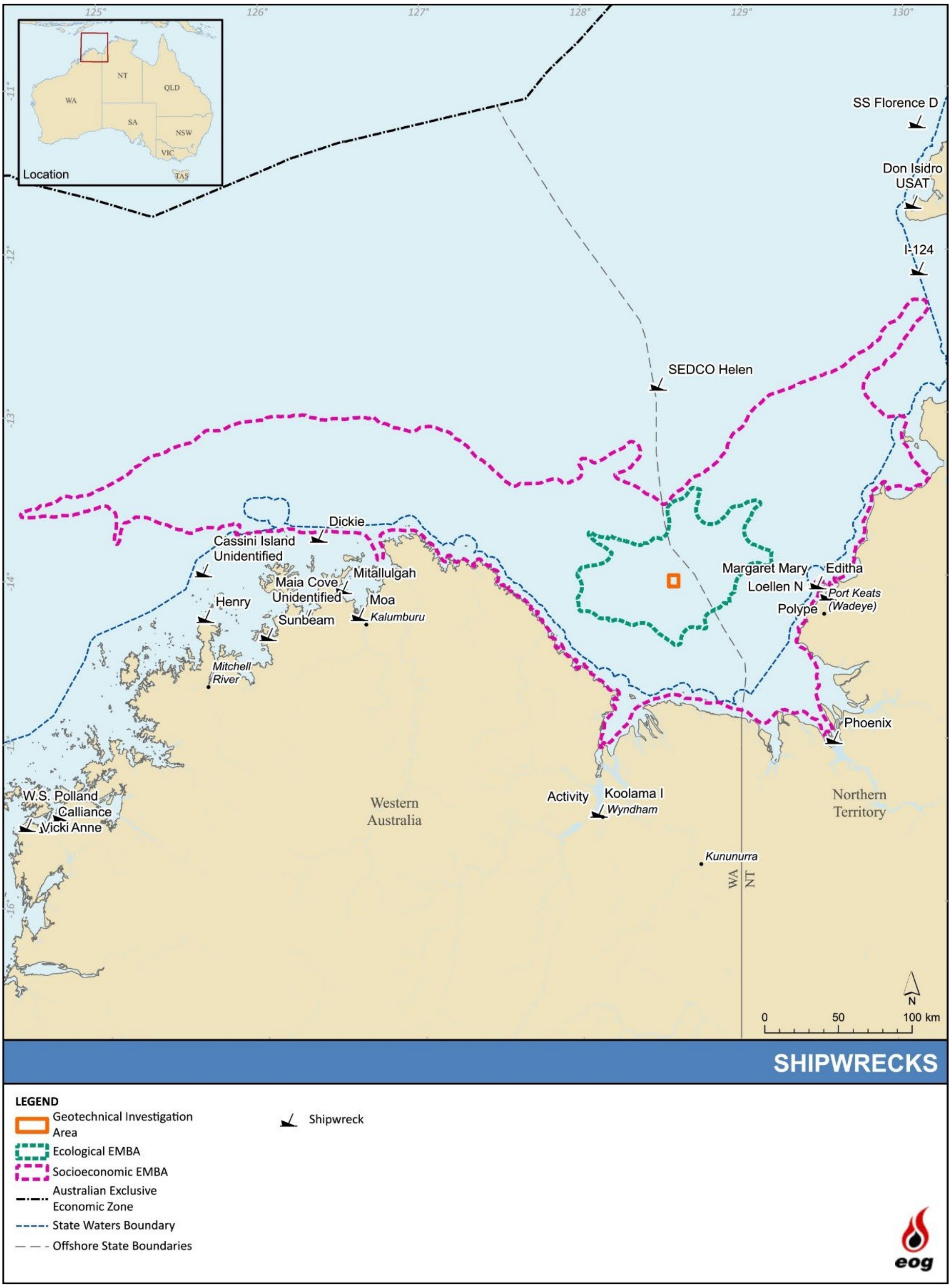


Figure 5.41 Shipwrecks intersected by the EMBA

5.6 Socio-economic environment

5.6.1 Commercial Fishing

Several Commonwealth, WA and NT commercial fisheries are licensed to operate in and around the activity area and the EMBA. These are described in the following sections.

Commonwealth-managed Fisheries

Commonwealth fisheries are managed by AFMA under the *Fisheries Management Act 1991*. Their jurisdiction covers the area of ocean from 3 nm from the coast out to the 200 nm limit (the extent of the Australian Fishing Zone [AFZ]). Commonwealth commercial fisheries with jurisdictions to fish the EMBA and activity area are the:

- Western Tuna and Billfish Fishery;
- Southern Bluefin Tuna Fishery;
- Northwest Slope Trawl Fishery;
- Western Skipjack Fishery; and
- Northern Prawn Fishery (NPF).

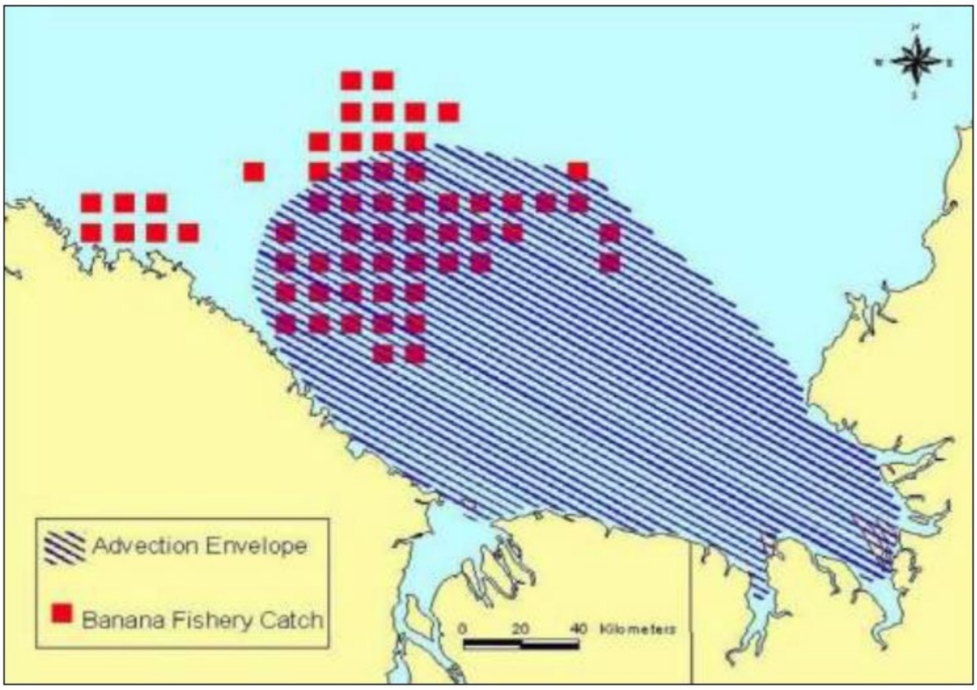
Of these fisheries, only the NPF has evidence of recent (within the last three years) fishing activity in the EMBA or activity area.

Northern Prawn Fishery

Due to the large tidal range (6–8 m) in the JBG and its reputed influence on prawn abundance in the region, red-legged banana prawns are fished on the neap tides, when tidal range and currents are minimal (Tonks *et al*., 2008). Thus, over a tide cycle, fishing effort is high on the late spring-neap, neap and early neap-spring tides, and low to non-existent at other times when the fleet moves to fishing grounds north of Melville Island and Port Essington, outside the JBG. The extra steaming time that this fishing pattern generates, together with the remoteness of the JBG and the lower price of red-legged banana prawns in comparison to other species of prawns, makes the JBG a less attractive area to fish than other parts of the NPF. As a result, the annual fishing effort in the JBG fishery is mostly dependent on the catch levels elsewhere in the NPF; if catches are good elsewhere, effort in the JBG is low (Loneragan *et al*., 2002).

Prawn species reach a commercial size at six months of age and can live for up to two years. Growth rates vary considerably between species and sexes, with females generally growing faster and to a larger size than males. Most species are sexually mature at six months, but fertility increases with age. Females can produce hundreds of thousands of eggs at a single spawning at twelve months old and may spawn more than once in a season. After spawning in offshore waters, the eggs sink to the bottom after release, where they hatch into larvae within about 24 hours. Usually <1% of these offspring survive the two-to-four-week planktonic larval phase to reach suitable coastal nursery habitats where they may settle. After one to three months in the nursery grounds, the young prawns move offshore into the fishing grounds.

Research indicates that *P. indicus* prawns spawn offshore near to the fishing area throughout the year with two spawning peaks: the late dry season (September to November) and the late wet season (March to May) (see Table 5.5). The larvae move inshore and then wash out as juveniles with the wet season floods. The migration of juvenile *P. indicus* in the JBG (as described in Table 5.5) is shown in Figure 5.42.



Source: Loneragan et al (2002).

Figure 5.42 Size and the probable advection envelope for post-larval *P.indicus* in the JBG

The JBG comprises about 30,000 km^2 of the westernmost portion of the NPF. Figure 5.43 and Figure 5.44 show the area of the fishery and fishing intensity for the 2019 and 2020 seasons. NPF catch in the JBG is comprised primarily of banana prawns (mainly *P. indicus* and some *P. merguiensis*), being more than double that of tiger prawns and endeavour prawns in 2019 combined (Patterson *et al*., 2020). Fishing for *P. indicus* is permitted day and night in both NPF fishing seasons. Fishing takes place in waters 35–70 m deep, with most fishing effort between 50 and 80 m (these water depths are deeper than those of the activity area). The trawling regime for this species is similar to the tiger prawn sub-fishery in other regions of the NPF, where the total duration of individual trawls is usually about 3 hours long. Although the JBG fishery comprises less than 5% of the area of the NPF, it contributes about 65% of the NPF's red legged banana prawn catch and around 20% of the NPF's total banana prawn catch (combined *P. merguensis* and *P. indicus*) (Loneragan *et al*., 2002).

A seasonal closure for the NPF in the JBG exists in the period 31 March – 15 June (AFMA, 2021) (Figure 5.45). The seasonal closure is an exclusion zone in place for all licence holders within the NPF, and the purpose of this closure is to protect small juvenile prawns as they migrate offshore to deeper waters in the southern JBG, where the adults are targeted during the trawling operations (AFMA, 2021). Any catch south of the seasonal closure line is taken in the second fishing season only (August to November), whereas catch taken north of the closure line is taken during both the first and second seasons. The activity area is located within this exclusion zone.

Table 5.14 summarises the key facts and figures of the NPF. Information on spawning for commercial prawn species is provided in Table 5.5 and Figure 5.11.

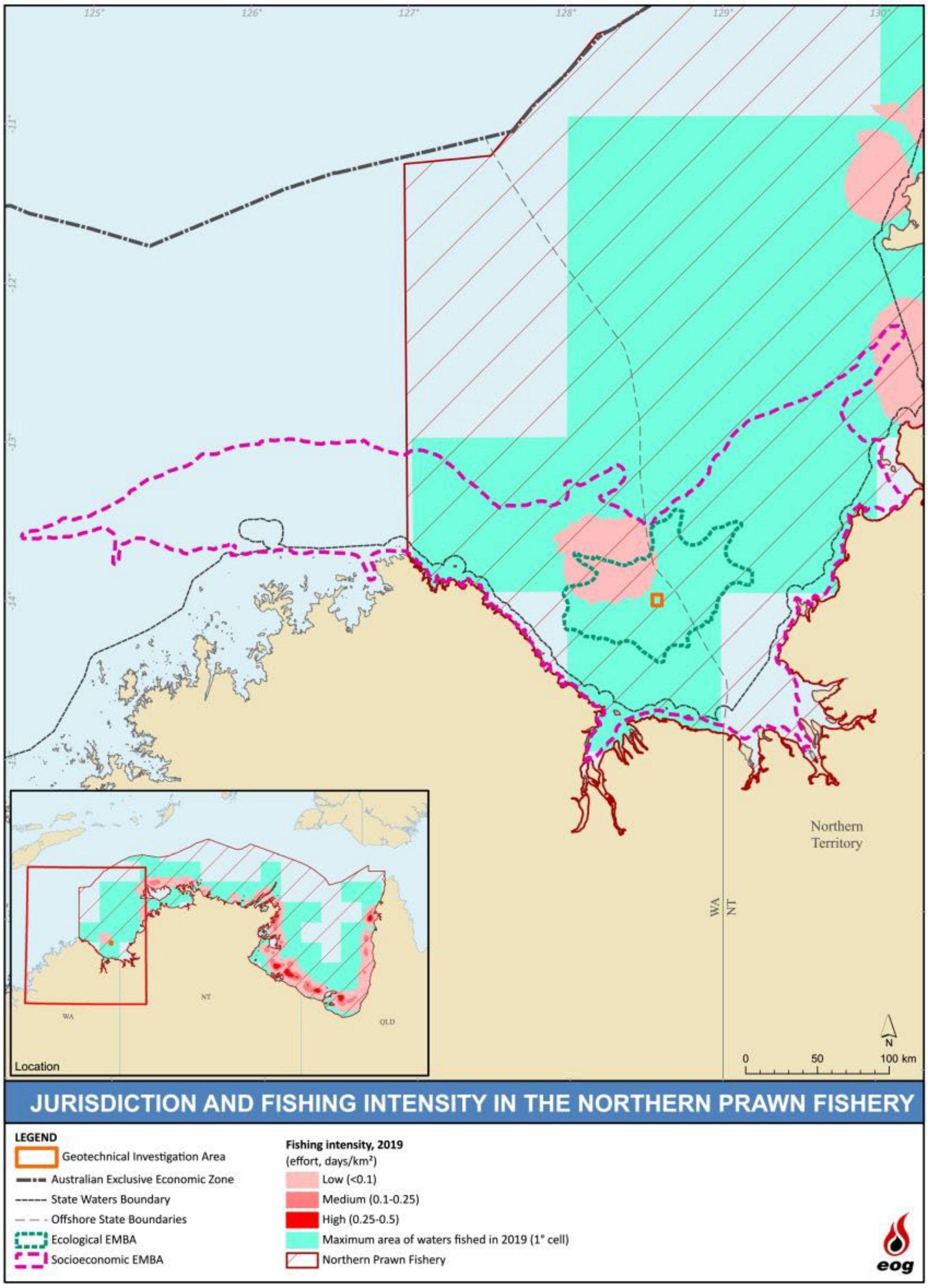


Figure 5.43 NPF fishing intensity in the EMBA (2019)

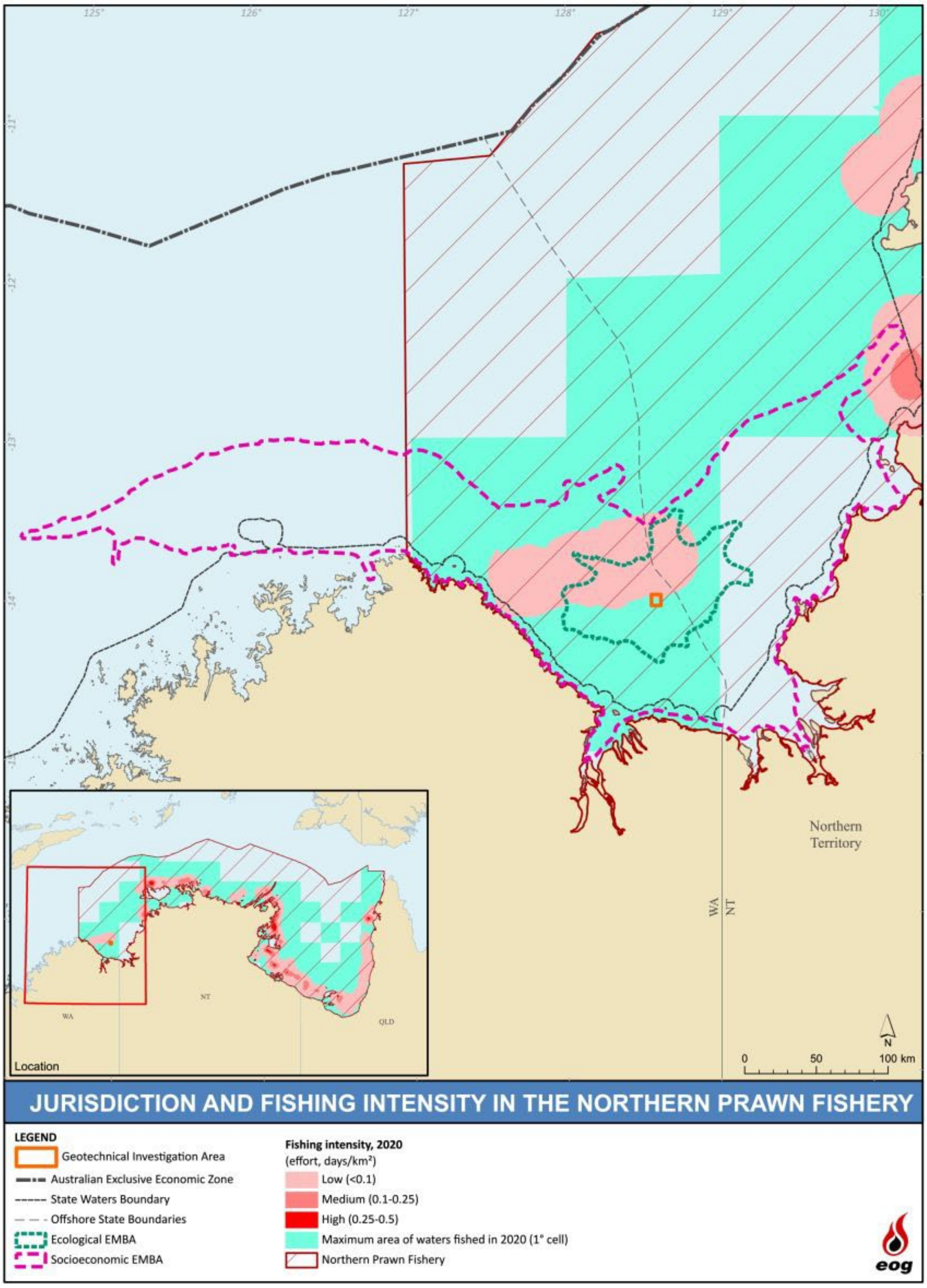


Figure 5.44 NPF fishing intensity in the EMBA (2020)

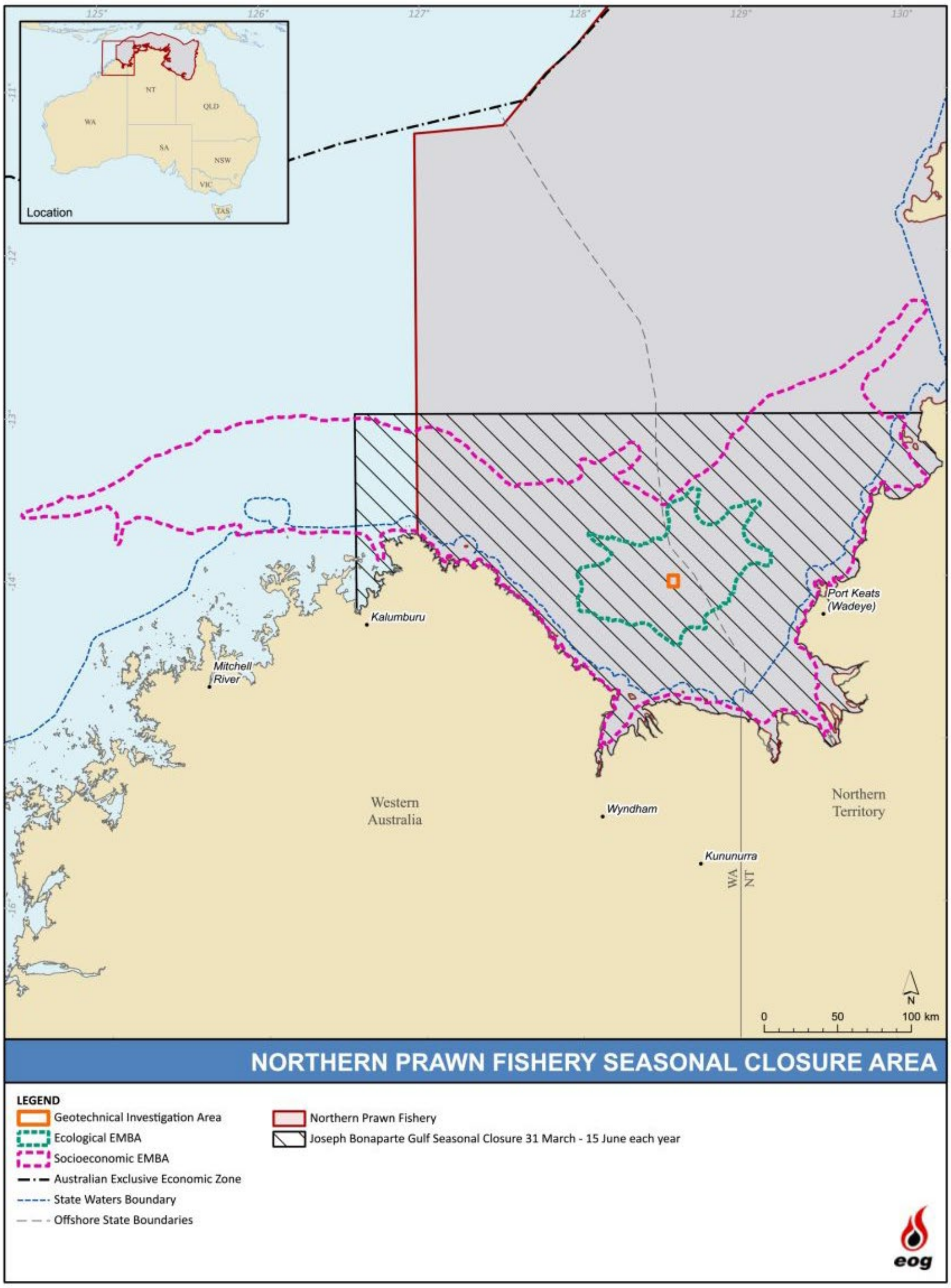


Figure 5.45 JBG seasonal closure area of the NPF

Table 5.14 Commonwealth-managed commercial fisheries with jurisdictions to fish in and around the activity area and EMBA

Fishery	Target species	Does fishing activity intersect activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
NPF (Figure 5.43 Figure 5.44)	Redleg banana prawn (*Fenneropenaeus indicus),* white banana prawn (*F. merguiensis*), brown tiger prawn (*Penaeus esculentus*), grooved tiger prawn (*P. semisulcatus*), blue endeavour prawn (*Metapenaeus endeavouri*) and red endeavour prawn (*M. ensis*)	**Activity area?** **Yes** **Spill EMBA?** **Yes**	The NPF operates in two seasons; • First – April to June, when banana prawns are the key catch species. • Second – August - November, when tiger prawns are the key catch species.	Otter trawl is the primary fishing method. In the 2020 fishing season, there were 52 fishing vessels and 52 active vessels in the fishery. The numbers were the same in 2019. The primary landing ports are Darwin (NT), Cairns and Karumba (Qld).	Catch data and economic value available for the last five years: • 2020 – 4,767 tonnes valued at $84.9 million. • 2019 – 8,581 tonnes valued at $117.1 million. • 2018 – 6,778 tonnes valued at $98.2 million. • 2017 – 6,602 tonnes valued at $118.1 million. • 2016 – 5,794 tonnes valued at $126.1 million.

Sources: Patterson et al (2021; 2020; 2019; 2018; 2017).

Western Australia-managed Fisheries

Western Australian-managed commercial fisheries that are authorised to harvest in the waters of the activity area and EMBA include the following (noting that not all actively fish):

- Mackerel Managed Fisheries (MMF) (Area 1 – Kimberley);
- Northern Demersal Scalefish Managed Fishery;
- Pearl Oyster Managed Fishery (Zone 3)
- Abalone Managed fishery (Area 8);
- Marine Aquarium Fish Fishery;
- Kimberley Crab Managed Fishery (North Coast Crab Fishery);
- Kimberly Prawn Managed Fishery; and
- Specimen Shell Fishery.

Through its consultation process with the WA DPIRD, EOG identified the MMF, the Northern Demersal Scalefish Managed Fishery, Kimberley Crab Managed Fishery, Kimberley Prawn Managed Fishery and the Kimberley Gillnet and Barramundi Fishery as the key fisheries that actively fish in the activity area and/or EMBA.

Table 5.15 presents information for the fisheries that have recent evidence of fishing in the activity area and/or EMBA.

Table 5.15 Western Australian-managed commercial fisheries with jurisdictions to fish within the activity area and EMBA

Fishery	Target species	Does fishing activity intersect activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Northern Demersal Scalefish Managed Fishery (Area 1, Zone A) Figure 5.46)	Targets predominately goldband snapper (*Pristipomoides multidens*), crimson snapper, red emperor (*Lutjanus sebae*) bluespotted emperor (*Lethrinus punctulatus*), saddletail snapper (*L. malabaricus*), rankin cod (*Epinephelus multinotatus*), brownstripe snapper (*L. vitta*), rosy threadfin bream (*Nemipterus furcosus*) and spangled emperor (*Lethrinus nebulosus*).	**Activity area?** **Unknown.** **Spill EMBA?** **Likely.**	Assumed to be year-round.	Although permitted to use handlines, droplines and traplines, since 2002 the fishery has been essentially trap based. Six vessels actively fished in 2019, which is down from seven vessels operating in 2016.	Catch data available for the last five years: • 2019 – 1,507 t. • 2018 – 1,297 t. • 2017 – 1,317 t. • 2016 – 1,173 t. • 2015 – 1,046 t. Majority of catch (87%) was landed in Zone B in the 2019 season.
MMF (Area 1 and 2) (Figure 5.47)	Spanish mackerel (*Scomberomorus commerson*)	**Activity area?** **Unknown.** **Spill EMBA?** **Likely.**	Fishing was primarily from May – November in 2019.	A total of 15 vessels operated during 2019 across the fishery. In 2014, only three vessels operated in the Kimberley region. Trolling and handline are the only allowable fishing methods.	Catch data available for the last five years: • 2019 – 291 t. • 2018 – 213 t. • 2017 – 283 t. • 2016 – 276 t. • 2015 – 302 t.
Kimberley Crab Managed Fishery (KCMF) (Figure 5.48)	Green mud crabs (*Scylla serrata*) and brown mud crabs (*Scylla olivacea*).	**Activity area?** **No.** **Spill EMBA?** **Likely.**	Generally March to November, with June to September being the most productive months.	Crab traps are the primary fishing method. In 2019, six people were employed as skippers and crew on vessels fishing for mud crab in the KCMF.	Catch data available for recent years: • 2019 – 7.4 t. • 2018 – 3.2 t. • 2017 – 9.0 t. • 2016 – 2.5 t.

Fishery	Target species	Does fishing activity intersect activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Kimberley Prawn Managed Fishery (Figure 5.49)	Banana prawns (*Fenneropenaeus indicus* and *F. merguiensis*) are the primary target species though brown tiger prawns (*Penaeus esculentus*) and blue endeavour prawns (*Metapenaeus endeavouri*) are taken as bycatch.	**Activity area?** **No.** **Spill EMBA?** **Yes.**	There are two fishing periods for the season (April to mid-June, then from August to the end of November) with around 90% of the total landings taken in the first fishing period.	Otter board trawl system is the primary fishing method.	Catch data available for the last five years: • 2019 – 100 t. • 2018 – 333 t. • 2017 – 269 t. • 2016 – 155 t. • 2015 – 175 t.
Kimberley Gillnet and Barramundi Fishery (Figure 5.50)	Barramundi (*Lates calcarifer*), king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*) are the primary target species.	**Activity area?** **No.** **Spill EMBA?** **Likely.**	Year round, though predominantly occurs from April to September.	Fishing is restricted to state waters. There are currently four licences to the fishery.	Catch data available for the last five years: • 2019 – 73.4 t. • 2018 – 91.8 t. • 2017 – 79.9 t. • 2016 – 74.6 t. • 2015 – 82.1 t.

Gaughan and Santoro (2021; 2020; 2018); Gaughan et al (2019), Fletcher et al (2017), Fletcher and Santoro (2015).

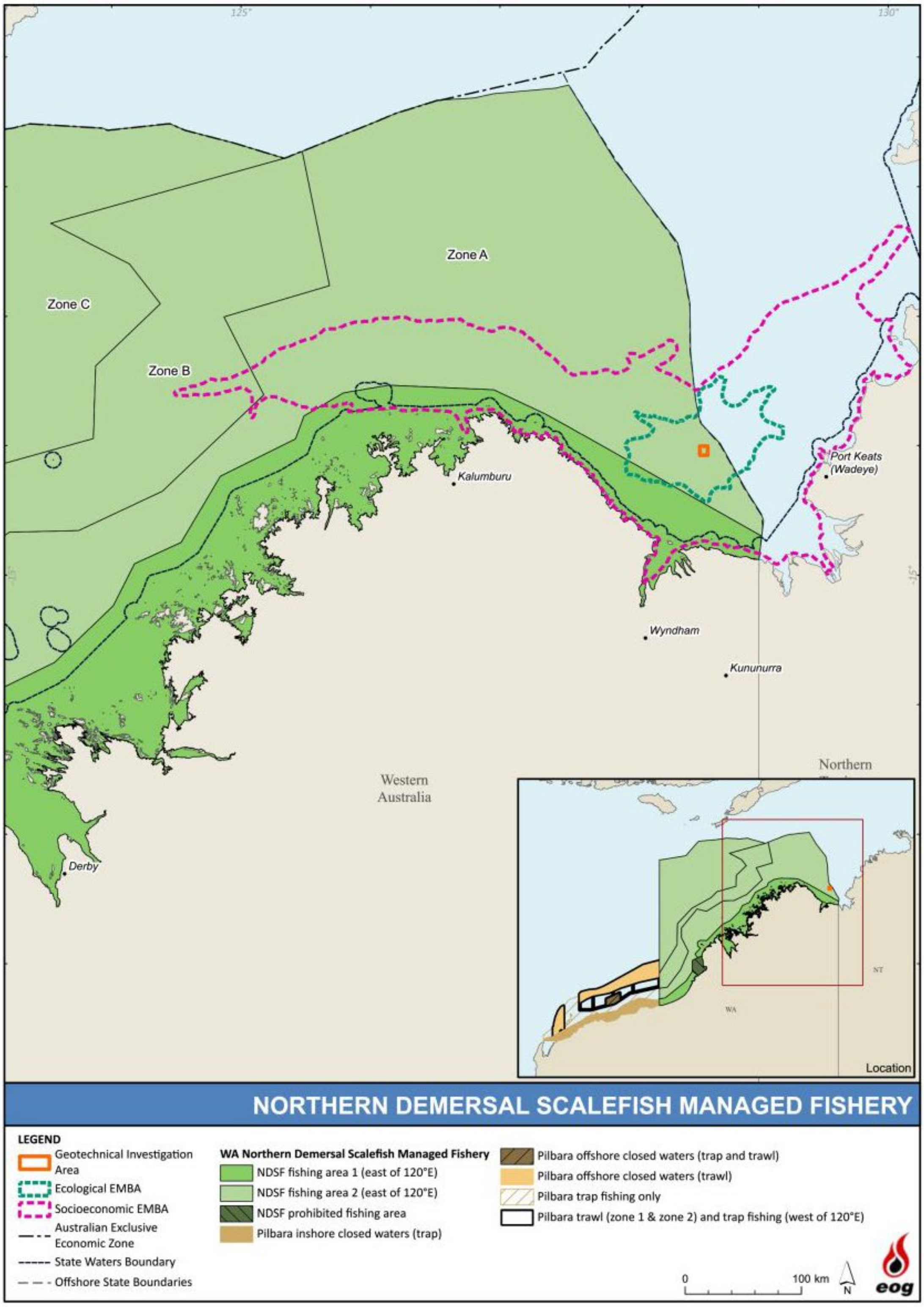


Figure 5.46 WA Northern Demersal Scalefish Fishery

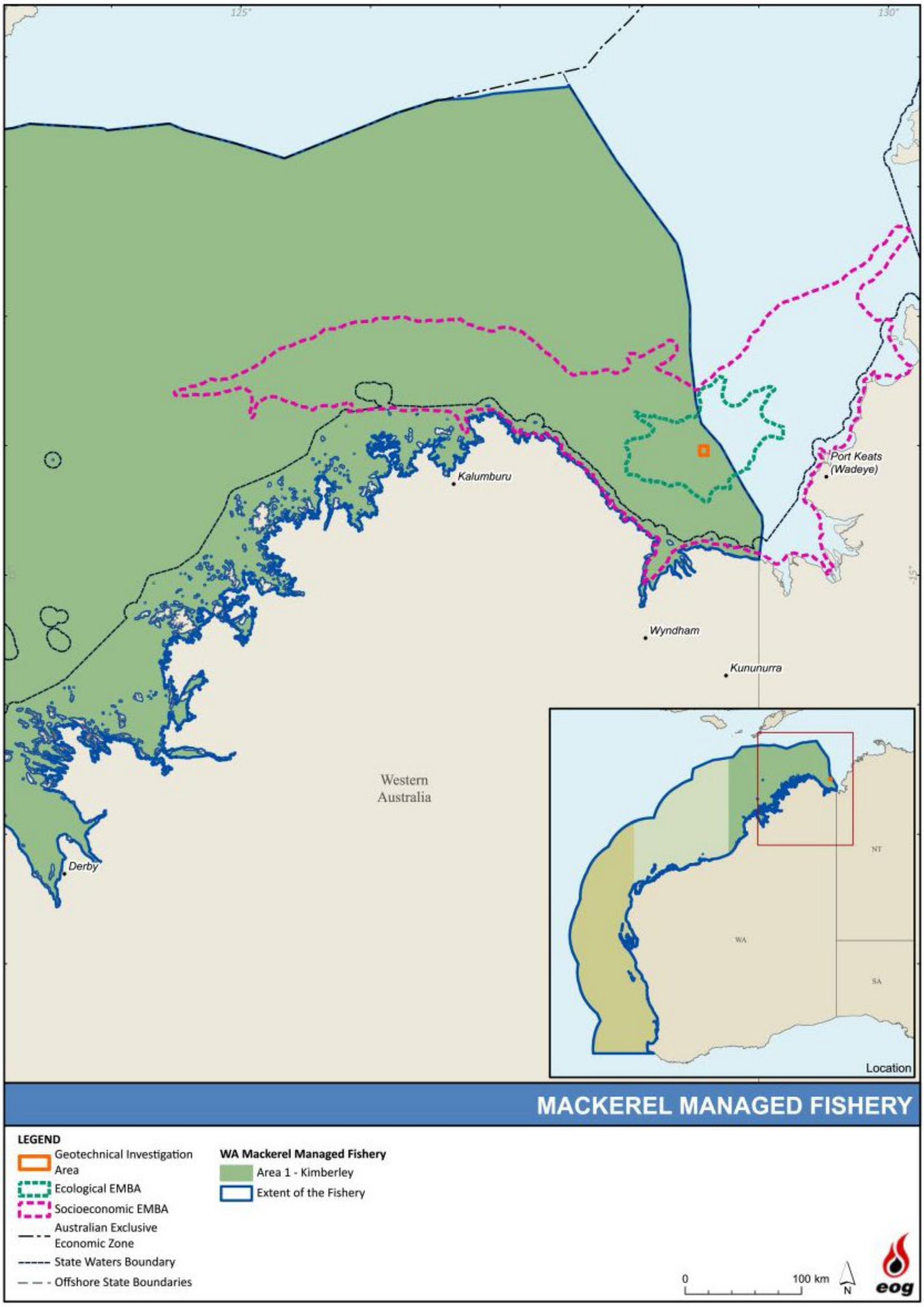


Figure 5.47 Western Australian Mackerel Managed Fishery

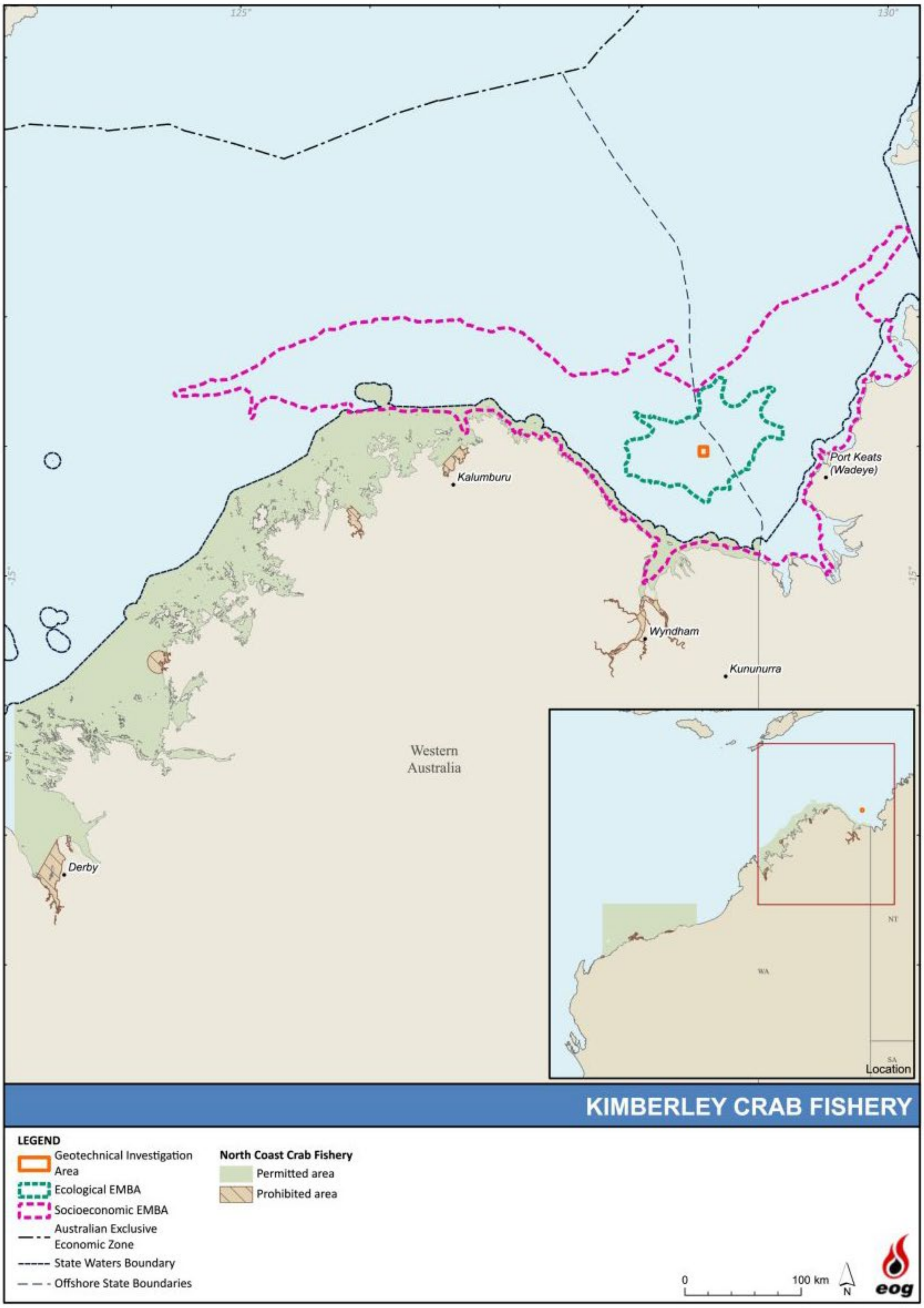


Figure 5.48 WA Kimberley Managed Crab Fishery (North Coast Crab Fishery)

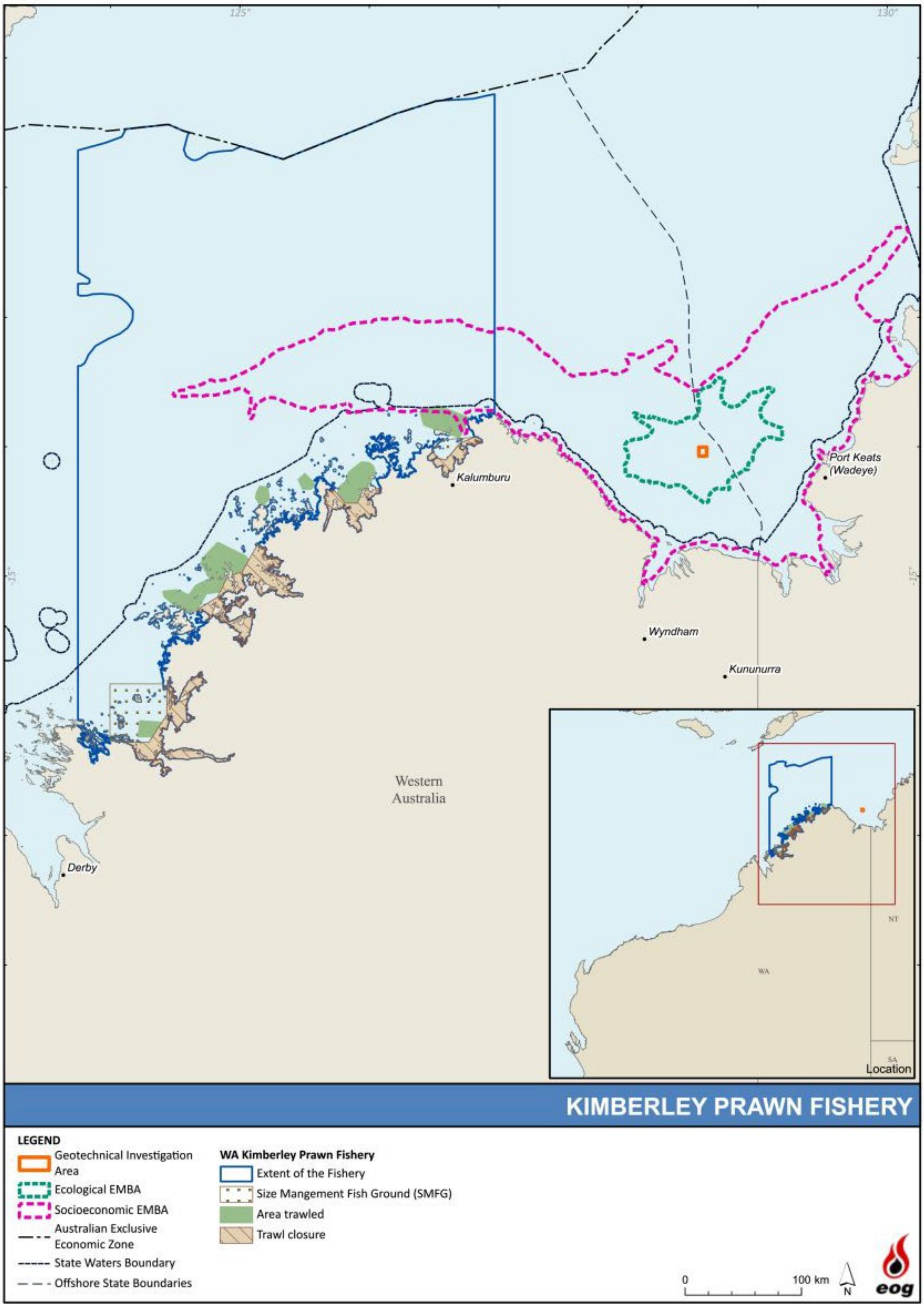


Figure 5.49 WA Kimberley Prawn Managed Fishery

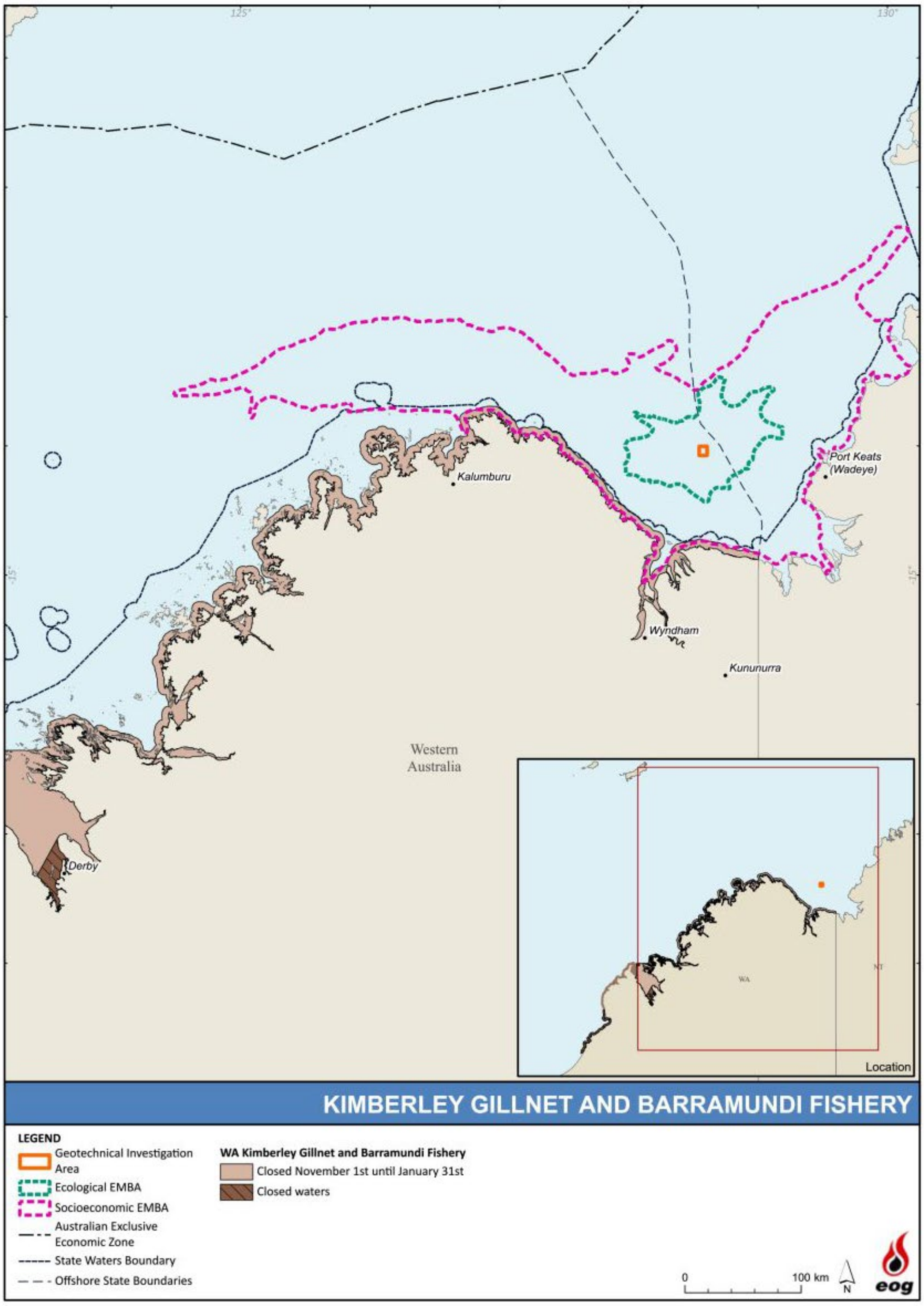


Figure 5.50 WA Kimberley Gillnet and Barramundi Fishery

Northern Territory-managed Fisheries

The NT DITT confirms there are no NT-managed commercial fisheries that fish within the activity area. NT-managed commercial fisheries that are authorised to harvest in the waters of the EMBA include the following (noting that not all actively fish in the EMBA): Spanish Mackerel Fishery; Barramundi Fishery; Coastal line fishery; Offshore Net and Line Fishery; and Demersal Fishery.

A review of data from the NT DITT website and consultation with DITT Fisheries identified the Demersal Fishery, Spanish Mackerel Fishery and Offshore Net and Line Fishery as likely to have fishing effort in the EMBA. Table 5.16 presents the available information for these fisheries.

Table 5.16 Northern Territory-managed commercial fisheries with jurisdictions to fish within the activity area and EMBA

Fishery	Target species	Does fishing activity intersect activity area or EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Demersal Fishery (Figure 5.51)	Primarily red snapper (*Lutjanus erythropterus*), goldband snapper (*Pristipomoides multidens*) and saddletail snapper (*L. malabaricus*).	**Activity area?** **No.** **Spill EMBA?** **Possibly.**	Assumed year-round.	Fishing method is through the use of vertical lines, drop lines, finfish long-lines, baited fish traps and semi-demersal trawl nets in two multi-gear areas. Seven vessels operated in 2016. In 2021 there were 18 licences in the fishery.	In 2017, 3,388 t (including 2,371 t of red snapper and 338 t of goldband snapper) was caught, with an estimated value of $17.9 million. In 2016, 3,463 t (including 2,510 t of red snapper and 318 t of goldband snapper) was caught.
Spanish Mackerel Fishery (Figure 5.52)	Primarily Spanish mackerel (*Scomberomorus commerson*).	**Activity area?** **No.** **Spill EMBA?** **Possibly.**	Assumed year-round.	The primary fishing method used by all sectors is trolling, where baited hooks or lures are towed behind a boat moving at 3–6 knots near reefs, headlands and shoals. In 2021 there were 15 licences in the fishery, all of which were allocated.	Catch data available for the last five years: • 2019/20 – 357 t. • 2018/19 – 408 t. • 2017/18 – 372 t. • 2016/17 – 411 t. • 2015/16 – 399 t.
Offshore Net and Line Fishery (Figure 5.53)	Primarily grey mackeral (*S. semifasciatus*) and black-tip sharks (*Carcharhinidae limbatus*), with other shark species including hammerhead, bull, tiger, pigeye, lemon and winghead.	**Activity area?** **No.** **Spill EMBA?** **Possibly.**	Assumed year-round.	Demersal or pelagic longlines or pelagic net gear is permitted.	No data available.

Sources: NT Government (2019), DPIR (2021, 2019, 2018).

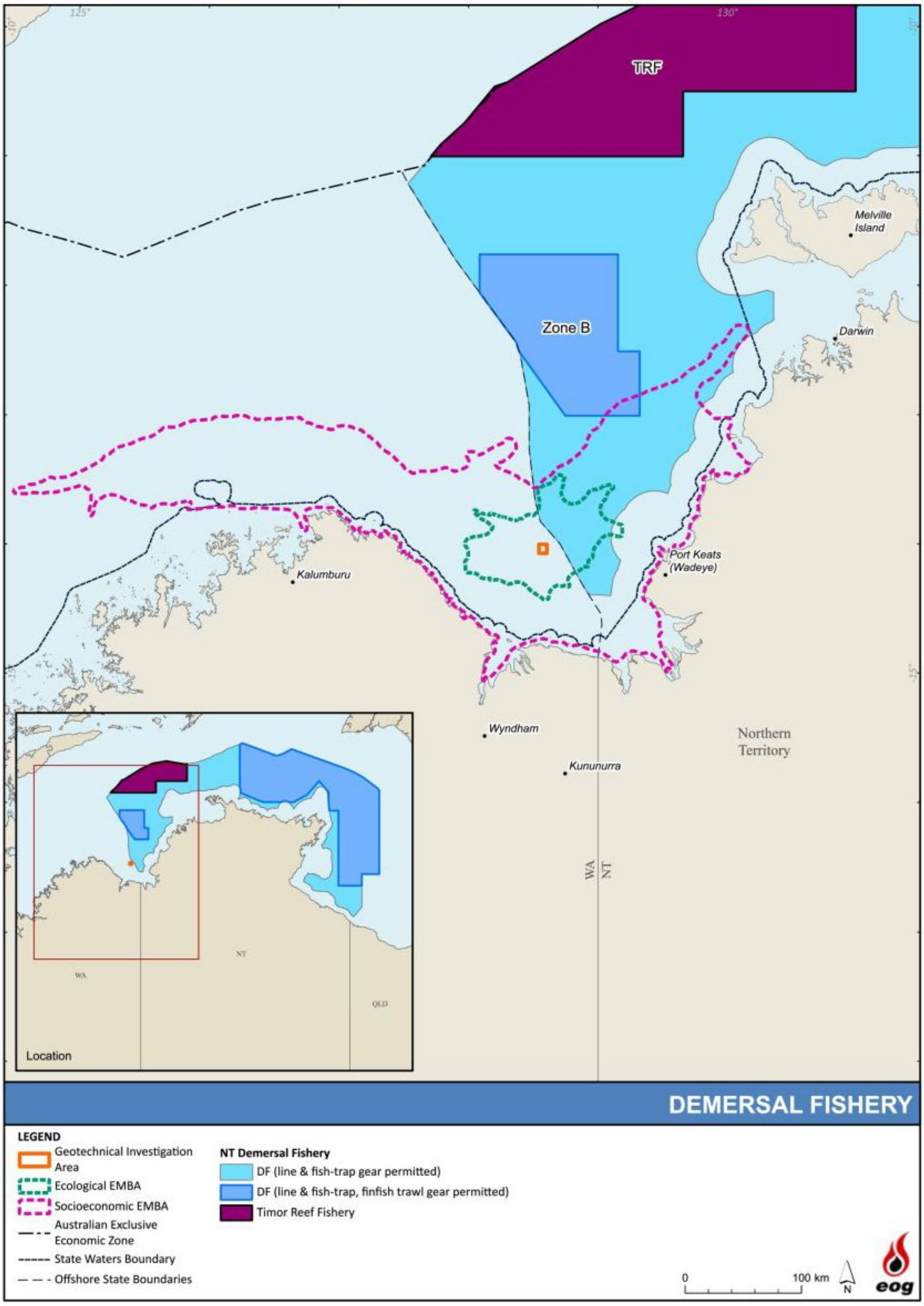


Figure 5.51 NT Demersal Fishery

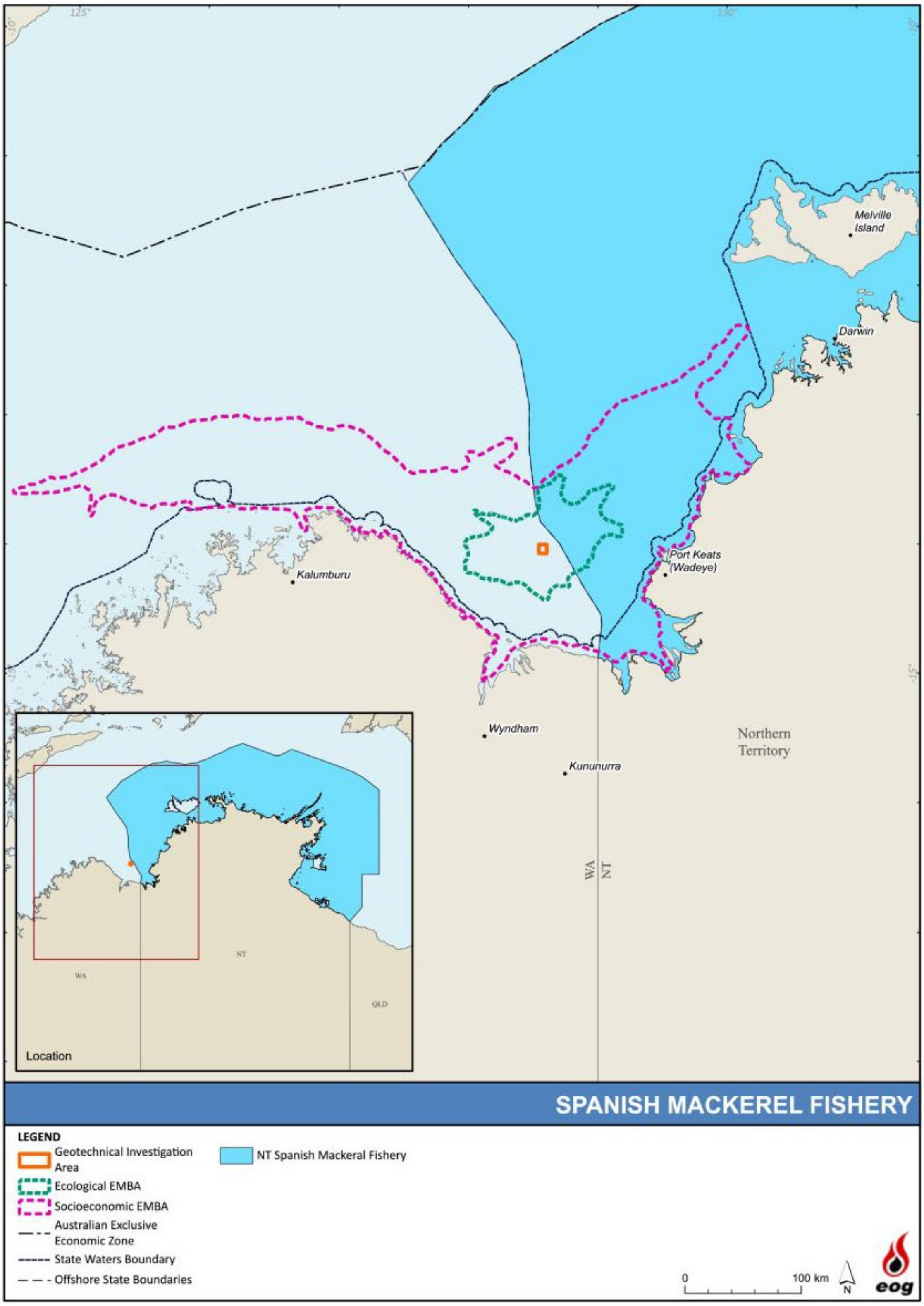


Figure 5.52 NT Spanish Mackerel Fishery

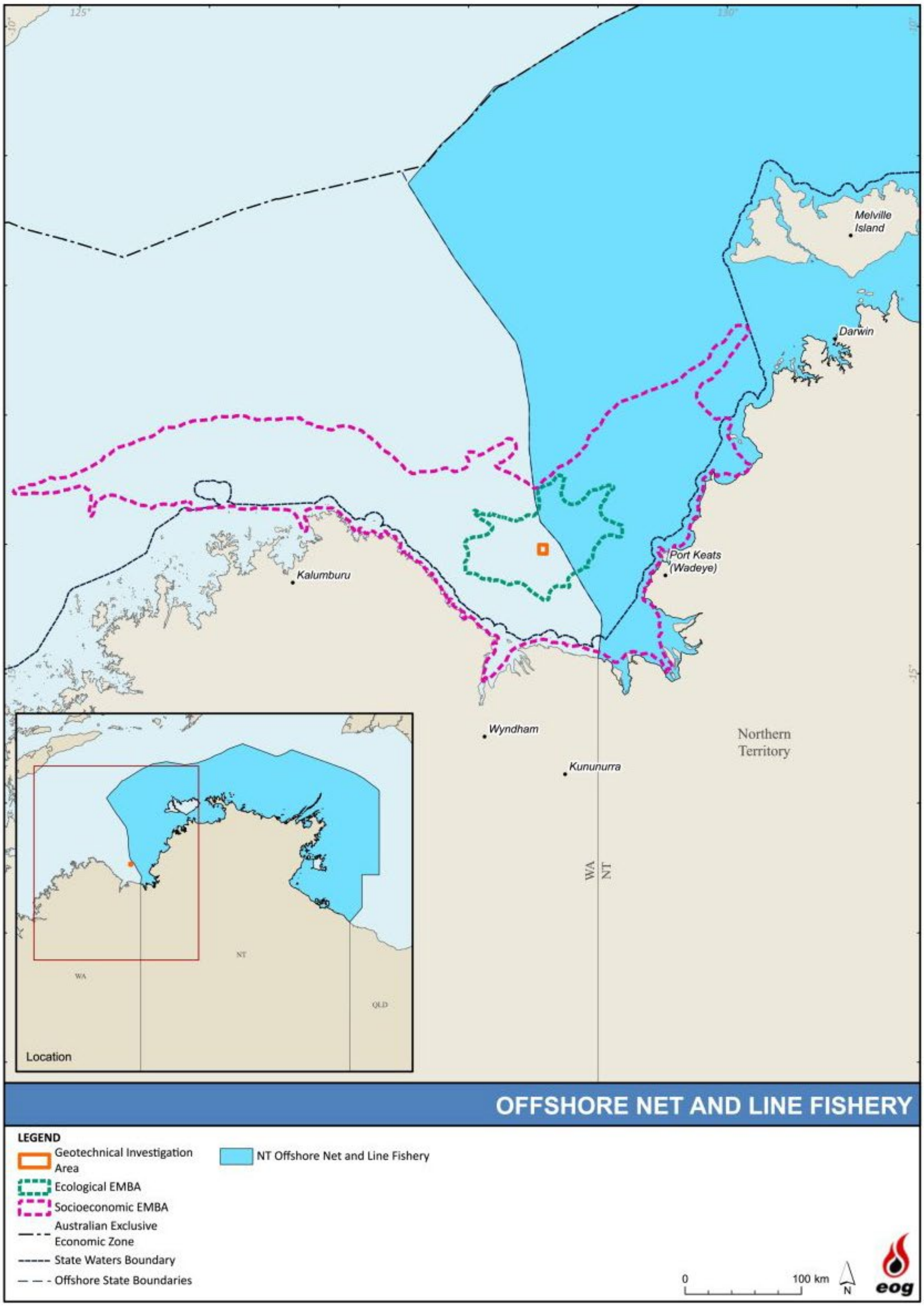


Figure 5.53 NT Offshore Net and Line Fishery

5.6.2 Recreational Fishing

Within the North Coast Bioregion, recreational fishing is experiencing significant growth, with a distinct seasonal peak in winter (Gaughan and Santoro, 2018). Offshore islands, coral reefs and continental shelf provide species of major recreational interest including tropical snapper, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish (Gaughan and Santoro, 2018). There are no islands, reefs or significant seabed features in the activity area that would attract recreational fishers to the activity area.

Recreational fishing activities are primarily based out of Darwin, located 288 km northeast of the activity area. Given the long distance of the activity area from the mainland and main population areas (e.g., Wadeye), there is expected to be little or no recreational fishing activities in the activity area.

RecFish West and the AFANT have not raised any issues regarding recreational fishing in or around the activity area.

5.6.3 Coastal Settlements

The coastline adjacent to the JBG is sparsely populated, with the townships of Wadeye, NT (85 km east) and Wyndham, WA (163 km south) being the closest.

The population of Wadeye was 2,260 people at the time of the 2016 census, with Aboriginal and/or Torres Strait Islander people making up 89.4% of the population (ABS, 2021). Of the employed people in Wadeye, the education and local government administration sectors were the largest employment sectors, which accounted for 21.7% of the workforce.

The population of Wyndham was 780 people at the time of the 2016 census, with Aboriginal and/or Torres Strait Islander people making up 53.7% of the population (ABS, 2021). Of the employed people in Wyndham, the social services, hospital and secondary education sectors were the largest employment sectors, which accounted for 30.5% of the workforce.

5.6.4 Tourism

The JBG is highly remote and therefore has not been significantly developed for tourism. For up to five months of the year, access to the JBG region is restricted to boat or helicopter due to wet season rains, and road access to areas of Aboriginal freehold land requires prior permission from the Northern Land Council (NLC) (Woodside, 2004).

There are no attractions in the activity area or immediate surrounds (e.g., known reefs, shipwrecks, canyons) to attract tourists.

Expedition cruise boats operate in the North Kimberley Marine Park in the dry season (April to October), between Broome and Wyndham or Darwin, and offer multi-day tours (DPW, 2016). Vessels used range from small fishing and sightseeing tour boats to large luxury cruise ships carrying up to 100 passengers (DPW, 2016). Access to the coast is possible although only by using a four-wheel drive. Scenic flights and fishing expeditions operate in connection with coastal accommodation or cruise boats as well as from Broome, Derby and Kununurra (DPW, 2016).

Charter fishing and tourism activities operate from Darwin and the Kimberley and target areas of high scenic value and/or offshore coral reef areas (Woodside, 2004). These attributes have been reported to be sparse in the offshore areas of the JBG, and therefore, given the isolated nature of the area, the likelihood of charter fishing and tourism is also anticipated to be low (Woodside, 2004). Charter boats operating out of Darwin and Broome/Derby may occasionally visit or pass through the JBG.

5.6.5 Offshore Energy Exploration and Production

The Bonaparte Basin is an established hydrocarbon province with a number of commercial operations. The closest operation is the Blacktip Gas Field, located in adjacent permit WA-33-L and operated by ENI Australia (Figure 5.54). The Blacktip Gas Field consists of an unmanned WHP, two producing wells, flowlines and a subsea gas export pipeline (GEP) that runs from the WHP to shore near Wadeye, NT. The Blacktip GEP is located over 5.5 km northeast of the activity area.

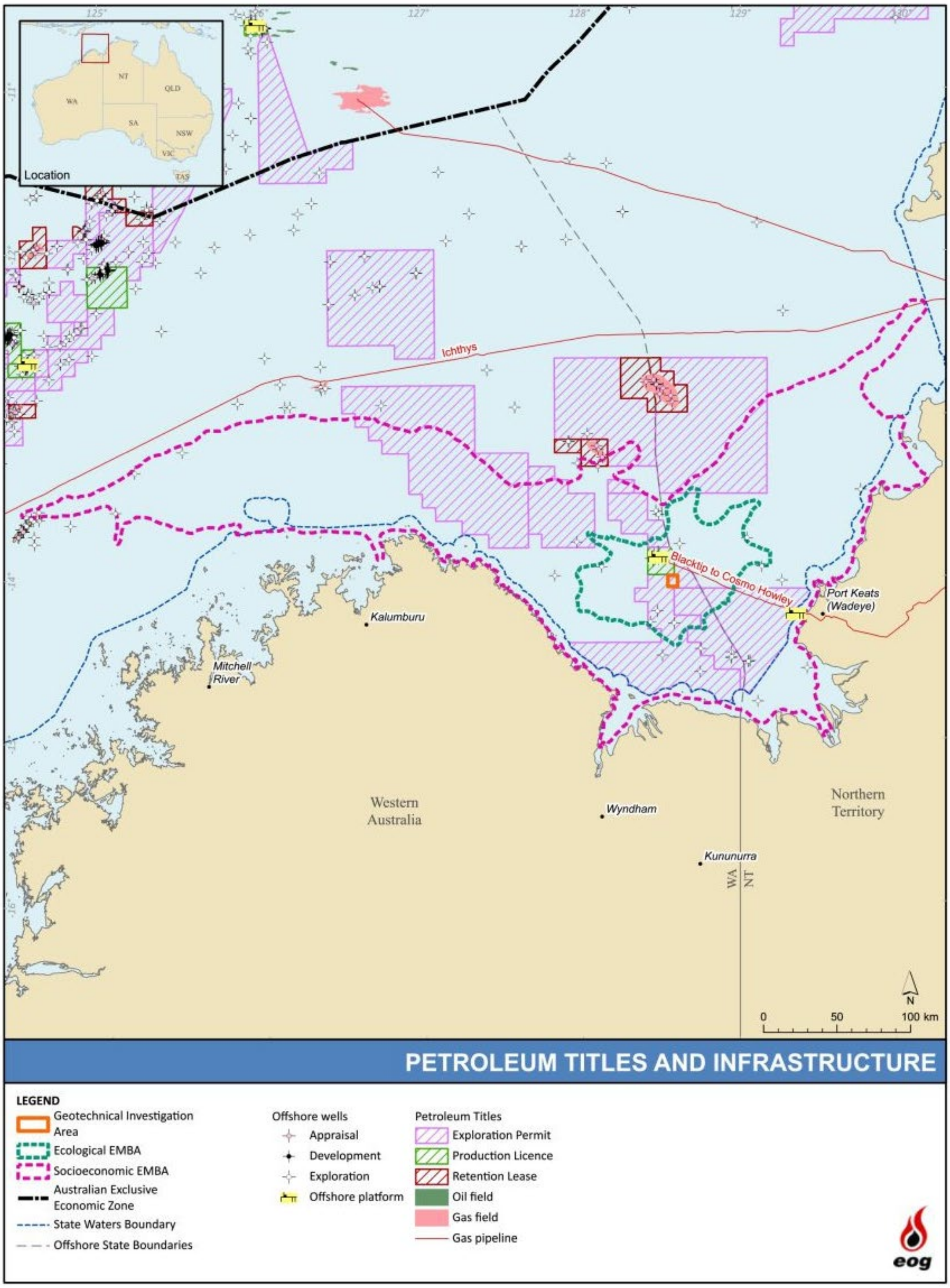


Figure 5.54 Petroleum activity in the spill EMBA

5.6.6 Commercial Shipping

The closest major commercial port is Darwin, located ~288 km northeast of the activity area. The location of the Darwin Port to Asia and the region's offshore oil and gas fields makes the surrounding area a key shipping region. High shipping and vessel traffic occurs in and around Darwin Harbour, around operating petroleum fields (such as Blacktip) and along key shipping routes to and from Southeast Asia and to and from oil and gas fields.

Very low levels of shipping traffic occur through the activity area. Using Automatic Identification System (AIS) data from AMSA and spatial analysis, it was determined that there is also a low level of shipping traffic in the areas immediately adjacent to the activity area and that vessels in this area are mainly transiting and not lingering. An analysis of the shipping traffic recorded from the activity area and its immediate surrounds (i.e., within 10 km of the activity area) is presented in Table 5.17. Shipping traffic in the activity area and EMBA using AIS data from August 2020 to July 2021 is presented in Figure 5.55. As indicated, the activity area is located south of the major shipping lanes coming out of Darwin, which contributes to the very low level of shipping traffic recorded in the region of the activity. The highest number of vessels (12) was recorded in June 2020 with only 1-2 vessels recorded in some months from August 2020-February 2021 and none recorded during March-April 2021. It is noted that some vessels may not possess AIS technology and therefore not appear in the AMSA dataset, though this is considered to be unlikely or representative of only a low number of smaller vessels.

Table 5.17 Commercial shipping traffic recorded in the activity area

Type	2020					2021						
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Undefined	2	1	-	-	-	-	-	-	-	5	8	-
Engaged in diving operation	-	-	-	1	-	-	-	-	-	-	-	1
Fishing	-	-	-	-	1	-	-	-	-	-	1	1
Other	-	-	1	-	-	-	-	-	-	-	1	1
Pleasure craft	-	-	-	-	-	-	-	-	-	-	1	-
Port tender	-	-	1	-	-	1	1	-	-	-	-	2
Sailing	-	-	-	-	-	-	-	-	-	1	1	1
Tanker - all	-	-	-	-	1	-	1	-	-	-	-	-
Total	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**-**	**-**	**6**	**12**	**6**

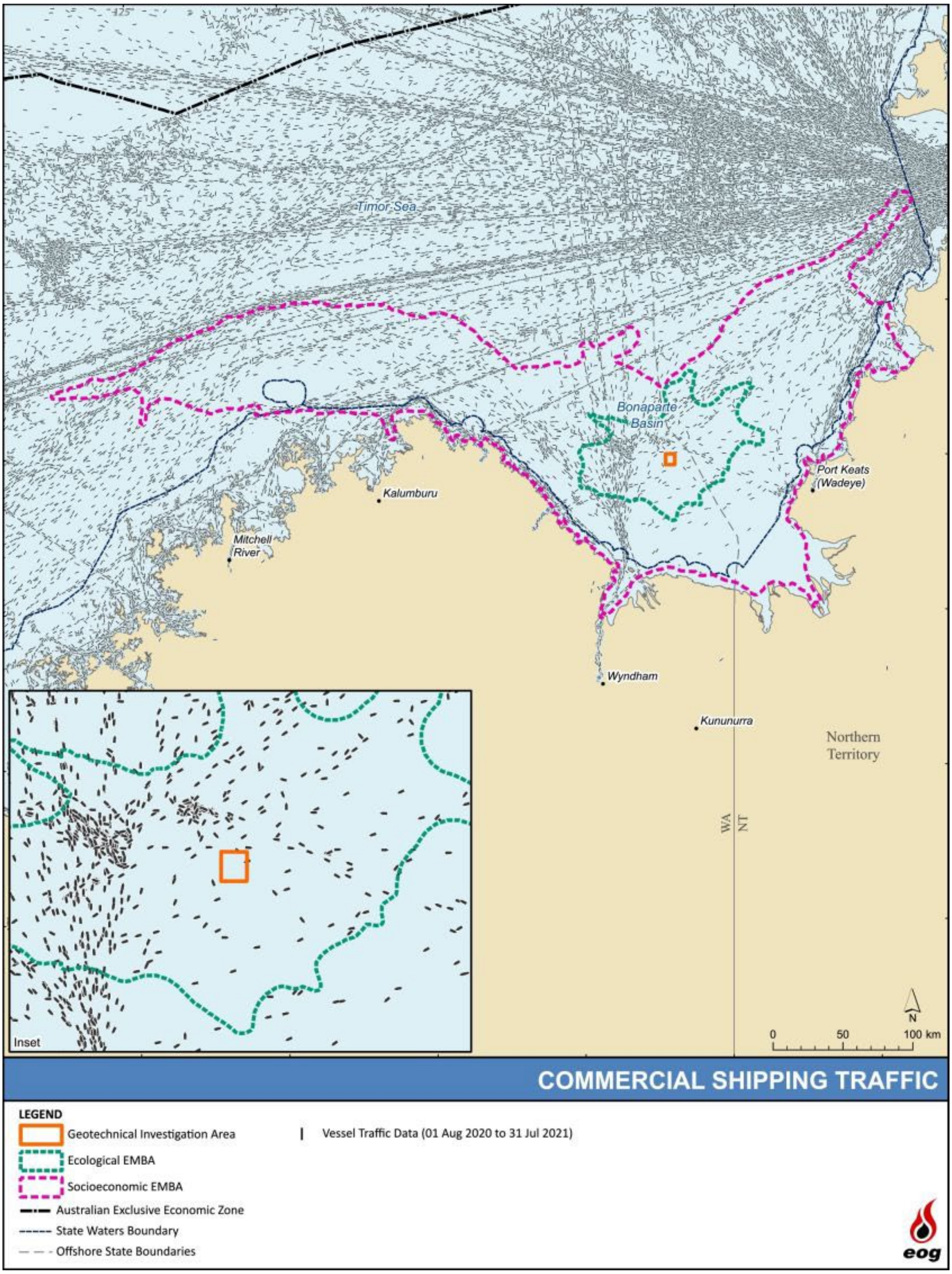


Figure 5.55 Commercial shipping traffic in the activity area and spill EMBA

5.6.7 Defence Activities

The activity area is overlapped by a defence training area, which is a maritime military zone administered by the Australian Defence Force (Figure 5.56). This is an area where exercises such as operational aerial training or live weapon firing may occur. The DoD has advised that military flying training may take place over the activity area, with aircraft flying as low as 500 feet above the water.

There are also an Air-to-Air Refuelling (AAR) and Airborne Early Warning and Control (AEW&C) airspaces that overlap the activity area and EMBA. The EMBA (but not the activity area) also intersects an area with potential for unexploded ordnance (UXO). The DoD have stated that beyond the data presented in Figure 5.57, there are no records of specific UXO in the activity area.

Australian Border Force and Australian Defence Force vessels undertake civil and maritime surveillance within the region with the primary purpose of monitoring the passage of illegal entry vessels and illegal fishing activity within these areas. Refugees seeking asylum in Australia are also known to utilise the area, travelling between Indonesia and Australia.

The DoD has advised that a multi-nation naval exercise will occur between 12 – 25 September 2022 in the North Australia Exercise Area (NAXA). This area overlaps the activity area and EOG has confirmed to the DoD that they will not be present in the NAXA during the specified exercise period (see Table 4.2 – DoD-13).

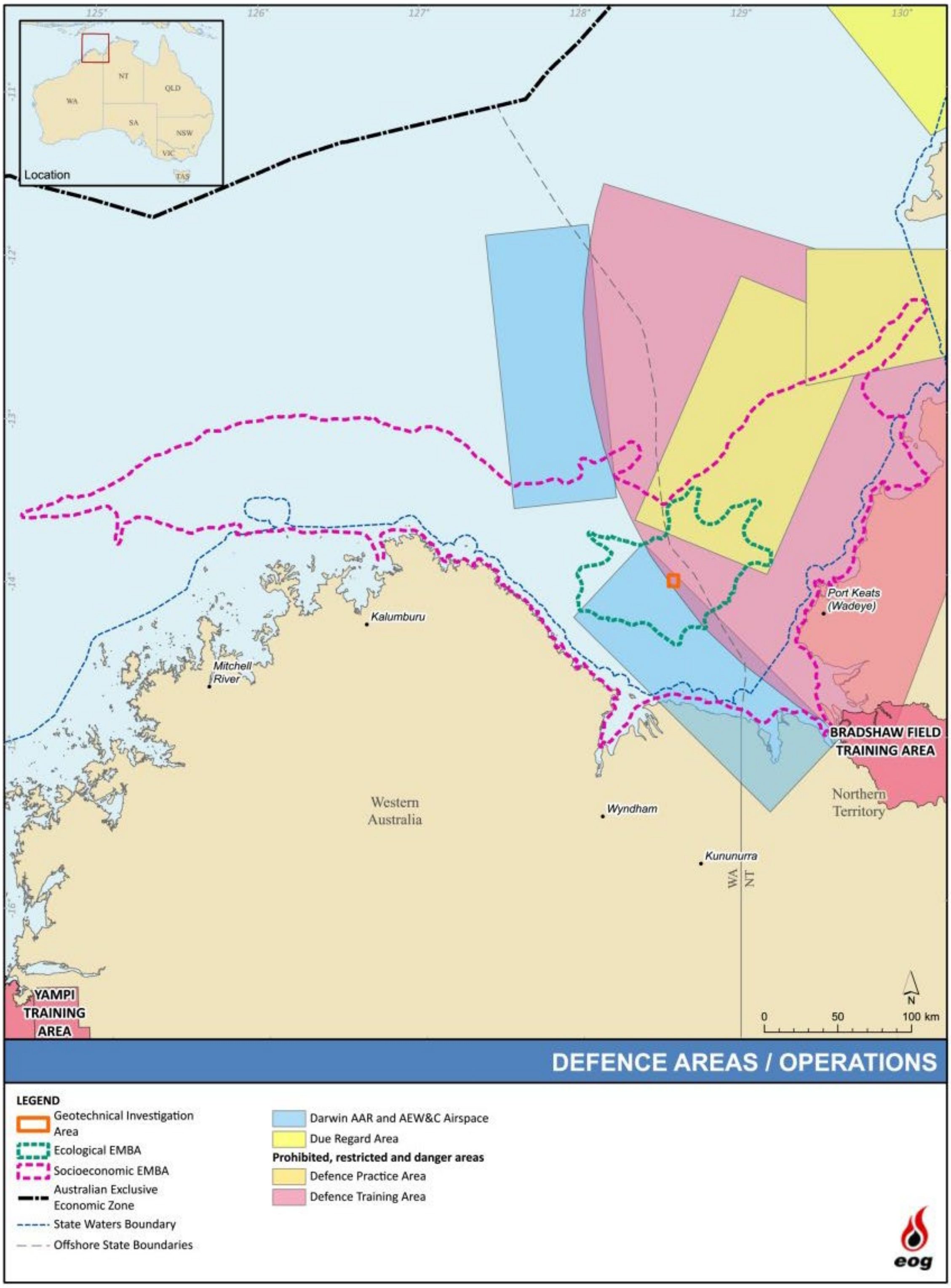
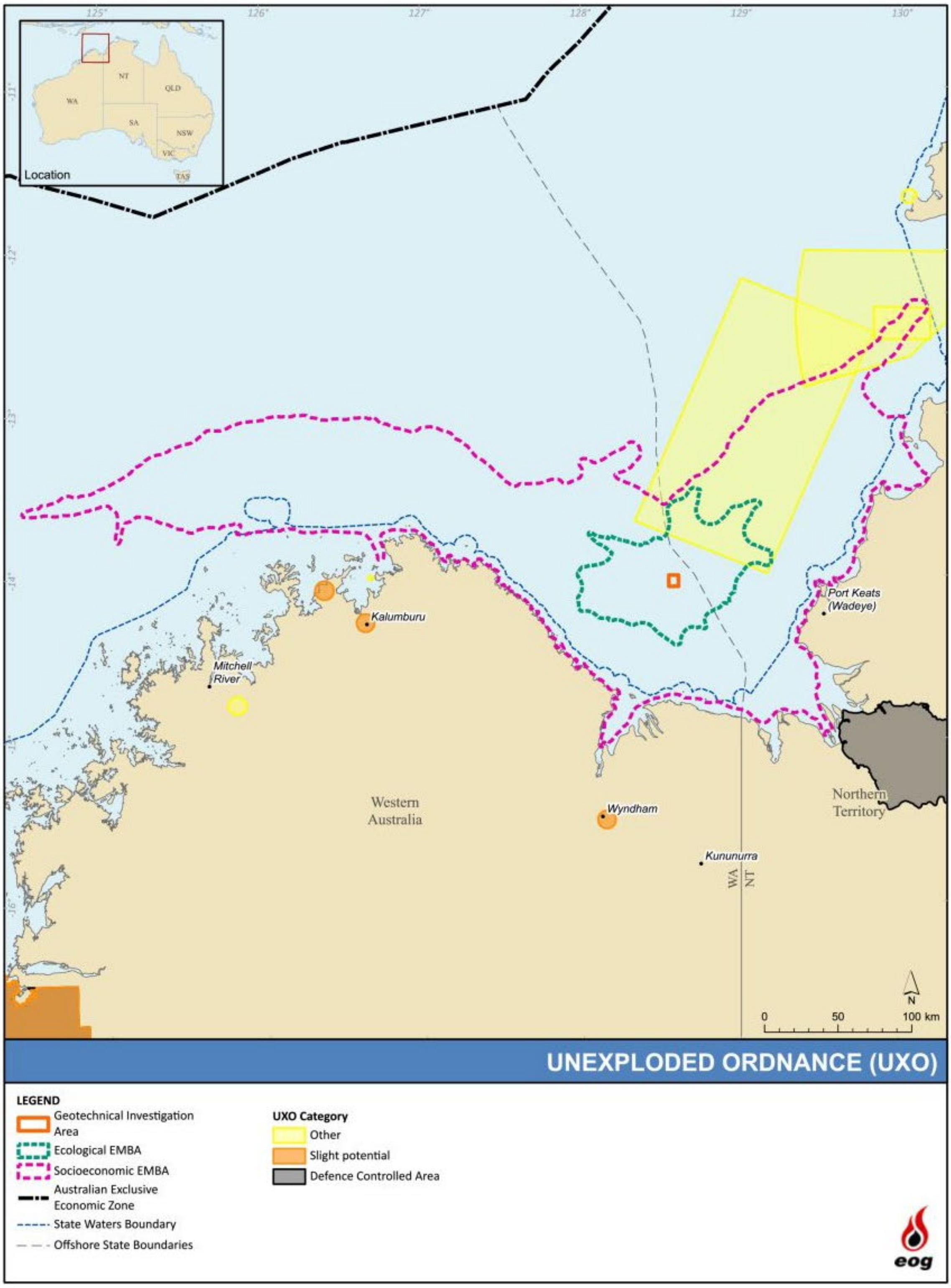


Figure 5.56 Defence areas intersected by the activity area and spill EMBA



Source: DoD (2021).

Figure 5.57 Unexploded ordnance risk in the EMBA

6 Environmental Impact & Risk Assessment Methodology

As required under Regulation 13(5) of the OPGGS(E), this chapter describes the environmental impact and risk assessment methodology used in this EP.

The EOG Environmental Management System defines the company's requirements to mitigate and manage environmental risks at all levels within the business, and this risk management framework is described in this section. This framework is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, *Risk Management – Principles and Guidelines*).

Figure 6.1 outlines the risk assessment management process, with each step of this process described in this chapter. Note that for simplicity, this process is called a risk assessment process, even though impacts and risks are defined differently (see Section 6.3.2 for more information).

Figure 6.1 Risk management framework

6.1 Step 1 – Establish the Context

The first step in the risk assessment process is to establish the context. This involves:

- Understanding the regulatory framework in which the activity takes place (described in the 'Environmental Regulatory Framework' in Chapter 3);
- Defining the activities that will cause impacts and create risks (outlined in the 'Activity Description' in Chapter 2);
- Understanding the concerns of stakeholders and incorporating those concerns into the design of the activity where appropriate (outlined in Chapter 4, 'Stakeholder Consultation'); and
- Describing the environment in which the activity takes place (the 'Existing Environment' is described in Chapter 5).

Once the context has been established, the hazards of the activity can be identified, along with the impacts and risks of these hazards. This process is described in the following sections.

6.2 Step 2 – Communicate and Consult

In accordance with Regulations 11A and 14(9) of the OPGGS(E), EOG has consulted with relevant persons in the development of this EP to obtain information about their functions, activities and interests and assess how the activity may impact on these. This information has been used to inform the impact and risk assessment in the EP. The stakeholder consultation process is described in detail in Chapter 4.

6.3 Step 3 – Identify Risks

The steps used to identify the risks associated with each aspect of the activity include:

- Identify each hazard associated with the activity;
- Identify the sensitive environmental resources within and adjacent to the activity area;
- Identify the impacts and risks associated with each hazard;
    - For impacts, identify the environmental consequence of the impacts.
    - For risks, identify the likelihood (probability) of the risk occurring and the consequence if it does occur.
- Identify control measures; and
- Assign a level of risk to each potential environmental impact using a risk matrix.

In accordance with this framework, all risks must be reduced to a level that is considered to be As Low As Reasonably Practicable (ALARP) (see Section 6.5.1).

6.3.1 Risk Identification and Assessment Workshop

A risk identification and assessment workshop was undertaken on 31 August 2021 to identify the key impacts and risks associated with the activity. This assessment was reviewed in July 2022 to ensure that no additional or increased impacts or risks would occur. Following the review of each hazard and their associated impacts and risks, control measures were also reviewed to ensure the impact consequence or risk rating is ALARP. An assessment of what is 'reasonably practicable' requires professional judgements to be made against the relevant matrices using the advice of technical experts as well as published standards, availability of mitigation measures and industry practice.

The information from this workshop is captured within the activity risk register, which has been used as the basis for the impact and risk assessment in Chapter 7.

6.3.2 Definitions of Impact and Risk

The OPGGS(E) Regulations 14(5)(6) require that the EP detail and evaluate the environmental impacts and risks for an activity, including control measures used to reduce the impacts and risks of the activity to ALARP and an acceptable level. This must include impacts and risks arising directly or indirectly from all activity operations (i.e., planned events) or potential emergency conditions or incidents (i.e., unplanned events).

In its *Environment Plan content requirements* guidance note (N-04750-GN1344, September 2020), NOPSEMA distinguishes between environmental impacts and risks. For context, Table 6.1 provides the definitions of impacts and risk according to the OPGGS(E) and international risk management standards.

Table 6.1 Definitions of impact and risk

Source	Impact	Risk
OPGGS(E) (Regulation 4)	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.	Not defined.
Environment Plan content requirements Guidance Note (N-04750-GN1344, September 2020)	A planned event, an inherent part of the activity.	Not defined.
Environment Plan decision making Guideline (N04750-GL1721, June 2021)	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.	Not defined.
NOPSEMA website (Environment > Assessment Process > Environment Plans > Titleholder FAQs)	Impact assessment is concerned with events that are reasonably certain to occur.	Risk assessment is concerned with events that may possibly occur.
ISO AS/NZS 31000: 2018 (Risk management – Principles and guidelines)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 14001: 2016 (Environmental management systems – Requirements with guidance for use)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 4360: 2004 (Risk management)	Not defined.	The chance of something happening that will have an impact on objectives.
HB203: 2012 (Managing environment-related risk)	Any change to the environment or a component of the environment, whether adverse or beneficial, wholly or partly resulting from an organisation's environmental aspects.	The effect of uncertainty on objectives. The level of risk can be expressed in terms of a combination of the consequences and the likelihoods of those consequences occurring.

For this activity, EOG has determined that impacts and risks are defined as follows:

- **Impacts** result from **planned** events – there *will* be consequences (known or unknown) associated with the event occurring. Impacts are an inherent part of the activity. For example, cuttings will be generated during coring activities during the geotechnical activity and this will have consequences for marine life.
    - For impacts, only a consequence is assigned from Table 6.2 (likelihood is irrelevant given that the event will occur). This consequence is then used in the risk matrix (Table 6.4).
- **Risks** result from **unplanned events** – there *may* be consequences if an unplanned event occurs. Risks are not an inherent part of the activity. For example, a hydrocarbon spill may occur if the survey vessel collides with another vessel, but this is not a certainty. The risk of this event is determined by multiplying the consequence of the impact (using factors such as the type and volume of hydrocarbons and the nature of the receiving environment) by the likelihood of this event happening (which may be determined objectively or subjectively, qualitatively or quantitatively).
    - For risks, the consequence (Table 6.2) and likelihood (Table 6.3) are combined to determine the risk rating (Table 6.4).

6.4 Step 4 – Analyse the Risks

When analysing risk, the following must be considered:

- Identify the maximum credible consequence (being the reasonable worst case but non-fanciful outcome) arising from the impact or risk without introducing controls ('inherent' consequence). Then do the same after controls are introduced to determine the 'residual' consequence.
- Identify the likelihood of the risk event occurring ('remote' through to 'likely'), considering the controls identified and their effectiveness (inherent and residual).
- For risks, determine the level of risk using the matrix, being the intersection of consequence and likelihood.

This process is outlined here.

6.4.1 Consequence Criteria

'Consequence' refers to the maximum credible outcome of an event affecting a receptor, value or use. EOG's consequence criteria are presented in Table 6.2. Where there is uncertainty or incomplete information, a conservative assessment is made on the basis of the maximum credible consequence. Consequence criteria have been developed to consider the extent, severity and duration of the impact or risk. Assigning a consequence criteria to a hazard also takes into account:

- Past records;
- Relevant experience;
- Industry practice and experience;
- Relevant published literature;
- Quantitative or engineering modelling; and
- Specialist or expert judgement.

Table 6.2 Consequence criteria

Consequence	Definition
Beneficial	• Likely to cause enhancement to the environment or socioeconomic benefits.
Negligible	• No changes, or small adverse changes unlikely to be noticed or measurable against background conditions.
Minor	• Adverse changes that can be monitored and/or noticed, but are within the scope of existing variability and do not meet any of the 'severe' or 'moderate' impact definitions.
Moderate	One or more of the following: • Localised, occasional violations of air or water quality standards or guidelines. • Localised contamination of sediments. • Localised damage to sensitive habitats such as hard bottom areas, chemosynthetic communities, mangroves or wetlands. • A few deaths or injuries of protected species, occasional, temporary disruption of their critical activities (e.g., breeding, nesting, nursing), and/or localized damage to their critical habitat. • Localised, short-term interference with fishing activities, recreation or tourism. • Localised damage to or contamination of beaches, parks, tourism areas, or other recreational resources. • Localised, short-term adverse impacts on the economy or socio-economic conditions.
Severe	One or more of the following: • Extensive, continual violation of air or water quality standards or guidelines. • Extensive, persistent contamination of sediments. • Extensive damage to sensitive habitats such as hard bottom areas, chemosynthetic communities, mangroves, or wetlands. • Extensive damage to non-sensitive habitats to the extent that ecosystem function and ecological relationships would be altered. • Numerous deaths or injuries of a protected species, continual disruption of their critical activities (e.g., breeding, nesting, nursing), and/or destruction of their critical habitat. • Extensive, continual interference with fishing activities, recreation, or tourism. • Extensive, persistent damage to or contamination of important cultural, historical or religious sites or tourism areas. • Extensive, persistent adverse impacts on the economy or socio-economic conditions. • A threat to public health or public safety. • Substantial public controversy or social unrest.

6.4.2 Likelihood Criteria

'Likelihood' refers to the chance of an event happening and the maximum credible consequence occurring from that event. EOG's likelihood criteria are presented in Table 6.3.

Table 6.3 Likelihood criteria

Probability	Definition
Likely	Can reasonably be expected to occur one or more times during the project. Impacts of most routine project activities are in this category.
Occasional	Not planned or expected, but could occur at some time during the project.
Rare	Highly unlikely; exceptional conditions may allow the event to occur during the project.
Remote	Has occurred before in the industry but is extremely unlikely to occur during the project.

6.4.3 Risk Matrix

Risk levels are assessed using the matrix presented in Table 6.4. The risk is evaluated by 'multiplying' likelihood and consequence. The recommended form of treatment action, escalation and monitoring for each risk level is provided in Table 6.5.

The 'initial' rating (pre-treatment) and 'residual' risk rating (with control measures adopted) for each impact and risk is provided in Chapter 7.

Table 6.4 EOG risk assessment matrix

LEGEND		**Decreasing impact consequence**				
		Beneficial	Negligible	Minor	Moderate	Severe
Decreasing probability	Likely	Beneficial	Negligible	Low	Medium	High
	Occasional	Beneficial	Negligible	Low	Medium	High
	Rare	Beneficial	Negligible	Negligible	Low	High
	Remote	Beneficial	Negligible	Negligible	Low	Medium

Table 6.5 Risk treatment action

Risk rating	Treatment action
VERY HIGH The risk is intolerable	• Modify the threat, the frequency or consequence so that the risk is reduced to 'high' or lower. • For an operational activity, the risk shall be reduced as soon as possible, typically within a timescale of not more than a few weeks. • For commercial risks, review the risks and where practicable reduce by additional mitigation measures such as hedging, insurance, etc.
HIGH The risk is tolerable if ALARP	• Repeat threat identification and risk evaluation processes to verify and, where possible, quantify the risk estimation; determine the accuracy and uncertainty of the estimation. • Where the risk ranking is confirmed to be 'high', if practicable, modify the threat, the frequency or consequence to reduce the risk ranking to 'medium' or 'low'. • Where the risk ranking cannot be reduced to 'medium' or 'low', to demonstrate ALARP it is necessary to review if it is reasonably practicable to remove threats, reduce frequencies and/or reduce the severity of consequences, and if it is reasonably practicable, these risk treatment actions shall be applied. If it is not reasonably practicable, no further action is required and ALARP is demonstrated. • For an operational activity, the reduction to 'medium' or 'low' or demonstration of ALARP shall be completed as soon as possible; typically within a timescale of not more than a few months.
MEDIUM The risk is tolerable	• Determine the management plan for the threat to prevent occurrence and to monitor changes that could affect the classification. • Management responsibility must be specified – monitor to determine if risk changes and needs to be reassessed.
LOW The risk is tolerable	• Review at the next review interval. • Manage by routine procedures – reassess at next review.
VERY LOW The risk is tolerable	• Review at the next review interval. • Manage by routine procedures – reassess at next review.

6.5 Step 5 – Evaluate the Risk

The purpose of impact and risk evaluation (herein referred to simply as risk assessment) is to assist in making decisions, based on the outcomes of analysis, about the sorts of controls required to reduce an impact or risk to ALARP. Planned and unplanned events are subject to risk assessment in the same manner.

Risk evaluation also considers the following:

- Defining the level of risk (higher and lower order impacts and risks);
- Demonstration of ALARP;
- Uncertainty of impacts and risks;
- Demonstration of acceptability; and
- Principles of ecologically sustainable development (ESD).

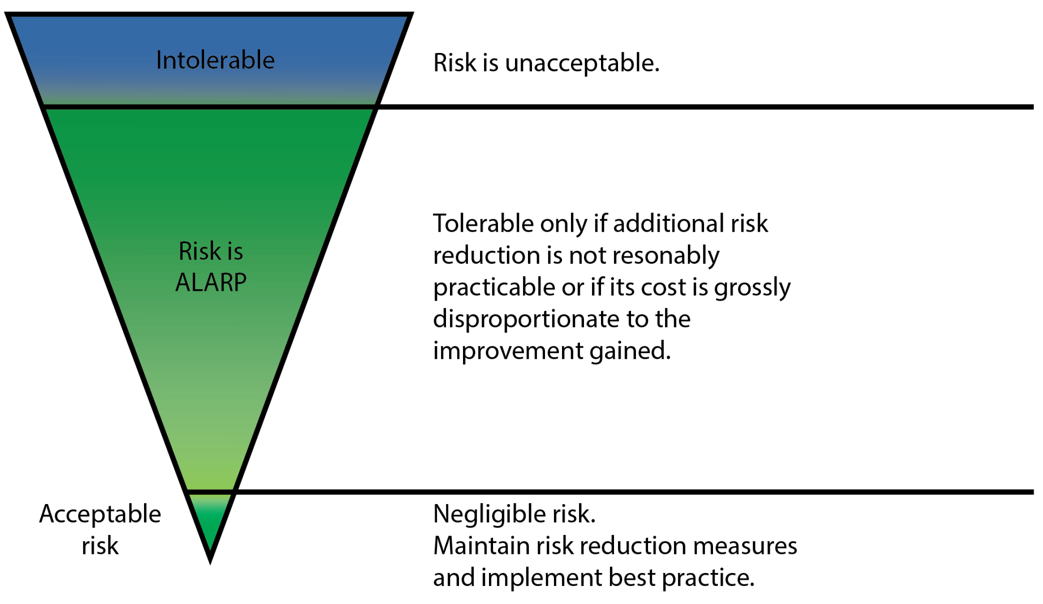
Each of these considerations is described in more detail in this section.

6.5.1 Demonstration of ALARP

The ALARP principle states that it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent attempting to reduce an impact or risk to zero. This concept is shown diagrammatically in Figure 6.2.

EOG's approach to demonstrating ALARP includes:

- Systematically identifying and assessing all potential environmental impacts and risks associated with the activity;
- Where relevant, applying industry 'good practice' controls to manage impacts and risks;
- Assessing available and feasible control measures for their environmental benefit and cost, which is summarised in a cost-benefit analysis; and
- For higher order impacts and risks, implementing further controls if feasible and reasonably practicable to do so.



Source: CER (2015).

Figure 6.2 The ALARP Principle

There is no universally-accepted guidance to applying the ALARP principle to environmental assessments. For this EP, the guidance provided in NOPSEMA's *Environment Plan decision making guideline* (N-04750-GL1721, June 2021) has been applied and augmented where necessary.

The level of ALARP assessment is dependent upon the:

- Residual impact and risk level (high versus low); and
- The degree of uncertainty associated with the assessed impact or risk.

An iterative risk evaluation process is employed until such time as any further reduction in the residual risk ranking is not reasonably practicable to implement. At this point, the impact or risk is reduced to ALARP. The determination of ALARP is outlined in Table 6.6.

Table 6.6 Alignment of EOG consequence and risk ratings with ALARP ratings

<table>
<tr><td>Consequence rating</td><td>Beneficial</td><td>Negligible</td><td>Minor</td><td>Moderate</td><td>Severe</td></tr>
<tr><td>ALARP level – planned event</td><td>Broadly acceptable</td><td colspan="3">Tolerable if ALARP</td><td>Intolerable</td></tr>
<tr><td>Residual impact category</td><td colspan="3">Lower order</td><td colspan="2">Higher order</td></tr>
<tr><td>Risk rating</td><td>Beneficial</td><td>Negligible</td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td>ALARP level - unplanned event</td><td>Broadly acceptable</td><td colspan="2">Tolerable if ALARP</td><td colspan="2">Intolerable</td></tr>
<tr><td>Residual risk category</td><td colspan="3">Lower order risks</td><td colspan="2">Higher order risks</td></tr>
</table>

A description of how the ALARP process is applied to the impact and risk assessment process for the project is presented in this section.

Hierarchy of Controls

EOG demonstrates ALARP, in part, by adopting the ‘Hierarchy of Controls’ philosophy (Figure 6.3). The hierarchy of controls is a system used across hazardous industries to minimise or eliminate exposure to hazards. The hierarchy of controls is, in order of effectiveness:

- Elimination;
- Substitution;
- Engineering controls;
- Administrative controls; and
- Personal protective equipment (PPE) – this has not been included here as it is specific to the assessment of safety risks rather than environmental management.

Although commonly used in the evaluation of occupational health and safety hazard control, the hierarchy of controls philosophy is also a useful framework to evaluate potential environmental controls to ensure reasonable and practicable solutions have not been overlooked. To this effect, the assessment of control measures presented in the impact and risk assessment in Chapter 7 take into account the hierarchy of controls, in the order listed above.

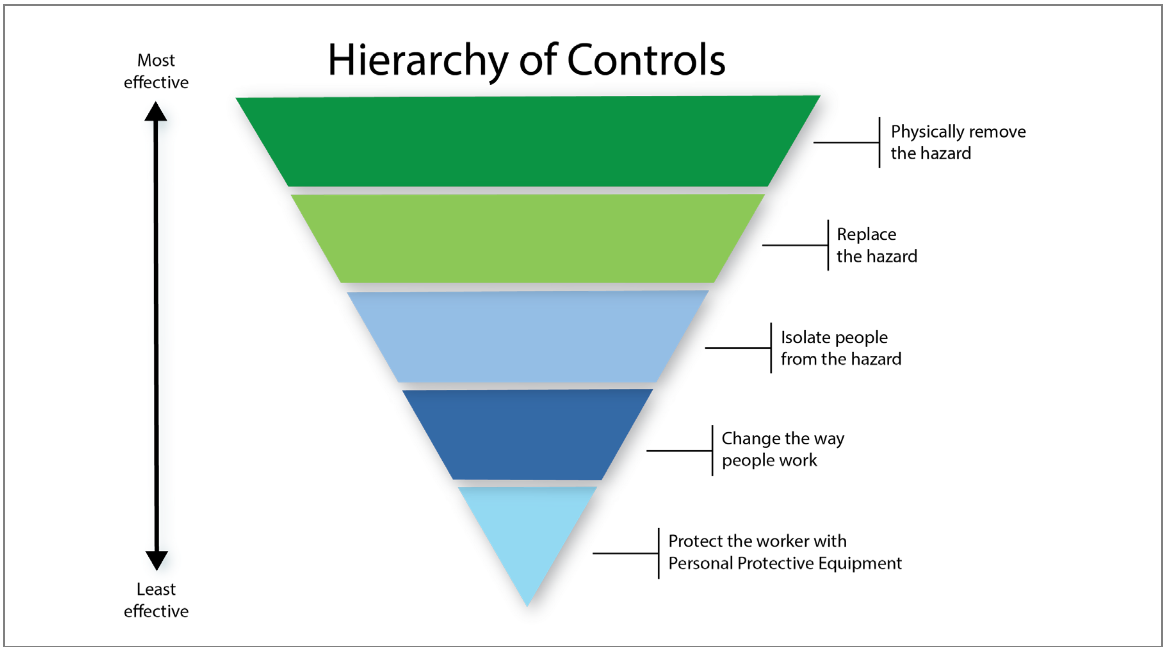


Figure 6.3 The Hierarchy of Controls

Assessing the Suitability of Available Control Measures

NOPSEMA's *Environment Plan decision making guideline* (N-04750-GL1721, June 2021) states that in order to demonstrate ALARP, a titleholder must be able to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure. This process is applied in the demonstration of ALARP sections in the impact and risk assessment tables throughout Chapter 7.

When deciding on whether to implement proposed control measures in the impact and risk assessment tables in Chapter 7, the issues outlined in Table 6.7 are considered.

Table 6.7 Considerations for the adoption of control measures

Consideration	Question
Environmental benefit (EB)	• Does it provide a clear or measurable reduction in environmental impact or risk? • What are the environmental benefits to receptors if the measure is adopted?
Cost (C)	• What is the relative cost (which includes money, time, and resources) that may be borne by EOG if the control measure is adopted? • Does it introduce additional risk in other operational areas (e.g., will the implementation of a control measure have an impact elsewhere (such as additional emissions and discharges or safety risks to personnel))? • Is it technically feasible and can it be implemented?
Evaluation (Ev)	• Is it consistent with national or industry standards and practices? • Will the change be effective, taking into account the: o Sensitivity of the receptor; o Current level of risk with the existing controls; o Amount of additional risk reduction that the control will deliver; o Level of confidence that the risk reduction impact will be achieved; and o Resources, schedule and cost required to implement the control.

Reducing impacts and risks to ALARP is an ongoing process and new risk reduction measures may be identified at any time, including during the activity. EOG actively encourages recording and review of observations through its incident management system. Incidents and lessons learned within EOG and from the wider industry are reviewed and utilised to identify hazards and controls.

Defining the Level of Risk

Lower-order Environmental Impacts and Risks

NOPSEMA defines lower-order environmental impacts and risks as those where the environment or receptor is not formally managed, less vulnerable, widely distributed, not protected and/or threatened and there is confidence in the effectiveness of adopted control measures.

Using EOG's risk matrix (see Table 6.4), impacts and risks are considered to be lower-order and ALARP when the residual:

- Impact consequence is rated as 'beneficial', 'negligible' or 'minor'; or
- Risk rating is 'beneficial', 'negligible' or 'low' (see also Table 6.5).

In these cases, applying 'good industry practice' (see Table 6.8 and good practice) control measures is sufficient to manage the impact or risk to ALARP.

Higher-order Environmental Impacts and Risks

NOPSEMA defines higher-order environmental impacts and risks as those that are not lower order risks or impacts (i.e., where the environment or receptor is formally managed, vulnerable, restricted in distribution, protected or threatened and there is little confidence in the effectiveness of adopted control measures).

Using EOG's risk matrix (see Table 6.4), impacts and risks are considered to be higher-order when the residual:

- Impact consequence is rated as 'moderate' or 'severe'; or
- Risk rating is 'medium' or 'high' (see also Table 6.5).

In these cases, further controls must be considered (see Table 6.8, good practice, engineering risk assessment and precautionary principle).

Decision Making Framework

Uncertainty of Impacts and Risks

Based upon the level of uncertainty associated with the impact or risk, the following framework, adapted by NOPSEMA (2015) from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) (Figure 6.4) provides the decision-making framework to establish ALARP.

This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). The decision type is selected based on an informed decision around the uncertainty of the risk. Decision types and methodologies to establish ALARP are outlined in Table 6.8.

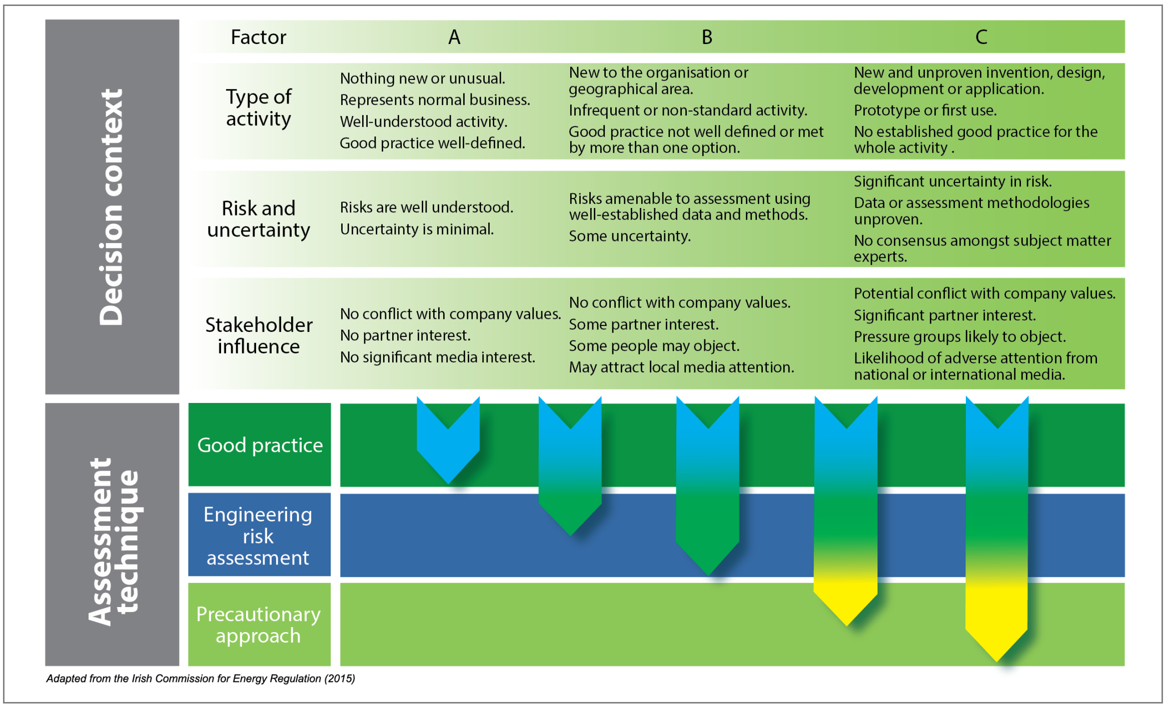


Figure 6.4 Impact and risk 'uncertainty' decision-making framework

Table 6.8 ALARP decision-making based upon level of uncertainty

Decision type	Decision-making tools
A	<u>Good industry practice</u> Identifies the requirements of legislation, codes and standards that are to be complied with for the activity. Applies the 'Hierarchy of Controls' philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks. Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards.
B	*In addition to decision type A:* <u>Engineering risk-based tools</u> Engineering risk-based tools to assess the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.
C	*In addition to decision type A and B:* <u>Precautionary Principle</u> Application of the Precautionary Principle is to be applied when good industry practice and engineering risk-based tools fail to address uncertainties.

The decision-making tools outlined in Table 6.8 are explained further below.

Good Practice

In the absence of an Australian definition, the OGUK (2014) and the Irish Commission for Energy Regulation (CER) (2015) define 'Good Practice' as:

> *The recognised risk management practices and measures that are used by competent organisations to manage well-understood hazards arising from their activities.*

NOPSEMA has not endorsed any 'approved codes of practice' or standards to give them a legal status in terms of good practice. Good practice is taken to refer to any well-defined and established standard or codes of practice adopted by an industrial/occupational sector, including 'learnings' from incidents that may yet be incorporated into standards.

Good practice can also be used as the generic term for those standards for controlling risk that have been judged and recognised as satisfying the law when applied to a particular relevant case in an appropriate manner. For this EP, sources of good practice, adapted from CER (2015) are the relevant:

- Commonwealth, state and territory legislation and regulations (outlined in Sections 3.2 and 3.3 and Appendix 1);
- Government guidance (outlined in Section 3.4 of the PDSA EP (link));
- International conventions (outlined in Section 3.5 of the PDSA EP (link)); and
- Industry standards (outlined in Section 3.6 of the PDSA EP (link)).

Good practice also requires that hazard management is considered in a hierarchy, with the concept being that it is inherently safer to eliminate a hazard than to reduce its frequency or manage its consequences (CER, 2015). This being the case, the 'hierarchy of controls' philosophy is applied to reduce the risks associated with hazards (described in Section 6.5.1).

Engineering Risk Assessment

All impacts and risks that require assessment beyond that of good practice (i.e., decision type A) are subject to an engineering risk assessment.

Engineering risk-based tools can include, but are not limited to, engineering analysis (e.g., structural, fatigue, mooring, process simulation) and consequence modelling (e.g., ship collision, dropped object) (CER, 2015). A cost-benefit analysis to support the selection of control measures identified during the risk assessment process may also be undertaken.

Precautionary Principle

All impacts and risks that do meet decision type A or type B and require assessment beyond that of good practice and engineering risk assessment are subject to the 'Precautionary Principle'. CER (2015) states that if the assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then the precautionary principle should be adopted in the hazard management process. While there is no globally recognised definition of the Precautionary Principle, it is generally accepted to mean:

> *Uncertain analysis is replaced by conservative assumptions which will increase the likelihood of a risk reduction measure being implemented.*

The degree to which this principle is adopted should be commensurate with the level of uncertainty in the assessment and the level of danger (hazard consequences) believed to be possible.

Under the precautionary principle, environmental considerations are expected to take precedence over economic considerations, meaning that an environmental control measure is more likely to be implemented. In this decision context, the decision could have significant economic consequences to an organisation.

6.5.2 Demonstration of Acceptability

Regulation 13(5)(c) of the OPGGS(E) requires the EP to demonstrate that environmental impacts and risks are acceptable.

EOG considers a range of factors to demonstrate the acceptability of the environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in Table 6.9. The criteria for demonstrating acceptability were developed based on EOG's interpretation of NOPSEMA's *Environment Plan decision making guideline* (N-04750-GL1721-GL1721, June 2021).

Table 6.9 Acceptability criteria

Test	Question	Acceptability demonstrated
Internal context		
Policy compliance	Is the proposed management of the hazard aligned with EOG's Safety and Environmental Policy?	The impact or risk must be compliant with the objectives of the policy.
Management System Compliance	Is the proposed management of the hazard aligned with EOG's Safety and Environment Management System?	Where specific EOG procedures, guidelines or expectations are in place for management of the impact or risk, acceptance is demonstrated.
External context		
Stakeholder engagement	Have relevant persons and stakeholders raised any concerns about activity impacts or risks? If so, are control measures in place to manage those concerns?	Merits of claims or objections raised by relevant persons and stakeholders must have been adequately assessed and additional control measures adopted where appropriate.
Legislation, industry standard and best practice		
Legislative context	Do the control measures meet the expectations of existing Commonwealth, WA or NT legislation?	The proposed control measures align with legislative requirements.
Industry practice	Do the control measures align with international and Australian industry guidelines and practices?	The proposed control measures align with relevant industry guidelines and practices.
Environmental context	What are the overall impacts and risks to MNES and other areas of conservation significance? Do control measures align with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans?	There are no long-term impacts to MNES and the proposed control measures ensure that impacts or risks are not inconsistent with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans.
ESD Principles*	Are the control measures aligned with the principles of ESD?	The EIA presented throughout Chapter 7 is consistent with the principles of ESD.

**See Table 6.10 for more information.*

Principles of Ecologically Sustainable Development

Based on Australia's National Strategy for Ecologically Sustainable Development (Council of Australian Governments, 1992), Section 3A of the EPBC Act defines ESD as:

> *Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.*

Table 6.10 outlines the principles of ESD as defined under the EPBC Act and describes how this EP aligns with these principles.

Table 6.10 Assessment of ESD principles

Principle		EP demonstration
A	Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	This principle is inherently met through the EP assessment process.
B	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	Serious or irreversible environmental damage resulting from the activity has been eliminated through the activity design (see Chapter 2). None of the residual impacts is rated higher than 'moderate' and none of the residual risks is rated higher than 'medium.' Scientific certainty has been maximised by employing a spill EMBA as a risk assessment boundary.
C	The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The EP assessment methodology ensures that risks from the activity are managed to be ALARP and acceptable.
D	The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	This principle is considered for each hazard in the adoption of environmental controls (i.e., environmental performance outcomes and environmental performance standards) that aim to minimise environmental harm. There is a strong focus in this EP on conserving biodiversity and ecological integrity by understanding the marine environment and commercial fishing activity in the activity area and EMBA (Chapter 5) and implementing control measures to minimise impacts and risks (Chapter 7).
E	Improved valuation, pricing and incentive mechanisms should be promoted.	This principle is not relevant to this activity.

6.6 Step 6 – Treat the Risk

The activity environmental impact and risk register (see Section 6.3.1) and this EP record the environmental control measures (e.g., measures to prevent, minimise and mitigate impacts and risks) that were determined by a qualified and experienced team familiar with the activity and the sensitivities of the existing environment.

These control measures are listed throughout the impact assessment and risk assessment tables in Chapter 7.

6.7 Step 7 - Monitor and Review

Monitoring and review activities are incorporated into the impact and risk management process to ensure that control measures are effective and efficient in both design and operation. This is achieved through the environmental performance outcomes and standards and measurement criteria that are assigned to each environmental hazard.

The monitoring and review process is undertaken to support the compliance reporting process and is an opportunity to identify emerging risks that have arisen, that need to be analysed and addressed, if required.

Monitoring and review of activities are described in the Implementation Strategy (Chapter 8).

7 Environmental Impact and Risk Assessment

This chapter presents the EIA and ERA for the environmental impacts and risks identified for the activity using the methodology described in Chapter 6, as required under Regulations 13(5)(6) of the OPGGS(E).

This chapter presents the control measures, EPO, EPS and measurement criteria required to manage (i.e., avoid, minimise or mitigate) the identified impacts and risks. The following definitions are used in this section, as defined in Regulation 4 of the OPPGS(E):

- **Control measure** – a system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks;
- **EPO** – a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level (i.e., the environmental objective);
- **EPS** – a statement of the performance required of a control measure; and
- **Measurement criteria** – defines the measure by which environmental performance will be measured to determine whether the EPO has been met.

A summary of the impact consequence rankings and risk ranking for each hazard identified and assessed in this chapter is presented in Table 7.1.

Table 7.1 Activity environmental impacts and risk summary

Identifier	Hazard	Inherent	Residual
Impacts			
1	Underwater sound – impacts to biological receptors		
	- Plankton	Negligible	Negligible
	- Crustaceans (i.e., prawns)	Negligible	Negligible
	- Fish (without swim bladders, i.e., sharks)	Negligible	Negligible
	- Fish (with swim bladders)	Negligible	Negligible
	- Cetaceans	Negligible	Negligible
	- Marine reptiles (i.e., turtles and sea snakes)	Negligible	Negligible
	- Avifauna	Negligible	Negligible
	- Commercial fisheries	Negligible	Negligible
2	Displacement of other marine users		
	- Commercial fisheries	Negligible	Negligible
	- Merchant shipping	Negligible	Negligible
3	Seabed disturbance	Negligible	Negligible
4	Light emissions	Negligible	Negligible
5	Atmospheric emissions	Negligible	Negligible
6	Putrescible waste discharges	Negligible	Negligible
7	Sewage and grey water discharges	Negligible	Negligible

Identifier	Hazard	Inherent	Residual
8	Cooling and brine water discharges	Negligible	Negligible
9	Bilge water and deck drainage discharges	Negligible	Negligible
Risk		Risk rating	
1	Accidental discharge of waste to the ocean	Low	Negligible
2	Vessel collision with megafauna	Low	Negligible
3	Introduction and establishment of IMS	Negligible	Negligible
4	Interference with other marine users	Negligible	Negligible
5	Damage to subsea infrastructure	Low	Negligible
6	MDO release		
	- Benthic fauna	Negligible	Negligible
	- Macroalgal communities	Negligible	Negligible
	- Plankton	Negligible	Negligible
	- Pelagic fish	Negligible	Negligible
	- Cetaceans	Negligible	Negligible
	- Marine reptiles	Negligible	Negligible
	- Seabirds and Shorebirds	Negligible	Negligible
	- Shoreline habitats (sandy beaches and rocky shores)	Negligible	Negligible
	- Commercial fisheries	Negligible	Negligible
7	MDO spill response activities		
	- Fauna disturbance	Low	Negligible
	- Fauna injury	Low	Negligible
	- Fauna death	Negligible	Negligible

7.1 IMPACT 1 – Underwater Sound Emissions

7.1.1 Hazard

Underwater sound emissions will be generated by:

- Operation of the geotechnical equipment; and
- Vessel operations.

The vessel will generate continuous sound from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment. The geotechnical operations include borehole sampling, in-situ testing (PCPT) and vibratory coring at the seabed. The dominant noise source will be from the vessel whilst maintaining position (DP: dynamic positioning) during the geotechnical surveys.

Geotechnical equipment

Erbe and Mcpherson (2017) measured radiated noise levels from marine geotechnical drilling and standard penetration testing (SPT) from a jack-up rig situated in 7-13 m of water at the Port of Geraldton and at James Price Point, WA in 2010. The broadband (30 Hz–2 kHz) drilling source levels were 145 dB re 1 µPa @ 1 m at Geraldton and 142 dB re 1 µPa @ 1 m at James Price Point. The broadband (20 Hz–24 kHz) SPT source levels were 160 and 151 dB re 1 µPa^{2}s @ 1 m at Geraldton and James Price Point, respectively. As these source levels are significantly lower than those generated by the vessel under DP, they are not further considered in this assessment.

Vessel sound

McCauley (1998) measured underwater broadband noise of up to 182 dB re 1 µPa @ 1 m from support vessels when holding position at a drill site, with levels decreasing by around 34 dB within 50 m, and dropping to around 120 dB re 1 µPa at 3.5 km from the rig. This sound level will be higher than for any machinery on the vessels. McCauley (1998) also measured underwater sound levels while the vessel was transiting at 11 kts, and found the distance to 120 dB re 1 µPa to be approximately 1 km. Similar noise levels are expected to be generated by the vessel used for this activity. The greatest noise will be when the vessel uses DP for holding position.

7.1.2 Known and Potential Environmental Impacts

The potential environmental impacts to marine fauna from underwater sound are:

- Behaviour:
  - Direct behavioural effects through disturbance or displacement, and consequent disruption of natural behaviours or processes (e.g., migration, resting, calving or spawning); and
  - Indirect behavioural effects by impairing/masking the ability to navigate, find food or communicate, or by affecting the distribution or abundance of prey species.
- Injuries:
  - Physical injury to auditory tissues or other air-filled organs;
  - Permanent threshold shift (PTS) – a permanent loss of hearing sensitivity caused by excessive noise exposure, considered an auditory injury); and
  - Temporary threshold shift (TTS) – the temporary loss of hearing sensitivity caused by excessive noise exposure).

The potential impacts of underwater sound to commercial fisheries include:

- Catchability – movement of stock away from traditional fishing grounds due to the sound;
- Loss of catch - direct mortality to mature individuals, juveniles or larval stages, resulting in immediate or future reduced fishing stock;
- Displacement – inability to fish in the activity area during the activity and/or having to fish areas not normally fished, thereby displacing other fishers (see Section 7.4); and
- Economic impacts - financial loss from reduced catch due to the above-listed factors.

Exposure Criteria

The thresholds and guidelines used for the assessment are listed in Table 7.2 and Table 7.3. Additional detail on thresholds, guidelines and weighting functions can be found in Popper et al. (2014), Finneran et al (2017), Southall et al (2019), NOAA (2019), Koessler et al (2020), Matthews et al (2020) and Matthews et al (2021).

Table 7.2 Exposure criteria for non-impulsive sound sources – Marine Mammals and Turtles

Hearing group	Behaviour SPL (dB re 1 µPa)	Injury: Frequency-weighted SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	
		TTS	PTS
Low-Frequency (LF) cetaceans	120	179	199
Mid-frequency (HF) cetaceans		178	198
High-frequency (HF) cetaceans		153	173

Cetacean functional hearing groups:

- *Low-frequency cetaceans (LFC) – mysticetes (baleen whales, including southern right, blue, humpback and fin whales);*
- *Mid-frequency cetaceans (MFC) – some odontocetes (toothed whales and dolphins); and*
- *High-frequency cetaceans (HFC) – odontocetes specialised for using high frequencies (e.g., harbour porpoise and Amazon River dolphin).*

Table 7.3 Exposure criteria for non-impulsive sound sources – fish and turtles

Distance from the source	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish eggs and larvae					
Near	Low	Low	Low	High	Moderate
Intermediate	Low	Low	Low	Moderate	Moderate
Far	Low	Low	Low	Low	Low
Fish with no swim bladder (includes sharks)					
Near	Low	Low	Moderate	High	Moderate
Intermediate	Low	Low	Low	High	Moderate
Far	Low	Low	Low	Moderate	Low
Fish with swim bladder not involved in hearing					
Near	Low	Low	Moderate	High	Moderate

Distance from the source	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Intermediate	Low	Low	Low	High	Moderate
Far	Low	Low	Low	Moderate	Low
Fish with swim bladder involved in hearing					
Near	Low	170 dB rms for 48 h	158 dB rms for 12 h	High	High
Intermediate	Low			High	Moderate
Far	Low			High	Low
Turtles					
Near	Low	Low	Moderate	High	High
Intermediate	Low	Low	Low	High	Moderate
Far	Low	Low	Low	Moderate	Low

Source: Popper et al (2014).

Guide to distance from the source

(N) Near = tens of metres.

(I) Intermediate = within hundreds of metres.

(F) Far = thousands of metres.

7.1.3 EMBA

The noise EMBA is the area where noise levels are predicted to be above the criteria for behavioural impacts. The largest extent of impacts is predicted to be for continuous (i.e., non-impulsive) underwater noise from the vessel activities using the exposure criteria for low frequency cetaceans (Table 7.2):

- Behavioural effect (3.5 km); and
- TTS (less than 50 m).

Receptors that are known to occur or may occur within the underwater sound EMBA, either as residents or migrants, are:

- Plankton;
- Benthic invertebrates (i.e., prawns);
- Fish (with and without swim bladders);
- Marine mammals;
- Marine reptiles (i.e., turtles); and
- Avifauna.

7.1.4 Evaluation of Environmental Impacts

The environmental significance of acoustic disturbances arising from the vessels during this investigation is considered to be negligible because:

- The activity will be of very short duration, and no more than a few hours at any one location);

- The activity will be undertaken over a small area (approximately 50 km^2);
- The presence of threatened cetaceans in the region is known to be low;
- There are no known sensitive benthic ecosystems in the activity area, such as reefs;
- There is only low intensity commercial fishing in the activity area;
- Fish species known to occur in the region are common and widely distributed and are likely to experience only temporary displacement from habitat (thus avoiding physiological effects); and
- There is no spatially limiting habitat for the fin fish and benthic species known to occur in the activity area.

Temporary and permanent threshold shifts are very unlikely to occur in any marine species as a result of vessel operations. The most sensitive faunal receptors in the region are LF cetaceans. Predicted TTS onset would occur at less than 50 m from the vessel when it is using dynamic positioning. The sounds produced by the vessels during this activity will not be outside the range of other anthropogenic sound and ambient underwater sound of the activity area (see Table 5.4).

Impacts to Plankton

Table 7.3 presents the exposure criteria for fish eggs and larvae. This indicates that the underwater noise generated would have a low probability of mortality impacts on fish larvae. Based on this evaluation, the impact consequence for plankton resulting from underwater noise generated by the activity is negligible at an ecosystem and population level.

Impacts to Fish

Fish species known to occur within the activity area and surrounds include finfish, sharks and rays (including sawfish), and are listed and/or described in Section 5.3.4. All fish studied to date are able to detect sound, with the main auditory organs in teleost (bony) fish being the otolithic organs of the inner ear (Carroll *et al*., 2017). Hearing in fish primarily involved the ability to sense acoustic particle motion via direct inertial stimulation of the otolithic organs or their equivalent. Many species also have the ability to sense sound pressure using an indirect path of sound stimulation involving gas-filled chambers such as the swim bladder (Carroll *et al*., 2017).

Table 7.3 indicates that physiological impacts are unlikely to occur to any fish species. Behavioural changes such as startle or alarm responses are expected to be localised and temporary, with displacement of pelagic or migratory fish likely to have insignificant repercussions at a population level (McCauley, 1994; McCauley & Kent, 2012; Popper *et al*., 2015; Popper *et al*., 2007).

Behavioural impacts to fish from survey equipment noise will be limited to behavioural responses within metres of the noise source. Fish (including sharks and rays) may be temporarily displaced from the vicinity of the noise emissions.

Limited research has been conducted on responses from elasmobranchs (sharks and rays, including juveniles) to underwater sound. This may be because sharks and rays differ from bony fish in that they have no accessory organs of hearing (i.e., a swim bladder) and therefore are unlikely to respond to acoustic pressure (Myrberg, 2001). Elasmobranchs sense sound via the inner ear and organs and as they lack a swim bladder it is thought that they are only capable of detecting the particle motion component of acoustic stimuli (Myrberg, 2001).

Sharks do not appear to be attracted by continuous signals or higher frequency sounds that presumably they cannot hear (Popper & Løkkeborg, 2008). Klimley and Myrberg (1979) established that an individual shark will suddenly turn and withdraw from a sound source of high intensity (more than 20 dB re 1 µPa above background ambient noise levels) when approaching within 10 m of the sound source. The available evidence indicates sharks will generally avoid sound sources, so the likely impacts on sharks are expected to be limited to short-term behavioural responses, such as avoidance of waters around the operating equipment.

There are no fish BIA in the activity area and ecological EMBA, meaning that biologically important activities of threatened fish species will not be impacted.

Some sawfish species may occur in the offshore waters of the activity area (Table 5.6), however the presence of sawfish in the activity area is likely to be limited to occasional transient adults. Given that sawfish do not possess a swim bladder and therefore have relatively limited ability to detect changes in sound pressure, impacts to sawfish are expected to be minor, highly localised and unlikely to impact species at a population level. Additionally, juvenile sawfish generally inhabit river and estuarine environments in shallow nearshore waters (e.g., nursery sites). Given the activity area is located over 70 km from the nearest shoreline and that underwater sound from the activity will not reach threshold levels at this distance, there will be no impacts to juvenile sawfish.

The Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015) does not list underwater sound as a threat to the five species listed in the plan (all of which, other than the speartooth shark, are species listed in Table 5.6 as occurring the activity area); rather, existing threats are fishing activities, habitat degradation, marine debris and the collection of animals for display in public aquaria. None of the 10 objectives listed in the recovery plan relate to underwater sound. As such, the generation of underwater sound from the activity is not considered to present a threat to sawfish and river sharks.

Threatened shark species that may migrate through or forage or breed within the activity area (e.g., great white shark) are not likely to experience effects that cause mortality (and thus impact on population dynamics) because of their biology; they lack a swim bladder, are generally transitory in nature, are known to avoid sudden sound increases and have wide ranging habitat with key breeding areas outside of the activity area. The Recovery Plan for the White Shark (DSEPWC, 2013) does not list underwater sound as a threat to the great white shark (*Carcharodon carcharias*); rather, existing threats are fishing activities, shark control activities, illegal trade in white shark products, habitat modification, ecotourism and climate change. None of the 10 objectives listed in the shark's recovery plan relate to underwater sound. As such, the generation of underwater sound from the activity is not considered to present a threat to the great white shark (and by extension, other sharks because of their shared biology).

Based on this evaluation, the impact consequence of underwater sound on fish is assessed as negligible.

Impacts to Marine Invertebrates (Crustaceans)

Crustaceans that are present in the activity area are described in Section 5.3.1. Commercial invertebrate species, such as prawns, are key invertebrate species in the JBG and are described in Section 5.6.1.

Invertebrates are less sensitive to noise impacts than fish species and marine mammals due to their lack of air-filled internal organs. Experiments on lobsters indicates that the statocyst (a mechano-sensory organ responsible for detecting gravity, body positioning and movement) is sensitive to sound and particle motion. The statocyst controls the righting response in lobsters that plays a vital role in the ability to escape predators (Day *et al*., 2019).

Wale et al (2013) undertook controlled tank-based experiments and showed that noise from lower level sources, such as ships, altered behaviour in the shallow water European shore crab (*Cancer maenus*) by disrupting feeding, slowing reaction time to threats, and hastening turn-over times for crabs placed on their backs.

Impacts to crustaceans are likely to be of negligible consequence based on the following:

- The sound at any one location will be localised and temporary.
- Although the activity window overlaps with parts of the spawning period for several commercial prawn species (brown tiger and endeavour prawns, the latter of which spawn year-round), these species tend to spawn in the shallower inshore waters (such as river and tidal creek systems along the JBG coastline) where the juveniles grow before moving to deeper waters. This means the activity is unlikely to take place in spawning grounds and there is a low likelihood of the activity taking place in waters with high numbers of juvenile prawns.
- Lethal effects to crustaceans have not been observed in studies (Christian *et al*., 2003; Parry and Gason 2006; Payne *et al*., 2007; Day *et al.,* 2016a).
- No significant impacts to adult female prawns berried with eggs are expected during the spawning season given that there have been no reports of acute or chronic mortality in adult lobsters and no mortality of embryos exposed to seismic impulses (Christian *et al*., 2003).
- Underwater sound is not expected to reach the threshold listed in .

Impacts to Cetaceans

Cetaceans are highly mobile, and behavioural effects are expected to be limited to short-term avoidance of the activity area if sounds levels create disturbance. The known temporal and spatial characteristics of cetaceans that may occur in and around the activity area make it unlikely that behavioural effects or TTS will occur because:

- Pygmy blue whales - migration is thought to follow deep oceanic routes, and a tagging study by Double et al (2014) identified that the shallowest waters occupied was ~1,300 m. There are no pygmy blue whale BIAs intersected by the activity area, so if this species is present in the region at the time of the activity, it is likely to be in low numbers and not undertaking critical life stages (such as breeding and calving, where animals would be present in one location for longer than if migrating through).
- Humpback whales - are unlikely to be encountered in the activity area as their peak presence in northwest Australia (June to September) is located far west of the activity area. Overall, this likelihood is considered low due to their preference for migrating along the edge of the continental shelf (in water depths of about 200 m).
- Cetaceans have an observed ability to avoid vessels and acoustic sound sources.
- Any reduction in plankton biomass in and immediately around the activity area as a result of underwater sound is expected to have a negligible effect on the foraging habits of baleen whales because the reduced biomass is temporary, the activity area is located well outside of plankton bloom areas (caused by cold water upwellings) and because they have vast foraging grounds, with the activity area representing a miniscule proportion of these foraging grounds.
- The activity will be of a short duration.
- There are no significant feeding, breeding or aggregation areas for marine mammals within the activity area (no BIAs are overlapped).

- Impacts would be limited to temporary behavioural impacts to individual fauna close to the sound source.

Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and the same species exposed to the same sound may react differently (Nowacek *et al*., 2004; Gomez *et al*., 2016; Southall *et al*., 2016). An individual's response to a stimulus is influenced by the context in which the animal receives the stimulus and how relevant the individual perceives the stimulus to be. A number of biological and environmental factors can affect an animal's response—behavioural state (e.g., foraging, travelling or socialising), reproductive state (e.g., female with or without calf, or single male), age (juvenile, sub-adult, adult), and motivational state (e.g., hunger, fear of predation, courtship) at the time of exposure as well as perceived proximity, motion and biological meaning of the sound and nature of the sound source.

Animals might temporarily avoid anthropogenic sounds but could display other behaviours such as approaching novel sound sources, increasing vigilance, hiding and/or retreating, that might decrease their foraging time (Purser & Radford, 2011). Some cetaceans might also respond acoustically to survey noise in a range of ways, including by increasing the amplitude of their calls (Lombard effect), changing their spectral (frequency content) or temporal vocalisation properties, and in some cases, cease vocalising (McDonald *et al*., 1995; Parks *et al*., 2007; Di loro & Clark, 2010; Castellote *et al*., 2012; Hotchkin & Parks, 2013; Blackwell *et al*., 2015). Masking can also occur (Erbe *et al*., 2015).

Southall et al (2007) extensively reviewed marine mammal behavioural responses to sounds as documented in the literature. Their review found that most marine mammals exhibit varying responses between an SPL of 140 and 180 dB re 1 µPa, but a lack of convergence in the data from multiple studies prevented them from suggesting explicit criteria. The causes for variation between studies included lack of control groups, imprecise measurements, inconsistent metrics, and context dependency of responses including the animal's activity state.

The dolphin species that may be encountered in the activity area (see Table 5.8) have broad distributions and habitat requirements. These species are known to ride the bow waves of vessels (Bannister *et al*., 1996, Perrin, 1998; Ross, 2006; Hawkins & Gartside, 2009; Barkaszi *et al*., 2012; Barry *et al*., 2012). The two threatened dolphin species listed in Table 5.8, the Australian humpback dolphin and Australian snubfin dolphin, are generally found in shallow protected waters along the coast and unlikely to be present in the activity area.

Humpback whale breeding and calving BIAs are located off the west Kimberley coastline and extends as far as Bigge Island, approximately 107 km south of the ecological EMBA. Humpback whales are therefore unlikely to be present in the activity area, so no impacts are expected to this species. Any individual within the activity area is expected to be transient.

The sei whale is known to prefer deep offshore waters with no known mating or calving areas in Australian waters. As such, the generation of underwater sound will not impact on this species. The fin whale is known to prefer deep offshore waters and are considered rare in Australia. As such, the generation of underwater sound will not impact on this species.

The expected underwater noise from the vessel under dynamic positioning may result in TTS within 70 m. Behavioural impacts may occur to 3.5 km. Cetaceans are highly mobile, and behavioural effects are expected to be limited to short-term.

The proposed geotechnical investigations will not have a 'significant' impact on threatened cetacean species when assessed against the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013) as outlined in Table 7.4.

Table 7.4 Assessment against EPBC Act Significant Impact Guidelines for cetaceans

Significant impact guideline	Assessment
Lead to a long-term decrease in the size of a population.	Underwater sound generated from the activities will not lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species.	Underwater sound generated from the activities will not lead to a reduction in the area of occupancy of cetaceans.
Fragment an existing population into two or more populations.	Underwater sound generated from the activities would not be expected to split up a single population into two or more populations.
Adversely affect habitat critical to the survival of a species.	Underwater sound generated from the activities will not affect habitat critical to the survival of a species. There is no overlap between underwater noise emissions and critical habitat for cetaceans.
Disrupt the breeding cycle of a population.	Underwater sound generated from the activities will not disrupt the breeding cycle of a population. There is no overlap between underwater noise emissions and cetacean breeding sites.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Underwater sound generated from the activities will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. Impacts will be localised and temporary.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The activity will not result in the introduction of IMS.
Introduce disease that may cause the species to decline.	The activity will not result in the introduction of disease.
Interfere with the recovery of the species.	Recovery of threatened cetaceans will not be interfered with given there is no overlap between underwater sound emissions and areas critical to species recovery (such as areas of calving, breeding or migration).

Impacts to Marine Reptiles

Threatened and migratory marine turtle species were identified as having the potential to occur in the activity area and EMBA these are the flatback, green, loggerhead, hawksbill, leatherback and olive ridley turtles. There are several BIAs for marine turtle species in the region, including those along the coastline in the JBG. The activity area overlaps the olive ridley, green and flatback turtle foraging BIAs, as well as an interesting BIA for flatback turtles (see Section 5.3.6).

A number of species of sea snakes are identified in the PMST as having the potential to occur in the activity area and EMBA (see Section 5.3.6). There are no mapped BIAs for sea snakes within the activity area or ecological EMBA (see Table 5.9).

Turtles

Morphological studies of green and loggerhead turtles (Ridgeway *et al*., 1969; Wever, 1978; Lenhardt *et al*., 1985) found that the sea turtle ear is similar to other reptile ears but has some adaptations for underwater listening. A thick layer of fat may conduct sound to the ear in a similar manner as the fat in jawbones of odontocetes (Ketten *et al*., 1999), but sea turtles also retain an air cavity that presumably increases sensitivity to sound pressure. Sea turtles have lower underwater hearing thresholds than those in air, owing to resonance of the aforementioned middle ear cavity, and hence they hear best underwater (Willis, 2016).

Electrophysiological and behavioural studies on green and loggerhead sea turtles found their hearing frequency range to be approximately 50–2,000 Hz, with highest sensitivity to sounds between 200 and 400 Hz (Ridgeway *et al*., 1969; Bartol *et al*., 1999; Ketten & Bartol, 2005; Bartol & Ketten, 2006; Yudhana *et al*., 2010; Piniak *et al*., 2011; Lavender *et al*., 2012; 2014), although these studies were all conducted in-air. Underwater audiograms are only available for three species. Two of these species, the red-eared slider (Christensen-Dalsgaard *et al*., 2012) and the loggerhead turtle (Martin *et al*., 2012), both demonstrated higher sensitivity at around 500 Hz (Willis, 2016). Recent work on green turtles has refined their maximum underwater sensitivity to be between 200 and 400 Hz (Piniak *et al*., 2016). Yudhana et al (2010)) measured auditory brainstem responses from two hawksbill turtles in Malaysia and found that peak frequency sensitivity occurred at 457 Hz in one turtle and at 508 Hz in the other.

The thresholds for TTS and PTS (Table 7.2) are unlikely to be reached. Sound levels defined by Popper et al (2014) show that animals are very likely to exhibit a behavioural response when they are near an underwater noise source (tens of metres), a moderate response if they encounter the source at intermediate ranges (hundreds of metres), and a low response if they are far (thousands of meters) from the source. Based on this information, avoidance behaviour may occur within 2 km of the sound source. McCauley et al (2003) indicated an avoidance response threshold of approximately 175 dB re 1 µPa SPL.

The Recovery Plan for Marine Turtles in Australia (DoEE, 2017c) identifies noise interference as a threat to turtles. It details that exposure to acute noise or temporary exposure to loud noise (e.g., seismic activity, sonar) in the marine environment may lead to avoidance of important habitat and in some circumstances physical damage to turtles noting there is little information pertaining to the impacts of acute noise on marine turtles.

Habitat critical to the survival of a species (referred as ‘habitat critical’) of marine turtle stocks under the EPBC Act, are identified in the Recovery Plan for Marine Turtles in Australia (DoEE, 2017c). ‘Habitat Critical’ is defined by the *EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* as areas necessary for:

- Activities such as foraging, breeding or dispersal;
- Long-term maintenance of the species (including the maintenance of species essential to the survival of the species);
- Maintaining genetic diversity and long-term evolutionary development; and
- The reintroduction of populations or recovery of the species.

The geotechnical survey will overlap the loggerhead, green and olive ridley turtle foraging BIAs and part of the flatback turtle interesting BIA (Figure 5.27, Figure 5.28, Figure 5.29 and Figure 5.30). Table 7.5 identifies the objectives and actions from the Recovery Plan for Marine Turtles in Australia (DoEE, 2017c) which are relevant to the activity.

Table 7.5 Assessment against the Recovery Plan for Marine Turtles 2017-2027

Interim Objective or Target	Assessment
Interim Objective 3: Anthropogenic threats are demonstrably minimised	
Target 3.1: Robust and adaptive management regimes that lead to a reduction in anthropogenic	The EPS listed in Table 7.6 will reduce the impact of noise emissions on turtles to ALARP and ensure

Interim Objective or Target	Assessment
threats to marine turtles and their habitats are in place.	the activity is conducted in a manner that is not inconsistent with this recovery target.
Target 3.2: Threat mitigation strategies are supported by high quality information.	The EPS listed in Table 7.6 are based on the project-specific EIA presented in this section, and the activity will not have any impacts on this recovery target.

Source: DoEE (2017c).

Any impacts to turtles are likely to be limited to avoidance behaviour (within 2 km of the sound source) where they may move away from a vessel whilst undertaking geotechnical investigations. Potential disturbances to turtles in the foraging BIAs (for green, loggerhead and olive ridley turtles) will be localised and short term and as such there are unlikely to be impacts to foraging behaviour, and the recovery of the stock will not be compromised.

The impacts of underwater sound to turtle species known to occur in the activity area are predicted below:

- Loggerhead turtles – the activity area is located over 50 km from the foraging BIA. Given that effects to behaviour are predicted to be low, impacts to this species are predicted to be negligible.
- Green turtles – the activity area overlaps the foraging BIA. With foraging primarily occurring in shallow benthic habitats (<10 m), disturbance to foraging from underwater sound is unlikely to occur given that the activity will take place in waters 30-50 m deep. Given that effects to behaviour are predicted to be low, impacts to this species are predicted to be negligible.
- Flatback turtle – the activity may overlap with the start of the peak nesting season for flatback turtles (i.e., July to September) (DoEE, 2017c) and the activity area overlaps the inter-nesting buffer BIA. Given that the nearest flatback habitat critical area occurs 77 km to the south (i.e., the rookery at Cape Domett) and that the distance to behavioural effects for turtles is predicted to be very small, impacts from underwater sound to nesting (i.e., deterrence from approaching or leaving nesting beaches) will not occur. Given that effects to behaviour are predicted to be low, impacts to this species are predicted to be negligible.
- Olive Ridley turtle – the activity area overlaps the foraging BIA. Given that effects to behaviour are predicted to be low, impacts to this species are not predicted.
- Hawksbill turtle – the activity area does not overlap any BIAs and this species is only likely to occur as transient individuals. Given their low abundance in the JBG and that effects to behaviour are predicted to be low, impacts to this species are not predicted.
- Leatherback turtle – the activity area does not overlap any BIAs and this species is only likely to occur as transient individuals. Given their low abundance in the JBG and that effects to behaviour are predicted to be low, impacts to this species are not predicted.

Sea snakes

There is limited available information on the hearing ability of sea snakes. Very few studies have assessed the potential impact of noise on sea snakes. Studies of hearing morphology in sea snakes indicate that they may detect particle motion and hear low frequency sounds within 100 m of the sound source (Crowe-Riddell *et al*., 2016). A study conducted by Chapuis et al (2019) investigating the noise impacts of seismic surveys on sea snakes found the hearing sensitivity of sea snakes is similar to species of fish without a swim bladder (see). Chapuis et al (2019) reports that sea snakes have not been observed to exhibit a behavioural response to sound and that they are likely to be less sensitive to sound than bony fishes and sea turtles.

Given most sea snakes prefer shallow water and reef habitats, there is a low likelihood of their presence in the activity area, and if present, numbers are likely to be low. Therefore, there is a low risk in the near and intermediate distances (which extends hundreds of metres) of behavioural impacts to sea snakes, with the potential impacts being limited to temporary avoidance of the area.

Impacts to Avifauna

The activity area contains potential foraging habitat for a diverse array of seabirds. In the event that individual birds or flocks are present in the activity area during the activity, vessel movement is expected to temporarily deter them from foraging in the immediate vicinity of the vessel. The risk of underwater sound significantly impacting a population of any given species or even individuals (during plunge/dive feeding) is extremely low.

An indirect impact may occur if underwater sound cause changes to the abundance or behaviour of prey species (fish). However, the extent to which temporary 'descending' or 'tightening' responses of schooling prey fish such as pilchards (if it occurs) affects availability to avifaunal predators either positively or negatively, is not known. As described in the previous section regarding fish, the effects to fish from the activity will be very localised and transitory, and it is not likely that significant impacts to predatory avifauna will be experienced.

Seabird species that may forage in the activity area (see Section 5.3.7) all have considerable foraging habitat present throughout JBG, with many listed as migratory. The small size of the activity area and location offshore is not significant relative to their normal foraging environment. Any temporary dispersal of prey species (i.e., fish) due to the geotechnical activities would not result in any significant decrease in availability of prey species that is of biological significance for these populations.

The timing of the activity overlaps with the breeding seasons of several seabirds (see Figure 5.31), but their breeding areas are along the coast and a great distance away from the activity area. Underwater sound from the activity will therefore have no impacts on seabird breeding.

Shorebird species such as the curlew sandpiper and lesser sand plover are not expected to be affected by the activity, given their preference for species of prey occurring in areas of intertidal sandflats and mudflats along the coastline.

There are no thresholds or assessment criteria for noise impacts to seabirds and shorebirds from underwater sound exposure. As most seabirds spend very little time under the water surface, and when they do it is for very limited periods (several seconds to a minute), impacts to seabirds will be negligible. The activity area does not contain spatially limiting food sources, with JBG providing abundant foraging grounds.

Impacts to Commercial Fisheries

Potential underwater noise impacts relevant to commercial fisheries stocks are assessed above (*Impacts to Plankton*, *Impacts to Fish* and *Impacts to Invertebrates*). Negligible consequences are expected and the risks from the activity are limited to possible localised displacement of fisheries species (and prey) in the immediate vicinity of the geotechnical vessel.

7.1.5 Impact Assessment

Table 7.6 presents the impact assessment of underwater sound generated from the activity on biological receptors.

Table 7.6 Impact assessment for underwater sound on biological receptors

<table>
<tr><th colspan="3">Summary</th></tr>
<tr><td>Summary of impacts</td><td colspan="2">Physiological or behavioural impacts to local populations of marine fauna and avifauna.</td></tr>
<tr><td>Extent of Impact</td><td colspan="2">Up to 2 km from the geotechnical vessel.</td></tr>
<tr><td>Duration of Impact</td><td colspan="2">Underwater sound generation will be of a short duration.</td></tr>
<tr><td>Level of certainty of impacts</td><td colspan="2">Moderate.</td></tr>
<tr><td rowspan="4">Impact decision framework context</td><td>Decision type</td><td>A – good industry practice required.</td></tr>
<tr><td>Activity</td><td>Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.</td></tr>
<tr><td>Risk and uncertainty</td><td>Risks are well understood, uncertainty is minimal.</td></tr>
<tr><td>Stakeholder influence</td><td>No conflict with company values, no partner interest, no significant media interest.</td></tr>
<tr><td>Defined acceptable level</td><td colspan="2">• No population level impacts to marine fauna and avifauna from the activity.
• Anthropogenic noise in BIAs will be managed such that turtles will continue to utilise the area without injury or displacement from foraging, migration and interesting areas.</td></tr>
<tr><th colspan="3">Impact consequence (inherent)</th></tr>
<tr><td colspan="2">Receptor</td><td>Consequence rating</td></tr>
<tr><td colspan="2">Plankton</td><td>Negligible</td></tr>
<tr><td colspan="2">Fish – with swim bladders</td><td>Negligible</td></tr>
<tr><td colspan="2">Fish – without swim bladders</td><td>Negligible</td></tr>
<tr><td colspan="2">Marine invertebrates (crustaceans)</td><td>Negligible</td></tr>
<tr><td colspan="2">Cetaceans</td><td>Negligible</td></tr>
<tr><td colspan="2">Marine reptiles (turtles & sea snakes)</td><td>Negligible</td></tr>
<tr><td colspan="2">Avifauna</td><td>Negligible</td></tr>
<tr><td colspan="2">Commercial fisheries</td><td>Negligible</td></tr>
</table>

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
EPBC Policy Statement 2.1 – Part A (Standard management procedures)	Engineering & administrative	No	**EB:** Improved ability to spot and identify marine fauna at risk of impact from underwater sound generated by activity equipment. **C:** Little additional cost – time to induct vessel crew and ensure compliance. **Ev:** Standard management procedures in Part A of the policy statement must be followed by all vessels conducting seismic surveys (including shallow seismic surveys) irrespective of location and time of year. The policy statement notes that these procedures should be sufficient in areas where there is a low likelihood of encountering whales. Very little benefit expected given the predicted negligible impacts from geotechnical activities.
EPBC Policy Statement 2.1 – Part B (Additional management measures) – use of a Marine Mammal Observer (MMO)	Administrative	No	**EB:** Improved ability to spot and identify marine fauna at risk of impact from underwater sound generated by activity equipment. **C:** Several thousand dollars to contract an MMO (based on day rate, travel and accommodation and activity duration). **Ev**: The use of MMOs is covered by Part B (Additional Management Procedures) of the policy statement. Adoption of Part B (either all or parts thereof) is recommended for vessels conducting seismic surveys (including shallow seismic surveys) in areas and/or seasons that have a moderate to high likelihood of encountering whales. The likelihood of encountering whales in the activity area during the activity window is low, with no whale BIAs within the activity area, so the use of an MMO is not considered necessary.
Vessel engines and thrusters are well maintained **(IMP-01: EPS-01)**	Engineering	Yes	**EB:** Efficient engines and thrusters are likely to result in lower sound and vibration, thereby minimising impacts to sound-sensitive marine fauna. **C:** Maintenance costs can be significant. **Ev:** Vessel maintenance is necessary to maintain a vessel in sea-worthy condition. EOG would not hire a vessel that is not sea-worthy, so there is no alternative to implementing this control measure.

Schedule the activity outside the flatback turtle inter-nesting BIA period (peak nesting at Cape Domett is July to September).	Administrative	No	**EB:** Even though there is a very small overlap between the activity area and the Cape Domett inter-nesting BIA, there are no environmental benefits of this control measure given that the nesting BIA is not intersected and that the Cape Domett nesting area is >70 km south of the activity area. **C:** The potential cost of not being able to undertake the survey during July and August could cost millions of dollars in delays. **Ev:** There is no evidence that flatback turtles swim into offshore waters during the inter-nesting period, with the inter-nesting buffer based on a study undertaken at the North West Shelf. The EIA for turtles indicates that injury and behavioural impacts are unlikely. With Cape Domett being over 70 km from the activity area, the distance to effect from the sound source for turtles being a few hundred metres and turtle hatchlings reportedly growing to maturity in shallow coastal waters, the extremely high cost associated with excluding July and August from the activity window is not commensurate with the low risk to this species.
Environmental awareness induction **(IMP-01: EPS-02)**	Administrative	Yes	**EB:** Ensures vessel crew are aware of potential impacts from underwater noise, thereby minimising impacts to megafauna. **C:** Minimal additional cost to prepare and present induction and associated educational material. **Ev:** Presenting inductions to ensure crew are aware of their obligations is an industry standard. The benefits outweigh the minor costs.

Environmental Controls and Performance Measurement		
Performance outcome	Performance standard (control)	Measurement criteria
No displacement or injury to whales and turtles.	**(IMP-01: EPS-01)** Engines and thrusters are maintained in accordance with manufacturer's instructions via the Planned Maintenance System (PMS) to ensure they are operating efficiently.	PMS records verify that engines and thrusters are maintained to schedule.

Impact consequence (residual)	
Receptor	Consequence rating
Plankton	Negligible
Fish – with swim bladders	Negligible
Fish – without swim bladders	Negligible
Marine invertebrates (crustaceans)	Negligible
Cetaceans	Negligible
Marine reptiles (turtles & sea snakes)	Negligible
Avifauna	Negligible
Commercial fisheries	Negligible

<table>
<tr><td colspan="3">The consequence of underwater sound emissions is assessed as negligible because:
• Underwater sound emissions are temporary;
• BIAs for cetaceans (as one of the more sound-sensitive fauna groups) do not occur in and around the activity area; and
• Distances to effect for underwater sound are very low.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>Management system compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard</td><td colspan="2">The residual impact consequence is Level 2 (negligible), which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">The NT DITT raised concerns about the impacts of underwater sound on fish (see Chapter 4). Impacts to fish are addressed in this section.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• EPBC Act 1999 (Cth):
o Section 229, 229A – all cetaceans protected in Australian waters, and it is an offence to kill, injure or interfere with a cetacean.</td></tr>
<tr><td rowspan="6">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented for this activity.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this activity take into account the management measures listed for exploration in Section 4.4.1 of the guidelines, which include:
• Considering sensitive locations and times of year for critical activities of species that are present.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines specifically regarding underwater sound for offshore activities.</td></tr>
<tr><td>Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)</td><td>Not applicable. The guidelines do not discuss the impacts of sound generation on marine life.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
• Noise (item 74). The preparation of this EP meets the objectives of these guidelines, whereby sensitive areas for marine life are identified.</td></tr>
<tr><td></td><td></td></tr>
</table>

	APPEA CoEP (2008)	The EPS developed for this activity meet the code's following objectives: • Reduce the impact on cetaceans and other marine life to ALARP and an acceptable level. • To reduce the impacts to benthic communities to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	Underwater sound created by the activity will not reach levels above ambient sound at AMPs.
	Ramsar wetlands	Underwater sound created by the activity will not reach levels above ambient sound at any wetlands.
	TECs	Underwater sound created by the activity will not reach levels above ambient sound at TECs.
	Nationally threatened and migratory species	Underwater sound created by the activity will not reach levels above ambient sound for threatened and migratory species.
	Other matters	
	KEFs	Underwater sound created by the activity will not reach levels above ambient sound at KEFs.
	NIWs	Underwater sound created by the activity will not reach levels above ambient sound at NIWs.
	State marine parks	Underwater sound generated by the activity will not reach levels above ambient sound at state marine parks, which are located around islands and along mainland coastlines.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	The Conservation Management Plan for the Blue Whale (DoE, 2015a); Sei Whale (TSSC, 2015b) and Fin Whale (TSSC, 2015c) identify noise interference as a threat to these species. The impact assessment found that the activity is not inconsistent with these management plans. The Recovery Plan for the White Shark (DSEWPC, 2013) does not list anthropogenic sound as a threat to this species.
		The Recovery Plan for Marine Turtles in Australia (DoEE, 2017c) identifies noise interference as a threat to turtles, and for acute noise such as seismic surveys, states that surveys planned to occur inside important inter-nesting habitat should be scheduled outside the nesting season. This requirement is not triggered by the geotechnical activity. There are no actions or interim objectives listed in the Recovery Plan relating to underwater sound. As such, the impacts of the activity are not inconsistent with the aims of this plan.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant) as outlined below:	

	A. Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	The timing of the activity has been selected to balance the requirements between peak fishing activity, whale migration times, sea state considerations and safe vessel operations.
	B. If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The scientific literature cited throughout this section indicates that TTS in cetaceans (as one of the more sound-sensitive fauna groups) is likely only within close proximity to the sound source (tens of metres), with PTS not considered credible.
	C. The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Impacts to biological receptors are assessed to be localised and temporary. These impacts will not affect present and future generations in terms of maintaining biodiversity for its intrinsic value.
	D. The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	Impacts to biological receptors are assessed to be localised and temporary. There will not be a loss of species diversity and abundance as a result of the underwater sound generated by the activity.
	E. Improved valuation, pricing and incentive mechanisms should be promoted.	Not relevant.

Statement of acceptability	EOG considers the impacts from underwater sound to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible for all receptors; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Underwater sound emissions from the activity will not have long-term or significant impacts on MNES; • The management of underwater sound emissions will ensure it is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of underwater sound emissions will ensure it is not inconsistent with the aims of relevant marine reserve management plans; and • The management of underwater sound emissions will ensure it is not inconsistent with ESD principles.
Environmental Monitoring	
• None.	
Record Keeping	
• Induction presentation and attendance sheets. • PMS records (engines/thrusters).	

7.2 IMPACT 2 – Displacement of Other Marine Users

7.2.1 Hazard

The physical presence of the geotechnical vessel undertaking the activity necessitates the temporary displacement of other marine users from around the vessel. This will result in the temporary displacement of other marine users such as commercial fishing vessels and merchant vessels from areas in which they would normally operate.

Displacement of other marine users differs from interference with other marine users, which is addressed in Section 7.13.

7.2.2 Known and Potential Environmental Impacts

The known and potential impacts of the displacement of other marine users are:

- Diversion from a planned travel route and additional time to re-join the planned route;
- Increased fuel use (and cost) as a result of this diversion; and
- Temporary exclusion from fishing grounds.

7.2.3 EMBA

Other marine users will be excluded from operating within a radius of 500 m (0.27 nm) of the vessel (approximately 0.785 km^2) during the activity. Receptors in the EMBA may include:

- Commercial fishing vessels; and

- Merchant vessels.

7.2.4 Evaluation of Environmental Impacts

Merchant Shipping

As illustrated in Figure 5.55 and detailed in Table 5.17, the activity area and the immediate surrounds has recorded 35 vessel trips (tankers, cargo chips, fishing vessels, etc) over a 12-month period (August 2020 to July 2021) and therefore overlaps an area of low shipping traffic. This is primarily due to its location south of the major shipping routes travelling to and from the Port of Darwin.

The temporary exclusion of other marine users is likely to result in a negligible increase in travel time and fuel cost to individual marine users because of the very small exclusion zone and short-term nature of the activity. In the context of the marine voyages undertaken by vessels in the region, a negligible increase in travel time and fuel use in order to divert around the path of the vessel undertaking geotechnical activities will have a negligible consequence.

Fisheries

The primary fishery with recent fishing history in the activity area is the NPF (see Section 5.6.1). A seasonal closure for the NPF in the JBG exists in the period 31 March – 15 June (AFMA, 2021). The activity window overlaps the fishing season (Table 5.14). The shipping data presented in Table 5.17 indicates there were only three fishing vessels recorded in the activity area between August 2020 and July 2021, with single vessels recorded in December, June and July. This indicates that the likelihood of the activity disrupting or displacing commercial fishing vessels is likely to be negligible to nil.

Given the short duration of the activity, the small area of potential displacement and the low fishing intensity in the activity area, the consequence of temporary displacement to these fisheries will have a negligible consequence.

7.2.5 Impact Assessment

Table 7.7 presents the impact assessment for displacement with other marine users.

Table 7.7 Impact assessment for displacement of other marine users

<table>
<tr><th colspan="3">Summary</th></tr>
<tr><td>Summary of impacts</td><td colspan="2">Presence of geotechnical vessel will temporarily displace other marine users (i.e., commercial fishing vessels, merchant shipping, etc) resulting in temporary exclusion in the area immediately around the vessel.</td></tr>
<tr><td>Extent of impacts</td><td colspan="2">Highly localised - 1 nm around vessel.</td></tr>
<tr><td>Duration of impacts</td><td colspan="2">Short-term – minutes for a third-party vessel detour.</td></tr>
<tr><td>Level of certainty of impacts</td><td colspan="2">HIGH – the impacts associated with displacement of other marine users is well understood.</td></tr>
<tr><td rowspan="3">Impact decision framework context</td><td>Decision type</td><td>A - good industry practice required.</td></tr>
<tr><td>Activity</td><td>Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.</td></tr>
<tr><td>Risk & uncertainty</td><td>Risks are well understood, uncertainty is minimal.</td></tr>
</table>

	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	Displacement of other marine users is no greater than the necessary for the reasonable exercise of rights afforded under the OPGGS Act. No unplanned interactions with other marine users.	

Impact Consequence (inherent)	
Receptor	Consequence
Merchant shipping	Negligible
Commercial fisheries	Negligible

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Do not conduct the activity in waters available to fisheries	Eliminate	No	**EB:** Eliminates the potential for displacement of fishers by conducting the activity only in waters that are closed to fishing. **C:** The activity objectives could not be met if confined to areas closed to fishing. **Ev:** There are low numbers of fishers working in the activity area and the area is closed to the NPF during the activity timing. The activity area does not represent critical fishing grounds for any WA-managed fisheries. The cost of implementing this control is grossly disproportionate to the environmental benefit.
Conduct the activity during the NPF JBG closure period (1st December 2021 to 1st August 2022)	Eliminate	No	**EB:** Eliminates the potential for displacement of NPF fishers by conducting the activity only when JBG waters are closed to prawn fishing. **C:** If a vessel of opportunity is only available during August, not taking this vessel has a lost opportunity cost. **Ev:** Data in 2020 indicates there were very few fishing vessels recorded in the activity area (see Table 5.16). Removing December to August from the activity window is therefore not commensurate with the low likelihood of displacing commercial fishing vessels.
Communicate the required area of displacement for the duration of the activity **(IMP-02:EPS-01, -02)**.	Administrative	Yes	**EB:** Informs other marine users of EOG's intentions, allowing time for planning so as to avoid or minimise displacement. **C:** Minimal cost to communicate with other marine users ahead of the activity through EOG notifications and the NTM. **E:** The benefit of avoiding or minimising displacement outweighs the minimal cost to implement this control measure.

Reduce the exclusion zone to the lowest area possible for safe operations **(IMP-02:EPS-03)**.	Administrative	Yes	**EB:** The exclusion zone (and thus extent of displacement) is reduced to the lowest possible extent necessary to achieve its aim and is linked to the length of the towed equipment. **C:** No cost to publish exclusion zone in NTM. **Ev:** Reducing the extent of displacement to the lowest possible level necessary for safe operations outweighs the cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Other marine users are made aware of the location of the activity.	**(IMP-02:EPS-01)** EOG provides pre-activity notification to commercial fisheries at least one month prior to activity commencement to ensure they are aware of the activity timing and safety exclusion zone requirements.	Consultation records verify that notifications to fisheries were provides at least one month ahead of the activity starting.
	(IMP-02:EPS-02) EOG provides pre-activity notification to the AHO at least one month prior to activity commencement to enable the promulgation of the NTM.	NTM is issued prior to the commencement of the activity and includes activity vessel details, location and timing.
Displacement is limited to the area necessary for safe operations.	**(IMP-02:EPS-03)** The exclusion zone is limited to 500 m around the geotechnical activity vessel.	NTM notes the exclusion zone is not larger than 500 m.

Impact Consequence (residual)	
Receptor	Consequence
Merchant shipping	Negligible
Fisheries	Negligible

The impact of displacement of other marine users is assessed as negligible because:

- The activity will be of a short duration;
- The area of displacement is extremely small and will not result in negligible increased time and fuel use for third-party vessels to divert around the activity vessel; and
- Thorough consultation has been undertaken in the development of the activity to minimise the impact of temporary displacement.

Demonstration of ALARP

A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.

Demonstration of Acceptability	
Policy compliance	EOG’s Safety and Environmental Policy objectives are met.
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.

Risk matrix standard compliance	The residual impact consequence is Level 2 (negligible), which is considered acceptable.	
Engagement	The NPFI raised concerns about displacement of commercial fishing vessels (see Table 4.2). These concerns have been addressed in this section and EOG will continue to consult with marine users as project planning continued.	
Legislative context	The EPS outlined in this table align with the requirements of: • OPGGS Act 2006 (Cth). ○ Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others) to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.	
Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed guidelines and codes of practice demonstrates that BPEM will be implemented for this activity	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore physical presence in Section 4.3.1 of the guidelines, which include: • Develop exclusion zones in consultation with key stakeholders, including local fishing communities; raise awareness of exclusion zones with all stakeholders. • Issue a 'Notice to Mariners' through the relevant government agencies, detailing the area of operations. • Ensure all vessels adhere to International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels. • Optimise vessel use to ensure the number of vessels required and length of time that vessels are on site is as low as practicable.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding physical presence for offshore activities.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of displacement of other marine users.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines specifically regarding physical presence for activity vessels.

	APPEA CoEP (2008)	The EPS developed for this activity meet the code's following objectives: • To reduce the impact on other marine resource users to ALARP and to an acceptable level. • To reduce risks to public safety to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	This hazard will not intersect nearby AMPs.
	Ramsar wetlands	This hazard will not intersect any Ramsar wetlands.
	TECs	This hazard will not intersect any TECs.
	Nationally threatened and migratory species	This hazard will not have any impacts on threatened or migratory species.
	Other matters	
	KEFs	This hazard will not intersect any KEFs.
	NIWs	This hazard will not intersect any NIWs.
	State marine parks	This hazard will not intersect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the impacts from displacement of other marine users to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is Level 2 (negligible); • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved; • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; and • Relevant legislation and industry best practice will be complied with.	
Environmental Monitoring		
• Continuous bridge monitoring.		
Record Keeping		
• Consultation records. • NTM.	• Operational reports. • Incident reports.	

7.3 IMPACT 3 – Seabed Disturbance

7.3.1 Hazard

The geotechnical activities that will result in seabed disturbance are:

- Seabed grab sampling and coring activities; and
- Cuttings discharge directly to the seabed (during borehole sampling).

Activities that *may* result in seabed disturbance (but have been included in the EIA section given the similarity of consequences) include:

- Dropped objects (in-water towed equipment or deck equipment); and
- Vessel anchoring (if required in an emergency, but distant from the Blacktip pipeline).

7.3.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of this localised seabed disturbance as a result of geotechnical survey investigations and potential vessel anchoring are:

- Localised and temporary turbidity of the water column at the seabed;
- Localised physical removal of seabed sediments and physical disturbance of benthic habitat;
- Localised and temporary smothering of seabed habitats; and
- Displacement of a small area of seabed habitat by dropped object (if not recovered).

These impacts may result in temporary disturbance, displacement or smothering of benthic habitats and fauna.

There are no listed shipwrecks present within the activity area, so there will be no impacts to shipwrecks as a result of the geotechnical activities.

7.3.3 EMBA

The EMBA for seabed disturbance is likely to be within the immediate vicinity of the activity (e.g., tens of metres).

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Benthic fauna;
- Benthic habitat (sand substrates);
- Demersal and pelagic fish; and
- Turtles.

7.3.4 Evaluation of Environmental Impacts

Water turbidity

Any turbidity created is likely to be within the limits of natural variability when considering the turbidity created by large tides in the JBG. This turbidity would temporarily inhibit light penetration into the water column but given its temporary nature would be unlikely to inhibit any macroalgae growth. Benthic fauna living in sediment (endobenthos) or on sediment (epibenthos) may be temporarily displaced by this turbidity.

Physical disturbance

The maximum area of seabed disturbance within the activity area is estimated to less than 100 m^2 (see Section 2.4). Surveys of seabed disturbance from anchoring activities indicate that recovery of benthic fauna in soft sediment substrates (such as the sandy seabed that dominates the activity area) occurs between 6 to 12 months after the disturbance was created (URS, 2001). The anchor depression acts as a trap for marine detritus and sand, which will quickly fill and be recolonised by benthic organisms (Currie and Isaac, 2005). The area impacted by single anchor points is extremely small, and given that anchoring will not be necessary, unless in the event of an emergency (and not in the activity area), this is not expected to pose a threat to seabed habitats or fauna communities.

Given the dominance of soft sediments (sandy and muddy substrates) in the activity area and JBG more generally, it is expected that holes created by coring activities will rapidly collapse in on themselves, leaving only shallow pock marks in the seabed that will be rapidly filled in and colonised, as described above.

Given the seabed morphology in the region is typically characterised by extensive sediment plains and high sediment deposition with sparsely distributed epifauna, the area of impact will be highly localised and temporary, with recovery expected within weeks to months (e.g., cored holes will collapse and quickly fill in with sediment and recolonise with benthic fauna).

There are no known sensitive seabed features (e.g., islands, emergent reef systems, canyons, shipwrecks) or sensitive benthic primary producer habitats (e.g. areas of hard corals, seagrass, macroalgae or mangroves) present in the activity area. In addition, the activity area does not overlap any KEFs, so there will be no impacts to such features.

Dispersion and deposition of borehole cuttings

As outlined in Table 2.3, each borehole will generate up to 0.402 m^3 of cuttings (dependent on depth of the borehole) with a maximum amount of 6.03 m^3 if 15 boreholes are drilled.

The discharge of these small volumes of core cuttings and adhered mud to the seabed will have negligible environmental impacts. Dispersion of cuttings across the seabed will be influenced by the prevailing currents and vertical settling forces, and a small proportion of cuttings (particularly fine material) could travel several hundred metres from the drilling location (Hinwood *et al*., 1994). There is potential for core cuttings to smother a small area of seabed (e.g., likely to be no greater than several square metres) and as such possibly generate anoxic conditions in the sediments over time. However, any smothering effects on the sparse benthic communities in the activity area would be highly localised. Given the small volumes of cuttings generated by the borehole sample, coarse and fine cuttings are unlikely to travel towards sensitive receptors, such as the rocky reef close to the shore (closest is 75 km from the activity area), in volumes that result in habitat smothering. As such, there are unlikely to be impacts to species dependent on those reefs for foraging (i.e., turtles, mantra ray).

To stabilise the boreholes, non-toxic, chemically inert water-based mud (WBM) will be used. This fluid consists of seawater containing guar gum (biodegradable) and/or bentonite (and barite chemically inert, non-bioavailable) as the viscosifier, and barite (as the weighting agents, which is inert). Drilling fluids will be discharged directly from the borehole to the marine environment. Because the WBM additives will contain no toxic ingredients, they will not pose a risk to water quality or to benthic or demersal biota. EOG's preferred drilling fluid is *Pure-Bore® Liquid* which has a Gold CHARM rating (see Section 2.4.1 – Drill Fluids).

Displacement of seabed habitat

Objects that may be dropped into the ocean capable of creating any substantial impact are restricted to large, non-buoyant equipment such as sea containers. Loss of such equipment overboard may be caused when items roll off the deck in poor ocean conditions (e.g., storms) or due to human error when equipment is deployed over the edge of the vessel (e.g., crane move).

Dropped objects would have the impact of smothering benthic habitat and fauna. Impacts from the loss of equipment overboard (assuming no buoyancy) would be the localised and temporary loss of a small area of benthic habitat. If the equipment lost overboard is solid and not recovered, it is likely to provide additional suitable substrate for benthic flora and fauna to colonise (much like subsea infrastructure, such as pipelines and wellheads provide).

7.3.5 Impact Assessment

Table 7.8 presents the impact assessment for seabed disturbance.

Table 7.8 Impact assessment for seabed disturbance

<table>
<tr><th colspan="4">Summary</th></tr>
<tr><td>Summary of impacts</td><td colspan="3">Localised turbidity of the water column at the seabed, smothering of seabed habitat by borehole cuttings, seabed damage and displacement of a small area of seabed habitat.</td></tr>
<tr><td>Extent of impacts</td><td colspan="3">Localised – within the immediate vicinity of the activity (tens of metres).</td></tr>
<tr><td>Duration of impacts</td><td colspan="3">Temporary – duration of the activity and likely up to a week either side of the activity occurring.</td></tr>
<tr><td>Level of certainty of impacts</td><td colspan="3">HIGH – the impacts of disturbance to seabed sediments are well known.</td></tr>
<tr><td rowspan="4">Impact decision framework context</td><td>Decision type</td><td colspan="2">A - good industry practice required.</td></tr>
<tr><td>Activity</td><td colspan="2">Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.</td></tr>
<tr><td>Risk & uncertainty</td><td colspan="2">Risks are well understood, uncertainty is minimal.</td></tr>
<tr><td>Stakeholder influence</td><td colspan="2">No conflict with company values, no partner interest, no significant media interest.</td></tr>
<tr><td>Defined acceptable level</td><td colspan="3">Seabed disturbance is limited to the areas required for sampling.</td></tr>
<tr><th colspan="4">Impact Consequence (inherent)</th></tr>
<tr><td colspan="4">Negligible</td></tr>
<tr><th colspan="4">Assessment of Proposed Control Measures</th></tr>
<tr><td>Control measure</td><td>Control type</td><td>Adopt</td><td>Justification</td></tr>
<tr><td>Recover drill cuttings from the seabed.</td><td>Elimination</td><td>No</td><td>EB: Eliminates potential for benthic habitat smothering from cuttings deposition on the seabed.
C: Significant additional cost (potentially hundreds of thousands of dollars)</td></tr>
</table>

			CBA: Additional cost and longer vessel time on location required to implement this control is not commensurate with the negligible consequences associated with the discharge of very small volumes of drill cuttings.
Do not use drilling muds or additives during borehole sampling.	Elimination	No	**EB:** Reduction in potential ecotoxicity. **C:** Significant cost to the survey design and data quality. **Ev:** Costs to the survey outweighs the benefits.
USE WBM fluids for borehole drilling rather than synthetic-based muds **(IMP-03:EPS-01, -02)**	Engineering	Yes	**EB:** Reduction in potential ecotoxicity. **C:** Minor cost in selection of WBM rather than synthetic-based muds. **Ev:** Environmental benefit outweighs the cost to implement the measure.
No anchoring in the activity area **(IMP-03:EPS-08)**.	Engineering	Yes	**EB:** Avoids potential multiple and repeat disturbances to the seabed. **C:** No additional cost due to the nature of the activity. **Ev:** The environmental benefits outweigh the costs of implementing the measure.
Take fewer seabed samples.	Engineering	No	**EB:** Impacts to the seabed are reduced. **C:** Significant cost to the quality of the survey data obtained. **Ev:** Costs to the survey outweighs the benefits.
Drill borehole samples to shallower depths.	Engineering	No	**EB:** Reduces disturbance to the seabed from borehole cuttings. **C:** Significant cost to the quality of the survey data obtained. **Ev:** Costs to the survey outweighs the benefits.
Use vessel procedures to conduct sampling to minimise the likelihood of lost equipment **(IMP-03:EPS-03, -04, -05, -06, -07)**	Administrative	Yes	**EB:** Ensures sampling is conducted in a controlled manner thereby reducing the likelihood of seabed disturbance from lost equipment. **C:** No additional cost due to the nature of the activity. **Ev:** The environmental benefits outweigh the costs of implementing the measure.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Only low toxicity, readily biodegradable and non-bioaccumulating WBM and additives will be used.	**(IMP-03:EPS-01)** The contractor will only use PLONOR, ‘D’/’E’ (non-CHARM) or ‘Gold’/’Silver’ (CHARM) OCNS-rated base fluids and additives in the drilling fluid system to minimise ecotoxicity impacts to marine fauna.	The Mud Chemical Inventory verifies that all chemicals are PLONOR, ‘D’/’E’ (non-CHARM) or ‘Gold’/’Silver’ (CHARM) OCNS-rated.

	(IMP-03:EPS-02) Where, for technical reasons an additive is required that has not been registered with CEFAS (and therefore does not have a rating), EOG will apply the CHARM or, in the case of non-CHARMable products, the OCNS process (https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment-process/) to calculate the CHARM rating or OCNS grouping. Only additives with a hazard quotient of <30 (gold/silver) or an OCNS grouping of D/E will be used.	MoC documentation verifies that, for products not registered with CEFAS, the CHARM and/or OCNS process has been applied and that only additives with a hazard quotient of <30 or an OCNS grouping of D/E are used.
Avoid the loss of deployed equipment.	**(IMP-03:EPS-03)** The contractor's quality control/assurance procedures will be used to guide the deployment of deployed equipment so that damage to (and potential loss of) equipment caused by rough seas is avoided.	Daily reports record weather conditions and verify that towed equipment is not deployed during rough seas.
Avoid objects being dropped overboard.	**(IMP-03:EPS-04)** Large bulky items are securely fastened to or stored on the deck to prevent loss to sea.	A completed pre-departure inspection checklist verifies that bulky goods are securely sea-fastened.
	(IMP-03:EPS-05) The crane/A-frame handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.	Completed handling and transfer procedure checklist, PTWs and/or risk assessments verify that the procedure is implemented prior to each transfer.
	(IMP-03:EPS-06) The crane/A-frame operators are trained to be competent in the handling and transfer procedure to prevent dropped objects.	Training records verify that crane operators are trained in the loading and unloading procedure.
	(IMP-03:EPS-07) Visual inspection of lifting gear is undertaken every quarter by a qualified competent person (e.g., maritime officer) and lifting gear is tested regularly in line with the vessel PMS.	Inspection of PMS records and Lifting Register verifies that inspections and testing have been conducted to schedule.
No anchoring in the activity area	**(IMP-03:EPS-08)** Vessel anchors are not used to hold position during the activity.	Operations reports verify that the vessel anchors were not used during the activity.
Impact Consequence (residual)		
Negligible		

The consequence of seabed disturbance is assessed as negligible because:

- Seabed grab sampling and coring activities are extremely localised, thereby reducing temporary turbidity in water column;
- Cored holes will collapse in on themselves and fill in quickly with sediments and recolonise with benthic fauna;
- Very low volumes of drilling fluids and cuttings will be discharged during borehole sampling; and.

• Vessels will not anchor during the activity.		
Demonstration of ALARP		
A 'negligible' residual impact consequence is considered to be ALARP and a 'lower order' impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.		
Demonstration of Acceptability		
Policy compliance	EOG's Safety and Environmental Policy objectives are met.	
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.	
Risk matrix standard compliance	The residual consequence is negligible, which is considered acceptable.	
Engagement	There have been no objections or claims made by relevant persons regarding seabed disturbance.	
Legislative context	There is no legislation associated with seabed disturbance.	
Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore marine use (physical disturbance) in Section 4.3.2 of the guidelines. In addition, this EP addresses the point of undertaking an environmental assessment to identify protected areas and local sensitivities.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	Not applicable. There is no guidance in these guidelines regarding seabed disturbance.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not provide environmental management guidance.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Not applicable. There is no guidance regarding seabed disturbance.
	APPEA CoEP (2008)	The EPS developed for this activity meet the code's following objectives: • To reduce the risk of release of substances into the marine environment to ALARP and to an acceptable level. • To reduce the impacts from events such as spills and loss of equipment to an acceptable level and reduce the risk to ALARP.

		• To reduce the impacts to benthic communities to acceptable levels and to ALARP.
Environmental context	MNES	
	AMPs	Seabed disturbance in the activity area will not impact the conservation values of nearby AMPs.
	Ramsar wetlands	Seabed disturbance in the activity area will not impact any Ramsar wetlands.
	TECs	Seabed disturbance in the activity area will not impact any TECs.
	Nationally threatened and migratory species	Seabed disturbance in the activity area will not impact any threatened or migratory species.
	Other matters	
	KEFs	Seabed disturbance in the activity area will not impact any KEFs.
	NIWs	Seabed disturbance in the activity area will not impact any NIWs.
	State marine parks	Seabed disturbance in the activity area will not impact any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the impacts from seabed disturbance to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Seabed disturbance will not have long-term or significant impacts on MNES; • The management of seabed disturbance is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of seabed disturbance is not inconsistent with the aims of relevant marine reserve management plans; and • The management of seabed disturbance is not inconsistent with ESD principles.	
Environmental Monitoring		
• None required.		
Record Keeping		

• Drilling mud chemical inventory. • Drilling mud MoC (if required). • PTWs. • Equipment pre-deployment inspections. • Handling and transfer procedure. • Completed handling and transfer checklists.	• Crane/A-frame operator qualification and training records. • PMS records. • Load ratings and load test certificates. • Daily reports. • Training records. • Incident reports.

7.4 IMPACT 4 – Routine Emissions – Light

7.4.1 Hazard

Light emissions will occur from the geotechnical vessel. The following activities will result in artificial lighting:

- Vessel navigation lighting will be maintained while vessels are on location for maritime safety purposes; and
- Deck lighting will be maintained for the safety of personnel working on deck.

7.4.2 Known and Potential Environmental impacts

The known and potential impacts of lighting are:

- Light glow may act as an attractant to light-sensitive species (e.g., seabirds, turtles, squid, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light); and
- Continuous lighting may result in localised alterations to normal marine fauna behaviours.

7.4.3 EMBA

According to the National Light Pollution Guidelines for Wildlife (DoEE, 2020), if there is important habitat for seabirds (e.g., foraging BIAs) and turtles (e.g., nesting beaches) within 20 km of a project, an EIA should be undertaken. The 20 km buffer is based on the observed grounding of seabirds in response to a light source at least 15 km away and observed disorientation of turtle hatchlings to a light source 18 km away (DoEE, 2020). Therefore, the EMBA for light emissions associated with vessel activities is considered to be a 20 km radius around the vessel, which is referred to as the 'light EMBA'.

Light-sensitive receptors that occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Turtles;
- Fish; and
- Seabirds.

7.4.4 Evaluation of Environmental Impacts

Turtles

Artificial light can disrupt critical behaviours in turtles such as adult nesting and hatchling orientation, sea finding and dispersal ability and can reduce the reproductive viability of turtle stocks (DoEE, 2020). Female turtles nest on sandy tropical and sub-tropical beaches predominantly at night where they rely on visual cues to select nesting beaches and orient on land. Most turtle hatchlings emerge at night and must rapidly orient for and find the ocean to avoid predation. Hatchlings orient for the ocean using both topographic and brightness cues, whereby they move toward the brighter oceanic horizon and away from the darkened silhouettes of the sand dunes on the beach (DoEE, 2020). This critical sea finding behaviour can be disrupted by artificial lights that disorient or misorient the movement of hatchling in a direction other than the sea, which often leads to mortality from predation, exhaustion or dehydration (DoEE, 2020).

The activity area is located 75 km from the nearest shoreline, which far exceeds the recommended 20 km buffer for artificial light applied to turtle nesting locations. Therefore, lighting from the activity vessels is not predicted to impact turtle hatchlings at any potential nesting locations. Although hatchlings have been found to be attracted to light sources in the nearshore environment (Wilson *et al*., 2018), the offshore waters of the activity area and its long distance from shorelines means that the impact of vessel lighting on hatchling dispersal will be negligible.

The light EMBA overlaps the following turtle BIAs (Figure 7.1):

- Green turtle – foraging;
- Flatback turtle – interesting; and
- Olive Ridley turtle – foraging.

These BIAs are associated with adult foraging turtles, so light emissions from the activity are anticipated to have a negligible consequence because lighting will not interfere with the behaviour of their prey and therefore disruption to normal foraging behaviour will not be negatively impacted. Light pollution is identified as a threat to turtles in the Recovery Plan for Marine Turtles 2017-2027 (DoEE, 2017c). An assessment of relevant interim recovery objectives and targets with the activity is provided in Table 7.9.

Table 7.10 provides an assessment of the light management options for turtle nesting beaches as outlined in Table 5 of the National Light Pollution Guidelines for Wildlife (DoEE, 2020) against the activity. Where management options have been deemed as feasible, they have been assessed and adopted as a control measure and associated EPS have been developed (Table 7.12).

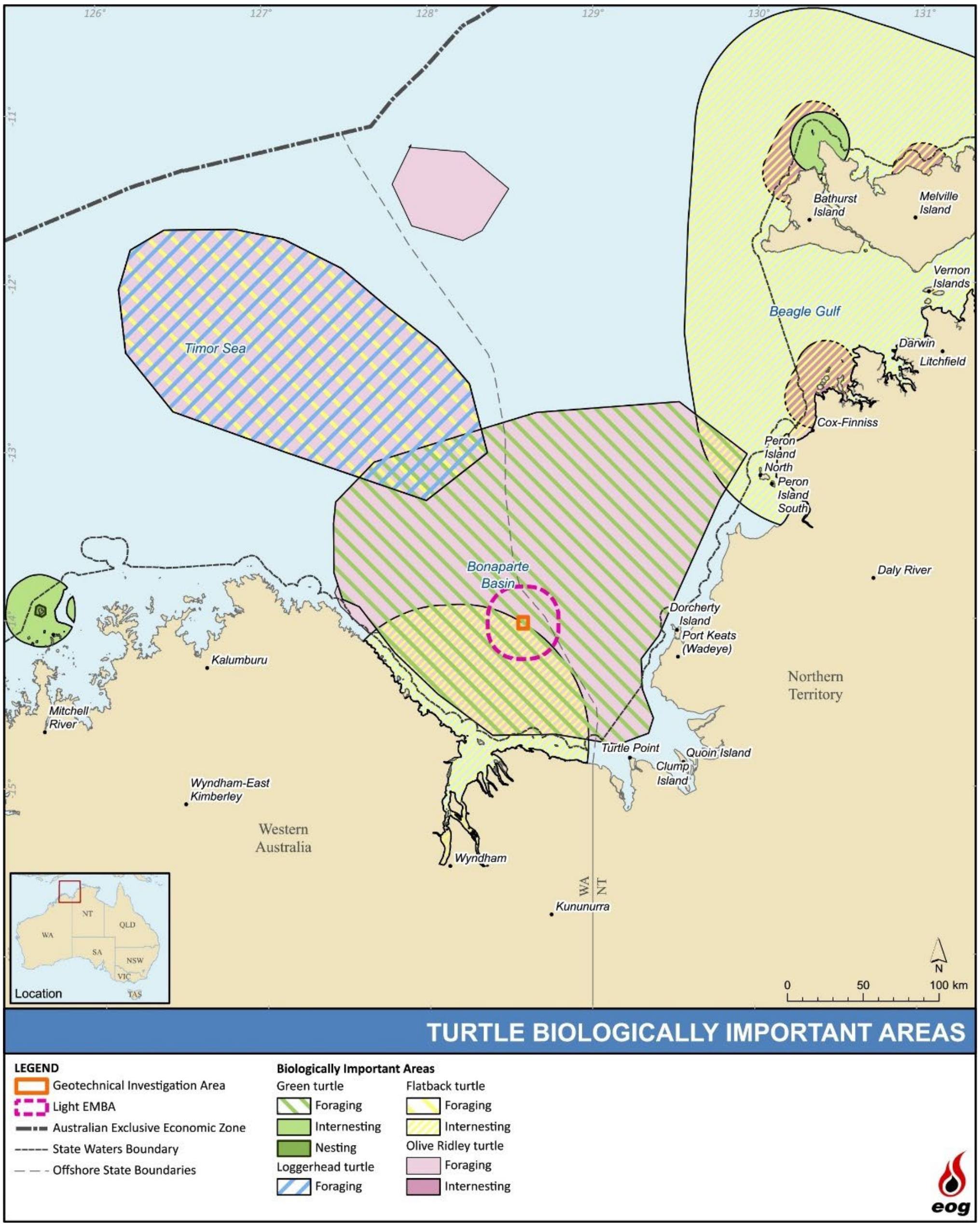


Figure 7.1 Turtle BIAs in the light EMBA

Table 7.9 Assessment against the Recovery Plan for Marine Turtles 2017-2027

Interim Objective or Target	Assessment
Interim Objective 3: Anthropogenic threats are demonstrably minimised.	
Target 3.1: Robust and adaptive management regimes that lead to a reduction in anthropogenic threats to marine turtles and their habitats are in place.	The EPS listed in Table 7.12 will reduce the impact of light emissions on turtles to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this recovery target.
Target 3.2: Threat mitigation strategies are supported by high quality information.	The activity will not have any impacts on this recovery target.

Table 7.10 Assessment of the light management options for turtle nesting beaches from the National Light Pollution Guidelines for Wildlife (DoEE, 2020)

Management option	Achievable?	Justification
Implement light management actions during the nesting and hatching season.	Yes	Achievable management actions are identified in this table and in Table 7.12 (adopted control measures and associated EPS).
Avoid direct light shining onto a nesting beach or out into the ocean adjacent to a nesting beach.	Yes	The nearest shoreline (and thus potential nesting location) is 75 km away on the southern coast of the JBG. As such, the vessel lighting will not shine on to the beach or the ocean adjacent to the beach.
Maintain a dune and/or vegetation screen between the nesting habitat and inland sources of light.	N/A	Not applicable to this activity.
Maintain a dark zone between turtle nesting beach and industrial infrastructure	Yes	The nearest shoreline (and thus potential nesting location) is 75 km away on the southern coast of the JBG. As such, there is a large dark zone between the coast and the activity area.
Install light fixtures as close to the ground as practicable.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).
Use curfews to manage lighting.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).
Aim lights downwards and direct them away from nesting beaches.	Yes	Where practicable, lights will be directed towards working areas for the safety of personnel (see Table 7.12).
Use flashing/intermittent lights instead of fixed beam.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).
Use motion sensors to turn on lights only when needed.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).

Management option	Achievable?	Justification
Prevent indoor lighting reaching beach.	Yes	Blinds will be lowered on portholes and windows at night where this does not interfere with safe work practices (see Table 7.12).
Limit the number of beach access areas or construct beach access such that artificial light is not visible through the access point.	N/A	Not applicable to this activity.
Work collectively with surrounding industry/private land holders to address the cumulative effect of artificial lights.	N/A	Not applicable to this activity.
Manage artificial light at sea, including on vessels, jetties, marinas and offshore infrastructure.	Yes	Achievable management actions are identified in this table and in Table 7.12 (adopted control measures and associated EPS).
Reduce unnecessary lighting at sea.	Yes	Achievable management actions are identified in this table and in Table 7.12 (adopted control measures and associated EPS).
Avoid shining light directly onto longlines and/or illuminating baits in the water.	N/A	Not applicable to this activity – no fishing is allowed from the activity vessel.
Avoid lights containing short wavelength violet/blue light.	No	The activity vessel is equipped with lighting required under legislation to identify itself to other vessels, reduce the risk of at-sea collision and provide for the safety of its crew. Most seabirds in the region are migratory, with no breeding areas (i.e., islands) within 75 km of the activity area. See Table 7.12 for adopted control and associated EPS.
Avoid white LEDs.	No	As above.
Avoid high intensity light of any colour.	No	As above.
Shield gas flares and locate inland and away from nesting beach.	N/A	Not applicable to this activity.
Industrial/port or other facilities requiring intermittent night-time light for inspections should keep the site dark and only light specific areas when required.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).

Management option	Achievable?	Justification
Industrial site/plant operators to use head torches.	No	geotechnical activity operations are conducted 24-hours a day and lighting of all areas is necessary for personnel safety. As such, the use of head torches is not necessary. Lighting will be reduced so far as is practicable and in accordance with maritime requirements and personnel safety. See Table 7.12 for adopted control and associated EPS.
Supplement facility perimeter security lighting with computer monitored infra-red detection systems.	N/A	Not applicable to this activity.
No light source should be directly visible from the beach.	Yes	The nearest shoreline (and thus potential nesting location) is 75 km away on the southern coast of the JBG. As such, the vessel lighting will not be visible from the beach.
Manage light from remote regional sources (up to 20 km away).	Yes	The nearest shoreline (and thus potential nesting location) is 75 km away on the southern coast of the JBG. As such, the vessel lighting will not be visible from the beach.

Fish and plankton

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

Overall, an increase in fish activity around the vessel may occur at night-time, but this is highly localised and short-term and therefore expected to have negligible impacts to the local and regional foodweb.

Cetaceans

There is no evidence to suggest that artificial light sources adversely affect the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly utilise acoustic senses to monitor their environment rather than visual sources (Simmonds et al., 2004), so light is not considered to be a significant factor in cetacean behaviour or survival and will therefore have a negligible impact.

Seabirds

Seabirds may be attracted to light glow at night-time. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with the vessel, or mortality from starvation due to disrupted foraging at sea (Wiese *et al*., 2001 in DSEWPC, 2011; Rajkhowa, 2014). This disorientation may also result in entrapment, stranding, grounding and interference with navigation (DoEE, 2020). The DoEE (2020) notes that seabird fledglings may be affected by lights up to 15 km away. Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al*., 2008) and that lighting can attract birds from large catchment areas (Wiese *et al*., 2001). The light may provide enhanced capability for seabirds to forage at night.

There are no seabird BIAs that are intersected by the light EMBA (Figure 7.2). Therefore, impacts to seabird breeding colonies from light emissions are not expected to occur. However, there is potential for foraging seabirds to be present at the time of the activity. Given the short duration of the activity and its distance from breeding colonies, the consequence of light emissions on seabird populations will be negligible.

Table 7.11 provides an assessment of the light management options for seabirds as outlined in Table 8 of the National Light Pollution Guidelines for Wildlife (DoEE, 2020). Where management options have been deemed as feasible, they have been assessed and adopted as a control measure and associated EPS have been developed (Table 7.12).

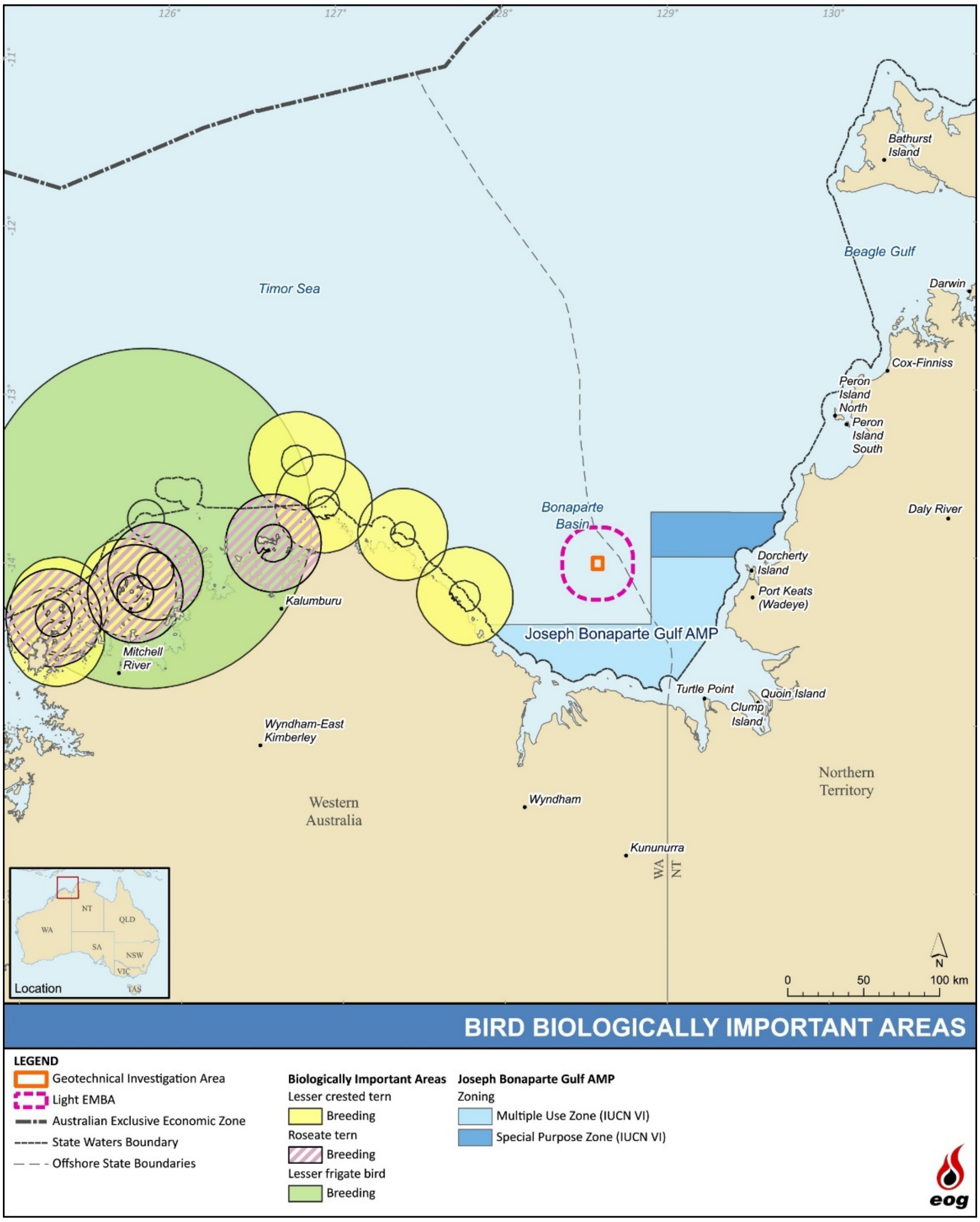


Figure 7.2 Seabird BIAs closest to the light EMBA

Table 7.11 Assessment of the light management options for seabirds from the National Light Pollution Guidelines for Wildlife (DoEE, 2020)

Management option	Achievable?	Justification
Implement management actions during the breeding season.	Yes	Achievable management actions are identified in this table and in Table 7.12 (adopted control measures and associated EPS).
Maintain a dark zone between the rookery and the light sources.	Yes	The nearest shoreline (and thus potential rookery location) is 75 km away on the southern coast of the JBG. As such, there is a large dark zone between the rookery and the activity area.
Turn off lights during fledgling season.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for navigational and personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).
Use curfews to manage lighting.	No	As above.
Aim lights downwards and direct them away from nesting areas.	Yes	Where practicable, lights will be directed towards working areas for the safety of personnel (see Table 7.12).
Use flashing/intermittent lights instead of fixed beam.	No	geotechnical activity operations are conducted 24-hours a day and light is necessary for personnel safety. Lighting will be reduced to the furthest extent possible for safe operations (see Table 7.12).
Use motion sensors to turn lights on only when needed.	No	As above.
Prevent indoor lighting reaching outdoor environment.	Yes	Blinds will be lowered on portholes and windows at night where this does not interfere with safe work practices (see Table 7.12).
Manage artificial light on jetties, wharves, marinas, etc.	N/A	Not applicable to this activity.
Reduce unnecessary outdoor, deck lighting on all vessels and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Yes	Lighting will be reduced to that required for safe operations and by maritime legislative requirements (see Table 7.12)
Night fishing should only occur with minimum deck lighting.	N/A	Not applicable - fishing is not permitted from the activity vessel.

Management option	Achievable?	Justification
Avoid shining light directly onto fishing gear in the water.	N/A	Not applicable - fishing is not permitted from the activity vessel.
Ensure lighting enables recording of any incidental catch, including by electronic monitoring systems.	N/A	Not applicable - fishing is not permitted from the activity vessel.
Avoid shining light directly onto longlines and/or illuminating baits in the water.	N/A	Not applicable - fishing is not permitted from the activity vessel.
Vessels working in seabird foraging areas during breeding season should implement a seabird management plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.	N/A	The activity vessel is equipped with lighting required under legislation to identify itself to other vessels, reduce the risk of at-sea collision and provide for the safety of its crew. Most seabirds in the region are migratory, with no breeding areas (i.e., islands) within 75 km of the activity area.
Use luminaires with spectral content appropriate for the species present.	No	The activity vessel is equipped with lighting required under legislation to identify itself to other vessels, reduce the risk of at-sea collision and provide for the safety of its crew. Most seabirds in the region are migratory, with no breeding areas (i.e., islands) within 75 km of the activity area. See Table 7.12 for adopted control and associated EPS.
Avoid high intensity light of any colour.	No	As above.
Shield gas flares and locate inland and away from seabird rookeries.	N/A	Not applicable – this activity does not involve flaring.
Minimise flaring on offshore oil and gas production facilities.	N/A	Not applicable – this activity does not involve flaring.
In facilities requiring intermittent night-time inspections, turn on lights only during the time operators are moving around the facility.	N/A	The activity vessel is equipped with lighting required under legislation to identify itself to other vessels, reduce the risk of at-sea collision and provide for the safety of its crew.
Ensure industrial site/plant operators use head torches.	No	geotechnical activity operations are conducted 24-hours a day and lighting of all areas is necessary for personnel safety. As such, the use of head torches is not necessary. Lighting will be reduced so far as is practicable and in accordance with maritime requirements and personnel safety. See Table 7.12 for adopted control and associated EPS.

Management option	Achievable?	Justification
Supplement facility perimeter security lighting with computer monitored infrared detection systems.	N/A	Not applicable to this activity.
Tourism operations around seabird colonies should manage torch usage so birds are not disturbed.	N/A	Not applicable to this activity.
Design and implement a rescue program for grounded birds.	No	Due to the distance between the activity area and seabird rookeries, grounding of birds is unlikely to occur and thus a rescue program is not necessary.

Marine Parks

The light EMBA does not intersect any AMPs.

Community

The distance of the closest point of the activity area from the nearest shoreline (75 km) and nearest town (Wadeye, 83 km) means that vessel lighting in the activity area will not be visible from land. Visual impacts to these communities from vessel lighting will not occur.

7.4.5 Impact Assessment

Table 7.12 presents the impact assessment for light emissions.

Table 7.12 Impact assessment for light emissions

Summary			
Summary of impacts	Light glow may act as an attractant to light-sensitive species (e.g., seabirds, turtles, fish, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).		
Extent of impacts	Localised for most marine fauna, and up to 15 km for turtle hatchlings and 20 km for seabirds.		
Duration of impacts	Temporary – short-term (duration of activity).		
Level of certainty of impacts	HIGH – the impacts of light glow on marine fauna are well known.		
Impact decision framework context	Decision type	A - good industry practice required.	
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.	
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.	
Defined acceptable level	The impacts of light emissions to EPBC Act-listed threatened and migratory bird species and marine turtles are not inconsistent with their in-force recovery plans or wildlife conservation plans/advice.		
Impact Consequence (inherent)			
Negligible			
Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Exclude night-time operations.	Eliminate	No	**EB:** Eliminates impact of night-time light emissions on sensitive species (e.g., seabirds and turtles foraging at night). **C:** Would double the duration of the activity and therefore double activity costs. **Ev:** Increased impacts in other areas due to a longer presence on location, including increase in waste discharges, air emissions, displacement of commercial fishers. Costs of extending the activity duration outweighs the benefits given the minor impacts.

Keep vessel external lighting to levels required for navigation, vessel safety and safety of deck operations **(IMP-04:EPS-01)**.	Engineering	Yes	**EB:** This keeps light to the minimum required to meet legislated navigation requirements. **C:** No additional activity costs. Vessel lighting is a legislative requirement for safe navigation and deck operations. **Ev:** Good practice is well defined and established in Marine Orders (Part 30 and Part 59) for vessel operating at sea. Lighting is required to provide navigational safety and meet legislative requirements. Lighting is reduced to the lowest practicable level to allow for safe work practices and legislative compliance.
Lower blinds on portholes and windows at night **(IMP-04:EPS-02)**.	Engineering	Yes	**EB:** Reduces light spill to the marine environment. **C:** No additional cost. Involves only time to discuss this during crew inductions and in undertaking routine inspections. **Ev:** Good practice and well established in the industry. Environmental benefits can be achieved without cost.
Install lighting shields.	Engineering	No	**EB:** Reduces light spill to the marine environment through physical barriers. **C:** These are not standard fixtures on vessels. There will be significant time and cost to install these, and they may reduce safety of deck operations. **Ev:** External lighting is necessary for safe navigation and deck operations. The cost of this control measure outweighs the minimal benefit this control measure would have.
Use of lighting with wavelengths that are less intrusive to marine fauna.	Engineering	No	**EB:** Some marine fauna are less sensitive to particular light wavelengths. **C:** High cost of sourcing specialised globes. **Ev:** Lighting will be managed in accordance with the relevant Australian and international standards to ensure that personnel and vessel safety is not compromised. This control measure is unlikely to result in reduced impact due to the diversity of species present in the region; no single light wavelength can reduce risks for all fauna groups. This control measure would result in negligible benefit at a high cost.
Direct vessel lighting to working areas only **(IMP-04:EPS-02)**.	Engineering	Yes	**EB:** Reduces light spill to the marine environment. **C:** No additional costs. **Ev:** Good practice and well established in the industry. Environmental benefits can be achieved with minimal cost.
Periodically inspect lighting on-board to confirm it complies with lighting standards **(IMP-04:EPS-02)**.	Administrative	Yes	**EB:** Provides mechanism to inspect the implementation of control measures and their associated environmental benefits. **C:** Cost of time only. **Ev:** Good practice and well established in the industry. Environmental benefits can be achieved with minimal cost.

<table>
<tr><th colspan="3">Environmental Controls and Performance Measurement</th></tr>
<tr><td>EPO</td><td>EPS</td><td>Measurement criteria</td></tr>
<tr><td>External vessel lighting conforms to that required by maritime safety standards.</td><td>(IMP-04:EPS-01) External vessel lighting is managed in accordance with:
• AMSA Marine Orders Part 30 (Prevention of Collisions).
• AMSA Marine Orders Part 59 (Offshore Support Vessel Operations).</td><td>Vessel class certifications are current.</td></tr>
<tr><td>Lighting is reduced to limit the localised attraction of marine fauna.</td><td>(IMP-04:EPS-02) Lighting is managed in accordance with the National Light Pollution Guidelines for Wildlife (DoEE) such that:
• Blinds will be lowered on all activity vessel portholes and windows at night.
• Lighting is directed to working areas (rather than overboard) to minimise light spill to the ocean.
• Periodically inspect lighting on-board to confirm it complies with lighting standards.</td><td>Completed environmental checklists.</td></tr>
<tr><th colspan="3">Impact Consequence (residual)</th></tr>
<tr><td colspan="3">Negligible</td></tr>
<tr><td colspan="3">The consequence of light emissions is assessed as negligible because:
• The activity is short-term;
• The vessel will be moving and will not be a permanent fixture;
• There are no seabird breeding colonies or turtle nesting beaches within the light EMBA;
• Wildlife potentially vulnerable to light (e.g., seabirds and turtles) will not be displaced from foraging habitat; and
• The control measures adopted are commensurate with the inherent level of impact consequence.</td></tr>
<tr><th colspan="3">Statement of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual impact consequence is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">There have been no objections or claims made by relevant persons regarding light emissions.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
• COLREGS 1972.
• Navigation Act 2012 (Cth):
  o Part 3 (Prevention of Collisions).
  o AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures).</td></tr>
</table>

	○ AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). ○ AMSA Marine Orders Part 30 (Prevention of Collisions). ○ AMSA Marine Order 58 (Safe Management of Vessels).	
Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed guidelines and codes of practice demonstrates that BPEM will be implemented for this activity.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Light emissions - minimise external lighting to that required for navigation and safety of deck operations **(IMP-05:EPS-01, -02)**.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding lighting for offshore activities.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of light emissions on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS listed in this table are in accordance with these guidelines with regard to: • Ship collision (item 120). To avoid collisions with third-party vessels, offshore facilities should be equipped with navigational aids that meet national and international requirements, including navigational lights on vessels **(IMP-05:EPS-01)**.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the impact on cetaceans and other marine life to ALARP and an acceptable level **(IMP-05:EPS-01, -02)**.
	Light-specific guidance	
	The National Light Pollution Guidelines for Wildlife (DoEE, 2020)	The EPS listed in this table meet the following management actions related to activities associated with the activity vessel: • Maintain a dark zone between the rookery and the light sources. • Aim lights downwards and direct them away from nesting areas **(IMP-05:EPS-02)**. • Prevent indoor light reaching outdoor environment **(IMP-05:EPS-02)**. • Reduce unnecessary outdoor, deck lighting on all vessels in known seabird foraging areas at sea **(IMP-05:EPS-02)**.

		An assessment of the activity against the management actions of these guidelines is included in Table 7.10 for turtles and Table 7.11 for seabirds.
Environmental context	MNES	
	AMPs	The light EMBA does not intersect any AMPs.
	Ramsar wetlands	Localised and temporary light emissions will not reach any Ramsar wetlands.
	TECs	Localised and temporary light emissions will not reach any TECs.
	Nationally threatened and migratory species	The activity will be managed in a manner such that nationally threatened and migratory species will not be impacted by localised and temporary light emissions.
	Other matters	
	KEFs	Localised and temporary light emissions will not reach any KEFs.
	NIWs	Localised and temporary light emissions will not reach any NIWs.
	State marine parks	Light emissions will not reach any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	Table 7.9 demonstrates that light emissions will not be inconsistent with the objectives of the Recovery Plan for Marine Turtles 2017-2027 (DoEE, 2017c).
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of Acceptability	EOG considers the impacts from light emissions to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Light emissions will not have long-term or significant impacts on MNES; • The management of lighting is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of lighting is not inconsistent with the aims of relevant marine reserve management plans; and • The management of lighting is not inconsistent with ESD principles.	
Environmental Monitoring		
• None.		
Record Keeping		
• Vessel class certification. • Completed environmental inspections checklists.	• Induction presentation. • Induction attendance sheet. • Incident reports.	

7.5 IMPACT 5 – Routine Emissions – Atmospheric

7.5.1 Hazard

The use of fuel to power the geotechnical vessel engines, generators, mobile and fixed plant and equipment, will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SOx) and nitrogen oxides (NOx).

The following activities generate atmospheric emissions:

- Combustion of MDO from the vessel engines, generators and fixed and mobile deck equipment;
- When transferring dry bulk products used for drilling (e.g., barite, bentonite), tank venting is necessary to prevent tank overpressure. The vent air will contain minor quantities of product particles, which will suspend in the air or settle on the sea surface.

7.5.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to gaseous emissions and particulates from MDO combustion; and
- Addition of GHG to the atmosphere (influencing climate change).

7.5.3 EMBA

The EMBA for atmospheric emissions associated is the local air shed, likely to be within hundreds of meters of the activity vessels, both horizontally and vertically.

Receptors that may occur within this EMBA, either as residents or migrants, are seabirds.

7.5.4 Evaluation of Environmental Impacts

Localised and temporary decrease in air quality from diesel combustion

The combustion of MDO fuel can create continuous or discontinuous plumes of particulate matter (soot or black smoke) and the emission of non-GHG, such as SO_X and NO_X. Inhaling this particulate matter can cause or exacerbate health impacts to humans exposed to the particulate matter, such as offshore project personnel or residents of nearby towns (e.g., respiratory illnesses such as asthma) depending on the amount of particles inhaled. Similarly, the inhalation of particulate matter may affect the respiratory systems of fauna. In the activity area, this is limited to seabirds overflying the vessel/s.

Particulate matter released from the activity vessels is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Port Keats (Wadeye) (NT) or Wyndam (WA)), as offshore winds will rapidly disperse and dilute particulate matter. This rapid dispersion and dilution will also ensure that seabirds are not exposed to concentrated plumes of particulate matter from vessel exhaust points and therefore has a negligible impact consequence.

Contribution to the GHG effect

The use of fuel to power engines, generators and any mobile/fixed plant will result in gaseous emissions of GHG such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are tiny on a regional, national and global scale, representing an insignificant contribution to overall GHG emissions and therefore has a negligible impact consequence. The activity is similar to other shipping activities contributing to the accumulation of GHG in the atmosphere.

Tank venting

Tank venting is a necessary safety control, and any dust emissions will be negligible and limited to the immediate vicinity of the activity vessels. The quantities of gaseous emissions are relatively small and will quickly dissipate into the surrounding atmosphere. Air emissions will be similar to other vessels operating in the region for both petroleum and non-petroleum activities.

7.5.5 Impact Assessment

Table 7.13 presents the impact assessment for atmospheric emissions.

Table 7.13 Impact assessment from atmospheric emissions

Summary		
Summary of Impacts	Decrease in air quality due to gaseous emissions and particulates from diesel combustion and contribution to the incremental build-up of GHG in the atmosphere (influencing climate change).	
Extent of impacts	Localised (local air shed for air quality), widespread (for GHG).	
Duration of impacts	Temporary (duration of activity) – emissions are rapidly dispersed and diluted.	
Level of certainty of impact	HIGH – the impacts of atmospheric emissions are well known.	
Impact decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	Atmospheric emissions are managed in accordance with legislated requirements.	
Impact Consequence (inherent)		
Negligible		

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
No incineration of wastes from vessels during the activity.	Eliminate	No	**EB:** Eliminates a source of atmospheric emissions. **C:** Increased health risk from long-term onboard storage of wastes. If shore transfers are involved, there is an increase in fuel usage and other routine discharges and emissions. **Ev:** Health and safety risks outweigh the benefit given the high energy offshore locations. The low cost of onboard incinerations outweighs the high cost of transporting waste to shore.

Use incinerators and engines with higher environmental efficiency.	Substitution	No	**EB:** Reduces the volume of emissions and improves air quality. **C:** Activity vessel is not yet contracted, so it is unreasonable to commit a contractor to potentially swapping out equipment, likely at significant cost. **Ev:** Cost to implement control measure is disproportionate to the low environmental benefit.
Use low sulphur (<0.5% m/m) MDO **(IMP-05:EPS-01).**	Engineering	Yes	**EB:** Reduces SOx emissions to the environment. This has been a MARPOL requirement since the start of 2020. **C:** Some additional cost, but this is factored into the vessel contract. **Ev:** Environmental benefits can be achieved with little additional cost.
Implementation of a PMS for combustion equipment **(IMP-05:EPS-02)**.	Engineering	Yes	**EB:** Reduces the volume of emissions. **C:** Negligible; maintenance is part of routine vessel operations. **Ev:** Benefits of ensuring efficient vessel combustion outweighs the negligible cost.
IAPP certification **(IMP-05:EPS-03)**.	Engineering	Yes	**EB:** Reduces the volume of emissions. **C:** Negligible; certification and re-certification costs are factored into routine vessel operations. **Ev:** Benefits of ensuring vessels comply with emissions reduction standards outweighs the negligible cost.
SEEMP **(IMP-05:EPS-04).**	Engineering	Yes	**EB:** Improved energy efficiency reduces the volume of emissions. **C:** Negligible; certification and re-certification costs are factored into routine vessel operations. **Ev:** Benefits of ensuring vessels comply with emissions reduction standards outweighs the negligible cost.
Ozone Depleting Substances (ODS) procedure **(IMP-05:EPS-05).**	Engineering	Yes	**EB:** Reduces emissions associated with global warming. **C:** Negligible; maintenance of equipment with ODS potential (e.g., HVAC) is part of routine vessel operations. **Ev:** Benefits of ensuring vessels comply with ODS reduction standards outweighs the negligible cost.
Waste incineration managed in accordance MARPOL and Marine Orders	Engineering	Yes	**EB:** Reduced impacts to air quality. **C:** Negligible; waste incineration in accordance with MARPOL requirements is part of routine vessel operations.

(IMP-05:EPS-06, -07, -08).			**Ev:** Benefits of ensuring vessels comply with MARPOL requirements outweighs the negligible cost.
Monitor fuel use **(IMP-05:EPS-09).**	Administrative	Yes	**EB:** May minimise excessive fuel use and associated air emissions by rapidly detecting abnormalities with fuel consumption patterns. **C:** Negligible; such monitoring is part of routine vessel operations. **Ev:** Benefits of avoiding excessive fuel consumption and unnecessary air emissions outweighs the minimal cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Combustion systems operate in accordance with MARPOL Annex VI (Prevention of Air Pollution from Ships) requirements.	**(IMP-05:EPS-01)** Only low-sulphur (<0.5% m/m) MDO will be used in order to minimise SOx emissions.	Bunker receipts verify the use of low-sulphur marine grade diesel.
	(IMP-05:EPS-02) All combustion equipment is maintained in accordance with the PMS (or equivalent).	PMS records verify that combustion equipment is maintained to schedule.
	(IMP-05:EPS-03) Vessels >400 gross tonnes possess equipment, systems, fittings, arrangements and materials that comply with the applicable requirements of MARPOL Annex VI.	IAPP Certificate is current.
	(IMP-05:EPS-04) Vessels >400 gross tonnes and involved in an international voyage implement their SEEMP to monitor and reduce air emissions.	SEEMP records verify energy efficiency records have been adopted.
	(IMP-05:EPS-05) Vessels >400 gross tonnes must ensure that firefighting and refrigeration systems are managed to minimise ODS.	ODS record book is available and current.
Solid combustible waste will only be burned within an incinerator, and only if logistics don't allow for the timely removal of waste from the vessel.	**(IMP-05:EPS-06)** Only a MARPOL VI-approved incinerator is used to incinerate solid combustible waste (food waste, paper, cardboard, rags, plastics).	IMO incinerator certificate verifies the incinerator meets MARPOL requirements.
	(IMP-05:EPS-07) Incineration is only conducted when the vessel is >12 nm from the shore.	Activity-specific discharges and emissions register indicates no incineration within 12 nm of the shore.
	(IMP-05:EPS-08) Oil and other noxious liquid substances will not be incinerated.	The Oil Record Book and Garbage Record Book verify that waste oil and other noxious liquid substances are transferred to shore for disposal.
Fuel use will be measured,	**(IMP-05:EPS-09)** Fuel use will be measured, recorded and reported for	Fuel use is recorded in the daily operations reports.

<table>
<tr><td>recorded and reported.</td><td>abnormal consumption, and in the event of abnormal fuel use, corrective action is taken to minimise air pollution.</td><td></td></tr>
<tr><th colspan="3">Impact Consequence (residual)</th></tr>
<tr><th colspan="3">Negligible</th></tr>
<tr><td colspan="3">The consequence of atmospheric emissions is assessed as negligible because:
• The activity is of a temporary nature;
• The activity area is located in a high energy offshore environment and air emissions will not impact on air quality in coastal towns;
• The quantities of gaseous emissions are relatively small and will dissipate into the surrounding atmosphere; and
• Management of atmospheric emissions will comply with legislated requirements.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.</td></tr>
</table>

<table>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual impact consequence is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">There have been no objections or claims from relevant person regarding air emissions.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
• Navigation Act 2012 (Cth):
  ○ Chapter 4 (Prevention of Pollution).
  ○ AMSA Marine Order Part 79 (Marine pollution prevention – air pollution).
• Protection of the Sea (Prevention of Pollution by Ships) Act 1983 (Cth):
  ○ Part IIID (Prevention of Air Pollution).
  ○ AMSA Marine Orders Part 97 (Air Pollution), enacting MARPOL Annex VI (especially Regulations 6, 14, 16).
• National Greenhouse and Energy Reporting Act 2007 (Cth).</td></tr>
<tr><td rowspan="2">Industry practice</td><td colspan="2">The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry
(IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Section 4.4.3 - Combustion emissions;
  ○ Use of high efficiency equipment to minimise power demand (IMP-06: EPS-04).
  ○ Selection of low sulphur diesel (IMP-06: EPS-01).</td></tr>
</table>

		○ Regular plant maintenance **(IMP-06: EPS-02)**. ○ Regular maintenance and emission control devices on vehicles and machinery **(IMP-06: EPS-02)**.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to management of fugitive emissions (item 22). The BAT are met for the activity vessels.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of atmospheric emissions on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Air emissions (item 11). The overall objective to reduce air emissions (all IMP-07 EPS except EPS-07). • Air emissions (item 12). During equipment selection, air emission specifications should be taken into account, as should the use of very low sulphur content fuels and/or natural gas **(IMP-06: EPS-01)**.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce GHG emissions to ALARP and an acceptable level (All **IMP-07** EPS).
Environmental context	MNES	
	AMPs	Atmospheric emissions do not directly affect nearby AMPs.
	Ramsar wetlands	Atmospheric emissions do not directly affect any Ramsar wetlands.
	TECs	Atmospheric emissions do not directly affect any TECs.
	Nationally threatened and migratory species	Atmospheric emissions do not directly affect threated or migratory species.
	Other matters	
	KEFs	Atmospheric emissions do not directly affect any KEFs.
	NIWs	Atmospheric emissions do not directly affect any NIWs.
	State marine parks	Atmospheric emissions do not directly affect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	The Recovery Plans and Conservation Advice for the blue, sei and fin whales list climate change as a key threat, though the most pervasive threats are whaling, vessel strike and entanglement.

		The Recovery Plan for Marine Turtles in Australia lists climate change as a key threat. Atmospheric emissions resulting from the activity are not inconsistent with this recovery plan.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the impacts from atmospheric emissions to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Atmospheric emissions from the activity will not have long-term or significant impacts on MNES; • The management of air emissions will ensure it is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of air emissions will ensure it is not inconsistent with the aims of relevant marine reserve management plans; and • The management of air emissions will ensure it is not inconsistent with ESD principles.	
Environmental Monitoring		
• Fuel use.		
Record Keeping		
• Vessel PMS records. • Vessel fuel use records. • Vessel bunkering receipts. • Waste manifests (for incineration).	• ODS record book. • Oil record book. • Garbage record book. • Activity-specific discharges and emissions register.	

7.6 IMPACT 6 – Routine Discharges – Putrescible Waste

7.6.1 Hazard

The generation of food waste (putrescible waste) from the vessel galley will result in the overboard discharge of this waste. The average volume of putrescible waste discharged overboard depends on the number of Persons on Board (POB) at any time, and the types of meals prepared.

A typical geotechnical vessel is likely to have up to 50 POB. NERA (2018) estimates the volume of putrescible waste to be in the order of 1-2 kg per person per day. Assuming 50 people work on the activity vessel, an estimated 100 kg of putrescible waste may be generated and discharged overboard daily.

7.6.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of putrescible waste discharges are:

- Temporary and localised increase in the nutrient content of waters surrounding the discharge point; and
- An associated increase in scavenging behaviour of marine fauna and seabirds (at the sea surface or within the water column).

7.6.3 EMBA

The EMBA for putrescible waste discharges is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex, WA).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and turtles); and
- Avifauna.

7.6.4 Evaluation of Environmental Impacts

The overboard discharge of macerated food wastes creates a localised and temporary increase in the nutrient load of near-surface waters. This in turn acts as a food source for scavenging marine fauna and/or seabirds, whose numbers may temporarily increase as a result. The rapid consumption of putrescible waste by scavenging fauna, and its physical and microbial breakdown, ensures that the impacts of such discharges are insignificant and therefore have a negligible impact consequence.

7.6.5 Impact Assessment

Table 7.14 presents the impact assessment for putrescible waste discharges.

Table 7.14 Impact assessment for putrescible waste discharges

<table>
<tr><th colspan="3">Summary</th></tr>
<tr><td>Summary of impacts</td><td colspan="2">Increase in nutrient content of near-surface waters around the discharge point, which may lead to an increase of scavenging behaviour of pelagic fish and seabirds.</td></tr>
<tr><td>Extent of impacts</td><td colspan="2">Localised – up to 100 m horizontally and 10 m vertically from the discharge point.</td></tr>
<tr><td>Duration of impacts</td><td colspan="2">Intermittent and temporary – until the discharge is completely consumed (likely to be several hours).</td></tr>
<tr><td>Level of certainty of impacts</td><td colspan="2">HIGH – the impacts of putrescible waste discharges on marine fauna are well known.</td></tr>
<tr><td rowspan="4">Impact decision framework context</td><td>Decision type</td><td>A - good industry practice required.</td></tr>
<tr><td>Activity</td><td>Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.</td></tr>
<tr><td>Risk & uncertainty</td><td>Risks are well understood, uncertainty is minimal.</td></tr>
<tr><td>Stakeholder influence</td><td>No conflict with company values, no partner interest, no significant media interest.</td></tr>
<tr><td>Defined acceptable level</td><td colspan="2">Putrescible waste discharges to sea meet legislated requirements such that there are no adverse impacts to biodiversity, ecological integrity or human health.</td></tr>
</table>

Impact Consequence (inherent)			
Negligible			
Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Store all putrescible waste onboard for onshore disposal.	Eliminate	No	**EB:** Eliminates decreased water quality and scavenging behaviour by marine fauna. **C:** Additional cost due to onshore disposal, additional fuel usage required to transfer wastes to shore, increased health and safety risk involved with storing organic wastes onboard. **Ev:** Cost is disproportionate to the minor consequence and the fact that the discharges are permitted under legislation.
GMP **(IMP-06: EPS-01)**.	Engineering	Yes	**EB:** Reduces probability of garbage being inappropriately discharged to sea, reducing potential impacts to fauna. **C:** Negligible; part of routine vessel operations. **Ev:** Benefits of ensuring responsible and compliant garbage handling outweighs negligible cost.
Putrescible waste is treated as per MARPOL Annex V requirements prior to discharge **(IMP-06: EPS-02, -03, -04, -05).**	Engineering	Yes	**EB:** Reduces probability of putrescible waste being inappropriately discharged to sea, reducing potential impacts to fauna. **C:** Negligible; part of routine vessel operations. Occasional high costs of replacing the macerator. **Ev:** Benefits of ensuring responsible and compliant putrescible waste handling outweighs minimal costs.
Environmental induction for vessel crew **(IMP-06: EPS-06)**.	Administrative	Yes	**EB:** Reduced likelihood of inappropriate waste disposal to the sea. **C:** Negligible; part of routine vessel operations. **Ev:** Environmental benefits can be achieved with little additional cost.

Environmental Performance Objectives and Measurement		
EPO	EPS	Measurement criteria
Discharge of putrescible waste to sea only.	**(IMP-06: EPS-01)** A MARPOL Annex V-compliant GMP is in place (for vessels >100 GRT tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	A GMP is in place, readily available onboard and kept current.
	(IMP-06: EPS-02) A macerator is on board the vessels, functional, in use and set to macerate putrescible waste to a particle size ≤25 mm using to ensure rapid breakdown upon discharge.	PMS records verify that the macerator is functional and regularly maintained or replaced.
	(IMP-06: EPS-03) Records of food waste disposal to be maintained in a Garbage Record Book.	A Garbage Record Book is in place and verifies waste discharge locations and volumes.
	(IMP-06: EPS-04) Macerated putrescible waste (≤25 mm) is only discharged overboard when the vessel is >3 nm from the shoreline.	

	(IMP-06: EPS-05) Un-macerated putrescible waste is only discharged overboard when the vessel is >12 nm from the shoreline.	
	(IMP-06: EPS-06) Waste management and housekeeping requirements are communicated to all vessel crew to ensure discharges are in accordance with MARPOL Annex V.	Vessel induction includes waste management requirements.

Impact Consequence (residual)
Negligible
The consequence of putrescible waste discharges is assessed as negligible because of: • The temporary duration of the activity; • The intermittent nature of the discharge; • The small discharge volumes; • Maceration of the waste prior to discharge; • High dilution and dispersal factor in open waters; • The long distance from shore; • Rapid consumption by fauna; • High biodegradability and low persistence of the waste; and • The absence of sensitive habitats in the activity area.
Demonstration of ALARP
A 'negligible' residual impact consequence is considered to be ALARP and a 'lower order' impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.

Demonstration of Acceptability		
Policy compliance	EOG's Safety and Environmental Policy objectives are met.	
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.	
Risk matrix standard compliance	The residual impact consequence is negligible, which is considered acceptable.	
Engagement	No objections or claims have been made by relevant persons with regard to putrescible waste discharges.	

Legislative context	The EPS align with the requirements of:
	• Navigation Act 2012 (Cth):
	  ○ Chapter 4 (Prevention of Pollution).
	  ○ AMSA Marine Order 95 (Marine Pollution Prevention - garbage).
	• Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
	  ○ Section 26F (which implements MARPOL Annex V).	

Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity.	
	Environmental management in the upstream oil and gas	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:

	industry (IOGP-IPIECA, 2020)	• Section 4.5.1 - organic (food) waste from the kitchen should, at a minimum, be macerated to <25 mm prior to discharge to sea, in compliance with MARPOL Annex V requirements **(IMP-07: EPS-03 and -04)**.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Environmental monitoring (item 26). The BAT are met for the activity with regard to monitoring waste streams.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of putrescible waste discharges on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Food waste from the kitchen should, at a minimum, be macerated to acceptable levels and discharged to sea, in compliance with MARPOL requirements **(IMP-07: EPS-04)**.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Putrescible waste discharges will not impact the conservation values of nearby AMPs.
	Ramsar wetlands	Putrescible waste discharges will not intersect any Ramsar wetlands.
	TECs	Putrescible waste discharges will not intersect any TECs.
	Nationally threatened and migratory species	Putrescible waste discharges do not have any significant impacts on threated or migratory species.
	Other matters	
	KEFs	Putrescible waste discharges will not intersect any KEFs.
	NIWs	Putrescible waste discharges will not intersect any NIWs.
	State marine parks	This hazard does not intersect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	The discharge of putrescible waste does not compromise the specific objectives or actions (regarding marine pollution) of any of the species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Statement of acceptability	EOG considers the impacts from putrescible waste discharges to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Putrescible waste discharges will not have long-term or significant impacts on MNES; • Putrescible waste discharges are not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • Putrescible waste discharges are not inconsistent with the aims of relevant marine reserve management plans; and • The management of putrescible waste discharges is not inconsistent with ESD principles.
Environmental Monitoring	
• Volume/weight of non-macerated waste sent ashore.	
Record Keeping	
• GMP. • PMS records. • Garbage Record Book.	• Training matrix. • Induction records.

7.7 IMPACT 7 - Routine Discharges – Sewage and Grey Water

7.7.1 Hazard

The use of ablution, laundry and galley facilities by vessel crew will result in the discharge of sewage and grey water. The composition of sewage and grey water (when untreated) may include:

- Particulate matter – such as solids composed of floating, settleable, colloidal and dissolved matter, substances that affect aspects of aesthetics such as ambient water colour, the presence of surface slicks/sheens and odour.
- Chemical contaminants – including:
  - Nutrients (e.g., ammonia, nitrite, nitrate and orthophosphate);
  - Organics (e.g., volatile and semi-volatile organic compounds, oil and grease, phenols, endocrine disrupting compounds); and
  - Inorganics (e.g., hydrogen sulphide, metals and metalloids, surfactants, phthalates, residual chlorine);
- Biological pathogens – including bacteria, viruses, protozoa and parasites.

AMSA (2016) states that most large vessels generate 5-15 m^3 wastewater/day, the majority of which is grey water (wastewater from showers, laundry, galley and wash basins). NERA (2017) estimates that the total volumes of sewage and grey water typically generated at offshore facilities range between 0.04 and 0.45 m^3 per person per day. Assuming 50 people working on the activity vessels, this equates to between 2.0 and 22.5 m^3 of sewage and grey water generated and discharged daily.

7.7.2 Known and Potential Environmental Impacts

The known and potential environmental impact of treated sewage and grey water discharges is:

- Temporary and localised increase in the nutrient content of surface waters around the vessels; and
- An associated increase in scavenging behaviour of marine fauna and seabirds (at the sea surface or in the water column).

7.7.3 EMBA

The EMBA for sewage and grey water discharges associated with vessel activities is likely to be the top 10 m of the water column and a 50 m radius from the discharge point. This is based on modelling of continuous wastewater discharges (including treated sewage and greywater) undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found:

- Rapid horizontal dispersion of discharges occurs due to wind-driven surface water currents;
- Vertical discharge is limited to about the top 10 m of the water column due to the neutrally buoyant nature of the discharge; and
- A concentration of a component within the discharge stream is reduced to 1% of its original concentration at no less than 50 m from the discharge point under any condition (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and turtles); and
- Seabirds.

7.7.4 Evaluation of Environmental Impacts

Water quality

Nutrients in sewage, such as phosphorus and nitrogen, may contribute to eutrophication of receiving waters (although usually only still, calm, inland waters), causing algal blooms, which can degrade aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans. Given the tidal movements and currents in open oceanic waters, eutrophication of receiving waters will not occur. Sewage will be treated through a Sewage Treatment Plant (STP) to a tertiary level, so there are no impacts relating to the release of chemicals and pathogens in untreated sewage.

Grey water can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, food waste, coliform bacteria and some medical waste. Grey water is treated through the STP, so pollutants will be largely removed from the discharge stream.

The effects of sewage and sullage discharges on the water quality at Scott Reef were monitored for a drill rig operating near the edge of the deep-water lagoon area at South Reef. Monitoring at stations 50 m, 100 m and 200 m downstream of the rig and at five different water depths confirmed that the discharges were rapidly diluted in the upper 10 m water layer and no elevations in water quality monitoring parameters (e.g., total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the high numbers of personnel onboard a drill rig (typically 100-120) compared with vessels undertaking the activity.

Treated sewage and grey water discharges will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand of the treated effluent is unlikely to lead to oxygen depletion of the receiving waters (Black et al., 1994), as it will be treated prior to release. On release, surface water currents will assist with oxygenation of the discharge.

Biological receptors

Plankton forms the basis of all marine ecosystems, and plankton communities have a naturally patchy distribution in both space and time (ITOPF, 2011a). They are known to have naturally high mortality rates (primarily through predation), however in favourable conditions (e.g., supply of nutrients), plankton populations can rapidly increase. Once the favourable conditions cease, plankton populations will collapse and/or return to previous conditions. Plankton populations have evolved to respond to these environmental perturbations by copious production within short generation times (ITOPF, 2011a).

Any potential change in plankton diversity, abundance and composition as a result of treated sewage and grey water discharges is expected to be very low (given the waste stream is treated) and localised (as outlined in the EMBA) and is likely to return to background conditions within tens to a few hundred metres of the discharge location (NERA, 2017). Accordingly, impacts higher up the food chain (e.g., fish, reptiles, birds and cetaceans) are expected to be negligible.

7.7.5 Impact Assessment

Table 7.15 presents the impact assessment for the discharge of treated sewage and grey water.

Table 7.15 Impact assessment for the discharge of treated sewage and grey water

Summary		
Summary of impacts	Reduction in water quality around the discharge point, increase in nutrients.	
Extent of impacts	Localised – up to 50 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Temporary – until the discharge is completely diluted (likely to be minutes to hours).	
Level of certainty of impact	HIGH – the impacts of sewage and grey water discharges to water quality are well known.	
Impact decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	Sewage and grey water discharges to sea meet legislated requirements such that there are no adverse impacts to biodiversity, ecological integrity or human health.	
Impact Consequence (inherent)		
Negligible		

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
No discharge of treated sewage and grey water at sea.	Eliminate	No	**EB:** Eliminates biodegradable waste stream that may result in decreased water quality and scavenging behaviour by marine fauna. **C:** Additional cost due to onshore disposal, increased health and safety risk involved with storing organic wastes onboard. **Ev:** Cost is grossly disproportionate to the minor consequence associated with the discharges that are permitted under legislation.
Routine discharges of treated sewage and grey water are managed in accordance with standard maritime practice **(IMP-07: EPS-01, -02, -03, -04)**	Engineering	Yes	**EB:** Reduces potential impacts of inappropriate discharge of sewage and ensures compliance with Marine Order 96 and MARPOL requirements as appropriate for vessel class. **C:** Negligible; part of routine vessel operations. **Ev:** Environmental benefits can be achieved with little additional cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Water pollution is avoided by treating and discharging sewage and grey water in accordance with Regulation 9 of MARPOL Annex IV.	**(IMP-07: EPS-01)** Where sewage is treated in a STP, the STP meets MARPOL standards.	ISPP certificate is valid and verifies the installation of a MARPOL-approved STP.
	(IMP-07: EPS-02) The STP is maintained in accordance with the vessel's PMS.	PMS records confirm that the STP is maintained to schedule.
	(IMP-07: EPS-03) In accordance with Regulation 11 of MARPOL Annex IV (as enacted by Marine Order 96), sewage is comminuted, disinfected and only discharged when: • Vessel is >3 nm from nearest land. • Sewage originating in holding tanks is discharged at a moderate rate while the vessel is proceeding en route at a speed not less than 4 knots.	Records verify that treated sewage is only discharged when the vessel is >3 nm from shore.
	(IMP-07: EPS-04) In the event of a STP malfunction or where a STP is not present on the vessel, untreated sewage and grey water is only discharged when the vessel is greater than 12 nm from shore in accordance with Regulation 11 of MARPOL Annex IV (enacted by AMSA Marine Orders Part 96, Sewage).	Activity-specific discharges and emissions register verifies that untreated sewage is only discharged when the vessel is greater than 12 nm from shore.

Impact Consequence (residual)
Negligible
The consequence of treated sewage and grey water discharges is assessed as negligible because of:

<table>
<tr><td colspan="3">The temporary nature of the activity;
The consistent movement of the vessel;
Low discharge volumes;
Intermittent nature of the discharge;
Treatment of the waste stream prior to discharge;
High dilution and dispersal factor in open waters;
The long distance from shore;
High biodegradability and low persistence of the waste; and
Absence of sensitive habitats in the activity area.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual impact consequence is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">No objections or claims have been made by relevant persons regarding treated sewage and grey water discharges during the activity.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
Navigation Act 2012 (Cth):
Chapter 4 (Prevention of Pollution).
AMSA Marine Order 95 (Marine Pollution Prevention - sewage).
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
Section 26D (which implements MARPOL Annex IV).</td></tr>
<tr><td rowspan="3">Industry practice</td><td colspan="2">The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this hazard are in line with the management measures listed in Section 4.5.1 - offshore discharges (sewage and grey water):
Grey and sewage water from showers, toilets, and kitchen facilities should be treated in an appropriate on-site marine sanitary treatment unit (IMP-08: EPS-03).
Sewage units to be in compliance with MARPOL Annex V requirements (IMP-08: EPS-01).</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines for offshore activities with regard to managing sewage and grey water discharges.</td></tr>
</table>

	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of sewage and grey water discharges on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Grey and black water should be treated in an appropriate on-site marine sanitary treatment unit in compliance with MARPOL **(IMP-08: EPS-01, -03)**.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Sewage and grey water discharges will not impact the conservation values of the JBG AMP.
	Ramsar wetlands	Sewage and grey water discharges will not intersect any Ramsar wetlands.
	TECs	Sewage and grey water discharges will not intersect any TECs.
	Nationally threatened and migratory species	Sewage and grey water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	KEFs	Sewage and grey water discharges will not intersect any KEFs.
	NIWs	Sewage and grey water discharges will not intersect any NIWs.
	State marine parks	Sewage and grey water discharges will not intersect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of Acceptability	EOG considers the impacts from treated sewage discharges to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Sewage and grey water discharges will not have long-term or significant impacts on MNES;	

	• The management of sewage and grey water discharges is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of sewage and grey water discharges is not inconsistent with the aims of relevant marine reserve management plans; and • The management of sewage and grey water discharges is not inconsistent with ESD principles.
Environmental Monitoring	
• None required.	
Record Keeping	
• ISPP certificate. • STP PMS records. • Activity-specific discharges and emissions register.	

7.8 IMPACT 8 - Routine Discharges – Cooling and Brine Water

7.8.1 Hazard

Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Seawater is drawn up from the ocean, where it is de-oxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers (in the process transferring heat from the machinery) and is then discharged to the ocean at depth (not at surface). Upon discharge, it will be warmer than the ambient water temperature and may contain low concentrations of residual biocide and scale inhibitors if they are used to control biofouling and scale formation.

The maximum cooling water discharge rate for the vessels that may be used is unknown. Also unknown is the temperature at which the heat exchangers are designed to discharge the cooling water at (though this is generally several degrees Celsius above ambient sea temperature). The volume depends on the equipment being cooled, but for this activity, it is likely to be tens of cubic meters each day.

Brine water (hypersaline water) is created through the desalination process that creates freshwater for drinking, showers, cooking etc. This is achieved through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). The freshwater produced is then stored in tanks on board. Upon discharge, the concentration of the brine is (based on other modern vessels) likely to range from 44-61 ppm, which is 9-26 ppm higher than seawater salt concentration (35 ppm). Brine concentration is dependent on throughput and plant efficiency.

7.8.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of cooling water and brine discharges are:

- Temporary and very localised increase in sea water temperature, causing thermal stress to marine biota;
- Temporary and very localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna from the ingestion of residual biocide and scale inhibitors.

7.8.3 EMBA

The EMBA for cooling water and brine discharges associated with vessel activities is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point and will be within background levels within 10 m vertically (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and turtles); and
- Avifauna.

7.8.4 Evaluation of Environmental Impacts

Temporary and localised increase in seawater temperature

Once in the water column, cooling water will remain in the surface layer, where turbulent mixing and heat transfer with surrounding waters will occur. Prior to reaching background temperatures, the impact of increased seawater temperatures down current of the discharge may result in changes to the physiological processes of marine organisms, such as attraction or avoidance behaviour, stress or potential mortality.

Modelling of continuous waste water discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008). As such, impacts to most receptors are expected to be negligible even within this mixing zone.

Temporary and localised increase in sea surface salinity

Brine water will sink through the water column where it will be rapidly mixed with receiving waters and be dispersed by ocean currents. Walker and MacComb (1990) found that most marine species are able to tolerate short-term fluctuations in water salinity in the order of 20-30%, and it is expected that most pelagic species passing through a denser saline plume would not suffer adverse impacts. Other than plankton, pelagic species are mobile and would be subject to slightly elevated salinity levels for a very short time as they swim through the 'plume.' As such, impacts to receptors are expected to be negligible.

Potential toxicity impacts

Scale inhibitors and biocide are likely to be used in the heat exchange and desalination process to avoid fouling of pipework. Scale inhibitors are low molecular weight phosphorous compounds that are water-soluble, and only have acute toxicity to marine organisms about two orders of magnitude higher than typically used in the water phase (Black *et al*., 1994). The biocides typically used in the industry are highly reactive and degrade rapidly and are very soluble in water (Black *et al*., 1994).

These chemicals are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process, ensuring there is little or no residual chemical concentration remaining upon discharge and thus have a negligible impact consequence.

7.8.5 Impact Assessment

Table 7.16 presents the impact assessment for the discharge of cooling and brine water.

Table 7.16 Impact assessment for the discharge of cooling and brine water

Summary			
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.		
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.		
Duration of impacts	Temporary – duration of the activity.		
Level of certainty of impact	HIGH – the impacts of sea surface temperature and salinity increases on marine fauna are well known.		
Impact decision framework context	Decision type	A - good industry practice required.	
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.	
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.	
Defined acceptable level	Cooling water and brine discharges to sea meet legislated requirements such that there are no adverse impacts to biodiversity, ecological integrity or human health.		
Impact Consequence (inherent)			
Negligible			
Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Store brine onboard prior to discharge onshore.	Elimination	No	**EB:** Eliminates impacts to the marine environment. **C:** Very high costs associated with vessel modifications to enable onboard storage. **Ev:** Cost outweighs the environmental benefit given the minor inherent consequence.
Low toxicity chemicals **(IMP-08: EPS-01)**.	Substitution	Yes	**EB:** Reduces potential water quality impacts through use of environmentally suitable chemicals. **C:** Low toxicity chemicals are generally more expensive than higher toxicity chemicals, but not by high margins. **Ev:** The minimal additional cost is outweighed by the environmental benefits.
Biocide dosing **(IMP-08: EPS-02)**.	Engineering	Yes	**EB:** Minimises the likelihood of out-of-specification discharges.

			C: Negligible; part of routine vessel operations. **E:** Environmental benefits can be achieved with negligible additional cost.
Freshwater generation volumes **(IMP-08: EPS-03)**.	Engineering	Yes	**EB:** Minimises the volume of brine discharges. **C:** Negligible; part of routine vessel operations. **E:** Environmental benefits can be achieved with negligible additional cost.
PMS **(IMP-08: EPS-04)**.	Engineering	Yes	**EB:** Minimises the likelihood of out-of-specification discharges. **C:** Negligible; part of routine vessel operations. **E:** Environmental benefits can be achieved with little additional cost.

Environmental Controls and Performance Measurement

EPO	EPS	Measurement criteria
Only the minimum required low-toxicity chemicals are used in the cooling and brine water systems.	**(IMP-08: EPS-01)** Only OCNS ‘Gold’/’Silver’ (CHARM) or ‘D’/’E’ (non-CHARM)-rated chemicals (i.e., low toxicity) are used in the cooling and brine water systems.	Vessel chemical inventories records verify that biocides and scale inhibitors are of low toxicity.
	(IMP-08: EPS-02) Biocide dosing kept to a minimum in accordance with the equipment manufacturer’s specifications	Review of PMS data with Chief Engineer verifies minimum biocide dosage.
The RO plant and equipment that requires cooling by water is well maintained.	**(IMP-08: EPS-03)** Freshwater generation will be limited to volumes necessary for operational requirements.	Review of tank volumes with Chief Engineer verifies minimum requirement for freshwater generation.
	(IMP-08: EPS-04) Plant and equipment that requires cooling by water is maintained in good working order in accordance with the vessels’ PMS.	Vessel PMS records verify that equipment that requires cooling is maintained in accordance with OEM requirements.

Impact Consequence (residual)

Negligible

The consequence of cooling and brine water discharges is assessed as negligible because of the:

- Temporary nature of the activity;
- Vessel will be constantly moving;
- Low discharge volumes;
- Intermittent nature of the discharge;
- ‘Consumption’ of the chemicals prior to discharge;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the activity area.

Demonstration of ALARP

A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or

<table>
<tr><td colspan="3">alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met through implementation of this EP.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual impact consequence is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">No objections or claims have been made by relevant persons regarding cooling and brine discharges.</td></tr>
<tr><td>Legislative context</td><td colspan="2">There are no legislative controls regarding cooling and brine water discharges.</td></tr>
<tr><td rowspan="4">Industry practice</td><td colspan="2">The consideration of the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry
(IOGP-IPIECA, 2020)</td><td>The EPS developed for this hazard are in line with the management measures listed for offshore discharges (cooling water and desalination brine) in Section 4.5.3 of the guidelines:
• Biocide dosing kept to a minimum in accordance with the equipment manufacturer’s specifications (IMP-09: EPS-02).
• Freshwater generation to be limited to volumes necessary for operational requirements (IMP-09: EPS-03).</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines for offshore activities with regard to managing cooling and brine water discharges.</td></tr>
<tr><td>Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)</td><td>Not applicable. The guidelines do not discuss the impacts of cooling water and brine discharges on marine life.</td></tr>
</table>

	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Cooling water (items 41 & 42). Antifouling chemical dosing to prevent marine fouling of cooling water systems should be carefully considered and appropriate screens to be fitted to the seawater intake to avoid entrainment and impingement of marine flora and fauna **(IMP-09:EPS-02)**. The cooling water discharge depth should be selected to maximise mixing and cooling of the thermal plume to ensure it is within 3°C of ambient seawater temperature within 100 m of the discharge point. • Desalination brine (item 43). Consider mixing desalination brine from the potable water system with cooling water or other effluent streams.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Cooling and brine water discharges will not impact the conservation values of nearby AMPs.
	Ramsar wetlands	Cooling and brine water discharges will not intersect any Ramsar wetlands.
	TECs	Cooling and brine water discharges will not intersect any TECs.
	Nationally threatened and migratory species	Cooling and brine water discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	KEFs	Cooling and brine water discharges will not intersect any KEFs.
	NIWs	Cooling and brine water discharges will not intersect any NIWs.
	State marine parks	Cooling and brine water discharges will not impact the conservation values of nearby AMPs.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Statement of Acceptability	EOG considers the impacts from cooling water and brine discharges to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Cooling water and brine discharges will not have long-term or significant impacts on MNES; • The management of cooling water and brine discharges is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of cooling water and brine discharges is not inconsistent with the aims of relevant marine reserve management plans; and • The management of cooling water and brine discharges is not inconsistent with ESD principles.
Environmental Monitoring	
• None required.	
Record Keeping	
• PMS records. • Potable water tank volumes. • Chemical inventories.	

7.9 IMPACT 9 – Routine Discharges – Bilge Water and Deck Drainage

7.9.1 Hazard

Bilge tanks on the vessel receive fluids from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats this water prior to discharge overboard in order to meet the MARPOL requirement that no greater than 15 ppm oil-in-water (OIW) is discharged overboard. The volume of these discharges is small and intermittent (as required, based on bilge tank storage levels). Where no OWS is present, these fluids are retained in tanks for onshore disposal.

Vessel decks that are not bunded and drain directly to the sea may lead to the discharge of contaminated water, caused by ocean spray and rain ('green water') or deck washing activities capturing trace quantities of contaminants such as oil, grease and detergents, or a chemical (e.g., hydraulic fluids, lubricating oils) or hydrocarbon spill or leak washed overboard.

7.9.2 Known and Potential Environmental Impacts

The known and potential environmental impacts of the discharge of bilge water and deck drainage are:

- Temporary and localised reduction of surface water quality around the discharge point; and
- Acute toxicity to marine fauna through ingestion of contaminated water in a small mixing zone.

7.9.3 EMBA

The EMBA for bilge and deck water discharges is likely to be the top 10 m of the water column and less than a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and turtles); and
- Avifauna.

7.9.4 Evaluation of Environmental Impacts

Temporary and localised reduction of surface water quality

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges and traces of chemicals or hydrocarbons discharged to the ocean through open deck drainage may temporarily reduce water quality.

Given the absence of sensitive habitat types in the water column of the EMBA for these discharges, the greatest risk will be to plankton and pelagic fish. These discharges will be rapidly diluted, dispersed and biodegraded to undetectable levels within a very small mixing zone (as per the EMBA) and thus have a negligible impact consequence.

Potential toxicity impacts

While small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality, such discharges are not expected to induce acute or chronic toxicity impacts to marine fauna or plankton through ingestion or absorption through the skin.

In the event a vessel OWS malfunctions and discharges of off-specification water, toxicity impacts may occur to marine fauna swimming through the discharge, though this is only likely in a highly localised mixing zone (meaning that few individuals would be exposed), meaning it will have a negligible impact consequence.

7.9.5 Impact Assessment

Table 7.17 presents the impact assessment for the discharge of bilge water and deck drainage.

Table 7.17 Impact assessment for the discharge of bilge water and deck drainage

Summary		
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Intermittent during vessel operations.	
Level of certainty of impacts	HIGH – the impacts of oily water discharges to the ocean are well known.	
Impact decision framework context	Decision type	A - good industry practice required.

	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.	
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.	
Defined acceptable level	Bilge water discharges and deck drainage meet legislated discharge requirements such that there are no adverse impacts to biodiversity, ecological integrity or human health.		
Impact Consequence (inherent)			
Negligible			
Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Store treated bilge onboard for disposal onshore.	Eliminate	No	**EB:** Eliminates oily water discharge, thereby eliminating potential impacts to water quality and marine fauna. **C:** Significant cost of re-designing and configuring storage space on vessels. **Ev:** Cost to implement control measures outweighs the benefit given the negligible inherent consequence.
Oily water treatment system **(IMP-09: EPS-01, -03, -04).**	Engineering	Yes	**EB:** Oily water is treated prior to discharge, thereby reducing impacts to water quality and marine fauna. Complies with Marine Order 91 and MARPOL requirements. **C:** Significant cost to install and minor costs to maintain, but part of routine vessel operations. **Ev:** Benefits to the marine environment outweigh the costs.
Maintain bilge water systems **(IMP-09: EPS-02).**	Engineering	Yes	**EB:** Efficient OWS ensures MARPOL requirements are met and impacts to water quality and marine fauna are minimised. **C:** Minor costs to maintain the OWS that is part of routine vessel operations. **Ev:** Benefits to the marine environment outweigh the costs.
Bunding of hydrocarbons and chemical storage areas **(IMP-09: EPS-07, -08)**	Engineering	Yes	**EB:** Increases likelihood that a spill will be caught and not discharged to the marine environment. **C:** Minor equipment installation and maintenance costs. **Ev:** Environmental benefit outweighs the costs.
SMPEP **(IMP-09: EPS-05, -09).**	Administrative	Yes	**EB:** Coordinated response to a spill reduces the area of impact to the marine environment.

			C: Minor equipment installation cost and maintenance costs, minor costs in time of training crew. **Ev:** Environmental benefit outweighs the costs.
Use of non-toxic, biodegradable deck cleaning product selection **(IMP-09: EPS-06).**	Administrative	Yes	**EB:** Improves quality of water discharge. **C:** Minor additional cost of environmentally acceptable deck cleaning products. **Ev:** Environmental benefit outweighs the minimal cost.
Availability of spill response kits **(IMP-09: EPS-10).**	Administrative	Yes	**EB:** Coordinated response to a spill reduces the area of impact to the marine environment. **C:** Minor equipment installation cost and maintenance costs, minor costs in time of training crew. **Ev:** Environmental benefit outweighs the minimal cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
No discharge of bilge water unless compliant with MARPOL Annex I requirements.	**(IMP-09: EPS-01)** For vessels >400 gross tonnes, all bilge water passes through a MARPOL-compliant OWS set to limit OIW to <15 ppm prior to overboard discharge.	IOPP certificate is current.
	(IMP-09: EPS-02) The OWS is maintained in accordance with the vessel PMS.	PMS records verify that the OWS is maintained to schedule.
	(**IMP-09: EPS-03)** The OWS is calibrated in accordance with the vessel PMS to ensure the 15 ppm OIW limit is met.	PMS records verify that the OWS is calibrated to schedule.
	(IMP-09: EPS-04) The residual oil from the OWS is pumped to tanks and disposed of onshore.	The Oil Record Book verifies that waste oil is transferred to shore.
Level 1 spills (<10 m^3) of oil or oily water overboard are rapidly responded to by the vessel contractor.	**(IMP-09: EPS-05)** The vessel-specific SMPEP is implemented in the event of an overboard spill of hydrocarbons or chemicals.	Incident report verifies that the SMPEP was implemented.
Planned open deck discharges are non-toxic.	**(IMP-09: EPS-06)** Deck cleaning detergents are biodegradable.	Safety Data Sheets (SDS) verify that deck cleaning agents are biodegradable.
Hydrocarbon or chemical spills to deck are prevented from being	**(IMP-09: EPS-07)** Hydrocarbon and chemical storage areas (process areas) are bunded and drain to the bilge tank.	Site inspections (and associated completed checklists) verify that bunding is in place and piping and instrumentation diagrams

discharged overboard.		(P&IDs) verify that, for vessels, they drain to the bilge tank.
	(IMP-09: EPS-08) Portable bunds and/or drip trays are used to collect spills or leaks from equipment that is not contained within a permanently bunded area (non-process areas).	Site inspections (and associated completed checklists) verify that portable bunds and/or drip trays are used in non-process areas as required.
Personnel are competent in spill response and have appropriate resources to respond to a spill.	**(IMP-09: EPS-09)** The vessel crews are competent in spill response and have appropriate response resources in order to prevent or minimise hydrocarbon or chemical spills discharging overboard.	Training records verify that vessel crews receive spill response training.
	(IMP-09: EPS-10) Fully stocked SMPEP response kits and scupper plugs or equivalent drainage control measures are readily available and used in the event of a spill to deck to prevent or minimise discharge overboard.	Site inspections (and associated completed checklists) verify that fully stocked spill response kits and scupper plugs (or equivalent) are available on deck in high-risk locations.
		Review of incident reports indicate that the spills of hydrocarbons or chemicals to deck are cleaned up.

Impact Consequence (residual)
Negligible
The consequence of bilge water discharges and deck drainage is assessed as negligible because the: • Activity is of a temporary nature; • Vessels will be constantly moving; • Discharges will be intermittent; • Discharges will be low volume; • High energy offshore waters will aid in dilution of discharges; and • Activity area does not contain sensitive habitats.
Demonstration of ALARP
A ‘negligible’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the impact to the point that any additional or alternative control measures either fail to lower the impact any further or are grossly disproportionate to the residual impact consequence.

Demonstration of Acceptability	
Policy compliance	EOG’s Safety and Environmental Policy objectives are met.
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.
Risk matrix standard compliance	The residual impact consequence is negligible, which is considered acceptable.

Engagement	There have been no objections or claims raised by relevant persons regarding bilge water discharges and deck drainage.	
Legislative context	The EPS align with the requirements of: • Navigation Act 2012 (Cth): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order 91 (Marine Pollution Prevention - oil). • Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth): o Part II (Prevention of pollution by oil). o Part III (Prevention of pollution by noxious substances).	
Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore discharges (deck drainage and bilge water) in Section 4.5.2 of the guidelines: • Vessels must have an IOPP Certificate (for vessels >400 gross tonnes) and equipped with MARPOL/IMO-compliant oil/water treatment system (as appropriate to vessel class) **(IMP-10: EPS-01)**. • Hydrocarbon and chemical storage areas are to be bunded with no residues/spills permitted to enter the overboard drainage system unless it first goes through a closed drainage treatment system **(IMP-10: EPS-07, -08)**. • Vessels to maintain an Oil Record Book (applicable to vessels >400 gross tonnes), including the discharge of dirty ballast or cleaning water **(IMP-10: EPS-04)**. • Discharge into the sea of oil or oily mixtures is prohibited except when the OIW of the discharge without dilution does not exceed 15 ppm **(IMP-10:EPS-01, -03)**. • Contaminated deck drainage and bilge water to be contained and treated prior to discharge in accordance with EHS Guidelines for Offshore Oil and Gas Development 2015. If treatment to this standard is not possible, these waters should be contained and shipped to shore for disposal. • Extracted hydrocarbons from oil-in water separator systems to be stored in suitable containers and transported to shore for treatment and/or disposal by a certified waste oil disposal contractor **(IMP-10: EPS-04)**.
	Best Available Techniques Guidance Document on	The EPS listed in this table meet these guidelines for offshore activities with regard to:

	Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	• Management of drain water (item 24). The BAT are met for vessel operations with regard to ensuring deck coaming is in place, maintaining a chemical inventory, implementing an inspection, maintenance and repair schedule and ensuring that personnel are trained in the use of spill kits **(IMP-10: EPS-09)**.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of bilge water and deck drainage discharges on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Bilge waters from machinery spaces in vessels should be routed to the closed drain system or contained and treated before discharge to meet MARPOL requirements **(IMP-10: EPS-01)**. Deck drainage water should be routed to separate drainage systems. This includes drainage water from process and non-process areas. All process areas should be bunded to ensure that drainage water flows into the closed drainage system **(IMP-10: EPS-07)**.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the risk of release of substances into the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs	Bilge water and deck drainage discharges will not impact the conservation values of nearby AMPs.
	Ramsar wetlands	Bilge water and deck drainage discharges will not intersect any Ramsar wetlands.
	TECs	Bilge water and deck drainage discharges will not intersect any TECs.
	Nationally threatened and migratory species	Bilge water and deck drainage discharges will not have any significant impacts on threated or migratory species.
	Other matters	
	KEFs	Bilge water and deck drainage discharges will not intersect any KEFs.
	NIWs	Bilge water and deck drainage discharges will not intersect any NIWs.
	State marine parks	Bilge water and deck drainage discharges will not intersect any state marine parks.

	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of Acceptability	EOG considers the impact from bilge water discharges and deck drainage to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual consequence rating is Level 2 (negligible); • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Bilge water discharges and deck drainage will not have long-term or significant impacts on MNES; • The management of bilge water discharges and deck drainage is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of bilge water discharges and deck drainage is not inconsistent with the aims of relevant marine reserve management plans; and • The management of bilge water discharges and deck drainage is not inconsistent with ESD principles.	
Environmental Monitoring		
• None required		
Record Keeping		
• PMS records. • IOPP certificate. • Oil Record Book. • Crew training records. • Inspection and checklist records.	• P&IDs. • SDS (for deck cleaning agents). • Incident reports. • SMPEP.	

7.10 RISK 1 – Accidental Discharge of Waste to the Ocean

7.10.1 Hazard

The handling and storage of materials and waste on board the vessel has the potential to result in accidental overboard disposal of hazardous and non-hazardous materials, waste, chemicals and fuel, creating marine debris and pollution.

Small quantities of hazardous and non-hazardous materials are used in routine operations and maintenance and waste is created, and then handled and stored on the vessels. In the normal course of operations, solid and liquid hazardous and non-hazardous materials and wastes will be stored until it is disposed of via port facilities for disposal at licensed onshore facilities. However, accidental releases to sea are a possibility, especially in rough ocean conditions when items may roll off or be blown off the deck.

The following non-hazardous materials and wastes will be disposed of to shore, but have the potential to be accidentally dropped or disposed overboard due to poor waste management (e.g., overfull bins), strong winds, high seas or crane operator error:

- Paper and cardboard;
- Wooden pallets;
- Scrap steel, metal and aluminium;
- Glass;
- Foam (e.g., ear plugs); and
- Plastics (e.g., hard hats).

The following hazardous materials (defined as a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal, and as outlined in Annex III to the Basel Convention, may be toxic, flammable, explosive and poisonous) may be used and waste generated through the use of consumable products and will be disposed to shore, but may be accidentally dropped or disposed overboard or could be lost as a result of hose connection failure, overfilling of tanks or emergency disconnection of hoses:

- Hydrocarbons, hydraulic oils and lubricants;
- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters);
- Batteries, empty paint cans, aerosol cans and fluorescent tubes;
- Contaminated personal protective equipment (PPE);
- Laboratory wastes (such as acids and solvents); and
- Larger dropped objects (that may be hazardous or non-hazardous) may be lost to the sea through accidents (e.g., crane operations) include:
    - Sea containers;
    - Towed equipment;
    - ROV; and
    - Entire skip bins/crates.

7.10.2 Potential Environmental Risks

The risks of the release of hazardous and non-hazardous materials and waste to the ocean are:

- Marine pollution (littler and a temporary and localised reduction in water quality);
- Acute toxicity to marine fauna through ingestion or absorption;
- Injury and entanglement of individual animals; and
- Localised (and normally temporary) smothering or pollution of benthic habitats.

7.10.3 EMBA

The EMBA for the accidental disposal of hazardous and non-hazardous materials and waste is likely to extend for kilometres from the release site (as buoyant waste drifts with currents) or localised for non-buoyant items that sink to the seabed.

Receptors susceptible to waste that may occur within this EMBA, either as residents or migrants, are:

- Benthic fauna;
- Benthic habitat;
- Pelagic fauna (fish, cetaceans and turtles); and
- Avifauna.

The EPBC Act-listed species documented as being negatively impacted by the ingestion of, or entanglement in, harmful marine debris (and known to occur in the activity area or EMBA) are:

- The six turtle species (loggerhead, green, flatback, olive ridley, leatherback and hawksbill);
- Sawfish and river sharks;
- Seabirds (Australian noddy, osprey, shearwater); and
- Cetaceans (Australian snubfin dolphin, Australian humpback dolphin, PBW).

7.10.4 Evaluation of Environmental Risks

Non-hazardous Materials and Waste

If discharged overboard, non-hazardous wastes can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by seabirds and fish). For example, the TSSC (2015d) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species).

Marine fauna including cetaceans, turtles and seabirds can be severely injured or die from entanglement in marine debris, causing restricted mobility, starvation, infection, amputation, drowning and smothering (DoEE, 2018). Seabirds entangled in plastic packing straps or other marine debris may lose their ability to move quickly through the water, reducing their ability to catch prey and avoid predators, or they may suffer constricted circulation, leading to asphyxiation and death. In marine mammals and turtles, this debris may lead to infection or the amputation of flippers, tails or flukes (DoEE, 2018). Plastics have been implicated in the deaths of a number of marine species including marine mammals and turtles, due to ingestion.

If dropped objects such as skip bins are not retrievable (e.g., by crane), these items may permanently smother very small areas of seabed, resulting in the loss of benthic habitat. However, as with most subsea infrastructure, the items themselves are likely to become colonised by benthic fauna over time (e.g., sponges) and become a focal area for sea life, so the net environmental impact is likely to be neutral. The benthic habitats in the activity area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance. Seabed substrates can rapidly recover from temporary and localised impacts.

Hazardous Materials and Waste

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical or hydrocarbon spills can (depending on the volume released) impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the chemical with the surrounding seawater. In an open ocean environment such as the JBG, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised. The absence of particularly sensitive seabed habitats and the widespread nature of the sandy seabed present in the activity area further limits the extent of potential impacts.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which is likely to result in a small area of substrate becoming toxic and unsuitable for colonisation by benthic fauna. The benthic habitats of the activity area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance.

All hazardous waste is disposed of at appropriately licensed facilities, by licenced contractors, so impacts such as illegal dumping or disposal to an unauthorised onshore landfill that is not lined are highly unlikely to result from the activity.

Entanglement of Cetaceans

The withdrawn conservation advice for the humpback whale (TSSC, 2015a) listed entanglement from marine debris as a threat to the species. Marine debris includes plastic garbage such as bags, bottles, ropes, derelict fishing gear and non-biodegradable floating materials list or disposed of at sea. There have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998. The vast majority (92.2%) of cetacean incidents relate to entanglement (TSSC, 2015a), and humpback whales dominated the available records, with around 48 entanglement incidents recorded.

Marine Debris

The Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018) lists specific management actions and objectives. Given that the activity has the potential to contribute to marine debris, an assessment of the management actions and objectives has been provided in Table 7.18. Table 7.18

Table 7.18 Assessment against the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018)

Objective and associated management actions	Assessment
1. *Contribute to long-term prevention of the incidence of marine debris*	
Establish a threat abatement plan (TAP) team to coordinate actions for the life of the TAP.	The activity will not have any impacts on this management action.
Limit the amount of single-use plastic material lost to the environment in Australia.	The EPS listed in Table 7.21 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with these management actions.
Encourage development of a circular economy in Australia.	The activity will not have any impacts on this management action.
Encourage innovation in recovery and waste treatment technologies.	The activity will not have any impacts on this management action.
Improve management of abandoned, lost and discarded fishing gear.	The activity will not have any impacts on this management action.

Objective and associated management actions	Assessment
Improve shipping waste management.	The EPS listed in Table 7.21 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with these management actions.
2. *Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities and locations*	
Update the list of marine debris impacted EPBC Act-listed vertebrate species as scientific evidence is published.	The activity will not have any impacts on this management action.
Monitor relevant ecological research to determine if further EPBC Act-listed ecological communities are threatened by marine debris.	The activity will not have any impacts on this management action.
Identify locations where aggregations of debris intersect with the temporal and spatial distribution of EPBC Act-listed species, especially during vulnerable life stages (e.g., whale and turtle migrations).	The activity will not have any impacts on this management action.
Build understanding related to plastic and microplastic pollution.	The activity will not have any impacts on this management action.
Survey marine plastic pollution in the Southern Ocean, sub-Antarctic islands and other high value offshore island environments.	The activity will not have any impacts on this management action.
Determine the relevance of microplastics to the Australian Government's Science and Research Priorities and corresponding Practical Research Challenges.	The activity will not have any impacts on this management action.
3. *Remove existing marine debris*	
Support beach-based clean-up efforts.	The activity will not have any impacts on this management action.
Improve the effectiveness of Australian Government grants in relation to marine debris outcomes.	The activity will not have any impacts on this management action.
Remove derelict fishing gear from Australia's oceans and coasts.	The activity will not have any impacts on this management action.
Develop understanding of the potential for biological breakdown of plastic to prevent it entering the marine environment, or aid its removal.	The activity will not have any impacts on this management action.
4. *Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris*	
Continue collection of data in long-term beach surveys.	The activity will not have any impacts on this management action.

Objective and associated management actions	Assessment
Develop a nationally consistent monitoring system for land-based plastic pollution.	The activity will not have any impacts on this management action.
Maintain a national database for long-term marine debris beach survey data and promote standard methods for collecting and ongoing monitoring of beach clean-up debris.	The activity will not have any impacts on this management action.
Assess the effectiveness of Australia's product stewardship and waste management in reducing the levels of plastics entering the marine environment.	The activity will not have any impacts on this management action.
Continue to monitor persistent organic pollutant contamination using plastic resin pellets from Australian beaches.	The activity will not have any impacts on this management action.
Regularly assess mean surface plastic loads and associated hazardous chemical contaminants across Australian jurisdictions and territories.	The activity will not have any impacts on this management action.
Enhance collection of data related to ghost net retrievals from Commonwealth waters across northern Australia.	The activity will not have any impacts on this management action.
Improve understanding of the impact and origins of ghost nets.	The activity will not have any impacts on this management action.
5. *Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change.*	
Raise the profile of marine debris impacts on marine vertebrate species, especially EPBC Act-listed threatened species.	The activity will not have any impacts on this management action.
Improve public communication about consumer waste and litter.	The activity will not have any impacts on this management action.

Marine debris is identified as a threat to turtles in the Recovery Plan for Marine Turtles 2017-2027 (DoEE, 2017c). As such, an assessment of relevant interim recovery objectives and targets with the activity is provided in Table 7.19.

Table 7.19 Assessment of Marine Debris against the Recovery Plan for Marine Turtles 2017-2027 (DoEE, 2017c) with the activity

Interim Objective or Target	Assessment
Interim Objective 3: Anthropogenic threats are demonstrably minimised.	
Target 3.1: Robust and adaptive management regimes that lead to a reduction in anthropogenic threats to marine turtles and their habitats are in place	The EPS listed in Table 7.21 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this recovery target.

Interim Objective or Target	Assessment
Target 3.2: Threat mitigation strategies are supported by high quality information	The activity will not have any impacts on this recovery target.

Habitat degradation and modification (e.g., through the presence of marine debris following accidental discharge) are a listed threat in the Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015c). Threatened species addressed in this plan that are relevant to the activity include the largetooth sawfish, green sawfish, dwarf sawfish and the northern river shark. An assessment of the relevant objectives and management actions of the Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015c) with the activity is provided in Table 7.20.

Table 7.20 Assessment of Marine Debris against the Sawfish and River Sharks Multispecies Recovery Plan (DoE, 2015c) with the activity

Objective or management action	Assessment
Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species	The EPS listed in Table 7.21 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this objective.
Action 5a. Ensure all future developments will not significantly impact upon sawfish and river shark habitats critical to the survival of the species, or impede upon the migration of individual sawfish or river sharks.	The EPS listed in Table 7.21 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this management action.
Action 5b. Determine the effect of river and estuarine barriers on the movements of sawfish and river sharks and undertake an audit of barriers to establish whether removal or modification is feasible to allow for the riverine migration of sawfish and river sharks.	The activity will not have any impacts on this management action.
Action 5c. Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.	The activity will not have any impacts on this management action.
Action 5d. Implement measures to reduce adverse impacts of habitat degradation and/or modification	The EPS listed in Table 7. 30 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this management action.
Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.	The EPS listed in Table 7. 30 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this objective.
Action 6a. Assess the impacts of marine debris including ghost nets, fishing gear and plastics on sawfish and river shark species.	The activity will not have any impacts on this management action.

Objective or management action	Assessment
Action 6b. Partner with marine debris organisations to support initiatives that reduce marine debris likely to impact on sawfish and river sharks.	The activity will not have any impacts on this management action. The EPS listed in Table 7. 30 will reduce the likelihood of accidental discharge of wastes to the ocean to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this management action.

7.10.5 Risk Assessment

Table 7.21 presents the risk assessment for the accidental disposal of hazardous and non-hazardous materials and waste.

Table 7.21 Risk assessment for the unplanned discharge of solid or hazardous waste to the marine environment

Summary		
Summary of risk	Marine pollution (litter and a temporary and localised reduction in water quality), injury and entanglement of individual animals (such as seabirds, cetaceans, turtles and sawfish) and smothering or pollution of benthic habitats.	
Extent of risks	Non-buoyant waste may sink to the seabed near where it was lost. Buoyant waste may float long distances with ocean currents and winds.	
Duration of risks	Short-term to long-term, depending on the type of waste and location.	
Level of certainty of risk	HIGH – the effects of inappropriate waste discharges are well known.	
Risk decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	No unplanned release of hazardous or non-hazardous solid waste or materials.	

Risk Assessment (inherent)		
Likelihood	Consequence	Risk rating
Occasional	Minor	Low

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Transfer wastes from the vessel to shore-based facilities during the activity.	Eliminate	No	**EB:** Reduces likelihood of accidental waste disposal through transfer to shore-based facilities, noting that there are risks of waste overboard during the transfer process. **C:** High costs for the use of a dedicated vessel to take waste, which also results in routine vessel impacts and risks.

			Ev: Cost to implement is grossly disproportionate to the benefit given the low inherent risk rating.
Vessel wastes are managed in accordance with the GMP **(RSK-01: EPS-01, -02, -03, -04).**	Engineering	Yes	**EB:** Reduces the likelihood of waste being discharged to sea, reducing potential impacts to marine fauna and water quality. **C:** Negligible; it is a standard MARPOL requirement. Minor administrative cost to produce documents and roll out to personnel. **Ev:** Benefits of ensuring responsible waste management outweighs the negligible cost.
Recover accidentally discharged wastes or lost equipment (if safe to do so) **(RSK-01: EPS-05)**	Administrative	Yes	**EB:** Removes debris from the environment, thereby reducing impacts to marine fauna and water quality. **C:** Potential down-time and equipment costs to retrieve materials. **Ev:** Environmental benefit of recovering marine debris outweighs the costs.
Chemical locker **(RSK-01: EPS-06).**	Administrative	Yes	**EB:** Separates hazardous substances in a designated area, making accidental discharge less likely. **C:** Negligible; it is a standard maritime requirement. Minor administrative cost to produce documents and roll out to personnel. **Ev:** Environmental benefit outweighs the negligible costs.
Dropped object prevention procedure **(RSK-01: EPS-07, -08, -09, -10, -11).**	Engineering	Yes	**EB:** Reduces the likelihood that materials will be accidentally lost overboard and impacts on marine fauna and water quality. **C:** Negligible; it is a standard maritime requirement. Minor administrative cost to produce documents and roll out to personnel. **Ev:** Environmental benefit outweighs the negligible costs.
Handling and storage procedures **(RSK-01: EPS-12, -13, -14, -15).**	Administrative	Yes	**EB:** Reduces the likelihood that materials will be accidentally lost overboard and impacts on marine fauna and water quality. **C:** Negligible; it is a standard maritime requirement. Minor administrative cost to produce documents and roll out to personnel. **Ev:** Environmental benefit outweighs the negligible costs.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria

No unplanned release of hazardous or non-hazardous solid wastes or materials.	**(RSK-01: EPS-01)** A MARPOL Annex V-compliant GMP is in place for the vessel (if >100 gross tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	A GMP is in place, readily available on board and kept current.
	(RSK-01: EPS-02) Waste is stored, handled and disposed of in accordance with the GMP. This includes measures including: • No discharge of general operational or maintenance wastes or plastics or plastic products of any kind. • Waste containers are covered with secure lids to prevent solid wastes from blowing overboard. • All solid wastes are stored in designated areas before being sent ashore for recycling, disposal or treatment. • Any liquid waste storage on deck must have at least one barrier to minimise the risk of spills to deck entering the ocean. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place. • Correct segregation of solid and hazardous wastes.	GMP is available and current. Inspections verify that waste is stored and handled according to its waste classification. Inspections verify that waste receptacles are properly located, sized, labelled, covered and secured for the waste they hold. A licensed shore-based waste contract is in place for the management of onshore waste transport and disposal.
	(RSK-01: EPS-03) Vessel crews and visitors are inducted into waste management procedures to ensure they understand how to implement the GMP.	Induction and attendance records verify that all crew members are inducted.
	(RSK-01: EPS-04) Waste types and volumes are tracked and logged.	Waste tracker is available and current.
	(RSK-01: EPS-05) Solid waste that is accidentally discharged overboard is recovered if reasonably practicable.	Incident records are available to verify that credible and realistic attempts to retrieve the materials lost overboard were made.
	(RSK-01: EPS-06) A chemical locker is available, bunded and used for the storage of all greases and non-bulk chemicals (i.e., those not in tote tanks) so as to prevent discharge overboard.	Site inspection verifies that greases and chemicals are stored in a chemical locker.
Avoid objects being dropped overboard	**(RSK-01: EPS-07)** Large bulky items are securely fastened to or stored on the deck to prevent loss to sea.	A completed pre-departure inspection checklist verifies that bulky goods are securely sea-fastened.
	(RSK-01: EPS-08) The vessel PMS is implemented to ensure that lifting equipment	PMS records verify that lifting equipment is maintained to

	remains in certification and fit for use at all times to minimise the risk of dropped objects.	schedule and in accordance with OEM requirements.
	(RSK-01: EPS-09) The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.	Completed handling and transfer procedure checklist, permit to work (PTW) and/or risk assessments verify that the procedure is implemented prior to each transfer.
	(RSK-01: EPS-10) The crane operators are trained to be competent in the handling and transfer procedure to prevent dropped objects.	Training records verify that crane operators are trained in the loading and unloading procedure.
	(RSK-01: EPS-11) Visual inspection of lifting gear is undertaken every quarter by a qualified competent person (e.g., maritime officer) and lifting gear is tested regularly in line with the vessel PMS.	Inspection of PMS records and Lifting Register verifies that inspections and testing have been conducted to schedule.
Chemicals and hydrocarbons are stored and transferred in a manner that prevents bulk release.	**(RSK-01: EPS-12)** All hydrocarbons and chemicals are stored within secure receptacles within bunded areas or dedicated chemical lockers that drain to bilge tanks.	Visual inspection verifies that hydrocarbons and chemicals are stored within secure receptacles within bunded areas or dedicated chemical lockers that drain to bilge tanks.
	(RSK-01: EPS-13) Vessel PMS is implemented to ensure the integrity of chemical and hydrocarbon storage areas and transfer systems are maintained in good order.	Vessel PMS records verify that chemical and hydrocarbon storage areas and transfer systems (e.g., bunds, tanks, pumps and hydraulic hoses) are maintained to schedule and in accordance with OEM requirements.
	(RSK-01: EPS-14) Where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.	Visual inspection verifies that where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.
	(RSK-01: EPS-15) Crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the vessel contractor lifting and loading procedure, or equivalent, and under a PTW.	PTW records verify that crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the procedure.

Risk Assessment (residual)		
Likelihood	Consequence	Risk rating
Minor	Rare	Negligible

<table>
<tr><td colspan="3">The risk of accidental discharge of waste to the ocean is assessed as negligible because:
Volumes of waste generated on the vessel will be small due to the nature of the activity and its short duration; and
Implementation of the control measures reduces the likelihood to accidental discharge of waste to the ocean to ALARP.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual risk rating is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual risk is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">No objections or claims have been raised by relevant persons regarding accidental discharge of wastes to the ocean.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
Navigation Act 2012 (Cth):
Chapter 4 (Prevention of Pollution).
Marine Orders Part 47.
Marine Orders Part 94 (Marine pollution prevention – packaged harmful substances).
Marine Orders Part 95 (Marine pollution prevention – garbage).
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
Part III (Prevention of pollution by noxious substances).
Part IIIA (Prevention of pollution by packaged harmful substances).
Part IIIC (Prevention of pollution by garbage).</td></tr>
<tr><td rowspan="2">Industry practice</td><td colspan="2">The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry
(IOGP-IPIECA, 2020)</td><td>The EPS developed for this activity are in line with the management measures listed for hazardous waste and non-hazardous waste discharges in Sections 4.6.2 and 4.6.3 of the guidelines, which include:
Segregating hazardous and non-hazardous wastes prior to disposal (RSK-01: EPS-01).
Managing hazardous waste in accordance with their SDS and tracking it to final destination.
Not deliberately discharging waste overboard.</td></tr>
</table>

	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Risk management for handling and storage of chemicals (item 19). The BAT are met for the activity with regard to implementing chemical transfer procedures and ensuring chemicals are stored in separate, labelled containers.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	Not applicable. The guidelines do not discuss the impacts of accidental waste discharge on marine life.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Waste management (items 46). Materials should be segregated offshore and shipped to shore for reuse, recycling or disposal. A waste management plan should be developed and contain a mechanism allowing waste consignments to be tracked **(RSK-01: EPS-01)**. • Hazardous materials management (item 72). Principles relate to the selection of chemicals with the lowest environmental and health risks.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level **(All EPS for RSK-01)**.
	Waste management-specific	
	Guidelines for the Development of GMPs (IMO, 2012)	The vessels' GMPs are developed in accordance with these guidelines **(RSK-01: EPS-01)**.
	International Dangerous Goods Maritime Code (IMO, 2014)	The storage and handling of dangerous goods on the vessels is managed in accordance with this code.
Environmental context	MNES	
	AMPs	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect nearby AMPs. The North Marine Parks Network Management Plan 2018 (DNP, 2018a) identifies marine debris as a threat to the AMP network. The EPS listed in this table aim to minimise the generation of marine debris and potential for accidental discharge and are aligned with the strategies outlined in the plan.

	Ramsar wetlands	The unplanned discharge of solid or hazardous waste is highly unlikely to reach Ramsar wetlands.
	TECs	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any TECs.
	Nationally threatened and migratory species	The unplanned discharge of solid or hazardous waste is highly unlikely to have any impacts on threated or migratory species.
	Other matters	
	KEFs	The unplanned discharge of solid or hazardous waste will not affect any KEFs.
	NIWs	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any NIWs.
	State marine parks	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	Assessments of the activity against the following species have been undertaken and presented earlier, and the control measures adopted ensure the activity will be conducted in a manner that is not inconsistent with each plan: • Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's coasts and oceans (DoEE, 2018). • The Sawfish and River Shark Multispecies Recovery Plan (DoE, 2015c).
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the risk of accidental discharge of waste to the ocean to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual risk rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Accidentally discharged wastes will not have long-term or significant impacts on MNES; • The management of wastes is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of wastes is not inconsistent with the aims of relevant marine reserve management plans; and • The management of wastes is not inconsistent with ESD principles.	
Environmental Monitoring		

• Waste tracking.	
Record Keeping	
• Vessel contractor pre-qualification report/s. • GMP. • Garbage Record Book. • Crew induction and attendance records.	• Inspection records/checklists. • Shore-based waste contract. • Incident reports.

7.11 RISK 2– Vessel Collision with Megafauna

7.11.1 Hazard

The movement of the geotechnical vessel throughout the activity area, together with the presence of in-water equipment, has the potential to result in collision or entanglement with megafauna, this being cetaceans and turtles.

7.11.2 Potential Environmental Risks

The risks of vessel strike with megafauna are:

- Injury; and
- Death.

7.11.3 EMBA

The EMBA for vessel strike or entanglement with megafauna is the immediate area around the vessel and deployed equipment.

7.11.4 Evaluation of Environmental Risks

Cetaceans are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly ‘bow ride’ with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al*., 1995).

Peel et al (2016) reviewed vessel strike data (2000-2015) for marine species in Australian waters and identified the following:

- Whales including the humpback, pygmy blue, fin, bryde’s, pygmy, sperm, and pygmy sperm were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction. A number of these species may migrate through the waters of the activity area (see Section 5.3.5).
- Dolphins including the Australian humpback, common bottlenose and Risso’s dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. A number of these species may reside in or pass through the waters of the activity area (see Section 5.3.5).
- All turtle species present in Australian waters are identified as interacting with vessels. The green and loggerhead species exhibited the highest incident of interaction. The presence of turtles in the activity area and EMBA is considered likely.

Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde's whale in Bass Strait in 1992), though the data indicates this is more likely to be associated with container ships and fast ferries (WDCS, 2006). Some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (WDCS, 2006). The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with an animal (species not defined) (NMSC, 2010).

The DoE (2015a) reports that there were two blue whale strandings in the Bonney Upwelling (western Victoria) with suspected ship strike injuries visible. When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise 'footprint' will alert cetaceans to its presence and thus elicit avoidance. Laist et al (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots. When the vessel is operating within the activity area, it will be travelling very slowly or will be stationery, so the risk associated with fast moving vessels is eliminated for this activity.

The Conservation Management Plan for the Blue Whale (DoE, 2015a) lists entanglement as a threat to the species. Entanglement has the potential to cause physical injury that can result in loss of reproductive fitness, and mortality of individuals from drowning, impaired foraging and associated starvation, or infection or physical trauma (DoE, 2015a). These wounds can then expose the animal to infection and entanglement can also result in amputation (e.g., of a flipper or tail fluke), and death over a prolonged period. An assessment of the relevant management actions listed in this Conservation Management Plan against the activity is provided in Table 7.22. Though the specific management action targets commercial fisheries, the intent of the management actions has been applied to the activity.

The Conservation Management Plan for the Blue Whale (DoE, 2015a) lists vessel disturbance in the form of collisions to be a threat that may inhibit the recovery of the species. Entanglement (in the context of fishing nets, lines or ropes) has the potential to cause physical injury that can result in loss of reproductive fitness, and mortality of individuals from drowning, impaired foraging and associated starvation, or infection or physical trauma. There is an almost negligible risk of this occurring to megafauna with towed equipment as the equipment is likely to break under the weight of entanglement. An assessment of the relevant management actions listed in the Conservation Management Plan against the activity is provided in Table 7.22.

Table 7.22 Assessment of Vessel Collision against the Conservation Management Plan for the Blue Whale (DoE, 2015a)

Management Action	Assessment
Relevant Interim Recovery Objectives	
4. Anthropogenic threats are demonstrably minimised.	Vessel disturbance in the form of collision is a threat to blue whales. The EPS listed in Table 7.27 will reduce the likelihood of vessel strike with blue whales to ALARP. Therefore, the activity will be managed in a manner that is not inconsistent with this interim recovery objective.
Relevant Interim Recovery Objective Targets	
Target 4.1: robust and adaptive management regimes leading to a reduction in anthropogenic threats to Australian blue whales are in place.	The EPS listed in Table 7.27 represent a robust and adaptive management regime for the activity with regard to blue whales. This results in a significant reduction in anthropogenic threats generated by the activity on blue whales. Therefore, the activity will be managed in a manner that is not inconsistent with this interim objective target.

Management Action	Assessment
Target 4.2: management decisions are supported by high quality information and high priority research projects identified in this plan are achieved or underway.	The information presented throughout this section and the subsequent EIA presented in Table 7.27 is based on high quality information, scientific literature and research projects. This in turn has informed the management decisions relevant to the activity. Therefore, the activity will be managed in a manner that is not inconsistent with this interim objective target.
Relevant Action Areas	
A.4. Minimising vessel collisions	The control measures adopted and associated EPS listed in Table 7.27 will reduce the likelihood of vessel strike with blue whales to ALARP. With control measures implemented, the activity will be managed in a manner that is not inconsistent with this management action.
Relevant Actions	
2. Ensure all vessel strike incidents are reported in the National Ship Strike Database.	Reporting of vessel strike incidents has been adopted for this activity and an appropriate EPS developed in Table 7.27. Therefore, the activity will be consistent with this action.
3. Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	This section of the EP provides an assessment of vessel strike risk and EPS have been adopted for the activity in Table 7.27. Therefore, the activity will be consistent with this action.

The Approved Conservation Advice for the Sei Whale (TSSC, 2015b) lists vessel strike as a threat with a minor consequence rating. An assessment of the listed management actions with the activity is provided in Table 7.23.

Table 7.23 Assessment of Vessel Collision against the Approved Conservation Advice for the Sei Whale (TSSC, 2015b)

Management Action	Assessment
Ensure all vessel strike incidents are reported in the National Vessel Strike Database.	Reporting of vessel strike incidents has been adopted as a control measure for this activity and an appropriate EPS developed in Table 7.27. Therefore, the activity will be consistent with this action.

The Approved Conservation Advice for the Fin Whale (TSSC, 2015c) lists vessel strike as a threat with a minor consequence rating. An assessment of the listed management actions with the activity is provided in Table 7.24.

Table 7.24 Assessment of Vessel Collision against the Approved Conservation Advice for the Fin Whale (TSSC, 2015c)

Management Action	Assessment
Ensure all vessel strike incidents are reported in the National Vessel Strike Database.	Reporting of vessel strike incidents has been adopted as a control measure for this activity and an appropriate

Management Action	Assessment
	EPS developed in Table 7.27. Therefore, the activity will be consistent with this action.

Table 7.25 provides an assessment of the objectives and relevant management actions of the National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna (DoEE, 2017a) with the activity.

Table 7.25 Assessment of Vessel Collision against the National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna (DoEE, 2017a)

Relevant Objectives and Management Actions	Assessment
Relevant objectives	
Reduce the likelihood and severity of megafauna vessel collision.	The adopted EPS listed in Table 7.27 are aligned with best-practice mitigation measures, which will reduce the likelihood of vessel strike with megafauna to ALARP. Therefore, the activity will be consistent with this objective.
Identify and adopt best-practice mitigation measures and emerging technologies, and encourage the development of new mitigation measures.	
Management actions	
Develop a mitigation measures toolkit that provides guidance to stakeholders and managers on what measures are most suited to specific locations, species and vessel types.	The adopted EPS listed in Table 7.27 will reduce the likelihood of vessel strike with cetaceans to ALARP. Therefore, the activity will be consistent with these actions.
Develop and implement vessel strike management plans which identify appropriate mitigation measures in locations where the relative risk of vessel strike is higher, as determined by a risk assessment.	
Adaptive management principles, including the use of regular reviews are used during the implementation of mitigation measures.	

The Recovery Plan for Marine Turtles in Australia lists entanglement in marine debris as a threat that can lead to restricted mobility, starvation, infection, amputation and drowning (DoEE, 2017c). Table 7.26 presents an assessment of the relevant objectives and targets of the Recovery Plan for Marine Turtles in Australia with the activity.

Table 7.26 Assessment of Vessel Collision against the Recovery Plan for Marine Turtles 2017-2027 (DoEE, 2017c)

Interim Objective or Target	Assessment
Interim Objective 3: Anthropogenic threats are demonstrably minimised.	
Target 3.1: Robust and adaptive management regimes that lead to a reduction in anthropogenic threats to marine turtles and their habitats are in place	The EPS listed in Table 7.27 will reduce the likelihood of vessel strike with cetaceans to ALARP and ensure the activity is conducted in a manner that is not inconsistent with this recovery target.
Target 3.2: Threat mitigation strategies are supported by high quality information	The activity will not have any impacts on this recovery target.

7.11.5 Risk Assessment

Table 7.27 presents the risk assessment for vessel collision or entanglement with megafauna.

Table 7.27 Risk assessment for vessel collision with megafauna

Summary		
Summary of risks	Injury or death of megafauna.	
Extent of risks	Localised – limited to individuals coming into contact with the vessel or towed/in-water equipment.	
Duration of risks	Temporary (if individual animal dies or has a minor injury) to long-term (if there is a serious injury).	
Level of certainty of risk	HIGH – injury may result in the reduced ability to swim and forage. Serious injury may result in death.	
Risk decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	No collision or entanglement with megafauna.	

Risk Assessment (inherent)		
Likelihood	Consequence	Risk rating
Occasional	Minor	Low

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Eliminate the use of vessels and in-water equipment.	Eliminate	No	**EB:** Eliminates the potential collision hazard. **C:** The activity could not proceed. **Ev:** The use of vessels and in-water equipment is the only way in which the activity can proceed. The cost of not using it is the cost of not fulfilling exploration obligations associated with the exploration permit and potential future lost hydrocarbon production.
No night-time/low visibility operations.	Eliminate	No	**EB:** Reduces the likelihood of collision or entanglement with megafauna. **C:** Doubles the length of time required to complete the activity and subsequent costs, resulting in increased impacts and risks in other areas such as more routine discharges, greater collision risk due to additional time spent on-water, etc).

			Ev: Cost outweighs the environmental benefit given the low residual risk to marine megafauna populations.
Australian National Guidelines for Whale and Dolphin Watching (2017) **(RSK-02: EPS-01).**	Administrative	Yes	**EB:** Observation for megafauna reduces likelihood for potential collision or entanglement through directing the Vessel Master to slow down or move away to avoid megafauna. **C:** No additional cost for vessel crew to implement this control measure. **Ev:** Environmental benefits outweigh the costs.
Environmental induction **(RSK-02: EPS-02).**	Administrative	Yes	**EB:** Ensures personnel are aware of obligations, which in turn reduces the risk of interactions with megafauna. **C:** Negligible; it is a standard on-water requirement. Minor administrative cost to prepare induction and roll out to crew. **E:** Environmental benefit outweighs cost.
Implement procedure for interacting with marine fauna (EPBC Regulations Part 8) **(RSK-02: EPS-03).**	Administrative	Yes	**EB:** Reduce the likelihood of impacts to cetaceans. **C:** No additional costs to the activity. **Ev:** Environmental benefits outweigh the cost to implement.
Notification and reporting of collisions with megafauna **(RSK-02: EPS-04, -05).**	Administrative	Yes	**EB:** Reduces risk of physical impacts to cetaceans from the activity vessels. **C:** No additional costs. **Ev:** Environmental benefit can be achieved without costs.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
No collision or entanglement with megafauna.	**(RSK-02: EPS-01)** Through constant bridge watch, vessels comply with the *Australian National Guidelines for Whale and Dolphin Watching for Vessels* (DoEE, 2017) when working within the activity area. This means: • Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone. • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod/group. • Do not encourage bow riding. • If animals are bow riding, do not change course or speed suddenly. • If there is a need to stop, reduce speed gradually.	Daily operations reports note when cetaceans and pinnipeds were sighted and what actions were taken to avoid collision or entanglement.

	(RSK-03: EPS-02) Vessel crew has completed an environmental induction covering the above-listed requirements for vessel and megafauna interactions.	Induction and attendance records verify that all crews have completed an environmental induction.
	(RSK-02: EPS-03) Vessel crew undertake observation for megafauna during daylight hours and record all interactions.	Daily operations reports note megafauna interactions.
Vessel strike or entanglement is reported to regulatory authorities.	**(RSK-02: EPS-04)** Vessel strike causing injury to or death of a cetacean is reported to the DCCEEW via the online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike) within 72 hours of the incident.	Electronic record of report submittal is available.
		Incident report is available within the OMS.
	(RSK-02: EPS-05) Entanglement of megafauna is reported to the Wildcare Helpline on (08) 9474 9055 (for cetaceans travelling towards WA) or the Marine Wild Watch Hotline on 1800 453 941 (for cetaceans travelling towards the NT) as soon as possible. No attempts to disentangle megafauna should be made by vessel crew.	Incident report verifies contact was made with the Wildcare Helpline or Marine Wild Watch Hotline.

Risk Assessment (residual)		
Likelihood	Consequence	Risk rating
Rare	Minor	Negligible

The risk of vessel strike or entanglement with megafauna is assessed as negligible because:

- The activity is temporary in nature;
- The activity is not a known aggregation area or key migration route for megafauna; and
- Implementation of the EPS will reduce the likelihood of vessel collision or entanglement with megafauna to ALARP.

Demonstration of ALARP

A ‘negligible’ residual risk rating is considered to be ALARP and a ‘lower order’ impact. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.

Demonstration of Acceptability	
Policy compliance	EOG’s Safety and Environmental Policy objectives are met.
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.
Risk matrix standard compliance	The residual risk is negligible, which is considered acceptable.
Engagement	No objections or claims have been raised by relevant persons regarding vessel strike or entanglement with megafauna.

<table>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
• EPBC Act 1999 (Cth):
  ○ Section 199 (failing to notify taking of listed species or listed ecological community).
• EPBC Regulations 2000 (Cth):
  ○ Part 8 (Interacting with cetaceans and whale watching).
  ○ AMSA Marine Notice 2016/15 – Minimising the risk of collisions with cetaceans.</td></tr>
<tr><td rowspan="9">Industry practice</td><td colspan="2">The consideration and alignment of EPS with the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented for this activity</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this activity are in line with the management measures listed for collision with marine fauna in Section 4.7.5 of the guidelines:
• Monitoring for the presence and movement of large cetaceans and pinnipeds so that avoidance can be taken when marine fauna is observed to be on a collision course with vessels (RSK-02: EPS-03).</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines for offshore activities with regard to minimising the risk of collisions with megafauna.</td></tr>
<tr><td>Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)</td><td>Not applicable. The guidelines do not discuss the impacts of vessel strike or entanglement on marine life.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>There are no guidelines regarding minimising the risk of vessel strike or entanglement with megafauna.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS for this activity meet the code's following objectives:
• To reduce the risks to the abundance, diversity, geographical spread and productivity of marine species to ALARP and to an acceptable level (all RSK-02 EPS).</td></tr>
<tr><td colspan="2">Megafauna collision-specific</td></tr>
<tr><td>The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017b)</td><td>The EPS listed in this table are aligned with the requirements of these guidelines.</td></tr>
<tr><td>National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017a).</td><td>The EPS listed in this table are aligned with objective 3 of this strategy, which is to reduce the likelihood and severity of megafauna vessel collisions.</td></tr>
</table>

Environmental context	MNES	
	AMPs	The risk of collisions with megafauna does not have any effect on nearby AMPs.
	Ramsar wetlands	The risk of collisions with megafauna does not have any effect on Ramsar wetlands.
	TECs	The risk of collisions with megafauna does not have any effect on TECs.
	Nationally threatened and migratory species	The low speed of the vessel, along with the temporary nature of the activity, makes it unlikely that vessel strike or entanglement with megafauna will occur. The activity is not inconsistent with the relevant management actions of the: • Conservation Management Plan for the Blue Whale (DoE, 2015a); • Approved Conservation Advice for the Sei Whale (TSSC, 2015b); • Approved Conservation Advice for the Fin Whale (TSSC, 2015c); • Recovery Plan for Marine Turtles in Australia, DoEE, 2017c); and • National Strategy for Reducing Vessel Strike on Cetaceans and Other Marine Megafauna (DoEE, 2017a). The EPS adopted for the activity will reduce the likelihood of vessel collision to ALARP, thereby enabling the activity to be conducted in a manner that is not inconsistent with these plans.
	Other matters	
	KEFs	The risk of collisions with megafauna does not have any effect on KEFs.
	NIWs	The risk of collisions with megafauna does not have any effect on NIWs.
	State marine parks	The risk of collisions with megafauna does not have any effect on state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	Vessel collisions (and/or entanglements) are listed as a threat to cetaceans in the: • Conservation Management Plan for the Blue Whale (DoE, 2015a); • Conservation advice for the sei whale (TSSC, 2015b); • Conservation advice for the fin whale (TSSC, 2015c); and The EPS listed in this table aim to minimise the risk of vessel strike with megafauna. The activity is not inconsistent with the relevant management actions of these plans.

ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).
Defined acceptable level	EOG considers the risks of collision and entanglement with megafauna to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual risk rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • Accidentally discharged wastes will not have long-term or significant impacts on MNES; • The management of wastes is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of wastes is not inconsistent with the aims of relevant marine reserve management plans; and • The management of wastes is not inconsistent with ESD principles.
Environmental Monitoring	
• Vessel crew sightings.	
Record Keeping	
• Vessel crew induction presentation and attendance records. • Megafauna sighting records. • Incident reports.	

7.12 RISK 3 – Introduction and Establishment of Invasive Marine Species

7.12.1 Hazard

The DAWR (2018) defines marine pests (referred to in this EP as invasive marine species, IMS) as:

Non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment.

The following activities have the potential to result in the introduction of IMS in the activity area:

- Discharge of vessel ballast water containing foreign species; and
- Translocation of foreign species through biofouling on vessel hulls, niches (e.g., thruster tunnels, sea chests) or in-water equipment.

The vessel may ballast and de-ballast to improve stability, even out vessel stresses and adjust vessel draft, list and trim, with regard to the weight of equipment on board at any one time.

Biofouling is the accumulation of aquatic microorganisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWR, 2015).

The DAWR estimates that ballast water is responsible for 30% of all marine pest incursions into Australian waters (DAWR, 2018). The DAWR declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (AQIS, 2011), while DAWR (2018) notes that the movement of vessels and marine infrastructure is the primary pathway for the introduction of IMS.

7.12.2 Potential Environmental Risks

The risks of IMS introduction (assuming their survival, colonisation and spread) include:

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Depletion of commercial fish stocks (and associated socio-economic effects); and
- Changes to conservation values of protected areas.

7.12.3 EMBA

The EMBA for IMS introduction is anywhere within the activity area (wherever vessel movements occur), though if IMS survive the introduction and go on to colonise and spread, this EMBA could extend to large parts of the ocean.

Receptors most at risk within this EMBA, either as residents or migrants, are:

- Benthic fauna (because of their limited ability to move to other suitable areas);
- Benthic habitat; and
- Pelagic fish.

7.12.4 Evaluation of Environmental Risks

Successful IMS invasion requires the following three steps:

1. Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
2. Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., activity area).
3. Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

If successful invasion takes place, the IMS is likely to have little or no natural competition or predation, thus potentially outcompeting native species for food or space, preying on native species or changing the nature of the environment. It is estimated that approximately one in six introduced marine species becomes pests (AMSA, n.d).

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion (AMSA, n.d). For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries. Similarly, the ability of the New Zealand screw shell (*Maoricolpus roseus*) to reach densities of thousands of shells per square metre has presented problems for commercial scallop fishers (MESA, 2017). The ABC (2000) reported that the New Zealand screw shell is likely to displace similar related species of screw shells, several of which occupy the same depth range and sediment profile.

Marine pests can also damage marine and industrial infrastructure, such as encrusting jetties and marinas or blocking industrial water intake pipes. By building up on vessel hulls, they can slow the vessels down and increase fuel consumption.

The CoA (2009) states that the operational and maintenance needs of immersible seismic survey equipment (which is analogous to the immersible geotechnical equipment associated with this activity) means that they do not typically pose a threat for biofouling accumulation and translocation, though biofouling can be present in collar joints.

The Interactive Map for Marine Pests in Australia (DAFF, 2021) does not identify any known pests within the Port of Darwin. Given that this is the largest port of the region a likely staging ground for the activity, the likelihood of marine pest introduction from this port is low.

The National Strategic Plan for Marine Pest Biosecurity (2018-2023) (DAWR, 2018) has five objectives and associated management activities. An assessment of the objectives and management activities of the National Strategic Plan for Marine Pest Biosecurity (2018-2023) is provided in Table 7.28.

Table 7.28 Assessment against the National Strategic Plan for Marine Pest Biosecurity (2018-2023)

<table>
<tr><th>Objectives and Activities</th><th>Assessment</th></tr>
<tr><td>Objective 1: Minimise the risk of marine pest introductions, establishment and spread</td><td>The adopted EPS listed in Table 7.29 are aligned with best-practice mitigation measures, which will reduce the likelihood of introduction of IMS to ALARP. Therefore, the activity will be consistent with this objective.</td></tr>
<tr><td>1.1. Implement nationally consistent domestic ballast water regulations under the Biosecurity Act 2015 (Cwlth).</td><td rowspan="2">The adopted EPS listed in Table 7.29 are aligned with best-practice mitigation measures, which will reduce the likelihood of introduction of IMS to ALARP. Therefore, the activity will be consistent with these management activities.</td></tr>
<tr><td>1.2. Ensure the use of ballast water management systems in Australian waters meets accepted environmental standards.</td></tr>
<tr><td>1.3. Investigate regulatory options to manage biosecurity risks associated with biofouling on vessels.</td><td>The activity will not have any impact on this management activity.</td></tr>
<tr><td>1.4. Review the National Biofouling Management Guidelines for marine sectors and update as required.</td><td>The activity will not have any impact on this management activity.</td></tr>
<tr><td>1.5. Investigate the benefits of an intelligence-gathering framework to monitor marine pest risk pathways and expand the International Biosecurity Intelligence System as appropriate.</td><td>The activity will not have any impact on this management activity.</td></tr>
<tr><td>Objective 2: Strengthen the national marine pest surveillance system</td><td>The activity will not have any impact on this objective.</td></tr>
<tr><td>2.1. Develop a national marine pest surveillance strategy.</td><td>The activity will not have any impact on this management activity.</td></tr>
</table>

Objectives and Activities	Assessment
2.2. Investigate Australia's current passive surveillance capability for marine pests and recommend possible improvements.	The activity will not have any impact on this management activity.
2.3. Promote tailored education and awareness materials to engage marine pest observer groups in passive surveillance activities.	The activity will not have any impact on this management activity.
2.4. Develop validation guidelines for marine pest molecular detection methods.	The activity will not have any impact on this management activity.
2.5. Validate molecular detection methods (including sampling methodology) for selected high-priority marine pest species.	The activity will not have any impact on this management activity.
2.6. Audit, maintain and share a database of marine pest identification capability.	The activity will not have any impact on this management activity.
2.7. Review surveillance information management needs and ensure an appropriate information system is in place.	The activity will not have any impact on this management activity.
2.8. Perform an audit of marine pest surveillance activities and data sets relevant to Australia.	The activity will not have any impact on this management activity.
Objective 3: Enhance Australia's preparedness and response capability for marine pest introductions	The activity will not have any impact on this objective.
3.1. Plan and implement a national program of marine pest emergency response exercises.	The activity will not have any impact on this management activity.
3.2. Develop a benefit–cost analysis framework to guide response efforts in the event of a nationally significant marine pest incursion.	The activity will not have any impact on this management activity.
3.3. Identify marine pest emergency response training needs.	The activity will not have any impact on this management activity.
3.4. Review the national Emergency Marine Pest Plan (EMP Plan) framework.	The activity will not have any impact on this management activity.
3.5. Plan and implement procedures to develop and update the EMP Plan rapid response manuals and related guidance materials.	The activity will not have any impact on this management activity.
Objective 4: Support marine pest biosecurity research and development	The activity will not have any impact on this objective.
4.1. Periodically review the national marine pest biosecurity research and development priorities.	The activity will not have any impact on this management activity.

Objectives and Activities	Assessment
4.2. Promote research coordination through the national marine pest research network.	The activity will not have any impact on this management activity.
4.3. Review the economic, environmental and social impacts of marine pests in Australia.	The activity will not have any impact on this management activity.
4.4. Conduct risk analyses of marine pest vectors and pathways, and make recommendations for improved management.	The activity will not have any impact on this management activity.
4.5. Assess the effectiveness of current management options for biofouling in niche areas.	The activity will not have any impact on this management activity.
Objective 5: Engage stakeholders to better manage marine pest biosecurity	The activity will not have any impact on this objective.
5.1. Identify and build a profile of marine pest biosecurity stakeholders.	The activity will not have any impact on this management activity.
5.2 Develop a national stakeholder engagement strategy for MarinePestPlan 2018–2023 and the Marine Pest Sectoral Committee.	The activity will not have any impact on this management activity.
5.3. Design a targeted national campaign to improve awareness of marine pest biosecurity risks, management actions and shared responsibilities.	The activity will not have any impact on this management activity.
5.4. Review, update and maintain the www.marinepests.gov.au website.	The activity will not have any impact on this management activity.
5.5. Establish an independent national marine pest network.	The activity will not have any impact on this management activity.

7.12.5 Risk Assessment

Table 7.29 presents the risk assessment for the introduction of IMS.

Table 7.29 Risk assessment for the introduction of IMS

Summary	
Summary of risks	Reduction in native marine species diversity and abundance, displacement of native marine species, socioeconomic impacts on commercial fisheries and changes to conservation values of protected areas.
Extent of risk	Localised (isolated locations if there is no spread) to widespread (if colonisation and spread occurs).
Duration of risk	Short-term (IMS is detected and eradicated, or IMS does not survive long enough to colonise and spread) to long-term (IMS colonises and spreads).

<table>
<tr><td>Level of certainty of risk</td><td colspan="3">HIGH – the impacts associated with IMS introduction are well known and the vectors of introduction are known. Regulatory guidelines controlling these vectors have been established.</td></tr>
<tr><td rowspan="4">Risk decision framework context</td><td>Decision type</td><td colspan="2">A - good industry practice required.</td></tr>
<tr><td>Activity</td><td colspan="2">Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.</td></tr>
<tr><td>Risk & uncertainty</td><td colspan="2">Risks are well understood, uncertainty is minimal.</td></tr>
<tr><td>Stakeholder influence</td><td colspan="2">No conflict with company values, no partner interest, no significant media interest.</td></tr>
<tr><td>Defined acceptable level</td><td colspan="3">No introduction of IMS.</td></tr>
<tr><th colspan="4">Risk Assessment (inherent)</th></tr>
<tr><th>Likelihood</th><th colspan="2">Consequence</th><th>Risk rating</th></tr>
<tr><td>Rare</td><td colspan="2">Minor</td><td>Negligible</td></tr>
<tr><th colspan="4">Assessment of Proposed Control Measures</th></tr>
<tr><th>Control measure</th><th>Control type</th><th>Adopt</th><th>Justification</th></tr>
<tr><td>Use only a locally sourced vessel for the geotechnical investigations.</td><td>Elimination</td><td>No</td><td>EB: Eliminates the potential for introduction of IMS from foreign waters.
C: Significant limitation on the activity. There are no specialist geotechnical vessels based in Australia, so vessels must be sourced opportunistically if they are in-country when required, or else internationally (e.g., southeast Asia). Where possible, a vessel can be contracted once it has completed another activity in Australian waters, thereby minimising IMS risks. However, this cannot be guaranteed.
Ev: There are significant implications for the activity by restricting the choice of vessel. The cost to implement is disproportionate to the risk if other controls are adopted.</td></tr>
<tr><td>International Anti-fouling System (IAFS) Certificate
(RSK-03: EPS-02).</td><td>Engineering</td><td>Yes</td><td>EB: Ensures that the activity vessels have an anti-fouling coating and associated certificate to reduce the likelihood of transfer of IMS from the hull to the activity area.
C: Significant cost to vessel contractor to have the vessel inspected and anti-fouling paint applied (generally every 5 years). Cost is passed on to EOG via vessel day rate.
Ev: Environmental benefit outweighs the cost.</td></tr>
</table>

Biofouling Management Plan and Biofouling Record Book **(RSK-03: EPS-01, -03).**	Administrative	Yes	**EB:** Provides for operational guidance to vessels for planning and actions required to manage vessel biofouling, in addition to outlining measures for the control and management of vessel biofouling in accordance with IMO Guidelines. Thereby reducing the likelihood of IMS transfer and establishment in the activity area. **C:** Small cost involved with personnel undertaking inspections and audits. **Ev:** Environmental benefit outweighs the cost.
IMS risk assessment **(RSK-03: EPS-04).**	Administrative	Yes	**EB:** Reduces the likelihood of introducing IMS. **C:** Small cost involved with EOG's consultants and contractors undertaking this desktop assessment. **Ev:** Environmental benefit outweighs the cost.
Cleaning of immersible equipment **(RSK-03: EPS-05).**	Administrative	Yes	**EB:** Reduces the likelihood of introducing IMS. **C:** Small cost involved in cleaning and verification during inspection. **Ev:** Environmental benefit outweighs cost.
Ballast water management plan. **(RSK-03: EPS-06, -07).**	Administrative	Yes	**EB:** Reduces likelihood of introducing IMS. **C:** Small costs associated with preparing and implementing the ballast water management plan and with maintaining record books and logs. **Ev:** Environmental benefit outweighs cost.
Incident reporting **(RSK-04: EPS-08).**	Administrative	Yes	**EB:** Alerts authorities to the known or potential introduction of IMS, thereby allowing authorities to deal with (or remove) the threat early so as to minimise environmental impacts. **C:** No cost. **Ev:** Environmental benefit outweighs the cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Biofouling		
No introduction of IMS through hull fouling.	**(RSK-03: EPS-01)** Vessel is managed in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (AQIS, 2009) and the to ensure they present a low biofouling risk. This means: • Biofouling risk is assessed. • Conducting in-water inspection by divers or inspection in drydock if deemed necessary (based on risk assessment). • Cleaning of hull and internal seawater systems, if deemed necessary. • Anti-fouling coating status taken into account, with antifouling renewal undertaken if deemed necessary.	Biofouling assessment report prior to mobilising to site confirms acceptability to enter the activity area.

	(RSK-03: EPS-02) The vessel will possess a current IAFS Certificate that is complaint with Marine Order Part 98 (Anti-fouling Systems).	IAFS Certificate is available and current.
	(RSK-03: EPS-03) The vessel is managed in accordance with the *Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species* (IMO, 2011), which involves ensuring that it: • Maintains a Biofouling Management Plan; • Maintains a Biofouling Record Book; • Installs and maintain an anti-fouling system; • Undertakes in-water inspections (and in-water hull cleaning, if appropriate); and • Instructs crews on the application of biofouling management procedures.	Vessel contractor Biofouling Management Plan and Biofouling Record Book are available and current.
	(RSK-03: EPS-04) An IMS risk assessment is undertaken based on the following: • Inspecting the IAFS certificate to ensure currency. • Reviewing recent vessel inspection/audit reports to ensure that the risk of IMS introduction is low. • Reviewing recent ports of call to determine the IMS risk of those ports. • Determining the need for in-water cleaning and/or re-application of anti-fouling paint if neither has been done recently in line with anti-fouling and in-water cleaning guidelines (DoA/DoE, 2015). • Implementing the biofouling guidance provided in Part 5 of the Offshore Installation Biosecurity Guideline (DAWR, 2019, v1.3).	IMS risk assessment document verifies that the biofouling risk evaluation took place and that the IMS risk is 'low.'
Immersible equipment does not introduce IMS to the activity area.	**(RSK-03: EPS-05)** Immersible equipment is cleaned (e.g., biofouling is removed from geotechnical equipment) prior to initial use in the activity area.	Records are available to verify that immersible equipment was cleaned prior to use.
Ballast water		
No introduction of IMS through ballast water.	**(RSK-03: EPS-06)** Vessels fulfil the requirements of the *Australian Ballast Water Management Requirements* (DAWR, 2020, v8). This includes requirements to: • Carry a valid Ballast Water Management Plan (BWMP).	BWMP is available and current. BWR (or exemption) is submitted prior to entry to the activity area. A valid BWMC is in place.

<table>
<tr><td rowspan="3"></td><td rowspan="2">• Submit a Ballast Water Report (BWR) through the Maritime Arrivals Reporting System (MARS).
o If intending to discharge internationally-sourced ballast water, submit BWR through MARS at least 12 hours prior to arrival.
o If intending to discharge Australian-sourced ballast water, seek a low-risk exemption through MARS.
• Hold a Ballast Water Management Certificate (BWMC).
• Ensure all ballast water exchange operations are recorded in a Ballast Water Record System (BWRS).</td><td>An up-to-date BWRS is in place.</td></tr>
<tr><td>An electronic Pre-Arrival Report (ePAR) is available and signed off by DAWR.</td></tr>
<tr><td>(RSK-03: EPS-07) As above, except a BWR is not required for domestic journeys (i.e., when moving between Australian ports and 200 nm of the coastline).
Note: ballast water management is not required between Australian ports if:
• Ballast water is taken up and discharged in the same place.
• Potable water is used as ballast.
• Ballast water was taken up on the high seas only.
• The vessel receives a risk-based exemption from ballast water management.</td><td>As above, except for the BWR.</td></tr>
<tr><td colspan="3">Reporting</td></tr>
<tr><td>Known or suspected non-compliance with biosecurity measures are reported to regulatory agencies.</td><td>(RSK-03: EPS-08) Non-compliant discharges of domestic ballast water are to be reported to the DAWR immediately (contact details in Section 8.7.2).</td><td>Incident report notes that contact was made with the DAWR regarding non-compliant ballast water discharges.</td></tr>
</table>

<table>
<tr><th colspan="3">Risk Assessment (residual)</th></tr>
<tr><td>Likelihood</td><td>Consequence</td><td>Risk rating</td></tr>
<tr><td>Remote</td><td>Minor</td><td>Negligible</td></tr>
<tr><td colspan="3">The risk of the introduction and establishment of IMS is assessed as negligible because:
• The control measures adopted are effective in reducing the risk to ALARP.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘negligible’ residual risk rating is considered to be ALARP and a ‘lower order’ impact. The adopted EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.</td></tr>
</table>

<table>
<tr><th colspan="2">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td>EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>OEMS compliance</td><td>Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
</table>

<table>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual risk is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">No objections or claims have been raised by relevant persons regarding the introduction and establishment of IMS.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS align with the requirements of:
• Biosecurity Act 2015 (Cth):
○ Chapter 4 (Managing biosecurity risk).
○ Chapter 5, Part 3 (Management of discharge of ballast water).
• Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Cth):
○ Part 2 (Application or use of harmful anti-fouling systems).
○ Part 3 (Anti-fouling certificates and anti-fouling declarations).
○ Marine Order 98 (Marine pollution – anti-fouling systems).</td></tr>
<tr><td rowspan="6">Industry practice</td><td colspan="2">The consideration and alignment of EPS to the mitigation measures outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this activity are in line with the management measures listed for the introduction of IMS in Section 4.7.6 of the guidelines:
• Complying with the International Convention on the Control of Harmful Anti-fouling Systems on Ships (RSK-03: EPS-02).
• Ensuring vessels of appropriate class have IAFS certificates (RSK-03: EPS-02).
• Ensuring compliance with local regulatory guidelines.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines for offshore activities with regard to minimising the risk of introducing IMS.</td></tr>
<tr><td>Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)</td><td>Not applicable. The guidelines do not discuss the impacts of sound generation on marine life.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>There are no guidelines regarding preventing the introduction of IMS.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS for this activity meet the code’s following objectives:
• To reduce the risk of introduction of marine pests to ALARP and to an acceptable level (All RSK-03 EPS).
• To reduce the impacts to benthic communities to ALARP and to an acceptable level.</td></tr>
</table>

	IMS-specific	
	Australian Ballast Water Management Requirements (DAWR, 2020, v8)	The EPS in this table reflect the guidance regarding ballast water management in the DAWR guide.
	Anti-Fouling and In-Water Cleaning Guidelines (DoA/DoE, 2015).	The EPS in this table reflect the general guidance regarding managing fouling in the DoA/DoE guidelines, which have since been updated in the aforementioned DAWR (2020) quarantine guide.
	Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species (IMO, 2011)	The EPS in this table reflect the guidance regarding minimising the transfer of IMS from biofouling.
	National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (DAFF, 2009)	The EPS in this table reflect the guidance regarding biofouling management in the DAFF guide.
Environmental context	MNES	
	AMPs	The North Marine Parks Network Management Plan 2018 (DNP, 2018) identifies invasive species introduction via ballast water in shipping, fishing vessels and other vessels as a potential biosecurity pressure to the AMP network. The implementation of the EPS makes it unlikely that IMS will be introduced to the activity area and spread to nearby AMPs.
	Ramsar wetlands	The risk of introducing IMS is highly unlikely to affect Ramsar wetlands.
	TECs	The risk of introducing IMS is highly unlikely to affect TECs.
	Nationally threatened and migratory species	The threatened and migratory species within the EMBA are all highly mobile species. There are no EPBC Act-listed benthic species listed as occurring in the activity area; these are generally more susceptible to the effects of IMS than mobile fauna.
	Other matters	
	KEFs	The risk of introducing IMS is highly unlikely to affect KEFs.
	NIWs	The risk of introducing IMS is highly unlikely to affect NIWs.
	State marine parks	This hazard does not intersect any state marine parks.

	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	The National Strategic Plan for Marine Pest Biosecurity (2018-2023) (DAWR, 2018) has five objectives. The EPS listed in this table are aligned with the plan's objective to minimise the risk of marine pest introductions, establishment and spread (noting that the other four objectives do not apply to the activity).
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
	Is there a threat of serious or irreversible environmental damage?	Possibly, but the EPS aim to avoid this.
	Is there scientific uncertainty as to the environmental damage?	Yes. Individual species fill different ecological niches and understanding how one or more species are likely to behave outside their native habitat is generally unknown until it occurs.
Statement of acceptability	EOG considers the risks of introducing IMS to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual risk rating is negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; • Relevant legislation and industry best practice will be complied with; • The management of IMS is not inconsistent with the aims of the National Strategic Plan for Marine Pest Biosecurity; and • The management of IMS is not inconsistent with ESD principles.	
Environmental Monitoring		
• None required.		
Record Keeping		
• Vessel contractor pre-qualification reports. • Biofouling risk assessment. • Ballast water risk assessments. • BWMP. • BWR.	• BWMC. • BWRS. • IAFS Certificates. • DAWR-signed ePARs.	

7.13 RISK 4 – Interference with Other Marine Users

7.13.1 Hazard

The presence of the geotechnical vessel may result in unplanned interference with other marine users and equipment, such as commercial fishing gear and merchant shipping.

7.13.2 Known and Potential Environmental Impacts

The known and potential impacts of interference with other marine users are:

- Collision potential with third-party vessels (and damage in the case of collision); and
- Damage to or loss of fishing equipment and/or loss of commercial fish catches.

7.13.3 EMBA

The EMBA for interference with other marine users is anywhere within the activity area (wherever vessel movements occur), and more specifically the immediate around the two intersecting vessels or equipment.

Receptors in the EMBA include:

- Recreational vessels;
- Commercial fishing vessels; and
- Merchant vessels.

7.13.4 Evaluation of Environmental Impacts

Collision with other marine users

Interference between the geotechnical vessel and other marine users is unlikely, mostly because of the low shipping traffic in and around the activity area (see Section 7.2 and Section 5.6.6), consultation undertaken prior to the activity with relevant persons, implementation of a safety zone around the vessel, the slow-moving nature of the vessel and its high visibility.

In the event of interference with other marine users that results in a vessel-to-vessel collision, health and safety impacts are more likely than environmental impacts. Should the force of a collision be enough to breach a vessel hull, an MDO spill may eventuate (the environmental consequences of which are addressed in Section 7.15).

Damage to or loss of fishing equipment

Interference from the geotechnical vessel undertaking and commercial fishing vessels is unlikely, for the same reasons stated above.

As such, it is unlikely that fishing gear (e.g., trawl nets used in the NPF, marker buoys and ropes for demersal fishing gear) would be damaged. In the event that third-party vessels breach the safety zone around by the vessel, there is potential for fishing gear to become entangled in the deployed geotechnical equipment, resulting in damage or loss. In addition to the cost of repairing or replacing this equipment, it could also result in the loss of income from caught fish during that fishing expedition.

7.13.5 Risk Assessment

Table 7.30 presents the impact assessment for interference with other marine users.

Table 7.30 Risk assessment for interference with other marine users

Summary	
Summary of risks	Presence of vessel (and associated equipment) potentially resulting in vessel-to-vessel collision, damage to or loss of fishing equipment and loss of commercial fish catches.
Extent of risks	Highly localised (immediately around vessel).
Duration of risks	Short-term (minutes for a third-party vessel detour) to long-term (vessel collision).
Level of certainty of risks	HIGH – the impacts associated with interference with other marine users is well understood.

Risk decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	No interference with other marine users.	

Impact Consequence (inherent)		
Likelihood	Consequence	Risk rating
Occasional	Minor	Low

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Exclusion (Safety) zone **(RSK-04: EPS-01).**	Engineering	Yes	**EB:** Prevents damage to the vessel's towed/in-water equipment and the other party's equipment. **C:** Minimal cost to prepare and issue notices to marine users. **Ev:** Benefits to safety for all parties outweighs the minimal costs.
Navigation equipment and procedures **(RSK-04: EPS-02, -05, -06, -10).**	Engineering	Yes	**EB:** Reduces the risk of collisions with other marine users. **C:** While the costs of navigation equipment are significant, it is standard on vessels and the costs of maintaining it are minimal. It is a requirement of maritime law. **Ev:** The safety benefits of having navigation equipment and procedures outweighs the cost.
Constant bridge watch **(RSK-04: EPS-03).**	Administrative	Yes	**EB:** Reduces the risk of collisions with other marine users or their equipment (e.g., marker buoys). **C:** No additional cost. **Ev:** Environmental benefits can be achieved with no additional cost.
Crew qualifications **(RSK-04: EPS-04).**	Administrative	Yes	**EB:** Reduces the risk of vessel collision by ensuring crew possess appropriate qualifications to operate the vessel. **C:** Negligible; it is a standard maritime requirement that crew possess such qualifications. **Ev:** Environmental benefits can be achieved with negligible additional cost.

Stakeholder notifications **(RSK-04: EPS-07, -11, -12).**	Administrative	Yes	**EB:** Ensures other marine users are aware of the activity and thus reduces likelihood of collision and interference. **C:** Minimal costs associated with EOG personnel preparing and issuing notifications and responding to stakeholders. **Ev:** Benefits outweigh the minimal cost.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
The EPS listed in 'displacement of other marine users' (see Section 7.2) also apply to this risk. Additional controls are provided here.		
No incidents or complaints of spatial conflict with third-party vessels or fishing equipment.	**(RSK-04: EPS-01)** An exclusion zone around the vessel is established for the duration of the activity and communicated to other marine users.	NTM is issued prior to the activity and includes details of the safety exclusion zone.
	(RSK-04: EPS-02) The vessel is readily identifiable to third-party vessels.	Visual inspection (and associated completed checklists) verify that the anti-collision monitoring equipment (e.g., 24-hour radar watch, GMDSS and Automatic Identification System [AIS]) is functional and in use.
	(RSK-04: EPS-03) Visual and radar watch is maintained on the bridge of the vessel at all times.	
	(RSK-04: EPS-04) The Vessel Master and deck officers have a valid SCTW certificate in accordance with AMSA Marine Order 70 (seafarer certification) (or equivalent) to operate radio equipment to warn of potential third party spatial conflicts (e.g., International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers [STCW95], GDMSS proficiency).	Appropriate qualifications are available.
	(RSK-04: EPS-05) The Vessel Master issues warnings (e.g., radio warning, flares, lights/horns) to third-party vessels approaching the safety exclusion zone in order to prevent a collision with the vessel and deployed equipment.	Radio operations communications log verifies that warnings to third-party vessels approaching the safety exclusion zone have been issued when necessary.
	(RSK-04: EPS-06) The vessel will display the appropriate lights and day shapes for a vessel with restricted ability to manoeuvre during activity operations.	Visual confirmation (and associated completed checklists) verifies that these measures are in place during activity start.
	(RSK-04: EPS-7) EOG notifies relevant persons ahead of the activity so that third-party marine users are aware of vessel location and timing.	Stakeholder correspondence verifies that EOG contacted relevant persons about the timing and location of the activity.

	(RSK-04: EPS-8) All incidents of spatial conflict with other marine users will be reported in the EOG incident register.	The incident register is current.
	(RSK-04: EPS-9) Fishing is prohibited from the geotechnical vessel.	Induction and attendance records verify that all crew members are aware of the commitment.
	(RSK-04: EPS-10) The geotechnical vessel will not be present in the activity area between 12 – 25 September 2022, as requested by the DoD.	Daily operations reports verify no activity during the specified dates.
Vessel-to-vessel collisions are managed in accordance with vessel-specific emergency procedures.	**(RSK-04: EPS-11)** The Vessel Master will sound the general alarm, manoeuvre the vessel to minimise the effects of the collision and implement all other measures as outlined in the vessel or structure collision procedure (or equivalent).	Incident report verifies that the relevant safety procedure was implemented.
	(RSK-04: EPS-12) Vessel collisions will be reported to AMSA if that collision has or is likely to affect the safety, operation or seaworthiness of the vessel or involves serious injury to personnel.	Incident report verifies that AMSA were notified of a vessel collision.

Impact Consequence (residual)		
Likelihood	Consequence	Risk rating
Rare	Minor	Negligible

The risk of interference with other marine users is assessed as negligible because:

- The activity will be temporary in nature;
- There is low shipping activity in and around the activity area;
- Thorough consultation has been undertaken with relevant persons to understand the risks and avoid potential interference; and
- The control measures adopted significantly reduce the likelihood of an incident of interference.

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' risk. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.

Demonstration of Acceptability	
Policy compliance	EOG's Safety and Environmental Policy objectives are met through implementation of this EP.
EMS compliance	Chapter 8 outlines the EP implementation strategy to be employed for this activity.
Risk matrix standard compliance	The residual risk is negligible, which is considered acceptable.
Engagement	As part of the consultation process, and in response to WAFIC's expectation of zero recreational fishing from any vessel, there will be no fishing permitted from

<table>
<tr><td></td><td colspan="2">vessels (RSK-04: EPS-09). In response to the DoD’s request to avoid possible conflict with a military exercise adjacent to the activity area, the geotechnical survey will not be present in the activity area between 12 – 25 September 2022 (RSK-04: EPS-10).</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS outlined in this table align with the requirements of:
OPGGS Act 2006 (Cth).
Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others).
Navigation Act 2012 (Cth).
Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions).
AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures).
AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment).
AMSA Marine Order Part 30 (Prevention of Collisions).</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and alignment of EPS with the mitigation measures outlined in the below-listed guidelines and codes of practice demonstrates that BPEM will be implemented for this activity</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this hazard are in line with the management measures listed for offshore physical presence in Section 4.3.1 of the guidelines, which include:
Develop exclusion zones in consultation with key stakeholders, including local fishing communities; raise awareness of exclusion zones with all stakeholders (RSK-04: EPS-01).
Issue a ‘Notice to Mariners’ through the relevant government agencies, detailing the area of operations (RSK-04: EPS-01).
Ensure all vessels adhere to International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels.
Optimise vessel use to ensure the number of vessels required and length of time that vessels are on site is as low as practicable.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines specifically regarding physical presence for offshore activities.</td></tr>
<tr><td>Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)</td><td>Not applicable. The guidelines do not discuss the risk of interference with other marine users.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for</td><td>There are no guidelines specifically regarding physical presence for activity vessels.</td></tr>
</table>

	Offshore Oil and Gas Development (World Bank Group, 2015)	
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the impact on other marine resource users to ALARP and to an acceptable level. • To reduce risks to public safety to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	This hazard will not affect nearby AMPs.
	Ramsar wetlands	This hazard will not affect any Ramsar wetlands.
	TECs	This hazard will not affect any TECs.
	Nationally threatened and migratory species	This hazard will not have any impacts on threatened or migratory species.
	Other matters	
	KEFs	This hazard will not affect any KEFs.
	NIWs	This hazard will not affect any NIWs.
	State marine parks	This hazard will not affect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the risk of interference with other marine users to be acceptable because: • It will adhere to the company's Safety & Environment Policy; • The residual consequence rating negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; and • Relevant legislation and industry best practice will be complied with.	
Environmental Monitoring		
• Continuous bridge monitoring.		
Record Keeping		
• Stakeholder communication records. • NTM. • Crew qualifications.	• Radio communication logs. • Incident reports. • Induction presentation and attendance sheets.	

7.14 RISK 5 - Damage to Subsea Infrastructure

7.14.1 Hazard

Eni's Blacktip gas pipeline is located approximately 5.5 km northeast of the activity area (Figure 5.54). There is no other known subsea infrastructure in the activity area (such as oil and gas wells and communications cables). The vessel and deployed geotechnical equipment may contact and damage the pipeline if:

- Freeboard (clearance between the pipeline and the vessel hull or equipment) is insufficient or drags across the pipeline; or
- The geotechnical equipment is deployed over the pipeline.

7.14.2 Potential Environmental Risks

The risks of damage to the Blacktip gas pipeline are:

- Loss of pipeline integrity (due to pipeline movement or reduction in wall thickness), which would be unlikely to lead to a loss of hydrocarbons.
- Disruption to commercial petroleum production activities (i.e., temporary suspension of production from any of the Blacktip wells).

7.14.3 EMBA

The EMBA for damage to the Blacktip pipeline is the pipeline itself. Receptors most at risk within this EMBA are:

- The pipeline infrastructure; and
- The geotechnical vessel.

7.14.4 Evaluation of Environmental Risks

The geotechnical investigations will take place over 5 km from the Blacktip pipeline. As such, the only way that borehole sampling, coring or grab sampling equipment could be deployed directly over the pipeline is due to a failure of the vessel positioning system. This is unlikely given the various redundancies in place to mitigate for such failures.

In the highly unlikely event that geotechnical equipment is deployed directly over the pipeline because all redundancies fail, there is a high likelihood that the pipeline would be damaged. If the damage is:

- Minor (i.e., does not rupture the pipeline, such as damage only to the concrete coating) – there is no environmental impact, but there would be financial impacts to Eni involved in repairing the pipeline (with costs being higher if it involves temporarily ceasing production in order to conduct those repairs). Damage to pipeline coating may hasten the corrosion of the steel pipeline.
- Major (i.e., involves pipeline rupture) – there is environmental impact associated with a gas and condensate release (this has not been modelled because it is not considered a credible scenario). The financial costs associated with pipeline rectification works and lost production from the Blacktip field would likely be several million dollars.

7.14.5 Risk Assessment

Table 7.31 presents the impact assessment for damage to third-party subsea infrastructure.

Table 7.31 Risk assessment for damage to subsea infrastructure

Summary		
Summary of risks	Loss of Blacktip gas pipeline integrity and lost field production.	
Extent of risks	Highly localised – immediately around the pipeline.	
Duration of risks	Long-term if damage requiring repair does occur (suspension of production from gas field while the pipeline is repaired).	
Level of certainty of risks	HIGH – the impacts associated with interference with other marine users is well understood.	
Risk decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.
	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	No damage to the Blacktip gas pipeline.	

Impact Consequence (inherent)		
Likelihood	Consequence	Risk rating
Rare	Moderate	Low

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Consultation with Eni prior to the activity **(RSK-05: EPS-01)**	Administrative	Yes	**EB:** Reduces the likelihood of incident between the two operations. **C:** No cost to hold and discuss operations. **Ev:** Environmental benefits outweigh the minor cost to implement.
No geotechnical activity over the pipeline **(RSK-05: EPS-02)**	Engineering	Yes	**EB:** Avoids the likelihood of damage to the pipeline. **C:** No cost to the activity given that future drilling could not occur in close proximity to the pipeline. **Ev:** Environmental benefits outweigh the minor cost to implement.
Pipeline coordinates **(RSK-05: EPS-03)**	Administrative	Yes	**EB:** Accurately mapping the location of the gas pipeline significantly reduces the likelihood of damage to it from geotechnical investigations. **C:** No additional cost to locate the exact pipeline location during the site investigations. **Ev:** Environmental benefits outweigh the cost to implement.

<table>
<tr><th colspan="3">Environmental Controls and Performance Measurement</th></tr>
<tr><td>EPO</td><td>EPS</td><td>Measurement criteria</td></tr>
<tr><td rowspan="3">No damage to the Blacktip gas pipeline.</td><td>(RSK-05: EPS-01) EOG will consult with Eni Australia to understand the implications of operating near the pipeline.</td><td>Consultation records verify discussions between EOG and Eni.</td></tr>
<tr><td>(RSK-05: EPS-02) There will be no geotechnical activities over the gas pipeline.</td><td>Daily reports confirm the activity as not occurring over the pipeline.</td></tr>
<tr><td>(RSK-05: EPS-03) EOG will ensure that the vessel contractor has the coordinates of the Blacktip gas pipeline marked in its navigation system to ensure that no geotechnical activities are conducted within 500-m of the pipeline.</td><td>Navigation display verifies that the correct pipeline coordinates are loaded into the GPS.</td></tr>
<tr><th colspan="3">Impact Consequence (residual)</th></tr>
<tr><td>Likelihood</td><td>Consequence</td><td>Risk rating</td></tr>
<tr><td>Remote</td><td>Minor</td><td>Negligible</td></tr>
<tr><td colspan="3">The risk of damage to the Blacktip gas pipeline is assessed as low because:
• The location of the pipeline is currently known, and is not located within the geotechnical activity area;
• Consultation has been undertaken with Eni to incorporate their concerns into the design of the activity; and
• The control measures adopted significantly reduce the likelihood of an incident of interference.</td></tr>
<tr><th colspan="3">Demonstration of ALARP</th></tr>
<tr><td colspan="3">A ‘low’ residual risk rating is considered to be ALARP and a ‘lower order’ risk. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.</td></tr>
<tr><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="2">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="2">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="2">The residual risk is low, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td colspan="2">No objections or claims have been raised by relevant persons regarding damage to the Blacktip gas pipeline. EOG’s consultation with Eni has led to the refinement of the geotechnical activity area such that it does not overlap the pipeline.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS outlined in this table align with the requirements of:
• OPGGS Act 2006 (Cth).
    ○ Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others).</td></tr>
</table>

	• *Navigation Act* 2012 (Cth). ○ Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions). ○ AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). ○ AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). ○ AMSA Marine Order Part 30 (Prevention of Collisions).	
Industry practice	The consideration and alignment of EPS with the mitigation measures outlined in the below-listed guidelines and codes of practice demonstrates that BPEM will be implemented for this activity	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS developed for this hazard are in line with the management measures listed for offshore physical presence in Section 4.3.1 of the guidelines, which include: • Develop exclusion zones in consultation with key stakeholders, including local fishing communities; raise awareness of exclusion zones with all stakeholders. • Optimise vessel use to ensure the number of vessels required and length of time that vessels are on site is as low as practicable.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding third-party subsea infrastructure.
	Guidelines for the conduct of offshore drilling hazard site surveys (IOGP, 2017)	The EPS listed in this table have been designed with consideration of the seabed impact and risks listed in Appendix A of the Guideline.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines specifically regarding third-party subsea infrastructure.
	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the impact on other marine resource users to ALARP and to an acceptable level. • To reduce risks to public safety to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	This hazard will not affect nearby AMPs.
	Ramsar wetlands	This hazard will not affect any Ramsar wetlands.
	TECs	This hazard will not affect any TECs.
	Nationally threatened and migratory species	This hazard will not have any impacts on threatened or migratory species.

	Other matters	
	KEFs	This hazard will not affect nearby KEFs.
	NIWs	This hazard will not affect any NIWs.
	State marine parks	This hazard will not affect any state marine parks.
	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	None triggered by this hazard.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the risk of interference with other marine users to be acceptable because: • It will adhere to the company's Safety & Environment Policy; • The residual risk rating is low; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons and stakeholders has been considered and incorporated into the design of the activity; and • Relevant legislation and industry best practice will be complied with.	
Environmental Monitoring		
• Continuous bridge monitoring.		
Record Keeping		
• Stakeholder consultation records. • SIMOPs records	• Operations reports. • Pipeline coordinates	

7.15 RISK 6 - Marine Diesel Oil Release

7.15.1 Hazard

A release of MDO may occur from the vessel. An MDO release may occur as a result of a vessel-to-vessel collision. The waters of the activity area are deep and bathymetry mapping indicates there are no sub-surface features (such as reefs or shoals) that present a risk of vessel grounding, so this risk has been discounted for this risk assessment.

DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m^3) for offshore vessels caused by collisions or fuel transfers.

7.15.2 Potential Environmental Risks

The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality;
- Injury or death of exposed marine fauna and seabirds;
- Habitat damage where the spill reaches shorelines; and
- Changes to the functions, interests or activities of other users (e.g., commercial fisheries).

7.15.3 EMBA

The EMBA for a 160 m^3 spill of MDO (sea surface, shoreline, entrained and dissolved hydrocarbons) is illustrated in Figure 5.1. Receptors most at risk within this EMBA, whether resident or migratory, are:

- Benthic assemblages;
- Macroalgal communities;
- Plankton;
- Fish (pelagic);
- Cetaceans;
- Marine reptiles (turtles);
- Avifauna (seabirds and shorebirds);
- Shoreline habitats (sandy beaches and rocky shores); and
- Commercial fisheries.

7.15.4 Evaluation of Environmental Risks

In line with OPGGS(E) Regulation 31 and Section 2.6 of NOPSEMA's *Environment Plan content requirement guidance note* (September 2020), EOG refers the reader to Section 7.16 of the accepted PDSA EP (996161-2022-Beehive#1-PDSA-EP-Rev2, available here) that provides the risk assessment for an MDO spill.
The assessment in the PDSA EP was reviewed during the preparation of this Geotechnical EP. No new environmental impacts or risks were identified. The existing controls were found to reduce the risk to ALARP and to be appropriate for the nature and scale of the activity. The risk was considered acceptable.

7.15.5 Risk Assessment

The risk assessment for an MDO is the same as that presented in Section 7.16 of the PDSA EP (996161-2022-Beehive#1-PDSA-EP-Rev2, available here). For completeness, Table 7.32 presents the MDO spill risk assessment.

Table 7.32 Risk assessment for an MDO spill

Summary		
Summary of risks	Localised and temporary reduction in water quality. Potential toxicity impacts to marine life. Temporary fisheries closures.	
Extent of risks	EMBA is defined in Figure 5.1.	
Duration of risks	Short-term (several days, depending on level of contact, location and receptor).	
Level of certainty of risks	HIGH – the environmental impacts of spilled hydrocarbons are well understood.	
Risk decision framework context	Decision type	A - good industry practice required.
	Activity	Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
	Risk & uncertainty	Risks are well understood, uncertainty is minimal.

	Stakeholder influence	No conflict with company values, no partner interest, no significant media interest.
Defined acceptable level	No unplanned discharge of MDO to sea.	

Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Negligible	Rare	Negligible
Macroalgal communities	Negligible	Rare	Negligible
Plankton	Negligible	Rare	Negligible
Pelagic fish	Negligible	Rare	Negligible
Cetaceans	Negligible	Rare	Negligible
Marine reptiles	Minor	Rare	Negligible
Seabirds	Negligible	Rare	Negligible
Shorebirds	Negligible	Rare	Negligible
Sandy beaches	Negligible	Rare	Negligible
Rocky shores	Negligible	Rare	Negligible
Commercial fisheries	Negligible	Rare	Negligible

Assessment of Proposed Control Measures			
Control measure	Control type	Adopt	Justification
Refuel in port only **(RSK-05:EPS-01)**	Administrative	Yes	**EB**: Reduces the risk of an at-sea spill. **C:** No additional cost. Vessel can undertake the activity without the need to refuel. **Ev**: Environmental benefits can be achieved without cost.
Navigation equipment and procedures **(RSK-05:EPS-02)**	Engineering	Yes	**EB:** Reduces the risk of collisions with other marine users. **C:** While the costs of navigation equipment are significant, it is standard on vessels and the costs of maintaining it are minimal. It is a requirement of maritime law. **Ev:** The safety benefits of having navigation equipment and procedures outweighs the cost.
Stakeholder notifications **(RSK-05:EPS-03)**	Administrative	Yes	**EB:** Ensures other marine users are aware of the vessel and thus reduces likelihood of collision and unplanned release. **C:** Minimal costs associated with EOG personnel preparing and issuing notifications and responding to stakeholders. **Ev:** Benefits outweigh the minimal cost.

SMPEP **(RSK-05:EPS-04, -05, -06, -07, -09)**	Administrative	Yes	**EB:** Ensures crew are well prepared to quickly respond to a spill, thereby minimising the volume spilled and the extent of sea affected. **C:** SMPEP should already be in place. Low costs to stock vessel with equipment and maintain it. This is standard maritime practice. **Ev:** Benefits outweighs the low costs.
OPEP **(RSK-05:EPS-08, -10, -11)**	Administrative	Yes	**EB:** Ensures EOG is well prepared to quickly respond to a spill, thereby minimising the extent of sea affected. **C:** Minimal cost to prepare OPEP and roll out training. This is standard industry practice. Significant costs for implementing response strategies and arranging call-off (standby) contracts for response resources. **Ev:** Environmental benefits outweigh the significant costs.
OSMP **(RSK-05:EPS-12)**	Administrative	Yes	**EB:** Ensures EOG is well prepared to quickly undertake operational and scientific studies, thereby supporting the future assessment of impacts resulting from the spill. **C:** High cost to prepare OSMP, detailed implementation plans and roll out training. This is standard industry practice. Low cost for putting call-off contracts in place and significant costs to implement the OSMP. **Ev:** Environmental benefits outweigh the significant costs.

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Preventative controls as per 'interference with other marine users' and 'routine emissions – light.' Additional controls are provided here.		
Preparedness		
No MDO is spilled at sea.	**(RSK-05:EPS-01)** No vessel refuelling is undertaken at sea (this will be done in port).	Bunker log verifies that refuelling was undertaken in port.

	(RSK-05:EPS-02) In order to minimise the risk of vessel-to-vessel collisions, the geotechnical vessel will:
	• Comply with the requirements of:
	  ○ *Navigation Act* 2012 (Cth), Chapter 3, Part 3 (Seaworthiness of vessels).
	  ○ Marine Order 21 (Safety and emergency arrangements).
		Vessel audit/assurance reports (prepared or commissioned by EOG) verify that vessels contracted to EOG meet legislative safety requirements.

	○ Marine Order 30 (Prevention of Collisions). ○ Marine Order 91 (Marine pollution prevention - oil). • Operate navigational lights and communication systems. • Maintain navigational lights and communication systems in accordance with their PMS. • Have trained and competent crew maintaining 24-hour visual, radar and radio watch for other vessels.	
	(RSK-05:EPS-03) EOG notifies relevant persons ahead of the activity so that third-party marine users are aware of vessel location and timing.	Stakeholder correspondence verifies that EOG made contact with relevant stakeholders about the timing and location of the activity.
Vessel crew is prepared to respond to a spill.	**(RSK-05:EPS-04)** Vessel has an approved SMPEP (that is implemented in the event of a large MDO spill.	Current SMPEPs are available.
		Spill incident report verifies that the actions were taken in accordance with the SMPEP.
	(RSK-05:EPS-05) Vessel crew is trained in spill response techniques in accordance with the SMPEP.	Training records verify that crews are trained in spill response.
	(RSK-05:EPS-06) In accordance with the SMPEP, oil spill response kits are available in relevant locations around the vessel, are fully stocked and are used in the event of hydrocarbon or chemical spills to deck.	Inspection/audit confirms that SMPEP kits are readily available on deck.
		Incident reports for hydrocarbon spills to deck record that the spill is cleaned up using SMPEP resources.
	(RSK-05:EPS-07) Prior to the activity commencing, a desktop oil spill response exercise is conducted to test the interfaces between the EOG OPEP, ERP and vessel contractor SMPEP.	Oil spill response exercise spreadsheet verifies that exercises have been undertaken.
Emergency response		
Vessel crew promptly responds to a spill.	**(RSK-05:EPS-08)** An OPEP and ERP are in place and tested annually in desktop exercises by those nominated in the plans to be part of the response strategies.	The OPEP and ERP are current.
		OPEP and ERP training schedule is available and remains live.
		The training matrix is maintained as a live document and verifies that personnel nominated to assist in emergency response are up to date with their training.

		OPEP and ERP exercise reports verify that exercises have been undertaken.
	(RSK-05:EPS-09) The Vessel Master will authorise actions in accordance with the vessel SMPEP.	Daily operations reports verify that the SMPEP was implemented.
	(RSK-05:EPS-10) The Beehive-1 geotechnical activity OPEP is implemented to limit the release of a Level 2 or 3 MDO spill.	Daily operations reports verify that the OPEP was implemented.
Recording & reporting		
EOG and regulatory authorities are promptly made of aware of near-misses and spills.	**(RSK-05:EPS-11)** EOG will report the spill to regulatory authorities within 2 hours of the spill or becoming aware of the spill.	Incident report verifies that contact with regulatory agencies was made within 2 hours.
Monitoring		
Characterise environmental impacts of a Level 2 or 3 spill.	**(RSK-05:EPS-12)** EOG will undertake operational and scientific monitoring in accordance with the OSMP.	Daily operations reports and overall study reports verify that the OSMP was implemented.

Risk Assessment (residual)

Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Negligible	Remote	Negligible
Macroalgal communities	Moderate	Remote	Negligible
Plankton	Moderate	Remote	Negligible
Pelagic fish	Moderate	Remote	Negligible
Cetaceans	Moderate	Remote	Negligible
Marine reptiles	Moderate	Remote	Negligible
Seabirds	Moderate	Remote	Negligible
Shorebirds	Moderate	Remote	Negligible
Sandy beaches	Moderate	Remote	Negligible
Commercial fisheries	Moderate	Remote	Negligible

The risk of an unplanned MDO release is assessed as negligible for all receptors because:

- The control measures adopted are effective at reducing the likelihood of an unplanned MDO release to remote.

Demonstration of ALARP

A 'negligible' residual risk rating is considered to be ALARP and a 'lower order' impact. The adopted controls and associated EPS have lowered the risk to the point that any additional or alternative control

<table>
<tr><td colspan="4">measures either fail to lower the residual risk rating any further or are grossly disproportionate to the residual risk rating.</td></tr>
<tr><th colspan="4">Demonstration of Acceptability</th></tr>
<tr><td>Policy compliance</td><td colspan="3">EOG’s Safety and Environmental Policy objectives are met.</td></tr>
<tr><td>EMS compliance</td><td colspan="3">Chapter 8 outlines the EP implementation strategy to be employed for this activity.</td></tr>
<tr><td>Risk matrix standard compliance</td><td colspan="3">The residual risk for each receptor is negligible, which is considered acceptable.</td></tr>
<tr><td>Engagement</td><td>Relevant persons</td><td colspan="2">No concerns have been raised with regards to MDO spills.</td></tr>
<tr><td>Legislative context</td><td colspan="3">The EPS align with the requirements of:
• Navigation Act 2012 (Cth):
  o Chapter 4 (Prevention of Pollution).
• OPGGS Act 2006 (Cth):
  o Section 572A-F (Polluter pays for escape of petroleum).
• OPGGS(E):
  o Part 3 (Incidents, reports and records).
• Protection of the Sea (Prevention of Pollution by Ships) Act 1983 (Cth):
  o Section 11A (SOPEP).</td></tr>
<tr><td rowspan="4">Industry practice</td><td colspan="3">The consideration and alignment of EPS with the mitigation measures in the below-listed codes of practice and guidelines demonstrates that BPEM will be implemented in this activity</td></tr>
<tr><td colspan="2">Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS developed for this activity are in line with the management measures listed for spills from vessels in Section 4.7.2 of the guidelines:
• Vessels having a SMPEP (RSK-05: EPS-04).
• Vessels having radar fitted and maintaining appropriate lighting and navigation systems (RSK-05: EPS-02).
• Having safety exclusion zones around facilities (RSK-05: EPS-01).</td></tr>
<tr><td colspan="2">Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>No guidance is provided regarding preventing or managing an offshore MDO spill, other than having a spill contingency plan in place. An OPEP is in place for the Beehive-1 geotechnical activity.</td></tr>
<tr><td colspan="2">Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
• Section 75 (Spills): Conducting a spill risk assessment, implementing personnel training and field exercises, ensuring spill response equipment is available (RSK-05: EPS-05, -06, -07).
• Sections 76-79 (Spill response planning): A spill response plan should be prepared (RSK-05: EPS-04, -08).</td></tr>
</table>

	APPEA CoEP (2008)	The EPS for this activity meet the code's following objectives: • To reduce the risk of any unplanned release of material into the marine environment to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs	The MDO EMBA intersects the JBG AMP. The AMP has the following relevant conservation value: - Carbonate banks and shoals. The consequence of an MDO spill on these conservation values is negligible and unlikely to result in long-term ecological impacts.
	Ramsar wetlands	There are no Ramsar wetlands intersected by the spill EMBA.
	TECs	There are no TECs identified in the spill EMBA.
	Nationally threatened and migratory species	Some nationally threatened species and migratory species have the potential to be present in the MDO spill EMBA, however as evaluated in the previous tables in this section, the consequence to individuals or populations of threatened and migratory species are considered negligible.
	Other matters	
	KEFs	The MDO EMBA intersects the Carbonate bank and terrace system of the Sahul Shelf KEF. The conservation values of this KEF are related to its benthic environment (diverse corals, sponges and demersal fish), and as such are unlikely to be affected by MDO because MDO is unlikely to occur at anything other than low thresholds near the seabed.
	NIWs	There are no NIWs that are intersected by the activity area or the spill EMBA.
	State marine parks	The MDO EMBA intersects the North Kimberley MP, which has the following environmental values: • River estuaries; • Turtle nesting beaches; • Fringing reefs; • Seabird and shorebird breeding sites; • Marine mammal foraging habitat; • Presence of pelagic finfish; and • Mangrove and intertidal mudflats. Given that these values and sensitivities will not be exposed to hydrocarbon concentration that are likely to cause ecological impact, it is anticipated that the impact to these values will be negligible.

	Species Conservation Advice / Recovery Plans / Threat Abatement Plans	Marine pollution is a threat identified for the Australian lesser noddy, Abbott's booby, red knot, curlew sandpiper, great knot, greater sand plover, lessor sand plover, Nunivak bar-tailed godwit, Northern Siberian bar-tailed godwit and eastern curlew. In general, population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Statement of acceptability	EOG considers the risk of an MDO release to be acceptable because: • It will adhere to the company's Safety & Environmental Policy; • The residual risk ratings are negligible; • An Implementation Strategy (described in Chapter 8) is in place to ensure the EPS are achieved. • Input from engagement with relevant persons has been considered and incorporated into the design of the survey; • Relevant legislation and industry best practice will be complied with; • An MDO release will not have long-term or significant impacts on MNES; • The management of an MDO release is not inconsistent with the aims of recovery plans/conservation plans/advice that are in force for EPBC Act-listed threatened and migratory species; • The management of an MDO release is not inconsistent with the aims of relevant marine reserve management plans; and • The management of an MDO release is not inconsistent with ESD principles.	
Environmental Monitoring		
• As per the OPEP and OSMP.		
Record Keeping		
• Vessel assurance reports. • Notices to Mariners. • Stakeholder consultation records. • SMPEPs. • OPEP. • ERP.	• Crew training records. • Bunkering procedure. • Bunkering PTWs, JSAs, inspection checklists. • Oil spill response exercise records. • Inspection/audit reports. • Incident reports.	

7.16 RISK 7 – Hydrocarbon Spill Response Activities

In line with OPGGS(E) Regulation 31 and Section 2.6 of NOPSEMA's *Environment Plan content requirement guidance note* (September 2020), EOG refers the reader to Section 7.17 of its accepted PDSA EP (996161-2022-Beehive#1-PDSA-EP-Rev2, available here) that provides the risk assessment for hydrocarbon spill response activities.

The assessment in the PDSA EP was reviewed during the preparation of this Geotechnical EP. No new environmental impacts or risks were identified. The existing controls were found to reduce the risk to ALARP and to be appropriate for the nature and scale of the activity. The risk was considered acceptable.

The response activities relevant to the geotechnical activity do not differ from those identified in the PDSA EP.

8 Implementation Strategy

The OPGGS(E) Regulation 14 requires that an Implementation Strategy be included in an EP. EOG retains full and ultimate responsibility as the Titleholder of the activity and is responsible for ensuring that the EPO and EPS outlined throughout Chapter 7 are adequately implemented.

8.1 Activity Organisational Structure

Figure 8.1 provides an overview of the relationship between EOG, contractors and consultants for the activity.

As the project manager for the activity, EOG, with support from Aventus Consulting (Aventus) and AGR Australia (AGR), has overall responsibility for the management of the activity to ensure that:

- Design and execution of the activity is in accordance with industry accepted practice and legislated standards;
- All regulatory approvals are obtained prior to activity commencement;
- Contractors have been pre-qualified as having appropriate resources and equipment to undertake the activity and have appropriate systems in place to ensure that these activities are undertaken in accordance with all legislative requirements;
- The environmental impacts and risks of the activity are minimised and reduced to ALARP and environmental performance is monitored; and
- The day-to-day direction and oversight of work by contractors is undertaken in accordance with the accepted EP.

The vessel contractor will have the day-to-day control and management of the vessel through the Vessel Master. The Vessel Master has over-riding authority and responsibility to make decisions with respect to pollution prevention and to request assistance as may be necessary.

8.2 Roles and Responsibilities

The environmental roles and responsibilities of key project team members are summarised in Table 8.1.

Day-to-day implementation of the activity (and the EP) will occur on the vessel under the leadership of the Vessel Master, Party Chief and the EOG Onboard Representative.

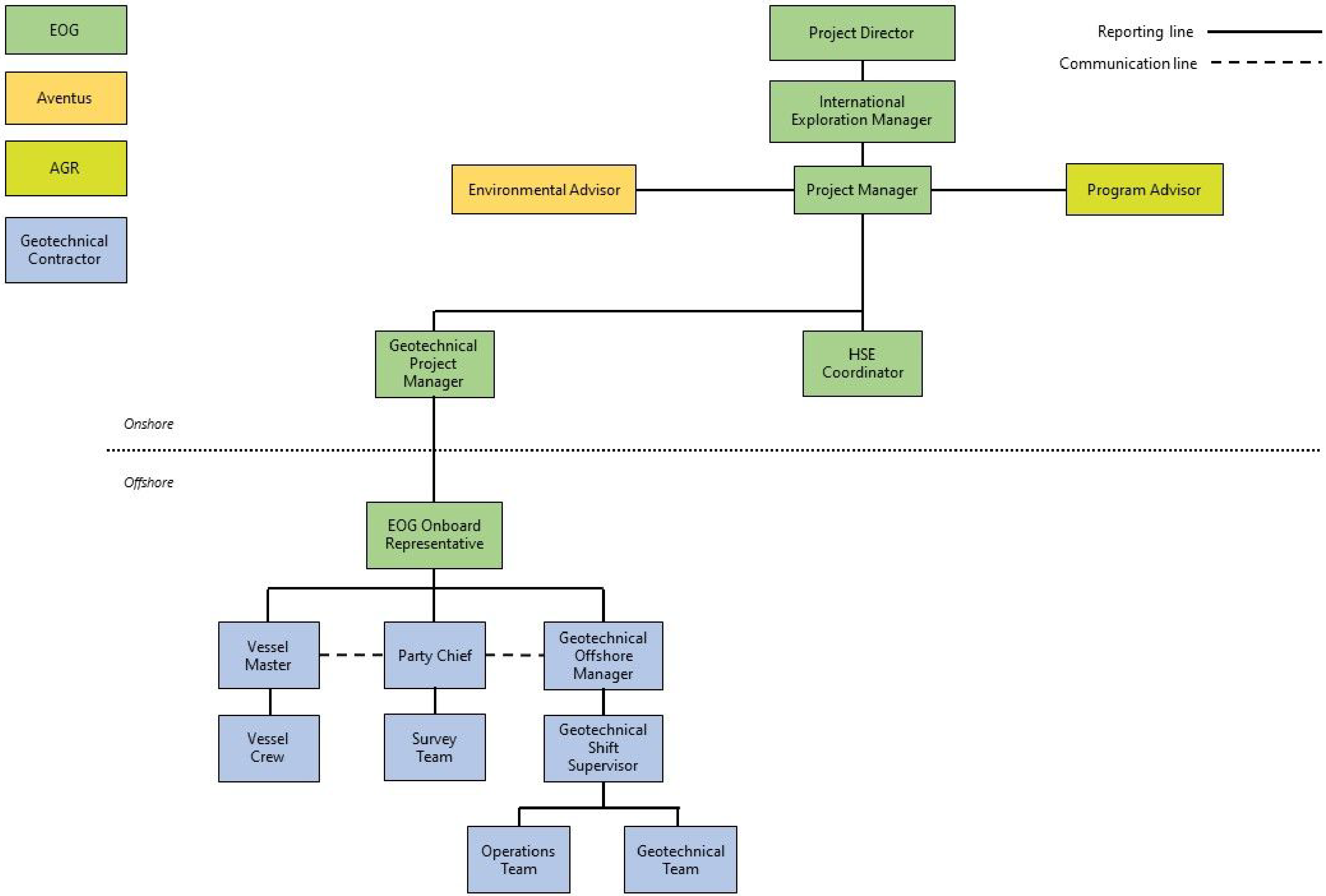


Figure 8.1 Activity organisation chart

Table 8.1 Environmental roles and responsibilities for the activity

Role	Environmental responsibilities
Onshore	
EOG	
Project Director	• Ensures EOG is adequately resourced to undertake the geotechnical activity. • Ensures AGR and Aventus are adequately resourced to support the geotechnical activity. • Provides direction on stakeholder consultation. • Approves this EP for submission to NOPSEMA. • Approves incident reports for submission to NOPSEMA. • Approves the Environmental Performance Report for submission to NOPSEMA. • Approves the end-of-activity notification for submission to NOPSEMA.
Vice President (Safety & Environment)	• Ensures EOG's Safety and Environmental Policy is applied to the activity.
Manager, Exploration, International New Ventures	• Provides guidance on operational procedures. • Reviews major changes to operations. • Attends stakeholder consultation, as required. • Reviews this EP. • Reviews incident investigation reports. • Reviews the Environmental Performance Report for submission to NOPSEMA. • Reviews the end-of-activity notification for submission to NOPSEMA.
Project Manager	• Overall project manager for the geotechnical activity. • Works with the EOG team, as well as all contractors, to execute a safe and successful geotechnical activity. • Liaises with AGR and Aventus for guidance • Attends operations meetings during the activity. • Reviews technical proposals to ensure compliance with industry best practice and EOG's Safety and Environmental Policy. • Confirms all required plans, audits and reviews are undertaken in accordance with the requirements of the EP. • Liaises with and submits incident reports for submission to NOPSEMA. • Reviews this EP. • Reviews incident reports and submits them to regulators, as required. • Ensures all notifications are prepared and submitted in a timely fashion. • Submits the Environmental Performance Report to NOPSEMA. • Submits the end-of-activity notification for submission to NOPSEMA.
Senior HSE Coordinator	• Manages the preparation of HSE regulatory approvals documents. • Reviews this EP. • Arranges for review of vessel contractor's HSE management system and other HSE documentation upon contract award. • Reviews emergency response plans. • Records and reports incidents to EOG. • Reviews incident reports and notifications. • Leads HSE incident investigation and reporting. • Provides HSE support during operations. • Ensures management systems processes and procedures are applied to the activity.

Role	Environmental responsibilities
Geotechnical Project Manager	• Reports to and maintains open and frequent communication with the EOG Project Manager. • Undertakes a technical review of the activity. • Ensures compliance with data acquisition technical requirements. • Ensures inductions, auditing and reporting requirements are met. • Prepares Scope of Work. • Liaises with EOG project team regarding operations. • Provides technical and operational advice. • Monitors offshore performance on a daily basis. • Attends daily operational meetings. • Makes technical decisions regarding operations.
SPECIALISTS	
AGR (Program Advisor)	• Supports EOG with vessel inspections to ensure compliance with scope of activity and EP. • Provides emergency response support and facilities. • Provides logistical and operational support before, during and after the activity.
Aventus (Environmental Advisor)	• Prepares the EP. • Provides technical input to stakeholder consultation. • Maintains the stakeholder consultation register. • Plans for the implementation of the EP. • Prepares the environmental induction. • Conducts inspections/audits of compliance with the EP. • Monitors environmental performance against the EPS in this EP. • Assists with review, investigation and reporting of environmental incidents. • Provides incident support. • Reviews major changes to operations. • Alerts EOG ahead of any required notifications. • Prepares monthly recordable incident reports for submission to NOPSEMA. • Prepares the end-of-activity notification for submission to NOPSEMA. • Prepares the end-of-activity environmental performance report for submission to NOPSEMA.
Offshore	
Vessel Master	• Ensures full compliance with all applicable navigational safety standards and regulations. • Conducts emergency drills. • Supervises vessel crew to ensure they are fit for duty and undertaking work only within their area of qualification and training. • Monitors, reports and takes appropriate action to remedy any vessel or equipment defects that may impact on safety and environmental performance of the vessel. • Maintains logs of emissions and discharges in accordance with MARPOL regulations. • Ensures that all crew are appropriately qualified, trained and equipped for their roles on the vessel. • Reports all incidents and near-misses to the Vessel Manager and EOG Onboard Representative, recording the details and taking initial actions with the Vessel Master to render the situation safe.

Role	Environmental responsibilities
	• Ensures megafauna observations are distributed to EOG at the completion of the activity.
EOG Onboard Representative	• Facilitates clear communications between EOG and the vessel contractor. • Attends incident investigations. • Conducts induction for all project personnel. • Ensures compliance with Scope of Work and EP. • Checks all data meets specifications and notes any deviations. • Provides daily feedback on operations progress to EOG Project Manager. • Reports all incidents to the EOG Project Manager. • Ensures the EP and EOG HSE Plan are followed throughout the work. • Confirms survey equipment supplied is fit for purpose. • Monitors work and confirms it is being completed to appropriate standards. • Attends and contributes to project meetings and any HAZIDs. • Supervises all aspects of the work. • Keep a project log for the duration of the work. • Tracks progress, issues, status and schedule. • Highlights any project risks to EOG Project Manager. • Submits daily reports and calls to EOG Project Manager. • Continually monitors and compares newly acquired data against EOG data and reports any deviations to EOG Project Manager. • Promotes a proactive approach to safety awareness and acts to prevent incidents, as required. • Reviews contractor documents for EOG. • Reports incidents and near-misses to the EOG Project Manager. • Analyses, makes recommendations and reports on contractor's HSE performance.
Party Chief	• Implements the Scope of Work, HSE Plan, EP (and ERP, if required). • Ensuring the procedures and work instructions required for operations are known, understood and followed by all vessel personnel. • Ensures toolbox meetings are carried out. • Ensures new employees receive inductions and training relevant to their role and are appropriately supervised. • Ensures HSE inspections and audits are undertaken. • Ensures that preventative maintenance is carried out on equipment and installations onboard. • Ensures that all working codes and practices are implemented for the activity in accordance with industry standards. • Promotes safe operations. • Maintains open and clear communication with the EOG Onboard Representative. • Attends project calls and meetings as required.
Vessel crew	• Apply operating procedures in letter and in spirit. • Follow good housekeeping procedures and work practices. • Attend all necessary toolbox talks and HSE inductions. • Encourage improvement in environmental performance wherever possible. • Immediately report environmental incidents or near-misses to their Supervisor.

8.3 HSE Management

EOG will have overall responsibility for the management, review and audit of HSE issues during implementation of the activity, ensuring the activity is conducted safely and in accordance with corporate policies and procedures, as well as relevant Australian legislation and international standards.

EOG's Australian Projects HSE Management Plan (996161-2022-Beehive#1-HSEPlan) is aligned with ISO 14001:2016 (*Environmental Management Systems – requirements with guidance for use*), ISO 31000:2009 (*Risk management*), ISO 45001:2018 (*Occupational health and safety management systems*) and ISO 9001:2016 (*Quality management systems–requirements*) to guide the management of the activity. The HSE Plan includes descriptions of the following:

- Leadership and commitment – HSE objectives and performance monitoring, stop work authority;
- Organisation – roles and responsibilities, reporting;
- HSE legislation and standards – occupational, health and safety legislation;
- Risk management – risk management procedures and matrix;
- HSE competence and training – training and induction requirements;
- Subcontractors – pre-qualification process, management;
- Communications – meetings, record keeping and reporting, HSE awareness programs;
- Work instructions – permit to work system;
- Management of change;
- Incident management – recording and reporting procedures, investigation procedure, communicating lessons learned;
- Safety critical equipment and activities – safety critical equipment, working at heights, confined space, PPE requirements, hot work;
- Emergency response;
- Occupation health – medical facilities, infectious disease management (e.g., COVID-19), hygiene, smoking, fatigue management, drugs and alcohol, heat stress, mental health;
- Security – International Ship and Port Facility Security (ISPS) compliance, security alert levels, port security, third-party interference;
- Environmental management – EP compliance, waste management, spill prevention, preparedness and response, biosecurity, monitoring; and
- Audit and review – inspection and audit program.

The vessel contractor will be required to have an HSE management system or plan that meets the requirements of the EOG Safety and Environmental Policy and the EOG Australian Projects HSE Management Plan.

8.4 Training and Awareness

8.4.1 Recruitment and Training

During its contractor selection process, EOG will conduct an HSE qualification to ensure that the vessel contractor has procedures in place to ensure the correct selection, placement, training and ongoing assessment of employees.

Procedures should also be in place to identify the training needs of an individual to competently perform their role, and evidence of corporate and/or vessel inductions will also be required.

8.4.2 Environmental Induction

An activity-specific HSE induction for all personnel working on the activity will be undertaken. The environmental component of the induction will include information on the following environmental issues:

- Description of the environmental sensitivities, conservation and heritage values of the activity area and spill EMBA;
- Control measures and commitments from the accepted EP that are required to be undertaken during the activity;
- The importance of following procedures and using JSAs to identify environmental risks and mitigation measures;
- Procedures for responding to and reporting environmental hazards or incidents;
- Overview of emergency response and spill management procedures;
- Overview of the waste management requirements; and
- Roles and environmental responsibilities of key personnel aboard the vessel.

Aventus will prepare the induction and the Onboard EOG Representative is responsible for ensuring personnel receive this induction prior to the commencement of the activity. All personnel will be required to sign an attendance sheet to confirm their participation in and understanding of the induction.

The vessel contractor will conduct their own company and vessel-specific inductions independently of the activity-specific HSE induction.

8.4.3 Oil Spill Response Training

Quarterly training of vessel crews in SMPEP procedures is a MARPOL requirement for vessels over 400 GRT (Annex 1, Regulation 37). During its contractor audit process, AGR will assess the vessel contractor's implementation of their SMPEPs (or equivalent, relevant to class).

An office-based desktop spill response exercise of the activity-specific OPEP will be conducted, involving EOG (if representatives are in-country) and key vessel contractor personnel prior to the activity commencing.

8.4.4 Toolbox Talks and HSE Meetings

Environmental matters will be included in daily toolbox talks as required by the specific task being risk assessed (e.g., waste management).

Environmental issues will also be addressed in daily operations meetings and weekly HSE meetings, where department leads will participate with the EOG Onboard Representative and Vessel Master in discussing HSE matters that have arisen during the week, and issues to consider for the following week.

Records associated with environmental training, inductions and attendance at toolbox meetings will be recorded and maintained onboard the vessel.

8.4.5 Communications

The Vessel Master, Vessel HSE Lead, Party Chief and EOG Onboard Representative are responsible for keeping personnel informed about HSE issues, acting as a focal point for personnel to raise issues and concerns, and consulting and involving all personnel in the following:

- Issues associated with the implementation of the EP;
- Any proposed changes to equipment, systems, or methods of operation of equipment, where these may have HSE implications; and
- Any proposals for the continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.

Table 8.2 outlines the key meetings proposed to take place onshore and offshore during the activity.

Table 8.2 Activity communication meetings

Meeting	Frequency	Attendees
Onshore		
EOG Project Management	Daily	Vessel Manager (if necessary), EOG Project Manager, EOG Onboard Representative, Party Chief.
Vessel		
Operations (including HSE)	Daily	Vessel Master, EOG Onboard Representative, Party Chief, vessel HSE Lead, Lead Processor, Medic, Heads of Departments
Pre-start safety meeting	Daily, prior to each shift	All personnel on shift
Toolbox	Before each task	All personnel involved in the task, including the Party Chief, EOG Onboard Representative and Medic (if necessary)

8.5 Environmental Emergencies and Preparedness

In the event of an emergency of any type, the Vessel Master will assume overall onsite command and act as the Emergency Response Coordinator (ERC). All personnel aboard the vessel will be required to act under the ERC's directions.

At the EOG corporate level, the EOG Onboard Representative will maintain communications with the EOG Project Manager, who will become the overall Incident Management Team (IMT) Leader and will coordinate EOG's IMT (if required), with support from AGR as required.

In the event of an emergency involving a hydrocarbon spill, the Vessel Manager will implement the vessel SMPEP, while AGR can provide several personnel with current IMO spill response training as well as other support, if the event requires it. Oil spill emergency response for this activity is outlined in Chapter 9.

8.5.1 Adverse Weather Protocols

It is Vessel Master's responsibility to be the focal point for all actions and communications with regards to adverse weather or sea state, to safeguard the vessel, all personnel onboard and the environment. During adverse weather, the Vessel Master is responsible for implementing the vessel's Severe Weather Plan (or equivalent), which includes:

- Ensuring the safety of all personnel onboard;
- Monitoring all available weather forecasts and predictions;
- Initiating the vessel safety management system, HSE procedures and/or ERPs;
- Keeping the EOG Onboard Representative fully informed of the prevailing situation and intended action to be taken;
- Assessing and maintaining security, watertight integrity and stability of the vessel; and
- Proceeding to identified shelter location(s) as appropriate.

Other appropriate responsibilities shall be taken into consideration as dictated by the situation.

In addition to using Very High Frequency (VHF) Marine Radio Weather Services, the vessel contractor will obtain daily weather forecasting from the Bureau of Meteorology (BoM) and/or other suitable weather monitoring services to monitor weather within the activity area in the lead up to and for the duration of the activity.

8.5.2 Vessel Emergencies and Oil Spills

Activity-specific emergency response procedures will be included in the HSE Plan, SMPEP and vessel contractors' ERP. The ERP will contain instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and emergency contact information.

Vessel-specific SMPEP and ERPs typically include vessel-specific procedures for the following:

- Vessel incidents – collision, grounding, hull damage, man overboard, equipment failure;
- Waste management;
- Hazardous materials and handling; and
- Hydrocarbon and chemical spills.

The SMPEP includes information about initial response, reporting requirements and arrangements for the involvement of third-parties having the appropriate skills and facilities necessary to respond effectively to oil spill issues. The SMPEP will be the principal working document for the vessel and crew in the event of a marine oil spill incident. This document will include specific emergency procedures including steps to control discharges for bunkering spills, hull damage, grounding and stranding, fire and explosion, collisions, vessel list, tank failure, sinking, and vapour releases. The SMPEP also includes requirements for regular drills of the plan and revision following drills or incidents.

The activity-specific OPEP (Chapter 9) will be implemented (and supplements the vessel-specific SMPEP) in the event of a Level 2 or Level 3 hydrocarbon spill that requires response resources beyond those immediately available to the vessels. The Vessel Master will ensure that all crew on board are fully aware of the vessel-specific requirements and that exercises for vessel-related incidents are conducted.

8.5.3 Emergency Response Training

The readiness and competency of EOG and the vessel contractor to respond to incidents and emergencies will be tested by conducting a desktop emergency response exercise no earlier than four (4) weeks prior to the activity commencing.

A scenario will be chosen that combines an emergency with risk to human life (such as fire) and risk to the environment (large hydrocarbon spill). This way several plans (i.e., the ERP and OPEP) can be tested simultaneously.

This exercise has the objectives of:

- Developing and testing the response arrangements as outlined in the emergency response procedures;
- Ensuring the skills and teamwork of the Emergency Response and Command Teams to respond to major emergency events are up-to-date. In particular, ensuring individual roles, responsibilities and reporting requirements are understood;
- Testing interfaces between all key parties involved in emergency response (EOG, AGR and vessel contractor); and
- Ensuring the correct communications are known and used and that contact details (e.g., phone numbers) are correct.

This exercise will be facilitated by an experienced facilitator. At the completion of the exercise, the facilitator will hold a debrief session during which the exercise is reviewed, and lessons learned and areas for improvement are identified.

Any learnings, findings or recommendations identified as part of the testing exercise will be addressed and incorporated into the relevant emergency response plans and procedures to ensure they remain effective.

8.6 Simultaneous Operations

Simultaneous operations (SIMOPs) refers to two or more operations occurring simultaneously in the same area that have the potential to interfere with each other.

The activity area is located approximately 5.5 km from the Blacktip gas pipeline, operated by Eni Australia. EOG will remain in contact with Eni so that SIMOPs issues can be addressed if and as required. Eni may be drilling production wells at the nearby Blacktip unmanned production platform, scheduled to occur during November and December 2022, and possibly extending into January 2023.

8.7 Incident Management

8.7.1 Recordable Incident Management

Regulation 4 of the OPGGS(E) regulations defines a ‘recordable’ incident as:

> *A breach of an EPO or EPS in the EP that applies to the activity that is not a reportable incident.*

Routine monthly recordable incident reports, including ‘nil’ incident reports, will be prepared by the EOG Environment Advisor and submitted to NOPSEMA by the 15th of each month. These are reported using the NOPSEMA template *Monthly environmental incident reports* (N-03000-FM0928). Table 8.3 summarises the recordable incident reporting requirements.

Table 8.3 Recordable incident reporting details

Timing	Reporting requirements	Contact
By the 15th of each month	• All recordable incidents that occurred during the previous calendar month. • The date of the incident. • All material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out. • The EPO and/or EPS breached. • Actions taken to avoid or mitigate any adverse environmental impacts of the incident. • Corrective actions taken, or proposed to be taken, to stop, control or remedy the incident. • Actions taken, or proposed to be taken, to prevent a similar incident occurring in the future. • Actions taken, or proposed, to prevent a similar incident occurring in the future.	NOPSEMA – submissions@nopsema.gov.au

8.7.2 Reportable Incident Management

Regulation 4 of the OPGGS(E) defines a 'reportable' incident as:

> *An incident that has caused, or has the potential to cause, moderate to significant environmental damage.*

In the context of the EOG Environmental Risk Matrix, EOG interprets 'moderate to significant' environmental damage to be those hazards identified through the EIA and ERA process (see Chapter 7) as having an inherent or residual impact consequence of 'moderate' or greater. Impacts and risks with these ratings (as outlined throughout Chapter 7) are:

- Damage to third-party subsea infrastructure; and
- MDO spill.

Table 8.4 presents the reportable incident reporting requirements.

Table 8.4 Reportable incident reporting requirements

Timing	Requirements	Contact
Verbal notification		
Within 2 hours of becoming aware of incident	• The verbal incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; and	• NOPSEMA – 1300 674 472

Timing	Requirements	Contact
	• The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	
	For a Level 1, 2 or 3 hydrocarbon spill, as above.	As above, plus: • AMSA – 1800 641 792 (24 hrs) • WA – (08) 9480 9924 • NT – 1800 064 567
	Oiled wildlife	• WA – (08) 9219 9108 • NT – 1800 064 567
	Suspected or confirmed IMS introduction	• WA Fisheries – 1800 815 507 • DCCEEW - 1800 803 772 (general enquiries)
	Injury or death of EPBC Act-listed or FFG Act-listed fauna (e.g., vessel collision or entanglement with streamers)	• WA – 9474 9055 • DCCEEW – 1800 803 772
Within 24 hours of discovery	Notify DCCEEW if previously unrecorded underwater cultural heritage (e.g., shipwreck) is found	Submit report at the following address: http://www.environment.gov.au/shipwreck/public/forms/notification.do;jsessionid=7DF6B6DBCFD9E9E1071EB71DC201B84C?mode=add.
Written notification		
Not later than 3 days after the first occurrence of the incident	A written incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent similar recordable incidents occurring in the future.	• NOPSEMA – submissions@nopsema.gov.au
Within 72 hours of the incident	As above, with regard to details of a vessel strike incident with a cetacean	• Upload information to DCCEEW online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike)
Within 7 days of the incident	As above, with regard to impacts to MNES, specifically injury to or death of EPBC Act-listed species	• EPBC.Permits@environment.gov.au
Within 7 days of providing	As above	• NOPTA – reporting@nopta.gov.au

Timing	Requirements	Contact
written report to NOPSEMA		

8.7.3 Incident Investigation

Any non-compliance with the EPS outlined in this EP will be investigated and follow-up action will be assigned as appropriate.

The findings and recommendations of inspections, audits and investigations will be documented and distributed to relevant vessel and project personnel for review. Tracking the recommendations and close-out actions arising from incident investigations will be managed via EOG's incident management system.

Investigation outcomes will be communicated to the project team via daily operations meetings and to the vessel crew during daily toolbox meetings and at weekly HSE meetings.

8.7.4 Routine Recording and Reporting

Routine recording and reporting of activity HSE matters will encompass the following:

- Daily teleconferences – held between the EOG Onboard Representative and EOG personnel each morning for an update on progress from the previous day and the forward plan, including any HSE matters that have arisen. AGR and the onshore vessel manager may participate if necessary.
- Daily operations reports – the Party Chief and EOG Onboard Representative will prepare a daily operations report, including data on activities conducted for the day and any HSE issues arising and distributed to the extended project team.
- HSE reporting – the Party Chief, vessel HSE Lead and the EOG Onboard Representative will collate key HSE performance statistics on a daily and/or weekly basis and communicate those to the wider project team during daily teleconferences and through reports.

8.8 Management of Change

EOG's Australian Projects HSE Management Plan outlines the Management of Change (MoC) procedure for the activity. The MoC procedure will be used to determine whether any changes to the design of the activity (or other factors) trigger revisions to the EP that require re-submission to NOPSEMA (see Section 8.9.3).

Permanent or temporary changes to organisation, equipment, plant, standards or procedures that have potential HSE and/or integrity impacts are subject to formal review and approval by the relevant EOG role with responsibility for the change prior to initiating the change to ensure risks remain acceptable and are reduced to ALARP. The level of management approval for each change is commensurate with the risk.

An MoC form must be completed. This is then reviewed by relevant specialists that have technical and project-specific knowledge and understanding to determine the impact (if any) and significance of the change. The relevant role with responsibility for the change shall look at any additional safety requirements needed to ensure the safety of personnel, the effect on schedule and cost, the effect on equipment and third-party assets and then decide whether to approve or reject the change. The results of the review shall then be documented in the MoC form and the relevant role will communicate the change to all those who may be affected by it. The MoC form will then be stored by EOG.

The vessel contractor MoC process will be applied to any vessel-related changes in accordance with its standard operating procedures. Routine optimisation of vessel operating parameters will be carried out using the vessel contractor procedures and is not subject to the formal change management control as described previously.

8.9 Assurance, Reporting and Review

8.9.1 Field Environmental Monitoring

EOG will maintain a quantitative record of emissions and discharges, and other environmental matters generated on location during the activity, as required under Regulation 14(7) of the OPGGS(E).

The vessel contractor is responsible for collecting this data and reporting it to the EOG Onboard Representative. This is facilitated by completing a daily environmental monitoring register that will be provided by EOG to the contractor, which captures the commitments made in Table 8.5 below.

Table 8.5 Summary of environmental monitoring requirements

Aspect	Monitoring parameter	Frequency	Record
Impacts			
Atmospheric emissions	Fuel consumption	Tallied at end of activity from daily reports and/or bunker receipts	Emissions register
Displacement of other marine users	Ongoing patrol for, and communications with, third-party vessels	Continuous during activity	Bridge communications book
Bilge water	Volume of bilge water discharged during the activity	Each discharge (infrequent)	Oil record book
Risks			
Waste disposal	Weight/volume of wastes sent ashore (including oil sludge, solid/hazardous wastes)	Tallied at end of activity	Waste manifest
Displacement or interference with other marine users	Ongoing patrol for, and communications with, third-party vessels	Continuous during activity	Bridge communications book
Introduction of IMS to activity area	Volume and location of ballast water discharges noted	Each discharge	Ballast water log
Vessel strike with megafauna	Megafauna observations	Continuous during vessel operations	Incident report
MDO spill	Operational monitoring in line with the OPEP and scientific monitoring in line with the OSMP (depending on spill volume)	As required	Incident reports

8.9.2 Routine Reporting and Notifications

Regulation 11A of the OPGGS(E) specify that consultation with relevant authorities, persons and organisations must take place. This consultation includes an implicit obligation to report on the progress of the activity. Table 8.6 outlines the routine reporting obligations that EOG will undertake with external organisations.

Table 8.6 External routine reporting obligations

Requirement	Timing	Contact details	OPGGS(E) regulation
Pre-activity			
Notify the DoD of the activity commencement date.	Five weeks prior to activity starting.	Offshore.Petroleum@defence.gov.au.	11A
Notify the AHO of the activity commencement date and duration to enable Notices to Mariners to be issued.	Three weeks prior to activity starting.	datacentre@hydro.gov.au	11A
Notify all other stakeholders in the stakeholder register with the activity commencement date.	Two weeks prior to activity starting.	Via email addresses in the stakeholder consultation register	11A
Notify NOPSEMA with the activity commencement date.	At least 10 days prior to activity starting.	submissions@nopsema.gov.au	29
Notify AMSA in order to issue daily AusCoast warnings.	Within 24 hours of activity starting.	rccaus@amsa.gov.au	11A
Activity completion			
Notify AMSA in order to cease daily AusCoast warnings.	Within 24 hours of activity completion.	rccaus@amsa.gov.au	11A
Notify all stakeholders in the stakeholder register.	Within 2 days of activity completion.	Via email addresses managed by the Environment Advisor	11A
Notify the AHO in order to cease the issuing of Notices to Mariners.	Within 2 days of activity completion.	datacentre@hydro.gov.au	11A
Notify NOPSEMA of the activity end date.	Within 10 days of activity completion.	submissions@nopsema.gov.au	29
Notify NOPSEMA of the end of the operation of the EP.	After acceptance of the end-of-activity EP performance report.	submissions@nopsema.gov.au	25A
Performance reporting			
Submit an end-of-activity EP Performance Report.	Within 3 months of activity completion.	submissions@nopsema.gov.au	26C

8.9.3 Environment Plan Review

EOG may determine that an internal review of the EP is necessary based on any one or all of the following factors:

- Changes to hazards and/or controls identified in the review of the EP, which in itself is supported by:
  - Reviewing changes to AMP management arrangements (through subscription to the AMP email update service at https://parksaustralia.gov.au/marine/about/).
  - Environment and industry legislative updates (through subscriptions to NOPSEMA, APPEA and legal firms).
  - Running a new EPBC Act PMST for the EMBA to determine whether there are newly-listed threatened species or ecological communities in the EMBA.
  - Remaining up to date with new scientific research that may impact on the EIA/ERA in the EP (for example, through professional networking and APPEA membership).
  - Remaining in regular contact with relevant persons.
- Implementation of corrective actions to address internal or external inspection or audit findings;
- An environmental incident and subsequent investigation identifies issues in the EP that require review and/or updating;
- A modification of the activity is proposed that is not significant but needs to be documented in the EP;
- Changes identified through the MoC process, such as hazards or controls, organisational changes affecting personnel in safety critical roles; and
- Changes to any of the relevant legislation.

The EOG Australia Operations Manager will seek advice on the material impact of the items listed above and whether or not a review of the EP should be undertaken. The scope of a review is determined by the factors that trigger the review and an appropriate team will be assembled by EOG to conduct the review. If a review of the EP relates to a topic that had previously been raised by a relevant person or stakeholder, an updated response will be prepared and provided to affected stakeholders.

Revisions Triggering EP Re-submission

EOG will revise and re-submit the EP for assessment as required by the OPGGS(E) regulations listed in Table 8.7.

Revisions and re-submission of the EP generally centre around ‘new’ activities, impacts or risks and ‘increased’ or ‘significant’ impacts and risks. EOG defines these terms in the following manner:

- **New** impact or risk – one that has not been assessed in Chapter 7.
- **Increased** impact or risk – one with greater extent, severity, duration or uncertainty than is detailed in Chapter 7.
- **Significant** change:
  - The change to the activity design deviates from the EP to the degree that it results in new activities that are not intrinsic to the existing Activity Description in Chapter 2.

- The change affects the ability to achieve ALARP or acceptability for the existing impacts and risks described in Chapter 7.
- The change affects the ability to achieve the EPO and EPS contained in Chapter 7.

A change in the activities, knowledge, or requirements applicable to the activity are considered to result in a ‘significant new’ or ‘significant increased’ impact or risk if any of the following criteria apply:

- The change results in the identification of a new impact or risk and the assessed level of residual impact consequence is higher than ‘minor’ or the residual risk rating is higher than ‘low’;
- The change results in the identification of a new impact or risk and the assessed level that is not acceptable and ALARP;
- The change results in an increase to the assessed impact consequence or risk rating for an existing impact or risk described in Chapter 7; and
- There is both scientific uncertainty and the potential for significant or irreversible environmental damage associated with the change.

Table 8.7 EP revision submission requirements

Regulations	OPGGS(E) regulation
Submission of a revised EP before the commencement of a new activity	17(1)
Submission of a revised EP when any significant modification or new stage of the activity that is not provided for in the EP is proposed	17(5)
Submission of a revised EP before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk not provided for in the EP	17(6)
Submission of a revised EP if a change in titleholder will result in a change in the manner in which the environmental impacts and risks of an activity are managed	17(7)

While an EP revision is being assessed by NOPSEMA, any activities addressed under the existing accepted EP are authorised to continue. Additional guidance is provided in NOPSEMA Guideline *When to submit a proposed revision of an EP* (N04750-GL1705, September 2020).

Minor EP Revisions

Minor revisions to this EP that do not require resubmission to NOPSEMA will be made where:

- Minor administrative changes are identified that do not impact on the environment (e.g., document references, contact details, etc.).
- A review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, as outlined in Table 8.7.

Minor revisions to the EP will not be submitted to NOPSEMA for assessment.

8.9.4 Inspections and Audits

Various inspections and audits will be undertaken for the activity using competent personnel, as outlined in Table 8.8. Any non-compliances or opportunities for improvement identified at the time of an inspection or audit will be communicated to the relevant EOG and contractor personnel at the time of the inspection or audit and to the EOG Project Manager in writing. These are tracked by EOG, which includes assigning responsibilities to personnel to manage the issue and verify that it is closed out.

A summary of the EP commitments for the activity will be distributed aboard the vessel and implementation of the EPS will be continuously monitored by Aventus through review of the completed weekly checklists and attendance at relevant meetings.

Table 8.8 Summary of environmental inspections and audits

Type	When	Frequency	Method	Details
HSE due diligence inspection	Post-award, pre-activity	Once	Desktop or in port/during mobilisation	Focused on ensuring HSE Plan and EPS in this EP can be met through review of relevant records and databases.
EP compliance inspection	During activity	Ongoing	In person on board	The EOG Onboard Representative will provide information to the Environmental Advisor, who in turn will determine compliance with the EP.
Ongoing informal inspections	During activity	Weekly	In person on board	Checklists provided by EOG to be completed by the Party Chief and/or the EOG Onboard Representative.

8.9.5 Regulatory Inspections

Under Part 5 of the OPGGS Act, NOPSEMA inspectors have the authority to enter EOG premises, including the vessel, to undertake monitoring or investigation against this EP. EOG will cooperate fully with the regulator during such investigations.

8.9.6 End of Activity Performance Report

In accordance with the OPGGS(E) Regulation 14(2), EOG will submit an end-of-activity EP performance report to NOPSEMA within three months of completion of the activity. Performance will be measured against the EPO and EPS outlined in Chapter 7. The information in the report will be based on the information collected during routine communications, inspections and audits, as outlined in this chapter.

8.9.7 Monitoring and Review

The vessel contractor will have specific contractual compliance obligations associated with implementing the EP, OPEP and other applicable plans. EOG will monitor the contractor against these obligations both in terms of deliverables and quality.

EOG will establish, maintain and review an EP commitments register to assist in monitoring against these EP. Learnings from this monitoring will inform continued operations and the development of EPs for future phases of the Beehive project.

8.9.8 Record Keeping

In accordance with Regulations 27 and 28 of the OPGGS(E), documents and records relevant to the implementation of this EP are stored and maintained by EOG for a minimum of five years. These records will be made available to NOPSEMA in electronic or printed form upon request.

8.10 Summary of Implementation Strategy Commitments

Table 8.9 summarises the commitments provided throughout the Implementation Strategy by assigning EPO, EPS and measurement criteria to each commitment.

Table 8.9 Summary of EP implementation strategy commitments

Section	EPO	EPS	Measurement criteria
8.4	Project personnel are trained and competent to fulfil their duties.	The project HSE Plan records and tracks core and critical HSE and technical compliance training.	Training records are readily accessible through.
		Due diligence is undertaken on contractors to ensure they are competent to work on the activity.	Contractor due diligence reports are readily available and verify their suitability to work on the activity.
	Project personnel are familiar with their HSE responsibilities.	All personnel working on the vessel are inducted into the activity HSE requirements.	Vessel crews and visitor lists, along with induction familiarisation checklists are readily available, verifying that all personnel working on and visiting the vessel are inducted.
	Project personnel are familiar with operations HSE issues.	Regular HSE communications take place between vessel- and office-based personnel.	HSE meeting records are available and verify regularity of communications.
8.5	Emergency response responsibilities are clearly defined.	The project HSE Plan, vessel SMPEP and ERP outline emergency responsibilities for project personnel.	The project HSE Plan, vessel SMPEP and ERP emergency responsibilities are communicated to project personnel prior to the activity commencing.
	Vessel- and office-based personnel are familiar with their emergency response responsibilities.	All relevant vessel- and office-based personnel participate in emergency response (e.g., ERP and OPEP) training, drills and exercises.	Training records verify that emergency response exercises were undertaken.
8.7	Incident reports are issued to the regulators as required.	Recordable incidents reports are issued monthly to NOPSEMA.	Recordable and reportable incident reports and associated email correspondence is available to verify their issue to NOPSEMA (and other agencies, as required).
		Reportable incidents are reported to NOPSEMA in accordance with the timing requirements provided in Table 8.4.	
	Incidents are investigated.	Incident investigations are undertaken by suitably qualified and experienced personnel in a timely manner.	Incident investigation reports are available and align with incidents recorded in the incident management system.
8.8	Changes to approved plans (including this EP), equipment, plant, standards or procedures are assessed through the MoC process.	Changes are documented in accordance with the MoC Directive.	MoC records are available in the Stature database.

Section	EPO	EPS	Measurement criteria
	All records relevant to implementation of the EP are available for five years.	All records relevant to implementation of the EP are retained by EOG.	EP documents are readily accessible.
8.9	Emissions and discharges from the vessels are recorded.	Emissions and discharges from the vessels are recorded.	Monitoring records are available and align with the requirements in Table 8.5.
	Regulatory agencies and stakeholders are aware of activity start and end.	Pre- and post-activity notifications to regulatory agencies and stakeholders are issued as per Table 8.6.	Notification records verify issue.
	The EP is reviewed for currency in light of any changes to the activity, controls, legislation or relevant scientific research.	EOG updates the EP as required.	The revision history of this EP is updated to record document changes.
	This EP is reviewed and updated on an as-required basis.	This EP is reviewed and updated based on the triggers presented in Section 8.9.3 on an as-required basis.	A record of EP reviews and updates is available.
			The review and/or update details are recorded in the document control page of this EP.
		If the review identifies that significant changes to the EP are required, the EP is updated and re-issued to the regulators.	A record of EP revision is included in the document control page of this EP.
			Correspondence is available to verify the re-issue of the EP to NOPSEMA.
	EP compliance inspections and audits are undertaken for the activity.	EP compliance is assessed pre-activity and during the activity by competent personnel.	Environmental inspection reports, completed checklists and audit report are available and verify compliance with this EP.
	An end-of-activity EP performance report is submitted to NOPSEMA.	The end-of-activity EP performance report is issued to NOPSEMA within three months of completion of the activity.	The end-of-activity EP performance report and associated email correspondence is available to verify its issue to NOPSEMA.

9 Oil Pollution Emergency Plan

In line with OPGGS(E) Regulation 31 and Section 2.6 of NOPSEMA's Environment Plan content requirement guidance note (September 2020), EOG refers the reader to Chapter 9 of its accepted PDSA EP (996161-2022-Beehive#1-PDSA-EP-Rev2, available here) that provides the OPEP for the activity.

The OPEP for the geotechnical activity does not differ from that presented in the PDSA EP.

10 References

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