Santos

Darwin Pipeline Duplication (DPD) Project – Offshore Construction Environmental Management Plan (CEMP)

PROJECT / FACILITY	Barossa DPD Project
REVIEW INTERVAL (MONTHS)	No review required
SAFETY CRITICAL DOCUMENT	NO

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	Pipeline Delivery Manager – Barossa Subsea & Exploration	Senior Environmental Approvals Manager	Barossa Project Director
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Abbreviations and acronyms

Abbreviation/acronym	Definition
AAPA	Aboriginal Areas Protection Authority
ABF	Australian Border Force
ABN	Australian business number
ABWM	Australian Ballast Water Management Requirements
AFANT	Amateur Fishers Association of Northern Territory
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
AFZ	Australian Fishing Zone
AHT	Anchor Handling Tugs
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
ALR Act	*Aboriginal Land Rights (Northern Territory) Act 1976*
AMCS-NT	Australian Marine Conservation Society – NT
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AMSA-NT	Australian Marine Sciences Association – NT
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ASS	Acid sulphate soils
ASSDMP	Acid Sulphate Soils and Dewatering Management Plan
ATRF	Arafura Timor Research Facility
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth)
AWR	Darwin air weapons range
AWTI	Above water tie-in
BHD	Backhoe dredge

Abbreviation/acronym	Definition
BIA	Biologically important area
BOM	Bureau of Meteorology
BWMS	Ballast water management system
CACO	Cultural awareness community observers
CAMBA	China-Australia Migratory Bird Agreement
CCWA	Conservation Council of Western Australia
CFA	Commonwealth Fisheries Association
CH_4	Methane
CHARM	Chemical hazard assessment and risk management
CHMP	Cultural Heritage Management Plan
CEMP	Offshore Construction Environment Management Plan
CLL	Crown Lands Licence
CMID	Common Marine Inspection Document
CMT	Crisis Management Team
CO_2	Carbon dioxide
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea, 1972
CSD	Cutter suction dredge
CSV	Construction support vessel
Cth	Commonwealth
DAC	Darwin Aquaculture Centre
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water and the Environment (now DAFF)
DCA	Department of Communications and the Arts
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DCMC	Department of the Chief Minister and Cabinet (NT)
DEPWS	Department of Environment, Parks and Water Security (NT)
DEWHA	Commonwealth Department of the Environment, Heritage, Water and the Arts
DGPS	Differential global positioning system
DGV	Default guideline value
DHAC	Darwin Harbour Advisory Committee

Abbreviation/acronym	Definition
DIPL	Department of Infrastructure, Planning and Logistics (NT)
DISR	Department of Industry, Science and Resources (Commonwealth)
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts (Commonwealth)
DITT	Department of Industry, Tourism and Trade (NT)
DLNG	Darwin Liquefied Natural Gas
DLRM	Department of Land Resource Management
DME	Department of Mining and Energy (NT)
DNP	Director of National Parks
DNRETAS	Department of Natural Resources and Environment Tasmania
DNV	Det Norske Veritas
DoD	Department of Defence (Commonwealth)
DoT	Department of Transport (WA)
DP	Dynamic positioning
DPA	Darwin Port Authority
DPD	Darwin Pipeline Duplication
DPFES	Department of Police, Fire and Emergency Services (NT)
DPIRD	Department of Primary Industries and Regional Development (WA)
DPMC	Department of the Prime Minister and Cabinet (Commonwealth)
DTFHC	Department of Territory Families, Housing and Communities (NT)
EAS	Environmental Assurance Activities Schedule
ECAP	Environmental Compliance Assurance Plan
ECNT	Environment Centre Northern Territory
EDO	Environmental Defenders Office
EDP	Exceptional Development Permits
EEZ	Exclusive Economic Zone
EIS	Environmental impact statement
ENVID	Environmental impact identification
EP	Environment Plan
EPA	Environment Protection Authority
EP Act	*Environment Protection Act 2019* (NT)
EP Regulations	*Environment Protection Regulations 2020* (NT)

Abbreviation/acronym	Definition
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPO	Environmental performance objective
EPS	Environmental performance standard
EMBA	Environment that may be affected
EMP	Environmental management plan
EMS	Environmental management strategy
ERP	Emergency Response Plan
ESD	Ecologically sustainable development
FCGT	Flood, clean, gauge and testing
FNCC	First Nations Consultative Committees
FPV	Fall pipe vessel
FRDC	Fisheries Research Development Council
GEP	Gas export pipeline
GMDSS	Global Maritime Distress and Safety System
GOMO	Guide for Offshore Marine Operations
GHG	Greenhouse gas
HAT	Highest astronomical tide
HDPE	High density polyethylene
HFO	Heavy fuel oil
HMAS	His Majesty's Australian Ship
HSE	Health, safety and environment
HSEQ	Health, safety, environment and quality
HV	Heavy vehicle
IACS	International Association of Classification Society
IBC	Intermediate bulk containers
IFO	Intermediate fuel oil
ILT	Inline tee
ILUA	Indigenous Land Use Agreement
ILSC	Indigenous Land and Sea Corporation
IMCA	International Maritime Contractors Association
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMDG	International Maritime Dangerous Goods

Abbreviation/acronym	Definition
IMO	International Maritime Organisation
IMR	Inspection, maintenance and repair
IMS	Introduced/invasive marine species
IMT	Incident Management Team
IPA	Indigenous Protected Area
ITF	Indonesian Through Flow
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
JRCC	Joint Rescue Coordination Centre
KEF	Key ecological feature
KLC	Kimberley Land Council
KNPMP	Kakadu National Park Management Plan
KP	Kilometre point
LAT	Lowest astronomical tide
LBL	Long baseline acoustic positioning system
LoR	Limit of reporting
LMS	Listed migratory species
LNG	Liquified natural gas
LTS	Listed threatened species
LV	Light vehicle
MARPOL	International Convention for the Prevention of Pollution from Ships
MARS	Maritime Aircraft Reporting System
MBES	Multibeam echosounder
MDO	Marine diesel oil
MEG	Mono ethylene glycol
MFE	Mass flow excavation
MFO	Marine fauna observer
MGO	Marine gas oil
MMNMP	Marine Megafauna Noise Management Plan
MNES	Matters of National Environmental Significance
MoC	Management of change
MSL	Mean Sea Level
N_2O	Nitrous oxide

Abbreviation/acronym	Definition
NAGD	National Assessment Guidelines for Dredging
NAXA	North Australian Exercise Area
NEMP	Nearshore Environmental Monitoring Program
NIAA	National Indigenous Australians Agency
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NLC	Northern Land Council
NMR	North Marine Region
NOEC	No Observable Effect Concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Commonwealth)
NORM	Naturally Occurring Radioactive Material
NO_x	Nitrogen oxides
NPFI	Northern Prawn Fishing Industry
NT	Northern Territory
NTASS Act	*Northern Territory Aboriginal Sacred Sites Act 1989* (NT)
NT EPA	Northern Territory Environment Protection Authority
NTGFIA	Northern Territory Guided Fishing Industry Association
NTM	Notice to mariners
NTSC	Northern Territory Seafood Council
NWMR	North-West Marine Region
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone depleting substances
OHS	Occupational Health and Safety
OPEP	Oil pollution emergency plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Commonwealth)
OPGGSER	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023
OVID	Offshore Vessel Inspection Database
OVMSA	Offshore Vessel Management and Self-Assessment
PASS	Potential acid sulphate soils
PDR	Preliminary Documentation Report

Abbreviation/acronym	Definition
PIG	Pipeline inspection gauge
PLET	Pipeline end termination
PLR	Pig launcher/receiver
PMP	Pipeline Management Plan
PMST	Protected Matters Search Tool
POLREP	Marine Pollution Report
PSL Act	*Petroleum (Submerged Lands) Act 1981*(NT)
PSV	Pipe supply vessel
PSV	Platform supply vessel
PTS	Permanent threshold shift
Q1, Q2, Q3 and Q4	Quarter 1, 2, 3 and 4
RAAF	Royal Australian Air Force
RFPA	Reef Fish Protection Area
RIB	Rock installation barge
RO	Reverse osmosis
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROV	Remote Operated Vehicle
SBP	Sub-bottom profiler
SDS	Safety data sheet
SER	Supplementary Environmental Report
SHB	Split Hopper Barges
SMPEP	Shipboard marine pollution emergency plan
SMS	Santos Management System
SOLAS	Safety of Life at Sea
SOP	Standard operational procedure
SOPEP	Shipboard oil pollution emergency plan
SO_x	Sulphur oxides
SSC	Suspended sediment concentration
SSS	Sidescan sonar
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
SWPLB	Shallow Water Pipelay Barge
TPWC Act	*Territory Parks and Wildlife Conservation Act 1976* (NT)
TSB	Territorial Sea Baseline

Abbreviation/acronym	Definition
TSDMMP	Trenching and Spoil Disposal Management and Monitoring Plan
TSHD	Trailer Suction Hopper Dredge
TSS	Total Suspended Solids
TTS	Temporary threshold shift
TWS	The Wilderness Society
UFP	Unexpected Finds Protocol
UCH	Underwater Cultural Heritage
UCH Act	*Underwater Cultural Heritage Act 2018* (Commonwealth)
USAT	United States Army Transport ship
USBL	Ultra-short baseline
UXO	Unexploded ordnance
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WMPC Act	*Waste Management and Pollution Control Act 1998* (NT)
WPDRG	Wickham Point Deed Reference Group
WWF	World Wildlife Fund

Glossary

Term	Definition
Biologically important area	Areas spatially defined and mapped by the Commonwealth Department of Environment (DoE) where aggregations of individuals of a species are known to display a biologically important behaviour such as breeding, foraging, resting or migration.
Consequence	Impact of an event or incident e.g. a loss, injury or concern. May be expressed qualitatively or quantitatively.
Environmental Performance Standard	A statement of performance required of a management action.
Environmental Performance Objective	Measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks are of an acceptable level.
Hydrotest	Hydrostatic pressure test
Impact	A positive or negative effect the DPD Project would have on the environment (including physical, ecological and socio-economic environments).
Intertidal	Pertaining to the zone between lowest astronomical tide (LAT) and highest astronomical tide (HAT)

Term	Definition
Licence	A licence granted under Part III or section 43 of the Energy Pipelines Act 1981 (NT) with respect to the portion of the DPD pipeline in NT Internal Waters and a licence granted under the PSL Act with respect to the portion of the DPD pipeline in NT Coastal Waters.
Licensees	The registered holder of a licence
Measurement Criteria	A system of measurements that define whether Environmental Performance Standards and Environmental Performance Objectives are being met.
NT Coastal Waters	NT waters between the TSB and the boundary of NT and Commonwealth waters 3 nm offshore from the TSB. Petroleum pipeline construction activities in NT Coastal Waters are governed by the PSL Act.
NT Internal Waters	Used herein to refer to the NT waters inshore of the TSB. Petroleum pipeline construction activities in NT Internal Waters are governed by the *Energy Pipelines Act 2018*.
Onshore CEMP	Onshore Pipeline Construction Environmental Management Plan (BAS-210 0025)
Onshore termination point	The point (KP122.479, approximately 2 m above highest astronomical tide) to which the pipeline will be pulled ashore to by the shore pull activity.
Performance Criteria	The standards by which success of management actions is evaluated.
Performance Indicators	Measurable performance requirements that with Targets, measure achievement of the Environmental Performance Objectives.
Pigs	Pipeline inspection gauges
Pipeline	A pipe or system of pipes that has or have a maximum allowable operating pressure greater than 1050 kilopascals or a hoop stress (being a circumferential stress arising from internal pressure) that is, at one or more positions, greater than 20% of the specified minimum yield stress specified in the manufacturing standard with which the pipe complies and that are used or intended to be used for the conveyance of an energy-producing hydro-carbon, and includes: a. all structures for protecting or supporting a pipeline; and b. (b) all loading terminals, works and buildings and all fittings, pumps, tanks, appurtenances, and appliances, c. used in connection with a pipeline, but does not include: d. a pipeline constructed or to be constructed on land used for residential, business, agricultural, commercial, or industrial purposes, designed for use solely for the residential, business, agricultural, commercial or industrial purposes carried on that land and situated wholly within the boundaries of that land; or

Term	Definition
	e. a pipeline or a pipeline of a class declared under section 4(2) of the *Energy Pipelines Act 1981* (NT) to be a pipeline in respect of which a licence is not required
Pipeline management plan	Pipeline management plan in force, in relation to a pipeline, means: a. a pipeline management plan for the pipeline submitted by or for the pipeline licensee and accepted under the Energy Pipelines Regulations 2001; or b. if the pipeline management plan is accepted in part – that part of the pipeline management plan that is accepted, as revised from time to time under the Energy Pipelines Regulations 2001), but does not include a pipeline management plan for which the acceptance has been withdrawn.
Project Area	The Project Area extends 2 km either side of the DPD pipeline route in NT waters and additionally includes a spoil disposal ground and an onshore area within the DLNG facility footprint. Refer **Figure 1-1**.
Residual risk	Risk remaining after implementation of mitigation measures.
Risk	A combination of the potential consequence of an event occurring and the likelihood of the consequence occurring.
Santos	Santos NA Barossa Pty Ltd
Sensitive receptor	A receptor that could be subject to adverse impacts from the DPD Project.
Target	Specific and measurable performance requirements to achieve Environmental Performance Objectives.

Units of measurement

Unit	Definition
°	degrees
%	per cent
µS	microSiemens
cm	centimetre
dB	decibels
dB(A)	A-weighted sound pressure level in decibels
g	grams
Hz	hertz
kHz	kilohertz
km	kilometre
km^2	square kilometre
m	metre
m^2	square metre
mg/L	milligrams per litre
mm	millimetre
nm	nautical mile (1.856 km)
Pa	pascal
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
t	tonne
µPa	micropascal

1 Introduction

1.1 Project overview

Santos NA Darwin Pipeline Pty Ltd is the operator of the existing Bayu-Undan to Darwin Gas Export Pipeline (GEP). The Bayu-Undan to Darwin GEP is a dry natural gas export pipeline transporting gas from the Bayu-Undan field located in Timor-Leste waters to the Darwin Liquefied Natural Gas (DLNG) facility at Wickham Point peninsula near Darwin, Northern Territory (NT), Australia. The Bayu-Undan to Darwin GEP has been operational since 2005. In anticipation of the end of the Bayu-Undan field's commercial production, the Barossa field is being developed to supply gas to the DLNG facility.

The supply of backfill gas to the DLNG facility was originally planned to be achieved through the installation of a 262 kilometre (km) Barossa GEP to a tie-in point on the existing Bayu-Undan to Darwin GEP. In recognition of potential Carbon Capture and Storage opportunities at the Bayu-Undan field, an alternative solution has been approved to construct an additional segment of pipeline to extend the Barossa GEP to the DLNG facility, instead of tying into the Bayu-Undan to Darwin GEP. It is proposed that the additional segment of pipeline be used to transport backfill gas to the DLNG facility. Construction of this segment of pipeline is referred to as the Darwin Pipeline Duplication (DPD) Project, as it will be installed parallel to the existing Bayu-Undan to Darwin GEP. The effective 'duplication' of the existing Bayu-Undan to Darwin GEP is considered the optimal route to minimise potential environmental and social impacts.

The DPD Project (in both Commonwealth and NT waters) was referred to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) (EPBC 2022/09372) and determined to be a controlled action. The DPD Project was approved by a delegate of the Minister for the Environment and Water under the EPBC Act on 15 March 2024.

The DPD Project within NT jurisdiction was referred to the NT Environment Protection Authority (EPA) under the *Environment Protection Act 2019* (NT) (EP Act) and approved on 22 December 2023 by the NT Minister for Environment, Climate Change and Water Security (EP2022/022-001), on the recommendation of the NT EPA.

Compliance with this Offshore CEMP is a condition of approval of the DPD Project under both the NT EP Act and under the EPBC Act.

The pipeline will run from a location where the Barossa GEP approaches the existing Bayu-Undan pipeline and continue through Darwin Harbour to the beach valve location at the DLNG facility at Wickham Point (**Figure 1-1**).

The Santos NA Barossa Pty Ltd (Santos) DPD Project includes the installation, pre-commissioning and operation of:

- a ~23 km pipeline segment in Commonwealth waters (Pipeline Licence NT/PL6) regulated under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act);* and
- a ~100 km segment in NT waters and land. Approximately 8.26 km of the ~100 km of pipeline within NT jurisdiction will be installed in NT Coastal Waters (Pipeline Licence NTC/PL5), (being waters between the territorial sea baseline (TSB) and the boundary of NT and Commonwealth waters). The activity in NT Coastal Waters is regulated under the *Petroleum Submerged Land Act 1981* (NT) (PSL Act). The remaining ~91.74 km of pipeline will be laid in NT Internal Waters (Pipeline Licence NTC/PL37) and on land, inshore of the TSB. The activity in NT Internal Waters and on land is regulated under the *Energy Pipelines Act 1981* (NT).

The DPD Project pipeline will be mostly located 50 – 100 m from the existing Bayu-Undan to Darwin pipeline, to minimise potential environmental and social impacts. The Project Area for the DPD Project installation and pre-commissioning activities includes a 2 km buffer around the pipeline route in NT

waters, the onshore construction area at the DLNG facility, and an offshore spoil disposal ground, and buffer, for the trench spoil disposal (**Figure 1-1**).

Pre-lay trenching is required to meet a number of objectives, including providing pipeline protection and stability (in combination with rock installation), reducing pipeline spanning and ensuring compliance with shipping channel clear water requirements. Sections of the pipeline route within the harbour, with a combined length of up to ~12.8 km, will be trenched using various equipment with the remainder of the pipeline laid directly on the seabed. Rock sourced from a local quarry will be used to backfill in some areas where anchor protection or additional stabilisation is required.

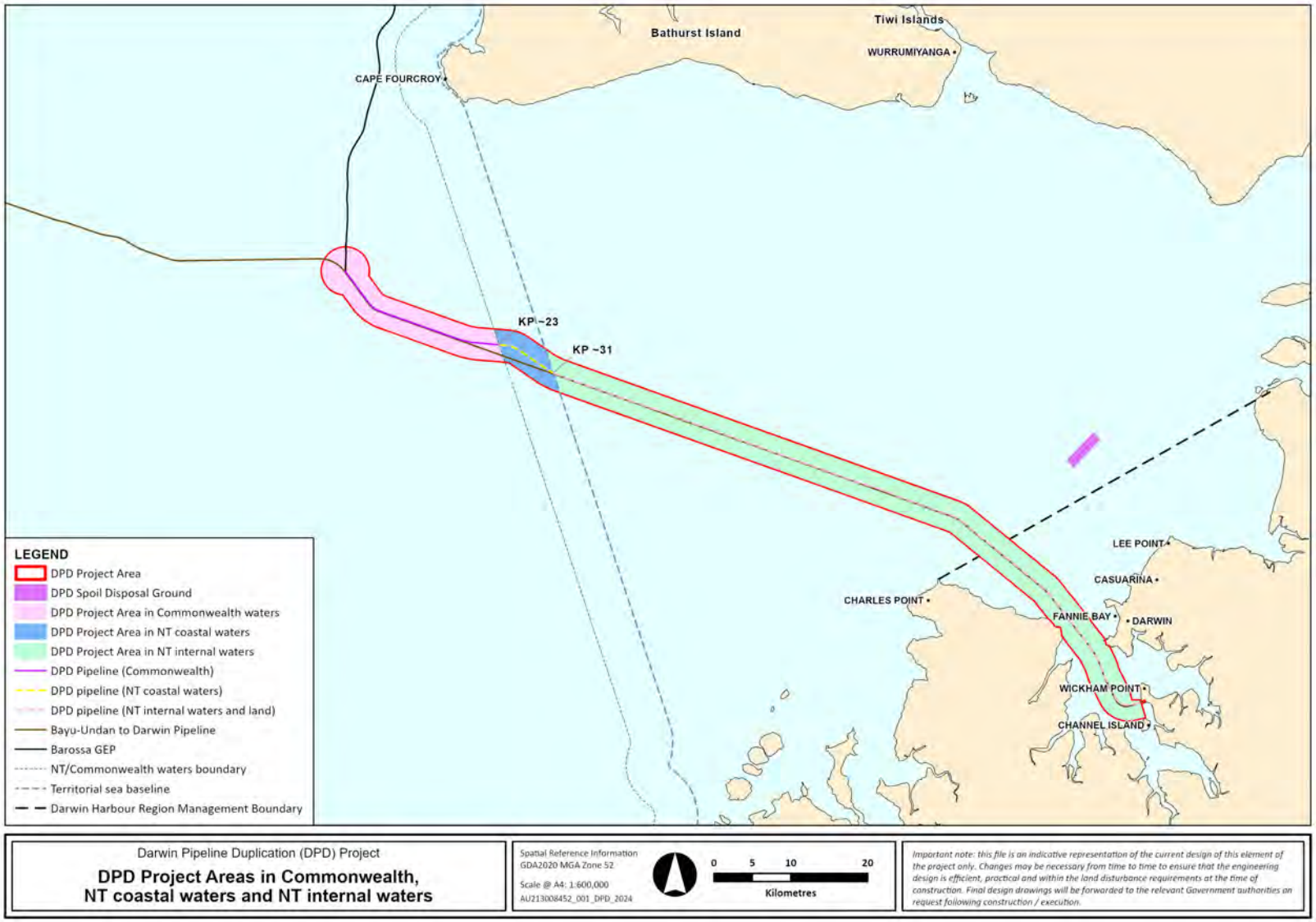


Figure 1-1: DPD Project Location

1.2 Purpose

This Offshore Pipeline Construction Environmental Management Plan (Offshore CEMP) has been prepared to detail environmental management requirements, to ensure the DPD Project pipeline construction and pre-commissioning activities in NT jurisdiction and on NT lands are undertaken in an environmentally responsible manner and are in line with regulatory requirements.

The purpose of this Offshore CEMP is to meet the relevant requirements of the:

- NT EP Act and *Environment Protection Regulations 2020* (NT) (EP Regulations), including conditions of approval of the DPD Project (EP2022/022-001).
- NT Draft Guideline for the Preparation of an Environmental Management Plan (NT EPA, 2015).
- EPBC Act as administered by the DCCEEW, including conditions of approval of the DPD Project (EPBC 2022/09372). This Offshore CEMP also considers relevant management and recovery plans and conservation advice for Matters of National Environmental Significance (MNES) and Commonwealth Marine Reserves Network Management Plans.
- NT Department of Mining and Energy (DME) policy statement that *the environment management components of the Pipeline Management Plan* (PMP) [required by the *Energy Pipelines Act 1981*] *are made public in an Environment Manage*ment *Plan (EMP) that* is submitted by the proponent and approved by the department and that *The EMP must demonstrate how environmental risks are controlled and reduced to a level that is as low as reasonably practicable (ALARP) and acceptable*.

This Offshore CEMP details the environmental impacts and risks associated with the activity and demonstrates how these will be managed. The Offshore CEMP provides an implementation strategy that will be used to measure and report on environmental performance during planned activities and unplanned events, to ensure impacts and risks are continuously reduced to and maintained at as low as reasonably practicable (ALARP) and an acceptable level. The environmental management of the activity described in the Offshore CEMP complies with the Santos Environment, Health and Safety Policy (**Attachment 1**) and with all relevant legislation (**Section 3**). All relevant stakeholder consultation performed has been considered in the development of this Offshore CEMP, where relevant (**Section 9**).

1.3 Scope

This Offshore CEMP addresses the construction and pre-commissioning of the ~100 km section of the DPD pipeline within NT jurisdiction. This includes the ~91.74 km section of the pipeline that is regulated under the *Energy Pipelines Act 1981* (NT), which is from the shore pull onshore termination point (location shown in **Figure 2-1**) to the boundary between NT Internal Waters and NT Coastal Waters. Spoil disposal activities at the nominated DPD spoil disposal area, are also covered under this Offshore CEMP.

Specific requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGSER) that apply to the construction and pre-commissioning of the ~8.26 km section of the DPD pipeline in NT Coastal Waters under the *Petroleum Submerged Land Act 1981* (NT) are addressed in the separate Barossa DPD NT Coastal Waters CEMP (BAS-210-0310).

This Offshore CEMP primarily covers activities supporting pipeline installation in marine waters, with some activities at the shoreline and onshore at the DLNG facility. The construction of the remaining section of pipeline between the onshore termination point and the upstream weld of the beach valve will be subject to the DPD Project Onshore Pipeline CEMP (BAS-210 0025) (Onshore CEMP) which is separate to this Offshore CEMP. The construction of the ~23 km pipeline section in Commonwealth waters is included in the Barossa DPD Environment Plan (BAA-200 0074) which has been accepted by the National Offshore Petroleum Safety and Environmental Management Authority.

A summary of activities relevant to each CEMP is provided in **Table 1-1,** which outlines the activities covered by this Offshore CEMP and the Onshore CEMP and those out of scope to the CEMPs.

This Offshore CEMP is an overarching management plan in NT waters and on land for the Santos Barossa DPD Project team and its contractors. Under this Offshore CEMP there are three additional management plans that provide further detail on the management of the environment during specific construction activities (**Figure 1-2**). These are the:

- Trenching and Spoil Disposal Monitoring and Management Plan (TSDMMP) (BAS-210 0023) that addresses all trenching and spoil disposal activities to the onshore termination point.
- Acid Sulphate Soil and Dewatering Management Plan (ASSDMP) (BAS-210 0049) that addresses all activities associated with acid sulphate soils (ASS) or potential ASS (PASS) from lowest astronomical tide (LAT) to the upstream weld of the beach valve.
- Marine Megafauna Noise Management Plan (MMNMP) (BAS-210 0045) that addresses all activities associated with noise impacts to marine megafauna from the Commonwealth/NT waters boundary to the onshore termination point.

In addition to the management plans listed above, a Cultural Heritage Management Plan (BAS-210 0208) for the DPD Project covering management of cultural heritage across both Commonwealth and NT waters has been developed to meet condition 4 of Environmental Approval 2022/011-001 under the NT EP Act.

This Offshore CEMP is valid for the duration of DPD pipeline construction and pre-commissioning activities including the period of DPD pipeline preservation, prior to commissioning and operation, which will be covered in separate operations environmental management plans, the NT Coastal Waters Operations Environmental Management Plan (BAS-210 0224) and the NT Internal Waters Operations Environmental Management Plan (BAS-210 0313).

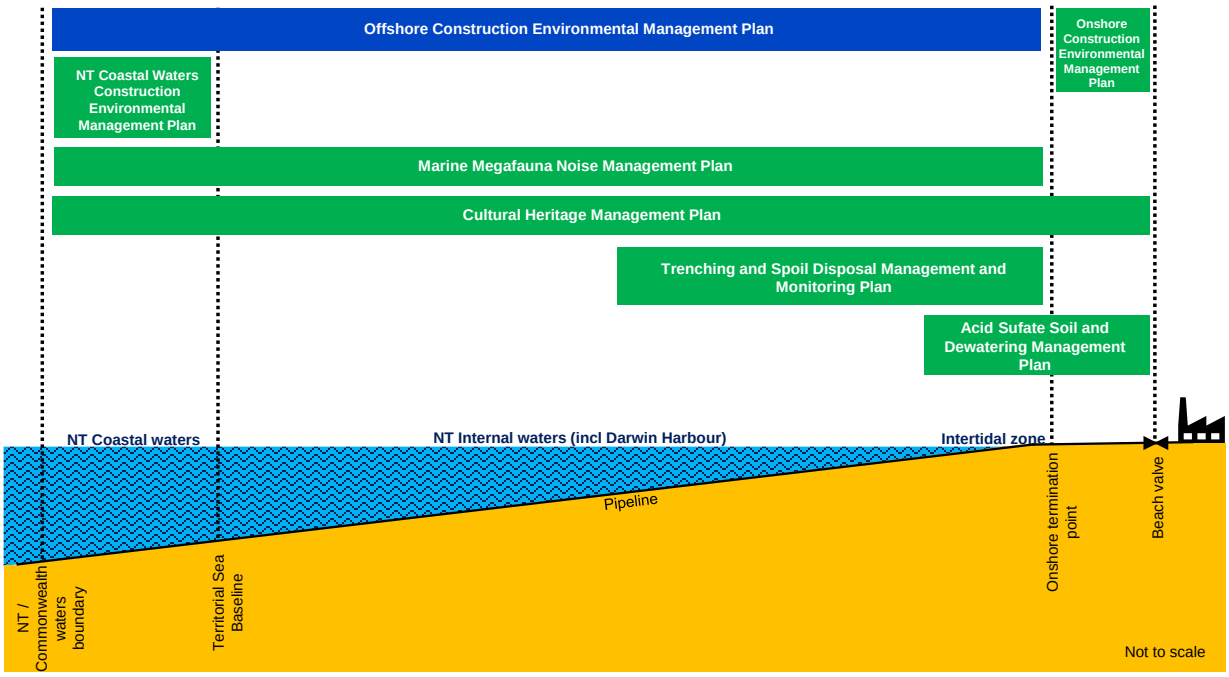


Figure 1-2: Conceptual model of management plan geographical scopes relevant to construction and pre-commissioning

Table 1-1: DPD Project Activities covered by the Offshore and Onshore CEMPs

Phases	Activities			
	Offshore CEMP		Onshore CEMP	Outside scope of CEMPs
	NT Coastal Waters[1]	NT Internal Waters and on land[2]	NT land[3]	
Surveys	Offshore Surveying during construction	Offshore Surveying during construction Environmental surveys during construction	Onshore surveying during construction	Low impact pre-construction surveys required to gather information for Project planning and approvals are out of scope for the CEMPs. These surveys include, but are not limited to, environment, heritage, geotechnical, geophysical and unexploded ordinance (UXO) surveys. Any surveys in Commonwealth waters.
Pre-lay works	Pre-lay span rectification	Targeted trenching (up to ~12.8 km in total) offshore from the onshore termination point to near the outer boundary of the Darwin Harbour Region Management Area. Spoil disposal at the nominated spoil disposal ground with some in situ placement in the intertidal zone to manage ASS risk. Pre-lay span rectification Cable crossings along the pipeline route Crossing of the Bayu-Undan to Darwin pipeline in two areas Installation of site buildings and generators	Onshore trenching of the pipeline route between the upstream weld of the beach valve location to the onshore termination point and onshore stockpile of trench material for use as trench backfill. This will involve: + Excavation of trench from the upstream weld of the beach valve to site pad + Extension of trench to the onshore termination point through the site pad zone once no longer in use + Storage of any identified ASS / PASS on limestone pads and treated with lime prior to reuse or disposal to landfill	Any pre-lay works within Commonwealth waters.

Phases	Activities			
	Offshore CEMP		Onshore CEMP	Outside scope of CEMPs
	NT Coastal Waters[1]	NT Internal Waters and on land[2]	NT land[3]	
		Construction of the site access road Installation of traffic plates over the existing Bayu-Undan pipeline Preparation of the site pad, including installation of geotextile and site hard stand areas, installation of holdback anchor, linear winch, trench and shore pull wire.		
Pipeline installation and pre-commissioning	Pipelay activities from the territorial sea baseline (TSB) to the NT/ Commonwealth waters boundary Post-lay span rectification Pipelay contingencies (including wet buckle repair and contingency treated seawater discharge).	Pipelay activities from the onshore termination point to the TSB In-line tee installation Rock backfill Post-lay span rectification Testing and pre-commissioning the pipeline offshore from the onshore termination point Post-lay trenching Pipelay contingencies (including wet buckle repair and contingency treated seawater discharge).	Installation of the onshore pipeline from the upstream weld of the beach valve to the onshore termination point Testing and pre-commissioning the pipeline between the onshore termination point and the beach valve Tie-in onshore pipeline to the offshore pipeline at the onshore termination point	Any installation or pre-commissioning within Commonwealth waters, including: + DPD Project Pipeline end termination (PLET) installation + Spool installation (between DPD Project PLET and Offshore Barossa GEP to PLET) + Discharge of treated seawater associated with pipeline pre-commissioning at the PLET. Installation of the beach valve and the pipeline between the beach valve and the DLNG facility Installation of the shore crossing CP monitoring system
Demobilisation	N/A	Removal of the pre-commissioning spread	Backfilling onshore pipeline trench	Any demobilisation in Commonwealth waters

Phases	Activities			
	Offshore CEMP		Onshore CEMP	Outside scope of CEMPs
	NT Coastal Waters[1]	NT Internal Waters and on land[2]	NT land[3]	
		Removal of the hard stand and geotextile Re-contouring of the site as applicable Removal of causeway/s	Site returned to pre-construction condition	
Pipeline preservation	Pipeline packed with nitrogen for preservation until commissioning commences	Pipeline packed with nitrogen for preservation until commissioning commences	Pipeline packed with nitrogen for preservation until commissioning commences	Preservation of the DPD pipeline in Commonwealth waters
Commissioning and operations	N/A – this will be covered under the Gas Export Pipeline NT Coastal Waters Operations Environmental Management Plan (BAS-210 0224)	N/A – this will be covered under the Gas Export Pipeline NT Internal Waters Operations Environmental Management Plan (BAS-210 0313)	N/A – this will be covered under the Gas Export Pipeline NT Internal Waters Operations Environmental Management Plan (BAS-210 0313)	Commissioning and Operations Inspection maintenance and repair
Decommissioning	N/A	N/A	N/A	Decommission pipeline Removal of subsea infrastructure Onshore decommissioning and rehabilitation As-left/ post-surveys

[1] Activities under the Offshore CEMP within NT Coastal Waters are those associated with construction of the pipeline between the territorial sea baseline (TSB) and the NT/ Commonwealth waters boundary. These activities are regulated under the PSL Act administered by DME and supporting regulations (NT Petroleum (Submerged Lands) (Application of Commonwealth Laws) Regulations 2004 and the OPGGSER). The specific requirements of the OPGGSER that apply to DPD Project in NT Coastal Waters are included in the Barossa DPD NT Coastal Waters CEMP (BAS-210-0310).

[2] Activities under the Offshore CEMP within NT Internal Waters and on land are those associated with the construction of the pipeline between the onshore termination point and the TSB. These activities are regulated under the Energy Pipelines Act 1981.

[3] Activities under the Onshore CEMP on NT land are those associated with the construction of the pipeline between the onshore termination point and the upstream weld of the beach valve. These activities are regulated under the Energy Pipelines Act 1981.

1.4 Plan structure

This Offshore CEMP has been prepared and structured in accordance with the Guideline for the Preparation of an Environmental Management Plan (in draft) (NT EPA, 2015). The requirements and where they have been addressed within the Offshore CEMP are detailed in **Table 1-2**.

Table 1-2: Offshore CEMP Plan Structure

Requirement **NT EPA: Draft Guideline for the Preparation of an Environmental Management Plan 2015**	**Relevant Offshore CEMP Section**
Project Overview Proponent details Key contacts	Section 1: Introduction
Clear and comprehensive project description	Section 2: Detailed Activity Description (includes location)
Legal and other obligations	Section 3: Legal and Other Obligation
Existing environment	Section 5: Existing Environment Attachment 2 DPD Values and sensitivities of the marine environment
Conceptual Site Model Environmental risk assessment	Section 6: Risk Assessment
Environmental Management Strategies	Section 7: Environmental Management Strategies Attachment 3: Management actions and performance standards and measurement criteria
Environmental management framework	Section 4: Environmental Management Framework Section 8: Implementation Strategy DPD Project Oil Pollution Emergency Plan (BAS-210 0026)
Communication	Section 9. Stakeholder consultation
Environmental management framework Communication	Attachment 1: Santos' Environment, Health & Safety Policy Section 9. Stakeholder consultation Section 8: Implementation Strategy

1.5 Proponent

1.5.1 Details of the proponent

Santos, as the operator of the Barossa Joint Venture, has received two pipeline licences from DME for the DPD pipeline within NT jurisdiction:

- Coastal and Territorial Waters Licence (NTC/PL5) for the 8.26 km section of the pipeline under the jurisdiction of the PSL Act in NT Coastal Waters; and
- Inland Waters Licence (NTC/PL37) for the 91.74 km section of pipeline under the jurisdiction of the *Energy Pipelines Act 1981* (NT) in NT Internal Waters.

An additional licence (NT/PL6) has been received for the ~23 km of pipeline in Commonwealth waters. Pipeline licences NTC/PL5 and NTC/PL37 are applicable to the section of pipeline within the scope of the Offshore CEMP. The titleholder details are provided in **Table 1-3**, with the nominated operator shown in bold.

Table 1-3: Titleholder details for Barossa DPD Project's NT pipeline licences

Title	Proponent	ABN	Interest	Contact details
Coastal and Territorial Waters Licence (NTC/PL5) (*Petroleum (Submerged Lands) Act 1981*) Inland waters licence (NTC/PL37) (*Energy Pipelines Act 1981*)	**Santos NA Barossa Pty Ltd** (nominated operator)	44 109 974 932	25.0%	Business Address: Level 7, 100 St Georges Terrace, Perth, Western Australia, 6000 Telephone number: (08) 6218 7100 Fax number: (08) 6218 7200 Email address: barossa.regulatory@santos.com
	Santos Offshore Pty Ltd	38 005 475 589	25.0%	
	SK E&S Australia Pty Ltd	55 158 702 071	37.5%	Business Address: Level 27, 152-158 St Georges Terrace, Perth WA 6000, Australia Telephone number: (08) 8 6186 2320 Fax number: None Email address: upstream@sk.com
	JERA Barossa Pty Ltd	18 654 004 387	12.5%	Business Address: Level 9 Brookfield Place, 125 St Georges Terrace, Perth, Western Australia, 6000 Telephone number: (08) 6311 7610 Fax number: (08) 6311 7613 Email address: barossa@jeraaustralia.com.au

1.5.2 Details of nominated liaison person

Name: Michael Marren

Title: Senior Stakeholder Adviser

Business address: Level 7, 100 St Georges Terrace, Perth, WA 6000

Telephone number: (08) 6218 7100

Email: offshore.consultation@santos.com

1.5.3 Notification procedure in the event of changed details

If there is a change in the nominated operator or a change in the contact details for the operator or liaison person, Santos will notify the DME and provide the updated details by email.

1.6 Document review, revision and availability

Under the Santos management system, this Offshore CEMP may be reviewed and revised in response to changing circumstances, as an outcome of continuous improvement processes and/or as new information come to hand concerning the existing environment and potential impacts and risks of the activity to that environment.

The previous revision of this Offshore CEMP (Revision 0, which followed Revision E) was provided to both the NT Minister for Environment, Climate Change and Water Security and DCCEEW in accordance with the required conditions of the environmental approvals, i.e., condition 9 of the NT EP Act approval (EP2022/022-001) and condition 8 of the EPBC Act approval (EPBC 2022/09372). Revision 0 was also provided to the NT Minister for Mining in support of the PMP required to construct a pipeline under the *Energy Pipelines Act 1981 (NT)* and *Energy Pipelines Regulations 2001 (NT)*. A pipeline licensee for a pipeline for which a PMP is in force must submit to the Minister a proposed revision of the PMP in the event of a change, or proposed change, of circumstances or operations under Regulation 33, when requested by the Minister under Regulation 34 or at the end of each five-year period under Regulation 35.

This revision (Revision 1) of the Offshore CEMP has been prepared to include for minor activity updates and to clarify the interface of this document and the DPD Project Coastal Waters Construction Environmental Management Plan (Coastal Waters CEMP) (BAS-210 0310).

This Offshore CEMP will be submitted to the NT Minister for Lands, Planning and Environment as per Condition 9 of Environmental Approval EP2022/022-001 and will be submitted to DCCEEW as per Condition 8 of the EPBC Act approval (EPBC 2022/09372).

Compliance with this Offshore CEMP is a condition of approval of the DPD Project (EP2022/022-001) under the NT EP Act. Implementation of this Offshore CEMP and achieving the environmental performance objectives and associated performance criteria is a condition of the DPD Project approval (EPBC2022/09372) under the EPBC Act.

2 Detailed activity description

2.1 Overview

Table 2-1 provides the key attributes of the activity covered by this Offshore CEMP. A detailed activity description is provided in **Section 2.3.** Construction and pre-commissioning activities are planned to occur 24 hours per day, seven days a week. The locations for activities along the DPD Project pipeline are described using 'kilometre points' (KP), where KP0 is the beginning of the pipeline from the end of the pipeline (pipeline end termination point) in Commonwealth waters and KP122.687 is the end of the pipeline (upstream weld of beach valve) (refer **Table 2-2** and **Figure 1-1).**

Table 2-1: Attributes of the Activity

Attribute	Summary
Activity location	The DPD pipeline will extend from the PLET at KP0 in Commonwealth waters to the upstream weld of the beach valve (KP122.687) onshore at the DLNG facility. The scope of this Offshore CEMP is limited to activities supporting the installation and pre-commissioning of the section of pipeline within NT waters and lands, from ~KP23 (NT/ Commonwealth boundary) to KP122.479 (the onshore termination point). Within NT waters, the pipeline installation activity between NT/ Commonwealth boundary at ~KP23 and the TSB at KP31.265 (i.e. installation within NT Coastal Waters) is governed by the PSL Act. The pipeline installation between the TSB at KP31.265 and the onshore termination point (KP122.479) is governed by the *Energy Pipelines Act 1981 (NT)*. The onshore termination point is approximately two metres above highest astronomical tide (HAT). The nominal coordinates of the KPs are provided in **Table 2-2**. The location of the Project Area within which construction and pre-commissioning activities covered within this Offshore CEMP will occur, is shown in **Figure 1-1** with further detail of the portion of the Project Area on land provided in **Figure 2-1**. Some activities covered by this Offshore CEMP will occur within the DLNG facility site and there will be some overlap in the areas used by Contractors operating under this Offshore CEMP with Contractors operating under the Onshore CEMP.
Pipeline characteristics	Approximately 100 km of pipeline will be installed under this Offshore CEMP from ~KP23 (NT/ Commonwealth boundary) to the onshore termination point (KP122.479). The pipeline diameter between the PLET (KP0) and a reducer at approximately KP61.8 (approximately 60 km offshore) is 26 inches. The pipeline inshore of the reducer has a diameter of 34 inches. An in-line tee is located at approximately KP62.8 with a 14 inch diameter branch for future tie-in opportunities. The pipeline will be constructed from carbon steel with an external anti-corrosion coating and sacrificial anodes to maintain the pipeline integrity. A concrete coating will provide stability and protection.
Key activities	Pre-lay works phase: + Delivering and transferring linepipe (sections of pipe) to the pipelay vessel + Targeted trenching along sections of the pipeline route (~12.8 km in total) from the shore pull onshore termination point to near the outer boundary of the Darwin Harbour Region Management Area, including a floatation channel (**Figure 2-2**) + Spoil disposal at a nominated spoil disposal ground (**Figure 2-2**) with some in-situ placement within the intertidal zone to reduce acid sulfate soil (ASS) risk + Pre-lay span rectification + Installation of cable crossings along the pipeline route

	Pipeline installation phase: + Pipelay activities + In-line tee installation + Pipeline shore pull + Trench backfill using rock + Post-lay span rectification Testing and pre-commissioning phase: + Flood, clean, gauge and testing (FCGT) + Preconditioning + Nitrogen packing Preservation phase: + Following testing and pre-commissioning the DPD pipeline will remain in a preserved state (non-production) until commissioning and operations activities commence (not covered under the Offshore CEMP) Offshore surveys (throughout activity): + Pre-lay surveys + As-laid surveys + Post-lay surveys + Magnetometer surveys + Post cyclone surveys (if required) + Cathodic protection surveys + Environmental monitoring Refuelling and supply activities (throughout activity): + Vessel bunkering + Helicopter refuelling + Vessel loading/backloading Unplanned and non-routine inspection, maintenance and repairs (IMR) (throughout activity)
Vessels	**Trenching**
	+ Backhoe Dredge (BHD) assisted by Split Hopper Barges + Cutter Suction Dredge (CSD) + Trailing Suction Hopper Dredge (TSHD)
	Pipelay and Rock Installation
	+ Shallow water pipelay barge (SWPLB) + Deep water pipelay vessel + Pipe supply vessels (PSV) + Construction support vessel/survey (CSV) + Nearshore CSV/survey (Span Rectification) + BHD and barges for rock installation + Fall pipe vessel (FPV) for rock installation

	Support Operations + Multicat (Shallow water anchor handling for SWPLB and CSD) + Anchor handling tugs (AHTs) + Supply boat for all vessels + Crew boat (crew changes) + Survey vessels (includes uncrewed survey vessels)
Other support	Helicopters Remotely operated vehicles
Vessel fuel	Vessels will use Group II hydrocarbon fuels such as marine gas oil (MGO) or marine diesel oil (MDO).
Proposed schedule	A probable DPD construction sequence and schedule is provided in **Section 2.4.** The construction activities will likely span a nominal period of up to 12 months in the field. Of this period, the duration of activities within NT coastal waters is expected to be relatively short (i.e. on a scale of days to weeks) given the expected rate of deep water pipelay in this area (refer **Section 2.3.2.1**).

Table 2-2: DPD Pipeline route key locations

Location	Kilometre point	Easting (m)*	Northing (m)*
PLET in Commonwealth waters (outside the scope of this Offshore CEMP)	0	598,748.4	8,670,737.9
Boundary between Commonwealth and NT waters (offshore limit of activities covered by this Offshore CEMP	KP23.2	618,775.4	8,661,154.3
TSB (Boundary between NT Coastal Waters and NT Internal Waters)	KP31.2	625,769.3	8,657,535.9
26x34 inch reducer	KP61.8	654,554.3	8,647,162.5
In-line tee	KP62.8	655,495.8	8,646,825.4
Shore pull onshore termination point (inshore limit of pipeline construction covered by this Offshore CEMP)	KP122.479	702,272.7	8,614,606.4
Upstream weld of the beach valve	KP122.687	702,472.3	8,614,655.7

*Coordinates in GDA 94, MGA zone 52

2.2 Project Area

DPD Project construction and pre-commissioning activities in NT jurisdiction will occur within a Project Area defined in **Figure 1-1**. The Project Area extends 2 km either side of the DPD pipeline route in NT waters and also includes the spoil disposal ground and an area within the DLNG facility footprint. Activities undertaken within the Project Area that are not associated with the DPD Project are beyond the scope of this Offshore CEMP.

The Project Area includes:

- NT Coastal Waters (NT waters between the TSB and the boundary of NT and Commonwealth waters 3 nm offshore from the TSB) regulated under the PSL Act;
- NT Internal Waters (NT waters inshore of the TSB and outside Darwin Harbour Region Management Area) regulated under the *Energy Pipelines Act 2018 (NT)*. Note, this includes the proposed location for spoil disposal within NT Internal Waters;
- Darwin Harbour (i.e., waters within the Darwin Harbour Management Area). These waters are classified as NT Internal Waters regulated under the *Energy Pipelines Act 2018 (NT)*; and
- Shore crossing and onshore location including the short onshore section of the pipeline to the upstream weld of the beach valve. This area is regulated under the *Energy Pipelines Act 2018 (NT).* Note, pipeline installation activities between the onshore termination point and the upstream weld of the beach valve are covered by an Onshore CEMP and not this Offshore CEMP (refer to **Section 1.3**).

The Project Area within the NT waters has not been amended since the DPD Project – NT EPA Referral (BAA-201 0003; Santos, 2021). However, there has been a refinement to the onshore area for the DPD Project to include the temporary access road, part of which previously fell outside of the Project Area. The Project Area is shown in **Figure 1-1** with further detail of the shore crossing at the DLNG facility, including support facilities, shown in **Figure 2-1**.

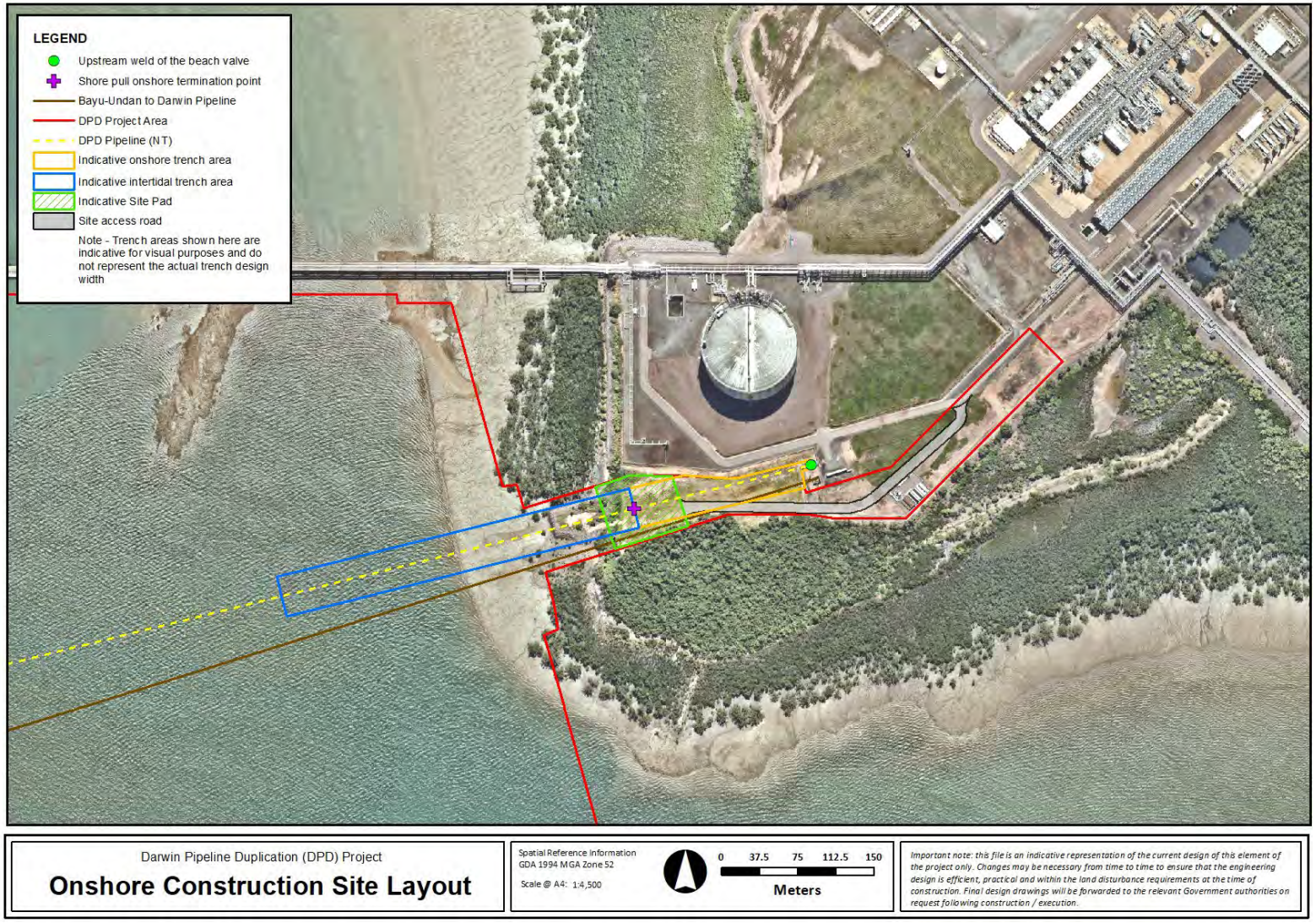


Figure 2-1: Shore crossing and indicative onshore layout within the Project Area

2.3 General detail of construction

While carbon steel pipe with concrete coating provides substantial protection to the DPD Project pipeline from external impacts, in shallower waters (including sections within Darwin Harbour) the DPD Project pipeline will require stabilisation due to exposure to waves, currents and tidal movement, as well as further impact protection from third-party activities (i.e. anchors). As such, in some areas the DPD Project pipeline will be installed and buried in a trench on the seafloor for stabilisation and protection.

The pipeline will be installed directly on the seabed (i.e. no pre-lay trenching required) from approximately the outer boundary of Darwin Harbour Region Management Area to the Commonwealth/NT waters boundary. Route optimisation has been conducted to avoid seabed features. Given pipeline stability is improved when the pipeline can be placed as flat as possible, some seabed intervention will be required as part of pre-lay rectification and/or stabilisation activities.

2.3.1 Pre-lay works

Pre-lay works required prior to installation of the pipeline include:

- Offshore surveying
- Onshore site set-up;
- Pipeline pre-lay trenching;
- Installation of rock causeway;
- Pre-lay span rectification; and
- Preparation for cable and pipeline crossings.

2.3.1.1 Offshore surveying

Surveys to be undertaken as part of the DPD Project include pre-lay surveys, surveys during pipeline trenching and installation. Surveys may continue throughout the construction and into pre-commissioning phase (which includes preservation) to monitor the activity and evaluate progress of the installation.

Pre-lay surveys identify debris, seabed features (including potential underwater cultural heritage [UCH]) or obstructions along the DPD pipeline route. It is not a full geophysical survey. An allowance of up to 250 m on either side of the DPD pipeline route allows for localised rerouting if any significant obstructions and areas of spanning are identified during the pre-lay survey. Geophysical pipeline route surveys (Fugro, 2022) and a maritime heritage archaeological assessment (Cosmos Archaeology, 2022) have already been undertaken for the DPD pipeline route and no debris or potential heritage items were identified that would need to be removed before installation or avoided.

As-laid, post-lay and cathodic protection surveys will also be progressively undertaken throughout the Activity. The data from these surveys will be used to determine the DPD pipeline position once laid, inform free-span rectification and identify deviations from straightness. Post cyclone surveys may be performed along the DPD pipeline, including during the preservation period, subject to cyclone intensity. Surveys will use the same techniques as outlined above and may also include visual inspections using ROVs, and cathodic protection inspections using passive field gradient sensing equipment.

The survey methods are non-intrusive and the equipment does not disturb the seabed. Survey methods include multibeam echosounder (MBES), sidescan sonar (SSS), sub-bottom profiler (SBP), ROV-mounted equipment (such as video, altimeter and obstacle avoidance sonar) and magnetometer.

MBES uses sound pulses to establish the seabed profile. Most modern MBES systems work by transmitting a broad acoustic pulse from a hull-, pole- or ROV-mounted transducer.

SBP determines the sea floor subsurface characteristics and composition using acoustics pulses transmitted from a towed surface or deep-sea source.

SSS detects debris and other obstructions on the sea floor using a towed transducer that transmits high-frequency acoustic pulses.

The magnetometer survey uses magnetic induction to identify the presence of iron (e.g. wrecks and unexploded ordnance) on the seabed from a towed surface or deep-sea source.

ROV-mounted obstacle avoidance sonar provides depth indications and object imaging to aid in navigation using sound waves. ROV-mounted altimeter measures an objects depth using depth or pressure sensors.

2.3.1.2 Onshore site set-up

Site works within the onshore portion of the Project Area will be required to support the offshore DPD Project construction and pre-commissioning activities up to the upstream weld of the beach valve (**Figure 2-4**). Earthworks will be required to facilitate the set-up of the onshore site and allow positioning of equipment, including removal of rock associated with an existing marine offloading facility (rock groyne), construction of a shore pull and Flood/Clean/Gauge/Testing (FCGT) site pad, and the creation of a temporary access road. The construction of the onshore site and onshore component of the shore crossing shall allow for shore pull activities, FCGT activities, onshore trenching and pipelay activities, and equipment layout for contingency operations, which include but not limited to allowing wet buckle dewatering to be performed whilst the pull head is attached to the winch wire.

To facilitate parallel activities at the site pad and shore crossing areas during trenching and pipeline installation of the onshore section, a temporary road will be built through the DLNG site. This will facilitate access to the shore crossing from the south side of the proposed pipeline route.

2.3.1.3 Pipeline pre-lay trenching

Locations of proposed trenching along the DPD pipeline route are all within NT Internal Waters as shown in **Figure 2-2.** There are various trench types that may be used depending on the overall design requirements. Proposed trench designs for the DPD Project are shown in **Figure 2-3**.

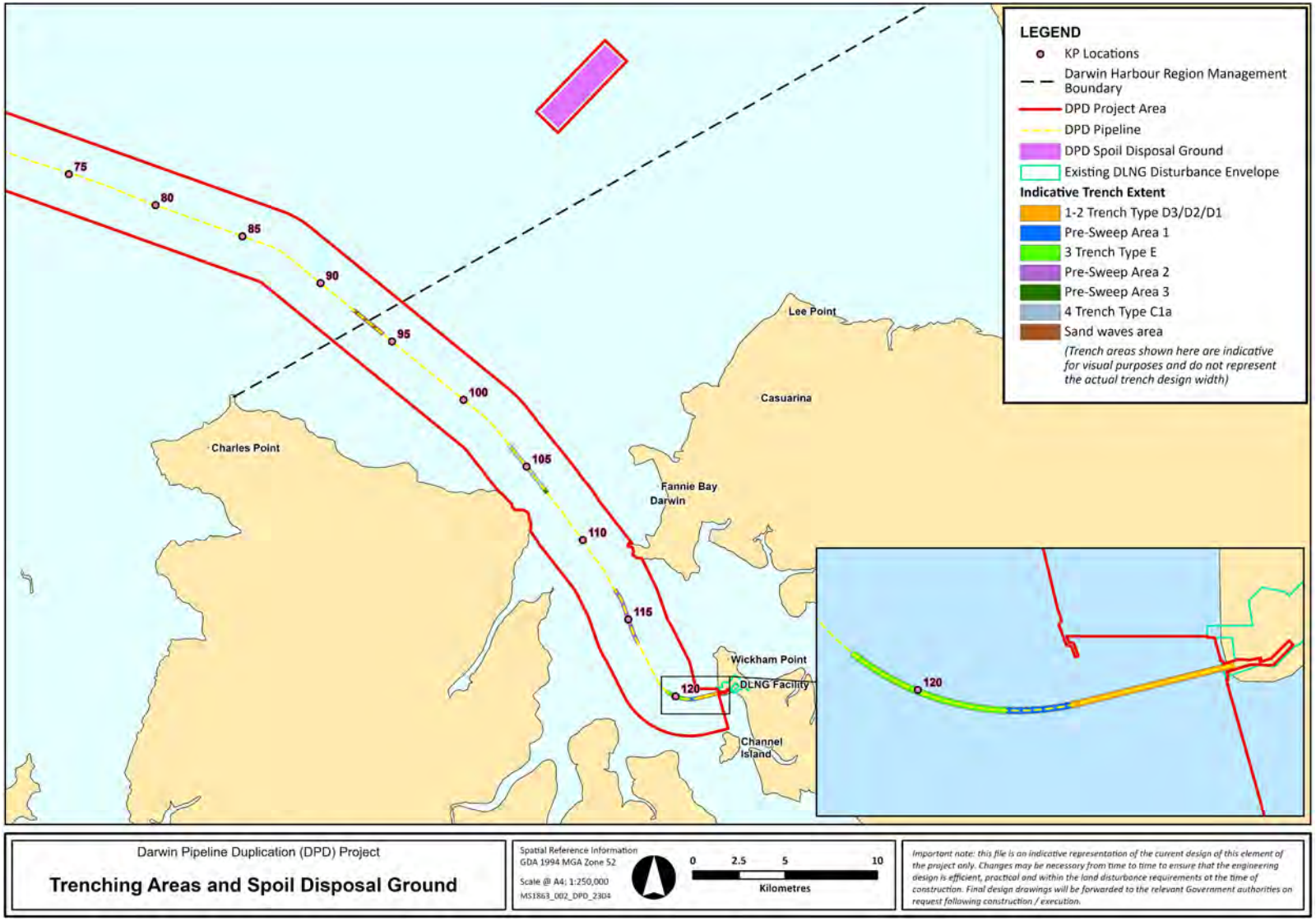


Figure 2-2: Indicative trench locations

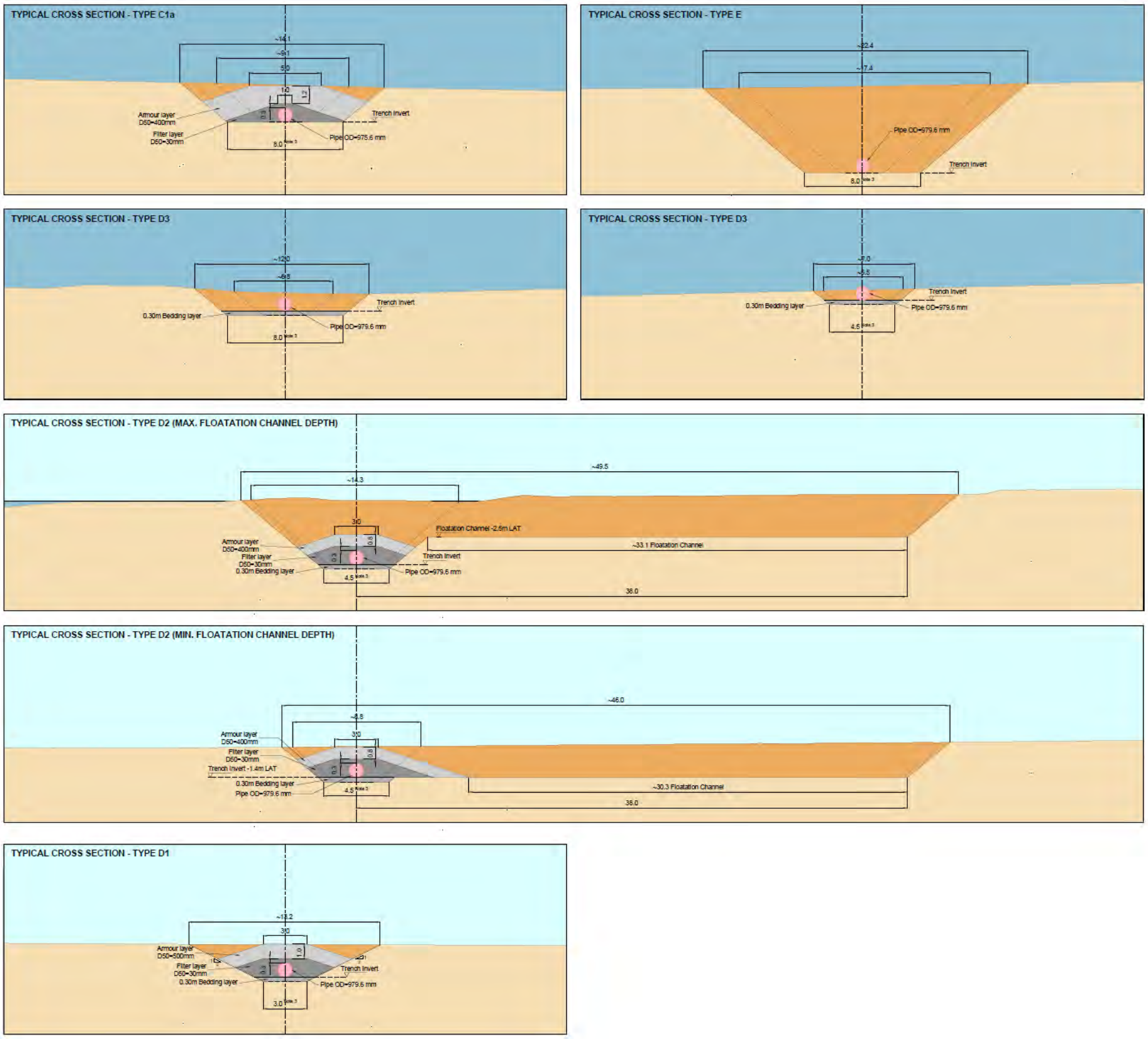


Figure 2-3: Indicative trench designs for the DPD Project

2.3.1.3.1 Darwin Harbour trenching

The pre-lay trenching associated with the DPD Project pipeline installation will involve the excavation of a trench along sections of the DPD pipeline route in Darwin Harbour (**Figure 2-2**) within an indicative trench design width up to 50 m. A trailer suction hopper dredge (TSHD), cutter suction dredge (CSD) and backhoe dredge (BHD) have been proposed for the pre-lay trenching works. Material will be excavated and disposed of at the spoil disposal ground (refer **Figure 2-2)**, adjacent to the previously used INPEX spoil disposal ground. To assist the trenching, a plough may be used in the trench areas to profile the trench bottom.

Closer to shore, a BHD will be used (Trench Type D3/D2/D1; **Figure 2-2**). Rock breaking tools may be used by the BHD for rock breaking. The BHD will be supported in shallow waters on spuds and will empty spoil onto split hopper barges. These barges are self-propelled or will be towed to the spoil disposal ground, where barges 'split' and spoil is released.

No blasting or rock fragmentation is proposed for the activity, however there may be some requirement for mechanical rock breaking using a BHD mounted hammer or Xcentric ripper at localised rock areas during trenching.

An indicative window for trenching activities is presented in **Section 2.4**. Depending on the final construction schedule, a maintenance dredging campaign may be required to ensure the trench is in specification for pipe lay. It is likely that only isolated pockets along the trench would require maintenance trenching.

Further information on trenching activities, impact assessment and monitoring/management measures is provided in the Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP) (BAS-210 0023).

2.3.1.3.2 Shore crossing

A combination of land-based excavators from onshore and a BHD from offshore will be used to dig the trench through the intertidal area of the shore crossing at the DLNG facility. To support this, some temporary shoreline modifications may be required, including the construction of a temporary causeway so the excavators can operate further from the current shoreline. The temporary causeway would be built with rock and fill (**Section 2.3.1.4**).

To enable the BHD to approach the shoreline, a floatation channel will also be dredged to create a safe passage for the BHD and Split Hopper Barges (SHBs). The channel is required to safely manage the large tidal range in the area.

Experience from the original Bayu-Undan to Darwin pipeline shore crossing works identified that the intertidal zone has potential to contain ASS. Some of the material excavated during the crossing construction was shown to have potential for ASS, which if left exposed to the air would have required treatment with lime. However, the ASS material recovered at the shore crossing was placed below the waterline, so no treatment was ultimately required.

If ASS or potential ASS (PASS) are identified during trenching activities, these will be managed by keeping the ASS/PASS material submerged. ASS/PASS material will be placed as close to lowest astronomical tide (LAT) as possible to keep the material wet under most tidal states, which will result in natural dispersion with the tides. PASS in both the intertidal zone and above highest astronomical tide (HAT) is anticipated to have sufficient acid-buffering capacity to avoid the generation of ASS.

Further information on ASS/PASS, impact assessment and monitoring/management measures is provided in the Acid Sulfate Soil and Dewatering Management Plan (ASSDMP) (BAS-210 0049).

2.3.1.3.3 Spoil disposal

Trenching for the DPD Project pipeline installation will result in the requirement to dispose of an estimated 323,000 m³ of spoil; however, up to 500,000 m³ has been considered as a contingency. The proposed spoil disposal ground for trenched material is located in NT Internal Waters to the north of Darwin Harbour, within the Beagle Gulf, approximately 12 km north-west of Lee Point. This location has been selected with consideration of technical, environmental, cost and safety aspects. The selected site is adjacent to the spoil disposal ground approved for use by INPEX for the Ichthys Gas Field Development Project (refer to **Figure 2-2**).

While most of the spoil material will be disposed of within the spoil disposal ground, material excavated at the shore crossing and up to the onshore termination point using land-based excavators will be placed as close to LAT as possible, resulting in the material being saturated across most tidal states. The material will naturally disperse via tidal action and any material remaining at high tide will be removed by BHD and disposed to the offshore DPD spoil disposal ground. This will be done to manage ASS risk and is further detailed in the ASSDMP (BAS-210 0049).

2.3.1.4 Rock causeway

A temporary rock causeway will be required to assist with the pre-lay trenching at the shore crossing (refer **Figure 2-5** for indicative design and location). Approximately 15,000 t of rocks will be required to be imported from the quarry for construction of the causeway. Revetment rocks will mostly be sourced from the location. A small layer of gravel or rocks will be applied as a top layer to allow machinery egress. The temporary causeway will cover a footprint of up to approximately 200 m long and 25 m wide, with height up to 4 m but an average height of 2 m.

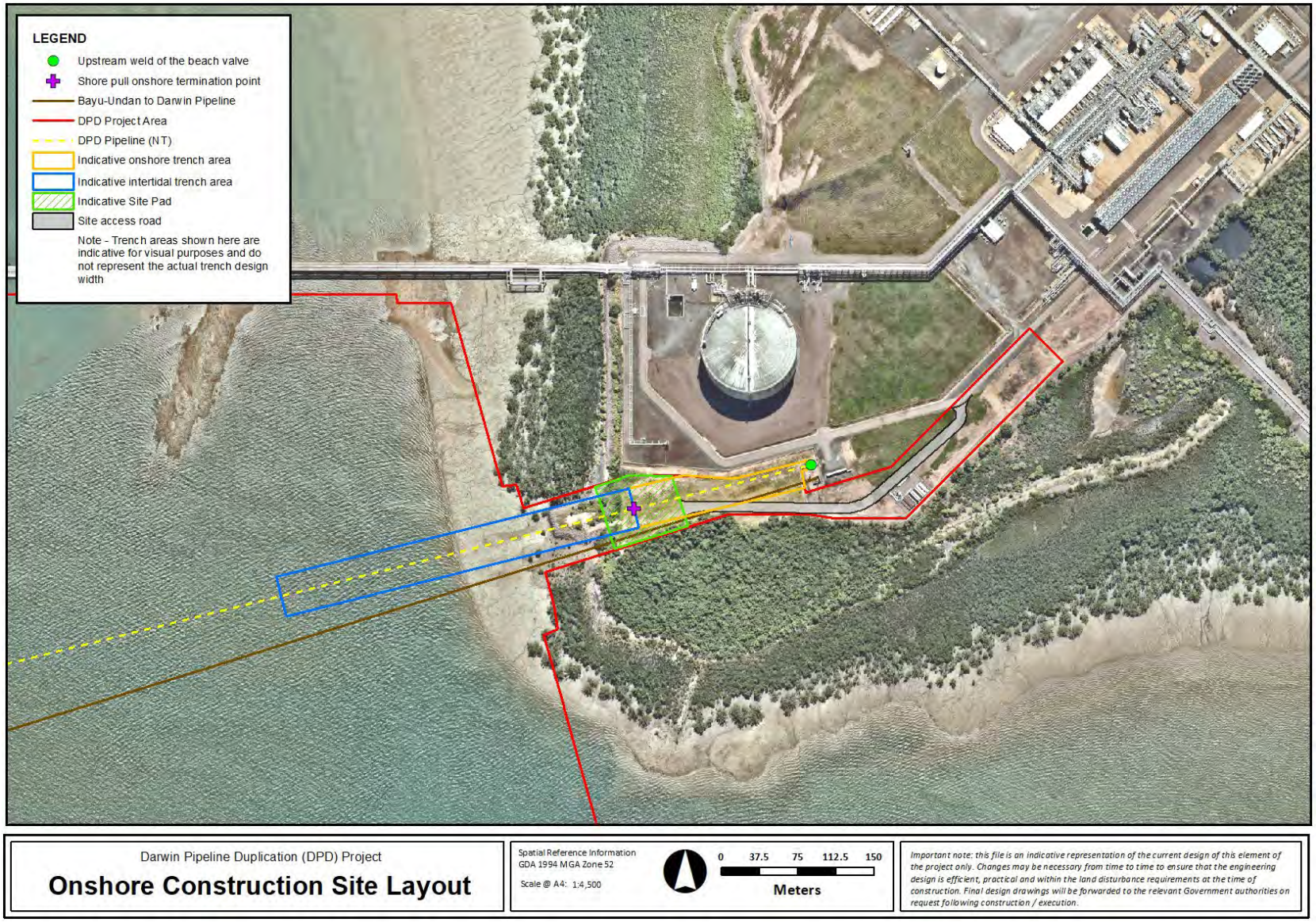


Figure 2-4: Onshore construction site layout

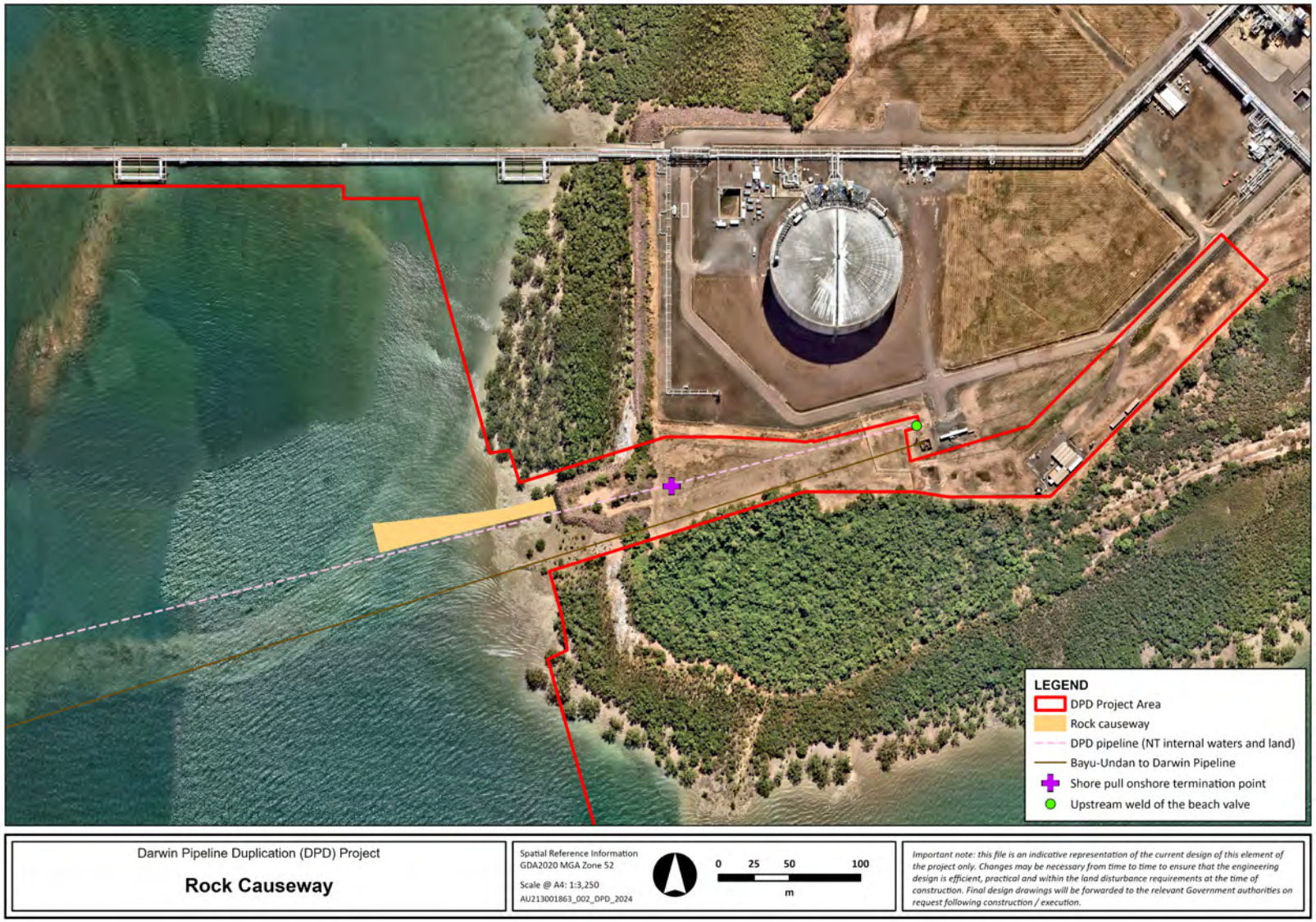


Figure 2-5: Location of causeway

2.3.1.5 Pre-lay span rectification and foundation installation

Pre-lay span rectification will be required in some areas to reduce pipeline spanning. The use of a TSHD to rectify sand waves by removal of sediment between KP92.2 and 94.4 (Sand waves area in NT Internal Waters) is shown in **Figure 2-2**. The TSHD may also be utilised within Pre-sweep areas within Darwin Harbour as shown in **Figure 2-2**. Otherwise, outside of these areas pre-lay span rectification will occur either through use of mass flow excavation (MFE), TSHD or concrete mattresses/grout bags.

An MFE tool works by accelerating a mass flow of water to blow away sediments within a localised area and can be used to accurately remove sediment high points and reduce pipeline spanning. MFE is an alternative to the installation of numerous concrete mattresses or grout bags. Where concrete mattresses or grout bags aim to support a spanning pipeline, the MFE will remove the span entirely, reducing pipeline exposure over its operational life and removing potential integrity concerns. The MFE would be deployed by a construction vessel using dynamic positioning and requires no additional seabed disturbance other than within the localised area in which the tool operates.

The use of MFE has been identified as a potential method to reduce sediment high points at eight locations within two areas along the offshore pipeline route in NT waters. Subject to timing and availability, the TSHD may also be utilised for pre-lay span rectification at these locations. The first area is between KP51 to KP53 (four sites), approximately 40 km offshore from the Darwin Harbour boundary. The second area is between KP72 and KP81 (four sites), approximately 12 km from the Darwin Harbour boundary. At each location it is typically expected that less than 100 m of excavation, to a nominal width of 3 m at the bottom of the excavation, will be required along the pipeline route.

The use of MFE would occur during pre-lay activities and is expected to take an indicative seven to 14 days to complete, with an estimated six hours of operation at each site. The TSHD would be expected to operate over a shorter window of up to seven days if utilised with spoil deposited at the designated spoil ground.

The installation of concrete mattresses or grout bags may also be used when MFE proves unsuitable (e.g., if consolidated sediments are encountered that cannot be removed by MFE), or as an adjunct if there is residual spanning that requires further rectification. Each concrete mattress footprint is ~18 m^2 and may be installed in groups and stacked on top of each other to reach the desired height.

Grout bags are commonly used to correct post-lay spans. Grout bags are made of flexible material (e.g. woven PP), which are filled with granular material such as sand. A binder (typically cement) is included to stabilise the granular material within the bag. Grout bags can also come filled with rock without any binding material (depending on the size of the rock particles). Depending on the height of the span, small, prefilled grout bags may be installed individually by ROV or may be lowered slowly to the seabed by crane in bulker bags for individual placement.

Higher spans are rectified using post-filled grout bags. The empty grout bags are positioned under the pipe by ROV and are filled from the surface using a liquid slurry of grout via a downline. The downlines are flushed to subsea after each operation to ensure the grout does not set in the downline between filling operations. Typically, post-filled grout bags are pyramidal in shape and the footprint of each grout bag is up to approximately 5 m by 5 m, depending on span height. The grouting operations may release up to 1.5 m^3 of grout per line with a maximum total volume 6 m^3. Grout is composed of cement, sand and water and is on the OSPAR PLONOR list. The fate of any grout released will not impact the seabed biota.

In addition, for the in-line tee, a steel pre-lay foundation may be installed, complete with scour protection using mattresses or grout filled mats, with an approximate footprint of 375 m^2.

2.3.1.6 Cable crossings

Telecommunications and power cables in Darwin Harbour will be protected during pipelay operations using concrete mattresses. Five cable crossings will be required in Darwin Harbour, with 4 cable crossings

requiring a single mattress and one requiring two mattresses to meet design requirements. Mattresses will support the pipeline to ensure a minimum separation of 300mmm between the pipeline and cable is maintained. Concrete mattresses have an estimated footprint of 12m x 6m with an expected total footprint of approximately 450 m^3.

For future cables, installation over the DPD pipeline will be managed in consultation with the owner/operator of the future cable and Santos.

Detailed surveys will be performed prior to any activities being performed in the vicinity of the power and telecommunication routes. Furthermore, anchoring associated with pipelay activities in this area will include appropriate pull-on and pull-off separation distances to ensure no interaction with the cables present, along with lifting exclusion zones to avoid dropped objects impacting these assets.

2.3.1.7 Pipeline crossings

The DPD pipeline crosses over the Bayu-Undan to Darwin pipeline at two locations in NT Internal Waters (KP110.6 and KP113.3) to avoid encroaching into the Darwin shipping channel. The crossing locations have been selected in regions where the Bayu-Undan to Darwin pipeline is covered by a rock berm and natural seabed morphology assists with pipeline crossing design. The DPD pipeline will be supported by concrete mattresses over the crossings to manage spanning and to ensure a minimum separation between the DPD pipeline and the Bayu-Undan to Darwin pipeline rock berm. It is expected that five concrete mattresses with a footprint of 12m x 12m each will be used, with a total disturbance footprint of approximately 720 m^3.

2.3.2 Pipeline installation and pre-commissioning

2.3.2.1 Pipelay activities

The pipeline will be 26/34-inch diameter carbon-steel with an external anti-corrosion coating and anodes to maintain the pipeline integrity, with concrete coating to provide stability and protection.

The DPD Project pipeline will be installed using a continuous assembly pipe-welding installation method, which involves the assembly of the single pipe joints (approximately 12 m in length) in a horizontal working plane on-board the pipelay vessel. The pipe joints are welded together and inspected, before the welded area is coated on-board the vessel and lowered behind the pipelay vessel. The pipelay uses an ‘S-lay’ method (with the S notation referring to the shape of the pipeline catenary as it is lowered to the seabed). As the pipeline is lowered, it is supported on-board the pipelay vessel using a curved steel structure fitted with rollers known as a ‘stinger’.

Both a dynamically positioned (DP) deep water pipelay vessel (Audacia, **Figure 2-6**) and an anchored nearshore pipelay barge vessel (Sandpiper, **Figure 2-7**) will be used to perform the pipeline installation. Pipelay in shallow water will be conducted using the nearshore pipelay barge, while pipelay in deeper water, including in NT Coastal Waters, will be conducted using the deep water pipelay vessel. KP91.5 is the nominated handover point between the vessels in approximately 20 m of water: however, the actual handover point where the deep water pipelay vessel will take over will depend on operational requirements.

In the waters offshore from KP91.5 (including the portion in NT Coastal Waters), the pipeline will be installed at approximately 2 km/day using the deep water pipelay vessel. For this ~65 km extent the installation footprint will be limited to a conservative width of 5 m along the pipeline route.

Figure 2-6: Deep water pipe lay vessel (Audacia)

Figure 2-7: Nearshore pipe lay barge (Sandpiper)

In shallower waters, predominantly within the Darwin Harbour, anchoring will be required and the speed of pipelay will be reduced to ~300–400 m/day, depending on the coordination of other supporting activities (i.e., anchor handling during normal operations and pipelay barge and winch operations during shore pull). For this ~34 km extent, the installation footprint will be limited to 1 m along the pipeline route, plus the footprints required for vessel anchoring. It is estimated that each of the 10 anchors has a footprint of ~10 m^2, including chain sweep. Between 10–20 anchor moves are expected each day, for a period conservatively estimated as 100 days.

When close to the pipeline shore crossing, pre-installed onshore anchors may be used. These will be within the proposed shore crossing (i.e., onshore) disturbance footprint. If onshore anchors are used, these anchors have a typical footprint of 5 m × 5 m with an additional 40 m^2 for anchor wire on the seabed.

The base case is for the DPD Project pipeline to be sequentially installed, beginning at the shore crossing, and progressing offshore through NT waters to the PLET in Commonwealth waters, thereby crossing the NT/Commonwealth waters boundary. For this to occur, the last section of pipe laid by the shallow water pipelay barge will have a recovery head arrangement installed, which will include a submersed pennant buoy that allows the pipe to be recovered by the deep water pipelay vessel. Once retrieved the recovery

head will be removed and the recovered pipe welded to the new section of pipe to commence the deep water pipelaying process.

An alternative to pipelaying sequentially from onshore to offshore is to pipelay concurrently with the deep water pipelay vessel and a shallow water pipelay barge. In this scenario, the shallow water vessel would still commence at the shore crossing to facilitate the shore pull and the deepwater vessel would begin lay at KP0. An above water tie-in (AWTI) would be performed where the two sections of pipeline meet. The AWTI would occur using the shallow water pipelay barge and would involve recovery of pipeline end sections using davits and subsequent welding from a temporary work platform. This activity would involve the installation of buoyancy modules on the pipe tails to support the pipeline end sections and facilitate correct alignment for welding. Timing of AWTI operations would coincide with neap tides where practicable.

2.3.2.2 Dead-man anchoring

In the scenario where the pipeline is not sequentially laid from nearshore to offshore, a dead-man anchor may be used during a midline start up by the deepwater pipe lay vessel in NT Internal Waters. The dead-man anchor will 'dig' into the seabed to provide stability for the deep water pipelay vessel during pipelay initiation.

In this scenario, a dead-man anchor will be employed adjacent to the DPD pipeline route, approximately 1,500 m shoreward from the deep water pipelay vessel on the proposed pipeline route. Due to the nature of a mid-line start-up, there is no 'target box' or 'cut-to-length' requirements for the dead-man anchor cable start-up location. All pipeline laid will remain part of the final pipeline system. Existing cut-to-length joints within the pipeline system will be utilised to achieve all required positional accuracies. The pipeline initiation point (for the deep water pipelay vessel) is located at approximately KP91.5 (in NT Internal Waters), with the dead-man anchor situated adjacent to the pipeline route at approximately KP90 (also within NT Internal Waters).

The expected duration of the dead-man anchor operation from connection of the dead-man anchor wire until head touchdown is approximately seven hours. This includes an allowance for contingency time.

Before the actual pipeline initiation can commence, the anchor will be installed and tested according to the procedure outlined in the Gas Export Pipeline – Audacia 26-inch Pipelay Procedure (BAS-273 5005). This is summarised below:

- Install the anchor, typically 22 t stevshark, fluke angle 32 degrees, at the midline start-up location adjacent to KP90;
- Move DP vessel to the required test location and pay out the 2.5-inch dead-man anchor cable from the dead-man anchor winch;
- The dead-man anchor will be tested by applying a factored bottom tension, for a duration of 30 minutes. To achieve the required test tension, the tension will be increased in a slow and controlled manner to allow the anchor to set firmly into the ground;

On successful completion:

- The dead-man anchor cable will be slackened from the dead-man anchor winch; and
- The dead-man anchor cable will be transferred outboard, re-routed over the stinger, and secured in the firing line. The dead-man anchor start-up rigging will be prepared and Audacia will set up at the start-up position.

A remotely operated vehicle (ROV) deployed from the dynamically positioned vessel or survey support vessel will perform the following tasks during installation and testing of the anchor:

- Monitor the correct landing of the dead-man anchor;
- Take a fix of the position of the dead-man anchor after landing;

- Monitor the anchor during the tensioning and testing of the dead-man anchor wire; and
- Take a fix of the dead-man anchor after completion of the test.

2.3.2.3 In-line tee

The in-line tee (ILT) will be installed at KP62.8 in NT Internal Waters during the pipelay activities by the deep water pipelay vessel. The ILT is welded into the DPD Project pipeline on-board the pipelay vessel and is installed as part of normal pipelay. A protection frame, approximately 5 m high, will be installed post-pipelay by crane or A-frame (guided by ROV).

2.3.2.4 Pipeline shore pull

Shore pull to bring the DPD Project pipeline onshore will use a conventional winch operation. The arrangement for the shore pull consists of a winch spread installed on a winch pad and attached to a hold back anchor located onshore.

The pipeline pull head on the shallow water pipelay vessel is connected to the winch using a pull wire and suitable rigging. The pipe will be pulled ashore from the pipelay vessel using the winch spread located onshore through the pre-constructed trench and winched up to ~2 m above HAT (i.e., the shore pull onshore termination point).

The pulling arrangement will allow for the shore pull to be completed as a continuous operation, which will take approximately two weeks.

2.3.2.5 Trench backfill

The primary method of maintaining pipeline stability on the seabed will be the concrete weighted pipeline coating. It will also be necessary to install localised secondary stabilisation/protection over the pipeline in trenched sections of the pipeline route within Darwin Harbour where the concrete weighted coating alone is not considered sufficient to provide stability and/or protection. Backfilling using rock will also be required to protect the pipeline in trenched areas within Darwin Harbour where 21.5 t anchors may be used by commercial vessels.

Rock sourced onshore from a local quarry (Mount Bundy) will be used for pipeline stabilisation and protection. The rock will be installed via a FPV and rock installation barge/s (RIB), with the potential to utilise a side dump rock vessel subject to vessel availability. In the harbour, a self-propelled DP FPV vessel or side dump vessel will be used to install rock over the pipeline in trenched areas. At the shore crossing, the RIB, potentially in conjunction with BHD support and split hopper barges, and onshore excavators, will install the rock. Rock will either be transported by support barges, split hopper barges, or loaded onto the FPV and RIB/s at Darwin Port or in the case of shore-based activities, road transport. The volume of rock required is expected to be 200,000 t and no more than 500,000 t. The RIB will either be positioned on spuds or utilise an anchoring system to ensure accurate rock placement.

2.3.2.6 Post-lay span rectification

To ensure pipeline integrity and resistance to overstressing and fatigue, post-lay span rectification may be required, and if so, would be undertaken by the installation of grout bags using a ROV. The likely disturbance footprint for each occasion of post-lay span rectification is 25 m^2. Downline flushing of the slurry will be required, which will result in a nominal amount of ~1.2 m^3 per fill cycle. It is estimated that there will be ~30 pre- or post-lay grout bags.

The actual locations will not be known until after the DPD Project pipeline is installed and surveyed and may be within either or both of NT Internal Waters and NT Coastal Waters.

2.3.2.7 Flood/ clean/ gauge/ testing (FCGT) and dewatering/ pre-commissioning

The following section outlines all aspects of the FCGT and dewatering/pre-commissioning processes: however, there is no planned discharge of FCGT fluids in NT waters and discharges are limited to Commonwealth waters in accordance with the relevant environmental approvals. Information provided on the FCGT process and discharges within Commonwealth waters has been provided for context as water extraction, filter flushing and pipelay contingencies outlined in **Sections 2.3.2.8** and **2.3.2.10** will occur within the Project Area.

FCGT activities will only occur once the pipeline has been laid in its entirety through NT and Commonwealth waters, with the pipeline installation in Commonwealth waters covered under a separate EP.

Once installed, the DPD Project pipeline internal surfaces need to be cleaned, tested, and preserved in preparation to carry hydrocarbons. This is conducted through pigging, whereby a series of pipeline inspection gauges (pigs) will be pushed through to clean and gauge the pipeline, and ensure all air is removed during the flooding process. Pigs are typically bullet shaped instruments that are pushed through the pipeline. Pig launcher/receivers (PLRs) will be installed on the PLET in Commonwealth waters and at the shore crossing. The pigs will be pushed from the shore crossing to the PLET using chemically treated seawater with seawater extracted from Darwin Harbour (termed water winning). The chemically treated seawater is typically a mixture of biocides (to prevent biofouling and bacterial corrosion on the internal surfaces), an oxygen scavenger (to control corrosion of the pipeline) and a dye (for leak detection during hydrotest). The proposed water treatment chemical is 'Hydrosure' or 'Hydro-3', however there may be a requirement to use other Santos approved chemical packages. The concentration of treated chemical will depend on the required preservation period, which is the period the pipeline will be left filled with the chemically treated seawater before being dewatered for tie-in and commissioning. However, the maximum concentration will be 400 parts per million (ppm).

Following pigging operations, the pipeline will be subjected to a hydrostatic pressure test (hydrotest). Hydrotesting will be completed in line with applicable Det Norske Veritas (DNV) standards and Santos procedures (DNVGL-ST-F101, DNVGL-RP-F115 and BAS-101 0253). The offshore pipeline installation contractor will source hydrotesting water by water winning from Darwin Harbour, which will be filtered to remove particulates and then chemically treated. A volume of chemically treated seawater will be pushed into the pipeline to raise its pressure. This hydrotest pressure will be held for a period of time as per the relevant standard to test the pipeline integrity. There will be small, localised discharges at the PLET as the pipeline is depressurised.

On completion of FCGT, the flooded pipeline will be dewatered of ~50,000 m^3 of treated seawater discharged at the PLET in Commonwealth waters. The pipeline will be dewatered using a train of dewatering pigs separated by mono ethylene glycol (MEG) slugs, driven by nitrogen, which will condition the pipeline. Approximately 1,000 m^3 of MEG is expected to be discharged. Dewatering is expected to take one week, and discharge will be at the seabed through a diffuser attached to the PLET.

On completion of dewatering, the pipeline will be left packed with nitrogen, ready for hook up.

While the current plan is to dewater the entire DPD Project pipeline in one event as described above, if there is a failure in the pipeline during installation that requires remedial construction work on the pipeline, or if a wet buckle occurs during pipelay (when there is a failure in the pipeline during installation resulting in the ingress of raw/untreated seawater), contingency plans will be implemented, with associated discharges. Refer to pipelay contingencies below for detail (**Section 2.3.2.10**).

2.3.2.8 Water extraction and filter flushing

To provide water for FCGT activities, water will be extracted (water winning) from Darwin Harbour. Water winning will occur via a pumping spread located on a small anchored construction support vessel, supplying water through a submerged high density polyethylene (HDPE) pipe to the DLNG site. It is anticipated that the support vessel and extraction hose will be positioned approximately 600 m from

shore in approximately 15 m of water at LAT. A screen will be installed over the intake of the hose to prevent marine fauna ingress. The total volume of water required will be dependent upon the nature of the FCGT and any contingency requirements (e.g., pipeline filling associated with responding to a wet buckle event). Planned FCGT water winning requirements are expected to require approximately 55,000 m^3 of water. Pumping rates are expected to be approximately nine to 16 m^3/minute, and water winning for FCGT activities is expected to take place over approximately three days (not including any contingency activities).

Water extracted from Darwin Harbour will be filtered prior to chemical treatment. To ensure the effectiveness of filters, regular backflushing is required. While the number of backflushes and volume of water associated with backflushing may vary depending upon the effectiveness of filters and level of clogging by suspended solids, it is estimated that a total of approximately 300 m^3 of backflush water is expected to be discharged. Backflush water will have a higher suspended solids loading compared to water extracted (i.e., higher than ambient Darwin Harbour water suspended solid concentration). The concentration of total suspended solids (TSS) within backflush water will depend upon the ambient concentration within Darwin Harbour, which will vary with tidal state and season. Water during spring tides and over the wet season are expected to be more turbid (higher TSS concentration) than water during neap tides and over the dry season.

Backflush water will be discharged onto the existing disturbed shore crossing construction site, where it will then drain into the intertidal area and solids will disperse with tidal movements. Where possible (and dependent on the progress of shore crossing rock installation at the time of FCGT activities), backflush water will be discharged onto installed rock, to baffle the flow of the discharged backflush .

2.3.2.9 Preservation period

The preservation period maintains the integrity of the subsea infrastructure after the infrastructure has been installed and pre-commissioned, including filling with nitrogen (refer **Section 2.3.2.7**), until such time that the DPD pipeline is commissioned and operated. Commissioning and operation of the DPD pipeline is outside the scope of this Offshore CEMP (refer **Table 1-1**).

2.3.2.10 Pipelay contingencies

While highly unlikely, failures in the DPD Project pipeline and wet buckling can occur during pipelay activities. In these situations, pipelay contingency activities will be required.

A ‘wet buckle’ event may occur during installation should the pipeline become buckled and fracture during pipelay, resulting in flooding of the pipeline with raw, untreated seawater. If this occurs, the raw seawater will need to be displaced from the pipeline to prevent corrosion to the undamaged section of pipeline. To remove the raw seawater, a slug of filtered seawater is launched between two contingency pigs to clean and flush the pipeline. The pigs and filtered seawater slug are pushed with compressed dry air supplied from a temporary spread at DLNG. The pipeline end is then recovered and pipelay can continue.

In the event of an extended period before pipelay can recommence, the pipeline will be flushed and then filled with inhibited seawater to safely preserve the pipeline in the intervening period before pipelay is recommenced. The inhibited seawater will be treated with chemicals to preserve the pipeline (i.e., the same treatment described in **Section 2.3.2.7**). If preservation is required, the entire content of the treated seawater within the pipeline will be discharged (dewatered) prior to pipelay recommencing.

The wet buckle event may occur anywhere along the proposed pipeline between KP0 and KP122.2 and therefore contingency dewatering could occur within this range. Treated seawater discharge modelling has been conducted at three locations in NT waters (KP84, KP102 and KP114) and at the boundary of NT and Commonwealth waters (KP23) to inform impact assessment of contingency treated seawater of discharge in NT waters. These sites were specifically selected due to their proximity of pipeline to areas of environmental importance (i.e., reefs, coral etc.) and/or to be representative of different metocean conditions and discharge volumes along the pipeline route in NT waters.

Both overflow (excess treated seawater discharged when filling the pipeline, modelled as a 600 m^3 release) and dewatering discharges were modelled at these locations with the exception of KP23 where only dewatering was modelled. During dewatering, the volume modelled varied due to the length of the pipe at the given location, shown below, noting that the pipeline would be filled from shore at ~KP122, therefore a discharge at a lower KP indicates a greater length/volume of pipeline dewatered.

- KP23 - 43,332.5 m^3 (NT Coastal Waters/ Commonwealth Waters boundary)
- KP84 – 19,958 m^3
- KP102 – 10,623 m^3
- KP114 – 4,400 m^3

2.3.2.11 Inspection, maintenance and repairs

Inspection, maintenance and repair (IMR) activities for the subsea infrastructure are not planned to occur during the construction and pre-commissioning (including the preservation period) phase covered by this Offshore CEMP. However, unplanned IMR activities of the infrastructure or supporting structures may be required due to unplanned events (e.g. unstable seabed conditions, significant earthquake, major cyclone events, anchor strike, dropped objects, and trawl gear interference) that could physically damage and affect the integrity of the infrastructure, possibly triggering the requirement for an inspection. IMR activities are typically undertaken from a vessel equipped with ROVs with transponders, supported by supply vessels, ROVs and divers (if required). These unplanned events are not expected to occur; however, they are included in this Offshore CEMP in the very unlikely event that they are required.

Inspection activities (such as cathodic protection surveys, MBES and general visual inspections) may occur on infrastructure.

Typical maintenance and repairs undertaken include:

- cathodic protection system maintenance, including anode replacement
- infrastructure repairs and servicing (including leak testing)
- restabilisation
- marine growth removal
- fishing nets or other marine debris removal
- pre-commissioning.

In the unlikely event of pipeline failure, intervention on the pipeline may be required. This may entail fitting a pipeline clamp or pressure retaining sleeve over the site of the damage, seabed rectification, span correction, underwater cutting, wet parking, removal of a pipeline section and subsequent tie-in using a replacement section. This may result in pipeline intervention and pre-commissioning activities using similar approaches to those detailed in preceding sections.

2.3.2.12 Demobilisation of onshore support facilities

At the completion of the pipeline installation and pre-commissioning activities, the offshore pipeline installation contractor/sub-contractors will be responsible for removing the onshore supporting facilities e.g., site pad, access roads (**Figure 2-1**), as well as demobilising any onshore equipment. Wastes will be disposed of, and site reinstatement undertaken as required.

The causeway will be removed upon completion of all activities at the shore crossing site. Excavators will start at the deep end and recover material into dump trucks for temporary storage, with material subsequently disposed offsite. A final survey will be completed to confirm that the rock material brought to site for the causeway has been removed to the extent that the site is returned to the pre-existing topography prior to causeway installation.

2.3.3 Summary of vessel and support activities

Vessel and support activities will include the operation of vessels, vehicles/mobile plant, helicopters and ROVs. Vessel and support activities associated with the DPD Project will be undertaken throughout all phases of the DPD Project.

2.3.3.1 Vessel activities

Several vessel types will be required to complete the proposed activities, including:

- Marine survey vessels – to support pre-lay and post-lay surveys of the Project pipeline, including verifying trench depth and rock placement, support pipeline and structure placement, and monitor spoil ground;
- Remotely operated uncrewed surface vessels (USV) may be used for launching electrical ROVs to undertake surveys to support pipelay vessels. The USV would be operated remotely by a Vessel Master at a remote operations centre and a support vessel would be available in Darwin should any assistance be required. Typical USV size is in the order of 12 m long and 2.3 m wide with a hybrid propulsion system. They are typically fitted with radars, an emergency anchor, loud speaker, night vision, 360º camera and VHF radio;
- Environmental monitoring vessel – to conduct environmental monitoring during construction activities;
- Pipelay vessels – a deep water pipelay vessel (NT Coastal Waters and NT Internal Waters) and shallow water pipelay barge (NT Internal Waters only), to install the pipeline and ILT;
- Construction vessels – to support installation of structures (i.e., mattresses for scour protection, mechanical protection, stabilisation and pipeline support) and pre-commissioning activities;
- Rock installation vessels – including FPV, side dump vessels, split hopper barges and non-propelled barges (NT Internal Waters only);
- Trenching and spoil disposal vessels – including a CSD, TSHD, BHD and SHB (NT Internal Waters only);
- Pipe supply vessels – to provide pipe to the pipelay vessel; and
- Supply vessels – to provide general support, crew transfers, material and supplies to all offshore activities.

For trenching and spoil disposal activities, 11 vessels are expected to be required in NT Internal Waters. For deep water and shallow pipelay activities, six and seven vessels are expected, respectively. For rock installation six vessels are expected to be involved, and for pre-commissioning four vessels are expected to be involved.

Supply vessels are expected to operate from local regional ports (i.e., Darwin) to transport fuel, stores, waste, and specialist supplies such as rock and pipe etc.

2.3.3.2 Bunkering

Bunkering (re-fuelling) of the vessels may take place either at sea (ship to ship refuelling) or in port.

The pipelay, construction vessels and USV may require ship to ship refuelling in the Project Area. A support or supply vessel will transfer MDO (marine diesel oil) or MGO (marine gas oil) to the vessel using a refuelling hose. The pipelay vessels are anticipated to bunker up to 700 m^3, with the construction vessels bunkering up to a maximum of 350 m^3. The USV is anticipated to require bunkering of up to 5 m^3 every 2 weeks.

2.3.3.3 Helicopter activities

Helicopters are the primary means of transporting passengers or urgent freight to and from the pipelay vessel and helideck equipped construction vessel during offshore installation and pre-commissioning activities. They are also the preferred means of evacuating personnel in the event of an emergency. Helicopter support will primarily be supplied from Darwin Airport. Helicopter operations will be approximately three days per week, typically with two flights each day. Helicopters will operate during daylight hours unless in the event of an emergency. Helicopters may be required to refuel offshore.

2.3.3.4 Remotely operated vehicle activities

Throughout the DPD Project, offshore activities will be supported by ROVs. The ROV can be fitted with various tools and camera systems that can be used to capture permanent records of the underwater operations and immediate surrounding environment. Typical ROVs are operated using hydraulic control fluids (synthetic blend base oil), with the largest hydraulic control fluid tank being 5 L. The USV will be supported by an electric ROV. Compared to a typical ROV, it is lighter, smaller and does not have a hydraulic fluid reservoir.

2.3.3.5 Onshore facilities and equipment

Constructing onshore facilities will be required to undertake activities up to the shore pull onshore termination point. The activities include:

- Preparation the site pad and temporary stockpile – this will include a pre-excavation survey to establish a baseline for re-contouring of the site at completion of works. Soil investigations will also be conducted at the causeway, winch installation area and temporary stockpile area. Excavation will then commence with ~5000 m^3 of material moved to the temporary spoil stockpile or intertidal area (location of spoil dependent on ASS inspection).
- Temporary road construction, installation of geotextile and site hard stand areas – compaction of loose soils will be done with vibratory rollers, and post compaction geo-fabric will be installed where hardstand material will be applied. The hardstand material shall be placed and compacted to a minimum thickness of 300 mm. Lighting will be provided for safety purposes during night activities.
- Site installation of the ablution facilities and office buildings - ablutions will be connected to a septic tank with sludge periodically removed. Office containers will be lifted in via mobile crane and electrical wiring connected to a generator, which will be in protective casing.
- Installation of holdback anchor, linear winch, trench and shore pull wire - the winch will be installed using a crane with lifting capacity of 300/350 tons. Prior to the pipe pull operations, an anchor pit will be excavated with ~1608 m^3 of material removed, which will be stored onsite and used as backfill for the pit on completion of activities. The anchor pit is above HAT, and as the water table is assumed to be equal with the sea level it is expected that the bottom of the pit will be dry (excluding rain events).

The types of equipment expected to be used include:

- Light vehicles (LV);
- Mobile equipment, such as excavators, graders, trucks, fuel trucks etc.; and
- Heavy equipment, such as cranes.

Facilities to be installed at the project site include:

- Muster point
- Generator
- Contractor's offices

- Meeting room
- Stores container
- Heavy vehicle (HV) parking area
- LV parking area
- Light towers
- Septic tank with water supply tank
- Ablution facility discharging into septic tank
- Gas detectors

All equipment and facilities are rated for cyclones as per the cyclone rated design report.

2.3.4 Resource requirements and access

Other resources required for the DPD Project will include:

- Personnel during the construction period. Labour will be recruited from the domestic and local labour market where possible; however, this is subject to the contractor's resourcing requirements at the time. Accommodation will be provided for the workforce within the Darwin area or onboard vessels.
- Power will likely be supplied by onsite generators to support construction amenities and operation of equipment.
- Water usage for onshore activities, including for dust suppression, washdown facilities and ablutions supply will likely be sourced from mains water supply within the DLNG facility or provided as self-sufficient water through containerised water trucks.
- Access to the shore crossing location (i.e., onshore site) will be via the existing DLNG access at the end of Middle Arm Peninsula into Wickham Point.

2.3.5 Fuels and chemicals

Chemical and fuel storage will be stored onboard vessels and onsite at the shore crossing location at the DLNG facility and will include bunded fuel storage/tanks and/or double skinned fuel trucks where possible. Fuel trucks will likely be used to supply fuel to onshore construction equipment including excavators, graders, cranes, and generators. Hydrotest chemicals will also be stored onshore within a hydrotest spread (i.e., biocides, oxygen scavenger and dye). Vessels will take onboard fuel (bunkering) at designated refuelling facilities at Darwin Harbour or through ship-to-ship refuelling. Helicopters may refuel onboard vessels with helidecks, including the deep water pipelay vessel and associated construction vessel.

2.3.6 Atmospheric Emissions

A greenhouse gas (GHG) emissions study was conducted to determine the scope 1 emissions from the DPD Project, as well as scope 1, 2 and 3 emissions from the broader Barossa development. The scope 1 emissions within NT jurisdiction are emissions that result directly from the construction of the DPD Project, including:

- Vessel-based construction activities
- Onshore construction activities from power generating equipment (i.e., engine and generators)

The broader Barossa project will generate additional Scope 1 emissions, as well as Scope 2 and Scope 3 emissions which comprise electricity use, transport and construction of materials and consumption of Barossa products by customers.

The predicted total scope 1 emissions for DPD Project vessel construction activities in NT jurisdiction are approximately 50,000 tCO_2-e.

2.3.7 Discharges

The DPD construction and pre-commissioning activities in NT waters will produce the following discharges:

- Vessel discharges as allowed under applicable maritime regulations (e.g., the International Convention for the Prevention of Pollution from Ships; MARPOL), including treated sewage effluent and greywater, cooling water, reverse osmosis (RO) brine, deck drainage and bilge and ballast;
- Contingency pigging and pipeline dewatering resulting in discharge of treated seawater (in the event of an unplanned wet buckle only);
- Downline flushing of grout lines;
- Trench spoil (offshore (NT Internal Waters), intertidal, and onshore including PASS); and
- Filter backflush discharges associated with FCGT activities (water extraction) (NT Internal Waters only).

Approximate volumes of these discharges are presented in **Table 2-3**.

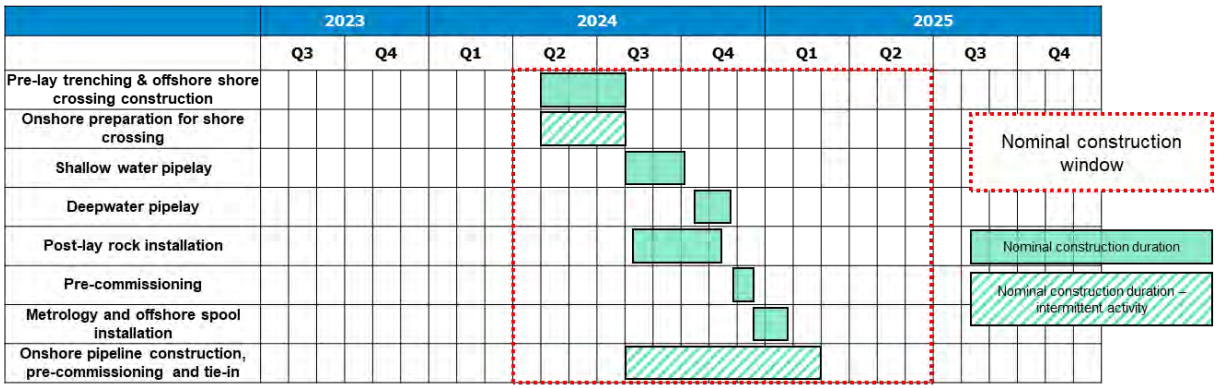
Table 2-3: Projected and contingency construction discharge volumes for the DPD Project in NT jurisdiction

Discharge source	Projected volume (m^3)	Contingency volume (m^3)
Vessel discharges	vessel/location dependent	n/a
Contingency treated seawater discharges	n/a	Dependent upon wet-buckle location. Example discharge volumes are provided below: ~43,332.5 (~KP23, NT Coastal Waters/ Cth Waters boundary) Within NT Internal Waters: ~19,958 (KP84) ~10,623 (KP102) ~4,400 (KP114)
Trench spoil	~323,000	Up to 500,000 (NT Internal Waters)
Downline flushing of grout lines	~40	n/a
Filter backflushing	~300	

2.4 Indicative construction schedule

Santos is targeting construction activities to be completed in readiness for Barossa first gas, which is currently expected in the third quarter of 2025. A nominal DPD construction sequence and schedule is shown in **Table 2-4** representing a start of construction activities at the beginning of a nominal construction window. The construction activities will span a nominal period of up to 12 months in the field. The actual construction sequence and schedule will be subject to the timely receipt of all regulatory approvals and drivers, such as vessel availability, operational issues, and weather. Santos' regulatory approvals and stakeholder consultation consider construction activities at any time between Q2 2024 to mid-2025.

Table 2-4: Preliminary pre-lay, construction, installation, and pre-commissioning schedule for DPD



3 Legal and other obligations

3.1 Legislative framework

Environmental legislative requirements governing the DPD Project are described in the following sections. All activities will comply with legislative requirements established under relevant Commonwealth and NT legislation. Key legislation is described below in **Sections 3.2.1**, **3.2.2**, **3.2.3** and **3.2.5**. Other relevant legislation is described in **Table 3-1** and **Table 3-2**. Relevant international conventions/agreements and standards, codes and guidelines for the DPD Project are outlined in **Sections 3.4** and **3.5**, respectively.

3.2 Key legislation

Key environmental and energy legislation is detailed below. The proposed DPD pipeline crosses Commonwealth and NT jurisdictions, and within NT waters the pipeline will be laid within NT Coastal Waters and NT Internal Waters. The application of key environmental and energy legislation across these jurisdictions is presented diagrammatically in **Figure 3-1**.

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of Climate Change Energy the Environment and Water (DCCEEW). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES). There are nine MNES to which the EPBC Act applies, these are: world heritage properties, national heritage places, wetlands of international importance, nationally threatened species and ecological communities, migratory species, Commonwealth marine areas, the Great Barrier Reef Marine Park, nuclear actions, and water resources (in relation to coal seam gas development and large coal mining development) (DCCEEW, 2022a). When a person proposes to take an action that they consider may need approval under the EPBC Act, they must refer the proposal to the Commonwealth Minister for the Environment and Water.

The DPD Project including activities in Commonwealth and NT waters (**Figure 3-1**) was referred to the DCCEEW under the EPBC Act on 7 October 2022 (EPBC 2022-09372). On 6 December 2022 the DPD Project was determined to be a Controlled Action requiring further assessment by Preliminary Documentation. Further information was requested under section 95A(2) of the EPBC Act on 23 December 2022.

It was determined that the Project may have a significant impact on the following controlling provisions under the EPBC Act:

- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 & 20A)
- Commonwealth marine areas (sections 23 & 24A).

Further information about relevant MNES is provided in Attachment 2.

The DPD Project Preliminary Documentation Report (PDR), including Santos' responses to public comments received from the PDR public submission period, has been assessed by the DCCEEW. Approval of the DPD Project by the Commonwealth Minister for the Environment and Water's delegate was received on 15 March 2024. The conditions of that approval relevant to the DPD in the NT jurisdiction include a requirement for Santos to implement this Offshore CEMP and to achieve all environmental outcomes and performance criteria set out in Table 7-5 to Table 7-41 inclusive.

3.2.2 Environment Protection Act 2019 (NT)

The *Environment Protection Act 2019* (NT) (EP Act) and associated *Environment Protection Regulations 2020 (NT)* (EP Regulations) are administered by the NT Department of Lands, Planning and Environment. The EP Act protects the environment and related purposes of the NT. The EP Act also:

- Promotes ecologically sustainable development;
- Recognises the role of environmental impact assessment and environmental approval in promoting the protection and management of the environment of the Territory;
- Provides for broad community involvement during the process of environmental impact assessment and environmental approval; and
- Recognises the role that Aboriginal people have as stewards of their country as conferred under their traditions and recognised in law, and the importance of participation by promotion of ecologically sustainable development.

The DPD Project within NT jurisdiction (**Figure 3-1**) was referred to the NT Environment Protection Authority (EPA) on 14 January 2022 under Section 55 of the EP Act. The NT EPA determined the DPD Project required assessment by SER (Tier 2) in accordance with the EP Regulations.

The DPD Project Supplementary Environmental Report (SER) (BAS-210 0020) was submitted to the NT EPA in May 2023 and addressed public and government authority submissions received on the referral as well as additional information requested by the NT EPA.

Following an additional round of public and government authority submission on the SER, the DPD Project was approved by the NT Minister for Environment, Climate Change and Water Security on 22 December 2023, on the recommendation of the NT EPA, subject to conditions which include the preparation of a Cultural Heritage Management Plan (CHMP) (BAS-210 0208) inclusive of an Unexpected Finds Protocol (UFP).

This Offshore CEMP has been developed under the guidance of the EP Act and the NT EPA Draft Guidelines for an Environmental Management Plan (NT EPA, 2015) and was submitted (as Revision E) to the NT EPA in support of the SER during the DPD Project assessment process.

As per DPD Project Environmental Approval (EP2022/022-001) condition 9, revised versions (Revision 0 and Revision 1) of this Offshore CEMP have been provided to the NT Minister for Environment, Climate Change and Water Security, with Revision 0 provided prior to the construction activities commencing.

It is also a condition of EP2022/022-001 the that this Offshore CEMP is implemented and complied with.

3.2.3 Energy Pipelines Act 1981 (NT)

The *Energy Pipelines Act 1981* (NT) allows for the creation of provisions for the construction, operation, maintenance and cessation of use or abandonment of pipelines for the conveyance of energy-producing hydrocarbons, and for related purposes. The *Energy Pipelines Act 1981* (NT) applies to the DPD Project in NT Internal Waters and on land, that is, waters inshore of the Territorial Sea Baseline (TSB) to the upstream weld of the beach valve (**Figure 3-1**).

The *Energy Pipelines Act 1981 (NT)* and subsidiary *Energy Pipelines Regulations 2001 (NT)* require the proponent to operate licensed pipelines in accordance with an accepted pipeline management plan (PMP). The *Energy Pipelines Regulations 2001 (NT)* do not require the PMP to explicitly consider environmental impacts and risks, however it is Department of Mining and Energy (DME) policy that an environmental management plan (EMP), demonstrating how environmental risks are controlled and reduced to a level that is as low as reasonably practicable (ALARP) and acceptable, is submitted with the PMP.

The previous revision of this Offshore CEMP (Revision 0) was submitted to DME (formerly DITT – Energy Division) on 28 March 2024 to support the assessment of the Barossa Nearshore Gas Export Pipeline

Trenching, Installation and Pre-commissioning Pipeline Management Plan (BAS-202 0052) for the DPD in NT Internal Waters, which was accepted under the *Energy Pipelines Act 1981 (NT)* on 9 April 2024.

3.2.4 Petroleum (Submerged Lands) Act 1981 (NT).

The *Petroleum (Submerged Lands) Act 1981* (NT) (PSL Act) allows for the creation of provisions with respect to the exploration for and the exploitation of the petroleum resources, and certain other resources, of certain submerged lands adjacent to the coasts of the NT and for other purposes. The PSL Act applies to the DPD pipeline in NT Coastal Waters, that is, waters between the NT/Commonwealth waters boundary and the TSB (**Figure 3-1**).

3.2.4.1 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023

The *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGSER) are Commonwealth regulations that are applied in NT by the *Petroleum (Submerged Lands) (Application of Commonwealth Laws) Regulations 2004 (NT)* and apply to NT Coastal Waters between the Commonwealth/NT waters boundary and the TSB (**Figure 3-1**). In Commonwealth waters, the OPGGSER are enacted under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and are administered by NOPSEMA (**Figure 3-1**). For NT Coastal Waters covered by the PSL Act, the OPGGSER are administered by DME. The DPD NT Coastal Waters CEMP (BAS-210 0310) relating to the activity in NT Coastal Waters has been developed in accordance with the content requirements for an environment plan (EP) under the OPGGSER and was accepted by DME on 13 November 2024.

The OPGGSER provide an objective based regime for the management of environmental performance for Australian offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction. Key objectives of the OPGGSER include to:

- Ensure operations are performed in a way that is consistent with the principles of ecologically sustainable development
- Adopt best practice to achieve agreed environment protection standards in industry operations
- Encourage industry to continuously improve its environmental performance.

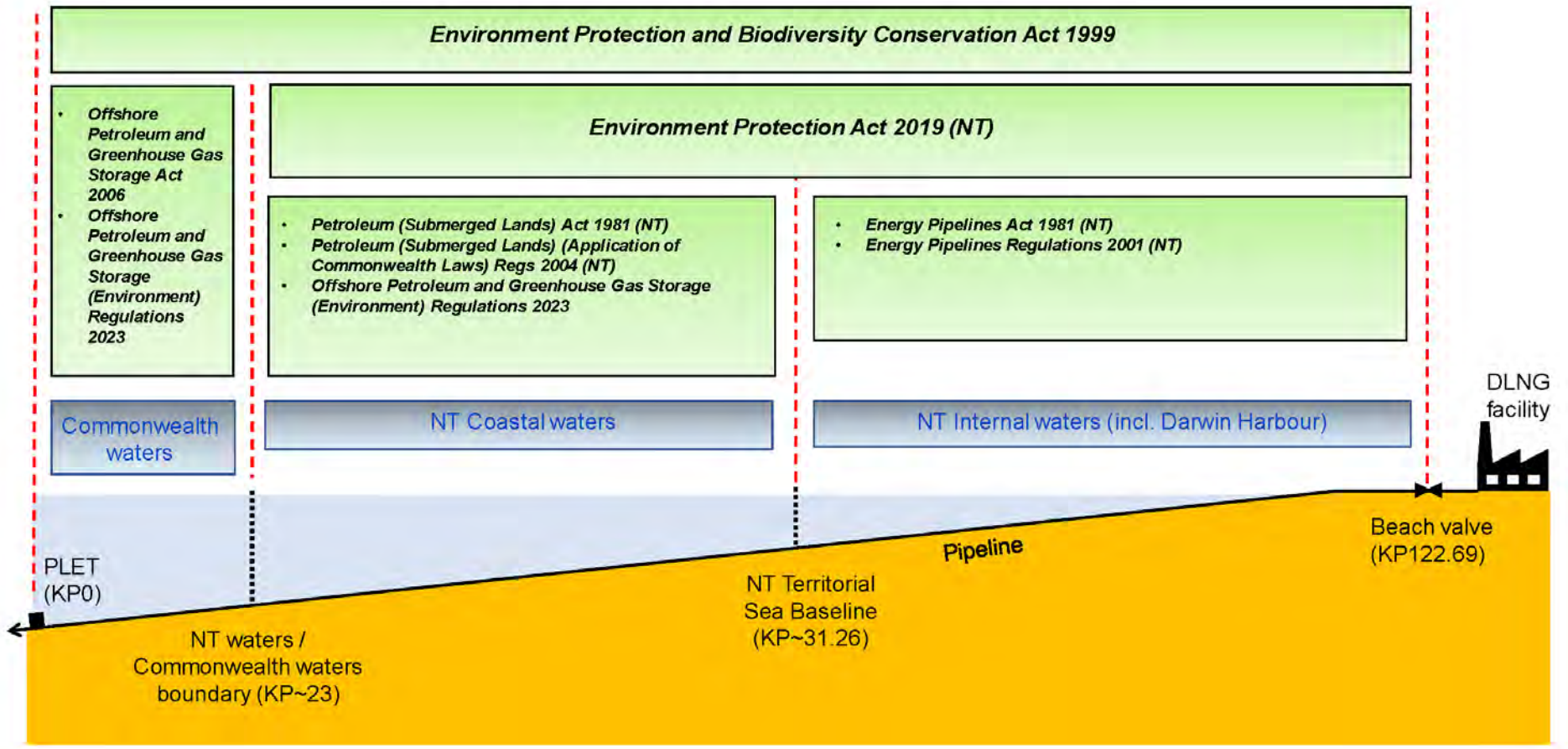


Figure 3-1 Key environment and energy legislation jurisdictional diagram

3.2.5 Northern Territory Aboriginal Sacred Sites Act 1989 (NT)

This *Northern Territory Aboriginal Sacred Sites Act 1989 (NT)* (NTASS Act) aims to provide a practical balance between the recognised need to preserve and enhance Aboriginal cultural tradition, in relation to certain land in the NT and the aspirations of the Aboriginal and all other peoples of the NT for their economic, cultural, and social advancement; by establishing a procedure for the protection and registration of sacred sites, providing for entry onto sacred sites and the conditions to which such entry is subject, establishing a procedure for the avoidance of sacred sites in the development and use of land and establishing an Authority for the purposes of the Act and a procedure for the review of decisions of the Authority by the Minister.

Aboriginal Areas Protection Authority (AAPA) certificates aim to protect indigenous sacred sites preventing damage from nearby works and outlines conditions to be followed when carrying out works on land and sea near to sacred sites across the NT. The AAPA administer these certificates under the NTASS Act.

Santos has received two AAPA Authority Certificates – Authority Certificate C2022-098 received on 23 December 2022 and a second Authority Certificate (C2024-034) received on 22 May 2024 to cover areas of seabed disturbance within the DPD Project Area in NT waters, and will ensure the requirements of the certificates (including avoidance of Restricted Work Areas) and the NTASS Act are met.

3.3 Other relevant legislation

3.3.1 Commonwealth legislation

Other Commonwealth legislative requirements relevant to the DPD activities under the Offshore CEMP are outlined in **Table 3-1**.

Table 3-1: Other Commonwealth legislation relevant to activities covered by the Offshore CEMP

Title	Description
Aboriginal Land Rights (Northern Territory) Act 1976	The Act, administered by the Attorney-General's Department and the Department of the Prime Minister and Cabinet (DPMC), provides the basis upon which Aboriginal Australian people in the NT can claim rights to land based on traditional occupation. There are no planned activities associated with this Offshore CEMP that will directly affect land claimed under the Act. The environment that may be affected (EMBA) intersects land claim areas made under the Act which extend to the low water mark. This Aboriginal land is held by the Arnhem Land ALT, the Cobourg Peninsula Sanctuary ALT, the Tiwi ALT, the Kenbi ALT, and the Delissaville/Wagait/Larrakia ALT. Section 5(2) of the ALR Act provides that ALTs cannot exercise their functions in relation to land they hold except in accordance with directions given to them by the Land Council for the area in which the relevant land is situated. Where any such directions are given, ALTs must comply with them. Accordingly, ALTs cannot act independently of Land Councils. Under the ALR Act, the functions of Land Councils with respect to ALTs involve administering ALTs in their area, including storing their common seals and deeds of grant, maintaining a register of ALT membership, negotiating agreements on behalf of ALTs and receiving moneys on behalf of ALTs. The NLC is the relevant Land Council for the Arnhem Land, Cobourg Peninsula Sanctuary, Kenbi and Delissaville/Wagait/Larrakia ALTs, while the TLC is the relevant Land Council for the Tiwi ALT.

Title	Description
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) (ATSIHP Act)	The purpose of this Act, administered by the Attorney-General's Department and the DCCEEW, is to preserve and protect places and objects in Australia and in Australian waters from injury or desecration; places or objects in question must be of particular significance to Aboriginal people with Aboriginal tradition. The Minister may make a declaration to protect such areas and objects. The Act also requires the discovery of Aboriginal remains to be reported to the Minister. The Act is not directly relevant to the environmental management of the activity as there are no areas within the Project Area subject of a 'significant Aboriginal areas' declaration under the Act. For completeness Santos notes that on 23 October 2023 it was informed by the DCCEEW that applications had been received under the ATSIHP Act in relation to certain areas of the sea. Santos understands that these areas are at least 200 km from the Project Area but overlap a small portion of the outer limits of the EMBA. Santos understands that no decisions have been made by the Minister in relation to the applications at the time of writing.
Aboriginal Land Rights (Northern Territory) Act 1976 (Cth) (ALR Act)	This Act provides for the granting of Traditional Aboriginal Land in the NT for the benefit of Aboriginals, and for other purposes. Establishes Land Councils and enables them to operate. The Act is not directly relevant to environmental management of the construction and pre-commissioning activity covered by this Offshore CEMP. There are no predicted impacts to Aboriginal land or nearshore locations (including the Tiwi Islands) associated with this activity. However, the EMBA for this activity, associated with an unplanned MDO spill, does overlap with Aboriginal land declared under the ALR Act. The TLC and NLC, established under the ALR Act, represent First Nations people in the protection of land, sea and environment. Accordingly, this Act has been identified for completeness.
Australian Maritime Safety Authority Act 1990 (Cth) (AMSA Act)	This Act establishes the Australian Maritime Safety Authority (AMSA), which manages the National Plan for Maritime Environmental Emergencies in coordination with industry. AMSA is also responsible for administering Marine Orders (made under Commonwealth legislation) applicable to International, Australian and Domestic Commercial Vessels. The Act also aims to promote maritime safety, protect the marine environment from pollution and environmental damage from ships, provide for a national search and rescue service and promote the efficient provision of service by AMSA. The Act does not contain any explicit requirements relevant to the environmental management of the Activity, it establishes and sets out the functions of AMSA, which functions relate to environmental management including in respect of response to spill events and administration of marine orders.
Biosecurity Act 2015 (Cth) Biosecurity Regulation 2016 (Cth) Australian Ballast Water Management Requirements, Version 8	The Act, administered by the Department of Agriculture, Fisheries and Forestry (DAFF), describes how to manage biosecurity threats to plant, animal and human health in Australia and its external territories, ensuring a very low level of risk. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information

Title	Description
	regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers. Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing invasive marine species (IMS) into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015* and include obligations under the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Implementation of the *Biosecurity Act 2015* is detailed in **Section 4.4.5** and **7.7.2**
Climate Change Act 2022 (Cth) (Climate Act)	The Climate Act and the Consequential Amendments Act commenced in September 2022. The Climate Act and Consequential Amendments Act sets out Australia's net-zero commitments and codifies Australia's net 2030 and 2050 greenhouse gas (GHG) emissions reductions targets under the Paris Agreement. While the oil and gas sector is not subject to direct obligations under these Acts, these Acts legislate Australia's emissions net zero targets by 2050. The Santos Climate Change Policy and target to become a net-zero scope 1 and 2 GHG emissions by 2040 are aligned with these Acts. The activities covered under this Offshore CEMP are consistent with the principles of ESD and ALARP to mitigate GHG emissions.
Fisheries Management Act 1991 (Cth)	Management plans for Commonwealth fisheries are established under this Act, and this Act also sets out the legislative basis for Statutory Fishing Rights (SFRs), licences and permits. This Act defines the Australian Fishing Zone (AFZ) and provides for the majority of Commonwealth fisheries offences. This Act also establishes the functions of the Australian Fisheries Management Authority (AFMA), including in relation to the pursuit of ecologically sustainable development. This Act is not directly relevant to the environmental management of the construction and pre-commissioning activity covered by this Offshore CEMP. However, in the event of a spill, this Act provides the regulatory framework for any necessary fisheries management decisions in Commonwealth waters. Further, the AFMA is responsible for managing Commonwealth fisheries and is a relevant agency where the Activity has the potential to impact on fisheries resources in AFMA managed fisheries. The EMBA overlaps four Commonwealth commercial fisheries managed by the AFMA. Accordingly, this Act has been identified for completeness.
Marine Orders	Marine Orders are subordinate rules made pursuant to the *Navigation Act 2012* (Cth), *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth), *Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006* (Cth) and the *Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Cth) affecting the maritime industry. They are a means of implementing Australia's international maritime obligations by giving effect to international conventions in Australian law. Various Marine Orders may apply to activities under this Offshore CEMP, including in relation to vessel movements, safety, discharges and emissions. Relevant Marine Orders (MO) include: • MO 21 – Safety and emergency arrangements

Title	Description
	• MO 27 – Safety of navigation and radio equipment • MO 30 – Prevention of collisions • MO 41 – Carriage of Dangerous Goods • Marine Order 71 Masters and deck officers • MO 91 – Marine pollution prevention – oil • MO 93 – Marine pollution prevention – noxious liquid substances • MO 94 – Marine pollution prevention – packaged harmful substances • MO 95 – Marine pollution prevention – garbage • MO 96 – Marine pollution prevention – sewage • MO 97 – Marine pollution prevention – air pollution • MO 98 – Marine pollution – anti-fouling systems.
Marine Safety (Domestic Commercial Vessel) National Law Act 2012 *Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013* (Cth)	This Act is a single regulatory framework for the certification, construction, equipment, design and operation of domestic commercial vessels inside the EEZ. The Act names AMSA as the National Marine Safety Regulator and confers functions on AMSA in relation to marine safety, including that AMSA may make and maintain Marine Orders. The Regulations under the Act set out the definition of a vessel and details and requirements of the accredited marine surveyor scheme.
National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act) *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	This Act, administered by the DCCEEW, introduces a single national reporting framework for the reporting and dissemination of information about GHG emissions, GHG projects and energy use and production of corporations. The Safeguard Mechanism is also administered under the NGER Act. Reporting of GHG emissions from Project activities will meet requirements of the Act. For the broader Barossa Development gas production activities – the Barossa gas field will be a designated large facility under the NGER Act and as such will be subject to the Safeguard Mechanism. This means that Santos, among other things, will have an obligation to ensure that the net covered emissions of GHGs from the production of gas at the Barossa gas field do not exceed the applicable baseline.
Native Title Act 1993 (Cth)	This Act, administered by the Attorney-General's Department and the DPMC, provides for the recognition and protection of native title, and provides or permits for the validation of past acts and intermediate period acts, invalidated because of the existence of native title. It additionally establishes ways in which future dealings affecting native title may proceed and sets standards for those dealings and establishes mechanisms for determining claims to native title. There are no planned activities associated with this Offshore CEMP that will affect determined areas under this Act. The EMBA associated with a worst-case spill event (**Section 5.1**), intersects the Croker Island and Larrakia Native Title determinations (Section 14.5.1 of **Attachment 2**)
Navigation Act 2012 (Cth)	The Act aims to promote the SOLAS and safe navigation, prevent pollution of the marine environment and ensure AMSA has the power to carry out inspection of vessels and enforce national and international standards. Specifically, this Act empowers AMSA to make Marine Orders, which are legislative instruments, with respect to any matter for which provision must or may be made by the regulations.

Title	Description
	A number of Marine Orders enacted under this Act may be relevant to vessels that carry out the Activity: • Marine Order 21: Safety and emergency arrangements • Marine Order 27: Safety of navigation and radio equipment • Marine Order 30: Prevention of collisions • Marine Order 41: Carriage of Dangerous Goods • Marine Order 58: Safe management of vessels • Marine Order 71 Masters and deck officers • AMSA has the authority and responsibility for the operational activities under the Act, including vessel certification, seafarers' qualifications, marine pollution prevention, monitoring and enforcement activities.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	This Act and associated regulations (Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995 (Cth)), administered by the DCCEEW, implements the requirements of the Vienna Convention and Montreal Protocol to avoid using ozone depleting substances. Management of atmospheric emissions will meet requirements of this Act as per **Section 7.6.8**
Protection of the Sea (Harmful Anti-fouling Systems) Act 2006	This Act, administered by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) and the Australia Maritime Safety Authority (AMSA), relates to the protection of the sea from the effect of harmful anti-fouling systems. It covers the application or use of harmful anti-fouling systems and the issue and endorsement of the required certificates and anti-fouling declarations. Santos implements a vessel vetting process (**Section 4.4.3**) before engaging contractor vessels which includes requirements for meeting technical, personnel (e.g. crew competencies) and operational standards. This includes relevant codes and conventions and local state requirements. Vessel class anti-fouling requirements will be met as per **Section 7.7.2**
Protection of the Sea (Powers of Intervention) Act 1981 (Cth)	This Act authorises the Commonwealth (through AMSA) to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction. The Regulations set out requirements to notify AMSA in respect of changes to the ownership or master of a vessel. This Act applies to vessel discharges and movements associated with the Activity. The Act is relevant in that Santos must comply with Marine Orders made under the Act.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	This Act, administered by the DITRDCA and AMSA, relates to the prevention of pollution (in any form) from ships and MARPOL requirements are implemented under this Act. The management of vessel discharges and atmospheric emissions, and the prevention of hydrocarbon spills, will meet the requirements of this Act, as demonstrated in **Sections 7.6.6**, **7.6.8** and **7.7.5** Santos implements a vessel vetting process (**Section 4.4.3**) before engaging contractor vessels which includes requirements for meeting technical, personnel (e.g., crew competencies) and operational standards. This includes relevant codes and conventions and local state requirements

Title	Description
Underwater Cultural Heritage Act 2018 *Underwater Cultural Heritage (Consequential and Transitional Provisions) Act 2018*	These Acts, administered by the DCCEEW, provide for the protection of shipwrecks, sunken aircraft and their associated artefacts that have lain in territorial waters for 75 years or more. It is an offence to interfere with any shipwreck covered by the Act. Some sites also have a protected zone around them. The *Underwater Cultural Heritage Act 2018* (UCH Act) also broadened protection to other types of Underwater Cultural Heritage (UCH) including Australia's Aboriginal and Torres Islander Underwater Cultural Heritage in Commonwealth waters. The management of activities with the potential for seabed disturbance will consider the presence of protected underwater cultural heritage under the UCH Act and the potential for finding previously unidentified cultural heritage. Detail on cultural heritage protected under the UCH Act is provided in **Section 5.2.5.2** and **5.3.12.2** and environmental management measures that will be employed to protect underwater cultural heritage are provided in **Section 7.6.2.**

Notes:

1. The *Environment Protection (Sea Dumping) Act 1981* (Cth) does not apply as spoil disposal will be within NT waters and therefore a sea dumping permit is not required.
2. There will be no trenching of the pipeline route or spoil disposal between the territorial baseline and NT Coastal Waters limit and therefore the activities included in this TSDMMP do not fall under the jurisdiction of the OPGGSER.

3.3.2 Northern Territory legislation

Other NT legislative requirements relevant to the DPD Project activities covered by this Offshore CEMP are outlined in **Table 3-2**.

Table 3-2: Other Northern Territory legislation relevant to activities covered by the Offshore CEMP

Title	Description
Aboriginal Land Act 1978	This Act, administered by the Department of the Chief Minister and Cabinet (DCMC), provides for the access to Aboriginal land, certain roads bordered by Aboriginal land and the seas adjacent to Aboriginal land. There are no planned activities associated with this Offshore CEMP that require access to Aboriginal land under the Act.
Bushfires Management Act 2016 Bushfires Management (General) Regulations 2017	The Act, administered by the NT Fire and Emergency Service, establishes the Bushfires Council and provides for the prevention and control of bushfires in the NT. The activity, particularly those activities that will be conducted on land, will comply with any requirements of the Act.
Crown Lands Act 1992	This Act, administered by the Department of Housing, Local Government and Community Development, makes provision for the tenure, management, and alienation of crown lands. "Crown lands" means all lands of the Territory, including the bed of the sea within the territorial limits of the NT. Santos has received a Crown Lands Licence (CLL) (CLL23/47), for the disposal of dredged spoil within the spoil disposal ground, and will abide by conditions of this licence. Santos will manage the disposal of spoil within the spoil disposal ground as per **Section 7.6.2**
Environmental Offences and Penalties Act 2011	This Act, administered by the Department of Lands, Planning and Environment, defines levels and penalties for environmental offences under various Acts, including the NT EP Act, *Energy Pipelines Act 2018, Waste Management and Pollution Control Act 1998* and the *Water Act 1992*. Santos will ensure the activity complies with the requirements of these Acts.
Fire and Emergency Act 1996 Fire and Emergency Regulations 1996	This Act, administered by the NT Fire and Emergency Service, provides for the establishment and operation of the NT Fire and Rescue Service and their operational and emergency response activities. The Regulations outline general requirements under the Act, such as storing flammable or combustible material and using cutting, heating and welding equipment. The activity, particularly those activities that will be conducted on land, will comply with any requirements of the Act.
Fisheries Act 1988	This Act, administered by the Department of Agriculture and Fisheries, provides for the regulation, conservation and management of fisheries and fishery resources to maintain their sustainable utilisation, to regulate the sale and processing of fish and aquatic life, and for related purposes. Santos has received a *Permit to Cause Shock Sound or Other Vibration* under S11 of the *Fisheries Act 1988* (Permit No. 2023-2024/ S11/ 524) from DITT – Fisheries Division (which formerly administered this Act) and will comply with conditions of the permit. This includes conducting permitted activities in accordance with applicable, laws, policies and standards, having regard for best practice and industry standards. It also includes using appropriate

Title	Description
	communications, signage, buoys, flags and other warning signals to alert any user of the Port of Darwin to the conduct of the permitted activities and of the perimeters of the areas within which the permitted activities may be conducted. Santos will manage its noise emission consistent with best practice and accepted industry standards (refer **Section 7.6.4**) and will use appropriate methods to notify other users of Darwin Port as detailed in **Section 7.6.1.** Santos will also adhere to notification requirements to the Director of Fisheries as included in **Section 8.8.**
Heritage Act 2011	This Act, administered by the Department of Lands, Planning and Environment, provides a framework for the identification, assessment, recording, conservation, and protection of the NT's cultural and natural heritage. Santos has conducted maritime archaeological heritage assessments as per an Archaeological Scope of Work provided by the Heritage Branch of the DTFHC, which formerly administered this Act (refer **Section 5.3.12.2**) and has developed a Cultural Heritage Management Plan (BAS-210 0208), inclusive of a maritime and First Nations Unexpected Finds Protocols to help ensure it meets obligations of the *Heritage Act 2011*. Detail on environmental management measures that will be employed to protect underwater cultural heritage are provided in **Section 7.6.2.**
Marine Act 1981	This Act, administered by the Department of Logistics and Infrastructure, is to regulate shipping within the NT and to provide for the application to the NT of the uniform shipping laws code and for related matters. Santos will implement measures to manage interactions with other marine users and avoid collisions, as per relevant regulatory requirements, as per **Sections 7.6.1** and **7.7.5**. Santos implements a vessel vetting process (**Section 4.4.3**) before engaging contractor vessels, which includes requirements for meeting technical, personnel (e.g., crew competencies) and operational standards. This includes relevant codes and conventions and local state requirements.
Marine Pollution Act 1999	This Act, administered by the Department of Lands, Planning and Environment, protects the marine and coastal environment by minimising intentional and negligent discharges of ship-sourced pollutants into coastal waters, and for related purposes. The Act enacts relevant annexures of MARPOL (annexures I, II, III and V). The management of vessel discharges and garbage and the prevention of hydrocarbon spills and loss of waste, will meet the requirements of this Act (enacting MARPOL), as demonstrated in **Sections 7.6.6, 7.7.1** and **7.7.5** Santos implements a vessel vetting process (**Section 4.4.3**) before engaging contractor vessels which includes requirements for meeting technical, personnel (e.g., crew competencies) and operational standards. This includes relevant codes and conventions and local state requirements.
Planning Act 1999 Planning Regulation 2000	This Act, administered by the Department of Lands, Planning and Environment, provides a framework of controls for the orderly use and development of land. The objective of the Act includes ensuring that strategic planning is applied to planning schemes and implemented in individual planning decisions, promotion of sustainable development of land and promotion of the responsible use of land and water resources to limit the adverse effects on development of ecological processes.

Title	Description
	Division 2 of the Act provides the planning basis for the submission, review, and authorisation of Exceptional Development Permits (EDPs), and related EDP variations. Santos has received a Development Permit for its trenching activities in Darwin Harbour and a variation to the DLNG facility's Exceptional Development Permit (EDP) (EDP02/00151) to cover DPD Project activities within the bounds of the EDP. Santos will adhere to conditions of these permits. Those relevant to the activities covered under the Offshore CEMP include: the requirements to conduct works (e.g., ground disturbance) in accordance with drawings attached to the EDP variation and the Development Permit; requirements to take reasonable and practicable measures to control erosion; compliance with obligations under the *Waste Management and Pollution Control Act 1998,* including taking all measures reasonable and practicable to minimise pollution or environmental harm and reduce the amount of waste; and requirements for approval under Section 53 of the *Port Management Act 2015*. Through its environmental management strategies for planned (**Section 7.6**) and unplanned events (**Section 7.7**), Santos has measures in place to ensure compliance with these conditions.
Ports Management Act 2015	This Act, administered by the Department of Logistics and Infrastructure, provides for the safe, efficient, and effective control, management, and operation of NT ports. Santos has received approval for the DPD Project pipeline route through Darwin Harbour from the Regional Harbourmaster under Section 53 of the *Ports Management Act 2015* and will abide by the conditions of approval.
Territory Parks and Wildlife Conservation Act 1976	This Act, administered by the Department of Tourism and Hospitality and the Department of Lands, Planning and Environment, provides for the establishment of Territory Parks and other parks and reserves and for the study, protection, and conservation of wildlife in NT. This includes provisions on changes and revocation of parks, reserves and sanctuaries, the preparation and implementation of plans of management, the creation and management of sanctuaries and on the management of wildlife, flora, and fauna. Territory Parks and Reserves near the Project Area are included in **Section 5.3.8** and wildlife protected under this Act potentially within the Project Area are listed in **Section 5.3.10**.
Validation (Native Title) Act 1994	This Act, administered by the Department of the Attorney-General, validates certain acts attributable to the Territory, including the *Native Title Act 1993*, to make provision for the effect of certain acts attributable to the Territory on native title, including the *Native Title Act 1993,* and for related purposes. There are no planned activities associated with this Offshore CEMP that will affect determined areas under this Act. The EMBA associated with a worst-case spill event (**Section 5.1**), intersects the Croker Island and Larrakia Native Title determinations (Section 14.5.1 of **Attachment 2**)
Waste Management and Pollution Control Act 1998 Waste Management and Pollution Control	This Act, administered by the Department of Land, Planning and Environment, provides for the protection of the environment through encouragement of effective waste management and pollution prevention and control practices and for related purposes. Where applicable, Santos will meet the general environmental duty (Section 12) of the Act through the implementation of its environmental management

Title	Description
(Administration) Regulations 1998	strategies to prevent or minimise pollution and to reduce the amount of waste associated with activities under this Offshore CEMP (refer **Sections 4.4.4, 7.6.2, 7.6.3, 7.6.6, 7.6.7, 7.6.8, 7.6.9, 7.7.1, 7.7.4, 7.7.5, 7.7.6**)
Water Act 1992	This Act, administered by the Department of Lands, Planning and Environment, provides for the management and protection of water resources in the NT. Santos has liaised with DEPWS on the requirement for a Waste Discharge Licence under the Act for the DPD Project, including for activities covered under this Offshore CEMP, including the discharge of spoil at the spoil disposal ground. It was advised that this is not required given an Environmental Approval (EP2022/022-001) under the NT EP Act would be in place providing conditions over these activities. Santos will adhere to the requirements of EP2022/022-001 including the requirement for the implementation and compliance with this Offshore CEMP and other management plans, including a Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP) (BAS-210 0023)
Weeds Management Act 2001	This Act, administered by the Department of Lands, Planning and Environment, allows for the classification of declared weeds or potential weeds, requirements for managing declared weeds or potential weeds and preparing management plans. Santos will ensure general duties of this Act are met where relevant.
Work Health and Safety (National Uniform Legislation) Act 2011	This Act, administered by the Department of the Attorney-General, sets out the objects, key principles, duties, obligations and rights in relation to occupational health and safety in the NT. Santos will ensure health and safety requirements are met in line with NT requirements and its Environmental, Health and Safety Policy (**Section 4.2**). The detail of workplace health and safety management measures is out of scope for this Offshore CEMP, other than where those same measures are used to manage environmental impacts and risks.

3.4 International conventions and agreements

Australia is signatory to numerous international conventions and agreements that obligate the Commonwealth government to prevent pollution and protect specified habitats for flora and fauna. Those which are relevant to the activity are outlined in **Table 3-3**.

Table 3-3: International agreements and conventions relevant to the activity

International agreements and conventions	
Title	**Description**
China-Australia Migratory Bird Agreement (CAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and China. Implemented in the EPBC Act.
Japan-Australia Migratory Bird Agreement (JAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Japan. Implemented in the EPBC Act.
International Convention for the Prevention of Pollution from Ships (MARPOL)	This convention is to eliminate international marine environment pollution through hydrocarbons and other toxic substances and to reduce the accidental discharge of such substances.
Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Korea. Implemented in the EPBC Act.
United Nations Convention on Biological Diversity – 1992	An international treaty to sustain life on earth.
Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	The Bonn Convention aims to improve the status of all threatened migratory species through national action and international agreements between range states of particular groups of species.
Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	Convention prescribes internationally agreed measures for the navigation, management and working of a vessel, and the lights and signals to be provided and used on a vessel. Given effect in Australia by Marine Order 30 – Prevention of Collisions.
International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004	This Convention was adopted by the IMO and entered into force globally in 2017. It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for managing and controlling ships' ballast water and sediments. Thus, ballast water management systems must be approved in accordance with this Convention. From 8 September 2017, all vessels that use ballast water are required to meet the Regulation D2 discharge standard of this Convention at their next renewal survey.
International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)	This Convention and Protocol (together known as MARPOL 73/78) build on earlier conventions in the same area. MARPOL is concerned with operational discharges of pollutants from ships. It contains 6 Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage, garbage and air pollution. Detailed rules are laid out as to the extent to which (if at all) such substances can be released in different sea areas. The legislation giving effect to MARPOL in Australia is the *Marine Pollution Act 1999* (NT), *Protection of the Sea (Prevention of Pollution*

International agreements and conventions	
Title	**Description**
	from Ships) Act 1983 (Cth), the *Navigation Act 2012* (Cth) and several Parts of Marine Orders made under this legislation.
International Convention for the Safety of Life at Sea 1974 (SOLAS) and its Protocol of 1988	This convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships. Implemented by the *Navigation Act 2012* (Cth) and Marine Orders under that Act.
Paris Agreement on Climate Change 2015	This Agreement aims to tackle climate change and its negative impacts. It sets the long-term goal of substantially reducing global GHG emissions to limit global temperature rise this century well below 2°C above pre-industrial levels while pursuing efforts to limit the temperature increase even further to 1.5 °C to prevent dangerous human-caused interference with the climate system
International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (OPRC 90)	This convention comprises national arrangements for responding to oil pollution incidents from ships, offshore oil facilities, sea ports and oil handling. The convention recognises that in the event of pollution incident, prompt and effective action is essential. Parts of this convention are implemented by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth).
International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers, 1978	Prescribes internationally agreed minimum standards relating to training, certification and watchkeeping for seafarers. Given effect in Australia by Marine Order 71 (Masters and Deck Officers).
United Nations Educational, Scientific and Cultural Organization Convention on the Protection of Underwater Cultural Heritage 2001	This Convention provides a framework preservation and protection of underwater cultural heritage. This includes traces of human existence of cultural, historical, or archaeological nature that have been submerged for at least 100 years. This Convention is aligned with the sustainable development objectives of the United Nations Agenda 2030.
United Nations Framework Convention on Climate Change (1992)	The objective of the convention is to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992, and it came into force on 21 March 1994.

3.5 Standards, codes and guidelines

There are several Australian Standards, Codes of Practice and Guidelines relevant to this Offshore CEMP, which have been identified below.

- AS2885 Pipelines - Gas and Liquid Petroleum
- AS/NZS 4801 Occupational Health and Safety (OHS) Management
- AS/NZS ISO 9001:2008, Quality management systems – Requirements
- AS/NZS ISO 14001:2004, Environmental management system – Requirements with guidance for use
- AS/NZS ISO 31000:2009, Risk management – Principles and guidelines
- HB 203:2006 Environmental Risk Management – Principles and Process
- Australian Ballast Water Management Requirements. Version 8 (ABWM Requirements; Commonwealth of Australia, 2020a)
- National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia, 2009a)
- National Biofouling Management Guidance for Non-trading Vessels (NSPMMPI, Commonwealth of Australia, 2009b)
- National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry 2009 (Commonwealth of Australia, 2009c)
- National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC & ARMCANZ, 2000)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)
- Darwin Port Environmental Management Plan (Darwin Port, 2020)
- Declaration of Beneficial Uses and Objectives, Darwin Harbour Region, Northern Territory Government Gazette No. G27, 7 July 2010
- Darwin Harbour Water Quality Protection Plan (DLRM, 2014)
- Darwin Harbour Strategy 2020–2025 (DHAC 2020)
- Guidelines for Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA, 2013)
- Draft Guidelines for the Preparation of an Environmental Management Plan (NT EPA, 2015)
- Guideline for Reporting on Environmental Monitoring (NT EPA, 2016)
- Water Quality Objectives for the Darwin Harbour Region – Background document (DNRETAS, 2010)
- Marine Bioregional Plan for the North Marine Region (DSEWPAC, 2012)
- National Guidance on the Management of Whale and Dolphin Incidents in Australian Waters (DSEWPAC, 2013).

4 Environmental management framework

4.1 Santos Management System

Santos' Management System (known as the SMS) exists to support its values and legal obligations to undertake work in a manner that is safe and sustainable. The framework of policies, standards, processes, procedures, tools, and control measures are designed to ensure:

- compliance with legal obligations
- A common health, safety and environment (HSE) approach is followed across the organisation
- HSE is proactively managed and maintained
- The mandatory requirements of HSE management are implemented and are auditable
- HSE management performance is measured, and corrective actions are taken
- Opportunities for improvement are recognised and implemented
- Workforce commitments are understood and demonstrated.

The Implementation Strategy (**Section 8**) and Stakeholder Consultation (**Section 9**) align with the Management System structure and are designed to require that:

- environmental impacts and risks continue to be identified for the duration of the activity and reduced to ALARP and acceptable levels
- management actions (control measures) are effective in reducing environmental impacts and risks to ALARP and acceptable levels
- environmental performance objectives (EPOs) and environmental performance standards (EPSs) set out in this Offshore CEMP are met
- consultation with relevant government authorities and relevant interested persons and organisations is maintained throughout the activity as appropriate.

4.2 Santos' environment, health, and safety policy

The activity will be undertaken in accordance with Santos' Environment, Health and Safety Policy (**Attachment 1**), which clearly sets out its strategic environmental objectives and the commitment of the management team to continuous environmental performance improvement. This Offshore CEMP has been prepared in accordance with the fundamentals of this policy. By accepting employment with Santos, each employee and contractor is made aware during the recruitment process that he or she is responsible for the application of this policy.

4.3 DPD Project environmental management plans

The geographical scope of the offshore CEMP and related DPD Project environmental management plans is displayed in **Figure 1-2.** This Offshore CEMP is an overarching management plan that covers DPD Project construction activities (as defined in **Section 2**) from NT/Commonwealth waters boundary to the onshore termination point. The Onshore CEMP (BAS-210 0025) covers the construction of the DPD Project pipeline from the onshore termination point to the upstream weld of the beach valve. Support facilities for activities under this Offshore CEMP may overlap the same areas used for activities covered under the Onshore CEMP.

The Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP) (BAS-210 0023), Acid Sulfate Soil and Dewatering Management Plan (ASSDMP) (BAS-210 0049) and the Marine Megafauna Noise Management Plan (MMNMP) (BAS-210 0045) sit under the Offshore CEMP and/or the Onshore CEMP and address specific activities and associated management measures requiring further detail and/or requested to be developed by the NT EPA for submission along with the DPD Project

Supplementary Environmental Report (SER) (BAS-210 0020). Following approval of the DPD Project under the *Environment Protection Act 2019* (NT) (NT EP Act), a Cultural Heritage Management Plan (CHMP) (BAS-210 0208), inclusive of an unexpected finds protocol (UFP) was developed to meet condition 4 of EP 2022/022-001. Further detail on the CHMP is provided in **Section 4.4.7**.

The DPD NT Coastal Waters CEMP (BAS-210 0310), applicable to DPD Project construction and pre-commissioning activities in NT Coastal Waters under the jurisdiction of the *Petroleum (Submerged Lands) Act 1981* (NT) (PSL Act), has been developed to meet the specific requirements of an Environment Plan under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGSER).

The Commonwealth waters DPD Environment Plan (EP) (BAS-210 0074), applicable to DPD Project construction activities in Commonwealth Waters (which are not the subject of this Offshore CEMP) under the jurisdiction of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act), has been developed to meet the specific requirements of an EP under the OPGGSER.

4.4 Supporting Management Processes and Procedures

4.4.1 Contractor Health, Safety and Environment requirements

The HSE requirements for contracts/contractor management during pre-contract planning, contracting, contract execution and contract completion and evaluation are outlined in the HSE Contractor Management Operating Standard (SMS-HSS-OS08) and the Contracting and Procurement Operating Standard (SMS-PRC-OS01). These include the following minimum requirements:

- Contractors to comply with all applicable HSE laws and regulations and any additional guidelines, operating standards and policies provided to the Contractor
- A review of the Contractor HSE Management System is completed before being contracted
- Provisions for Santos to conduct audits/inspections of the Contractor's operations, equipment and emergency procedures at any time.

4.4.2 Chemical selection and assessment procedure

All chemicals that are planned to be operationally discharged to the environment during the DPD construction activity will be evaluated using a defined framework and set of tools to ensure potential impacts are acceptable, as low as reasonably practicable (ALARP) and met Santos' expectation for environmental performance.

All chemicals that may be discharged to the environment will be detailed in a chemical register that is maintained and updated by the construction contractor. The contractor will submit the chemical application forms, with a safety data sheet (SDS), to Santos for approval.

Chemicals that are planned to be discharged to the environment will also require an environmental risk assessment which includes an assessment following principles of the United Kingdom Offshore Chemical Notification Scheme (OCNS) rating system. The chemical hazard assessment and risk management (CHARM) model under the OCNS is the primary tool to rank offshore chemicals based on assessment of toxicity, biodegradation and bioaccumulation data provided by the chemical supplier. Santos will approve chemicals planned to be discharge to the environment if they are Gold/Silver (OCNS CHARM) or OCNS group rating D/E (if not CHARM rated) or have an environmental risk assessment submitted by Contractor and approved by Santos.

4.4.3 Santos marine vessel vetting process

Santos manages marine vessel vetting and assurance using a hierarchy of procedures, outlined below. These requirements for vessel acceptance criteria include technical, personnel (e.g., crew competencies) and operational requirements for marine vessels engaged by Santos.

4.4.3.1 Marine assurance

The Marine Offshore Assurance Criteria (1530-045-STN-0001) is a standard that requires all vessels used by Santos to be vetted. The vetting process is based on industry standards and best practices along with considerations of guidelines and recommendations from recognised industry organisations such as Oil Companies International Marine Forum (OCIMF) and International Maritime Contractors Association (IMCA), and international regulatory agencies like the International Maritime Organisation (IMO) and vessel Classification Societies. The Marine Offshore Assurance Criteria requires a valid Offshore Vessel Inspection Database (OVID) report or Common Marine Inspection Document (CMID) report as required for vessel operation types. For vessels where the OVID and/or CMID are not valid or available, a Santos Approved Inspection Report is required.

4.4.3.2 Marine standards & compliance

The Santos Marine Operations Manual (IOSC/OPS/HBK/0003) details:

- standard operating procedures for all vessels under contract with Santos
- compliance requirements for relevant maritime legislation and relevant guidelines, standards and codes
- compliance requirements for international conventions and agreements, including:
    - International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004
    - SOLAS 1974 and its Protocol of 1988
    - International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)
    - Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)
    - International Convention on Standards of Training, Certification and Watchkeeping (STCW) for Seafarers, 1978.
- compliance requirements for industry standards as set up by:
    - OCIMF
    - IMCA
    - Guidelines for Offshore Marine Operations
    - Nautical Institute.
- Santos and contractor standards, procedures and best practice management, including:
    - vessels' safety of navigation
    - vessels using DP systems
    - vessels' bunkering procedures
    - crew competency and training records
    - biosecurity management
    - chemical storage and handling procedures
    - discharge management procedures
    - waste management procedures
    - anchoring procedures

- vessel and equipment maintenance procedures as per the vessel-specific safety management system.

Before commencing activities, Santos performs a risk assessment or HSE qualification evaluation process for each vessel to identify any HSE issues or specific management requirements

4.4.4 Santos waste management process

The Santos Environment Hazard Controls Procedure (SMS-EXA-OS01-PD02) requires that for all waste generated by contractors under its influence, the hierarchy of waste management applies whereby wastes are (in order of preference) avoided, reduced, re-used, recycled, treated and/or correctly disposed. A waste inventory must be documented, and onshore waste disposal records standardised (Waste Monitoring and Reporting Procedure – SMS-EXA-OS01-PD02-PD01) to allow accurate and consistent waste tracking. Contractors under this Offshore CEMP will demonstrate waste management processes will be aligned with regulatory and Santos' requirements through the provision of a Waste Management Plan for Santos acceptance.

4.4.5 Ballast water requirements

The Australian ballast water requirements set out the obligation on vessel operators with regards to the management of ballast water and ballast tank sediment when operating within Australian seas. All internationally operating vessels entering Australia will require:

+ An approved Ballast Water Management Plan
+ Maintenance of a complete and accurate record of all ballast water movements including those conducted in Australian waters
+ An international Ballast Water Management Certificate.

Ballast water exchange should be conducted in areas at least 12 nm from the nearest land and in water at least 50 metres deep. Volumetric exchange must be at least 95% of the relevant tank. Records on ballast water exchange shall include the start and finish times and geographic coordinates of the operation.

All ballast water management equipment such as pumps will be maintained as per the vessel preventive maintenance system and regularly tested to ascertain accurate calculations for ballast water exchange operations.

4.4.5.1 Australian pre-arrival report

All international vessels must submit a Ballast Water Report and a Pre-Arrival Report, 96 to 12 hours prior to arriving in an Australian port through the Maritime Aircraft Reporting System (MARS), for the Australian Department of Agriculture to review and process.

MARS is the online portal for commercial Vessel Masters and Shipping Agents to submit reports required of all international vessels seeking Australian biosecurity clearance; and request services such as coastal strip, waste removal, ship sanitation certification and crew change.

Department of Agriculture will request evidence from vessels with a ballast water management system (BWMS) of:

+ Valid ballast water management plan specific to the vessel (consistent with the Convention)
+ Valid ballast water management certificate, or certificate of compliance, that is approved by a port state administration, or a recognised survey authority (consistent with the Convention)
+ Ballast water management records that clearly demonstrate the BWMS has been operated consistent with the ballast water management plan.

A Department of Agriculture biosecurity officer will board the vessel to verify the Pre-Arrival Report and Vessel Master must ensure the vessel and personnel are available and able to demonstrate proficiency in the operation and maintenance of the BWMS.

4.4.6 Biofouling management

IMS may be present as biofouling on the vessel hull, or within piping, sea chests, etc. The biofouling which may be found on and in a vessel reflects the vessel's design, construction, maintenance, and operations. Each of these aspects introduces biofouling vulnerabilities but also offers opportunities to limit the extent and development of biofouling, with a commensurate reduction in biosecurity risks.

4.4.6.1 Vessel risk assessment

Vessels mobilised to the Project Area from international or domestic waters will comply with the Australian National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009c). This includes:

- Completion of a biofouling risk assessment
- Implementation of mitigation measures commensurate with the level of risk.

Figure 4-1 presents the risk assessment process. Factors that will inform risk are:

- Timing of marine pest risk assessment relative to vessels selection and movement to the title area to ensure there is sufficient time to implement control measures in cases where management is warranted.
- History of the vessels including time spent in ports of call since last dry dock and clean to inform whether the facility or vessel may have been exposed to high-risk ports/locations.
- Level of biofouling and the presence of species of concern (particularly presence of marine pests) within biofouling communities on the vessels associated with the activity (often informed by biofouling record books and/or maintenance/cleaning or inspection programs).
- Operational profile relevant to biosecurity risk such as operating speed, time alongside a facility and the need for ballast exchanges within the title area.
- Receiving environment including the presence of shallow water sensitivities within proximity to the activity and the presence and area of non-biocidal surfaces on facilities that could harbour marine pests.
- Presence and effectiveness of external and internal marine growth prevention systems including effectiveness and integrity of antifouling coatings and functionality of internal treatment systems.
- Qualifications and competency of personnel conducting and reviewing the risk assessment and making management decisions.

4.4.6.2 Vessel risk status

There are three outcomes from the risk assessment which categorise the vessels risk status as outlined below. Vessels are required to have a 'low' risk status to demonstrate to the government that Santos has taken all reasonable measures to minimise the risk of IMS.

- Low – low risk of introducing IMS; no additional management measures required.
- Uncertain – risk of introducing IMS is not apparent; precautionary approach adopted, additional management measures required to achieve low status.
- High – high risk of introducing IMS; additional management measures will be required.

4.4.6.3 Potential management measures to achieve low risk status

The outcome of the risk assessment will determine management measures required. If the vessel is deemed as 'low' risk status, no other measures are required providing the vessel does not exceed the seven-day threshold at stationary or slow speed, in waters outside Australia (in a similar region).

For vessels that present an 'uncertain' or 'high' risk, Contractors will engage a qualified IMS inspector to conduct inspections and/or provide advice on obtaining low status. **Table 4-1** lists mitigation measures that can be applied to achieve 'low' risk status.

Table 4-1: Biofouling mitigation measures

No.	Mitigation Measure	Overview
1	IMS inspection	Visual inspection of submerged surfaces and niche areas by a qualified biosecurity inspector to better understand the actual biosecurity risk. IMS Inspectors will have the qualifications and align inspections and reports with the Department of Primary Industries and Regional Development (DPIRD) guidance in: Criteria for Suitably Qualified Invasive Marine Pests Experts (DPIRD, 2017a) Best Practice Guidelines for Invasive Marine Species Inspections (DPIRD, 2017b) Invasive Marine Species Report Requirements (DPIRD, 2017c)
2	In-water cleaning	The appropriateness of in-water cleaning operations must be a decision made closely with IMS inspector on a case-by-case basis. Many factors will be considered, including: Degree and type of biofouling; Location of biofouling on the vessel. Prior to undertaking in-water cleaning within Australia, approval from the relevant state/territory authority must be granted and conditions may be imposed. Application to the administering authority (Harbour Master, local government or state environmental protection agency) at least five working days prior to the proposed commencement of the work.
3	Dry docking cleaning	Dry docking and the removal/cleaning of biofouling will include hull surfaces, niche areas such as sea chests, all retractable equipment such as thrusters, intakes and outlets, anodes and voids.
4	Temporal or spatial controls	Temporal or spatial controls to limit vessel exposure to sources of risk.
5	Application of anti-fouling coating	Depending on age the vessel may require application of new anti-fouling coating. The anti-fouling coating type will be based on technical advice and carried out by professional operators. All vessels greater than 400 gross tonnes will retain Antifouling System Certificate.
6	Treatment of internal seawater systems	In the absence of a marine growth prevention system, cleaning of internal seawater systems may be required, which may include: Dehydration Heat Physical removal Chemical treatment.

No.	Mitigation Measure	Overview
		Treatment of Internal Seawater systems will ideally be undertaken prior to mobilisation to Australia. Where chemical treatments are to be undertaken within Australian waters, advice will be sought from the Australian Pesticides and Veterinary Medical Authority (www.apvma.gov.au) in relation to permit and reporting requirements as it is prohibited to clean internal systems without a permit.

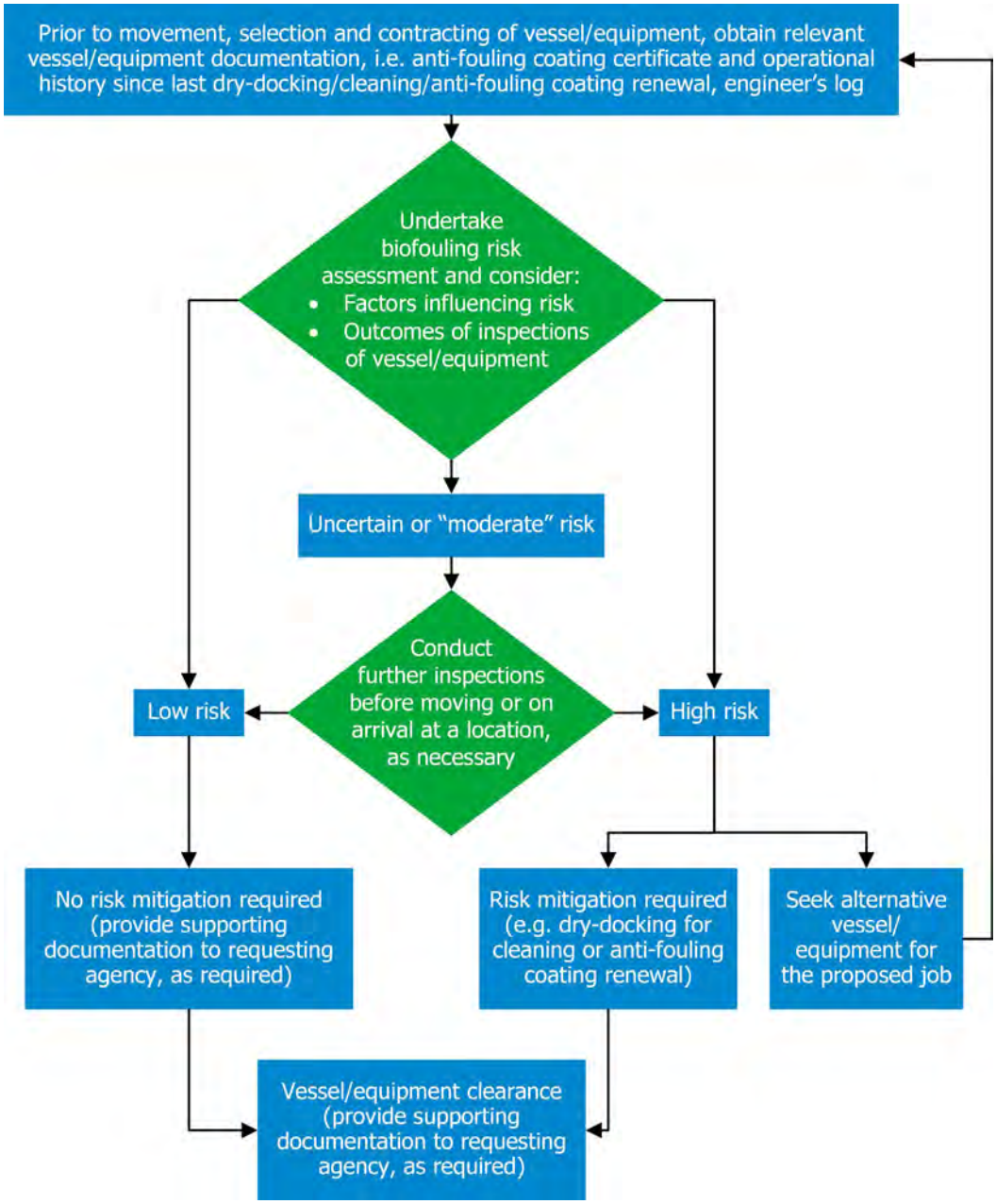


Figure 4-1: Generic biofouling risk assessment process (from Department of Agriculture, Fisheries and Forestry, 2009)

4.4.7 Cultural Heritage Management Plan

As per condition 4 of environmental approval of the DPD Project (EP 2022/022-001) under the NT EP Act, a CHMP has been developed by a suitably qualified and experienced person on behalf of Santos to protect to First Nations and maritime cultural heritage along the DPD pipeline route. As presented in Section 5.3.12.2, there are three protected shipwrecks within the Project Area, the wreck of the Japanese submarine I-124, the USAT Mauna Loa wreck an the USAT Meigs wreck. The wreck of the USS Peary is a protected wreck on the boundary of the Project Area. The results of Underwater Cultural Heritage (UCH) assessments have not identified any actual or potential UCH features likely to be impacted by the DPD Project activities within the Project Area.

In the event that any underwater cultural heritage finds are identified during construction or any related activities impacting the seafloor, Santos has engaged suitably qualified underwater archaeologists and developed procedures and reporting to be implemented if UCH is discovered during construction. Procedures and reporting for both maritime and First Nations UCH are addressed below. If any underwater cultural heritage of clear archaeological character, including any Aboriginal or Macassan objects, are identified by a suitably qualified underwater archaeologist, Santos will notify the relevant NT and Commonwealth authorities in accordance with applicable regulations.

4.4.7.1 Maritime underwater cultural heritage unexpected finds protocol

In the unlikely event of an unexpected maritime UCH find, Santos will implement the unexpected finds protocol (UFP) for maritime UCH (Appendix 4 of the CHMP). The UFP was developed in consultation with appropriate specialists in the fields of archaeology (including maritime), who, under the UFP, are on-call for the duration of the Activity to assist with the identification and management of any unexpected maritime UCH.

The UFP for maritime UCH is summarised as follows:

- upon discovery of a potential archaeological object, the Santos Client Representative (SCR) is to be notified
- the SCR will then determine whether it is a possible heritage object or significant archaeological deposit using the Object Recognition Sheet
- if the object is assessed as a possible heritage object, work is to cease in the vicinity of the discovery of the object's find location and the project maritime archaeologist is to be immediately contacted, following the steps in Recording Methods and Procedures.
- cultural objects encountered on the sea floor, for example, during ROV survey, should be left and recorded in situ, unless they are under imminent threat of destruction. The guidelines for whether an object is to be retained for conservation or put back in the water near where it was found is presented in Artefact Collection and Curation Policies.

Stop work triggers and notification protocols are further described in **Figure 4-2**.

All Santos and contractor staff identified as relevant to implementation of this protocol, will complete an induction on the UFP for maritime underwater cultural heritage, and shall confirm by signature their understanding of the requirements.

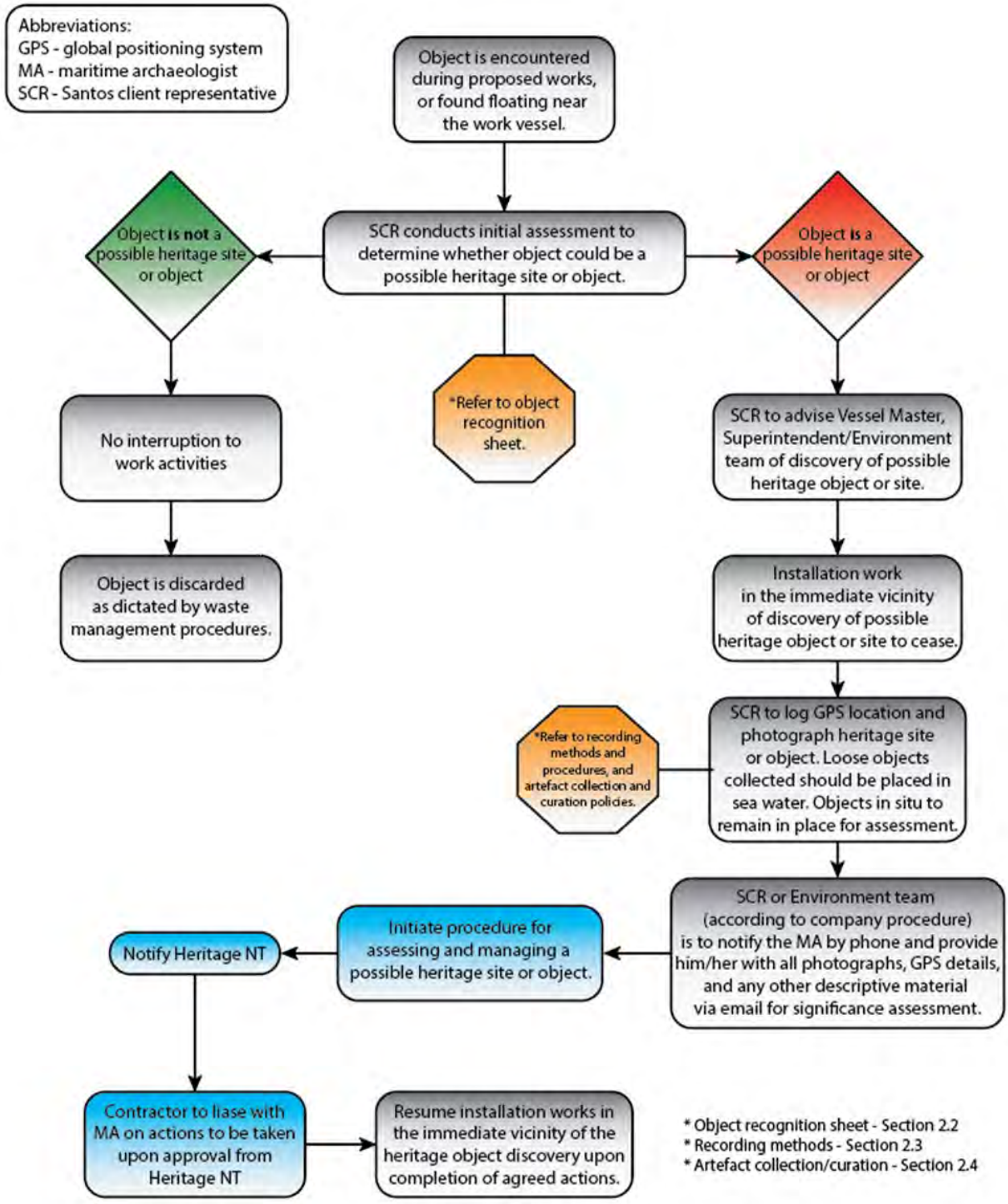


Figure 4-2: Stop work triggers and notification protocol for unexpected maritime finds

4.4.7.2 First Nations underwater cultural heritage unexpected finds protocol

In the unlikely event of an unexpected First Nations UCH find, Santos will implement the UFP for First Nations underwater cultural heritage (Appendix 5 of the CHMP). The UFP for First Nations cultural heritage was developed in consultation with appropriate specialists in the fields of archaeology (including First Nations and underwater archaeology), who, under the Protocol, are on-call for the duration of the Activity to assist with the identification and management of any unexpected First Nations UCH finds (including Macassan archaeological sites).

The UFP for First Nations cultural heritage has been divided into 2 phases based on the activity type and the ability to respond to unexpected finds, and is summarised as follows:

Phase 1 (pre-trenching and pre-lay survey activities):

- Upon observing an object that the operatives believe could be a potential archaeological object ("an article that appears to be underwater cultural heritage"), the SCR is to be notified.
- The SCR will then use imagery available to determine whether the object is a possible First Nations object or significant archaeological deposit using the Object Recognition Sheet. If required, the SCR will involve the Archaeologist to better enable an accurate determination of the what the object is.
- If the object:
    - is assessed as a likely cultural heritage object and it is likely to be impacted by the pipelay construction activities, a possible route deviation or sidestep within the prelay corridor will be assessed and the new route/lateral deviation shall be surveyed, if not yet covered. Given the limitations within Darwin Harbour, it is unlikely that re-routing in this section will be possible. Steps in the Recording Methods and Procedures should be followed. If rerouting the pipeline is not practical/possible then options to recover the likely cultural heritage object should be discussed and agreed as per the Artefact Collection and Curation Policies.
    - cannot be positively identified from the imagery available, further investigation of the object may be required if requested by the by the SCR and Archaeologist. This may take the form of additional ROV deployment to obtain better quality imagery, to enable a positive identification. Steps in the Recording Methods and Procedures (Section 3.5) should be followed.
- If the unexpected find is identified by the Archaeologist as a possible heritage site or object, the Archaeologist and a First Nations representative will undertake a significance assessment and provide management advice in accordance with heritage guidelines.
- If any First Nations underwater cultural heritage is present, it would more likely be identified during Phase 1 pre-lay surveys. However, Phase 2 of the UFP will be implemented during construction or pipelay activities to reduce risk to ALARP, as summarised below.

Phase 2 (construction or pipelay activities):

- Upon observing an object that the operatives, including the SCR, believe could be a potential archaeological object ("an article that appears to be underwater cultural heritage"), the SCR is to be notified. If required, the SCR will involve the Archaeologist to better enable an accurate determination of the what the object is.
- The SCR and Archaeologist will then use available imagery to determine whether the object is a possible First Nations object or significant archaeological deposit using the Object Recognition Sheet (Figure 3-3) and their collective experience.
- If the object is assessed as being a possible heritage site or object the Vessel Master, Superintendent/ Environment team will be notified by the SCR.

- If the object is assessed by the SCR and Archaeologist as:
  - Likely to be human remains, and these remains are located directly in the path of the pipeline, then works in the immediate area (within 10 m) must be halted pending the results of appropriate further investigation.
  - Likely to be a cultural heritage object that is directly in the path of the pipeline, then the following steps should be undertaken:
    - Log the GPS location and photograph the heritage site or object while in situ.
    - If the pipeline cannot be locally re-routed around the object in a timely manner, then attempt to recover, manage and assess the object for the cultural heritage and significance.
    - Once recovered, SCR, Archaeologist, and First Nations representative to assess, confirm or not the identification of the object as cultural heritage and undertake a significance assessment for identified heritage.
  - Likely to be a cultural heritage object that is not directly in the path of the pipeline, then the following steps should be undertaken:
    - Log the GPS location and photograph the heritage site or object while in situ.
    - Leave object in situ.
- Construction work may continue, although further actions may be requested by the SCR, Archaeologist and First Nations representative after a positive identification of the object as First Nations cultural heritage and the significance assessment results.
- Construction work cannot be performed within 10 m of the potential cultural heritage object until approved by the SCR and Archaeologist, if the potential cultural heritage object is detected prior to work encroaching within this distance.

Figure 4-3 illustrates the response process upon encountering a potential unexpected First Nations cultural heritage find during Phase 1 (pre-trenching and pre-lay survey activities). Figure 4-4 illustrates the response process upon encountering a potential unexpected First Nations cultural heritage find during Phase 2 (construction or pipelay activities).

All Santos and contractor staff identified as relevant to implementation of this protocol, will complete an induction on the UFP for First Nations cultural heritage, and shall confirm by signature their understanding of the requirements.

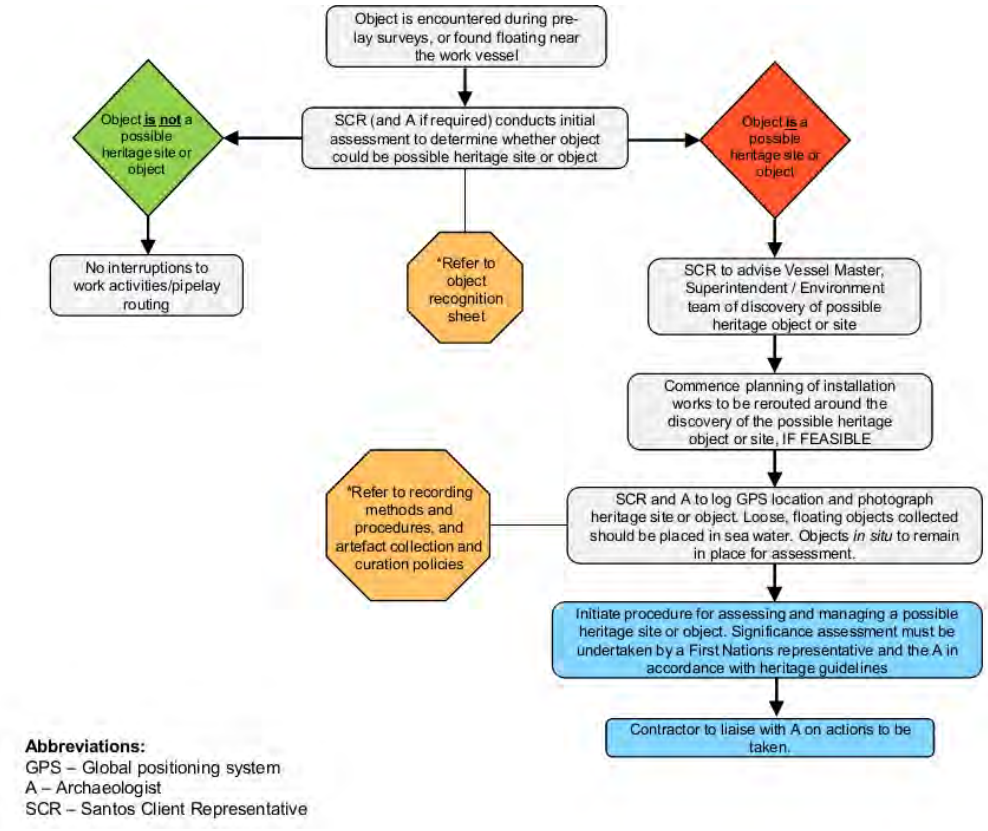


Figure 4-3: Phase 1 (during pre-trenching and pre-lay surveys) heritage response process upon encountering unexpected potential First Nations UCH

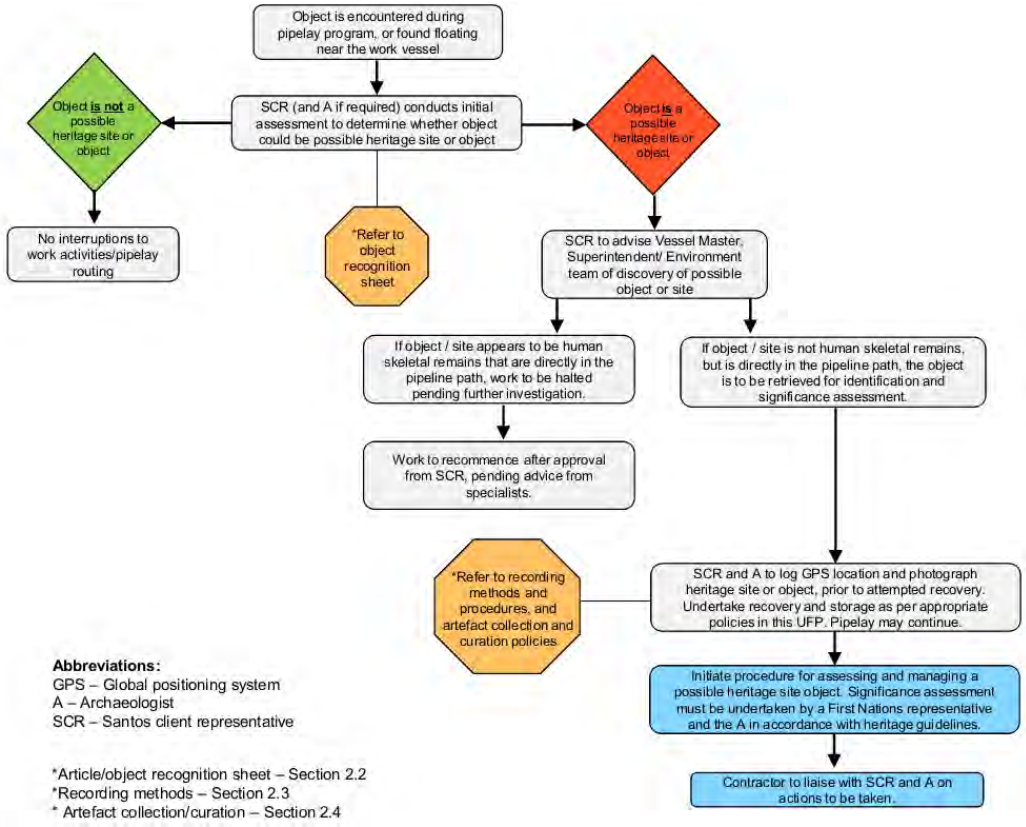


Figure 4-4: Phase 2 (construction or pipelay activities) heritage response process upon encountering unexpected potential First Nations UCH

5 Existing environment

This section describes the key physical, biological, socioeconomic and cultural characteristics (values and sensitivities) of the existing environment that may be affected (EMBA), including the Project Area, by the construction and pre-commissioning activity covered by this Offshore CEMP, including both planned and unplanned events associated with the activity. The description of the environment applies to two areas—the Project Area (including the spoil disposal ground) and a larger area - the EMBA, as shown in **Figure 5-1** as determined from worst case credible hydrocarbon spill modelling.

Information provided in this section is consistent with and in some instances drawn from the following existing Santos documents:

- DPD Project SER (BAS-210 0020)
- DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**)

5.1 Determining the EMBA

Stochastic hydrocarbon dispersion and fate modelling has been applied to worst case credible hydrocarbon spill scenarios relevant to the activity to inform the spatial extent of the EMBA. In stochastic modelling, hundreds of individual hypothetical oil spill simulations are overlayed onto a single map, with each simulation representing a different set of metocean conditions drawn from historical records. Stochastic modelling reduces uncertainty in assessing risk and spill response planning. The map does not indicate the extent of a single real spill event.

Modelling considers key physical and chemical phases of hydrocarbons that pose differing environmental and socioeconomic risks—surface, entrained, dissolved aromatic and shoreline accumulated hydrocarbons. The modelling also considers hydrocarbon exposure values to determine the area that might be contacted by hydrocarbons for these various hydrocarbon phases.

The EMBA is based on stochastic modelling using 300 spill simulations, using low exposure values (**Table 5-1**). The EMBA encompasses the outermost boundary of the overlaid worst-case spatial extent of the hydrocarbon phases for the credible spill scenario.

The low exposure values are used as a predictive tool to set the outer boundaries of the EMBA and may not necessarily result in ecologically significant impacts. To inform the evaluation of potential environmental consequences of a hydrocarbon release (impact assessment), modelling is undertaken using higher exposure values (i.e., the concentrations at which environmental consequences may result).

Stochastic hydrocarbon dispersion and fate modelling, applied to the worst-case spill scenario identified as relevant to the Activity, was undertaken to inform the EMBA. The outer extent of the EMBA for this Offshore CEMP is based on the results of stochastic oil spill modelling for a vessel collision scenario[1], as this represented the largest spatial extent of potential changes to ambient environment conditions. The stochastic modelling used 300 spill simulations (100 different simulations for each of the 3 seasons) for the hypothetical oil spill event. Simplistically, each simulation considers a different combination of metocean conditions over time. The EMBA is illustrated in **Figure 5-1**.

[1] The maximum credible spill volume is 559 m³ of MDO from a vessel collision resulting in a fuel tank rupture. Santos had previously modelled a 700 m³ spill volume. Instead of re-modelling the smaller spill volume of 559 m³, this management plan will present modelling data based on a 700 m³ spill volume for the spill collision analysis. This approach is conservative.

Table 5-1 Hydrocarbon exposure values

Hydrocarbon phase	Exposure value		
	Low	Moderate	High
Surface (g/m^2)	1	10	50
Shoreline accumulation (g/m^2)	10	100	1,000
Dissolved aromatics (ppb)	10	50	400
Entrained (ppb)	10	n/a	100

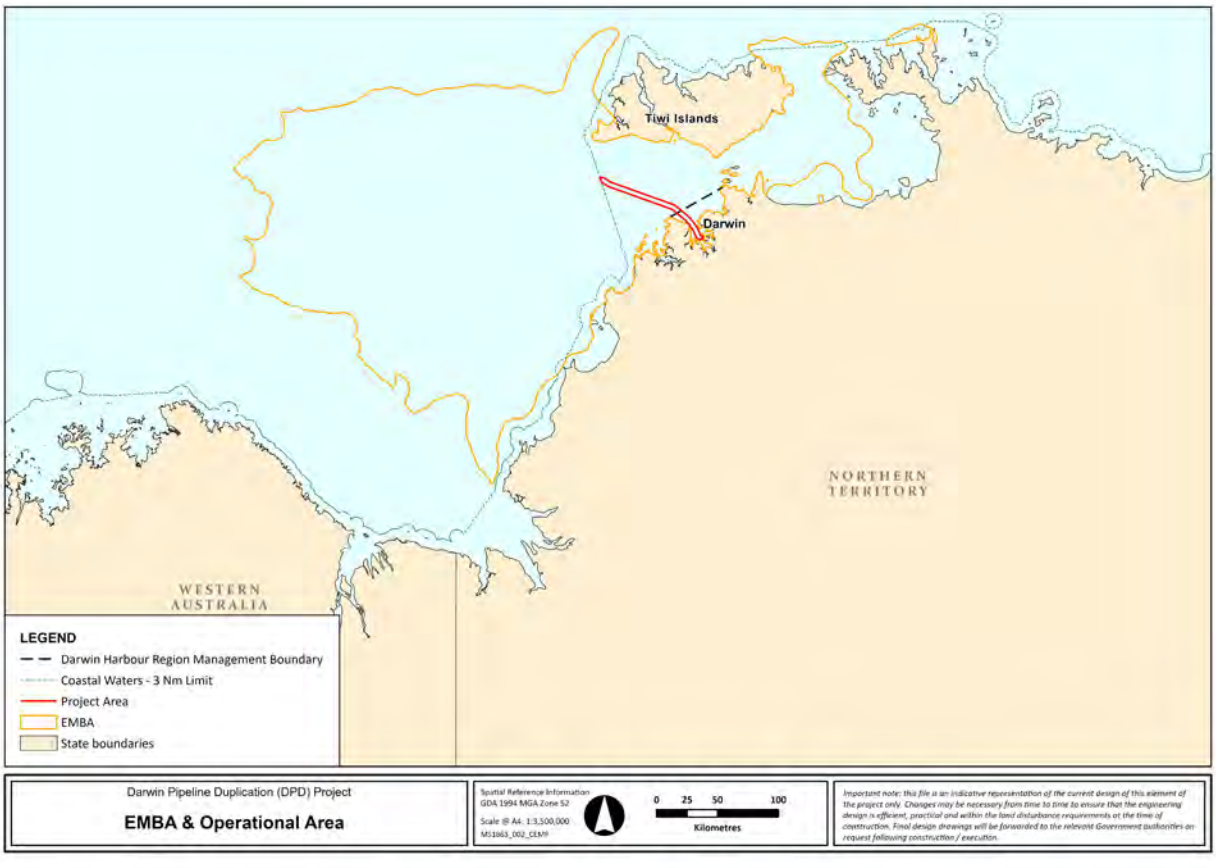


Figure 5-1 EMBA and Project Area location

5.2 EMBA values and sensitivities summary

This section summarises environmental values and sensitivities within the marine and coastal environment that are relevant to the broader EMBA, and which could potentially be contacted from a worst-case hydrocarbon spill scenario associated with the activity.

Section 5.3 provides a more detailed analysis of the values and sensitivities within the Project Area that is relevant to the planned events and associated impacts expected from the activity.

A comprehensive description of the environmental values and sensitivities of the existing environment in the EMBA is provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**). The information in this section draws upon EPBC Act protected matters reports, bioregional plans and fauna recovery plans relevant to the EMBA.

5.2.1 Physical environment

The EMBA within Commonwealth waters intersects with the North Marine Region (NMR) (CoA, 2012a) and the North-West Marine Region (NWMR; CoA, 2012b). A detailed description of the key physical characteristics of the NMR and NWMR are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

A summary of the key physical characteristics of the NMR relevant to the EMBA is provided below (CoA, 2012a):

- a wide continental shelf, with water depths averaging less than 70 m and ranging from approximately 10 m to a maximum known depth of 357 m
- currents driven predominantly by strong winds and tides, a monsoonal climate and complex weather patterns
- limestone pinnacles, which forms part of a key ecological feature (KEF)—pinnacles of the Bonaparte Basin, valued for hard substrate in an otherwise soft sediment environment and so are important for sessile species
- banks, ridges and terraces of the Van Diemen rise, which forms part of a KEF—carbonate bank and terrace system of the Van Diemen Rise, valued for enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity
- cultural features including Sea Country.

The key physical characteristics of the NWMR relevant to the EMBA include (CoA, 2012b):

- the Indonesian Throughflow, a low-salinity water mass that is one of the major elements of the global transfer of heat and water between oceans, and which plays a key role in initiating the Leeuwin Current
- a chain of carbonate banks and shoals, which forms part of a KEF—carbonate bank and terrace system of the Sahul Shelf, valued for enhancing biodiversity and local productivity relative to their surrounds
- limestone pinnacles, which forms part of a KEF—pinnacles of the Bonaparte Basin, valued for hard substrate in an otherwise soft sediment environment and so are important for sessile species
- cultural features including Sea Country.

5.2.1.1 Provincial Bioregions

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA; Department of the Environment and Heritage [DoEH], 2006), the bioregions relevant to the Project Area and the EMBA are listed in **Table 5-2**. A detailed description of features within these provincial bioregions is provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133).

Table 5-2: IMCRA Provincial Bioregions within the Project Area and EMBA

Bioregion	Project Area	EMBA
Northern Shelf Province	✗	✓
Northwest Shelf Transition	✓	✓

5.2.1.2 Benthic habitats

The mean sea level water depths within the EMBA range from 0 m to greater than 180 m deep. Intertidal and sub-tidal benthic habitats include hard substrate and soft sediments and associated habitat forming biota, including hard corals, seagrasses, macroalgae and filter feeding organisms, including sponges and soft corals. Shoreline habitats within the EMBA include intertidal sand/mudflats, beaches, intertidal rock/reef platforms. Fringing mangrove communities are present on stretches of shoreline associated with intertidal sand/mudflats.

The EMBA overlaps several Commonwealth KEFs (**Table 5-3**), which include values relating to their seabed features (CoA, 2012a; CoA, 2012b). A detailed description of benthic habitats is provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.2 Protected and significant areas

Protected and significant areas, including national heritage places, world heritage properties, marine parks, Ramsar and nationally important wetlands and Commonwealth KEFs, identified as overlapping with the EMBA, are listed in **Table 5-3**.

Table 5-3: Protected areas and KEFs within the EMBA

Value/sensitivity name	EMBA
National heritage place / world heritage property	
Kakadu National Park	✓
Australian Marine Parks	
Oceanic Shoals Marine Park	✓
Joseph Bonaparte Gulf	✓
Marine National Park	
Garig Gunak Barlu	✓
Wetlands of international importance (Ramsar site)	
Cobourg Peninsula	✓
Kakadu Ramsar site	✓
Nationally important wetlands	
Adelaide River Floodplain System	✓
Cobourg Peninsula System	✓
Finniss Floodplain and Fog Bay Systems	✓
Kakadu National Park	✓
Mary Floodplain System	✓
Port of Darwin	✓
Key ecological features	
Carbonate bank and terrace system of the Van Diemen Rise	✓
Pinnacles of the Bonaparte Basin	✓
Carbonate bank and terrace system of the Sahul Shelf	✓

5.2.2.1 National heritage place and world heritage property

Kakadu National Park is both a listed national heritage place and a listed world heritage property. The outer extent of the EMBA meets the outer boundary of Kakadu National Park. The Project Area is over 150 km from the park boundary.

Kakadu is managed in accordance with the Kakadu National Park Management Plan 2016–2026 (KNPMP) (DNP, 2016). The EPBC Regulations (Schedule 8) prescribe the Australian International Union for Conservation of Nature (IUCN) management principles for each IUCN category. The Australian management principles relevant to Kakadu National Park are those for IUCN protected area category II which require taking account of the needs and aspirations of traditional owners and other Indigenous people in the park, specifically:

- The needs of Indigenous people, including subsistence resource use, to the extent that they do not conflict with the Australian IUCN management principles; and
- The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with Australian IUCN management principles should be recognised and taken into account (DNP, 2016).

The listed values, relevant to the EMBA, within the KNPMP are:

- biologically important areas (BIAs) for dolphins and turtles;
- habitat critical to the survival of flatback and olive ridley turtles;
- tidally influenced mudflats and mangroves provides important habitat and refuge for birds;
- important habitat for sawfish, river sharks, crocodiles and dugongs; and
- Bininj are the traditional custodians of the land in the northern section of Kakadu National Park which represents a long-standing cultural interaction with landscape and culturally significant as a source of food.

The Kakadu National Park values are further described in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.2.2 Marine parks

The EMBA overlaps two Australian Marine Parks (AMPs)—Oceanic Shoals Marine Park and Joseph Bonaparte Gulf Marine Park, together with one national marine park—Garig Gunak Barlu. The Project Area does not overlap any AMPs.

The AMPs are divided into management zones and managed in accordance with the North MPNMP (DNP, 2018a); the values for these AMPs that overlap the EMBA are summarised in **Table 5-4**. The AMPs and associated cultural features are further described in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

Management plans for AMPs were developed and enacted on 1 July 2018. Under these plans, AMPs are allocated conservation objectives (IUCN Protected Area Category) based on the Australian IUCN Reserve Management Principles in Schedule 8 of the EPBC Regulations 2000. These principles determine what activities are acceptable within the different zones of the AMP network.

Garig Gunak Barlu is managed by the NT Parks and Wildlife Commission and declared under the *Cobourg Peninsula Aboriginal Land, Sanctuary and Marine Park Act 1981*. The Cobourg Marine Park Plan of Management (NT Government, 2011) expired in 2021.

Table 5-4: MPNMP listed Marine Park values overlapping the EMBA

Value Sensitivity	Management Zone(s)	Values overlapping the EMBA
AMP		
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI) Special Purpose Zone (IUCN VI)	The Joseph Bonaparte Gulf Marine Park values (DNP, 2018a): + ecosystems representative of the Northwest Shelf Transition— dynamic environment influenced by strong tidal currents, monsoonal winds, cyclones and wind-generated waves + a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act + sea country, which is valued for Indigenous cultural identity, health and wellbeing + commercial fishing, tourism, mining and recreation, including fishing, are important activities in the Marine Park.
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI) Multiple Use Zone (IUCN VI) National Park Zone (IUCN II) Habitat Protection Zone (IUCN IV)	The Oceanic Shoals Marine Park values (DNP, 2018a): + ecosystems representative of the Northwest Shelf Transition 2 KEFs: + carbonate bank and terrace systems of the Sahul Shelf + pinnacles of the Bonaparte Basin + a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act + BIAs that include foraging and internesting habitat for marine turtles + sea country, which is valued for Indigenous cultural identity, health and wellbeing + commercial fishing, tourism, and recreation, including fishing, are important activities.
Marine National Park		
Garig Gunak Barlu	Multiple Use A Zone Multiple Use B Zone	+ Multiple Use A and B zones provide for multiple use of the park's resources, including commercial fishing activities. Multiple Use A zone has more intensive fishing, such as prawn trawling and netting. These zones also provide protection of important conservation and scientific values + provides BIAs for dolphins, seabirds and marine turtles

Value Sensitivity	Management Zone(s)	Values overlapping the EMBA
		+ habitat critical to the survival of flatback, green and olive ridley turtles + habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish and crustacean species of fisheries significance *Note: The EMBA intersects the perimeter of the marine park with no predicted shoreline or surface oil contact at or above low threshold values.*

5.2.2.3 Wetlands of international and national importance

The Ramsar Convention on Wetlands is an intergovernmental treaty that aims to conserve wetlands of international importance. Ramsar wetlands are recognised as MNES under the EPBC Act (DSEWPaC, 2010). The EMBA intersects one Ramsar wetland – Kakadu National Park – and is adjacent to a second Ramsar wetland— Cobourg Peninsula. The Cobourg Peninsula Ramsar site does not include the surrounding marine waters, and modelling predicts no shoreline contact should occur at this site.

A description of the values of Kakadu National Park Ramsar site and nationally important wetlands that overlap with the EMBA is provided in **Table 5-5**.

Table 5-5: Wetland values that overlap the EMBA

Value Sensitivity	Description	Values that overlap or are adjacent to the EMBA
Wetlands of international importance		
Cobourg Peninsula Ramsar site	Declared a Ramsar site in 1974. The Cobourg Peninsula system comprises of coastal and inland wetlands. It consists of intertidal forested wetlands and mudflats, seasonal freshwater marshes and permanent freshwater pools. Garig Gunak Barlu National Park includes the marine waters surrounding the peninsula, but these are not included in the Ramsar site (BMT WBM, 2011).	N/A. This Ramsar site does not include marine waters as a value and modelling predicts no shoreline or surface oil contact at or above low threshold values.
Kakadu Ramsar site	In 2010, 2 Ramsar sites were combined to form a single Ramsar site encompassing the entire National Park, covering 19,810 km^2. The park meets all 9 criteria for identifying wetlands of international importance under the Ramsar Convention.	+ BIAs for dolphins and turtles + habitat critical to the survival of flatback and olive ridley turtles + tidally influenced mudflats and mangroves provide important habitat and refuge for birds supporting more than 1% of the East Asian-Australasian Flyway population. + important habitat for sawfish, river sharks, crocodiles and dugongs

Value Sensitivity	Description	Values that overlap or are adjacent to the EMBA
Nationally important wetlands		
Adelaide River Floodplain System	Adelaide River Floodplain System is an irregular floodplain and tidal wetland system consisting of several swamps, lakes, lagoons, mudflats, rivers and dams, covering 1,350 km^2 (Jaensch, 1993).	+ nationally significant mangrove habitats + significant migration stop-over area for shorebirds.
Cobourg Peninsula System	The Cobourg Peninsula system is comprised of intertidal forested wetlands and mudflats, seasonal freshwater marshes and permanent freshwater pools. The site covers 2,207 km^2 (BMT WBM, 2011).	+ BIAs for dolphins, seabirds and marine turtles such as habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish and crustacean species of fisheries significance.
Finniss Floodplain and Fog Bay Systems	Finniss Floodplain and Fog Bay Systems consist of a beach-fringed bay with intertidal mudflats and a floodplain with paperbark swamps. The wetland supports the breeding and migration of various bird species and significant populations of marine turtles and mammals, such as the dugong and Australian humpback dolphin. The site covers 813 km^2 (Jaensch, 1993).	N/A: the EMBA does not overlap the wetland (adjacent); however, the EMBA overlaps nesting and foraging BIAs for marine turtles.
Mary Floodplain System	Mary Floodplain System consists of the entire floodplain of the Mary River, covering 1,276 km^2. There are 3 principal plant formations and the largest wooded swamp areas in the NT. The wetland supports a major breeding area for the magpie goose, a refuge for waterbirds and saltwater crocodiles during the dry season, and supports at least several thousand migrant shorebirds at a time.	N/A: the EMBA does not overlap the wetland (adjacent)
Port of Darwin	Entirely tidal, with mangrove forests present, covering 488 km^2. One of the NT's largest areas of mangrove swamps and features a shallow branching embayment (Jaensch, 1993).	+ nursery area for estuarine and offshore fish and crustaceans + mangrove communities are the most extensive and species–rich of any NT embayment. + BIAs for dolphins (Australian snubfin, Australian humpback (previously known as Indo-Pacific humpback) and spotted bottlenose) and turtles (flatback).

5.2.2.4 Key ecological features

Key ecological features (KEFs) are those components of the marine ecosystem that are important for biodiversity or the ecosystem function and integrity of a Commonwealth marine area. The KEFs within the EMBA are listed in **Table 5-3**. The Project Area does not overlap any KEFs.

Further detail on the values of the KEFs are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.3 Threatened and migratory fauna

Table 5-6 lists the EPBC Act listed threatened and migratory species identified as overlapping the EMBA along with their environmental values and sensitivities. The species were identified using the Protected Matters Search Tool (PMST) and for each species identified, the extent of the likely presence is described in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

Table 5-7 includes information on relevant conservation advice, recovery/ management plans for those EPBC Act listed species identified to overlap the EMBA from the Protected Matters Search.

Table 5-7: Relevant conservation advice/management plans and objectives, threats and conservation actions for EPBC Act listed species overlapping with the EMBA

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats/strategies Identified as relevant to the Activity	Relevant conservation actions
All vertebrate fauna	Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018)	There are 4 main objectives: contribute to the long-term prevention of the incidence of harmful marine debris remove existing harmful marine debris from the marine environment mitigate the impacts of harmful marine debris on marine species and ecological communities monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.	Marine debris	No explicit management actions for non–fisheries-related industries (note that management actions in the plan relate largely to managing fishing waste (e.g. 'ghost' gear), and state, territory and Commonwealth management through regulation).
All sawfish and river sharks including: dwarf sawfish green sawfish largetooth sawfish speartooth shark northern river shark	Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks with a view to: improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species 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 (DoEE, 2018).	Habitat degradation and modification	Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.
Dwarf sawfish	Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009)	No explicit relevant objectives.	Habitat degradation and modification	No explicit management actions for industry.
Largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (TSSC, 2014b)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
Green sawfish	Approved Conservation Advice for Green Sawfish (DEWHA, 2008a)	No explicit relevant objectives.	Habitat degradation and modification	No explicit relevant management actions.
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit relevant management actions.
Speartooth shark	Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit management actions for industry (note that the responsibility for the action identified is for Commonwealth Government to implement).
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild with a view to:	Pollution and disease	Review and assess the potential threat of introduced species, pathogens and pollutants.

		improving the population status ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark.	Ecosystem effects as a result of habitat modification	Review the level and spatial extent of protection measures at key aggregation sites to ensure appropriate levels of protection, and a consistent approach to the designation and implementation of protective measures, are applied. Use BIAs to help inform the development of appropriate conservation measures, including applying advice in the marine bioregional plans on the types of actions that are likely to have a significant impact on the species and updating such conservation measures as new information becomes available.
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range with a view to: improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objective of the recovery plan (relevant to industry) is: Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.	Ecosystem effects as a result of habitat modification	No explicit relevant management actions.
Whale shark	Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g)	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.	Boat strike from large vessels	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations along the northward migration route that follows the northern WA coastline along the 200 m isobath (TSSC, 2015g).
			Habitat disruption from mineral exploration, production and transportation	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit relevant management actions.
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. The specific objective of the strategy (relevant to industry) is: Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.	Vessel collision	Encourage innovation and collaboration between research organisations and industry.
Blue whale (includes pygmy blue whale)	Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the blue whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Noise interference assess and address anthropogenic noise	Assess and address anthropogenic noise: shipping, industrial and seismic noise.
			Habitat modification	No explicit relevant management actions.
			Vessel disturbance	Minimise vessel collisions: develop a national vessel strike strategy that investigates the risk of vessel strike on blue whales and also identifies potential mitigation measures ensure all vessel strike incidents are reported in the National Ship Strike database7F6F

				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.
			Marine debris	No explicit relevant management actions.
Fin whale	Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program.	Habitat degradation including pollution (increasing port expansion and coastal development)	No explicit relevant management actions.
			Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of fin whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
			Vessel strike	Develop a national vessel strike strategy that investigates the risk of vessel strikes on fin whales and identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Ship Strike database4.
Sei whale	Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program.	Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of sei whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
			Vessel strike	Minimise vessel collisions: develop a national vessel strike strategy that investigates the risk of vessel strikes on sei whales and also identifies potential mitigation measures ensure all vessel strike incidents are reported in the National Ship Strike database4.
			Habitat degradation including pollution	No explicit relevant management actions.
Water Mouse	Conservation Advice for *Xeromys myoides* (Water Mouse) (DAWE, 2021)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
All marine turtles (flatback, green, hawksbill, leatherback, loggerhead, olive ridley)	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.	Light pollution	Best practice lighting design incorporates these design principles: start with natural darkness and only add light for specific purposes use adaptive light controls to manage light timing, intensity and colour light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill use the lowest intensity lighting appropriate for the task use non-reflective, dark-coloured surfaces use lights with reduced or filtered blue, violet and ultraviolet wavelengths.
		Long-term recovery objective:	Marine debris	Reduce the impacts from marine debris:

	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)	minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: anthropogenic threats are demonstrably minimised.		support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life (DoEE, 2018).
			Chemical and terrestrial discharge	Minimise chemical and terrestrial discharge.
			Vessel disturbance	Vessel interactions identified as a threat. No specific management actions in relation to vessels prescribed in the plan.
			Light pollution	Minimise light pollution: manage artificial light within or adjacent to habitat critical to the survival of marine turtles such that marine turtles are not displaced from these habitats develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches. identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.
			Noise interference	Assess and address anthropogenic noise: understand the impacts of anthropogenic noise on marine turtle behaviour and biology.
			Habitat modification	Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to their survival. Manage anthropogenic activities in BIAs to ensure that biologically important behaviour can continue.
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b)	No explicit relevant objectives.	Boat strike	No explicit relevant management actions.
			Habitat degradation (changes to breeding sites and degradation to foraging areas)	Identify and protect migratory corridors between nesting beaches and common foraging areas to facilitate colonisation.
			Marine debris	No explicit relevant management actions.
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.	Light pollution	Best practice lighting design incorporates these design principles: start with natural darkness and only add light for specific purposes use adaptive light controls to manage light timing, intensity and colour. light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. use the lowest intensity lighting appropriate for the task. use non-reflective, dark-coloured surfaces. use lights with reduced or filtered blue, violet and ultraviolet wavelengths.
Bridled tern	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Seabirds and their habitats are protected and managed in Australia.	Pollution (marine debris, light, water)	Enhance contingency plans to prevent and/or respond to environmental emergencies that impact seabirds and their habitats.

Common noddy Great frigatebird Greater crested tern Lesser frigatebird Little tern Osprey Streaked shearwater Wedge-tailed shearwater White-tailed tropicbird			Habitat loss and degradation from pollution	No explicit relevant management actions.
			Anthropogenic disturbance	Ensure all areas of important habitat for seabirds are considered in the development assessment process. Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.
Asian dowitcher Bar-tailed godwit Black-tailed godwit Common greenshank Curlew sandpiper Eastern curlew Great knot Greater sand plover Grey plover Lesser sand plover Little curlew Little ringed plover Long-toed stint Marsh sandpiper Oriental plover Pacific golden plover Pectoral sandpiper Red knot Red-necked stint Ruddy turnstone Sanderling Sharp-tailed sandpiper Streaked shearwater Terek sandpiper Whimbrel	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.	Habitat degradation/modification	No explicit relevant management actions.
			Anthropogenic disturbance	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia. Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes (specifically for coastal developments).
			Pollution/contamination	No explicit relevant management actions.
Asian dowitcher	Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW, 2024f)	No explicit relevant objectives.	Pollution/contamination	No explicit relevant management actions.
Australian Painted Snipe	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (TSSC, 2013)	No explicit relevant objectives.	Habitat loss, degradation and modification	No explicit relevant management actions.

	National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (DCCEEW, 2022a)	No explicit relevant objectives.	Habitat loss, degradation and modification	No explicit relevant management actions.
Black-tailed godwit	Conservation Advice for *Limosa limosa* (black-tailed godwit) (DCCEEW, 2024e)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Common greenshank	Conservation Advice for *Tringa nebularia* (common greenshank) (DCCEEW, 2024h)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	No explicit relevant objectives.	Habitat loss and degradation from pollution	No explicit relevant management actions.
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f)	Australian objectives: achieve a stable or increasing population. maintain and enhance important habitat. reduce disturbance at key roosting and feeding sites.	Habitat loss and degradation from pollution	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Great knot	Conservation Advice for *Calidris tenuirostris* (great knot) (DCCEEW, 2024d)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Greater sand plover	Conservation Advice *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016)	No explicit relevant objectives.	Habitat loss and degradation	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Grey falcon	Conservation Advice *Falco hypoleucos* (Grey Falcon) (TSSC, 2020)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Grey plover	Conservation Advice for *Pluvialis squatarola* (grey plover) (DCCEEW, 2024g)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Lesser Sand Plover, Mongolian Plover	Conservation Advice *Charadrius mongolus* (Lesser Sand Plover, Mongolian Plover) (TSSC, 2016d)	No explicit relevant objectives.	Habitat loss and degradation	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Partridge Pigeon (eastern)	Conservation Advice *Geophaps smithii smithii (Partridge Pigeon [eastern])* (TSSC, 2015)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Masked Owl (northern)	Conservation Advice *Tyto novaehollandiae kimberli* (masked owl [northern]) (TSSC, 2015a)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Conservation Advice *Limosa lapponica baueri* (Bar-tailed godwit [western Alaska]) (TSSC, 2016a)	No explicit relevant objectives.	Habitat loss and degradation	Protect important habitat in Australia.
			Pollution/contamination	Protect important habitat in Australia.
Red Goshawk	Conservation Advice *Erythrotriorchis radiatus* (Red goshawk) (TSSC, 2015h)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Red knot	Conservation Advice for *Calidris canutus* (red knot) (DCCEEW, 2024c)	No explicit relevant objectives.	Pollution/contamination impacts	No explicit relevant management actions.
			Habitat loss and degradation	No explicit relevant management actions.

			Anthropogenic disturbance	No explicit relevant management actions.
Ruddy turnstone	Conservation Advice for *Arenaria interpres* (ruddy turnstone) (DCCEEW, 2024a)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Sharp-tailed sandpiper	Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW, 2024b)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Terek sandpiper	Conservation Advice for *Xenus cinereus* (terek sandpiper) (DCCEEW, 2024i)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands)	Conservation Advice *Melanodryas cucullata melvillensis* (hooded robin [Tiwi Islands]) (TSSC, 2018a)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Tiwi Masked Owl, Tiwi Islands Masked Owl	Conservation Advice Tyto *novaehollandiae melvillensis* (masked owl [Tiwi Islands]) (TSSC, 2015i)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.

Table 5-6: EPBC Act listed threatened and migratory fauna identified from the Protected Matters Search of the EMBA

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Mammals					
Blue whale[2]	*Balaenoptera musculus*	Endangered, Migratory Marine	✗	✓	Species or species habitat likely to occur within area
Bryde's whale	*Balaenoptera edeni*	Migratory Marine	✗	✓	Species or species habitat likely to occur within area
Fin whale	*Balaenoptera physalus*	Vulnerable, Migratory Marine	✗	✓	Species or species habitat may occur within area
Humpback whale	*Megaptera novaeangliae*	Migratory Marine	✗	✓	Species or species habitat likely to occur within area
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory Marine	✗	✓	Species or species habitat may occur within area
Australian humpback dolphin (previously referred to as the Indo-Pacific humpback dolphin)	*Sousa sahulensis* (previously referred to as *S. chinensis*)	Migratory Marine	✗	✓	Breeding known to occur within area
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory Marine	✗	✓	Breeding known to occur within area
Killer whale, orca	*Orcinus orca*	Migratory Marine	✗	✓	Species or species habitat may occur within area
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus* (Arafura/Timor Sea populations)	Migratory Marine	✗	✓	Species or species habitat known to occur within area

[2] *In Australian waters there are two subspecies of blue whale, the pygmy blue whale (B. m. brevicauda) and the Antarctic blue whale (B. m. intermedia). It is more likely that the pygmy blue whale could be encountered within the EMBA.*

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	**Scientific name**				
Dugong[3]	*Dugong dugon*	Migratory Marine	✗	✓	Species or species habitat known to occur within area
Water Mouse	*Xeromys myoides*	Vulnerable	✗	✓	Species or species habitat likely to occur within area
Reptiles					
Flatback turtle	*Natator depressus*	Vulnerable, Migratory Marine	✗	✓	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Vulnerable, Migratory Marine	✗	✓	Breeding known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory Marine	Vulnerable	✓	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle, leathery turtle, luth	*Dermochelys coriacea*	Endangered, Migratory Marine	Critically endangered	✓	Foraging, feeding or related behaviour known to occur within area
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory Marine	Vulnerable	✓	Foraging, feeding or related behaviour known to occur within area
Olive ridley turtle, Pacific ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory Marine	Vulnerable	✓	Breeding known to occur within area
Salt-water crocodile, estuarine crocodile	*Crocodylus porosus*	Migratory marine	✗	✓	Species or species habitat likely to occur within area
Fish					
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable, Migratory marine	Vulnerable	✓	Species or species habitat known to occur within area

[3] Species or species habitat may occur within the light / noise boundary (20 km buffer around the Project Area)

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	*Pristis pristis*	Vulnerable, Migratory marine	Vulnerable	✓	Species or species habitat known to occur within area
Giant manta ray	*Mobula birostris*	Migratory marine	✗	✓	Species or species habitat likely to occur within area
Green sawfish	*Pristis zijsron*	Vulnerable, Migratory marine	Vulnerable	✓	Species or species habitat known to occur within area
Grey nurse shark	*Carcharias taurus*	Vulnerable	✗	✓	Species or species habitat likely to occur within area
Largetooth sawfish	*Pristis pristis*	Vulnerable, Migratory marine	Vulnerable	✓	Species or species habitat known to occur within area
Longfin mako	*Isurus paucus*	Migratory marine	✗	✓	Breeding known to occur within area
Narrow sawfish	*Anoxypristis cuspidata*	Migratory marine	✗	✓	Species or species habitat likely to occur within area
Northern river shark	*Glyphis garricki*	Endangered	Endangered	✓	Species or species habitat known to occur within area
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory marine	✗	✓	Species or species habitat likely to occur within area
Reef manta ray	*Mobula alfredi*	Migratory marine	✗	✓	Species or species habitat may occur within area
Scalloped hammerhead	*Sphyrna lewini*	Conservation dependent	✗	✓	Species or species habitat may occur within area
Shortfin mako	*Isurus oxyrinchus*	Migratory marine	✗	✓	Species or species habitat may occur within area
Southern Bluefin Tuna	*Thunnus maccoyii*	Conservation dependent	✗	✓	Species or species habitat may occur within area

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Speartooth shark	*Glyphis glyphis*	Critically endangered	Vulnerable	✓	Species or species habitat known to occur within area
Whale shark	*Rhincodon typus*	Vulnerable, Migratory marine	✗	✓	Reported as occurring within or near the Project Area as part of the Barossa marine studies program.
White shark	*Carcharodon carcharias*	Vulnerable, Migratory marine	✗	✓	Species or species habitat may occur within area
Seabirds and shorebirds					
Alligator Rivers yellow chat	*Epthianura crocea tunneyi*	Endangered	Endangered	✓	Species or species habitat likely to occur within area
Asian dowitcher	*Limnodromus semipalmatus*	Vulnerable, Migratory Wetlands, Overfly marine	✗	✓	Species or species habitat known to occur within area
Australian painted snipe	*Rostratula australis*	Endangered, Overfly Marine	Endangered	✓	Species or species habitat may occur within area
Barn swallow	*Hirundo rustica*	Migratory Terrestrial, Overfly Marine	✗	✓	Species or species habitat known to occur within area
Bar-tailed godwit	*Limosa lapponica*	Endangered, Migratory Wetlands	Critically endangered	✓	Species or species habitat known to occur within area
Black-tailed godwit	*Limosa limosa*	Vulnerable, Migratory Wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Broad-billed sandpiper	*Limicola falcinellus*	Migratory Wetlands, Overfly Marine	✗	✓	Roosting known to occur within area
Common noddy	*Anous stolidus*	Migratory marine	✗	✓	Species or species habitat likely to occur within area
Common sandpiper	*Actitis hypoleucos*	Migratory wetlands	✗	✓	Species or species habitat known to occur within area

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Common greenshank	*Tringa nebularia*	Endangered, Migratory wetlands, Overfly marine	✗	✓	Species or species habitat known to occur within area
Curlew sandpiper	*Calidris ferruginea*	Critically endangered, Migratory wetlands, Overfly Marine	Critically endangered	✓	Species or species habitat known to occur within area
Eastern curlew	*Numenius madagascariensis*	Critically endangered, Migratory wetlands, Marine	Critically endangered	✓	Species or species habitat known to occur within area
Fork-tailed swift	*Apus pacificus*	Migratory marine, Overfly marine	✗	✓	Species or species habitat likely to occur within area
Great frigatebird	*Fregata minor*	Migratory marine	✗	✓	Species or species habitat known to occur within area
Great knot	*Calidris tenuirostris*	Vulnerable, Migratory Wetlands, Overfly Marine	Critically endangered	✓	Roosting known to occur within area
Greater crested tern	*Thalasseus bergii*	Migratory wetlands	✗	✓	Breeding likely to occur within area
Greater sand plover	*Charadrius leschenaultii*	Vulnerable, Migratory wetlands, Marine	Vulnerable	✓	Species or species habitat known to occur within area
Grey falcon	*Falco hypoleucos*	Vulnerable, Migratory wetlands, Marine	Vulnerable	✓	Species or species habitat known to occur within area
Grey plover	*Pluvialis squatarola*	Vulnerable, Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Grey-tailed tattler	*Tringa brevipes*	Migratory wetlands,	✗	✓	Roosting known to occur within area
Lesser frigatebird	*Fregata ariel*	Migratory marine	✗	✓	Species or species habitat known to occur within area
Lesser sand plover	*Charadrius mongolus*	Endangered, Migratory wetlands	Endangered	✓	Roosting known to occur within area

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Little curlew	*Numenius minutus*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Little ringed plover	*Charadrius dubius*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Little tern	*Sternula albifrons*	Migratory marine	✗	✓	Breeding known to occur within area
Long-toed stint	*Calidris subminuta*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Marsh sandpiper	*Tringa stagnatilis*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Masked owl (northern)	*Tyto novaehollandiae kimberli*	Vulnerable	Vulnerable	✓	Species or species habitat known to occur within area
Nunivak bar-tailed godwit, Western Alaskan bar-tailed godwit	*Limosa lapponica baueri*	Vulnerable	✗	✓	Species or species habitat known to occur within area
Oriental cuckoo, horsfield's cuckoo	*Cuculus optatus*	Migratory terrestrial	✗	✓	Species or species habitat known to occur within area
Oriental plover, oriental dotterel	*Charadrius veredus*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Oriental pratincole	*Glareola maldivarum*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Oriental reed-warbler	*Acrocephalus orientalis*	Migratory wetlands	✗	✓	Species or species habitat may occur within area
Osprey	*Pandion haliaetus*	Migratory wetlands	✗	✓	Breeding known to occur within area

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Pacific golden plover	*Pluvialis fulva*	Migratory wetlands	✗	✓	Roosting known to occur within area
Partridge pigeon (eastern)	*Geophaps smithii smithii*	Vulnerable	Vulnerable	✓	Species or species habitat known to occur within area
Pectoral sandpiper	*Calidris melanotos*	Migratory wetlands	✗	✓	Species or species habitat known to occur within area
Pin-tailed snipe	*Gallinago stenura*	Migratory wetlands, Overfly marine	✗	✓	Roosting likely to occur within area
Red goshawk	*Erythrotriorchis radiatus*	Vulnerable	Vulnerable	✓	Species or species habitat known to occur within area
Red knot, knot	*Calidris canutus*	Vulnerable, migratory wetlands, Overfly marine	Endangered	✓	Species or species habitat known to occur within area
Red-necked stint	*Calidris ruficollis*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Red-rumped swallow	*Cecropis daurica*	Migratory terrestrial, Overfly marine	✗	✓	Species or species habitat known to occur within area
Ruddy turnstone	*Arenaria interpres*	Vulnerable, Migratory wetlands	✗	✓	Roosting known to occur within area
Rufous fantail	*Rhipidura rufifrons*	Migratory terrestrial, Overfly marine	✗	✓	Species or species habitat known to occur within area
Sanderling	*Calidris alba*	Migratory wetlands	✗	✓	Roosting known to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	Vulnerable, Migratory wetlands	✗	✓	Roosting known to occur within area
Streaked shearwater	*Calonectris leucomelas*	Migratory Marine	✗	✓	Species or species habitat known to occur within area

Value/sensitivity – Marine fauna		EPBC Act status	NT listed threatened species	May be present	Particular values or sensitivities
Common name	Scientific name				
Swinhoe's snipe	*Gallinago megala*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Terek sandpiper	*Xenus cinereus*	Vulnerable, Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Tiwi Islands hooded robin	*Melanodryas cucullata melvillensis*	Critically Endangered	Critically Endangered	✓	Species or species habitat likely to occur within area
Tiwi masked owl	*Tyto novaehollandiae melvillensis*	Endangered	Endangered	✓	Species or species habitat known to occur within area
Wandering tattler	*Tringa incana*	Migratory wetlands	✗	✓	Roosting known to occur within area
Whimbrel	*Numenius phaeopus*	Migratory wetlands	✗	✓	Roosting known to occur within area
White-tailed tropicbird	*Phaethon lepturus*	Migratory Marine	✗	✓	Species or species habitat may occur within area
Wood sandpiper	*Tringa glareola*	Migratory wetlands, Overfly marine	✗	✓	Roosting known to occur within area
Yellow wagtail	*Motacilla flava*	Migratory terrestrial, Overfly marine	✗	✓	Species or species habitat known to occur within area

Table 5-7: Relevant conservation advice/management plans and objectives, threats and conservation actions for EPBC Act listed species overlapping with the EMBA

Name	Recovery plan/conservation advice/management plan	Relevant objectives	Threats/strategies Identified as relevant to the Activity	Relevant conservation actions
All vertebrate fauna	Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE, 2018)	There are 4 main objectives: contribute to the long-term prevention of the incidence of harmful marine debris remove existing harmful marine debris from the marine environment mitigate the impacts of harmful marine debris on marine species and ecological communities monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.	Marine debris	No explicit management actions for non–fisheries-related industries (note that management actions in the plan relate largely to managing fishing waste (e.g. 'ghost' gear), and state, territory and Commonwealth management through regulation).
All sawfish and river sharks including: dwarf sawfish green sawfish largetooth sawfish speartooth shark northern river shark	Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks with a view to: improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species 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 (DoEE, 2018).	Habitat degradation and modification	Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.
Dwarf sawfish	Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009)	No explicit relevant objectives.	Habitat degradation and modification	No explicit management actions for industry.
Largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (TSSC, 2014b)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
Green sawfish	Approved Conservation Advice for Green Sawfish (DEWHA, 2008a)	No explicit relevant objectives.	Habitat degradation and modification	No explicit relevant management actions.
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit relevant management actions.
Speartooth shark	Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014)	No explicit relevant objectives.	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit management actions for industry (note that the responsibility for the action identified is for Commonwealth Government to implement).
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild with a view to:	Pollution and disease	Review and assess the potential threat of introduced species, pathogens and pollutants.

		improving the population status ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark.	Ecosystem effects as a result of habitat modification	Review the level and spatial extent of protection measures at key aggregation sites to ensure appropriate levels of protection, and a consistent approach to the designation and implementation of protective measures, are applied. Use BIAs to help inform the development of appropriate conservation measures, including applying advice in the marine bioregional plans on the types of actions that are likely to have a significant impact on the species and updating such conservation measures as new information becomes available.
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range with a view to: improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder recovery in the near future, or impact the conservation status of the species in the future. The specific objective of the recovery plan (relevant to industry) is: Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.	Ecosystem effects as a result of habitat modification	No explicit relevant management actions.
Whale shark	Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015g)	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.	Boat strike from large vessels	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations along the northward migration route that follows the northern WA coastline along the 200 m isobath (TSSC, 2015g).
			Habitat disruption from mineral exploration, production and transportation	Implement measures to reduce adverse impacts of habitat degradation and/or modification.
			Marine debris	No explicit relevant management actions.
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. The specific objective of the strategy (relevant to industry) is: Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.	Vessel collision	Encourage innovation and collaboration between research organisations and industry.
Blue whale (includes pygmy blue whale)	Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the blue whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Noise interference assess and address anthropogenic noise	Assess and address anthropogenic noise: shipping, industrial and seismic noise.
			Habitat modification	No explicit relevant management actions.
			Vessel disturbance	Minimise vessel collisions: develop a national vessel strike strategy that investigates the risk of vessel strike on blue whales and also identifies potential mitigation measures

				ensure all vessel strike incidents are reported in the National Ship Strike database7F6F[4] 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.
			Marine debris	No explicit relevant management actions.
Fin whale	Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program.	Habitat degradation including pollution (increasing port expansion and coastal development)	No explicit relevant management actions.
			Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of fin whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
			Vessel strike	Develop a national vessel strike strategy that investigates the risk of vessel strikes on fin whales and identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Ship Strike database[4].
Sei whale	Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program.	Anthropogenic noise	Once the spatial and temporal distribution (including BIAs) of sei whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
			Vessel strike	Minimise vessel collisions: develop a national vessel strike strategy that investigates the risk of vessel strikes on sei whales and also identifies potential mitigation measures ensure all vessel strike incidents are reported in the National Ship Strike database[4].
			Habitat degradation including pollution	No explicit relevant management actions.
Water Mouse[5]	Conservation Advice for *Xeromys myoides* (Water Mouse) (DAWE, 2021)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
All marine turtles (flatback, green, hawksbill, leatherback, loggerhead, olive ridley)	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives.	Light pollution	Best practice lighting design incorporates these design principles: start with natural darkness and only add light for specific purposes use adaptive light controls to manage light timing, intensity and colour light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill use the lowest intensity lighting appropriate for the task

[4] https://data.marinemammals.gov.au/report/shipstrike/new

[5] Species or species habitat is not known to be present in the Project Area. Hence, some threats typically relevant to petroleum activities (such as debris) have been assessed as not relevant and are not discussed further.

		A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.		use non-reflective, dark-coloured surfaces use lights with reduced or filtered blue, violet and ultraviolet wavelengths.
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)	Long-term recovery objective: minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: anthropogenic threats are demonstrably minimised.	Marine debris	Reduce the impacts from marine debris: support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life (DoEE, 2018).
			Chemical and terrestrial discharge	Minimise chemical and terrestrial discharge.
			Vessel disturbance	Vessel interactions identified as a threat. No specific management actions in relation to vessels prescribed in the plan.
			Light pollution	Minimise light pollution: manage artificial light within or adjacent to habitat critical to the survival of marine turtles such that marine turtles are not displaced from these habitats develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches. identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.
			Noise interference	Assess and address anthropogenic noise: understand the impacts of anthropogenic noise on marine turtle behaviour and biology.
			Habitat modification	Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to their survival. Manage anthropogenic activities in BIAs to ensure that biologically important behaviour can continue.
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b)	No explicit relevant objectives.	Boat strike	No explicit relevant management actions.
			Habitat degradation (changes to breeding sites and degradation to foraging areas)	Identify and protect migratory corridors between nesting beaches and common foraging areas to facilitate colonisation.
			Marine debris	No explicit relevant management actions.
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023b)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives.	Light pollution	Best practice lighting design incorporates these design principles: start with natural darkness and only add light for specific purposes use adaptive light controls to manage light timing, intensity and colour. light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. use the lowest intensity lighting appropriate for the task. use non-reflective, dark-coloured surfaces.

		A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.		use lights with reduced or filtered blue, violet and ultraviolet wavelengths.
Bridled tern Common noddy Great frigatebird Greater crested tern Lesser frigatebird Little tern Osprey Streaked shearwater Wedge-tailed shearwater White-tailed tropicbird	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Seabirds and their habitats are protected and managed in Australia.	Pollution (marine debris, light, water)	Enhance contingency plans to prevent and/or respond to environmental emergencies that impact seabirds and their habitats.
			Habitat loss and degradation from pollution	No explicit relevant management actions.
			Anthropogenic disturbance	Ensure all areas of important habitat for seabirds are considered in the development assessment process. Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.
Asian dowitcher Bar-tailed godwit Black-tailed godwit Common greenshank Curlew sandpiper Eastern curlew Great knot Greater sand plover Grey plover Lesser sand plover Little curlew Little ringed plover Long-toed stint Marsh sandpiper Oriental plover Pacific golden plover Pectoral sandpiper Red knot Red-necked stint Ruddy turnstone Sanderling Sharp-tailed sandpiper Streaked shearwater Terek sandpiper Whimbrel	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.	Habitat degradation/modification	No explicit relevant management actions.
			Anthropogenic disturbance	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia. Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes (specifically for coastal developments).
			Pollution/contamination	No explicit relevant management actions.

Asian dowitcher	Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW, 2024f)	No explicit relevant objectives.	Pollution/contamination	No explicit relevant management actions.
Australian Painted Snipe	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (TSSC, 2013)	No explicit relevant objectives.	Habitat loss, degradation and modification	No explicit relevant management actions.
	National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (DCCEEW, 2022a)	No explicit relevant objectives.	Habitat loss, degradation and modification	No explicit relevant management actions.
Black-tailed godwit	Conservation Advice for *Limosa limosa* (black-tailed godwit) (DCCEEW, 2024e)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Common greenshank	Conservation Advice for *Tringa nebularia* (common greenshank) (DCCEEW, 2024h)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	No explicit relevant objectives.	Habitat loss and degradation from pollution	No explicit relevant management actions.
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f)	Australian objectives: achieve a stable or increasing population. maintain and enhance important habitat. reduce disturbance at key roosting and feeding sites.	Habitat loss and degradation from pollution	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Great knot	Conservation Advice for *Calidris tenuirostris* (great knot) (DCCEEW, 2024d)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Greater sand plover	Conservation Advice *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016)	No explicit relevant objectives.	Habitat loss and degradation	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Grey falcon	Conservation Advice *Falco hypoleucos* (Grey Falcon) (TSSC, 2020)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Grey plover	Conservation Advice for *Pluvialis squatarola* (grey plover) (DCCEEW, 2024g)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Lesser Sand Plover, Mongolian Plover	Conservation Advice *Charadrius mongolus* (Lesser Sand Plover, Mongolian Plover) (TSSC, 2016d)	No explicit relevant objectives.	Habitat loss and degradation	No explicit relevant management actions.
			Pollution/contamination	No explicit relevant management actions.
Partridge Pigeon (eastern)	Conservation Advice *Geophaps smithii smithii (Partridge Pigeon [eastern])* (TSSC, 2015)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Masked Owl (northern)	Conservation Advice *Tyto novaehollandiae kimberli* (masked owl [northern]) (TSSC, 2015a)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Conservation Advice *Limosa lapponica baueri* (Bar-tailed godwit [western Alaska]) (TSSC, 2016a)	No explicit relevant objectives.	Habitat loss and degradation	Protect important habitat in Australia.
			Pollution/contamination	Protect important habitat in Australia.
Red Goshawk	Conservation Advice *Erythrotriorchis radiatus* (Red goshawk) (TSSC, 2015h)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.

Red knot	Conservation Advice for *Calidris canutus* (red knot) (DCCEEW, 2024c)	No explicit relevant objectives.	Pollution/contamination impacts	No explicit relevant management actions.
			Habitat loss and degradation	No explicit relevant management actions.
			Anthropogenic disturbance	No explicit relevant management actions.
Ruddy turnstone	Conservation Advice for *Arenaria interpres* (ruddy turnstone) (DCCEEW, 2024a)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Sharp-tailed sandpiper	Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW, 2024b)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Terek sandpiper	Conservation Advice for *Xenus cinereus* (terek sandpiper) (DCCEEW, 2024i)	No explicit relevant objectives.	Pollution	No explicit relevant management actions.
Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands)	Conservation Advice *Melanodryas cucullata melvillensis* (hooded robin [Tiwi Islands]) (TSSC, 2018a)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.
Tiwi Masked Owl, Tiwi Islands Masked Owl	Conservation Advice Tyto *novaehollandiae melvillensis* (masked owl [Tiwi Islands]) (TSSC, 2015i)	No explicit relevant objectives.	No explicit relevant threats	No explicit relevant management actions.

5.2.4 Socio-economic features

5.2.4.1 Energy industry

Several energy companies hold petroleum permits and/or conduct operations in or adjacent to the EMBA. Detail on these permits and operations are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.4.2 Shipping

Commercial shipping traverses the EMBA with traffic generally concentrated along shipping channels associated with major State and Territory ports, or within transit routes used by supply vessels supporting offshore developments. The closest major commercial port to the EMBA is Darwin and the primary shipping channels within the EMBA are between Darwin and Southeast Asian ports. Darwin Port services both commercial and non-commercial vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels. In 2022–2023, there were 1,569 vessel calls to port (Landbridge Darwin Port, 2024). While the Darwin Port remains the primary active port in the region, there is small-scale port activity to the north and east of the project area, at the Tiwi Islands

Further detail on shipping operations within the EMBA are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.4.3 Defence

The EMBA intersects parts of the North Australian Exercise Area (NAXA) and Darwin air weapons range. These areas are maritime military zones administered by the Department of Defence. The NAXA comprises practice and training areas and extends about 300 km offshore in two arcs east and west from Darwin into the Arafura Sea. The area is used for offshore naval exercise and onshore weapon-firing training. The EMBA also intersects the His Majesty's Australian Ship (HMAS) Coonawarra Naval Base located within Darwin Harbour.

The Australian Border Force also undertake civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which include the Exclusive Economic Zone (EEZ). During their surveillance, Australian Border Force vessels may transit the EMBA.

Further detail on Defence areas within the EMBA are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.4.4 Telecommunications and power cables

The EMBA area includes telecommunication (e.g., the North-West Cable System) and power cables operated by NT Power and Water and telecommunication cables operated by Vocus and Telstra. The project pipeline will intersect telecommunications and power cables at five locations within the Project Area in Darwin Harbour. The activity will have no interaction with power or telecommunication cables outside of the Project Area.

5.2.4.5 Recreation and tourism

Water-based recreation and tourism activities within the EMBA include fishing, boating, diving and wildlife watching. International cruise ships also traverse the EMBA enroute to/from Darwin Port and several small, luxury expedition cruise ships use Darwin as a base to explore the remote Northern Australian coastline (NT Tourism, 2023). Recreation and tourism activities are likely to be more concentrated within coastal waters of the EMBA, but activities such as deep-water fishing and scuba diving around offshore shoals/reefs or on shipwrecks may take place in offshore areas of the EMBA. The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities. Kakadu National Park is also an important visitor attraction which has coastal values that intersect the EMBA.

Further detail on recreation and tourism within the EMBA are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.2.4.6 Commercial fisheries and aquaculture

The EMBA includes a number of Commonwealth, NT and WA managed commercial fisheries. The Timor and Arafura seas support various shark, demersal and pelagic finfish and crustacean species of commercial importance. Of the fisheries with zones overlapping with the EMBA, key active fisheries include the following:

- Northern prawn fishery
- Spanish mackerel fishery
- Offshore net and line fishery
- Pearl oyster fishery
- Demersal fishery
- Trepang
- Barramundi fishery
- Coastal line fishery
- Coastal Net Fishery
- Mud crab fishery
- Bait Net Fishery
- Mollusc Fishery

Further detail on commercial fisheries within the EMBA are provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

Marine aquaculture (mariculture) in the EMBA is mostly associated with pearl oyster (*Pinctada maxima*) production in NT waters, which is focused in four main areas (NT Government, 2023):

- Bynoe Harbour
- Beagle Gulf
- Cobourg Peninsula and Croker Island
- around the islands northwest of Nhulunbuy.

The NT Government, via the Darwin Aquaculture Centre (DAC), is also encouraging the development of aquaculture of other species, including barramundi, sea cucumber, blacklip oysters, and giant clams. The DAC is based on Channel Island in Darwin Harbour, approximately 3.5 km south of the DLNG facility and 1.5 km south of the Project Area. Barramundi is currently grown in ponds on the Adelaide River, and trials on Groote Eylandt and Goulburn Island are looking at growing clams in sea-based cages (NT Government, 2023).

5.2.5 Cultural heritage

The EMBA is host to a wide range of historical, spiritual and heritage values that are significant to the people of the NT and Australia. These values have been broadly categorised as either First Nations and non-First Nations cultural heritage and are summarised in the following **Sections 5.2.5.1** and **5.2.5.2** with further detail provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**, Sections 14.5 and 14.6).

5.2.5.1 First Nations cultural features

First Nations cultural features relevant to the Activity are summarised in **Table 5-8** including a description of the cultural feature, sourced information and an assessment of relevance to the EMBA or Project Area (if known). Context for these features is described below:

- Cultural heritage protected areas – cultural knowledge and the passing down of cultural education to children can occur from performing of ceremonies and rituals and through dreaming narratives and songlines. Traditional laws and customs amongst a group or groups can define indigenous traditions amongst the group or groups. For example, laws and customs can provide a format for social life and ceremonial matters. The transfer of knowledge of traditional law and customs may be integral to a group's[6] intangible cultural heritage (UNESCO, 2003) There may be implications to the transfer of First Nations knowledge if, for example, relevant aspects of the environment disappear. Ongoing observance of First Nations traditional laws and customs can also be recognised through Native Title determinations, and knowledge of and connection with country (land and sea) can be recognised through a range of mechanisms including indigenous land use agreements, indigenous protected areas and Aboriginal land rights claims.
- Sacred sites – areas that are traditionally accessed by First Nations people, such as sea country and sacred sites, are important for transferring traditional knowledge and for caring for country. If physical landscapes are altered this could impact the values of sacred sites. Sacred sites and protection of these is a known cultural heritage concern.
- Cultural fishing, hunting and gathering – Through consultation it was identified that a number of marine species provide sustenance to some First Nations people and are obtained through cultural fishing, customary hunting (turtles and dugongs) and gathering (turtle eggs and seagull eggs).
- Culturally significant marine species – A range of marine species (such as marine turtles, fish, dugongs, whales, sea-eagle, crocodile and manta rays) were raised during consultation as being important for Aboriginal dreaming, or as having totemic status and significance culturally. The First Nations people maintain a continuing spiritual connection with sea country, through caring for sea country and access to cultural food sources.
- Marine Parks – Commonwealth and State Marine Park Management Plans have sought to recognise cultural interests of First Nations groups within Marine Parks, and the sea country value of Marine Parks to First Nations people.
- Sea country connection through songlines – Cultural stories and songlines can extend from the shoreline to deep water areas and they tell an important cultural story (Corrigan, 2023, 2024). If spiritual injury occurs from an activity, some First Nation people believe that songlines can be damaged. It is believed that damaging songlines may have the potential to interfere with ability for First Nation people to reproduce cultural knowledge and continue to provide cultural education of their children.
- Sea country connection through dreaming sites and stories, and spiritual beings – Some First Nations people believe dreamings relate to powerful creative ancestors who left much of the natural and human world behind them as they travelled (Corrigan, 2023, 2024). It is believed ancestors can travel to areas such as in the water or land below the seas, where these ancestors continue to use these areas. Some First Nations people are of the opinion that if spiritual injury is caused it can damage dreaming tracks. They believe it is their responsibility to look after these dreaming sites to protect the known travels of the spiritual beings. Information provided to Santos by First Nations communities during consultation, also highlighted the importance of

[6] As noted in Munkara v Santos NA Barossa Pty Ltd (No 3) [2024] FCA 9, this cultural heritage must be held communally by the group, although need not be the subject of consensus.

cultural spiritual beings, such as Ampitji, as protectors of First Nations communities, and that if spiritual beings are upset or offended it can result in natural disasters or sickness among First Nations communities.

Table 5-8: Summary of First Nations cultural features and heritage values

Identified cultural feature	Description	Source	Project Area presence	EMBA presence
First Nations UCH	A First Nations archaeological assessment for the DPD Project Area was based on a detailed geomorphological assessment. This study focussed on the likelihood for deposits associated with the Last Glacial Maximum (LGM) to be impacted by the DPD Project. Only one location where potential sediments associated with the LGM were indicated was in the vicinity of KP36.4 to KP37.9. At this location, potential sediments are assessed likely to be at a depth of approximately 18 m below the sea floor. At this depth, no activities related to the construction of the DPD Project will have any direct or indirect impact on these potential sediments. There are no declared protected First Nations UCH sites within the DPD Project Area.	Desktop First Nations Archaeological Assessment Report: Darwin Pipeline Duplication Project, (OzArk, 2024)	No	Possible (not declared or spatial extent undefined)
Native title	First Nations people have interests in an area of land and/or water according to its traditional laws and customs, as recognised through cultural heritage legal and regulatory frameworks. The Project Area does overlap the Larrakia native title determination (DCD2006/001), however the outcome of which was that native title does not exist over that area. The EMBA intersects the Croker Island native title determination	Spatial datasets were downloaded from the National Native Title Tribunal website [7] and confirmed during consultation with First Nations people and representative groups. Sections 14.5.3 and 14.5.7 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-	No	Yes

[7] Source: http://www.nntt.gov.au/assistance/Geospatial/Pages/Spatial-aata.aspx

Identified cultural feature	Description	Source	Project Area presence	EMBA presence
	(DCD1998/001) and Larrakia native title determination (DCD2006/001).	210 0133) (**Attachment 2**) provide further detail.		
Indigenous land use agreements	There are no ILUAs within the Project Area, however the EMBA does overlap the areas of land and tidal waters (between the low water mark and the high-water mark) of the Kenbi and Mary River ILUAs.		No	Yes
Indigenous protected areas	There are no IPAs that overlap the Project Area or EMBA.		No	No
Sacred Sites	There is overlap of sacred sites in Darwin Harbour within the Project Area (a nominal 2km buffer each side of the pipeline route) in NT Internal Waters. However no sacred sites have been found to be directly impacted by the DPD Project infrastructure footprint, as acknowledged in Corrigan (2024). Nominated Subject Land Areas within Project Area, where Activity seabed disturbance may occur (for example by anchoring), are subject to AAPA Authority Certificates (C2022-098 and C2024-034) and restricted works areas in Darwin Harbour. There are many NT coastal sites along the mainland and island coastlines and potentially the surrounding waters that overlap the EMBA.	AAPA Authority Certificates (C2022-098 and C2024-034). **Section 5.3.12.1** below provides further detail on these AAPA Authority Certificates and locations of Subject Land Areas. Consultation feedback and Corrigan 2024 Report including a view of extensive ethnographic studies. Refer Section 14.5.6 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Yes – in NT Internal Waters	Yes
Land rights	There is no Aboriginal land either claimed or granted under the ALR Act, or sea closures put into effect in accordance with that Act, that	ALC (2023). Refer Section 14.5.7 of the Santos' DPD Values & Sensitivities of	No	Yes

Identified cultural feature	Description	Source	Project Area presence	EMBA presence
	overlap with the Project Area. The EMBA does overlap areas of land and tidal waters (between the low water mark and the high-water mark) granted under the ALR Act. This Aboriginal land is held by the Arnhem Land ALT, the Cobourg Peninsula Sanctuary ALT, the Tiwi ALT, the Kenbi ALT, and the Delissaville/ Wagait/ Larrakia ALT.	the Marine Environment (BAS-210 0133) (**Attachment 2**).		
Marine Parks	The North MPNMP and the North-West MPNMP identify natural, cultural and spiritual values associated with AMPs, specifically the Oceanic Shoals AMP and the Arafura AMP.	DNP (2018a, 2018b). Refer Section 14.5.7 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	No	Yes
Cultural fishing, hunting and gathering	Cultural fishing, hunting and gathering of marine species such as fish, shellfish, turtles, dugongs, eggs (turtle and seagull). Cultural fishing, hunting and gathering does occur in Darwin Harbour and therefore may occur in the Project Area in NT Internal Waters.	Corrigan (2024) Report and consultation with First Nations people and representative groups. Refer Section 14.5.9 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Yes – in NT Internal Waters	Yes
Culturally significant marine species	First Nations persons and groups that have a deep connection with the sea through totems and dreamings such as marine fauna (marine turtles, whales, dugong) and consider them to be of cultural significance.	2022 Statement of Reasons requests and NLC consultation feedback in relation to the D&C EP. Consultation feedback and Corrigan reports (2023, 2024) including a view of extensive ethnographic studies Refer Section 14.5.10 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Yes (including the Project Area in NT Coastal Waters)	Yes

Identified cultural feature	Description	Source	Project Area presence	EMBA presence
Sea country connection through songlines	Songlines can go from land to sea and were identified as important by the Croker Island and Tiwi Islands people, as well as Larrakia people and other First Nations peoples with interests in the DPD Project route. They ordinarily traverse areas in a manner of travelling from named places to named places.	Consultation feedback and Corrigan reports (2023, 2024) including a view of extensive ethnographic studies Refer Section 14.5.11 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Possible for both NT Internal Waters and NT Coastal Waters (spatial extent undefined)	Possible (spatial extent undefined)
Sea country connection through dreaming sites and stories and spiritual beings	Dreaming Dreamings were identified as being associated with the sea, winds and stars and regarding the moon and the seasons, mermaid dreaming and dreamings near the Charles Point lighthouse. A number of marine species are significant to Aboriginal dreaming such birds, crocodiles, shellfish, whales, manta rays, crabs, dugong, sea turtle, gropers, sea-eagles and octopus.	Consultation feedback and Corrigan reports (2023, 2024) including a view of extensive ethnographic studies. NLC consultation feedback in relation to the D&C EP. Refer Sections 14.5.10 and 14.5.11 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Possible for both NT Internal Waters and NT Coastal Waters (spatial extent undefined)	Possible (spatial extent undefined)
	Spiritual beings Spiritual beings are important to Croker Island people and Tiwi Island people, as well as Larrakia people and other First Nations peoples with interests in the DPD project route for their role as protectors of First Nations people and the natural environment. Spiritual beings are believed to be present in the vicinity of the islands.	Consultation feedback and Corrigan reports (2023, 2024) including a review of extensive ethnographic studies Refer Sections 14.5.12 of the Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).	Possible for both NT Internal Waters and NT Coastal Waters (spatial extent undefined)	Possible (spatial extent undefined)

5.2.5.2 Non-First Nations heritage

A search of the Commonwealth PMST within the EMBA identified the following Commonwealth Heritage Areas:

- Larrakeyah Barracks Headquarters Building
- Larrakeyah Barracks Sergeants Mess
- Larrakeyah Barracks Precinct
- RAAF Base Precinct
- RAAF Base Commanding Officers Residence
- RAAF Base Tropical Housing Type 2
- RAAF Base Tropical Housing Type 3

The Larrakeyah Barracks (Headquarters Building, Precinct and Sergeants Mess) are located in Darwin and are listed due to their architectural significance and association with a notable architect (B. C. G. Burnett) (DAWE, 2022). While they are located on the Darwin foreshore and were picked up in the PMST search, the Project is not considered to have any direct or indirect impacts relevant to the heritage (architectural) values of this area. Furthermore, the Royal Australian Air Force (RAAF) Base Commonwealth Heritage Areas are also located in Darwin and while picked up in the PMST search they are located well inland from the coastline (and therefore the edge of the EMBA) and are not discussed further.

There are multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites occur within the EMBA. The historic shipwrecks and sunken aircraft, including associated artefacts, are subject to automatic protection under the UCH Act. Shipwrecks, sunken aircraft and other types of underwater cultural heritage that have been underwater less than 75 years can be protected through an individual declaration to DCCEEW based on an assessment of heritage significance. Underwater heritage artefacts continue to be protected after removal from the water.

The UCH Act may declare a protected zone around wrecks which require a permit to enter. There are currently two shipwrecks with UCH Act protected zones within the EMBA. These are the Japanese submarine I-124 (1942) and the SS Florence D (1942). The Regional Harbourmaster has also ordered the Booya and Catalina 6 wrecks to have closed water controls over them and permission from the Heritage Branch is needed to enter the zones.

Darwin Harbour is host to several shipwrecks and sunken aircraft, some of which are protected under the *Heritage Act 2011* (NT). Most wrecks are associated with either the bombing of Darwin in 1942 or Cyclone Tracy in 1974.

Further detail on non-First Nations heritage within the EMBA is provided in Santos' DPD Values & Sensitivities of the Marine Environment (BAS-210 0133) (**Attachment 2**).

5.3 Project Area values and sensitivities summary

5.3.1 Physical environment

5.3.1.1 Meteorological conditions

5.3.1.1.1 Climate

The Project Area resides within the monsoonal (wet-dry) tropics of Northern Australia, which is subject to two distinct seasons a hot wet season from November to March and a warm dry season from May to September, with both April and October acting as transitional months between wet and dry seasons, respectively.

Temperatures are hot year-round with mean maximum temperatures >30 °C. November is the hottest month of the year ranging from 25 °C mean minimum temperature to 33 °C mean maximum temperature. June and July are the coolest months in the year ranging from 19 °C mean minimum temperature to 30 °C mean maximum temperature (BOM, 2022).

5.3.1.1.2 Rainfall

The annual mean rainfall for Darwin is 1723.8 mm with the majority of this (87%) rainfall coming in wet season months between November and March. Mean monthly evaporation ranges from 160 mm in February to 245 mm in October, with annual daily evaporation of 6.7 mm. Mean 9 am and 3 pm relative humidity is also higher in the wet season following similar trends to rainfall (BOM, 2022). Monthly and annual mean, max and min rainfall averages from 1941 to 2022 for Darwin International Airport are provided in **Table 5-9**.

Table 5-9: Average monthly and annual mean, max and min rainfall (mm) from 1941 to 2022 for Darwin International Airport (BOM, 2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	431	369	311	102	21	2	1	5	17	70	142	252	1724
Max	940	1110	1014	396	296	51	27	84	130	339	371	665	2777
Min	136	103	88	0.6	0	0	0	0	0	0	17	19	1025

5.3.1.1.3 Wind direction and speed

During the wet season winds are predominately light westerly and west–north–west winds, whilst in the dry season winds are varying from the south–east through to the north. Mean wind speeds are generally stronger in the afternoon than in the morning throughout the year (BOM, 2022). Mean morning wind speeds are typically stronger in the dry season, whilst mean afternoon wind speeds increase during the late dry season and build into the wet season where stronger winds are associated with afternoon storm cells.

5.3.1.1.4 Cyclone activity

The monsoonal tropics are also subject to intermittent cyclone activity usually resulting in the strongest winds and heaviest amount of rainfall. The cyclone season runs from 1 November to 30 April. Cyclones in the Anson-Beagle region are known to occur with low to moderate frequency. Storm surges often result in flooding, increased tidal levels, and increased wave heights resulting in damage. Most of the damage caused by cyclones occurs near to the coast within 50 km from the coastline, causing concern for vessels and coastal developments in the area. Storm surges are hard to predict and dependent on the characteristics of the associated cyclone such as speed, intensity and the angle it crosses the coast. Bathymetry also contributes to the risk level of storm surges (BOM, 2022).

5.3.2 Coastal morphology

5.3.2.1 Offshore from Darwin Harbour

The bathymetry of the Project Area offshore from Darwin Harbour has been thoroughly investigated and is well understood. Recent surveys have shown that the seabed along the DPD Project pipeline route offshore from Darwin Harbour (including within the spoil disposal area) is generally flat, sandy, featureless, and typically less than 30 m in depth.

Approximately 7.5 km (north) of the Project Area resides the Carbonate bank and terrace system of the Van Diemen Rise KEF of regional significance. The feature consists of banks, terraces, channels, and valleys and the variability in water depth and substrate composition may contribute to the presence of unique ecosystems in the channels. The feature has enhanced biodiversity and productivity relative to

surrounding areas and supports relatively high species diversity. This area will not be directly impacted by the DPD Project.

5.3.2.2 Darwin Harbour

Darwin Harbour is a large, drowned river system approximately 500 km^2 in extent. It is comprised of three arms (East Arm, West Arm, and Middle Arm), which along with the smaller Woods Inlet converge into a single unit before opening to the ocean and into Beagle Gulf in the north.

Freshwater inflow from the Elizabeth River into the East Arm and the Blackmore and Darwin rivers into the Middle Arm generally occurs between January and April creating more estuarine conditions.

Port Darwin's main channel is approximately 1,525 m wide and 15 – 25 m deep, with a maximum recorded depth of 36 m LAT. The channel is generally deeper on the eastern side of the Harbour, while the western side is broader and shallower areas with intertidal flats and shoal being more extensive.

The channel extends into the East Arm with depths of more than 10 m below LAT, the bathymetry of this area has been modified by dredging associated with the development of East Arm Wharf. A slightly deeper channel can be found in the Middle Arm extending up to the western side of Channel Island.

5.3.3 Oceanography

5.3.3.1 Offshore from Darwin Harbour

The NMR has no major ocean currents. However, there are tidal currents that play a role in the movement of water, biota, and benthic sediments. There are three recognised large-scale ecological systems in the NMR which are the:

+ Gulf of Carpentaria
+ Arafura
+ Joseph Bonaparte Gulf.

The Project Area traverses two meso-scale bioregions, the Bonaparte Gulf and Anson-Beagle Bioregions. The Bonaparte Gulf bioregion is predominately within offshore Commonwealth waters, but overlaps with NT Coastal Waters, south of Bathurst Island.

Oceanic currents within the Bonaparte Gulf are influenced by the Indonesian Through Flow (ITF) and South Equatorial Current. During the dry season (May to September) nearshore currents are generally westerly, whilst in the wet season (November to March) nearshore currents are easterly. Tides are semi-diurnal (two highs and two lows each day) and vary throughout the bioregion from offshore microtidal range (2 to 3 m variation) to inshore mesotidal range (3 to 4 m variation).

The Project Area within the Anson-Beagle Bioregion traverses Beagle Gulf. Due to the extent of the continental shelf ocean currents only have a minor influence on the Beagle Gulf region. Beagle Gulf has limited oceanic interaction and is strongly influenced by strong internal circulation. During the dry season (May to September) there is a south westerly drift due to south-easterly winds, the ITF, and the South Equatorial Current. Whilst during the wet season (November to March) there is a north-easterly drift due to the north westerly monsoonal winds. Tides in the gulf range from 6 to 8 m (IMCRA Technical Group, 1998).

Wave action in Beagle Gulf is seasonal; monsoonal north-westerly winds during the wet season (November to March) increase wave energy within Beagle Gulf and at the entrance to Darwin Harbour, due to the uninterrupted fetch over the Timor Sea. Whilst in the dry season (May to September) south-easterly trade winds generate low wave energy due to limited fetch.

5.3.3.2 Darwin Harbour

Darwin Harbour has a macrotidal (more than four metres) regime with tide range reaching 8 m which is considerable by world standards. Tides are generally semi-diurnal (two highs and two lows each day) with some inequality between successive tides in a single day. Neap tides result in a two-day period where tidal conditions are nearly diurnal (one high and one low each day). There is a great degree of variation in daily tidal range with the presence of spring-neap tide cycle approximately every 15 days. The spring phase of the cycle has an average tidal range of 6 m, while the neap phase average tidal range is 3 m. Large tidal movements and to a lesser extent wind, drives rapid and regular exchange of large volumes of water between Darwin Harbour and Beagle Gulf.

Darwin Harbour is considered sheltered with tsunamis and swell waves unlikely to occur due to the harbour's orientation, shallow bathymetry and protection afforded by the Tiwi Islands. Most waves are generated within Darwin Harbour or Beagle Gulf and are well below 1 m with periods of 2 – 5 seconds, under non-cyclone conditions. Tropical cyclones can cause extreme wave conditions producing significant wave height of 4.5 m and approximate periods of 7.5 seconds at the entrance to Darwin Harbour. Inside the harbour waves heights are reduced by the bathymetry to approximately 0.7 m (GHDM, 1997).

5.3.4 Water quality

5.3.4.1 Offshore from Darwin Harbour

The INPEX Ichthys nearshore environmental monitoring program (NEMP) monitoring found that waters in Beagle Gulf were highly turbid in the wet season compared to the dry season likely due to stronger winds, larger waves, greater rainfall, and increased freshwater input (Cardno, 2014).

Environmental surveys to support the Barossa GEP Installation EP investigated water quality within the Barossa field (seasonal through 2015) and along the Barossa GEP (July to August 2017). This included areas close to the Project Area in Offshore NT waters, in which results showed metal concentrations below dissolved metal trigger values from the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ; 2000) (Santos, 2021).

In 2021, water sampling and analysis along the DPD pipeline route and at the spoil disposal ground in the offshore NT waters of the Project Area was completed (RPS, 2023a, BAS-210-0014). Concentrations of three metals in water samples were detected above Australian and New Zealand Guidelines (ANZG; 2018) default guideline values (DGVs) (for slightly to moderately disturbed marine offshore ecosystems, at the 95% species protection level). Copper concentrations in samples from three sites at the western end of the offshore pipeline route were above the DGV; one of these exceedances was much higher than the DVG with the other two only slightly greater than the DVG, therefore it is likely an outlier and indicative of a potential contaminant. Lead concentrations were found to be much higher in the offshore Darwin Harbour samples than in samples taken at the spoil ground, with one sample above the DGV. Zinc concentrations were found at or above the DGV in five samples collected from the western end of the offshore pipeline route and across the proposed spoil disposal ground, with no clear trend in exceedances between surface and bottom waters. Arsenic was recorded below the ANZG (2018) DGV (RPS, 2023a).

All nutrient concentrations were below the associated ANZG (2018) DGV (RPS, 2023a). Dissolved hydrocarbons were below the limits of reporting (LoR) for all samples. Naturally Occurring Radioactive Material (NORMs) were detected in low concentrations in near-seabed samples at two sites along the offshore pipeline route.

TSS concentrations were all above the LoR and ranged from 1.7 to 8.6 mg/L at offshore sites and 1.4 to 6.2 mg/L at spoil disposal grounds. There was no correlation between depth and TSS at either location.

Water column profiles at sites along the offshore pipeline and at the spoil ground showed no indications of stratification of the water column.

5.3.4.2 Darwin Harbour

Typically, water quality is high in the harbour, although naturally turbid as well. Water quality is highly variable within Darwin Harbour due to tide, sampling location, and season (**Table 5-10**). Darwin Harbour water quality is affected by high levels of surface runoff in the wet season (November to March), which can extend until April or May depending on rainfall received. Tides also influence water quality in the harbour with neap tides promoting water clarity while spring tides carry sediment for fringing mangrove and resuspend fine sediment from the harbour floor (DHAC, 2008).

Water temperatures within Darwin Harbour are predominately high with some seasonal variation, averaging 30.6°C in the wet season and 24.5°C in the dry season. The lowest water temperatures occur in June and July (23°C) while the highest occur in October and November (33°C) (Padovan, 1997).

Salinity within Darwin Harbour is also subject to seasonal variation, with lower mean salinity levels in the Harbour during the wet season due to the greater influence of freshwater (**Table 5-11**). Seawater salinity has a global average of 35 ppt (parts per thousand), however salinities throughout the harbour are approximately 37 ppt during the dry season. Salinity is higher in the dry season due to increased evaporation and less freshwater inflow. Areas in the middle of the harbour such as Weed Reef can experience salinity as low as 27 ppt due to monsoonal inflow during February and March (Parry & Munksgaard, 1995). Salinities in the arms are heavily influenced by freshwater inflow in the wet season and can drop to 17 ppt. The water column during this time is heavily stratified. Parry and Munksgaard (1995) reported salinities on the bottom of the harbour to be up to 12 ppt higher than the surface.

Darwin Harbour waters remain well oxygenated throughout the year. Padovan (1997) finding no seasonal effects. Dissolved oxygen levels range from 74% to 96%, averaging approximately 84%. Dissolved oxygen levels are slightly higher at the harbour mouth compared to further into the estuary. Additionally, during spring tide cycles, oxygen levels increased by 7% at high tide compared low tide (Padovan, 1997).

Darwin Harbour waters have a narrow pH range of 8.3 – 8.6. Padovan (1997) found no seasonal, spatial, or tidal effect on the pH of the harbour.

Turbidity in the Darwin Harbour is higher in the wet season compared to the dry season, mainly due to the influx of terrigenous sediment and somewhat due to surface water sheet flow. Light levels at the bottom of the harbour can be as low as 1% of surface light levels during the wet season (Padovan, 1997). However, the most important factors affecting turbidity are tidal cycle and location (Padovan, 1997). Spring tides are associated with higher current velocities, and therefore a greater capacity of water to move sediment, which results in higher turbidity (DHAC, 2005).

5.3.5 Sediment quality

Sediments sampled in the Santos Barossa DPD Pipeline Benthic Survey were found to be represented by slightly gravelly muddy sands to gravelly sands (RPS, 2023a) The silt/clay and gravel components indicated a transition in benthic sediments from KP0 to the shore crossing at KP122.5. Sampled areas including the offshore pipeline, the spoil ground, the sand wave dredge area in the northern part of Darwin Harbour and the pipeline route in southern Darwin Harbour (near the shore crossing). All sites were significantly different in terms of particle size distribution, with clay/silt and gravel content highest in Darwin Harbour. Similar transitional patterns were observed for infauna biological assemblage composition along the offshore pipeline route and at the spoil ground. It is likely that other unmeasured factors, e.g., current speeds/site energy, riverine input into Darwin Harbour (e.g., freshwater, silt), salinity profiles up the river and sediment chemistry also contribute, and that there is likely to be seasonal variability in the distribution and composition of benthic faunal assemblages.

Overall, no contaminants of concern were found in the sediments along the pipeline route or at the potential spoil disposal ground with elevated levels of arsenic above NAGD (CoA, 2009a) screening levels,

which are considered to be naturally occurring and are unlikely to be bioavailable (INPEX Browse Ltd, 2014). Therefore, the sediments along the pipeline route are suitable for unconfined ocean disposal, as per the NAGD (CoA, 2009a) and NT EPA (2013) guidelines for dredging.

5.3.5.1 Acid sulphate soils

Acid sulfate soils (ASS) are formed naturally and often occur in low lying coastal areas (BAA-201 0003; Santos, 2021). Coastal estuarine and mangrove environments develop ASS due to its typical waterlogged nature, saltwater influences and anaerobic soils.

ASS mapping over the Darwin region indicates that the Project Area shore crossing has a high potential for ASS to occur (BAA-201 0003; Santos, 2021). However, considering the historical earthworks undertaken as part of the development of the DLNG facility, the natural material has been removed across the onshore zone and replaced by imported (non-ASS) fill material (generally sand) up to a depth of approximately 6 m below ground level. Therefore, ASS associated with the naturally occurring soil material is no longer expected to be present within the onshore zone and the risk has been diminished, however the presence of ASS cannot be completely discounted and may require management. (BAS-210-0049; Santos, 2023).

5.3.6 Underwater noise

Underwater noise, excluding naturally occurring noise, within Darwin Harbour is influenced by the existing shipping traffic, biological sources, and weather. Natural prominent sources of noise include thunderstorms, lightning strikes, and heavy wet-season rains, which all generate noise at considerable intensities, although these natural sources of noise all occur seasonally. Vessel traffic in Darwin Harbour is a year-round source of noise with the Port of Darwin recording 1,510 trading vessel visits in 2021 – 2022 financial year (Darwin Port Operations, 2022). Large commercial vessels, such as cargo ships, liquified natural gas (LNG) tankers, cruise ships and offshore oil and gas vessels enter, exit and move around the harbour on a daily basis. Vessel movements are concentrated along designated shipping channels and around berthing and anchorage areas. The proposed DPD pipeline route and associated trenching areas are adjacent to these shipping channels.

Underwater noise measurements have been taken in Darwin Harbour by Salgado-Kent *et al.* (2015) during a period where dredging and piling activities were being conducted in East Arm for the INPEX Ichthys Project. Salgado-Kent *et al.* (2015) found that in the absence of Ichthys project pile driving or dredging in East Arm, the most intense noises dominating the environment were from a range of vessel, and to a lesser extent machinery, operating in the area. Noise emissions from vessels were found to be broadband, with most energy ranging from tens of Hz to several kHz and often reaching 130 to 140 dB re 1 Pa. The study found intense broadband anthropogenic noise from vessels and machinery also occurred typically between 5 to 20 times per day throughout the recording period in the frequency band of approximately 10 Hz to 2 kHz with noise periods lasting from approximately 1 hour to 5 hours and with intensity levels reaching close to 160 dB re 1 µPa during some periods (Salgado Kent *et al.* 2015). Underwater noise measurements taken by SVT (2009) and provided within the Ichthys EIS (INPEX Browse, 2010) also show relatively high measured background noise levels within East Arm of 150-170 dB re 1 µPa2/Hz.

Salgado-Kent *et al.* (2015) found that in comparison to East Arm, the ambient underwater noise levels in Middle Arm were on average lower, likely due to fewer vessel movements. It is also expected that, all other things being equal, received noise levels from vessel traffic will be lower in shallower areas of Darwin Harbour due to reduced sound propagation in shallow waters. This was found during surveys by SVT (2009) where measured ambient noise levels in the shallower Elizabeth River were lower than those for the broader East Arm.

5.3.7 Benthic habitats

The Project Area supports several types of benthic habitats supporting biota including mangroves, coral, seagrass, macroalgae, filter feeders and soft-bottom benthos. Santos undertook baseline investigations in October 2021 and June 2022 using drop/towed video at 30 sites and ROV video transects at 42 sites respectively (RPS, 2023a). These surveys were used to describe the seabed of the DPD Project pipeline route and to ground truth the results of the Australian Institute for Marine Science (AIMS) 2021 Revised Predicted Benthic Habitat Map for Darwin Harbour (Udyawer et al., 2021). The results are summarised below and are included in full in the publicly available DPD Project Supplementary Environmental Report (SER) (BAS-210 0020) (Santos, 2023).

5.3.7.1 Offshore from Darwin Harbour

The benthic habitats surveyed along the offshore DPD Project pipeline route verified the expectations from the AIMS (2021) Revised Predicted Benthic Habitat Map (Udyawer et al., 2021) where this overlapped and were found to be silty shelly sand habitat with burrows and polychaete worm tubes. Biota commonly associated with this habitat type were very sparse to sparse, and included hydroids, soft corals (gorgonians, *Junceella* and Alcyoniidae), sea stars and sponges. This soft sediment habitat was also present at the offshore end of the DPD Project pipeline route. Within three of these silty, shelly sand sites, there were sections of sand waves, roughly one metre high, with silty sand in the troughs and coarse shelly sand at the peaks. This substrate was associated with very sparse epibiota. The proposed sand waves dredge area (sand waves) was found to contain rippled coarse sand with very little epibiota (<1% abundance), consisting of some sparse soft corals and crinoids.

The spoil disposal ground sites all consisted of the same soft substrate habitat. This habitat is defined by silty/clay sediment with medium density biota. Biota commonly seen at this habitat were soft corals (gorgonians, *Junceella* and Alcyoniidae), branching and encrusting sponges, Bryozoa (lace coral), invertebrate burrows, polychaete tubes, brown algae and occasional motile crinoids.

5.3.7.2 Darwin Harbour

Benthic habitat surveys were completed in Darwin Harbour in October 2021 and in June 2022 (RPS, 2023a). The October 2021 survey was completed systematically to describe habitats along the proposed pipeline route. The June 2022 survey targeted sites which were predicted by the AIMS (2021) Revised Predicted Benthic Habitat Map (Udyawer et al., 2021) to have unique habitat or showed features from geophysical surveys, that were considered to potentially represent maritime heritage features. The comparison between the AIMS and survey datasets revealed differences between predicted and observed habitat types, particularly with the level of information provided (approximate densities of biota, substrate types are not available in AIMS data).

Sections **5.3.7.2.1** and **5.3.7.2.2** summarise the findings of the October 2021 and June 2022 surveys respectively.

5.3.7.2.1 October 2021 survey

Darwin Harbour benthic habitats comprised soft sediment habitats with two hard substrate habitats recorded during the surveys. Hard substrates were recorded along the section of the pipeline route offshore from Fannie Bay and low profile reef was recorded offshore of Woods Inlet with medium to high density epibiota. The soft substrate habitat adjacent to hard substrate habitats in Darwin Harbour were generally silty, shelly sand with very sparse soft corals to no conspicuous epibiota. As this habitat was recorded both adjacent to and between hard substrate habitats, this soft substrate habitat is potentially a veneer overlying submerged geology. Other recorded soft sediment benthic habitats in Darwin Harbour included:

+ Sand waves <1 m with coarse shelly sand and very sparse epibiota

- Silt/clay, shelly sand, with very sparse to sparse biota (soft corals and crinoids) (at the southern end of the pipeline, near the shore crossing)
- Silty, shelly sand with sparse epibiota (soft corals) and scattered bombora (at the southern end of the pipeline, near the shore crossing).

5.3.7.2.2 June 2022 survey

Key objectives of the June 2022 survey were to collect additional samples and benthic habitat imagery during other surveys to augment the benthic dataset and to ground truth the AIMS (2021) Revised Predicted Benthic Habitat Map at selected sites within Darwin Harbour and to increase the number of benthic survey sites along the pipeline route. Ground-truthing within Darwin Harbour focused on sites predicted to be suitable for rarer high-value biota types (e.g., macroalgae, hard corals and seagrass) that were closest to the proposed pipeline route (and therefore had the greatest potential to be influenced by DPD Project construction activities, including trenching). This included an area west of the pipeline route where the route comes closest to the shoreline of Cox Peninsula (including sites HAB 1-4), an area west of the pipeline route where the route comes closest to Weed Reef (including sites HAB 6-8) and sites close to the shore crossing (HAB 9 and 10) (refer to **Figure 5-2**).

Results from these surveys showed that the selected sites which were predicted as suitable for macroalgae, seagrass and/or hard coral by the AIMS (2021) Revised Predicted Benthic Habitat Map (Udyawer et al., 2021) typically did not show presence of these biota types (RPS 2023a, **Figure 5-2** – **Figure 5-4**). Additional to these benthic habitat ground-truthing sites, a number of benthic habitat monitoring sites used by INPEX during the Ichthys project were ground-truthed including hard coral sites (INPHCMAN, INPHCWED, INPHCCHI, INPHCSSI and INPHCNEW) and seagrass sites (INPSGWOD and INPSGCPW) (refer **Figure 5-2** – **Figure 5-4**). Surveys from these sites generally confirmed the presence of seagrass or hard coral as expected, although seagrass was observed at very low densities. The additional sites surveyed along the pipeline route within Darwin Harbour in June 2022 provided results consistent with surveys in October 2021 in that sites comprise a mix of hard substrate and sediments supporting varying densities of filter-feeding biota such as soft corals, hydroids, crinoids and sponges but with an absence of photosynthetic biota such as hard corals, seagrass and algae (RPS, 2023a; **Figure 5-2** – **Figure 5-4**).

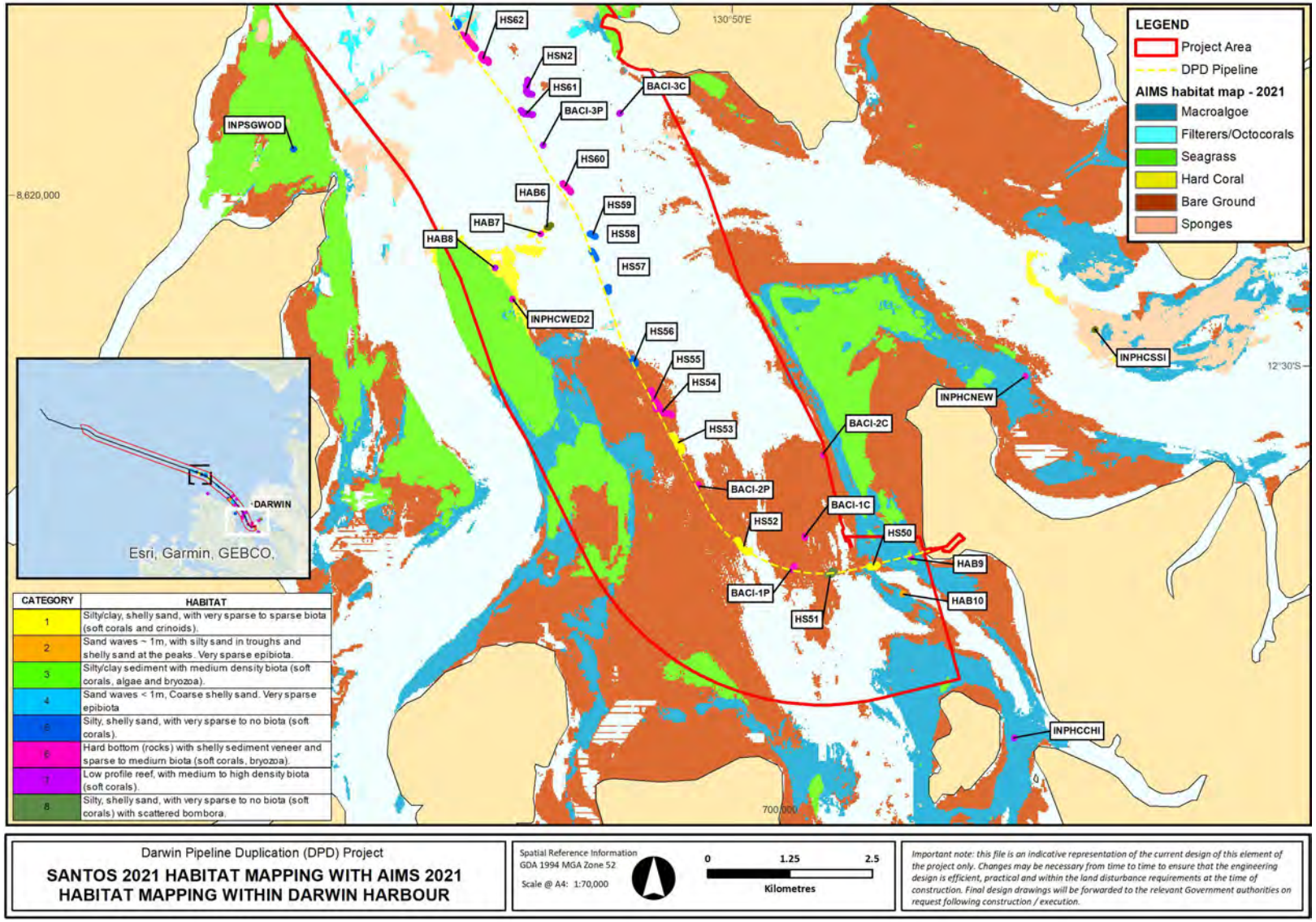


Figure 5-2: RPS surveys habitat mapping against AIMS 2021 habitat mapping within Darwin Harbour (Udyawer et al. 2021; RPS, 2023a)

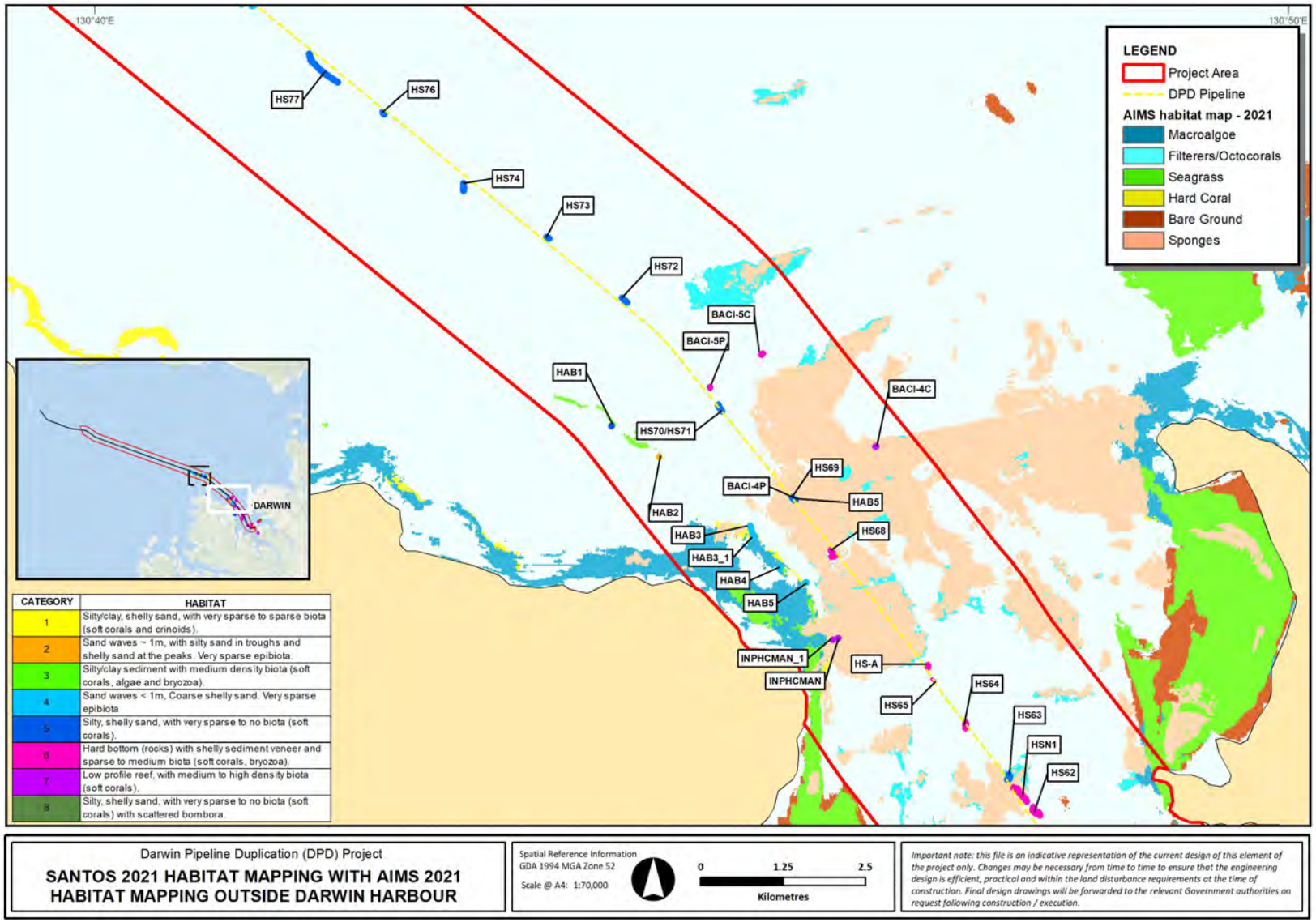


Figure 5-3: RPS survey habitat mapping against mapping against AIMS 2021 habitat mapping outside Darwin Harbour (Udyawer et al. 2021; RPS, 2023a)

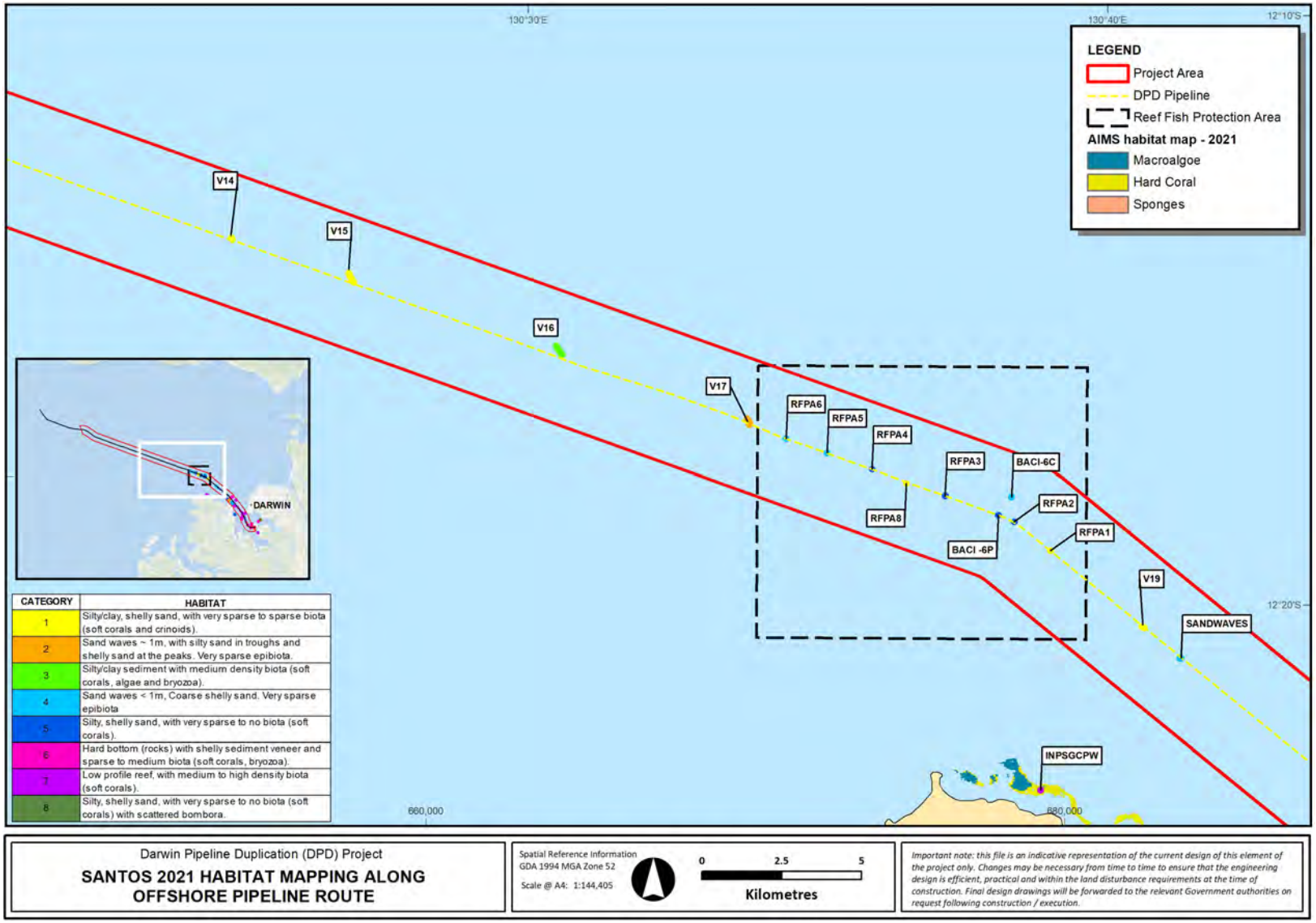


Figure 5-4: RPS surveys habitat mapping along offshore pipeline route (RPS, 2023a)

5.3.8 Protected/significant areas

Protected/significant areas identified near or overlapping the Project Area are detailed in **Table 5-10**. NT Reef Fish Protection Areas (RFPA) are described in **Section 5.3.8.1**.

Table 5-10: Protected areas near or overlapping the Project Area

Value/ sensitivity	Name	Overlaps Project Area	Protection classification/ zone
Nationally Important Wetlands	Port Darwin	✓	-
Northern Territory Reserves	Casuarina	✗	Coastal Reserve
	Charles Darwin	✗	National Park
NT Reef Fish Protection Areas	Charles Point Wide	✓	Reef Fish Protection Area
	Lorna Shoal	✗	Reef Fish Protection Area

5.3.8.1 NT reef fish protection areas

The DPD Project pipeline route intersects the Charles Point Wide RFPA and is approximately 9 km west of the Lorna Shoal RFPA, both within NT Internal Waters (refer **Figure 5-5**). No fishing activities are permitted within RFPAs. Protection of these areas prevents over-fishing of golden snapper, black jewfish and other vulnerable reef species. The Project Area in NT Internal Waters is also in close proximity to East Point Aquatic Life Reserve and Doctors Gully Aquatic Life Reserve (refer **Figure 5-5**).

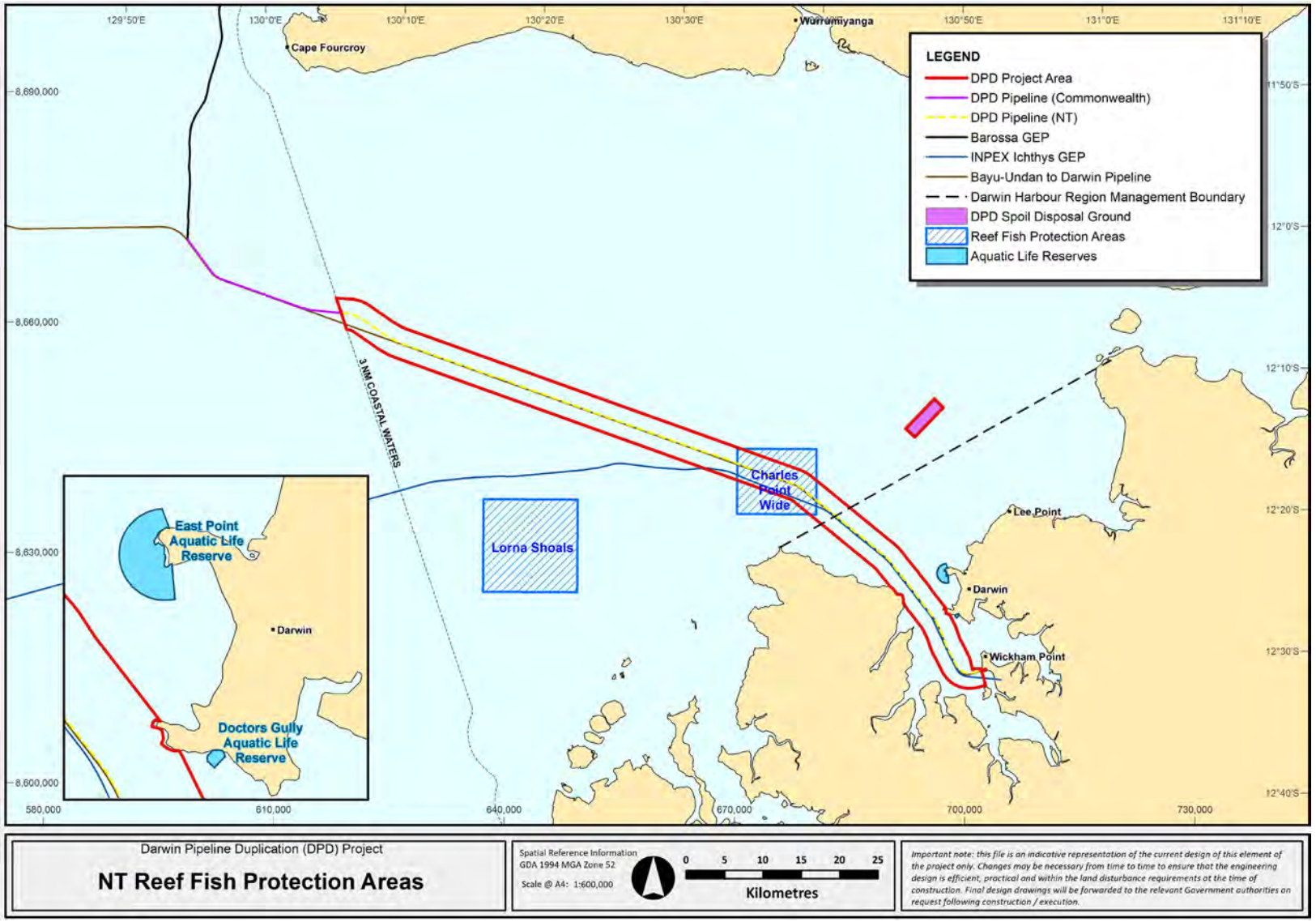


Figure 5-5: Northern Territory Aquatic Reserves and Reef Fish Protection Areas

5.3.9 Terrestrial ecosystems

5.3.9.1 Flora

A search of the DEPWS Natural Resource Maps database for threatened flora and significant flora within 5 km of the onshore Project Area identified one significant flora species, Byblis (*Byblis aquatica*) (DEPWS, 2022). This species is listed as near threatened under the *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act) and was recorded approximately 5 km to the south-east of the onshore Project Area. It grows in semi-aquatic conditions and is insectivorous to acquire nutrients in nutrient-poor environments (Atlas of Living Australia, 2022). This species is commonly found in areas specifically between Darwin and Berry Springs.

Previous flora surveys of the DLNG Facility disturbance envelope did not identify the presence of any threatened or conservation significant flora species (BAA-201 0003; Santos, 2021). The Byblis is unlikely to occur within the onshore Project Area as it has been previously disturbed and there are no permanent freshwater habitats present (BAA-201 0003; Santos, 2021).

5.3.9.2 Mangroves

Monitoring of the mangrove communities surrounding the DLNG Facility has being ongoing since 2006 (ConocoPhillips, 2018). They are comprised of predominately *Rhizophora* and *Sonneratia* species and to a lesser extent *Aegialitis*, *Avicennia*, *Osbornia* and *Aegiceras* species. The data collected indicates that the mangrove communities are in good health, with no significant deterioration or stress resulting from DLNG Facility operations.

CDM Smith's (2021) vegetation assessment of the DPD shore crossing location identified less than five individuals of one mangrove species, *Sonneratia alba*, within 20 m either side of the DPD pipeline alignment. This species of mangrove is a common taxon that is well represented and characterised in the DLNG Facility's mangrove monitoring program. CDM Smith (2021c) concluded that the vegetation in proximity to the DPD pipeline is of low ecological value and well represented in the area.

These mangroves are located outside of the pipeline alignment for the approximately 200 m section of onshore pipeline, therefore are unlikely to be impacted by the onshore works relevant to this Offshore CEMP.

5.3.10 Fauna

5.3.10.1 Threatened and migratory fauna

The PMST is used to search for matters (including species) protected under the EPBC Act and generates a list of protected matters that may occur in or near a selected area. PMST searches were undertaken on 10 January 2024 within one kilometre either side of the Project Area.

A summary of the Listed Threatened Species (LTS) and Listed Migratory Species (LMS) identified by the PMST for the Project Area and surrounds is shown in **Table 5-11**.

Table 5-11: Summary of EPBC Act Listed Threatened (LTS) and Listed Migratory Species (LMS) overlapping the Project Area identified by the Protected Matters Search Tool

Threatened and migratory fauna type	Number of species
LTS	50 (birds – 19, mammals – 13, reptiles – 10, sharks – 8): Critically Endangered – 5 Endangered – 16 Vulnerable – 28 Conservation Dependent – 1
LMS	62 (marine mammals – 10, marine birds – 7, terrestrial birds – 5, wetland birds – 21, marine reptiles – 7, sharks/rays - 12), 26 of which are also listed as 'Threatened': Critically Endangered – 2 Endangered – 7 Vulnerable – 17
Total	86

Those fauna listed as threatened or migratory species under the EPBC Act and which have been identified as being likely to occur or potentially present within the Project Area, are listed in **Table 5-12**. This table also identified where those species are listed under the TPWC Act.

The Project Area also overlaps four areas identified as Biological Important Areas (BIAs) for marine reptiles (1) and marine mammals (3). These are presented in **Table 5-13** and shown in **Figure 5-6**, **Figure 5-7**, **Figure 5-8, Figure 5-9**, and **Figure 5-10**.

Table 5-12: EPBC Act listed threatened and migratory marine fauna with a likely or potential presence within the Project Area

Common name	Scientific name	EPBC Act status	TPWC Act status	Presence	Particular values or sensitivities
Marine reptiles					
Flatback turtle	*Natator depressus*	Vulnerable, Migratory	Not listed	Likely	Species is known to occur in Darwin Harbour and surrounding waters. Refer **Figure 5-6**.
Olive ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory	Vulnerable	Likely	Species unlikely to occur in Darwin Harbour but is likely to occur in shallow soft-bottomed habitats of protected waters represented within the Project Area seaward of Darwin Harbour. Refer **Figure 5-7.**
Green turtle	*Chelonia mydas*	Vulnerable, Migratory	Not listed	Likely	Species is known to occur in Darwin Harbour and surrounding waters.
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory	Vulnerable	Likely	Species is known to occur in Darwin Harbour and surrounding waters.
Leatherback turtle	*Dermochelys coriacea*	Endangered, Migratory	Critically endangered	Potential	Species unlikely to occur within Darwin Harbour, but potentially occurs in surrounding waters.
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory	Vulnerable	Potential	Species unlikely to occur within Darwin Harbour, but potentially occurs in surrounding waters.
Salt-water crocodile	*Crocodylus porosus*	Migratory	Not listed	Likely	Species is known to occur within Darwin Harbour; individuals sighted on boat ramps near Project Area. There is no important habitat for the species in the Project Area.
Marine mammals					
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	Not listed	Likely	Suitable habitat for the species is present. Individuals of the species have previously been recorded in Darwin Harbour and near Catalina Island, located to the east of the Project Area. Refer **Figure 5-8**.
Dugong	*Dugong dugon*	Migratory	Not listed	Likely	Individuals of the species are known to occur within Darwin Harbour.
Australian humpback dolphin (previously known as the Indo-Pacific humpback dolphin)	*Sousa sahulensis,* (previously known as *S. chinensis*)	Migratory	Not listed	Likely	Suitable habitat for the species is present. The species is widely known from Darwin Harbour. Refer **Figure 5-9**.
Spotted bottlenose dolphin	*Tursiops aduncus*	Migratory	Not listed	Likely	Suitable habitat for the species is present. The species is widely known to occur within Darwin Harbour. Refer **Figure 5-10**.
Birds					
Asian dowitcher[1]	*Limnodromus semipalmatus*	Vulnerable, Migratory	Not listed	Potential	Some species recorded in proximity to the Project Area. Potential habitat in Darwin Harbour.
Common sandpiper [1]	*Actitis hypoleucos*	Migratory	Not listed	Potential	The Project Area does not contain suitable habitat for nesting/roosting, however there is suitable habitat for foraging on either side of the Project Area which may result in this species traversing the Project Area.
Grey plover [1]	*Pluvialis squatarola*	Vulnerable, Migratory	Not listed	Potential	The Project Area does not contain suitable habitat for nesting/roosting however there is suitable habitat for foraging on either side of the Project Area which may result in this species traversing the Project Area.
Oriental plover[1]	*Charadrius veredus*	Migratory	Not listed	Potential	Some species recorded in proximity to the Project Area. Potential habitat in the Darwin Harbour and offshore of Wagait Beach.
Osprey	*Pandion haliaetus*	Migratory	Not listed	Potential	The Project Area and surrounds contain suitable foraging habitat for the species. It is noted that there is an osprey nest on the DLNG site (atop an artificial pole).

Notes:

1. It is important to note that although there is a number of migratory species as having the potential to or likely to occur within or nearby to the Project Area, several of these were migratory birds, most of which would likely be transiting to areas either side of the Project area where suitable habitat is known to occur (i.e., shoreline crossing is within a disturbed area). Other than the osprey, which is known to nest on tall artificial structures, migratory birds have not been considered further. In addition, given the shore crossing is located within the existing DLNG disturbance envelope and there is no suitable habitat for other migratory terrestrial species within the Project area, migratory terrestrial species have not been considered further.

Table 5-13: Biological Important Areas (BIAs) identified within 5 km of the Project Area

Species	BIA	Project Area overlap
Marine reptiles		
Flatback turtle	Nesting/Internesting	Overlaps (NT Coastal and Internal Waters sections)
Marine mammals		
Australian snubfin dolphin	Breeding	Overlaps (NT Internal Waters section)
Australian humpback dolphin (previously referred to as the Indo-Pacific humpback dolphin)	Breeding	Overlaps (NT Internal Waters section)
Spotted bottlenose dolphin	Breeding	Overlaps (NT Internal Waters section)

Relevant recovery plans, conservation advice, and wildlife conservation plans for EPBC Act listed species in the Project Area include the following:

- Threat Abatement Plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)
- National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)
- National Light Pollution Guidelines (DCCEEW, 2023a)
- Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)
- Wildlife Conservation Plan for Seabirds (CoA, 2020)
- Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)

Further detail on the above plans/ conservation advice is included within **Table 5-14**. Recovery plans set out the research and management actions necessary to stop the decline of and support the recovery of LTS. **Table 5-14** summarises the threats relevant to each LTS in the Project Area with references to the Offshore CEMP sections where these are addressed.

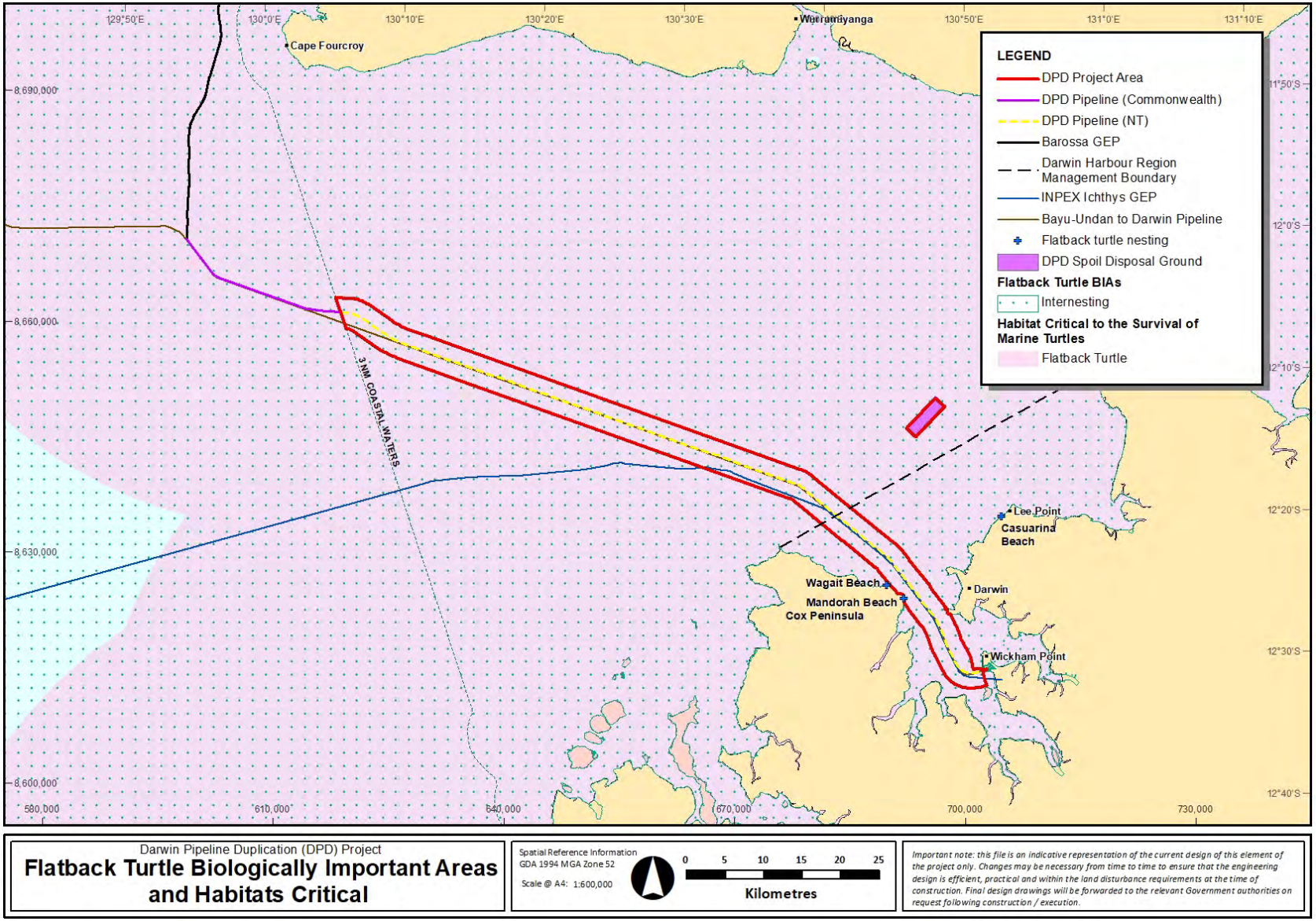


Figure 5-6: Flatback turtle BIA and Habitats Critical to survival

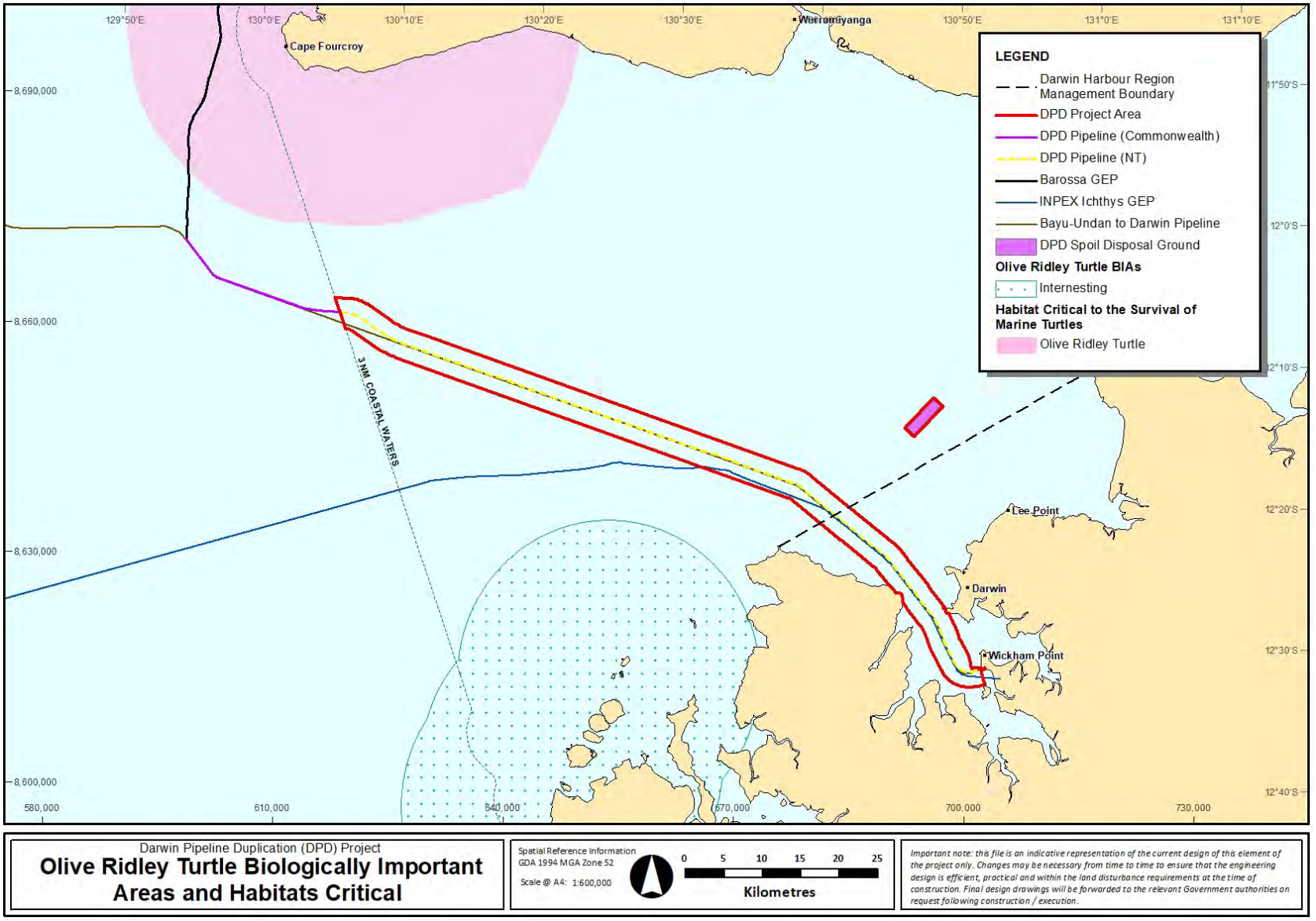


Figure 5-7: Olive ridley turtle BIA and Habitats Critical to survival

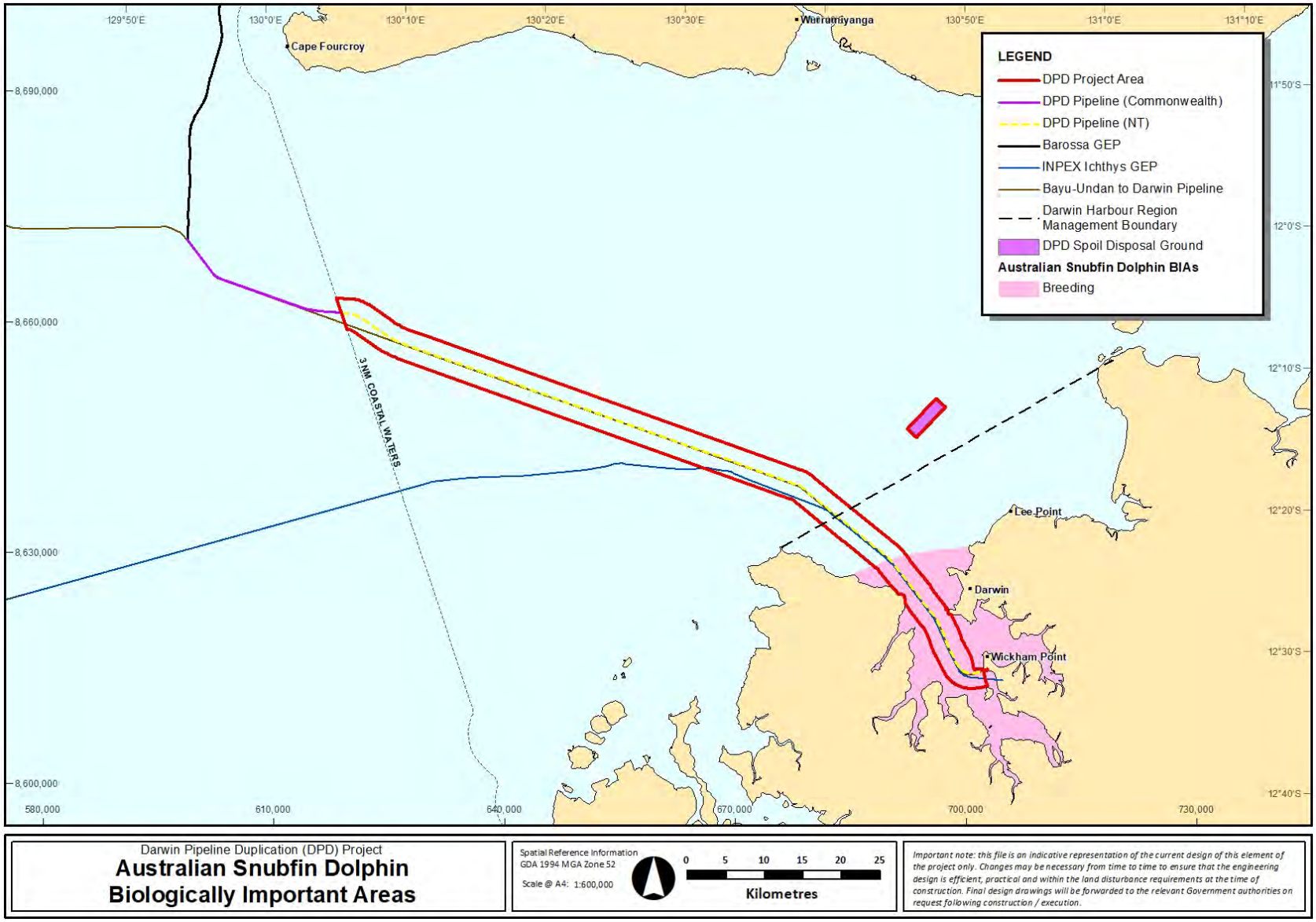


Figure 5-8: Australian snubfin dolphin BIA

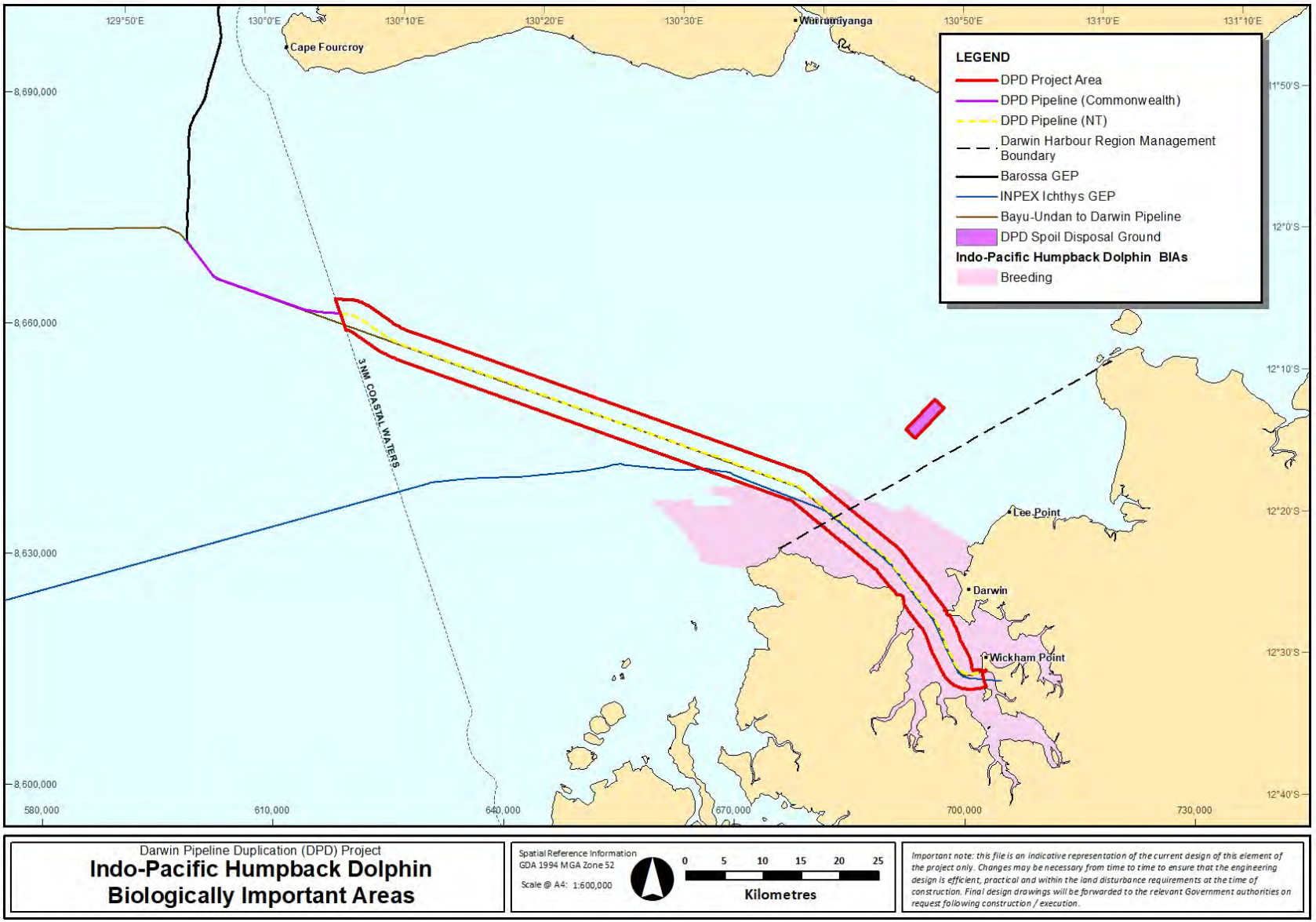


Figure 5-9: Australian humpback dolphin (previously referred to as the Indo-Pacific humpback dolphin) BIA

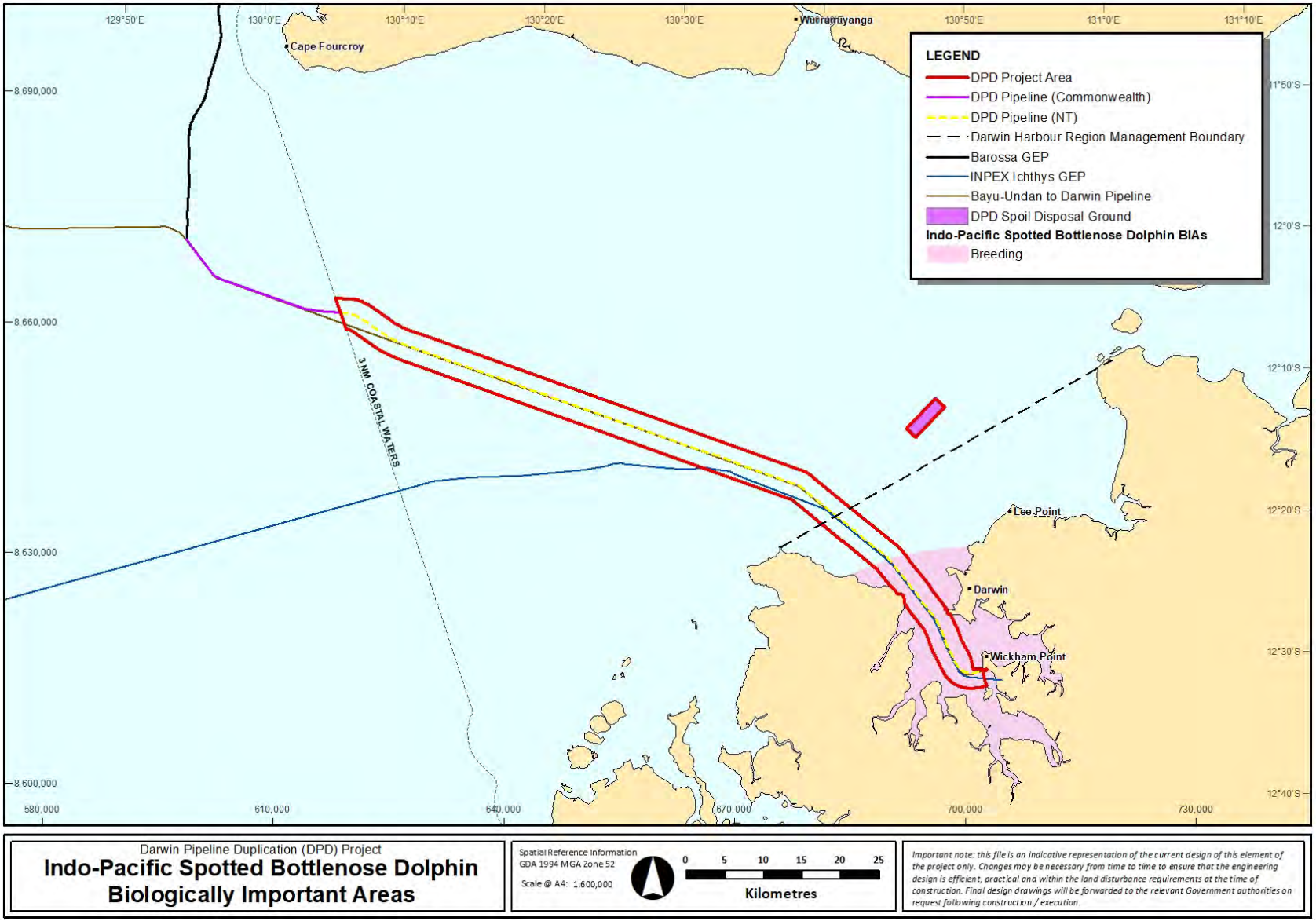


Figure 5-10: Spotted bottlenose dolphin BIA

Table 5-14: Threats from recovery plans, conservation advice and wildlife conservation plans relevant to the activity

Name	Recovery Plan/Conservation Advice/ Management Plan	Threats identified as relevant to the activity	Addressed (where relevant)
All vertebrate fauna	Threat Abatement Plan for impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia, 2018)	Marine debris	**Section 7.7.1**
Marine megafauna			
All cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017)	Vessel strike	**Section 7.7.3**
All marine turtles	National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (DCCEEW, 2023)	Light pollution	**Section 7.6.5**
	Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a)	Noise interference	**Section 7.6.4**
		Deteriorating water quality	**Section 7.6.2** **Section 7.6.6** **Section 7.6.7** **Section 7.6.9** **Section 7.7.2** **Section 7.7.4** **Section 7.7.5**
		Marine debris	**Section 7.7.1**
		Loss of habitat	**Section 7.6.2** **Section 7.6.9** **Section 7.7.1** **Section 7.7.2**

Name	Recovery Plan/Conservation Advice/ Management Plan	Threats identified as relevant to the activity	Addressed (where relevant)
			Section 7.7.4 **Section 7.7.5**
		Light pollution	**Sections 7.6.5**
		Vessel disturbance	**Section7.6.4** **Section 7.7.3**
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008)	Vessel strike	**Section 7.7.3**
		Marine debris	**Section 7.7.1**
		Loss of habitat	**Section 7.6.2** **Section 7.6.9** **Section 7.7.1** **Section 7.7.2** **Section 7.7.4** **Section 7.7.5**
Seabird and shorebirds			
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023a) Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b) Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015)	Light pollution	**Sections 7.6.5**
		Habitat loss and degradation	**Section 7.6.2** **Section7.6.3** **Section 7.6.7** **Section 7.6.9**

Name	Recovery Plan/Conservation Advice/ Management Plan	Threats identified as relevant to the activity	Addressed (where relevant)
			Section 7.7.1 **Section 7.7.2** **Section 7.7.5** **Section 7.7.4**
		Pollution and contaminants	**Section 7.6.2** **Section 7.6.6** **Section 7.6.7** **Section 7.6.9** **Section 7.7.4** **Section 7.7.5**

5.3.10.2 Marine reptiles

There are six species of marine turtle known to occur in NT waters, of these only green, hawksbill and flatback turtles are known to occur in Darwin Harbour regularly. Olive ridley and loggerhead turtles are known to occasionally occur in Darwin Harbour, and leatherback turtles are unlikely to occur in the Harbour as they are an oceanic species (Whiting, 2001; Whiting, 2003). The closest nesting sites to the Project Area are Casuarina Beach and Cox Peninsula beaches, although these are not considered significant nesting areas and Casuarina Beach is additionally a popular recreational area (Pendoley Environmental, 2022a). Other more significant turtle nesting sites in the region include Bare Sand Island and Quail Island, located approximately 50 km from Darwin and over 25 km from the Project Area near the mouth of Bynoe Harbour.

5.3.10.3 Marine mammals

Dolphin species are the most recorded marine mammal in Darwin Harbour, with the Australian snubfin (*Orcaella heinsohni*), Australian humpback (*Sousa sahulensis,* previously known as *S. chinensis*) and Indo-Pacific spotted bottlenose (*Tursiops aduncus*) having known populations in Darwin Harbour. There are approximately 150 individuals across all species thought to inhabit the Darwin region (Brooks & Pollock, 2015).

Dugongs (*Dugong dugon*) are also known to occur in the Darwin region. Ichthys NEMP dugong monitoring estimates approximately 180 to 300 individuals inhabit the Darwin Region (Cardno, 2014).

5.3.10.4 Other fauna

5.3.10.4.1 Bony fishes and sharks

Darwin Harbour supports an abundance of fish species across an array of habitats. There is a diverse range of species within the harbour, from small site-specific species such as gobies, cardinals, and pipefish to larger species of recreational and commercially importance such as mackerel, trevallies, and barramundi. Barramundi is the most targeted recreational species in the NT accounting for 26% of total recreational catch; however, barramundi only accounts for 5% of total catch in Darwin Harbour. Jewfish are the most targeted species in Darwin Harbour followed by golden snapper.

Juvenile recreationally and commercially important fish species utilise mangroves within Darwin Harbour for habitat.

Three protected sawfish species listed on the PMST search results have been recorded within the Darwin Harbour region—the dwarf sawfish (*Pristis clavata*), freshwater sawfish *(Pristis pristis* or *Prisitis microdon*) and green sawfish (*Pristis zijsron*). However, they are unlikely to be encountered in the Project Area.

Whale sharks are known to migrate to Australian waters seasonally, aggregating at Ningaloo Reef and in the Coral Sea following surges in food productivity. The migratory paths of whale sharks are not known to include Darwin Harbour and records from NT coastline are anecdotal (Woinarski *et al*., 2007).

5.3.10.4.2 Seabirds and shorebirds

Of the 37 species of migratory shorebirds that regularly visit Australia (Commonwealth of Australia, 2017b; Lilleyman *et al*., 2018), 25 of them occur along the coastlines of Darwin Harbour, which has a variety of coastal habitats that migratory shorebirds use during the non-breeding season (Lilleyman *et al*., 2018). This includes natural sites such as beaches, rocky reefs, intertidal sand and mud flats, but also an artificial site – the dredge spoil disposal ponds at Darwin Port's East Arm Wharf.

Lilleyman *et al*. (2018) undertook aerial surveys of Darwin Harbour and recorded 724 individuals of 19 species of bird during the low tidal phase of the survey and at high tide recorded 789 individual shorebirds belonging to 13 species. The study was focused on the Far Eastern curlew (*Numenius*

madagascarensis), two flocks of which were identified in numbers that meet the threshold for protection of threatened shorebirds under the EPBC Act. One flock was recorded at East Arm Wharf, where large congregations assemble frequently. The other flock was at a saltpan, south-east of East Arm Wharf, adjacent to the DLNG Plant (although it was noted that this roosting site may not be available at the highest tides) (Lilleyman *et al*., 2018).

5.3.10.4.3Phytoplankton

Inner Darwin Harbour is known to have low concentrations of bio-available nutrients, low light levels and high turbidity which limits the growth of phytoplankton. The large tidal range also ensures that the Harbour is well flushed. Ichthys NEMP monitoring found low biomass of phytoplankton indicated by low chlorophyll-a fluorescence, although there was a slight increase in phytoplankton biomass during the wet season compared to the dry season. This could be due to the additional nutrient input from increase rainfall and subsequent runoff. Variations in phytoplankton biomass within Darwin Harbour follows complex patterns indicating that multiple factors may influence the productivity of phytoplankton in the Harbour.

5.3.11 Community and economy

5.3.11.1 Socio-economic environment

Socio-economic activities that may occur within the Project Area and surrounds including recreational, traditional and commercial fishing, shipping, energy infrastructure operations, defence activities, operation of power and communication cables and tourism, as summarised in **Table 5-15**.

Table 5-15: Summary of socio-economic activities that occur within the Project Area

Value/ sensitivity	Description
Commercial fisheries – Commonwealth	The Northern Prawn Fishery is the only active Commonwealth managed fishery overlapping the Project Area. There are three other inactive or low operating (less than five vessels active in the fishery each year since 2005) Commonwealth managed fisheries overlapping the Project Area: Southern Bluefin Tuna Fishery, Western Tuna and Billfish Fishery and the Western Skipjack Tuna Fishery (Commonwealth of Australia, 2020c; DAFF, 2022).
Commercial fisheries and aquaculture – NT	The following NT managed fisheries intersect the Project Area: Trepang Fishery, Coastal Net and Line Fishery, Pearl Oyster, Mud Crab Fishery, Mollusc Fishery, Offshore Net and Line, Spanish Mackerel, Bait Net Fishery and Aquarium Fishery. There are no aquaculture activities within the Project Area, however Darwin Aquaculture Centre at Channel Island is 1.5 km south of the Project Area
Recreational fishing	Recreational fishing does occur within the Project Area. The Darwin Harbour/Surrounds fishing zone supporting 63% of total fishing effort within the Greater Darwin Area (Matthews *et al*. 2019).
Traditional fishing	Traditional Australian Indigenous fishing in NT waters predominately occurs within inshore tidal waters. Approximately 55% of NT's coastline is owned by Traditional Aboriginal Owner groups in the Northern Land Council region (NLC, 2022).
Shipping	The closest major commercial port to the Project Area is Darwin. The Darwin Port Corporation serves multiple shipping and cargo markets, including cruise and naval vessels, livestock exports, dry bulk ore, offshore oil and gas rig services, and container and general cargo. The AMSA shipping routes close to the Project Area are shown in **Figure 5-13**.
Tourism	Within Darwin Harbour common tourism/recreational activities include fishing, boating, scuba-diving, sailing, water-skiing, and beach use. The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities.
Defence	The Project Area intersects a Central Defence Practice Area of the Darwin Air Weapons Range (AWR), a maritime military zone administered by the Department of Defence. The Project Area is also nearby to the NAXA Defence Training Area approximately 3km to the South. During their surveillance, Australian Border Force vessels may transit the EMBA.
Telecommunications and power cables	The Project Area overlaps a power cable operated by NT Power and Water and telecommunication cables operated by Vocus and Telstra. The project pipeline will intersect telecommunications and power cables at five locations within Darwin Harbour.
Petroleum industry	Several offshore petroleum projects are in operation and there is considerable petroleum exploration activity within the NMR. The existing INPEX Ichthys and Santos Bayu-Undan to Darwin gas export pipelines overlap with the Project Area.

Value/ sensitivity	Description
First Nations heritage	The Darwin region was traditionally occupied by the Larrakia people, whose country runs from Cox Peninsula in the west to Gunn Point in the north, Adelaide River in the east and down to the Manton Dam area southwards (Larrakia Nation, 2023). The waters of Darwin Harbour, Bynoe Harbour, Shoal Bay, Adam Bay, and parts of Beagle Gulf also form part of Larrakia country (Cosmos Archaeology, 2022). The Larrakia people maintain an innate connection to the land and sea in the region. Cultural, spiritual and heritage sites of significance are located throughout the region where traditional harvesting remains an important practice (DHAC, 2020). Offshore from Darwin Harbour, the waters around the Tiwi Islands (including Bathurst Island, Melville Island and the Vernon Island) similarly hold a spiritual connection, and a source of food and wellbeing, for the Tiwi people (Tiwi Land Council, 2021). Dr Corrigan, an independent anthropologist, prepared an anthropological survey report (Corrigan, 2024) on cultural and spiritual values in relation to the DPD Project which includes the Project Area. Dr Corrigan concluded that a precise boundary which captures the extent of interests of both the Tiwi Islanders and Larrakia Peoples in the context of the DPD is unclear. However, cultural and spiritual values of these groups are understood as extending out into the seas for an indeterminate distance.
Maritime heritage	Three historic shipwrecks listed under the UCH Act and/or *Heritage Act 2011* (NT) are overlapped by the Project Area: I-124 Japanese Submarine (1942) 800 m radial protection zone, Mauna Loa United States Army Transport ship (USAT) (1942) 100 m radial protection zone and Meigs USAT (1942) unlisted protection zone (DCCEEW, 2022b). Santos has undertaken maritime heritage surveys within the Project Area to determine the presence of additional maritime heritage objects and will apply measures to ensure these are not impacted.

5.3.11.2 Commercial fishing and aquaculture

5.3.11.2.1 Commonwealth fisheries

The Northern Prawn Fishery is the only active Commonwealth managed fishery that overlaps the Project Area (Santos, 2021) however the area of overlap has a relatively low fishing effort. The Commonwealth managed Southern Bluefin Tuna Fishery, the Western Tuna and Billfish Fishery and the Western Skipjack Tuna Fishery overlap with the Project Area but have been excluded from assessment as these fisheries are either inactive or operate at extremely low levels (<5 vessels active each year since 2005) within or nearby the Project Area (DAFF, 2022; Santos, 2021).

5.3.11.2.2 Northern Territory fisheries

NT managed fisheries in the Project Area include the Aquarium Fishery, the Offshore Net and Line Fishery, the Spanish Mackerel Fishery, the Coastal Line Fishery, and the Demersal Fishery (Santos, 2021). The Aquarium Fishery includes freshwater, estuarine, and marine habitats to the outer boundary of the Australian Fishing Zone (AFZ), which is 200 nm offshore (Santos, 2021). The Offshore Net and Line Fishery and the Spanish Mackerel Fishery extend from the low water mark of NT waters to the outer boundaries of the AFZ (Santos, 2021). The Demersal Fishery extends 15 nm from the NT low water mark to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery (Santos, 2021). The Coastal Line Fishery extends seaward from the high water mark to 15 nm from the low water mark, covering the entire NT coastline (Santos, 2021).

The Aquarium Fishery is a small-scale, multi-species fishery that is active within the Project Area (Santos, 2021). Licensees employ several types of nets, hand pumps, freshwater pots, and hand-held instruments to collect specimens. The fishery supplies local, interstate, and international pet retailers and wholesalers, including aquarium fishes (mostly rainbowfish, catfish, scats), invertebrates (hermit crabs, snails, whelks, and hard and soft corals) and plants.

The Offshore Net and Line Fishery permits the use of pelagic gillnets and longline gear (Santos, 2021). Pelagic gill nets are the primary gear utilised and are generally set within 15 nm of the coast (Santos, 2021). Most fishing effort is within 12 nm of the coast and immediately offshore in the Gulf of Carpentaria (Northern Territory Government, 2022b). The fishery targets Australian blacktip sharks (*Carcharhinus tilstoni*), common blacktip sharks (*C. limbatus*) and grey mackerel (*Scomberomorus semifasciatus*), other shark species (i.e. hammerhead, bull, tiger, pigeye, lemon, winghead and dusky whalers) and finfish (i.e. Spanish mackerel, longtail tina, black pomfret) are also caught by the fishery (Northern Territory Government, 2021). There is potential for fishing to overlap with the Project Area; however, stakeholder consultation conducted by Santos (2021) only identified one licence holder that may fish off the south-west end of the Tiwi Islands.

The Spanish Mackerel Fishery permits the use of troll lines, floating handlines, and rods, solely targeting Spanish mackerel (*Scomberomorus commerson*) (Santos, 2021). Most of the fishing effort occurs around reefs, headlands, and shoals off the western and eastern mainland coast and near islands including Bathurst Island, Groote Eylandt, and the Wessel Islands (Northern Territory Government, 2021). There are 15 fishery licences allowed (NT Government, 2023). There is potential for fishing to occur close to or within the Project Area. Stakeholders have advised during stakeholder consultation by Santos (2021), that there is potential for fishing to occur within the southern extent of the original Barossa GEP (Santos, 2021).

The Coastal Line Fishery permits the use of a variety of gear types including rod and line, hand lines, cast nets (for bait only), scoop nets and gaffs (Northern Territory Government, 2016a). Drop lines and five fish traps are permitted beyond 2 nm from the coast; however, fish traps are only permitted in the Eastern zone of the fishery (Northern Territory Government, 2016b). Black jewfish and golden snapper are the main targeted species of the fishery, although emperor, cod and other snapper species are caught as bycatch. Fishing effort is concentrated within nearshore waters, therefore there is potential for fishing to occur within or close to the nearshore Project Area.

The Demersal Fishery permits the use of fish traps, hand lines, droplines, and semi-demersal trawl nets (Northern Territory Government, 2022). It is important to note that semi-demersal trawl nets are only permitted in two defined multi-gear areas (Northern Territory Government, 2022). Trap catch is mainly goldband snapper and red snapper with red emperor and cod caught as bycatch (Northern Territory Government, 2022). Trawl catch is mainly saddletail snapper and crimson snapper with painted sweetlip, redspot emperor and goldband snapper caught as bycatch. There are 18 licences currently issued for the fishery (Santos, 2021). Most fishing effort occurs within deep offshore waters along the Timor Reef Fishery eastern boundary in water depths 80 – 100 m, therefore there is low potential for fishing to overlap with the Project Area.

Most fisheries are not permitted to operate within Darwin Harbour, except for the coastal line fishery and aquarium fishery (DPIR, 2015). Therefore, there is little to no commercial fishing taking place within Darwin Harbour.

The Darwin Aquaculture Centre is located on Channel Island in the Middle Arm Peninsula. It is a research facility undertaking a range of research and development projects on several species including pearl oysters, sea cucumbers, giant clams, prawns, barramundi, mud crabs, reef fish, as well as undertaking several disease investigations (Northern Territory Government, 2018).

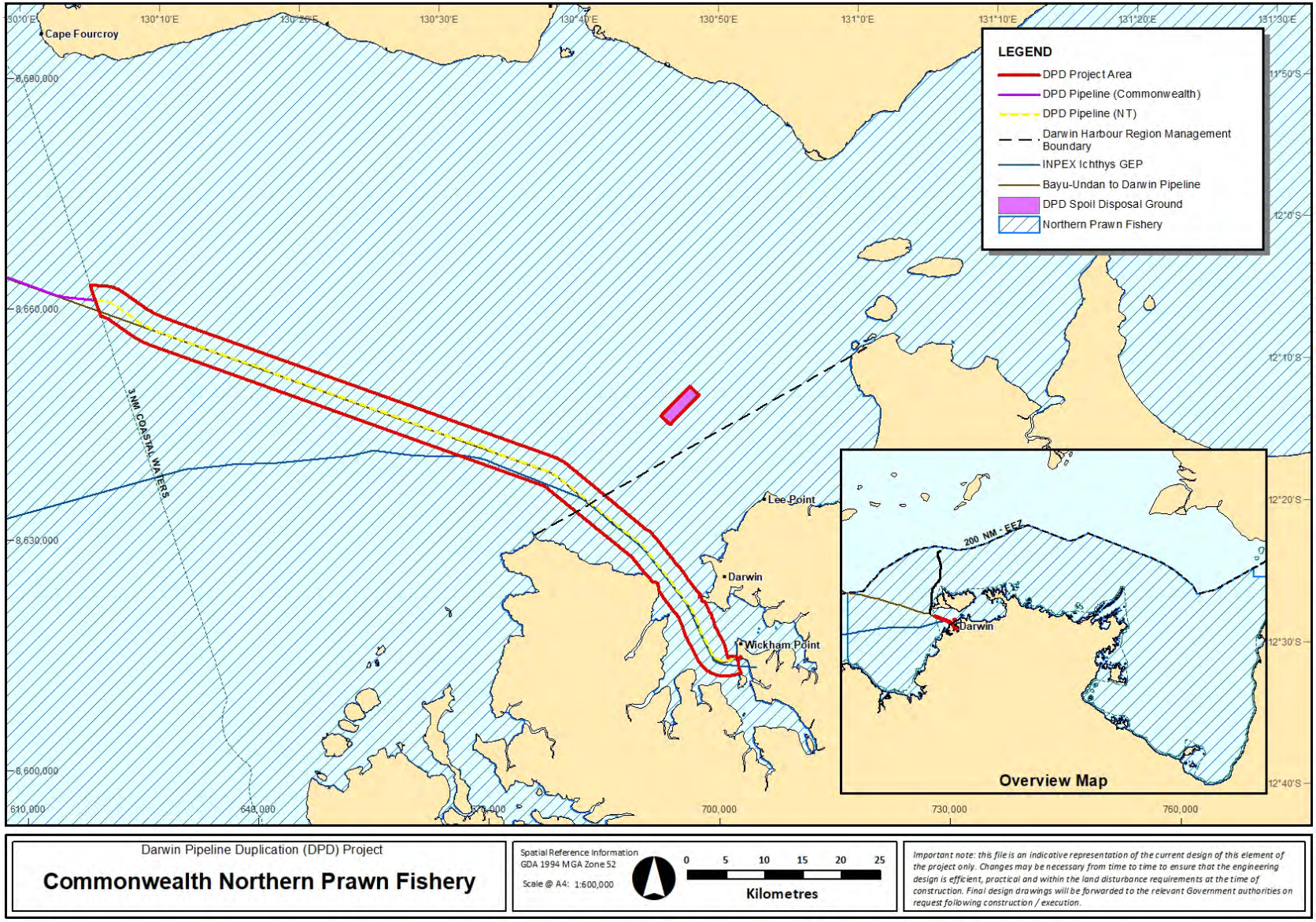


Figure 5-11: Commonwealth managed Northern Prawn Fishery

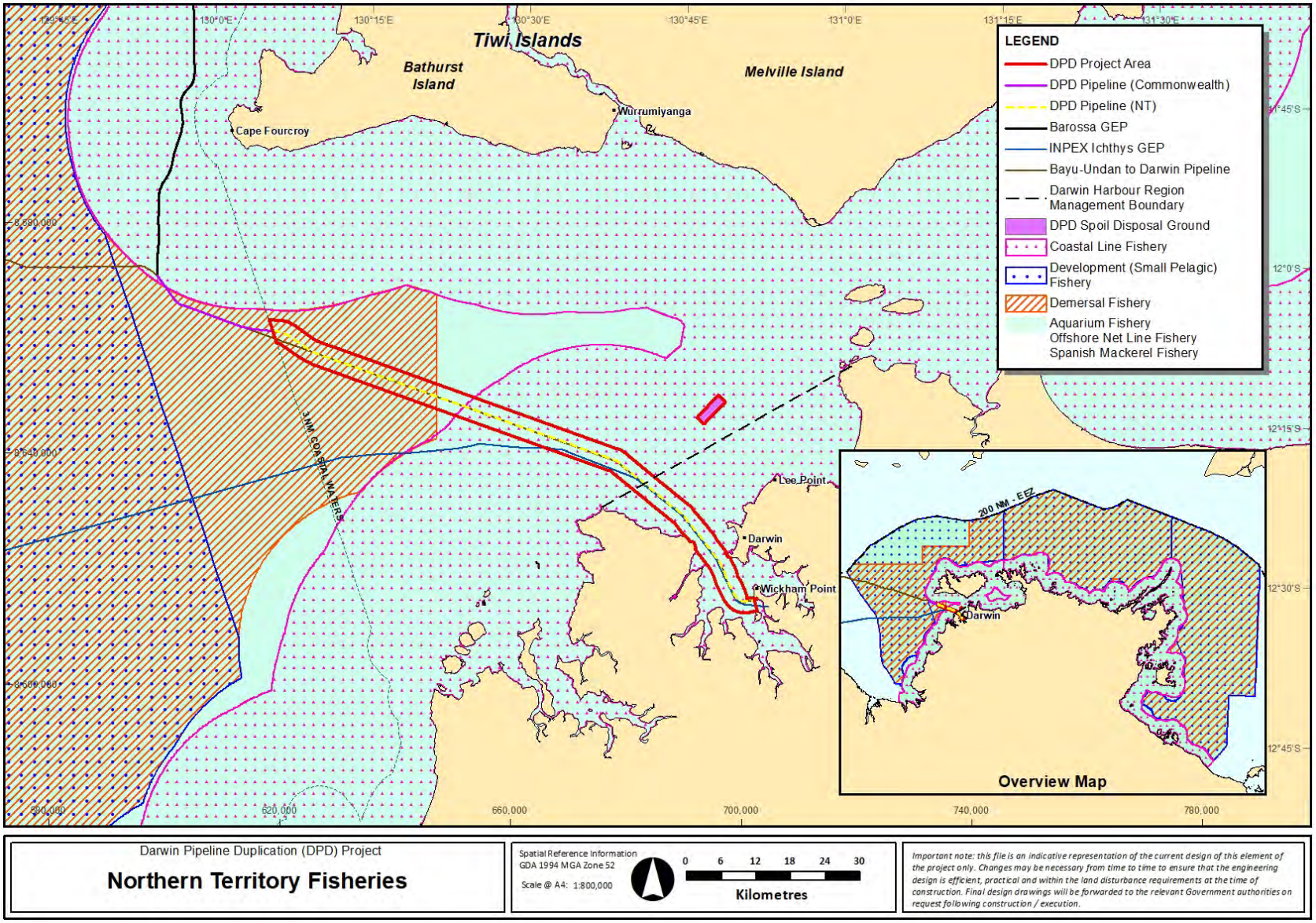


Figure 5-12: Northern Territory managed commercial fisheries

5.3.11.3 Shipping

Vessel traffic data from the AMSA Marine Traffic Database (AMSA, 2021) for the Project Area during March 2021 is shown in **Figure 5-13**, which shows the Project Area intersects areas of high shipping traffic.

Shipping traffic in the offshore waters of the Project Area is relatively light; however, at the approach to Darwin Harbour, and within the harbour itself, several notable shipping traffic lanes converge to create a high-density shipping traffic area that overlaps with the Project Area.

The Port of Darwin recorded 1,569 trading vessel visits in 2022-(Landbridge Darwin Port, 2024) with traffic in the Port typically influenced by number of the well-established industrial and commercial facilities that receive a wide of maritime traffic (i.e., cargo, livestock vessels, LNG tankers and cruise ships).

Whilst 61 cruise ships visited Darwin Port in 2020-21, with the majority travelling between South East Asia and the eastern coast of Australia, this number dropped significantly with the onset of the Covid-19 pandemic with 36 cruise ships recorded in 2021-22. Regional commercial shipping activities are also associated with support and supply vessels servicing oil and gas offshore facilities. For example, in 2021-22, there were 283 rig tender vessel calls to Darwin Port facilities. The Port forms the main base for oil and gas contracted supply vessels that support northwest Australia offshore activities (Darwin Port Authority, 2021).

Although Darwin Port remains the primary active port in the region, there is small-scale port activity at the Tiwi Islands. Port Melville is located on Melville Island (122 km north of Darwin) and the wharf infrastructure at Port Melville was constructed in 2013. Shipping traffic associated with the route between Darwin Port and the Tiwi Islands, including Port Melville, is shown in **Figure 5-13**.

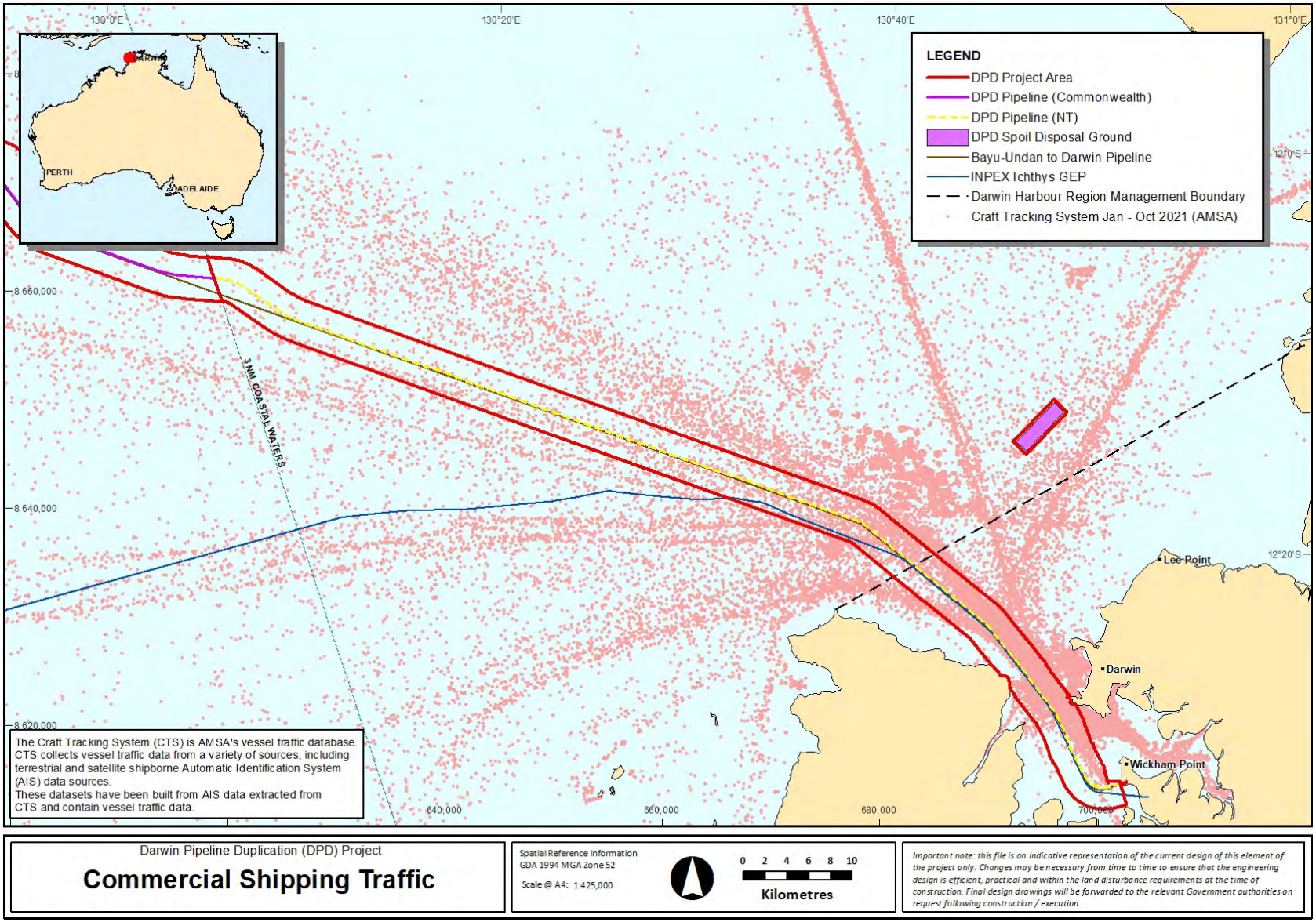


Figure 5-13: Commercial shipping traffic

5.3.11.4 Recreational activities and tourism

During 2021 there were 1,283,000 visitors to the NT, which contributed an estimated $1.84 billion to the local community (Tourism NT, 2022). This was substantially lower than 2019, with 2,001,000 visitors contributing an estimated $2.6 billion, likely due to the reduction in international visitation resulting from border closures (Tourism NT, 2022).

The Darwin Harbour supports a range of commercial and recreational uses, including fisheries, tourism and recreational shipping and boating activities. Fishing tours often frequent Fenton Patches located approximately 30 km north-west of Darwin Harbour. Recreational fishers also visit Casuarina Bay and Lee Point.

The water surrounding Middle Arm Peninsula is used for recreational fishing, sailing, and boating. However, tour boats tend to avoid this section of the Harbour due to navigational hazards associated with the shallow nearshore waters (URS, 2002).

5.3.11.5 Traditional fishing and hunting

Traditional Tiwi and Larrakia fishing and hunting in NT waters predominately occurs within inshore tidal waters. Approximately 80% of NT's coastline is recognised as Aboriginal land and sea ownership under the NT *Aboriginal Land Rights Act 1976* (NT Government, 2022). Several areas within this coastal region have been declared Aboriginal sacred sites, which are restricted from other recreational and commercial fishing. Almost all traditional fishing effort (93%) is concentrated within coastal waters (up to 3 Nm) of the NT coastline and Tiwi Islands (NT Government, 2017).

Within Darwin Harbour, fishing and foraging for food and other resources occurs within the intertidal regions, mainly around Nightcliff, Coconut Grove, Kululuk, Sadgroves Creek, and Lee Point, adjacent to but outside the Project Area. As such, Indigenous fishing may occur near the Project Area but there is unlikely to be a significant level of effort within the Project Area itself. Furthermore, there are no DPD Project construction activities in the intertidal region of Darwin Harbour, other than those at the existing DLNG facility which is a restricted access area.

On the Tiwi Islands, traditional fishing effort is greatest near the larger communities of Wurrumiyanga on Bathurst Island, and Pirlangimpi and Milikapiti on Melville Island (DPIF, 2014). Tiwi People continue to undertake the customary harvesting of sea turtles and dugongs. Green turtles are the main species harvested in the water while eggs of all turtle species are taken periodically. Dugongs are also taken occasionally (Tiwi Land Council, 2022). Tiwi Islands coastal waters, within which fishing and hunting occur, do not overlap the DPD Project Area.

5.3.11.6 Defence

A search on National Map (DCA, 2021) was undertaken and identified that the Project Area intersects the Darwin Air Weapons Range (AWR) Central Defence Practice Area and the NAXA Defence Training Area is approximately 3 km to the south at its closest point, as shown in **Figure 5-14**.

The HMAS Coonawarra Naval Base is located within Darwin Harbour, adjacent to the Project Area, and naval vessels utilise the Project Area in transit and for anchorage. During Defence exercises, the number of vessels utilising Darwin Harbour is expected to increase. Santos has consulted with the Department of Defence with respect to its Offshore CEMP activities and will continue to engage with respect to potential overlap with Defence exercise activities planned for 2024.

The Australian Border Force also undertakes civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which includes the Australian EEZ. During their surveillance, Australian Border Force vessels may transit through the Project Area.

5.3.11.7 Telecommunications and power cables

The Project Area includes power cables operated by NT Power and Water and telecommunication cables operated by Vocus and Telstra. The project pipeline will cross telecommunications (Telstra) and power cables (NT Power and Water) at five locations within the Project Area in Darwin Harbour where these cables cross the harbour between Mandorah and Darwin CBD. The Vocus telecommunication cable runs parallel to the DPD pipeline route from the Darwin CBD out through the mouth of Darwin Harbour.

5.3.11.8 Energy industry

The Project Area contains two existing GEPs, the Bayu-Undan to Darwin GEP (approx. 50-100 m to the west of the proposed DPD Project pipeline route) and the INPEX Ichthys GEP which is further to the west of the Bayu-Undan to Darwin GEP (**Section 2.2**).

The two primary LNG facilities on Middle Arm Peninsula are the DLNG Facility operated by Santos, and the Ichthys LNG Project operated by INPEX. The Project pipeline will connect into the existing DLNG Facility, and the Project Area overlaps the DLNG Facility disturbance footprint

The DLNG Facility is a gas processing facility which includes units for:

- Gas receiving facilities (including the beach valve, pig receiver and meter station for the Bayu-Undan to Darwin pipeline)
- Acid gas removal
- Dehydration and mercury removal
- Propane and ethylene refrigeration
- Liquefaction, methane compression and nitrogen rejection.

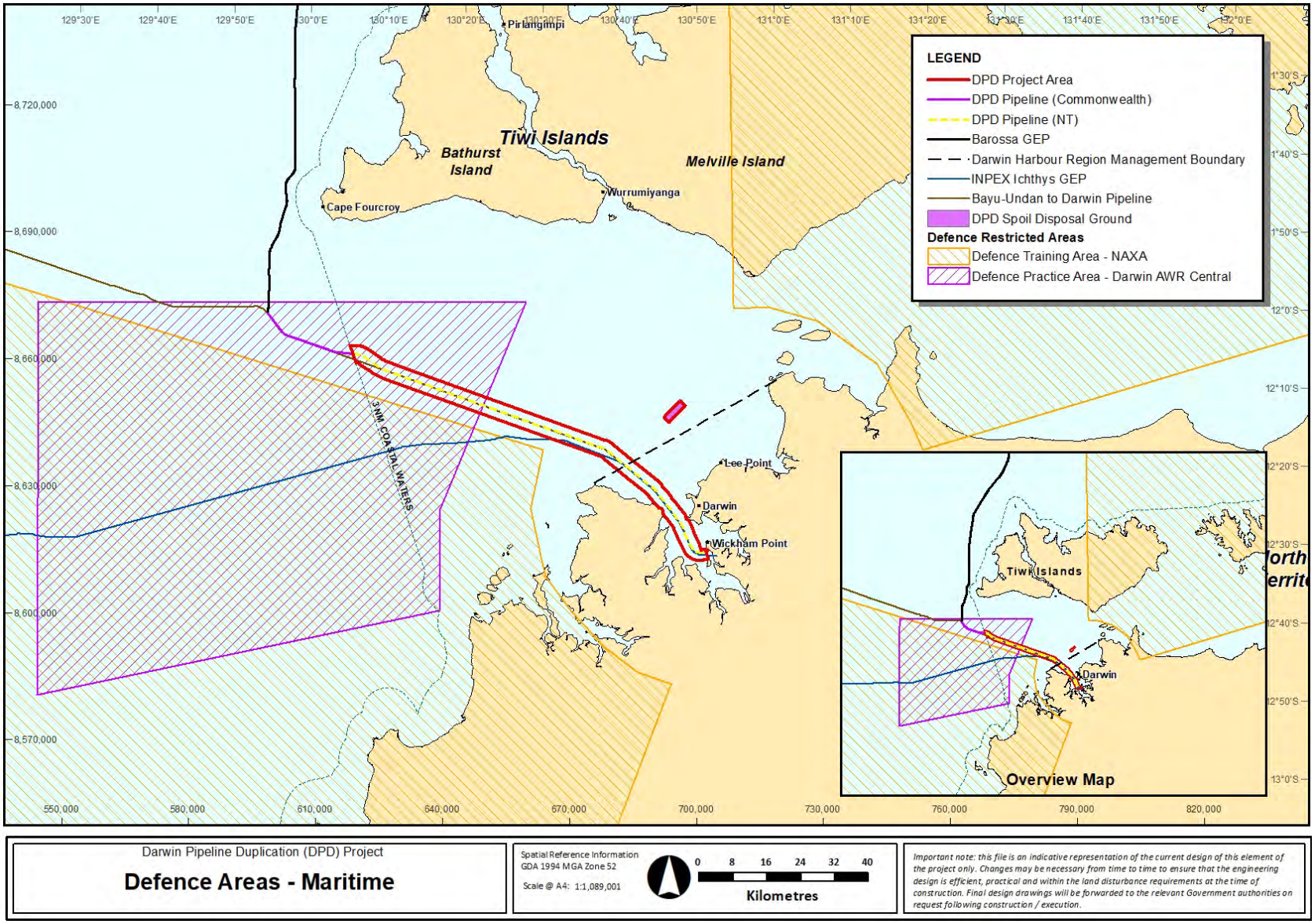


Figure 5-14: Defence areas – maritime

5.3.12 Culture and heritage

The Project Area is host to a wide range of historical, spiritual and heritage values that are significant to the people of the NT and Australia. These values have been broadly categorised as either First Nations or non-First Nations cultural heritage. **Section 5.2.5** has provided an overview of First Nations and non-First Nations cultural values within the broader DPD EMBA. **Sections 5.3.12.1** and **5.3.12.2** below provide further detail on specific sites and studies within the DPD Project Area.

5.3.12.1 First Nations heritage

The Project Area includes Beagle Gulf waters, offshore from Darwin Harbour and to the south of the Tiwi Islands, waters within Darwin Harbour and an additional area of land within the existing DLNG facility footprint at Wickham Point. The Darwin region was traditionally occupied by the Larrakia people, whose country runs from Cox Peninsula in the west to Gunn Point in the north, Adelaide River in the east and down to the Manton Dam area southwards (Larrakia Nation, 2023). The waters of Darwin Harbour, Bynoe Harbour, Shoal Bay, Adam Bay, and parts of Beagle Gulf also form part of Larrakia country (Cosmos Archaeology, 2022). The Larrakia people maintain an innate connection to the land and sea in the region and cultural, spiritual and heritage sites of significance are located throughout the region where traditional harvesting remains an important practice (DHAC, 2020).

Offshore from Darwin Harbour, the waters around the Tiwi Islands (including Bathurst Island, Melville Island and the Vernon Island) similarly hold a spiritual connection, and a source of food and wellbeing, for the Tiwi people (Tiwi Land Council, 2021).

Santos recognises that First Nations people view their land and waters as integral to their identity, culture, and spirituality and they have a deep respect for the natural world. The cultural heritage of First Nations peoples includes a vast array of cultural artifacts, practices and beliefs. Santos acknowledges the cultural features of the First Nations people includes their intangible spiritual and cultural heritage stories, song lines and connections to their lands and waters, including sea country, and that these connections are rooted in their traditional communal beliefs and practices. Within the Project Area, there are marine fauna that hold special significance to First Nations people as totemic and/or culturally important species. This includes marine turtles, dugongs, crocodiles, fish, crabs, octopus and shellfish.

Cultural heritage and sacred sites in the NT are protected by the *Heritage Act (2011)* (NT) and the *Northern Territory Aboriginal Sacred Sites Act 1989 (NT)* respectively, and in some circumstances may be protected under the UCH Act. The purpose of the *Heritage Act (2011) (NT)* is to provide for the conservation of the Territory's cultural and natural heritage, whereby the significance of a place or object includes its aesthetic, historical, scientific and social significance.

Sacred sites are places within the landscape that have a special meaning or significance under Indigenous traditions, including hills, rocks, waterholes, trees, plains, lakes, billabongs (AAPA, 2022). There are many sacred sites within Darwin Harbour and the surrounding waters and at the Tiwi Islands. In coastal and sea areas, sacred sites may include features which lie both above and below the water (AAPA, 2022).

The Kenbi (Cox Peninsula) Land Claim No. 37 (CoA, 2000) publishes detail on the location and significance of culturally significant First Nations sites within Darwin Harbour and Bynoe Harbour to the east (which are separated by the Cox Peninsula), including registered sacred sites. These sites and areas include those used for hunting, fishing, gathering, camping, ceremonies and associated with dreamings. There are numerous sites identified in this report on the western side of Darwin Harbour adjacent to or intersecting the DPD Project Area, including those associated with dreamings of totemic marine fauna species, including Ngalwatnyini (manta ray dreaming), Memarrandjamul-nyini (dugong dreaming), lyn.garrayn-nyini (sea turtle dreaming) (CoA, 2000). The report also identifies three sites on the north-eastern side of Darwin Harbour.

The AAPA is an independent statutory authority established under the *Northern Territory Aboriginal Sacred Sites Act 1989* (AAPA, 2022). AAPA is responsible for overseeing the protection of Aboriginal

sacred sites on land and sea across the whole of Australia's Northern Territory. AAPA protects Aboriginal sacred sites through:

- Sacred site avoidance surveys and issuing of Authority Certificates for any proposals of development.
- The provision of information to the public about existing sacred sites data through abstracts of Authority records and access to the Registers maintained by the Authority.
- The registration of Aboriginal sacred sites (AAPA, 2022).

Authority Certificates are based on consultations between AAPA and custodians and provide clear instructions on what can and cannot be done in and around sacred sites (AAPA, 2022). An Authority Certificate provides a statutory indemnity against prosecution in relation to the works or uses covered by the Certificate, provided the applicant complies with any conditions imposed to protect sacred sites (AAPA, 2022). Certificates are voluntary and are considered to provide an effective risk management tool for developers and act as site protection measures for custodians (AAPA, 2022).

Santos has applied for and received an Authority Certificate (C2022-098) from AAPA on 23 December 2022, which covers potential land/seabed disturbance areas (termed 'subject land areas' and representing for the most part, a 1,000m buffer each side of the pipeline route, the spoil disposal ground and an onshore area within the DLNG facility disturbance footprint) from Wickham Point to the boundary of NT and Commonwealth waters.

Authority Certificate (C2022-098) identifies a registered sacred site that overlaps the subject land areas in Darwin Harbour and conditions that a restricted works area (RWA 1) associated with this feature will apply to the DPD Project construction activities, within which no work or damage can occur.

Santos also applied for, and received on 22 May 2024, a second Authority Certificate (C2024-034) from AAPA to cover areas of seabed disturbance outside of certificate C2022-098, associated with nearshore pipelay barge anchoring in Darwin Harbour, water quality logger installation in Darwin Harbour (for monitoring water quality during trenching and spoil disposal operations) and onshore disturbance within the existing DLNG Facility disturbance footprint.

Santos will ensure that the conditions of AAPA Authority Certificates and requirements of the *Northern Territory Aboriginal Sacred Sites Act 1989 (NT)* and the *Heritage Act 2011 (NT)* will be adhered to during the activities covered by this Offshore CEMP.

Additional to the AAPA sacred site assessment, Santos has undertaken consultation with First Nations people and groups (refer **Section 9**) and is undertaking ongoing consultation and engagement with Traditional Owners in relation to First Nations cultural values and heritage within the DPD Project Area.

Santos has prepared a Cultural Heritage Management Plan (CHMP) (BAS-210 0208), and an Unexpected Finds Protocol, as required as a condition of DPD Project approval (EP2022/022-001) under the NT EP Act. The CHMP incorporates measures identified through consultation with Indigenous stakeholders to protect sacred site / restricted works area identified from the AAPA Authority Certificate (C2022/98).

A First Nations archaeological assessment for the DPD Project Area has been conducted (OzArk, 2024) based on a detailed geomorphological assessment of the Project Area. This study focussed on the likelihood for deposits associated with the Last Glacial Maximum (LGM) to be impacted by the DPD Project. Only one location where potential sediments associated with the LGM were indicated was in the vicinity of KP36.4 to KP37.9. At this location, potential sediments are assessed likely to be at a depth of approximately 18 m below the sea floor. At this depth, no activities related to the construction of the DPD Project will have any direct or indirect impact on these potential sediments. There are no declared protected First Nations UCH sites within the DPD Project Area.

As required as a condition of DPD Project approval (EP2022/022-001) under the NT EP Act the DPD Project Cultural Heritage Management Plan (CHMP) (BAS-210 0208) includes Unexpected Finds

Protocols, including a First Nations protocol (refer **Section 4.4.7**). The First Nations protocol will be followed if any potential First Nations finds are encountered during the Activity.

5.3.12.2 Non-First Nations heritage

Darwin Harbour is host to several shipwrecks and sunken aircraft, some of which are protected under the *Heritage Act 2011* (NT) and/or the UCH Act (**Figure 5-15**). Most wrecks are associated with either the bombing of Darwin in 1942 or Cyclone Tracy in 1974. The Project Area is within ~2 km east of the oldest known wreck in Darwin Harbour the *SS Ellengowan*, a nineteenth-century Norwegian-built iron steamer, which is of high significance to maritime archaeology (Northern Territory Government, 1999; **Figure 5-15**).

The Australian National Shipwrecks Database has identified three historic wrecks that overlap the Project Area, which are protected under the UCH Act (DCCEEW, 2022b) and/or *Heritage Act 2011 (NT)* (**Figure 5-15)**. These wrecks are the Japanese submarine I-124 (1942) and 800 m radial protection zone, Mauna Loa USAT (1942) 100 m radial protection zone and Meigs USAT (1942) unlisted protection zone (DCCEEW, 2022b). The USS Peary wreck is on the boundary of the Project area. The pipeline route has been deliberately altered to avoid the I-124 and Mauna Loa USAT wrecks and their exclusion zones, and passes 100m from the I-124 exclusion zone and 15m from the Mauna Loa USAT (**Figure 5-15**).

The regional harbourmaster has also ordered the Booya and Catalina 6 wrecks to have closed water controls over them and permission from the Heritage Branch is needed to enter the zones. There are an additional two sites in the EMBA that have a declared protected zone, the SS Florence and SS Macumba.

No European heritage is currently listed at Wickham Point, with the remnants of artefacts documented and removed prior to the construction of the DLNG facility. There are no World, National or Commonwealth Heritage places within or near the Project Area.

As per an Archaeological Scope of Works provided by the Heritage Branch of the NT Department of Territory Families, Housing and Communities, Santos engaged the services of maritime archaeologists to undertake underwater heritage assessments of the pipeline route, trenching areas and surrounding buffer where anchoring may occur (Cosmos Archaeology, 2022, 2023; Ellengowan Enterprises, 2024). The maritime heritage study area included a minimum 1,000 m buffer on either side of the DPD Project route (e.g. both Commonwealth and NT waters) and Cosmos Archaeology analysed data collected during the geophysical survey conducted by Fugro in 2021. Twenty nine known but unlocated shipwrecks and 25 known but unlocated aircraft wrecks are believed to have sunk within the study area vicinity based on recorded historical accounts (Cosmos Archaeology, 2022). Therefore, these unlocated shipwrecks and aircraft wrecks could potentially be located within the EMBA but outside the Project Area. Cosmos Archaeology identified 17 known shipwrecks, 5 unexploded ordnance (UXO) and 6 instances of maritime infrastructure (including anti-submarine defences and telegraph cables) within the study area, but outside of the Project Area (Cosmos Archaeology, 2022).

Cosmos Archaeology (2022, 2023) identified a number of geophysical anomalies within the maritime heritage study area including the location of three WWII anti-submarine net mooring blocks (trots) within the vicinity (<50 m) of the proposed pipeline route in Darwin Harbour, however trenching and pipelay activities were not predicted to disturb these identified trots nor any other potential cultural features (Cosmos Archaeology, 2022, 2023; Ellengowan Enterprises, 2024). Geophysical anomalies in Darwin Harbour, that have the potential to be cultural, were also identified within the area where Project vessel anchoring (in particular nearshore pipelay barge anchoring) will occur. Santos will avoid these locations, as per the recommendation by Cosmos Archaeology (2022, 2023), and on that basis these anomalies have not been investigated further.

Santos will adopt procedures and protocols to ensure that impacts to existing known and any potential future cultural heritage objects identified during the construction activity will be avoided or reduced as far as practicable. These will be included within a CHMP, and an Unexpected Finds Protocol, as required as a condition of DPD Project approval (EP2022/022-001) under the NT EP Act.

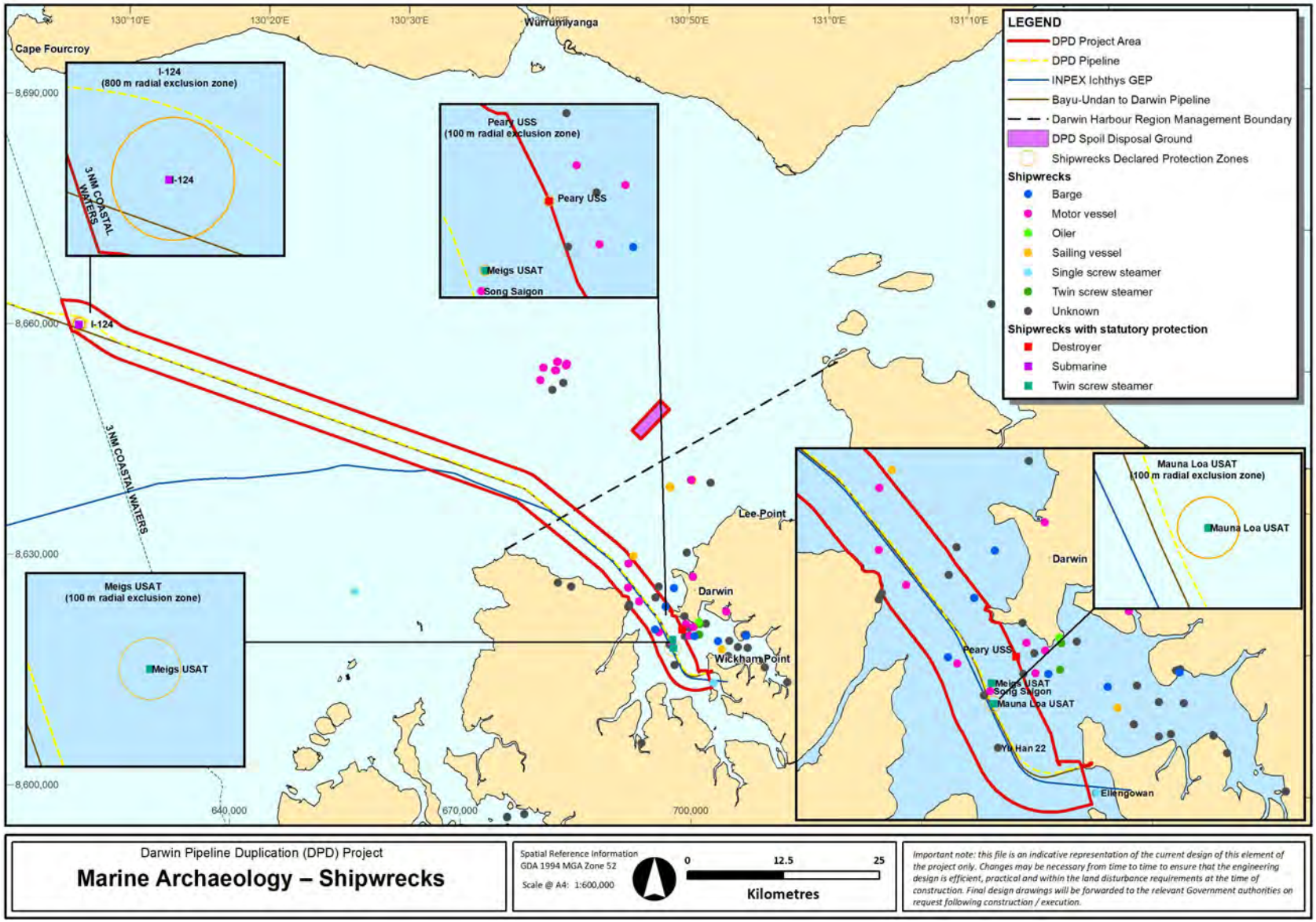


Figure 5-15: Shipwreck locations within and adjacent to Darwin Harbour

5.4 Windows of sensitivity

Timing of peak activity for threatened species and other sensitive receptors is outlined in **Table 5-16**.

Table 5-16: Windows of sensitivity in the vicinity of the Project Area

Key	
	Peak activity, presence reliable and predictable
	Lower level of abundance/activity/ presence
	Very low activity/presence
	Activity can occur throughout year
Footnotes	
[1] The 'run-off' is towards the end of the wet season and is the peak Barramundi fishing season for recreational fishers (https://northernterritory.com/things-to-do/outdoor-activities/fishing/fishing-seasons/the-run-off)	
[2] Chatto & Baker (2008)	

Receptors (critical lifecycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Seagrass												
Coral (spawning periods)												
Larger Macroalgae												
Turf Algae										Build-up season		
Mangroves (increased productivity)												
Other benthic and terrestrial habitats												
Fish/sharks and fisheries species												
Barramundi			'The Run-Off'[1]									
Goldband snapper	Spawning								Spawning			
Black jewfish							Spawning					
Grey mackerel									Spawning			
Narrow-barred Spanish mackerel										Spawning		
Marine mammals												
Dugong (breeding)	Breeding						Breeding					
Australian snubfin Dolphin	Breeding											
Australian Humpback Dolphin (previously referred to as the Indo-Pacific Humpback Dolphin)	Breeding											
Spotted Bottlenose Dolphin									Breeding			
Marine reptiles												
Hawksbill turtle (resident adult and juveniles[2])	Widespread throughout North Australian waters, highest density of adults and juveniles over hard bottom habitat (coral reef, rocky reef, pipelines, etc.)											
Flatback turtle (resident adult and juveniles[2])	Widespread throughout North Australian, increased density over soft bottom habitat 10 to 60 m deep, posthatchling age classes and juveniles spread across shelf waters											
Flatback turtle (nesting[2])												
Green turtle (resident adult and juveniles[2])	Widespread throughout North Australian, highest density associated with seagrass beds and macro algae communities, high density juveniles in shallow waters off beaches, among mangroves and in creeks											
Loggerhead turtle (resident adult and juveniles[2])	Widespread throughout the North Australian, increased density associated with soft bottom habitat supporting their bivalve food source, juveniles associated with nearshore reef habitat											
Socio-economic												
Northern Prawn Fishery												
Oil and gas												
Shipping												
Tourism/recreational												

6 Impact and risk assessment

This Offshore CEMP has employed a systematic impact and risk assessment process to the planned and unplanned events associated with the DPD Project construction and pre-commissioning activities. The impact and risk assessment process has been developed in line with Santos' Environmental Impact Identification (ENVID) process and is consistent with the requirements of the NT Environment Protection Authority (EPA) Draft Guideline for the Preparation of an Environmental Management Plan (NT EPA, 2015). The impact and risk assessment process meets Department of Mining and Energy (DME) requirements for environmental management plans (EMPs) for activities regulated under the *Energy Pipelines Act 1981 (NT)* in reducing impacts and risks to a level that is as low as reasonably practicable (ALARP) and acceptable.

6.1 Conceptual site model

A conceptual site model, as required by the NT EPA, is a written or illustrated representation of the nature, fate and transport of discharges, wastes or contaminants that allows assessment of potential and/or actual exposure of the environment to contaminants (NT EPA, 2015). The Conceptual Site Model for this Offshore CEMP is embedded within the risk assessment which details receptors and pathways, refer **Table 6-7**.

6.2 Impact and risk assessment methods

The Offshore CEMP environmental impact and risk assessment was performed consistent with the Santos' Risk Matrix Procedure (SMS-LRG-OS01-TP02) and identification of management actions was consistent with Santos' Environment Hazard Controls Procedure (SMS-EXA-OS01-PD02). An environmental aspect, for the purpose of this environmental management plan, is defined as characteristics of the construction activities that could potentially affect the environment.

6.2.1 Identification of environmental hazard

Environmental hazards for this Offshore CEMP were identified using Santos' DPD Project NT EPA Referral (BAA-201 0002; Santos, 2021), DPD Project Basis of Approval (BAS-210 0005; Santos, 2022), DPD Project SER (BAS-210 0020), and discussion by the DPD Project team and environmental specialists. Key DPD Project construction activities and associated hazards and results from key technical studies were presented during ENVID workshops to inform the impact and risk assessment process.

6.2.2 Standard controls

The standard controls identified in **Section 7** were drawn from:

- Santos' DPD Project NT EPA Referral (BAA-201 0002; Santos, 2021)
- Santos' DPD Project SER (BAS-210 0020)
- Santos' environmental plans and procedures for similar activities
- Regulator approved management plans developed by other proponents.

Additional controls were provided by ENVID workshop attendees based on their relevant experience.

6.2.3 Application of consequence, likelihood and risk

All impacts identified were assigned a consequence level following the six levels and criteria outlined in Santos' Risk Matrix Procedure (SMS-LRG-OS01-TP02).

The consequence is defined as the resulting severity of an impact following an event occurring and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at a population, ecosystem or industry level. Consequence levels for this assessment were based on credible worst-case scenarios. Categories of environmental consequences, and definitions of severity,

are outlined in **Table 6-1**. More detailed consequence criteria are provided in **Table 6-2.** Given the impact and risk assessment process described herein was also used to support the environmental impact assessment of the DPD Project under the NT EP Act, the consequence criteria in **Table 6-2** have been categorised against the five NT EPA Key Environmental Factors considered relevant to the DPD Project based on NT EPA direction and stakeholder feedback.

For unplanned events, both likelihood and consequence levels were assigned. The likelihood describes the probability that the unplanned event will occur. When determining the likelihood, proposed prevention controls were identified to reduce the likelihood of the event occurring. A detailed description of likelihood levels used is outlined in **Table 6-3**.

For unplanned events, risk rankings were then assigned using the residual likelihood and consequence levels as per the Santos Risk Matrix Procedures (SMS-LRG-OS01-TP02), using the matrix shown in **Table 6-4.**

For planned events, only a consequence level is assigned as the likelihood of the event occurring is certain. For planned events, impacts with a residual consequence level of I-Negligible or II-Minor are considered acceptable, while those with residual consequence levels of III-Moderate, IV-Major, V-Severe or VI-Critical are not acceptable and the consequence level must be reduced through application of further measures.

Table 6-1: Summary of Santos environmental consequence level descriptions

Consequence Level	Consequence Level Description
I	**Negligible** – No impact or negligible impact
II	**Minor** – Detectable but insignificant change to local population, industry or ecosystem factors
III	**Moderate** – Significant impact to local population, industry or ecosystem factors
IV	**Major** – Major long-term effect on local population, industry or ecosystem factors
V	**Severe** – Complete loss of local population, industry or ecosystem factors AND/OR extensive regional impacts with slow recovery
VI	**Critical** – Irreversible impact to regional population, industry or ecosystem factors

Table 6-2: NT EPA Key Environmental Factor Consequence Descriptors

Consequence Level		I	II	III	IV	V	VI
Acceptability		Acceptable	Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Consequence Level Description		**Negligible** No impact of negligible impact	**Minor** Detectable but insignificant change to local population, industry or ecosystem factors Localised effect	**Moderate** Significant impact to local population industry or ecosystem factors	**Major** Major long-term effect on local population industry or ecosystem factors	**Severe** Complete loss of local population industry or ecosystem factors AND/OR extensive regional impacts with slow recovery	**Critical** Irreversible impacts to regional population industry or ecosystem factors
Environmental Receptors	**Marine Ecosystems** Fauna, habitat, conservation significant areas and ecological function, processes and integrity	Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle/ vales of a protected area. No introduction of disease and no reduction in habitat area/function.	Detectable but insignificant decrease in local population size and threat to local population viability. Insignificant disruption to the breeding cycle of local population / area of occupancy of species / loss of habitat critical to survival of a species/ values of a protected area. Detectable but insignificant loss of area/function of habitat with rapid recovery within 2 years.	Moderate. Significant decrease in local population size but no threat to overall population viability. Significant behavioural disruption or disruption to the breeding cycle of local population / Significant reduction in area of occupancy of species / loss of habitat critical to survival of a species. Modify, destroy, remove or decrease availability of quality habitat to the extent that a long-term decline in local population or function of habitat is likely with recovery over medium term (2-10 years) Introduction of disease likely to cause significant population decline	Long term decrease in local population size and threat to local population viability. Major disruption to the breeding cycle of local population / area of occupancy of species / loss of habitat critical to survival of a species/ values of a protected area Fragmentation of existing population / Loss or change of habitat to the extent that a long-term decline in local population and function of habitat is likely with slow recovery over decades Introduction of disease likely to cause long term population decline	Complete loss of local population, habitat critical to survival of local population or protected area/conservation significant area Widespread (regional) decline in population size or habitat critical to regional population Extensive destruction of local habitat with no recovery or long term (decades) or widespread loss of area or function of primary producers on a regional scale	Complete loss of regional population Complete loss of habitat critical to survival of regional population
	Marine Environmental Quality Water quality, sediment quality, ecosystem health and parameters that support fishing, aquaculture, recreation, aesthetics and cultural/spiritual values	Negligible. No or negligible reduction in physical environment nor decrease in ecosystem function/health. No or negligible loss of value to socio-economic activities	Detectable but localised, short term and insignificant impact to physical environment or ecosystem function/health or value to socio-economic activities. Rapid recovery evident within ~ 2 years.	Significant wide-scale medium term impact to physical environment, decrease in ecosystem function/health or value to socio-economic activities. Recovery over medium term (2-10 years).	Wide-scale, long term impact to physical environment, long term decrease in ecosystem function/health or value to socio-economic activities. Slow recovery over decades.	Extensive impact to/destruction of physical environment with no recovery or shutdown of socio-economic activities Long term (decades) and widespread loss of ecosystem function/health on a regional scale that damages value to socio-economic activities.	Complete destruction of regional physical environment / habitat with no recovery Complete loss of area or function of primary producers on a regional scale

Consequence Level		I	II	III	IV	V	VI
	Coastal Processes Geophysical processes, primary productivity/ nutrient cycling, conservation significant areas/coastal landforms and cultural, aesthetic or recreation values	Short term changes to local geophysical/hydrological processes, widespread loss of area or function of primary producers/nutrient cycling or conservation significant areas on a regional scale	Detectable but insignificant loss or change to local geophysical/hydrological processes, area or function of primary producers/nutrient cycling or conservation significant areas with rapid recovery within 2 years.	Moderate. Significant modification, destruction, removal or change of local geophysical/hydrological processes, wide-scale loss of area or function of primary producers/nutrient cycling or conservation significant areas on a regional scale with recovery over medium term (2-10 years).	Long term loss or change of local geophysical/hydrological processes, widespread loss of area or function of primary producers/nutrient cycling or conservation significant areas on a regional scale with slow recovery over decades	Extensive destruction of local geophysical/hydrological processes, widespread loss of area or function of primary producers/nutrient cycling or conservation significant areas on a regional scale with no recovery or long term (decades)	Complete loss or change of geophysical/hydrological processes. Complete loss of area or function of primary producers/nutrient cycling or conservation significant areas on a regional scale.
	Community and Economy Includes: fisheries (commercial and recreational); tourism; oil and gas; defence; commercial shipping	No or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity.	Detectable but insignificant short-term loss of value of the local industry. Detectable but insignificant reduction in key natural features or population supporting the local activity.	Significant loss of value of the local industry. Significant medium-term reduction of key natural features or populations supporting the local activity.	Major long-term loss of value of the local industry and threat to viability. Major reduction of key natural features or populations supporting the local activity.	Shutdown of local industry or widespread major damage to regional industry. Permanent loss of key natural features or populations supporting the local industry.	Permanent shutdown of local or regional industry Permanent loss of key natural features or populations supporting the local or regional industry
	Culture and heritage Includes: Indigenous heritage and maritime heritage (i.e. shipwrecks)	No or negligible impact on the area's cultural or heritage values. No or negligible alteration, modification, obscuring or diminishing of the area's cultural or heritage values.	Detectable but insignificant impact on one or more of the area's cultural or heritage values. Detectable but insignificant alteration, modification, obscuring or diminishing of the area's cultural or heritage values.	Significant impact on one or more of the area's cultural or heritage values. Significant alteration, modification, obscuring or diminishing of the area's cultural or heritage values.	Major long-term effect on one or more of the area's cultural or heritage values. Major alteration, modification, obscuring or diminishing of the area's cultural or heritage values.	Complete loss of one or more of the area's cultural or heritage values.	Permanent loss of one or more of the area's cultural or heritage values with no recovery.

Table 6-3: Likelihood descriptions

Code	Meaning	Description
F	Almost Certain	Occurs in almost all circumstances OR could occur within days to weeks
E	Likely	Occurs in most circumstances OR could occur within weeks to months
D	Occasional	Has occurred before in Santos OR could occur within months to years
C	Possible	Has occurred before in the industry OR could occur within the next few years
B	Unlikely	Has occurred elsewhere OR could occur within decades
A	Remote	Requires exceptional circumstances and is unlikely even in the long term

Table 6-4: Santos Risk assessment matrix

		Consequence					
		I	II	II	IV	V	VI
Likelihood	F	Low	Medium	High	Very High	Very High	Very High
	E	Low	Medium	High	High	Very High	Very High
	D	Low	Low	Medium	High	High	Very High
	C	Very Low	Low	Low	Medium	High	Very High
	B	Very Low	Very Low	Low	Low	Medium	High
	A	Very Low	Very Low	Very Low	Low	Medium	Medium

6.3 Impact/risk assessment summary

A summary of the ENVID impact and risk assessment process is provided in **Table 6-7**, inclusive of a description of the planned or unplanned event, the associated construction activity, and the nature, scale and severity of the resultant impact. This output is consistent with the environmental impact assessment provided within the DPD Project SER (BAS-210 0020), provided to support the approval of the DPD Project under the NT EP Act and the DPD Project Preliminary Documentation Report (PDR) (BAS-210 0115), provided to support the approval of the Project under the EPBC Act. For each planned and unplanned event within **Table 6-7**, reference is made to the relevant environmental management strategy within **Sections 7.6** and **7.7**.

The residual consequence levels from the assessment of planned events following implementation of standard and additional (ALARP) management actions (control measures) is summarised in **Table 6-5** while the residual risk rankings from the assessment of unplanned events is provided in **Table 6-6**. During the ENVID process, some events were assigned multiple residual consequence levels or risks since multiple NT EPA Environmental Factors were assessed against. In these cases, the residual consequence level or risk of greatest severity was chosen for this summary.

Table 6-5: Summary of the residual consequence levels associated with planned events

Offshore CEMP section	Planned event	Residual consequence
7.6.1	Interactions with other marine users	II - Minor
7.6.2	Seabed and benthic habitat disturbance	II - Minor
7.6.3	Onshore ground disturbance	II – Minor
7.6.4	Noise emissions	II - Minor
7.6.5	Light emissions	II - Minor
7.6.6	Routine vessel discharges	I - Negligible
7.6.7	Pre-commissioning water extraction and discharges	II - Minor
7.6.8	Atmospheric emissions	I - Negligible
7.6.9	Contingency Pipeline Discharges	II - Minor

Table 6-6: Summary of the residual risk level associated with unplanned events

Offshore CEMP section	Unplanned event	Residual risk
7.7.1	Dropped objects	Low
7.7.2	Introduction of invasive marine species	Low
7.7.3	Unplanned marine fauna interaction	Low
7.7.4	Release of liquid hazardous material	Low
7.7.5	Release of hydrocarbon (offshore bunkering or vessel tank rupture)	Low
7.7.6	Release of dry natural gas	Very Low

Table 6-7: Summary of impact and risk assessment outcomes

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
Planned events							
Interaction with other marine users	Vessel activities including: + Surveys/ROV operations + Pre-lay works (including trenching and spoil disposal) + Pipeline installation and pre-commissioning Marine DPD Project infrastructure including: + Pipeline and supporting/stabilising structures (including rock installation) + Pipeline crossings + Cable crossings + Coastal DPD Project infrastructure and equipment required to construct it, including: + Temporary causeway/s	Impact to other marine users may occur as a result of the presence of vessels and associated exclusion zones, where applicable, in the Project Area, causing potential inconvenience. For trenching and spoil disposal activities, an expected 11 vessels will be involved, for deep water and shallow pipelay activities an expected 6 and 7 vessels, respectively, will be involved, for rock installation an expected 6 vessels will be involved and for pre-commissioning an expected 4 vessels will be involved. On an ongoing basis, subsea infrastructure may present a hazard to marine users due to the potential for snagging. The temporary physical presence of the causeway structures (approximately 200 m in length) and associated activities at the shore-crossing location may exclude other users from this intertidal/ shoreline area, although given this is within the existing disturbance footprint for the DLNG Facility, interactions are considered unlikely and impact negligible.	**Spatial** Localised around the Project vessels (and vessel exclusion zones, advised through a notice to mariners [NTM], as applicable), pipeline route and shore crossing activities including temporary causeway structures. Vessel exclusion zones are typically 500 m and will apply to Project vessels, including pipelay vessel, construction vessels and dredging vessels. **Temporal** Temporary and intermittent presence of project vessels within the Project Area within a nominal 12-month construction period. Ongoing presence of the pipeline within the Project Area once construction has been completed. Temporary presence of causeway structures.	Interactions with other marine users including potential displacement from commercial, recreation, cultural and tourism areas or alteration of routes to avoid exclusion areas. Turbidity generated from trenching activities may dissuade other users from the area while it is present. Construction and the presence of a causeway/s at the shore-crossing area may exclude other users from the area during construction.	**Community and economy** (commercial fishers, traditional fishing, tourism and recreational activities, shipping traffic and other oil and gas activities)	II-Minor	**Section 7.6.1**
Seabed and benthic habitat disturbance	Pre-lay trenching with: + Cutter suction dredge (CSD) + Trailer suction hopper dredge (TSHD) + Backhoe dredge (BHD) + Land-based excavators + Spoil Disposal at: o Spoil ground o In situ Vessel activities: + Vessel anchoring during pipelay installation (pipelay,	**Temporary and permanent infrastructure** Temporary and permanent infrastructure placement, resulting in direct disturbance to seabed, benthic habitat and cultural sites. Temporary disturbance will occur from anchoring and the presence of temporary causeway/s. Permanent disturbance will occur from placement of permanent infrastructure (pipeline, rock protect etc.). Potential change to current flows Alteration of currents within Darwin Harbour will also occur due to temporary causeway/s blocking the flow of water.	**Spatial** Localised within the Project Area to the pipeline, supporting structure footprints, trenching zones, causeway/s, spoil ground, anchoring footprints and the zones of moderate impact and zones of influence derived from sediment dispersion modelling. **Temporal** Construction activities will typically occur for days to months at a site. Temporary causeway/s is in place for the duration of construction activity.	**Temporary and permanent infrastructure** Disturbance of benthic habitat. Disturbance of the seabed from vessel anchoring or placing of infrastructure and rock could: + Disturb the seabed and result in loss of habitat + Impact infauna/ epifauna and primary producers + Increase water turbidity and sedimentation Anchoring has the potential to result in disturbance to maritime heritage	**Marine environmental quality** (water quality, physical parameters that support fishing, aquaculture, recreation and aesthetics, sediment quality). **Marine ecosystem** (potential loss of the following habitats: macroalgae, sandy sediment with filter feeders and sponges, infauna, epifauna and biota quality, benthic habitats, and primary producer habitat, including mangroves).	II-Minor	**Section 7.6.2**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
	water winning, cutter dredge, rock installation barge) + Positioning on spuds for back hoe and cutter + Installation of underwater positioning structures + Installation of marine DPD Project infrastructure including: + Pipeline installation + ILT installation (including foundations) + Pre-lay span and supporting/stabilising structures including cable crossings and post-lay span rectifications and potential use of Mass Flow Excavation (MFE) + Rock placement + Installation of coastal DPD Project infrastructure and equipment including: + Causeway/s (expected to be 132 m x 44 m)	**Trenching and spoil disposal** Spoil from trenching areas will be transported to and disposed of in the DPD spoil disposal area in offshore NT waters, which will result in permanent disturbance from smothering due to sedimentation. Spoil from trenching activities at the shore crossing in the intertidal area will be side cast to the lower intertidal area to provide a mitigation to potential acid sulphate soil risk (i.e., to keep wet under most tidal conditions). Dependent upon access by BHD this build-up of spoil will be subsequently removed (if not already dispersed) for disposal to the DPD spoil disposal area in offshore NT waters using a BHD and SHB.	Ongoing presence of the pipeline within the Project Area. Permanent presence of DPD spoil ground in offshore NT waters. Sporadically during high rainfall events due to increased levels of runoff.	and sacred sites protected under the *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) and the *Heritage Act 2011* (NT). The pipeline will create an artificial reef that could attract and support marine biota including fish which may benefit recreational fishing resources. Rock placement may result in creation of artificial reef that could attract and support marine biota including fish which may benefit recreational fishing resources. Creation of barrier to coastal processes. Potential disturbance up to 20 m x 200 m in inter-tidal area. Change to current flows. Alteration of currents due to temporary project infrastructure with potential for seabed scouring/coastal erosion. **Mass Flow Excavation (MFE)** The MFE tool will generate localised turbidity at the seabed during the excavation process. At the locations identified for MFE use, the sediment characteristics, as identified by DPD Project sediment sampling (RPS, 2023a), indicate a high proportion of sand/gravel (70 – 90 %) and a smaller proportion of fine sediments (silt/clay) (10 – 30 %). Given the method, the area of operation and the type of sediments observed at the excavation sites, turbidity created by the MFE tool is predicted to be localised and temporary only. The lower fine sediment content will also help mitigate large plume generation and limit turbidity. **Trenching and spoil disposal.**	**Coastal processes** (bathymetry and seabed features). **Community and economy** (impacts to demersal fish habitats) **Culture and heritage** (heritage areas, shipwrecks, maritime archaeology, sacred sites and First Nations spiritual connections with sea country).		

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
				Increase in sedimentation and reduction in water quality from: + Trenching activities + Disposal of spoil + Additional run off created by onshore land and vegetation clearing and onshore site pad. Direct and indirect impact to benthic habitats, including removal and smothering of benthic habitats. Reduction in available food for marine species utilising the area. Potential to impact fish health and other fauna. Evaluation of trenching and spoil disposal impact are provided in detail within the TSDMMP (BAS-210 0023). **Potential risk of coastal erosion.** If heavy rainfall is received, water may need to be pumped from the trench to adjacent land area. If stormwater runoff enters Darwin Harbour, coastal water quality may be impacted. **Acid Sulfate Soils (ASS)** Trenching nearshore in mangrove muds may result in ASS leaching and reduction in health of intertidal marine animals. If trenching reaches groundwater, there is potential for acid release and metal leaching into the groundwater from oxidised ASS.			
Onshore ground disturbance	Onshore construction (above HAT) including: + trench/excavation + temporary storage of fill to be stockpiled in the disturbance footprint for use as backfill + disposal of excess fill	Clearing of regrown native grasses and weeds in a previously disturbed area will be required prior to excavating a trench for onshore pipeline section. Excavated soil will be temporarily stockpiled within the onshore Project Area to be used as fill or disposed of if in excess. Preparation of the DPD site pad, including vegetation clearing.	**Spatial** Localised within the Project Area. **Temporal** Temporary duration when the section of trench will be open. The trench will be backfilled at the conclusion of pre-commissioning works.	Excavating the trench may result in: + minimal clearing of the ground/vegetation + digging soil and placing it adjacent for later re-use + additional fill of specific parameters to be brought to site if engineered backfill required. This may require	**Marine environmental quality** (coastal water quality). **Marine ecosystem** (marine fauna). **Terrestrial impacts** (sediment quality, vegetation and terrestrial fauna) . **Air quality**	II – Minor	**Section 7.6.3**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
	+ site clearing for onshore activities including pull winches and site buildings + Placement of geotextile and hardstand + Access road		The clearing of any vegetation currently present onsite will be permanent.	disposal of excess 'original' soil – may need to be tested/treated prior to disposal + potential risk from erosion + spread of weeds If heavy rainfall is received, water may need to be pumped from the trench to adjacent land area. If stormwater runoff enters Darwin Harbour, coastal water quality may be impacted. If trenching reaches groundwater, there is potential for acid release and metal leaching into the groundwater from oxidised ASS.			
Noise emissions	Pre-lay works including: + CSD + TSHD BHD for excavating with potential used of hydraulic tools (Xcentric Ripper, hydraulic hammer) for fracturing rock + MFE Construction of two temporary causeways either side of the trench at the shore crossing. Pipelay by nearshore pipelay barge in shallower waters including Darwin Harbour. Pipelay by dynamic positioning (DP) deep water vessel in deeper waters outside of Darwin Harbour. Operation of onshore plant and equipment within Project Area at DLNG facility. Support operations including: + General vessel operations during all DPD Project activities + Vessel survey and subsea positioning equipment e.g.	Vessel noise is considered non-impulsive (continuous) and broadband and includes vessel thrusters, engines and propellers, as well as noise emitted onboard which is converted to underwater noise through the hull. The main source of vessel noise will be from propellers or dynamic positioning (DP) thrusters (deeper water pipelay only). Project vessels (excluding trenching vessels) may emit noise up to ~180 dB re 1 µPa at 1 m. Typical survey equipment (MBES and SSS) may emit noise at intensities as follows: + MBES – for example Reson SeaBat 7125 transmitting at 400 kHz. At 400 kHz, it has a 1° beamwidth along the track, and a source level of 220 dB re 1 µPa (Coastal Frontiers, 2017) + SSS is generally considered a high acoustic density source and medium frequency generator. The frequency ranges from 75 to 900 kHz (Jiménez-Arranz et al., 2017). The sound pressure level ranges from 200–235 dB re 1µPa SPL. Trenching will be completed using different trenching vessels, including a	**Spatial** For TSHD, CSD and BHD trenching and Xcentric Ripper tool use, permanent threshold shift (PTS) SEL24 hour ranges for dolphins, dugongs and turtles modelled at <50 m. Equivalent threshold range for hydraulic hammer modelled at 100- 160 m. For TSHD, CSD and BHD trenching and Xcentric Ripper tool use, temporary threshold shift (TTS) SEL24 hour ranges for dolphins, dugongs and turtles modelled at 40-350 m. Equivalent threshold range for hydraulic hammer modelled at 950- 2,500 m. The PTS and TTS ranges were shown to decrease with reduced hammering time (per 24 hours) for the hydraulic hammer. For behavioural response thresholds, ranges for marine mammals (dolphins and dugongs) varied from 100s of metres to 10s of kilometres for scenarios modelled at MSL. Spatial scales for other activities are as follows: Localised: A support vessel using main engines and bow thrusters to maintain position will become inaudible above	Project activities including trenching, pipelay, additional vessel operations and will add to the existing underwater noise profile inside and outside Darwin Harbour during construction. The use of sound in the underwater environment is important for marine animals, particularly cetaceans, to navigate, communicate and forage effectively, along with reptiles, sharks/rays and other fish, for a range of functions such as social interaction, foraging and orientation. Underwater noise could result in: **Acoustic masking**: + Disruption to underwater acoustic cues + Masking of vocalisations and signals from predators and prey **Behavioural response:** + Modification of fauna behaviour (avoidance, attraction and disruption of normal behaviour) + Disturbance, leading to behavioural changes or displacement from areas	**Marine ecosystem** (marine mammals particularly cetaceans, marine reptiles, sharks, rays, pelagic and demersal fish, seabirds, shorebirds and invertebrates). **Marine environmental quality** (impact to parameters that support fishing, aquaculture, recreation, aesthetics and cultural/ spiritual values).	II-Minor	**Section 7.6.4**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
	Multibeam Sonar (MBES), Sidescan Sonar (SSS), Long Baseline (LBL) /Ultra Short Baseline (USBL) arrays) + Helicopter operations	BHD, a TSHD and a CSD. Noise includes operation of vessel engines for propulsion (as applicable), onboard equipment, pumps and interaction of trenching equipment with the seabed. The following source levels are considered representative of trenching vessel non-impulsive noise: + TSHD: 184 dB re 1µPa @1m + CSD: 182 dB re 1µPa @1m + BHD: 175 dB re 1µPa @1m BHD rock breaking tools will be either non-impulsive from Xcentric Ripper tool or impulsive from hydraulic hammer (contingency only). Representative source levels are: + Xcentric Ripper: 184.8 dB re 1 µPa2 s m^2 + Hydraulic hammer: 192 dB 1 µPa2s m^2	background noise within thousands of metres. Localised: A conservative estimate is that survey equipment (MBES/SSS) will be inaudible within thousands of metres, depending on the activity characteristics. Localised: Helicopter noise will be highly localised and most of the noise will not transfer into the water. **Temporal** Vessel noise for the duration of the construction activity (indicatively 12 months), with intermittent survey equipment and helicopter noise. Trenching vessel noise expected over indicative period of 2-3 months.	+ Indirectly by inducing behavioural and physiological changes in predator or prey species. **Physiological impacts:** + Increased stress levels + Physical injury to fauna from exposure to excessive noise (barotrauma, hearing loss including TTS and PTS Onshore construction activities are not expected to have an impact as they will not occur in water.			
Light emissions	Construction activities undertaken at night: + Surveys/ROV operations + Pre-lay works (including trenching and spoil disposal) + Pipeline installation and pre-commissioning + Lighting of Project Area at shore crossing	Potential impacts from light emissions may occur in the Project Area from: Operational, safety and navigational lighting on the vessels including: + Pipelay vessel + CSD, TSHD and BHD + Construction vessel/survey vessel + Anchor handler (e.g. Multicat) + Platform supply vessel (PSV) + SHB Spot lighting that may also be used as needed, such as equipment deployment and retrieval. Task and security lighting at the shore crossing. Lighting will typically consist of bright white (i.e., metal halide, halogen, fluorescent) lights typical of lighting used in the offshore petroleum industry and not dissimilar to lighting used by other	**Spatial** Localised: Limited light 'spill' or 'glow' on surface waters surrounding a vessel. Light spill modelling conducted for an offshore pipelay vessel and an offshore construction vessel, considered 'worst-case' in terms of vessel lighting for the DPD Project, indicates that vessel light spill intensity is around 10 times that of a full moon at 150-200 m from these vessels (either individually or side by side) and drops to the intensity of a full moon at 500-1000 m (Pendoley Environmental, 2022b). At a distance of 2.5-4.5 km, light spill was modelled to have dropped to 0.1 (10%) of a full moon. At this level, lighting is considered unlikely to have any impacts on marine turtle hatchlings (which are considered particularly sensitive to lighting impacts) (Pendoley Environmental, 2022b). **Temporal** Navigational and task lighting is required 24 hours a day for the duration of the	Change in fauna behaviour due to light emissions from vessels including: + Disrupting nesting turtles + Disorientating hatchlings + Hatchlings getting caught in vessel light pools with increased predation + Attract seabirds and shorebirds	**Marine ecosystem** (marine mammals, Marine reptiles, Pelagic and Demersal fish, Sharks, Rays, Seabirds and Shorebirds). **Marine environmental quality** (impact to parameters that support fishing, aquaculture, recreation, aesthetics and cultural/ spiritual values). **Community and economy** (fisheries and tourism).	II-Minor	**Section 7.6.5**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		vessels in the Project Area, including shipping and fishing vessels.	construction activities (indicatively 12 months) in the marine environment. When onshore it is expected that night works will be undertaken as required.				
Routine vessel discharges	All vessel activities	Only those discharges allowable under maritime regulations will be permitted as would apply to other commercial vessel using Darwin Harbour and NT waters. Planned discharges from vessels to the marine environment include: Deck drainage/run off including residual chemicals. Deck drainage from rainfall or wash-down operations would discharge to the marine environment. Deck drainage would contain particulate matter and residual chemicals such as cleaning chemicals, oil and grease. Treated sewage effluent and grey water. The volume of sewage waste is directly proportional to the number of persons on-board the vessels. Depending on waste production rates and the specifications of sewage systems available, the total volume of this sewage and greywater generated typically ranges between 0.03 and 0.04 m^3 per day per person. Treated sewage/greywater will be disposed in accordance with Marine Order 96 and MARPOL Annex V, as enacted by the *Prevention of the Sea (prevention of pollution from ships) Act 1983* (Cth). Cooling water. Seawater is used as a heat exchange medium for cooling machinery engines. Cooling water temperatures vary, depending on the vessel's engines' workload and activity. Bilge water. MARPOL Annex I as enacted by the *Prevention of the Sea (prevention of pollution from ships) Act 1983* (Cth) and	**Spatial** Localised: The small volumes of non-hazardous discharges may cause localised nutrient enrichment, organic and particulate loading, toxic impacts to marine fauna, thermal impacts and increased salinity in waters around discharge points and in the direction of the prevailing current. Discharges will likely be contained within the Project Area and are predicted to be localised on a scale of metres to 10s of metres in the upper 5 m of the water column. **Temporal** Intermittent and Short-term: During the period of the vessel activities (weeks to months), localised impacts to water quality will occur.	The small volumes discharged may cause localised nutrient enrichment, organic and particulate loading, toxic impacts to marine fauna, thermal impacts and increased salinity.	Marine environmental quality (water quality) **Marine Ecosystem** (ecosystem health). **Coastal processes** (primary productivity/nutrient cycling). **Community and economy** (fisheries commercial and recreational) and tourism).	I-Negligible	**Section 7.6.6**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		the *Marine Pollution Act 1999* (NT)) allow for discharges in some areas where the discharge of oily water is filtered to a concentration of up to 15 ppm through an approved oily water filter system. Brine (if a reverse osmosis unit is used for water treatment). If a reverse osmosis unit is used for water treatment, waste brine generated will be discharged to the ocean at a salinity of approximately 10% higher than seawater. The volume of the discharge depends on the requirement for fresh (or potable) water and demand based on the number of people on-board. Ballast water Ballast water could potentially be discharged to the marine environment from vessel ballast tanks. The risk of Invasive Marine Species (IMS) introduction from ballast waters is covered below under 'Introduction of IMS'. Grout. Post-filled grout bags may be used for span rectification. Empty grout bags are filled from the surface using a liquid slurry of grout through a downline. These are flushed after each operation releasing up to ~1.2 m^3 of grout per line. Grout is composed of cement, sand and water and is on the OSPAR PLONOR list.					
Pre-commissioning water extraction and discharges	Water winning and filter flushing for pipeline pre-commissioning.	Water winning from Darwin harbour is required to provide water for filling pipeline with treated seawater for FCGT activities. Water is required to be filtered to remove particulates prior to being treated with chemical and pumped into pipeline. The filtering equipment will be required to be backwashed back into Darwin Harbour to clean the filter. The backwashed water will have a higher	**Spatial** Localised: Backflush water will be discharged onto existing disturbed shore crossing construction site to drain into the intertidal area. Backflush water will also potentially be discharged onto the installed rock causeway to baffle the flow of the discharged backflush water. **Temporal**	The small volumes discharged may cause localised nutrient enrichment, organic and particulate loading, toxic impacts to marine fauna, thermal impacts and increased salinity. Injury or mortality of marine fauna entrained in water extraction.	**Marine environmental quality** (water quality). **Marine Ecosystem** (ecosystem health). **Coastal processes** (primary productivity/nutrient cycling). **Community and economy** (fisheries (commercial and recreational) and tourism).	II - Minor	**Section 7.6.7**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		particulate concentration than ambient water conditions and will cause increased turbidity at the discharge point. Total backflush volume is expected to be approximately 300 m^3 over 3 days. TSS concentration of backflush water waster will be approximately 1,500 mg/L in the wet season and 680 mg/L in the dry season. Entrainment of marine fauna during water extraction process.	Intermittent and Short-term: During the period of the water winning for pre-commissioning (three days).				
Atmospheric emissions	Atmospheric emissions from combustion engines associated with vessels, helicopters, equipment and vehicles impacting on air quality and adding to GHGs in the atmosphere.	Operation of vessel engines, helicopters, generators, mobile and fixed plant and equipment. These emissions will include GHG emissions, such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and non-GHG emissions, such as sulphur oxides (SO_X) and nitrogen oxides (NO_X) Operation of incinerators on vessels Although the vessels may use ozone-depleting substances (ODS), this will be in a closed rechargeable refrigeration system and there is no plan to release ODS to the atmosphere.	**Spatial** Localised: The quantities of gaseous emissions are relatively small and will, under normal circumstances, quickly dissipate into the surrounding atmosphere. **Temporal** For the duration of the construction activities.	Atmospheric emissions from activity vessels can result in deterioration of local air quality. Emissions of GHG can cause an incremental increase in global GHG concentrations. Given the nature and scale of DPD Project construction activities (low frequency and relatively short duration), both risks are considered to have a negligible impact on air quality.	**Marine environmental quality** (Local air quality). **Community and economy** (tourism).	I-Negligible	**Section 7.6.8**
Contingency pipeline discharges	Discharge of treated seawater in the event of pipeline remedial work during construction such as responding to a wet buckle event or stuck pig that requires flushing, filling and dewatering using treated seawater. (Note – the wet buckle event is an unplanned event but in response to a wet buckle or stuck pig, there will be the planned response).	Contingency flushing and dewatering of treated seawater to the marine environment. During installation and pre-commissioning, in the event of a wet buckle or stuck pig, contingency flushing, filling and dewatering may be required in order to displace raw seawater from the pipeline that would otherwise lead to corrosion. Treated seawater discharge was modelled at three location in NT waters and at the boundary of NT and Commonwealth waters (KP23)–: KP23 - 43,332.5 m^3 dewatering KP84 – 600 m^3 overflow + 19,958.3 m^3 dewatering KP102 – 600 m^3 overflow + 10,623.3 m^3 dewatering and	**Spatial** Localised reduction in water quality in proximity to the discharge areas was predicted (BAS-210 0035; RPS, 2022a, 2024). Modelling discharge at the boundary between NT and Commonwealth waters (RPS, 2024) indicated the maximum distances from the KP23 release location to reach the PC99% of 0.06 ppm were 8.68 km for the 50^{th} percentile and 14.68 km for the 95^{th} percentile concentrations. The maximum distances to achieve the LC50 of 1 ppm reduced to 0.06 km for the 50^{th} percentile and 0.11 km for the 95^{th} percentile concentrations. There was no exposure predicted to nearby shoals.	Contamination/toxic effects to marine fauna. Potential impacts to fish and fisheries (commercial and recreational). Treated seawater discharge modelling does not identify any areas where dosage of biocide (time and concentration) will exceed the No Observable Effect Concentration (NOEC) and 99% species protection level (PC99%), i.e., 48 – 96 hour dosage of 0.06 – 0.1 mg/L).	**Marine environmental quality** (water quality, sediment quality and physical parameters that support fishing, aquaculture, recreation and aesthetics). **Marine ecosystem** (infauna, epifauna and biota quality, marine mammals, marine reptiles, pelagic and demersal fish and sharks and rays). **Community and economy** (physical parameters that support fishing and pelagic and demersal fish).	II-Minor	**Section 7.6.9**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		KP114 – 600 m^3 overflow + 4,399.9 m^3 dewatering.	For discharges in NT waters (RPS 2022a), the discharge at KP84 resulted in a preservation chemical plume that was generally continuous up to ~1.4 km from the release location, with small, isolated patches predicted up to 9.61 km. Isolated patches beyond 2 km were predicted to occur during 2 of the 25 simulations and the plume was predicted to travel a maximum distance of 9.61 km in only one simulation. The isolated patches were due to an accumulation of the treated seawater, which had occurred during a current reversal, causing it to concentrate. The potential areas of exposure based on the PC99%, PC95% and PC90% thresholds 0.40 km^2, 0.17 km^2 and 0.08 km^2, respectively. The discharge at KP102 resulted in isolated patches of the preservation chemical up to 6.78 km from the release location due to the plume drifting into the shallow intertidal areas, reducing the potential for mixing and dilution. The modelling also predicted a continuous area of exposure up to ~4 km west offset from the release location due to the plume migrating into the shallower waters, mixing less, resulting in the concentration accumulating. The area of exposure for the PC99% threshold was 4.14 km^2. The discharge at KP114, resulted in a maximum distance from the release location of 2.40 km and an area of exposure based on the PC99% threshold of 1.45 km^2. The preservation chemical concentrations did not trigger any other threshold over a 12-hour continuous duration. **Temporal** Temporary reduction in water quality in proximity to the discharge areas as treated seawater discharge modelling found (BAS-210 0035; RPS, 2024; 2022a):				

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
			The release duration for pipeline overfilling or overflow has been estimated to be 38 minutes at the three modelled locations. The release duration for dewatering activities varied due to the length of the pipeline at the given locations (KP23>69.9 hours, KP84 >21.4 hours, KP102 >11.4 hours and KP114 >4.7 hours).				
Unplanned events							
Dropped objects	Vessel activities including: + Surveys/ROV operations + Pre-lay works + Pipeline installation and pre-commissioning, e.g., post-lay span rectification	Solid objects such as those listed below can be accidentally released to the marine environment. Non-hazardous solid wastes, such as paper, plastics and packaging, personal protective equipment, small tools and unsecured deck equipment. Hazardous solid wastes, such as batteries, fluorescent tubes, medical wastes, and aerosol cans. Equipment and materials, such as hard hats, tools or infrastructure (e.g., pipe joints, mattresses, frames) dropped could result from: Loss of control of suspended loads (e.g., concrete mattresses for pipeline stabilisation) may also be accidentally dropped through operator error or mechanical failure. Loss of equipment and waste off vessel deck. Larger objects, such as A-frames and sea containers, are secured to the vessel deck and cannot credibly be lost overboard. Dropped objects resulting in damage to the Bayu-Undan to Darwin pipeline and subsequent dry natural gas release is covered specifically as a separate unplanned event below.	**Spatial** The event will only occur within the Project Area, and all non-buoyant waste material or dropped objects are expected to remain within the Project Area. Buoyant objects could potentially move beyond the Project Area. **Temporal** An unplanned release of solids may occur during construction activities. Water contamination from hazardous objects could cause prolonged or permanent reduction in water quality.	If an object is dropped overboard, potential impacts would be limited to minor and localised disturbance of the seabed and benthic habitats near the dropped object. Benthic habitat loss. Potential damage to communication cables in Darwin Harbour. Potential damage to cultural heritage objects and sites. Potential reduction in water quality from water contamination, cause by objects such as batteries.	**Marine environmental quality** (water quality and sediment quality). **Marine ecosystem** (benthic habitats, infauna and epifauna and protected areas [Charles Point Wide RFPA]) **Community and economy** (oil and gas operations, other users, e.g., fisheries, tourism and recreational fishers and other industries e.g. telecommunications).	Low	**Section 7.7.1**
Introduction of IMS	Vessels mobilised from other countries or from outside of the Project area/Darwin Harbour	Introduction of IMS may occur due to:	**Spatial** Localised (seabed and water column within the Project Area) to widespread if successfully translocated to new areas via	Potential establishment of IMS in the marine environment as a result of the project requires IMS to:	**Marine environmental quality** (ecosystem health). **Marine ecosystem** (benthic habitats, benthic communities	Low	**Section 7.7.2**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		+ Biofouling on vessels and external/internal niches (such as sea chests, seawater systems) + Biofouling on equipment that is routinely submerged in water (such as survey equipment) + Discharge of high-risk ballast water + Cross-contamination between vessels + Once established, IMS have the potential to out-compete indigenous species and affect overall native ecosystem function.	ocean currents or project equipment transit. **Temporal** Temporary to long-term (in the event of successful translocation).	+ Be present on a vector (biofouling on activity vessels and ballast water are considered credible vectors) + Be released from the vector + Establish in the receiving environment If established, impact could include localised (seabed and water column near the Project Area) to widespread impacts, if IMS successfully establish to new areas. IMS could displace and outcompete local species.	and ecological function and processes) **Coastal processes** (ecological processes). **Community and economy** (other users e.g., commercial and recreational users and ports and shipping).		
Unplanned marine fauna interactions	Vessel activities including: + Surveys/ROV operations + Pre-lay works (including trenching and spoil disposal using dredging vessels – CSD, TSHD and BHD) + Pipeline installation and pre-commissioning	There is the potential for vessels or equipment (for example, TSHD, CSD, and ROV) involved in construction activities to interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality.	**Spatial** Within the Project Area, in the immediate vicinity of the vessels or subsea equipment. **Temporal** During all construction activity (indicative 12-month period).	Collisions may result in behavioural impacts, physical injury to, or the death of the fauna involved.	**Marine ecosystem** (marine fauna – marine mammals, reptiles, fish and sharks).	Low	**Section 7.7.3**
Release of liquid hazardous material (excluding diesel release from bunkering and vessel tank rupture which is presented below)	Vessel activities including: + Surveys/ROV operations + Pre-lay works (including trenching and spoil disposal using dredging vessels – CSD, TSHD and BHD) + Pipeline installation and pre-commissioning	Hazardous liquids used on the DPD Project include fuels and oils for equipment and machinery and other task-specific chemicals required for construction activities. Causes for accidental hazardous liquid releases include: ROV failure (including oil seal, hydraulic system hose and quick-disconnect system failures) (approximately 0.05 m^3 (50 L)) Stern tube oil (non-hydrocarbon-based lube oil) from the vessel thruster/propeller stern tube (approximately less than 1 m^3) Loss of primary containment (drums, tanks, intermediate bulk containers {IBCs}) due to handling, storage and dropped objects (such as swinging load during lifting activities)	**Spatial** Volumes are likely to be small and limited to the volume of individual containers (such as IBCs, 44 gallon drums) stored on the deck of supply vessels or tank/hose sizes within equipment/machinery. A worst-case credible spill for this scenario is considered to be the loss of an intermediate bulk container (1 m^3). Spills to the marine environment of this size will disperse rapidly. Concentrations above toxic or harmful thresholds are expected to occur at short distances from the release point, and should a spill occur, potential impacts beyond the Project Area are not expected in the event of a worst-case spill. **Temporal**	Decreases in water and sediment quality. The potential impacts to water and sediment quality are expected to be localised and temporary given the volumes of hazardous materials that may credibly be lost overboard. Impacts to fauna may result in injury or mortality through contact and/or ingestion; however, while this would reasonably be expected to impact upon individual animals; no population-scale impacts would credibly occur.	**Marine environmental quality** (water quality and sediment quality). **Marine ecosystem** (marine fauna – marine mammals, reptiles, fish, sharks, seabirds and shorebirds).	Low	**Section 7.7.4**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
		Vessel pipework failure or rupture, hydraulic hose failure and inadequate bunding Spills or leaking machinery accidentally discharged overboard in deck drainage water Overflow of the open and closed drainage systems Oily water from vessels includes bilge water and deck drainage water.	Potentially toxic or harmful threshold concentrations will be limited to a very short period following a release, as a spill is expected to disperse rapidly.				
Release of hydrocarbon (offshore bunkering or vessel tank rupture)	Vessel activities including: + Surveys/ROV operations + Pre-lay works (including trenching and spoil disposal using dredging vessels – CSD, TSHD and BHD) + Pipeline installation, rock installation and pre-commissioning, e.g. Post-lay span rectification + Vessel bunkering	A minor spill (of up to ~10 m^3) of MGO or MDO could occur during vessel-to-vessel refuelling. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling. It is considered credible that a release of diesel to the marine environment could occur from a vessel fuel tank rupture. For the purpose of risk assessment, a worst-case discharge of up to 700 m^3 of MDO or MGO is considered credible from the offshore pipelay vessel and rock installation vessel of up to 635 m^3 and a spill of up to 300 m^3 is considered credible for other project vessels in Darwin Harbour excluding the rock installation vessel (e.g., the nearshore pipelay barge, dredging vessels).	**Spatial** MDO spill trajectory modelling of a vessels fuel tank release at the NT/Commonwealth waters boundary with a volume of 700 m^3 (PTS location, RPS 2021a). This scenario formed the basis of defining the spatial extent of the EMBA for this Offshore CEMP and extends as follows (using the lowest threshold of 1-10 g/m^2 for shoreline contact, 0.5-10 g/m^2 for surface oil, and 10 ppb for entrained and dissolved hydrocarbons): + Shoreline contact could occur between Minjilang and Daly on the mainland and on Dorcherty, Field, Peron, Vernon and Bathurst, Mogogout, Greenhill, Morse, Burford and Melville islands + Surface oil could extend up to 86 km west of the release point + The entrained fraction could extend up to 304 km west southwest from the release point and + The dissolved fraction could extend 111 km south southwest from the release point. MDO spill trajectory modelling (BAS-210 0030; RPS, 2023b) at KP91.5 (just outside Darwin Harbour) indicated that there was some probability of a 700 m^3 marine diesel oil (MDO) spill, extending as follows (using the moderate exposure thresholds):	A release to the marine environment, would be likely to rapidly disperse and evaporate but could lead to a reduction in: + Water quality + Sediment quality + Ecosystem health and impact to parameters supporting commercial and recreational uses + Behavioural/physiological impact to marine fauna (particularly those associated with the surface such as cetaceans and marine turtles) and plankton within the upper water column and/or associated with shallow waters and shorelines + Impact to other users due to spill response activities + Impacts to benthic habitats, including intertidal habitats and primary producers + Impact to culture and heritage areas.	**Marine environmental quality** (water quality, physical parameters that support socio-economic activities). **Marine ecosystem** (marine fauna, benthic habitats, intertidal habitats, protected areas [Charles Point Wide RFPA]). **Coastal processes** (primary productivity e.g., mangroves). **Community and economy** (community and economy e.g., commercial and recreational users). **Culture and heritage** (impacts to sacred sites or important cultural heritage significance).	Low	**Section 7.7.5**

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
			+ Shoreline loading was predicted to occur along the Cox-Finniss region, outside the Harbour to the west and within the West Arm in the dry season and along the Cox-Finniss region, outside the Harbour to the East and west and within the East Arm in the wet season. + Surface oil was predicted to occur within approximately 19.9 km (Dry season) and 19.3 (Wet season) of the release location. + Total submerged oil was predicted to occur within approximately 36.9 km (Dry season) and 51.3 km (Wet season) of the release location + Dissolved hydrocarbons were predicted to occur with approximately 10 km (Dry season) and 13.7 km (Wet season) of the release location. MDO spill trajectory modelling for vessel fuel tank rupture (BAS-210 0030; RPS, 2023b) at KP114 (in the middle of Darwin Harbour) indicated that there was some probability of a 300 m^3 MDO spill respectively, extending as follows (using the moderate exposure thresholds): + Shoreline loading was predicted to occur within the East Arm, Middle Arm, West Arm of the Harbour and at Wickham Point in both wet and dry seasons. During the wet season shoreline loading is also expected outside the harbour to the east and west + Surface oil was predicted to occur within approximately 19.6 km (Dry season) and 18.9 km (Wet season) of the release location + Total submerged oil was predicted to occur within approximately 30.3 km (Dry season) and 32.4 km (Wet season) of the release location				

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
			+ Dissolved hydrocarbons were predicted to occur with approximately 0.6 km (Dry season) and 7.3 km (Wet season) of the release location + The extent of shoreline loading, and distance travelled of MDO from smaller spills of 87.5 m^3 and 10 m^3 modelled at KP114 will be lower than that described for the 300 m^3 scenario. **Temporal** MDO spill trajectory modelling at KP91.5 for 700 m^3 indicated that within a 50-day simulation: + 85% of spilled oil will have evaporated into the atmosphere + 5% of spilled oil will remain on the shoreline + 8% of spilled oil will have decayed by the end of the simulation + No spilled oil will remain on the water's surface + MDO spill trajectory modelling at KP114 for 87.5 m^3 indicated that within a 20-day simulation: + 85% of spilled oil will have evaporated into the atmosphere + 12% of spilled oil will remain on the shoreline + 2% of spilled oil will have decayed by the end of the simulation + No spilled oil will remain on the water's surface. MDO spill trajectory modelling at KP114 for 10 m^3 indicated that within a 10-day simulation: + 80% of spilled oil will have evaporated into the atmosphere + 20% of spilled oil will remain on the shoreline. MDO spill trajectory modelling at KP114 for 300 m3 indicated that within a 30-day simulation:				

Aspect	Activity	Description of hazard	Spatial and temporal scale	Impact	Sensitive receptors (NT EPA Factors)	Residual consequence level (planned events)/ risk ranking (unplanned event)	Management strategy
			+ 71% of spilled oil will have evaporated into the atmosphere + 25% of spilled oil will remain on the shoreline + 3% of spilled oil will have decayed by the end of the simulation + No spilled oil will remain on the water's surface.				
Release of dry natural gas	During DPD Project construction – dropped object damages the existing Bayu-Undan to Darwin GEP.	A Bayu-Undan pipeline leak would result in a release of dry gas to the environment. Damage to the Bayu-Undan pipeline during construction activities could occur due to anchor impact/drag or objects being dropped from vessels.	**Spatial** The scale of a pipeline leak is dependent on the nature of the damage. Small 'pinhole' leaks will result in a stream of bubbles which may dissolve before reaching the surface. A major rupture (e.g., catastrophic failure) would result in the discharge of a large volume of dry gas forming a large plume in the water column and dispersing into the atmosphere. A catastrophic failure is considered to be the worst-case credible release from the pipeline. **Temporal** The worst case discharge could occur during construction.	The gas cloud may result in impacts to air-breathing fauna, such as marine mammals, marine reptiles and birds. Animals breathing in the immediate vicinity of the release may be asphyxiated, potentially resulting in mortality. Given the dispersion of gas into the atmosphere, this potential effect would be highly localised to the release location. The gas cloud poses a risk to the health and safety of other users, such as fishers (traditional and commercial), tourism and recreational users. A gas cloud could potentially form an explosive mix which, if ignited, result in injury/death and damage to property. However, all other marine users will be excluded from the exclusion zone and therefore will not be within 500 m of an event, if it occurs.	**Marine environmental quality** (water quality, ecosystem health and physical parameters that support socio-economic activities). **Marine ecosystem** (marine fauna and protected areas [Charles Point Wide RFPA]). **Community and economy** (other users e.g., commercial and recreational activities). **Culture and heritage**	Very Low	**Section 7.7.6**

6.4 Evaluation of ALARP and acceptability

For planned and unplanned events, an ALARP assessment was undertaken as part of the ENVID to determine if the standard measures adopted reduced the impact (consequence level) or risk to ALARP. This process relies on demonstrating that further potential control measures to avoid or mitigate impacts/risks would require a disproportionate level of cost/effort to reduce the level of impact or risk. If this cannot be demonstrated, then the further proposed measures are adopted. The level of detail included within the ALARP assessment is commensurate to the nature and scale of the potential impact or risk. A summary of the ENVID ALARP assessment for each planned and unplanned event, including the additional measures considered, is provided at the end of each the environmental management strategies contained in **Sections 7.6** and **7.7**.

Additional to the ALARP assessment, Santos also assesses the acceptability of an impacts and risk associated with planned and unplanned events, respectively, based on a number of criteria.

Santos considers that the residual impact or risk is acceptable if the following criteria, where relevant, are satisfied:

- The consequence of a planned event is ranked as I or II; or the risk from an unplanned event is ranked Very Low to Medium;
- Sufficient information or studies have been considered to validate the consequence assessment;
- ESD principles have been assessed; and
- The acceptable levels of impact and risks have been informed by relevant species recovery plans, threat abatement plans and conservation advice.
- The environmental performance objectives (outcomes), management actions (control measures) and associated performance standards and measurement criteria:
    - are consistent with legal and regulatory requirements;
    - are consistent with Santos' Environment, Health and Safety Policy (**Attachment 1**);
    - are consistent with industry standards;
    - take into consideration relevant person feedback; and
    - have been demonstrated to reduce the impact or risk to ALARP.

The outcomes of the acceptability assessment for all planned and unplanned events are presented in **Table 6-8** and **Table 6-9**, respectively.

Table 6-8: Acceptability Evaluation Planned Impacts

	Interaction with other marine users	Seabed and benthic habitat disturbance	Onshore ground disturbance	Noise emissions	Light Emissions	Routine vessel discharge	Pre-commissioning water extraction and discharges	Atmospheric emissions	Contingency Pipeline Discharges
Is the consequence ranked as I or II?	✓- II	✓- II	✓- II	✓- II	✓- II	✓- I	✓- II	✓- I	✓- II
Is further information required to validate the consequence assessment?	X	✓- A benthic habitat assessment has been undertaken along the pipeline route and is considered sufficient to inform the consequence assessment. As per the Trenching and Spoil Disposal Monitoring and Management Plan (TSDMMP) Santos will be undertaking further post-trenching benthic habitat studies to validate consequence assessment and confirm no material harm to benthic communities beyond the zone of impact as per condition 5-1(2) of Environmental Approval EP2022/022-001	X	X – underwater noise modelling has been undertaken and is considered adequate for information consequence assessment.	X – a light emission study and light spill modelling has been undertaken and is considered adequate for information consequence assessment.	X	X	X	✓- Contingency treated seawater discharge modelling has been undertaken. If a contingency dewatering discharge of treated seawater is required, Santos will be undertaking water sampling to validate modelling and confirm dilution and dispersion has occurred consistent with condition 7.2 of Environmental Approval EP2022/022-001.
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.

	Interaction with other marine users	Seabed and benthic habitat disturbance	Onshore ground disturbance	Noise emissions	Light Emissions	Routine vessel discharge	Pre-commissioning water extraction and discharges	Atmospheric emissions	Contingency Pipeline Discharges
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	✓	✓-Localised seabed disturbance will not compromise the objectives and actions of relevant species recovery plans and conservation advice. Impacts to the marine environment from seabed disturbance will be highly localised.	✓	✓- Consistent with relevant species recovery plans, conservation management plans and management actions including: Recovery Plans: Recovery Plan for Marine Turtles in Australia 2012 - 2027 identifies noise interferences as a threat to marine turtles	✓- Consistent with relevant species recovery plans, conservation management plans and management actions, including: + National Light Pollution Guidelines + Recovery Plan for Marine Turtles in Australia 2017-2027 + Wildlife Conservation Plan for Seabirds + Recovery plans / conservation advice for other species that may occur in the light assessment boundary do not identify light emissions as a key threat or have explicit relevant objectives or management actions related to light emissions. For all these plans the objectives are achieved by adopting the environmental management strategy for light emissions.	✓- The following material published in relation to the key threatened and migratory species within the Project Area identifies pollution as a threat Conservation Advice: + Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) + Wildlife Conservation Plan for Seabirds (CoA, 2020). Recovery plans / conservation advice for other species that may occur in the Project Area do not identify pollution as a key threat or have explicit relevant objectives or management actions. The implementation of environmental management strategy will ensure that the quality of and productivity of water, sediment and biota are maintained and environmental values are functioning.	✓	✓- The Marine Bioregional Plan for the North Marine Region includes consideration of the effects of air quality on species Implementation of the environmental management strategy will ensure atmospheric emissions from the activity will not compromise conservation efforts.	✓- The following material published in relation to threatened and migratory species within the Project Area identifies pollution as a threat : Conservation Advice: + Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) + Wildlife Conservation Plan for Seabirds (CoA, 2020). Recovery plans / conservation advice for other species that may occur in the Project Area do not identify habitat degradation / modification or pollution as a key threat or have explicit relevant objectives or management actions. The implementation of the environmental management strategy for contingency pipeline discharges will ensure that the quality of and productivity of water, sediment and biota are maintained and environmental values are functioning.

	Interaction with other marine users	Seabed and benthic habitat disturbance	Onshore ground disturbance	Noise emissions	Light Emissions	Routine vessel discharge	Pre-commissioning water extraction and discharges	Atmospheric emissions	Contingency Pipeline Discharges
Are performance outcomes, management measures and associated performance standards consistent with legal and regulatory requirements?	✓- Management measures consistent with SOLAS 1974 and various Commonwealth Acts. Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act and EPBC Act. Management measures consistent with requirements of Fisheries Permit (Permit No. 2023-2024/ S11/ 524).	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act and EPBC Act.	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act and EPBC Act.	✓- The management plan requires activities to be consistent with EPBC Act Part 8 and relevant conditions of DPD Project EPBC Act approval. Compliance with this Offshore CEMP is also a condition of DPD Project approval under the NT EP Act. Management measures consistent with requirements of Fisheries Permit (Permit No. 2023-2024/ S11/ 524).	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- Vessel discharges comply with the requirements of the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983, which in Australian waters reflects MARPOL and is enacted by: + Marine Order 91 (Marine pollution prevention – oil) + Marine Order 95 (Marine pollution prevention – garbage) + Marine Order 96 (Marine pollution prevention – sewage). Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- Management measures are consistent with Ozone Protection and Synthetic Greenhouse Gas Management Act 1989, Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (and associated regulations), and MARPOL VI/Marine Order 97. Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.
Are performance outcomes**, management measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?**	✓	✓	✓	✓	✓	✓	✓	✓	✓
Are performance outcomes**, management measures and associated performance standards consistent with industry standards?**	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.
Have performance outcomes**, management measures and associated performance standards taken into consideration relevant person feedback?**	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)

	Interaction with other marine users	Seabed and benthic habitat disturbance	Onshore ground disturbance	Noise emissions	Light Emissions	Routine vessel discharge	Pre-commissioning water extraction and discharges	Atmospheric emissions	Contingency Pipeline Discharges
Do management measures reduce impacts or risks to ALARP?	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 6-9: Acceptability evaluation for unplanned events

	Dropped objects	Introduction of invasive marine species	Marine fauna interactions	Release of liquid hazardous material	Release of hydrocarbon (offshore bunkering or vessel tank rupture)	Release of dry natural gas
Is the consequence ranked as very low to medium?	✓- Low	✓- Low	✓- Low	✓- Low	✓- Low	✓- Very Low
Is further information required to validate the consequence assessment?	X	X	X	X	X – spill modelling has been undertaken of worst case credible MDO spill scenarios to inform the consequence assessment using established industry methodologies. If an unplanned MDO spill were to occur then environmental monitoring would be triggered, as required, through the DPD Project Oil Pollution Emergency Plan (BAS-210 0026)	X
Are the risks and impacts consistent with the principles of ecologically sustainable development (ESD)?	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.	✓- activity evaluated in accordance with Santos' Offshore Division Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004), which considers principles of ESD. The DPD Project, inclusive of the activities included in this Offshore CEMP has been approved under the NT EP Act which requires principals of ESD to be addressed.

	Dropped objects	Introduction of invasive marine species	Marine fauna interactions	Release of liquid hazardous material	Release of hydrocarbon (offshore bunkering or vessel tank rupture)	Release of dry natural gas
Have the acceptable levels of impact and risks been informed by relevant species recovery plans, threat abatement plans and conservation advice and Australian marine park zoning objectives?	ü- controls implemented will reduce the potential impacts from the activity, to an acceptable level, to species identified in recovery plans and approved conservation advices as having the potential to be impacted by solid objects. The following material published in relation to threatened and migratory species within the Project Area identifies marine debris: + Approved Conservation Advice for Dermochelys coriacea (Leatherback Turtle) + Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW, 2024a) + Conservation Advice for *Pluvialis squatarola* (grey plover) (DCCEEW, 2024e) Recovery Plans: + Threat Abatement Plan for impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018) + Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) + Wildlife Conservation Plan for Seabirds Management Plans: + National Plastics Plan The activity is not inconsistent with these objectives.	✓- The following material published in relation to threatened and migratory species within the Project Area identifies disease, pathogens and invasive species as a threat: Recovery Plans + Wildlife Conservation Plan for Migratory Shorebirds The environmental management strategy for invasive marine species achieve the relevant objectives identified in the recovery plan.	✓- The following material published in relation to threatened and migratory species within the Project Area identifies vessel or anthropogenic disturbance as a threat Conservation advice: + Conservation Advice for *Dermochelys coriacea* (Leatherback turtle) + National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna + Recovery Plan for Marine Turtles in Australia 2017 - 2027 + Wildlife Conservation Plan for Seabirds + Wildlife Conservation Plan for Migratory Shorebirds For all plans identified, the objectives are achieved through adoption of the environmental management strategy for unplanned marine fauna interactions.	✓	✓- The following material published in relation to key threatened and migratory species within the EMBA identifies pollution or oil spills as a threat: Conservation Advice: + Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) + Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) + Wildlife Conservation Plan for Seabirds (CoA, 2020). The implementation of the environmental management strategy for unplanned hydrocarbon spills will ensure that the quality of and productivity of water, sediment and biota are maintained and environmental values are functioning. + AMP zoning principles and objectives of the Marine Bioregional Plan for the North Marine Region were considered such as the conservation values of the identified protection priorities, including the Oceanic Shoals AMP The objectives of these publications were considered during impact and risk assessments.	✓- The following material published in relation to key threatened and migratory species within the Project Area identifies pollution as a threat: Conservation Advice: + Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b) + Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c) + Wildlife Conservation Plan for Seabirds (CoA, 2020). The implementation of the environmental management strategy for an unplanned dry gas release will ensure that the quality of and productivity of water, sediment and biota are maintained and environmental values are functioning.
Are performance outcomes, control measures and associated performance standards consistent with legal and regulatory requirements?	✓- management measures are consistent with MARPOL Annex V (through the *Protection of the Sea [Prevention of Pollution from Ship]) Act 1983*, the *Navigation Act 2012* and Marine Order 95: Marine pollution prevention – garbage), Annex X (IMO Marine Litter Action Plan) and International Maritime Dangerous Goods Code. Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- management measures are consistent with the *Biosecurity Act 2015,* Australian Ballast Water Requirements: Version 8 (DAWE, 2020a), Australian biofouling management requirements (DAWE, 2022a), International Convention for the Control and Management of Ships' Ballast Water and Sediments, Marine Order 98 (Marine pollution – anti-fouling systems), IMO Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (2011) and National	✓- management measures are consistent with EPBC Regulations Part 8 and relevant conditions of DPD Project EPBC Act approval. Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- management measures are consistent with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth), Navigation Act 2012 (Cth), MARPOL Annex V and Marine Order 91 (Marine pollution prevention – oil) and Industrial Chemicals (Notification and Assessment) Regulations 1990 (Cth). National Industrial Chemicals Notification and Assessment Scheme (NICNAS). Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- management measures are consistent with Commonwealth Acts and Marine Orders listed below: Marine Safety (Domestic Commercial Vessel) National Law Act 2012 and Navigation Act 2012, Marine Order 30: Prevention of Collisions, and Marine Order 21: Safety of Navigation and Emergency Procedures. Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.	✓- Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.

	Dropped objects	Introduction of invasive marine species	Marine fauna interactions	Release of liquid hazardous material	Release of hydrocarbon (offshore bunkering or vessel tank rupture)	Release of dry natural gas
		Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2009). Compliance with this Offshore CEMP is a condition of DPD Project approval under the NT EP Act.				
Are performance outcomes, control measures and associated performance standards consistent with Santos' Environment, Health and Safety Policy?	✓	✓	✓	✓	✓	✓
Are performance outcomes, control measures and associated performance standards consistent with industry standards?	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.	✓-comparable with recent construction developments in the NT. ENVID workshop was attended by representatives with significant pipeline construction/dredging experience. Control measures and performance standards subject to Contractor review.
Have performance outcomes, control measures and associated performance standards taken into consideration relevant person feedback?	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)	✓ refer Stakeholder Consultation (**Section 9**)
Do management measures reduce impacts or risks to ALARP?	✓	✓	✓	✓	✓	✓

6.5 Assessment of potential for cumulative impacts

The following sections provide a summary of the assessment of potential cumulative impacts associated with DPD Project construction activities as included within the DPD Project SER (BAS-210 0020).

6.5.1 Cumulative assessment methodology

Existing activities and proposed projects in the vicinity of the NT Project Area were screened to determine their potential to cumulatively interact with the DPD Project impacts. This included government and private infrastructure projects, Darwin Harbour dredging projects and resource processing operations. The degree of cumulative impact between the DPD Project and identified nearby projects and activities was determined based on the potential for spatial and temporal interaction. The list of projects and activities considered to have a high or medium potential to interact cumulatively with DPD Project impacts, based on spatial and temporal overlap, is provided within the SER (BAS-210 0020) (Santos, 2023). The potential cumulative impacts are discussed in further detail within the SER and have been summarised below. Cumulative impacts to all NT EPA Environmental Factors from the DPD Project and other projects/activities are not considered to be significant.

6.5.2 Cumulative impacts to marine environmental quality

This Offshore CEMP's activities have the potential to elevate turbidity levels within Darwin Harbor due to sediment suspension from trenching activities. Sediment dispersion modelling completed for the DPD Project (BAS-210 0036; RPS, 2023c) predicted that there will be no exceedance of suspended sediment concentration (SSC) thresholds where influence or impact to sensitive benthic habitats (hard corals and seagrass) could occur, with modelling showing that sedimentation threshold exceedance would be restricted to within or immediately adjacent to the trenching footprint (RPS, 2023c). These zones do not overlap with equivalent zones for other dredging activities in Darwin Harbour that may occur at the same time or close to the time of DPD Project trenching (including Mandorah Marine Facilities, HMAS Coonawarra dredging, INPEX maintenance dredging and Darwin Shiplift and Marine Industries dredging). Therefore, there is low potential for turbidity to result in cumulative impacts to water and sediment quality with other projects activities.

6.5.3 Cumulative impacts to marine ecosystems

This Offshore CEMP's activities will have direct impacts to the benthic habitats which will all be restricted to within or immediately adjacent to Project infrastructure footprints, including the designated spoil disposal ground. Benthic habitats in the infrastructure footprints do not consist of rare or sensitive receptors (i.e., hard corals or seagrass) and are predominately hard substrate or sediment substrates supporting filter feeding biota; these habitats are well represented throughout the Project Area. Direct impacts to benthic habitat are not predicted to have significant impacts to ecosystem functions. Although other projects will have direct impacts to benthic habitats, the cumulative impacts are unlikely to be significant when considered against the total available benthic habitat within Darwin Harbour.

There is also potential from indirect impacts to marine ecosystem, for example impacts to benthic habitats from increased SSC and sedimentation. As described above, SSC and sedimentation from DPD Project trenching is unlikely to interact significantly with water quality impacts from other dredging projects in Darwin Harbour, therefore the DPD Project is unlikely to result in significant cumulative indirect impacts to marine ecosystems.

Construction activity will temporarily increase vessel traffic in Darwin Harbour and if construction activity timing overlaps with other projects activities, then vessel traffic will be further increased. Increased vessel activity has the potential to result in higher levels of sound and light emissions. It is however unlikely that cumulative activity from noise and light emissions will have a significant impact, as Santos considers proposed controls and management actions to be effective.

6.5.4 Cumulative impacts to atmospheric processes

This Offshore CEMP's activities will generate atmospheric emissions during construction which will contribute to the overall concentration of greenhouse gases (GHG) in the Earth's atmosphere. Emissions resulting from construction activities (i.e., vessel combustion engines) will occur on a short-term basis and be limited to the construction phase of the project. As an overall contribution to GHG gas levels, this will be a negligible increase. The DPD Project is included in Santos' Climate transition action plan and will adhere to the Santos GHG Management plan and energy management program.

6.5.5 Cumulative impacts to coastal processes

This Offshore CEMP's activities are not expected to significantly alter hydrological or geophysical process. The trenching activity and the installation of temporary (e.g., causeways at the shore crossing) or longer-term infrastructure (e.g., pipeline and rock protection) may have a slight and local effect on water movement in NT Internal Waters, however not to the extent where this would be expected to change coastal geomorphology or coastal ecosystem processes. Furthermore, there are no known projects which would interact with any localised changes in hydrology from the DPD Project to create cumulatively impacts.

6.5.6 Cumulative impacts to community and economy

This construction activities will increase vessel activity within Darwin Harbour, which has the potential to cause cumulative impacts to other commercial and recreational harbour users, in particular if the timing of construction activities overlap with other projects activities. It is important to note that the potential for cumulative impacts from vessel activities would occur primarily during the construction phase, which will be temporary (12 – 15 months). Furthermore, the increase in vessel activity related to the DPD Project is not expected to add significantly to the overall movements within Darwin Harbour based on annual harbour statistics and historical year to year variation. Therefore, DPD Project vessel activities are unlikely to contribute a significant extent to cumulative vessel impacts on harbour marine users.

6.5.7 Cumulative impacts to culture and heritage

Following controls in place, the DPD Project will not impact on identified First Nations sacred sites and will avoid maritime heritage objects as far as practical, with any maritime heritage disturbance localised to the pipeline route and done in accordance with regulatory requirements. There are no other activities or projects which are considered to have the potential for cumulative impacts with the DPD Project to identified cultural heritage sites.

7 Environmental management strategies

This section outlines the environmental management strategies (EMS) that will be implemented for activities covered by this Offshore CEMP to reduce impacts and risks to the environment to a level that is as low as reasonably practicable (ALARP) and acceptable.

The EMS to be implemented as part of this Offshore CEMP comprise the following:

- Planned impact management strategies (**Section 7.6**)
- Unplanned risks management strategies (**Section 7.7**).

These EMS outline environmental performance objectives EPOs and measurable targets and management actions in place to ensure that the EPOs and targets are met. Performance indicators and monitoring activities (where applicable) are used to quantify success in meeting targets and identify the need for corrective actions. This ensures the continuous improvement of the effectiveness of the DPD Project's EMS. The EMS define the reporting requirements, terms, and responsibilities.

All EMS are structured to align with the template presented in **Table 7-1**.

The performance standards and measurement criteria for the management actions are provided in **Attachment 3**.

Table 7-1: Environmental management strategy template

Item	Content
Environmental performance objective (EPO)	Environmental management goal(s) tailored to each aspect per NT EPA requirements (Key Environmental Factors).
Target/ Performance standard	Aspect specific measurable performance necessary to successfully achieve objective. Part 1 of NT EPA required performance criteria. Performance standard/s have been developed for each management action to provide the specific level of performance required and provide a measurable commitment against which compliance will be checked.
Performance indicator/ Measurement criteria	Quantitative or qualitative measures representing the performance related to Target(s). Part 2 of NT EPA required performance criteria. Measurement criteria provide the record or evidence required to be produced to demonstrate the performance standard has been met.
Management actions	Management actions are actions to be undertaken to meet the EPOs and reduce impacts and risks to ALARP and acceptable levels. The management actions provided in this Offshore CEMP are consistent with those provided within the DPD Project Supplementary Environmental Report (SER), provided to support approval of the DPD Project under the NT EP Act.

7.1 NT EPA hierarchy

In the development of the EMS outlined within this Offshore CEMP Santos applied the Environmental Decision-Making Hierarchy outlined within the EP Act. This hierarchy being:

- To ensure that actions are designed to avoid adverse impacts on the environment;
- to identify management options to mitigate adverse impacts on the environment to the greatest extent practicable; and

- if appropriate, provide for environmental offsets in accordance with the EP Act for residual adverse impacts on the environment that cannot be avoided or mitigated[8].

7.2 Environmental performance objectives

Environmental performance objectives (EPOs) have been defined and are listed in following sections for each planned and unplanned event. The EPOs set the desired outcomes/goals for the activity, consistent with the NT EPA environmental factor objectives, and guide the setting of performance criteria.

7.3 Performance criteria (Targets and performance indicators)

To assess whether EPOs are being achieved, specific performance criteria have been defined, taking the form of targets and performance indicators. Detailed specific measurable targets must be defined and then met to achieve overarching EPOs. Performance indicators are the factor that is measured to assess whether the performance targets have been achieved.

7.4 Management actions

To avoid or mitigate impacts and risks of the DPD Project construction and pre-commissioning activities and to achieve EPOs and meet performance criteria, management actions have been defined. This include standard management actions that will be implemented as part of normal operations, and adaptive management actions that will be implemented if triggered. For each management action, performance standards and measurement criteria have been defined in **Attachment 3** to allow compliance to be measured.

7.5 Adaptive management mechanism

While the consequences of all planned impacts were assessed as either minor or negligible and the level of unplanned risks were assessed as low or very low, a monitoring and adaptive management mechanism will be applied to the following events to ensure EPOs are met:

- Seabed and benthic habitat disturbance via generation of turbid plumes and sedimentation during trenching. These adaptive management actions are detailed in **Table 7-6** and the TSDMMP [BAS-210 0023]
- Disturbance of marine fauna via noise generated during construction activities. These adaptive management actions are detailed in **Table 7-10** and the MMNMP [BAS-210 0045].

Adaptive management can also be triggered through Santos' incident response and assurance processes (**Section 8.3**), with corrective actions implemented and management adapted as required to address any identified incidents and non-conformances.

7.6 Planned event - impact management strategies

Santos' environmental impact assessment identified impacts related to nine planned events associated with DPD Project construction activities in the Project Area (Refer to **Section 6**).

7.6.1 Interaction with other marine users

7.6.1.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-2**.

[8] No offsets were deemed appropriate for this project.

Table 7-2: Interaction with other marine users (including construction activities and Project infrastructure) EPOs and associated performance criteria

EPO	Performance criteria	
	Target/s	Performance Indicator/s
Avoid incidents resulting from interaction with other marine users	Zero incidents resulting from interactions	+ Number of recorded incidents
Minimise impacts to other marine users	Zero impacts to other marine users activities	+ Number of complaints from other marine users
Stakeholders are well-informed of the DPD Project and its associated restrictions	DPD Project stakeholder are provided with activity update/s and notification of commencement of trenching and spoil disposal activities.	+ Stakeholder notification records

These EPOs in conjunction with the economic benefits of the Project to the Darwin economy align with the following NT EPA Factor objective (NT EPA 2022):

+ Community and economy – Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.

The management actions for this planned event are shown in **Table 7-3**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-3: Management actions for interaction with other marine users

MA Reference	Management Action
Standard management actions	
Avoidance	
DPD-MA01	Intertidal and shoreline construction is in pre-disturbed area (DLNG footprint) with no public access
DPD-MA02	Installation of the pipeline within pre-agreed route, with no incursions into the shipping channel (as defined in consultation with the regional harbour master)
Mitigation	
DPD-MA03	Anti-snag protection for mechanical support structures
DPD-MA04	Activity vessels equipped and crewed in accordance with Australian maritime requirements
DPD-MA05	Development and implementation of communication plan (including applicable notifications) for relevant stakeholders (including recreational and commercial fishing bodies and tourism operations) to minimise adverse impacts on other marine users
DPD-MA06	Implementation of cautionary zones around DPD Project vessel to mitigate against adverse interactions
DPD-MA07	One vessel will act as a surveillance vessel within the Project Area during gas export pipeline installation and trenching activity
DPD-MA08	The proposed pipeline route will be marked on marine charts, in the same way that the existing pipelines are gazetted and marked on marine charts
DPD-MA09	Construction activities undertaken in accordance with Santos HSE management and marine vessel vetting processes
DPD-MA10	Causeway/s will be temporary structure/s and will be removed following trenching and pipeline installation
DPD-MA54	Vessels will adhere to Port of Darwin vessel speed limits
Additional (ALARP) management actions	
Avoidance	
DPD-MA11	Pipeline will not be installed in the vicinity of the jewfish aggregation area within the Charles Point Wide RFPA
DPD-MA108	HSE inductions will include environmental requirements and cultural values

Table 7-4: Additional management actions not adopted for interaction with other marine users.

Additional management actions not adopted		Reasoning for rejection
1	Signage to alert small boat users of activities and key locations (e.g., boat ramps)	Evidence from previous construction activities in Darwin Harbour indicates that this is not an effective method of public notification. Therefore, Santos has committed to ongoing consultation with relevant stakeholders to develop more effective public notification.
2	Divide the pipeline installation scope into multiple campaigns to minimise work performed during peak marine user periods and avoid the Northern Prawn Fishery season periods of sensitivity (2 April to 15 June and 1 August to 21 November)	Significant costs and increase in the construction and pre-commissioning activity duration to demobilise/remobilise the vessels. It also increases the risk profile of the operation. The Project Area does not overlap areas historically fished by prawn trawlers.

7.6.1.2 Demonstration of ALARP and residual impact

No alternative options to the use of vessels are possible to undertake the marine activity.

The presence of the vessels, the pipeline and associated infrastructure (together with cautionary zones) and causeway/s is not expected to significantly impact tourism, commercial and traditional fishing operations or shipping traffic, given the localised areas of vessel activities, the relatively short durations of activities at any given point along the pipeline route, the various routes that can be taken to avoid the area and the limited number of users active in the vicinity.

For shoreline and onshore works, the construction activities will be within the existing DLNG disturbance footprint with no public access and therefore other marine user interaction will be avoided. For other constructions works within and outside the harbour, the pipeline will be laid mainly outside of shipping channels, which will help limit interactions with shipping traffic, and a number of measures will be employed to mitigate negative interactions and/or pre-warn other users of construction activities and associated infrastructure. These include marine user notifications and charting of infrastructure, use of assured and experienced vessels and crew and the implementation of cautionary zones and surveillance vessels. Construction infrastructure will be removed if not required (e.g., rock causeway) and protected to mitigate snagging, where relevant (e.g., anti-snag protection).

The proposed management controls for marine user interaction are considered appropriate to manage the risk to ALARP and acceptable levels. Standard management actions to reduce interaction with other marine users due to vessel presence during construction activities have been adopted.

An additional management actions that was deemed practicable and reduce the consequence of the presence of the pipeline on other marine users has been adopted (**Table 7-3**). Additional management actions that have not been adopted and the reasoning for rejection are found in **Table 7-4**. The overall worst-case consequence is assessed as Minor. If the management controls are adhered to, then the risk of interfering with other marine users will be reduced to ALARP and the impact level is considered Minor and acceptable.

7.6.2 Seabed and benthic habitat disturbance

7.6.2.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-5**.

Table 7-5: Seabed and benthic habitat disturbance EPOs and associated performance criteria

EPO	Performance criteria	
	Target/s	**Performance Indicator/s**
Minimise direct impacts to sensitive marine habitat, cultural values and socio-economic sensitivities	Pipeline alignment and trench areas designed to minimise trenching requirements and direct footprint of seabed disturbance	+ Quantitative risk assessment (BAS-201 0925) + Nearshore pipeline route selection report- Darwin Harbour (BAS-200 0642)
	No trenching outside the pre-defined boundaries[1] of the trench areas or outside pre-sweep/ sand wave rectification areas	+ Nearshore pipeline trench and trench backfill alignment details 34in northern route (BAS-200 0523 001) + Trenching out-survey reports
	No anchoring on sensitive seabed areas	+ Incident reports of anchoring inside anchoring exclusion zone

EPO	Performance criteria	
	Target/s	**Performance Indicator/s**
	No installation activities (pipelay, and causeway construction, trench backfill etc.) outside of the proposed footprint	+ Records of construction areas, including: + Construction activity logs, vessel logs + Post-construction survey
	No damage to known heritage sites of significance or existing submerged infrastructure	+ Incident reports of damage to heritage sites/ artefacts of significance, or existing infrastructure
	Potential culturally significant objects discovered during construction reported and managed as per Unexpected Finds Protocol	+ Unexpected finds notification records
Avoid sediment dispersion and sedimentation related impacts on seagrass and hard coral habitats from trenching and spoil disposal activities	No DPD Project related reduction in water quality or sedimentation resulting in impact to seagrass and hard coral marine habitats	+ Water quality and benthic habitat monitoring data (refer to TSDMMP; BAS-210 0023) + Attributability assessments + Reports on adaptive management actions and effectiveness
Minimise impacts from spoil disposal	No spoil disposal outside of DPD spoil disposal ground	+ During and post spoil disposal Hydrographic surveys + Spoil disposal logs

Notes:

1. Boundaries of direct seabed and benthic habitat disturbance are defined by the trench design and any approved changes to that design.

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

+ Coastal processes – Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.
+ Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.
+ Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.
+ Culture and heritage – Protect culture and heritage.

The management actions for this planned impact are shown in **Table 7-6**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-6: Management actions for seabed and benthic habitat disturbance

MA reference	Management actions
Standard management actions	
Avoidance	
DPD-MA12	Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry)
Mitigation	
DPD-MA13	Overflow from the TSHD will be undertaken through the adaptive management processes There will be 'environmental valve' or 'green valve' where available (attached to O/F to reduce air entrained, to reduce billowing and facilitates sediment sinking) as standard which will be used as a first step
DPD-MA14	Standard operating procedure for spoil disposal will be used.
DPD-MA15	Spoil will not be disposed of in a single location, to avoid developing a single large mound.
DPD-MA16	Spoil will only be placed *in situ* within a short section of trenching within intertidal zones to keep wet under most tidal conditions and will be removed subsequently where accessible by BHD and SHB for offshore disposal
DPD-MA17	When available, the base case is for the DP pipelay vessel to be used to install as much of the pipeline as depth allows DP vessel can be used in deeper water from KP23 (Territorial water boundary) to ~KP91.5 where the shallow water pipelay (<20 m) and associated anchoring will begin
DPD-MA18	Anchor management plans will be developed to allow safe anchoring of vessels undertaking pipelay, trenching, rock installation and other support activities in the vicinity of sensitive habitats and nearshore heritage or sacred sites
DPD-MA19	Trained and competent anchor handling operators will be used
DPD-MA20	Anchors exclusion areas will be implemented to avoid sensitive habitats and heritage sites
DPD-MA21	Objects identified as cultural heritage objects that cannot be avoided will be managed as per NT Heritage Branch requirements
DPD-MA22	Differential global positioning system (DGPS) will be used on the pipelay vessels to maintain accurate vessel position during installation
DPD-MA23	DGPS used to confirm ILT foundation structure position during installation Underwater positioning system (USBL/ transponders) and ROV to confirm installation location and positioning (within required location accuracy to reduce disturbance to the seabed)

MA reference	Management actions
DPD-MA24	Installation plan will be developed and include: requirement for trained and experienced vessel crews pipe to be installed in trench as per approved design
DPD-MA25	Span-specific rectification plans developed that include: pre-span method selection real-time monitoring of span rectification post-rectification inspections
DPD-MA26	Permanent rock installation will be limited to only those pipeline sections requiring stabilization and/or anchor protection, as informed by a quantitative risk assessment
DPD-MA27	Causeway/s will be temporary structure/s and will be removed following trenching and pipeline installation
DPD-MA107	A CHMP will be in place for the activity and include: + Cultural heritage induction requirements for site personnel + An internal heritage clearance process prior to construction activities + Procedures for anchoring and establishment of exclusions zones + Procedures to mitigate risks to unexpected maritime heritage objects, including a stop work protocol
Monitoring	
DPD-MA28	Adaptive management process will be implemented as defined within the TSDMMP (BAS-210 0023) which will include environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels
DPD-MA29	Continuous monitoring of anchor wire tensions to prevent anchor drag on seabed and wire length measurement of the winch will be monitored to prevent anchor drag
Additional (ALARP) management actions	
Avoidance	
DPD-MA30	Pre-lay surveys will confirm the nature of the seabed within the ILT foundation location to ensure the structure is installed on bare area of the seabed. Post-lay surveys will allow verification of the impact assessment.
DPD-MA31	Where practicable rock installation will not exceed seabed level within practical installation tolerances.
DPD-MA108	HSE inductions will include environmental requirements and cultural values

MA reference	Management actions
DPD-MA109	Cultural heritage training and cultural ceremony
DPD-MA110	First Nations cultural heritage monitor in the field, subject to availability of the cultural heritage monitor
DPD-MA111	Establish a subsea infrastructure inventory

Table 7-7: Additional management actions not adopted for seabed and benthic habitat disturbance

Additional management actions not adopted		Reasoning for rejection
1	No trenching using CSD	Not technically feasible to stabilize and protect pipeline without trenching. The CSD is a significant mitigation in the event hard soils are encountered. Not utilising the CSD may pose substantial schedule and cost impacts if harder soil types are encountered that are beyond the operating limits of the TSHD and BHD.
2	No trenching using TSHD	Not technically feasible to stabilise and protect pipeline without trenching using TSHD
3	No trenching using BHD	Not technically feasible to stabilise and protect pipeline without using BHD
4	Restrict timing of activities to operate outside of known sensitive periods. Flatback turtle peak nesting period is June to September and Dolphin peak calving is October to April.	Beaches closest to the Project Area are not considered significant turtle nesting beaches. Beyond ALARP to prevent trenching in peak dolphin calving period, based on excessive cost and schedule implications relevant to the potential minor impacts identified. Monitoring programs have been unable to determine spatial and temporal patterns in occurrence and abundance of dolphins in Darwin Harbour or any links to anthropogenic activities and behavioural disruption. Trenching areas are adjacent high use areas for vessels and the effects of turbidity are expected to be minor in the context of natural variability.
5	No offshore spoil disposal	Spoil will be generated from trenching activities. The only alternative is for onshore disposal of spoil, however the additional time in the field that would be required, would be prohibitive, prolong impact to other users of Darwin Harbour and additional environmental impacts would occur with onshore disposal. Given the minor impacts predicted from the offshore disposal of spoil, this control is rejected.
6	Spoil to be disposed of in a manner to create a uniform thickness of spoil	Spoil will not be disposed in one area only however will not be uniformly spread. The additional effort to ensure uniform thickness of spoil is not reasonably practicable in comparison to any potential benefits and would create additional turbidity. Sediment modelling has not identified re-suspension and ongoing transportation of sediments to be significant.

Additional management actions not adopted		Reasoning for rejection
7	No vessel anchoring	Given the shallow water depths, it is not feasible to use a DP vessel to install the pipeline and consequently, the use of an anchored pipelay vessel is required. Using a DP vessel will add a lot of noise in the shallow waters which is likely to be a bigger problem than disturbances from anchoring.
8	Pre-lay and post-lay benthic habitat surveys along the full gas export pipeline route	Habitats along the pipeline route are well known having been extensively studied through geophysical surveys and drop camera/ROV survey. The route has been shown to be devoid of unique habitat or high value primary producer habitat and additional surveys would provide no significant further information for informing management measures.
9	Pre-lay and post-lay surveys at anchoring locations	A conservative approach has been adopted for managing anchoring activities. Exclusion zones will apply to seabed areas identified as sacred sites, potential maritime heritage sites (identified by maritime heritage assessment) and mapped sensitive benthic habitat (hard coral and seagrass). Given the numerous anchoring locations which would be required to be surveyed and the conservative approach taken to delineate avoidance areas, pre- and post- anchoring surveys are considered to have a disproportionate level of cost and effort.
10	Pre-lay and post-lay surveys at ILT foundation location	Habitats along the pipeline route are well known as having been extensively studied through geophysical surveys and drop camera/ROV survey. The route has been shown to be devoid of unique habitat or high value primary producer habitat such as seagrass and hard corals. Pre- or post-lay benthic habitat surveys would provide no significant further information of environmental benefit and have been ruled out.
11	Not using rocks to protect and stabilize the pipeline	Rocks are required to provide anchor protection adequate for mitigating risks associated with current and future vessel use within the Project Area. Rock protection has been reduced as far as practical while still maintaining adequate protection.
12	Do not use temporary causeway/s	Causeway/s required to allow excavator to access into deeper waters.

7.6.2.2 Adaptive management mechanism

An adaptive management process is defined within the TSDMMP (BAS-210 0023) which includes a water quality monitoring program with management measures applied if water quality exceeds turbidity trigger levels.

7.6.2.3 Demonstration of ALARP and residual risk

Trenching has been minimised as far as practicable. Standard management actions have been adopted to reduce the impact of construction activities and the presence of the pipeline to the seabed and benthic habitats. Additional feasible management actions that reduce the impacts from seabed and benthic habitat disturbance have been adopted, including an adaptive management strategy designed to reduce turbidity effects from trenching through the application of management actions if monitored turbidity exceeds set threshold levels (detailed in the TSDMMP BAS-210 0023) (**Table 7-6**). Additional management actions that have not been adopted are outlined in **Table 7-6**, with the reasoning for their rejection.

Construction activities (trenching, stabilization and freespan correction/prevention) will only be undertaken in pre-identified areas. Pre-lay surveys will be conducted to confirm the seabed characteristics of these areas.

During trenching, overflow from the TSHD will be managed via an 'environmental valve' (where available) to reduce entrained air, billowing, and facilitate sediment sinking. As per the spoil disposal SOP, spoil will not be disposed of in a single location in the spoil disposal ground (to avoid developing a large mound) and will only be placed *in situ* within a short section of trenching in the intertidal zone, before being removed for offshore disposal.

During pipe laying, installation and span-specific rectification plans will be developed and implemented, which include requirements for experienced vessel crews, approved installation designs, and span-specific method selection and monitoring.

When available, the DP pipelay vessel is to be used to install as much of the pipeline as depth allows. Anchor management plans and anchor exclusion areas will be implemented to allow the safe anchoring of construction vessels around sensitive habitats or nearshore heritage sites. To prevent anchor-drag on the seabed, anchor wire tensions and wire length measurements on the winch will be continuously monitored. Differential global positioning systems (DGPS) will be operational on the pipelay vessels to maintain accurate vessel position during installation, which will be confirmed via an underwater positioning system (USBL/transponder) and ROV.

Permanent rock installation will be limited to those pipeline sections requiring stabilization and/or anchor protection, as informed by a quantitative risk assessment. Rock installation will also not exceed seabed level within practical installation tolerances. Causeway/s used during construction will be temporary structures and will be removed following trenching and pipeline installation.

Seabed disturbance created from trenching activities and construction activities associated with the causeway/s are not expected to significantly impact coastal processes, given the large volumes of water movement and temporary and localised nature of activities.

To avoid/manage impacts to maritime and First Nations heritage associated with the seabed, Santos has followed guidance provided by Department of Territory Families, Housing, and Communities – Heritage Branch. Additionally, Santos has received Authority Certificates from AAPA for the DPD Project (Authority Certificate C2022/098 and C2024/034) and will ensure conditions of the certificate and the requirements of the *Northern Territory Aboriginal Sacred Sites Act 1989* are met.

Santos will also meet the requirements of a Cultural Heritage Management Plan (CHMP) (BAS-210 0208), as required by the Environmental Approval under the NT EP Act, which includes requirements for:

- Cultural heritage induction requirements for site personnel

- An internal heritage clearance process prior to construction activities
- Procedures for anchoring and establishment of exclusions zones
- Procedures to mitigate risks to unexpected maritime heritage objects, including a stop work protocol.

In relation to spiritual and/or cultural heritage beliefs and connections to sea country and related concerns of some First Nations people, Dr Corrigan suggested that Santos consider engaging cultural monitors to provide guidance and advice on the protection and maintenance of the cultural and spiritual places and activities during the DPD construction process (Corrigan, 2024). This recommendation has been adopted (refer DPD-MA110). Further, a common practice is the use of ceremonies to introduce activities or the presence of strangers to spiritual beings. This practice has also been adopted (refer DPD-MA109). Santos has also been implementing cultural heritage training and ceremony in the course of undertaking activities authorised pursuant to the GEP EP since November 2023 with broad support of First Nations communities as a culturally appropriate practice and response to cultural concerns. This will continue as part of the DPD Project (refer DPD-MA109).

Management actions are considered to manage risks to ALARP and acceptable levels. Activities which may cause seabed and benthic habitat disturbance are localised in nature and there is a lack of unique habitats, hard coral or significant seagrass areas within the pipeline route and trenching areas. Additionally, original habitat that will be disturbed or removed is expected to recolonise rapidly on the pipeline and rock installation.

Residual impacts are expected to be temporary, as habitats under the pipeline and trenching zone footprints will be removed permanently but will recover rapidly as new habitat establishes. The area potentially impacted is small compared to the total area that the same habitats occupy outside of the disturbance footprint. The habitats in the direct disturbance footprint are not considered rare nor identified as critical foraging habitats for marine species. Additionally, no impacts are predicted to benthic habitats outside of the direct disturbance footprint. Therefore, no long-term impacts to marine species are expected.

7.6.3 Onshore ground disturbance

7.6.3.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-8**.

Table 7-8: Ground disturbance and clearing EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	**Performance Indicator/s**
Avoid impacts to native vegetation and fauna from ground disturbance and clearing	Ground disturbance within previously cleared areas	Recorded areas disturbed via excavation logs
	Zero incidents of disturbance to vegetation outside previously cleared areas	Number of recorded incidents of damage to environment outside of previously cleared areas
	Zero incidents of injury to terrestrial native fauna as a result of the DPD construction activities	Number of recorded incidents relating to terrestrial fauna injury or mortality as a result of ground disturbance.
Prevent project attributable mobilisation of heavy metals and	No incidents of project attributable mobilisation of heavy metals and	Records of ASS presence in sediment/soil via excavation

acidification products to the surrounding environment	acidification products to the surrounding environment	logs/ daily observations/ photographs Incident investigation records

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Terrestrial environmental quality – Protect the quality and integrity of land and soils so that environmental values are supported and maintained
- Terrestrial ecosystems – `Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning
- Marine environmental quality (coastal water quality)
- Marine ecosystem (marine fauna).

The management actions considered for this planned event are shown in **Table 7-9**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-9: Management actions for onshore ground disturbance during DPD construction activities

MA Reference	Management Action
Standard management actions	
Avoidance	
DPD-MA32	Restrict disturbance to within the onshore Project Area and existing DLNG site area
DPD-MA33	Establish appropriate access restrictions into the onshore Project Area
Mitigation	
DPD-MA34	Direct stormwater runoff from the open trench to filter through the rock causeway, when present
DPD-MA35	Install geotextiles under primary construction area (i.e., site pad)
DPD-MA36	Return area to natural grade to match existing topography
DPD-MA37	All personnel to complete the DLNG HSE site induction
DPD-MA38	Maintain batters or install fauna ladders on trench entry and exit to allow fauna to exit the trench
DPD-MA39	Implement ASS and groundwater management and monitoring requirements within the ASSDMP (BAS-210-0049). The ASSDMP includes requirements for: Soil stockpiling, laboratory testing and treatment, dependent upon location of work and encountering ASS Groundwater laboratory testing and treatment, if groundwater is reached Maintenance of testing and inspection records
DPD-MA40	Plan onshore works to minimise the amount of time soil is exposed to the air
DPD-MA41	Trench inspections to be performed daily to check for trapped wildlife
DPD-MA42	Insert caps on ends of pipe if the pipe is to be unattended for periods >12 hours; to prevent fauna ingress
DPD-MA43	Ensure any native vertebrates injured by DPD construction activities are referred to an appropriate wildlife carer group or veterinarian

MA Reference	Management Action
Additional (ALARP) management actions	
Avoidance	
DPD-MA44	Limit vehicles to access roads, prepared site pad or defined boundaries within the onshore Project Area/DLNG disturbance
DPD-MA108	HSE inductions will include environmental requirements and cultural values
Mitigation	
DPD-MA45	Use water truck for dust suppression
DPD-MA46	Establish and implement vehicle speed controls
DPD-MA47	Wet parking area will be monitored daily, with photographs taken

7.6.3.2 Demonstration of ALARP and residual impact

Construction works for the onshore activities covered by this Offshore CEMP will be confined to the Project area and existing disturbed areas within the DLNG site area. Given the type of construction occurring there are no credible alternatives to reduce ground disturbance. **Table 7-9** details the management actions to reduce impact to onshore sediment quality, water quality, air quality, vegetation, and terrestrial fauna.

Geotextiles will be installed under the primary construction area (i.e., site pad) to enhance the drainage and stability of the soil. Water trucks will be used to suppress dust during construction, and the Project Area will be returned to its natural grade to match the existing topography at the conclusion of pre-commissioning works.

During the construction of the Bayu-Undan pipeline natural material within the onshore Project Area was replaced by imported (non-ASS) fill material (generally sand) up to a depth of approximately 6 m below ground level. Hence it is considered that material at the site is likely to be non-ASS. None-the-less, should ASS material be encountered during earthworks within the onshore Project Area, it will be managed in line with the ASSDMP (BAS-210-0049), which includes requirements for soil stockpiling and testing, and the maintenance of testing and inspection records Additionally, onshore works will be planned to minimise the amount of time the soil is exposed to the air.

If trenching reaches groundwater, there is potential for acid release and metal leaching into the groundwater from oxidised ASS. Groundwater will be managed and monitored through the ASSDMP (BAS-210 0049), which includes requirements for groundwater testing and treatment.

Terrestrial fauna and vegetation may interact with stockpiled soils, however given that these will be managed within short temporal scales in accordance with the ASSDMP there would likely be an insignificant impact.

To prevent fauna ingress, caps will be inserted on the ends of the pipe (if unattended for periods >12 hours). Batters and fauna ladders will be used on trench entry and exit to allow fauna to exit the trench and prevent entrapment and stress. Daily inspections will be performed to check for trapped wildlife, and any native vertebrates injured by DPD construction activities will be referred to an appropriate wildlife care group or veterinarian.

Given the temporary and localised nature of the impacts, and the existing disturbance at the site, the implementation of standard and additional (ALARP) management actions in place, including the implementation of the ASSDMP (BAS-210 0049) are appropriate for the nature and scale of this activity. Therefore, the assessed residual consequence for the impact of physical presence is minor and acid sulphate soils is negligible and both cannot be reduced further. Additional known residual impacts have been reduced to ALARP and are considered acceptable.

7.6.4 Noise Emissions

7.6.4.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-10**.

Table 7-10: Noise emissions EPOs and associated performance criteria

EPO	Performance criteria	
	Target/s	Performance Indicator/s
Avoid hearing injury impacts to protected marine species from underwater noise generated by DPD Project trenching and spoil disposal activities	Zero incidents of injury or mortality to EPBC Act listed marine fauna from noise generated during DPD construction activities	Incident reports of injured or dead EPBC Act listed fauna MFO records of EPBC Act listed fauna within vessel observation/exclusion zones
	Zero incidents of trenching or rock breaking while EPBC Act listed marine fauna observed in exclusion zone	MFO records of EPBC Act listed fauna within vessel exclusion zone

This EPO aligns with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this planned impact are shown in **Table 7-11**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

7.6.4.2 Adaptive management mechanism

Adaptive management mechanisms related to noise emissions are outlined in the MNMMP (BAS-210 0045).

Table 7-11: Management actions for noise emissions during routine construction including the use of an Xcentric Ripper tool

MA reference	Management actions
Standard management actions	
Avoidance	
DPD-MA48	Observation and shut-down zones for marine fauna have been developed based on noise modelling results and standard protocols
Mitigation	
DPD-MA49	Vessel inductions for all crew will address marine fauna risks and the required management controls
DPD-MA50	Vessel and helicopter contractor procedures will comply with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interaction with marine fauna
DPD-MA51	Personnel trained in marine fauna observation (MFO) will be present on pipelay, dredge and rock installation vessels/barges during daylight hours, including one crew member with MFO training on the bridge at all times
DPD-MA52	All marine fauna interactions and observations will be appropriately recorded and reported to DEPWS/NT EPA and DCCEEW as required
DPD-MA53	Soft-start procedures for rock breaking (BHD) for night-time activities where observation is not possible
DPD-MA54	Vessels will adhere to Port of Darwin vessel speed limits
DPD-MA55	Maintenance of vessel, vehicle, helicopter and equipment combustions engines and vessel incinerators as per planned maintenance system
DPD-MA100	Vessel equipped and crewed in accordance with Australian maritime requirements
Additional (ALARP) management actions	
Avoidance	
DPD-MA56	Observation and shut-down zones for marine fauna have been developed based on noise modelling results for trenching and standard protocols and include: Observation (150 m) and exclusion (50 m) zones for marine mammals and turtles. Observation zone monitored for 10 minutes prior to commencing trenching during daylight only. A Marine Megafauna Observation and Adaptive Management Protocol for routine trenching operations, including the use of Xcentric Ripper tool, is to be followed as per MMNMP (BAS-210 0045)

MA reference	Management actions
Mitigation	
DPD-MA57	Soft start (ramp-up) of hydraulic tools (rock breaking) by BHD Soft start (ramp-up) of trenching equipment, where practicable, will apply to the BHD, CSD and TSHD
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA109	Cultural heritage training and cultural ceremony
DPD-MA110	First Nations cultural heritage monitor in the field, subject to availability of the cultural heritage monitor
DPD-MA114	Vessel speed restrictions in NT Coastal Waters

Table 7-12: Additional environmental management actions for contingency rock breaking using hydraulic hammer

MA reference	Management actions
Contingency management actions	
1	Increased Observation and Exclusion Zones for hydraulic hammering based on noise modelling results will be applied as follows: If up to 8 hours of rock breaking is required, an increased Observation Zone of 2.5 km (marine mammals) and 1 km (turtle) will apply and an increased Exclusion Zone of 150 m for marine mammals and turtles will apply If up to 6 hours of rock breaking is required, an increased Observation Zone of 2 km (marine mammals) and 750 m (turtle) will apply and an increased Exclusion Zone of 100 m for marine mammals and turtles will apply If up to 4 hours of rock breaking is required, an increased Observation Zone of 1.5 km (marine mammals) and 750 m (turtle) will apply and an increased Exclusion Zone of 100 m for marine mammals and turtles will apply If up to 2 hours of rock breaking is required, an increased Observation Zone of 1 km (marine mammals) and 500 m (turtle) will apply and an increased Exclusion Zone of 50 m for marine mammals and turtles will apply
2	Contingency hydraulic hammering protocols for managing noise impacts will be followed as per MMNMP (BAS-210 0045)
3	Hydraulic hammering for no greater than 8 hrs over a 24 hr period.
4	No hydraulic hammering at night
5	A separate vessel with MFO onboard will be required to patrol the Observation Zone prior to and during hydraulic hammering

Table 7-13: Additional (ALARP) management actions not adopted for noise emissions

Additional management actions not adopted		Reasoning for rejection
1	Schedule trenching activities outside of peak flatback turtle nesting period (May to October) or outside of peak Darwin Harbour dolphin calving period (October to April)	It would not be possible to avoid both peak periods. The potential benefit of avoiding locations of higher marine megafauna sensitivity at certain times of the year, such as nesting periods for turtles and dolphin calving periods, is considered disproportionately low compared to the implications to Project scheduling and costs. While there are known flatback turtle nesting sites (Cox Peninsula and Casuarina Beach), and a known period of increased nesting activity (May to October), the densities of nesting turtles in these areas are very low and not significant on a regional scale (Chatto and Baker, 2008). Furthermore, these sites are on a scale of 1000s of meters away from the pipeline route and trenching areas (as they are from existing vessel traffic using navigation channels) and the relative risk of behavioural effects to turtles at this scale from vessel noise is considered low (Popper et al., 2014). For dolphins, there is evidence that there is a peak in calving within Darwin Harbour between October and April (Palmer, 2010). Important areas have not been defined however and given the high mobility of dolphin species within Darwin Harbour and the use of adjoining coastal areas (Griffiths et al., 2019) it is unlikely that behavioural disturbance around DPD Project activities, relative to the total area of Darwin Harbour and surrounding coastal waters, would have a significant impact on calving behaviour.
2	The observation period for marine megafauna prior to commencing dredging and pile driving is 20 minutes and the MFO is solely dedicated to the task of sighting and recording marine megafauna interactions prior to, and during, dredging and pile driving operations	A 20-minute observation period was considered excessive for the size of the Observation Zone (150 m) and a 10-minute observation period was considered sufficient to monitor this zone for marine fauna. An additional 10 minutes would prolong dredging operations without any appreciable benefit. A MFO for the pre-start up observation period was considered warranted; however, a MFO solely to the task of sighting and recording marine megafauna for the entirety of dredging operations was not considered warranted given that the dredging vessel to have multiple crew with marine fauna observation training onboard during daylight hours and the vessel bridge to be constantly manned, with at least one crew with MFO training on the bridge at all times.
3	No use of DP vessels	Not using DP vessels will cause additional seabed and benthic habitat impacts through the need to use anchoring to hold position during pipelay. The use of DP also decreases pipelay duration and reduces impact to other users through shorter timeframe.
4	Cease noise generating activities (e.g. DP) when near marine fauna	Ceasing DP activities when near sensitive fauna may reduce the potential for impacts, however, the potential for impacts beyond behavioural disturbance are very low. Engine/DP thruster noise cannot reliably be ceased due to the safety critical role of vessel propulsion. It is also not practical to cease

Additional management actions not adopted		Reasoning for rejection
		pipelay or other critical construction activities in a short timeframe as safely abandoning such operations can often take a number of hours (namely laying down the pipeline or disconnecting from a structure), during which time the impacted fauna will have left the area. Therefore, this control is not deemed feasible.
5	Soft start/power-up procedures for use of sonar equipment and use of fauna observation and shutdown zones	The systems being used are at a low power or are an intermittent type such that the reduced cumulative exposure would reduce TTS or PTS impacts for marine fauna and behavioural impacts were not considered credible
6	No use of helicopters	Use of helicopters required (e.g. vessel/crew transfers) and restriction will result in an overall longer duration construction activity and therefore noise impacts
7	Avoidance of night work for routine trenching and Xcentric Ripper use	Avoidance will result in an overall longer duration construction activity and therefore noise impacts and also increase the safety risk profile. The cost of implementing this far exceeds the benefit gained.

7.6.4.3 Demonstration of ALARP and residual impact

The use of vessels on DP, survey equipment, and ROVs for the Activity are unavoidable as there are no other options for safe installation methods. The activity vessels are expected to produce similar noise emissions to other marine vessels that frequent or transit through the vicinity of the Project Area.

The sound levels generated by surveys are medium to high frequency and decay rapidly with distance travelled from the source, as demonstrated by Zykov (2013), with the furthest distance survey noise is expected to travel being hundreds of metres.

Using helicopters to transfer personnel to and from activity vessels is necessary to allow operational activities to occur safely and effectively. Some personnel also need to be rotated to and from other locations, and a rapid method to transfer personnel is required in an emergency. A control measure prohibiting helicopters from landing or taking off in the presence of marine megafauna would introduce an unacceptable risk to human life. Lastly, the use of additional vessels for crew transfer would also prolong the presence of noise generating sources (i.e. vessel engines and thrusters) within the Project Area.

Trenching and rock breaking activities within Darwin Harbour will follow industry standard measures to prevent physiological impact to marine megafauna from noise (as per MMNMP BAS-210 0045), including implementation of Observation and Exclusion Zones and associated adaptive management measures, use of marine fauna observers to monitor zones and use of soft-starts where practicable. Observation (150 m) and exclusion (50 m) zones for marine mammals and turtles have been informed by underwater noise modelling and appropriate thresholds to ensure the scale of these zones are sufficient to meet environmental objectives. Observation zones will be monitored (during daylight) for 10 minutes prior to commencing trenching in order to reduce any potential fauna disturbance.

In addition to the implementation of monitored zones, marine megafauna are expected to display avoidance behaviour of sound source at close ranges, thereby reducing the potential for physiological impact. For contingency hydraulic hammering, while not expected to be required, the zones have been increased significantly and additional measures put in place (as per MMNMP BAS-210 0045) to ensure physiological impacts to do not occur to marine megafauna. These measures include limiting hydraulic hammering to no more than 8 hrs over a 24 hr period (daylight hrs only) and using a separate MFO vessel to patrol the observation zone.

While there is the potential for behavioural response on larger scales of 100s of metres to 1000s of metres from continuous noise from trenching activities, depending upon fauna type, the activities are not expected to produce emissions significantly louder than other marine vessels that frequent or transit through the vicinity of the Project Area (e.g., cargo ships, LNG tankers, cruise ships and offshore oil and gas vessels). Given construction activity is temporary and trenching is expected to last for ~2-3 months, the addition of Project noise sources to the existing ambient noise environment is not expected to result in any significant additional behavioural effects within Darwin Harbour. The activity is unlikely to affect the health of and/or displace marine megafauna, as biologically important behaviours can continue given the widespread availability of suitable habitat within Darwin Harbour relative to the size of behavioural effect ranges.

Santos has considered the actions prescribed in various recovery plans and conservation advice, such as the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), when developing the controls relevant to potential construction activities to minimise noise impacts on marine fauna. Management controls are in place to reduce operating noise, including vessel operational protocols, and to adhere to the fauna interaction management stated in EPBC Regulations (Part 8). Trained MFO personnel will be present on pipelay, dredge and rock installation vessels/barges during daylight hours, including one crew member with MFO training on the bridge at all times. All marine fauna interactions and observations will be appropriately recorded and reported to DEPWS/NT EPA and the DCCEEW, as required. As such, noise emitted during the activities is not expected to significantly impact on marine fauna within the Project Area.

The potential benefit of avoiding locations of higher marine megafauna sensitivity at certain times of the year, such as nesting periods for turtles and dolphin calving periods, is considered disproportionately low compared to the implications to Project scheduling and costs. There are also mutually exclusive sensitivity periods for dolphins and turtles. While there are known flatback turtle nesting sites (Cox Peninsula and Casuarina Beach), and a known period of increased nesting activity (June to September), the densities of nesting turtles in these areas are very low and not significant on a regional scale (Chatto and Baker, 2008). Furthermore, these sites are on a scale of 1000s of meters away from the pipeline route and trenching areas (as they are from existing vessel traffic using navigation channels) and the relative risk of behavioural effects to turtles at this scale from vessel noise is considered low (Popper et al., 2014).

For dolphins, there is evidence that there is a peak in calving within Darwin Harbour between October and April (Palmer, 2010). Important areas have not been defined however and given the high mobility of dolphin species within Darwin Harbour and the use of adjoining coastal areas (Griffiths et al., 2019) it is unlikely that behavioural disturbance around DPD Project activities, relative to the total area of Darwin Harbour and surrounding coastal waters, would have a significant impact on calving behaviour.

Other additional management actions were considered but rejected due to lack of feasibility, the associated cost or because the effort was disproportionate to any benefit (**Table 7-11**). Therefore, the risks to marine fauna from noise associated with the DPD Project activities are considered to be ALARP.

The potential consequence of noise emissions on receptors is assessed as II - Minor following the implementation of standard and additional (ALARP) management actions and will not have a significant impact on any habitat identified as critical to the survival of marine megafauna. With the management actions in place, no significant impacts are expected. Therefore, the impacts of noise emissions to the receiving environment are ALARP and considered environmentally acceptable.

7.6.5 Light emissions

7.6.5.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-14**.

Table 7-14: Light emissions EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
Minimise light disturbance to fauna and fauna habitat (including to turtle nesting beaches and turtle hatchlings)	Nighttime task light generation is minimised as described in management actions	Records of vessel light spill on Darwin Harbour turtle nesting beaches Records of HSE inspections Records of inductions i.e., inductions cover use of excessive task lighting at night.

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this planned impact are show in **Table 7-11**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-15: Management actions for light emissions

MA Reference	Management actions
Standard management actions	
Avoidance	
DPD-MA58	Pipelay vessels will have enclosed pipe welding decks
Mitigation	
DPD-MA59	Shielding, where practicable, and/or orienting operational lights (excluding navigational lighting) on vessels to limit light spill to the environment
DPD-MA60	Housekeeping measures will be adopted, including requiring all crew to keep shutters on windows closed at night, to limit light emissions from vessels
Additional (ALARP) management actions	
Mitigation	
DPD-MA61	Vessel searchlights will only be operated in an emergency situation
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA109	Cultural heritage training and cultural ceremony
DPD-MA110	First Nations cultural heritage monitor in the field, subject to availability of the cultural heritage monitor
Monitoring	
DPD-MA62	Santos will document vessel light spill on Darwin Harbour turtle nesting beaches as part of the DPD Project's environmental monitoring program

Table 7-16: Additional management actions not adopted for light emissions

Additional management actions not adopted		Reasoning for rejection
1	Crew transfers or loading of supplies (not including linepipe deliveries) which require direction of floodlights outside vessel will not occur during hours of darkness within 10 km of turtle nesting beaches during peak hatchling season. Linepipe loading may require additional lighting as deemed necessary during operation to maintain a safely lit work area.	Nearby beaches are not significant turtle nesting beaches. Significant turtle nesting beaches are >10 km from the Project Area. Therefore, the cost of this management action is disproportionately higher than the change to environmental impact.

Additional management actions not adopted		Reasoning for rejection
2	Do not undertake gas export pipeline installation during peak turtle nesting and hatchling emergence season	Nearby beaches are not significant turtle nesting beaches. Significant turtle nesting beaches are >10 km from the Project Area. Therefore, the cost of this management action is disproportionately higher than the change to environmental impact.
3	Sequence activities to limit the time pipelay, and associated activities, are performed within peak internesting periods and near important habitat for listed marine turtles.	Nearby beaches are not significant turtle nesting beaches. Significant turtle nesting beaches are >10 km from the Project Area. It is additionally not practicable to time the start date of the activity due to scheduling constraints. Therefore, the cost of this management action is disproportionately higher than the change to environmental impact.
4	Vessels shall be fitted with turtle friendly (low vapour sodium or LED) directional lighting (requirement applies to external lighting only)	Nearby beaches are not significant turtle nesting beaches. Significant turtle nesting beaches are >10 km from the Project Area. Not practicable to change out vessel lights for short duration activities and also lighting must meet navigational requirements. White lights required for operational requirements will be directed onto work areas and/or shielded to limit external light spill. It is therefore not feasible.
5	Marine fauna observers specifically looking out for turtle hatchlings entrapped within light spill with adaptive management measures should a significant number be spotted.	Possibility of entrapment will be low, due to use of shaded and directed inward lighting and with only very low-density turtle nesting locations nearby. Nearby beaches are not significant turtle nesting beaches. While dedicated observers for turtle hatchlings are not proposed, project vessels will record all fauna interactions and incidents observed. Corrective actions will apply as part of the incident reporting and investigation process.
6	Do not perform pipe transfer operations at night when operating within 10 km of marine turtle nesting habitat during peak hatchling emergence season.	Nearby beaches are not significant turtle nesting beaches. If pipe transfer is restricted to day light hours, the pipelay vessel will run out of pipe and it will have to slow lay, stop laying or lay down the pipe. Slowing down pipelay will result in an increase in the amount of time that the pipelay is operating within 10 km of marine turtle nesting habitat. Light spill during pipe transfer will be minimal as flood lights will be directed onto the deck of the PSV and not the surface of the water. It is also temporary. Therefore, the cost of this management action is disproportionately higher than the change to environmental impact.
7	Restrict lighting to navigation lights only	Operational lighting, including lighting of work areas and decks, is required for safe working conditions. Therefore, the cost and increased risk of this management action is disproportionately higher than the change to environmental impact.

7.6.5.2 Demonstration of ALARP and residual impacts

Artificial lighting is required 24 hours a day during the activity to maintain operational and navigational safety. A minimum level of artificial lighting is required on a 24-hour basis to alert other marine users of the activity. There are also minimum light requirements that will be necessary to provide safe working conditions. To reduce lighting at night further would restrict the activity hours resulting in the activity taking approximately twice as long to complete. This would increase the period of time the Project Area would need to be avoided by other marine users and the amount of waste, discharges and emissions produced. The larger scale consequences associated with reducing light levels during construction activities are disproportionate to the environmental benefits.

Lighting of the vessels is industry standard and required to meet relevant maritime and safety regulations. Pipelay vessels will have enclosed pipe welding decks, and vessel operational lights will be shielded and/or oriented (excluding navigational lights) to limit light spill into the environment and sensitive receptors. The potential consequences of the anthropogenic light sources in the Project Area are considered to be restricted to short-term behavioural impacts on individual fauna that may be present in the Project Area during the activity.

The activity will not compromise the objectives as set out in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b) or the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023a), as biologically important behaviours of nesting turtle adults and emerging/dispersing hatchlings at important sites can continue given that there are no regionally significant turtle nesting beaches close to the Project Area. Additional management actions that were considered feasible and cost effective were adopted, such as documenting vessel light spill on Darwin Harbour turtle nesting beaches, and only operating vessel searchlights in an emergency situation (**Table 7-15**). Therefore, the use of 24-hour per day artificial lighting at an intensity to allow work to proceed safely is considered ALARP and acceptable.

BIAs for flatback turtles overlap the Project Area. Significant impacts are not expected on nesting turtles or emerging/dispersing hatchlings, and light emissions from the activity will not cause turtles to be displaced from these habitats. The nearest known nesting sites are at Cox Peninsula and at Casuarina Beach, although these are not considered significant nesting areas and Casuarina Beach is also a popular recreational area with significant potential for land disturbance from people and animals, including lighting (e.g., bonfires).

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) specifies the following priority action for the turtles in relation to light pollution:

+ Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.

The Project Area overlaps an internesting buffer habitat critical to the survival of flatback turtles, which extends 60 km from key nesting locations. However, internesting female turtles are not impacted by light emissions from either natural or anthropogenic sources, as they do not use light as a cue for this behaviour. Therefore, light emissions will not have a significant residual impact on marine turtles or any habitat identified as critical to the survival of marine turtles, and residual impact is considered environmentally acceptable.

7.6.6 Routine vessel discharges

7.6.6.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-17**.

Table 7-17: Routine vessel discharges EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
Minimise environmental impacts from waste and liquid discharges generated during DPD construction activities	Zero recorded environmental incidents of vessel discharges not meeting regulatory requirements	Incident records of non-compliant discharges

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this planned impact are shown in **Table 7-18**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-18: Management actions for routine vessel discharges

MA reference	Management Action
Standard management actions	
Mitigation	
DPD-MA63	Vessels will comply with relevant regulatory requirements under *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and *Navigation Act 2012* with respect to planned discharges and waste management, including: Marine Order 91 – Marine Pollution Prevention: Oil, which implements Annex I of the MARPOL Marine Order 95 – Marine Pollution Prevention: Garbage, which implements Annex V of the MARPOL Marine Order 96 – Marine Pollution Prevention: Sewage, which implements Annex IV of the MARPOL Vessels will comply with *Marine Pollution Act 1999* (NT) and the *Waste Management and Pollution Control Act 1998* (NT) with respect to planned discharges
DPD-MA65	Santos Marine Assurance Process
Additional management actions	
N/A	
DPD-MA108	HSE inductions will include environmental requirements and cultural values

Table 7-19: Additional management actions not adopted for routine vessel discharges

Additional management actions not adopted		Reasoning for rejection
1	Compulsory storage and transport of sewage, putrescible and waste for disposal onshore regardless of legislative requirement	Waste is managed in accordance with required legislative controls and discharge of sewage, greywater, and putrescible results in a negligible impact. This may include discharge to marine waters where this is permissible or storing and disposing onshore. If onshore discharge was designated as compulsory for the Project the additional costs for transport and disposal, increased health, and safety risks (e.g., hygiene) and increased environmental impact (e.g., atmospheric emissions from vessels transporting waste) may outweigh any environmental benefit gained. This may differ from vessel to vessel depending upon the sewage storage and treatment options and the location of the vessel with relation to Darwin Port, NT waters and Commonwealth waters.

7.6.6.2 Demonstration of ALARP and residual impact

Vessel waste is managed in accordance with marine legislation governing the discharge of sewage, greywater, and putrescibles. The additional costs, health and safety risks (i.e., hygiene) and environmental impact (i.e., emissions) may outweigh any environmental benefit gained by taking vessel waste for onshore disposal. Notwithstanding this, the Project Area is within NT waters and therefore discharges of food wastes cannot occur in the Project Area (unless for safety reasons or that results from damage to a vessel or vessel equipment) as per MARPOL V, given effect by the *Marine Pollution Act 1999* (NT). Discharge of sewage from vessels in Australian waters is permissible provided requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, which reflects requirements of MARPOL Annex IV and AMSA Marine Order 96, are met. The MARPOL standard is considered to be the most appropriate standard, given the nature and scale of the activities. These standards are internationally accepted and used industry wide.

The proposed standard management actions and additional management actions that are considered feasible and cost effective for routine vessel discharges are considered appropriate to manage the risk to ALARP. Additional management actions that were not adopted are detailed in **Table 7-19**, with reasoning for their rejection.

Routine vessel discharges are not expected to have a negligible impact to the receiving environment with the management controls proposed, including compliance with all MARPOL requirements. Therefore, compliance with the relevant and appropriate MARPOL requirements and standards is expected to reduce the residual impacts to a level which is considered environmentally acceptable.

7.6.7 Pre-commissioning water extraction and discharges

7.6.7.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-20**.

Table 7-20: Pre-commissioning discharges EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
Minimise environmental impacts from pre-commissioning water extraction and discharges generated during DPD construction activities	Zero environmental harm resulting from mismanagement of pre-commissioning water extraction and discharges	Number of recorded incidents and severity of incidents

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this planned impact are shown in **Table 7-21**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3.**

Table 7-21: Management actions for pre-commissioning water extraction and discharges

MA reference	Management Action
Standard management actions	
Mitigation	
DPD-MA66	Protection/screening of abstraction hose end to prevent fauna entrainment during water winning activities
DPD-MA67	Backflush water will be discharged onto existing disturbed shore crossing construction site so that it drains into the intertidal area and solids disperse with tidal movement, minimising turbidity effects
Additional management actions	
DPD-MA68	Where possible, and dependant on the progress of shore crossing rock installation at time of FCGT activities, backflush water will be discharged onto installed rock, to baffle the flow of discharged backflush water

Table 7-22: Additional management action not adopted for pre-commissioning water extraction and discharges

Additional management actions not adopted		Reasoning for rejection
1	Use of potable water instead of seawater for pre-commissioning activities	Potable water isn't typically used for pre-commissioning due to the difficulties in obtaining the large volumes required – potable water is normally transported by road tankers with only 20 – 30m^3 capacity, compared with ~ 50,000 m^3 required to fill the DPD Pipeline. Potable water would also require treatment with some chemicals such as oxygen scavengers and biocides to mitigate oxygen or bacterial corrosion. A reverse osmosis (RO) plant could be set up on site to manufacture "potable water" from seawater, but normally the chloride levels will be higher from an RO plant than potable water which could lead to corrosion. This would also need a seawater winning spread. This would introduce additional impacts such as discharge of a high salinity waste stream and would have large pumping/energy requirements.

7.6.7.2 Demonstration of ALARP and residual impact

There are no additional practicable alternatives to using seawater for pre-commissioning. Potable water is not used for testing due to the difficulties in obtaining the large volumes required. As discussed in **Table 7-22**, the use of potable water or an RO plant are not practicable.

The proposed standard management actions and additional management actions that are considered feasible and cost effective for pre-commissioning water extractions and discharges are considered appropriate to manage the risk to ALARP. Additional management actions that were not adopted are detailed in **Table 7-21**, with reasoning for their rejection.

There have been no additional control measures, relevant to pre-commissioning water extraction and discharges, adopted as a result of consultation (**Section 9).**

Pre-commissioning discharges are not expected to have significant residual impact to the receiving environment with the management controls proposed, including compliance with all requirements. As there is potential for marine fauna entrapment from water winning activities the abstraction hose will be fitted with protection/screening preventing impacts to marine fauna. Increased turbidity will be limited by draining it into the disturbed construction intertidal area which allows solids to disperse with the tidal flow.

Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan and some bird and shark species. However, the routine vessel and pre-commissioning discharges are not expected to have significant residual impact to the receiving environment with management actions proposed. Therefore, the impact level of routine vessel and pre-commissioning discharges due to vessel-based activities is considered ALARP and acceptable.

7.6.8 Atmospheric emissions

7.6.8.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-23.**

Table 7-23: Atmospheric emissions EPOs and associated performance criteria

EPO	Performance criteria	
	Target/s	Performance Indicator/s
Minimise environmental impacts from atmospheric emissions generated during DPD construction activities	Compliance with preventative maintenance procedures for equipment utilised for construction activities that generate atmospheric emissions combustion engines, incinerators and ozone depleting substances (ODS) containing equipment	Planned maintenance records

These EPOs align with the following NT EPA Factor objective (NT EPA 2022):

+ Air quality – Protect air quality and minimise emissions and their impact so that environmental values are maintained.

The management actions for this planned impact are shown in **Table 7-24.** Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-24: Management actions for atmospheric emissions

MA reference	Management actions
Standard management actions	
Mitigation	
DPD-MA55	Maintenance of vessel, helicopter, vehicle and equipment combustions engines and vessel incinerators as per planned maintenance system
DPD-MA69	Atmospheric emissions from combustion, incinerators and ODS managed in accordance with standard maritime practice (MARPOL) MARPOL standards include no incineration in harbour
DPD-MA70	Monitoring and reporting of fuel consumption and calculated GHG emissions
DPD-MA71	Use of low sulphur diesel
DPD-MA100	Vessel equipped and crewed in accordance with Australian maritime requirements
Additional (ALARP) management actions	
DPD-MA108	HSE inductions will include environmental requirements and cultural values
N/A	

7.6.8.2 Demonstration of ALARP and residual risk

Power generation through combustion of fossil fuels is essential to undertaking the construction activities. There are no practicable alternatives to the use of equipment, vessels and vehicles powered by combustion engines for the activity. Given the routine maintenance of these systems by suitably qualified personnel, all practicable management measures are considered to have been implemented.

Atmospheric emissions from vessels are managed in accordance with marine legislation and results in negligible impacts. Part of the Project Area is within Darwin Harbour, where incineration is prohibited. However, for other areas outside of Darwin Harbour the additional costs, health and safety risks and environmental impact (i.e., emissions) from returning waste to shore for vessel operating outside of the harbour (i.e., additional increased fuel combustion for additional vessel trips) outweigh any environmental benefit gained by preventing incineration, so incineration may be used in these areas.

There is no option other than to use refrigeration systems (e.g., air conditioning and food refrigeration) to provide acceptable workplace conditions and meet food hygiene standards. Additionally, there is no practical alternative to using ODS as refrigeration chemicals. Accidental release and fugitive emissions of ODS has the potential to contribute to ozone layer depletion. Maintenance of refrigeration systems containing ODS is on a routine, but infrequent basis, and with controls implemented, the likelihood of an accidental ODS release of material volume is considered rare.

Records of fuel consumption during construction works will be maintained to identify the quantity of GHG emissions generated from fuel combustion. This information would inform annual reporting under the *National Greenhouse and Energy Reporting Act 2007*. Atmospheric emissions from vessels are permissible under the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, which is enacted in Australian waters by Marine Order 97 (Marine pollution prevention – air pollution) (which also reflects MARPOL Annex VI requirements). This is an internationally accepted standard that is used industry wide, and compliance with MARPOL standards is required under Australian law. Regulations include the requirement to control the level of NO_X and SO_X from vessel engines. This is managed by using low sulphur diesel called MGO or MDO. These fuels have lower sulphur content and burn cleaner resulting in lower emissions of nitrogen oxides and particulate matter. Compliance with these requirements, together with implementation of the controls listed above, reduces to ALARP and acceptable the environmental impacts associated with air emissions.

The assessed residual consequence for this impact is negligible and cannot be reduced further. It is considered therefore that the impact of the activities conducted is ALARP and considered environmentally acceptable.

7.6.9 Contingency pipeline discharges

7.6.9.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-25**.

Table 7-25: Contingency construction and pre-commissioning pipeline discharges EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	**Performance Indicator/s**
Minimise environmental impacts from contingency treated seawater discharge	No significant impact to marine water quality from due to contingency pipeline dewatering	Water quality monitoring report
	Treated seawater chemical usage and discharge preformed as	Contingency treated seawater discharge procedure and post-discharge report

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
	detailed in management actions (**Table 7-26)**	

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this planned impact are shown in **Table 7-26.** Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-26: Management actions for contingency construction and pre-commissioning pipeline discharge

MA reference	Management actions
Standard management actions	
Avoidance	
DPD-MA72	Pipeline installation procedures Maintenance requirements for pipelaying equipment to minimise risk of operational failure Redundancy in nearshore pipelay vessel anchors Deep water pipelay vessel will have redundancy in station keeping capabilities in operating in DP2 (as a minimum)
Mitigation	
DPD-MA73	Chemical selection procedure for all chemicals planned to be release to the marine environment
DPD-MA74	Calibrated chemical dosing system in place to ensure accuracy of chemical dosing
DPD-MA75	If contingency use and discharge of treated seawater is required, the lowest required concentration of treated chemical will be evaluated and used (up to a maximum discharge of 400 ppm) in order to meet pipeline preservation requirements
DPD-MA76	Pipeline dewatering of treated seawater will be through arrangement orientated to promote dispersion and direct discharge away from seabed
Monitoring	
DPD-MA77	In the unlikely event that the pipeline requires contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair, water quality monitoring at the discharge location will be conducted to confirm the concentration and dispersion of treatment chemicals
Additional management actions	
Mitigation	
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA112	Contractor contingency pipeline preservation procedure and specification

Table 7-27: Additional management actions not adopted for contingency pipeline discharges

Additional management actions not adopted		Reasoning for rejection
1	Do not discharge treated seawater	Chemically treated seawater will be used as a last resort, should it be necessary to ensure the long-term integrity of the Nearshore GEP Pipeline. If recovery from a wet buckle does not occur within a short period (days to 1-2 weeks), then the risk of corrosion beyond that already that already allowed for in the pipeline design will need to be mitigated, with the displacement of any raw seawater with treated seawater. Company requires the ability to use treated seawater to protect the integrity of the pipeline to cover all possible scenarios.

7.6.9.2 Demonstration of ALARP and residual impact

Contingency treated seawater discharge is a planned response to prolonged wet buckling or a stuck pig which is an unplanned event. The use of chemically treated seawater will only occur if it is necessary to ensure the long-term integrity of the pipeline. If recovery from a wet buckle does not occur within a short period (days to 1 – 2 weeks), then the risk of corrosion beyond that already allowed for in the pipeline design will need to be mitigated, with the displacement of any raw seawater with treated seawater. Santos requires the ability to use treated seawater to protect the integrity of the pipeline to cover all possible scenarios.

Standard management actions have been adopted to avoid the discharge activity in the first instance by ensuring that correct procedures are followed, and operations equipment are properly maintained to reduce the risk of operational failures during pipelay activities. Additionally increasing vessel stability with anchoring and DP will reduce the risk of damage to the pipeline.

Should an event occur, the mitigations reduce the impact of treated seawater discharge by ensuring that chemicals that minimise impact on marine fauna and water quality are utilised and the amount of these used are calculated for the lowest required concentration. Further, by positioning the discharge valve in a specific direction dispersion is promoted reducing localised impacts. Finally, the monitoring in place confirms the concentration and dispersion of the treatment chemicals and allows for timely adjustments. All feasible and cost-effective additional management actions have been adopted to manage the risks to ALARP and acceptable levels. Additional management actions that have not been adopted are described in **Table 7-26**, with the reasoning for rejection.

The potential consequence of contingency pipeline discharges has been determined by discharge modelling and impacts are predicted to be minor and not significant. The assessed residual consequence for this impact cannot be reduced further and is considered ALARP and acceptable.

7.7 Unplanned event - risk management strategies

The Santos environmental assessment identified six unplanned events associated with for the activities to be undertaken in the Project Area. Risk management strategies have been adopted in this Offshore CEMP based on the ENVID undertaken for construction activities in June 2022 (Refer to **Section 6**).

7.7.1 Dropped objects

7.7.1.1 Environmental performance objectives, performance criteria and management actions

The EPO relevant to this impact, including performance criteria, are described in **Table 7-28**.

Table 7-28: Dropped objects (including accidental release of non-hazardous waste) EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
No environmental impact resulting from accidental release of non-hazardous solid waste and dropped objects	Zero incidents of loss of equipment/cargo overboard from vessels resulting in a consequence II – Minor or above	Incident records

These EPOs align with the following NT EPA Factor objectives (NT EPA 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this unplanned risk are shown in **Table 7-29**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-29: Management actions for dropped objects

MA reference	Management Actions
Standard management actions	
Avoidance	
DPD-MA64	Vessels will comply with relevant Marine Orders, including: Marine Order 95 – Marine Pollution Prevention: Garbage
DPD-MA78	Implementation of Santos approved standards and procedures for outboard lifts (including lifts over live infrastructure)
DPD-MA79	All lifting and winching equipment will undergo inspection, testing and certification as per applicable Laws, Codes and Standards
Mitigation	
DPD-MA80	Dropped object recovered where safe and practicable to do so
DPD-MA81	Identification of no lift zones or additional controls where relevant in proximity to subsea assets and infrastructure as documented in relevant lifting and operational procedure/s
DPD-MA82	No outboard lifting operations will be completed in Company defined “no lifting zones” which will be identified in navigational systems
DPD-MA83	Emergency response implemented to minimise potential for impacts in the event a dropped object causes a loss of containment from the existing Bayu-Undan GEP
Additional management actions	
Avoidance	
DPD-MA84	Pipeline installed along pre-approved route, which is designed where practicable to avoid the potential for impact to habitat/cultural seabed features or assets from a dropped object
DPD-MA108	HSE inductions will include environmental requirements and cultural values
Additional management actions not adopted	
N/A	

7.7.1.2 Demonstration of ALARP and residual risk

Table 7-17 details the management actions adopted to reduce impacts of dropped objects to ALARP. These control measures are well understood and defined through legislative requirements and are standard industry practice. With the above controls in place, Santos considers the residual risk arising from a dropped object is ALARP. By following safe lifting procedures and ensuring equipment reliability the risk of accidents is reduced, which prevents the occurrence of a dropped object and therefore subsequent damage to the seabed and benthic environment. Through the adoption of no lifting zones and the installation of the pipeline along a pre-surveyed and approved route, the potential for any dropped objects impacting important habitat or cultural features is mitigated. Where practicable and safe to do so, dropped objects will be recovered.

Vessel will adhere to the requirements of ASMA Marine Order 95 / MARPOL Annex V (as enacted through legislation) with respect to the management of garbage to prevent waste from entering the sea and potentially harming marine life and habitats.

The activity, and management actions will be conducted in a manner that is acceptable under the Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia, 2018), relevant recovery plans, conservation advice, and wildlife conservation plans.

With the controls in place to prevent accidental release of dropped objects the residual impact to the marine environment is considered low and reduced to a level that is considered acceptable.

7.7.2 Introduction of invasive marine species

7.7.2.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-30**.

Table 7-30: Introduction of invasive marine species EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
Avoid introducing IMS into NT waters	DPD Project vessels assessed as low risk for IMS prior to entry into Project Area/Darwin Harbour Ballast water management will be done according to the Australian Ballast Water Management Requirements.	Records of vessel IMS risk assessment Ballast water records system maintained by vessels.

These EPOs align with the following NT EPA Factor objective (NT EPA 2022):

+ Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this unplanned risk are shown in **Table 7-31**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-31: Management actions for introduction of invasive marine species

MA reference	Management Action
Standard management actions	
Avoidance	
DPD-MA85	Vessels equipped with effective anti-fouling coatings as required for class
DPD-MA86	Ballast water management will comply with MARPOL requirements (as applicable to class), Australian Ballast Water Management Requirements and *Biosecurity Act 2015*
DPD-MA87	Apply risk-based IMS management for vessels and immersible equipment – vessel and immersible equipment mobilised from outside of the Project Area/Darwin Harbour must be assessed as having a low risk of IMS prior to entering the Project Area/Darwin Harbour
DPD-MA88	Vessels having suitable anti-fouling coating (marine growth prevention system) in accordance with the *Protection of the Sea Act 2006*
DPD-MA65	Santos Marine Assurance Process
Additional management actions	
Avoidance	
DPD-MA108	HSE inductions will include environmental requirements and cultural values

Table 7-32: Additional management actions not adopted for the introduction of invasive marine species

Additional management actions not adopted		Reasoning for rejection
1	Use of Australian vessels only	Not feasible to only use Australian vessels given constraints on availability and suitability. This also doesn't guarantee that a vessel is IMS free depending on where in Australia the vessel is mobilised.
2	All vessels to be dry docked, cleaned, and inspected for IMS	Santos requires a risk assessment to be undertaken for project vessels which considers factors that lessen the risk of IMS incursion and requires vessel to achieve a low risk score. These factors include a vessel's history of dry-docking, cleaning and IMS inspection but these activities are not necessarily mandatory depending upon vessel history and other risk factors. The costs of applying mandatory dry-docking and cleaning is considered disproportionate given the existing risk-based approach being applied.
3	Heat or chemical treatment of ballast water to eliminate IMS	Cost and effort is considered to outweigh benefits given existing regulatory requirements for ballast exchange will be adhered to

7.7.2.2 Demonstration of ALARP and residual risk

Vessels and submersible equipment are required for the DPD Project.

Ballast water exchange will be managed as per the Australian Ballast Water Management Requirements (Commonwealth of Australia, 2020a), and a vessel biosecurity risk assessment in accordance with the Santos IMSMP (EA-00-RI-10172) will be undertaken to demonstrate vessels have low risk of IMS introduction. The vessels and equipment that are internationally mobilised will meet Australian biosecurity requirements, and proposed management is consistent with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009c).

Santos has adopted a risk-based approach to managing biofouling. Such an approach is consistent with other petroleum operators and is beyond that enforced on most commercial and recreational vessels that regularly transit the same bioregion. International vessels are given the highest priority to prevent the introduction of IMS into Australian waters. However, domestic vessels (interstate and locally sourced) mobilising from outside of the Project Area/Darwin Harbour are also risk-assessed to reduce the likelihood of spreading marine pest species already established in Australian waters. The biofouling risk assessment approach adopted by Santos will ensure the associated regulations prohibiting the introduction of non-endemic marine species will be met.

A combination of international and domestic vessels will be sourced for construction activities. Standard management actions to reduce the risk of an introduction of IMS to ALARP have been adopted. Other identified management actions were deemed not feasible and the reasoning for their rejection is provided in **Table 7-31**. With the above management actions and adherence to legislation and regulations, the risk of introducing IMS has been reduced to ALARP and acceptable levels. Therefore, the residual risk associated with IMS is considered by Santos to be environmentally acceptable.

7.7.3 Unplanned marine fauna interaction

7.7.3.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-33**.

Table 7-33: Unplanned marine fauna interactions EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	Performance Indicator/s
Avoid interactions resulting in injury to or mortality of protected marine megafauna	Zero incidents of interactions resulting in the injury or mortality of marine megafauna	+ Number of recorded incidents relating to marine fauna injury or mortality + MFO reports of sightings of live, injured or dead marine megafauna.

These EPOs align with the following NT EPA Factor objective (NT EPA, 2022):

+ Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this unplanned risk are shown in **Table 7-34**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-34: Management actions for marine fauna interaction

MA reference	Management Actions
Standard management actions	
Avoidance	
DPD-MA50	Vessel and helicopter contractor procedures will comply with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interaction with marine fauna
DPD-MA51	Personnel trained in MFO will be present on pipelay, dredge and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times
DPD-MA54	Vessels will adhere to Port of Darwin vessel speed limits
DPD-MA56	Observation and shut-down zones for marine fauna have been developed based on noise modelling results for trenching and standard protocols and include: + Observation (150 m) and exclusion (50 m) zones for marine mammals and turtles + Observation zone monitored for 10 minutes prior to commencing trenching. A Marine Megafauna Observation and Adaptive Management Protocol for routine trenching operations, including the use of Xcentric Ripper tool, is to be followed as per the MMNMP (BAS-210 0045)
DPD-MA66	Protection/screening of extraction hose end to prevent fauna entrainment during water winning activities
DPD-MA89	Inductions to include observing marine fauna
DPD-MA90	The TSHD shall be fitted with pre-sweeping mechanisms/chain curtains to mitigate turtle entrainment
Mitigation	
DPD-MA52	All marine fauna interactions and observations will be appropriately recorded and reported to the DEPWS/NT EPA and the DCCEEW as required
Additional management actions	
Avoidance	
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA114	Vessel speed restrictions in NT Coastal Waters

Table 7-35: Additional management actions not adopted for unplanned marine fauna interactions

Additional management actions not adopted		Reasoning for rejection
1	Restrict the timing of activities to operate outside of known sensitive periods only. Flatback turtle peak nesting period is June to September and olive ridley nesting peaks April to July. Dolphin peak calving is October to April	Project schedule is unable to avoid sensitive periods. Additionally, there is a low risk of impacts to individual fauna, and there is not expected to be an impact at population level or significant impacts on migratory or breeding behaviours. Beaches closest to the project area are also not considered significant turtle nesting beaches so this control is not considered relevant.
2	Activities will only occur during daylight hours	Construction works need to occur 24/7 to maintain project schedule. Increased project schedule may result in increase in vessel movements and potential for more cumulative impacts. Halting operations overnight could have pipeline fatigue implications that may reduce the pipeline integrity.

7.7.3.2 Demonstration of ALARP and residual impact

No alternative options to the use of vessels and supports (e.g. ROV and helicopters) are possible in order to undertake the activity. Any impact caused by the physical presence of vessels and supports is likely to be localised and temporary behavioural impacts only (e.g., avoidance behaviour) and are not expected to significantly impact any key life-cycle processes of marine fauna. Marine species are expected to resume normal behavioural patterns in the waters surrounding the Project Area in a short time frame following completion of the construction activities.

The use of a TSHD for trenching and water winning activities pose a risk of fauna entrainment. Dredging has been listed as a key threatening process for turtles (Commonwealth of Australia, 2017a) with dredging equipment potentially being the direct source of turtle mortality; however, the TSHD will be fitted with pre-sweeping mechanisms/chain curtains to mitigate unplanned impact with turtles. Additionally, the abstraction hose for water winning activities will have protection/screening for marine fauna. This is considered to manage this to ALARP and acceptable levels.

The inherent likelihood of encountering fauna in the Project Area is limited by the expected behaviour of individuals to move away from vessel noise. However, having trained MFO personnel onboard pipelay, dredge, and rock installation vessels will allow for early detection of marine fauna, which then prevents accidental disturbances. With low vessel speeds and compliance with fauna interaction procedures, including Regulation 8 of the EPBC Regulations 2000 (which aim to prevent adverse interactions of vessels with marine megafauna), a fauna collision is considered very unlikely. With the controls adopted, the assessed residual risk for this impact is ALARP and acceptable.

Marine fauna interaction risks are well understood and subject to regulation. The vessels and personnel that are mobilised will meet Australian requirements, and proposed management is consistent with relevant recovery plans, conservation advice, wildlife conservation plans, including the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a). Vessel personnel will complete Inductions outlining fauna interaction requirements, and there will be watchkeeping maintained from the vessel bridge to further reduce the impact.

It is considered that the proposed controls will reduce the residual level of impact to minor. Therefore, the residual risk associated with marine fauna interactions is considered by Santos to be environmentally acceptable.

7.7.4 Release of liquid hazardous materials

This section does not include management strategies for the release of fuels due to a vessel bunkering incident or a vessel tank rupture; these risks are discussed in **Section 7.7.5**.

7.7.4.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-36**.

Table 7-36: Release of liquid hazardous materials EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	**Performance Indicator/s**
Avoid significant environmental impact resulting from release of hazardous materials	Zero incidents of release of hazardous materials to the marine environment during DPD construction activities	Number of recorded incidents
	Response to incident implemented as per the relevant emergency response plans	Incident report including details of response

These EPOs align with the following NT EPA Factor objectives (NT EPA, 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this unplanned risk are shown in **Table 7-37**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-37: Management actions for release of hazardous material

MA reference	Management actions
Standard management actions	
Avoidance	
DPD-MA55	Maintenance of vessel, vehicle, helicopter and equipment combustions engines and vessel incinerators as per planned maintenance system
DPD-MA91	Inspection and maintenance for all equipment containing chemicals/hydrocarbons and chemical/hydrocarbon storage areas
DPD-MA93	ROV operations undertaken in accordance with good industry practice (in relation to hydraulic fluid control)
DPD-MA94	Procedures for helicopter refuelling
DPD-MA100	Vessel equipped and crewed in accordance with Australian maritime requirements
Mitigation	
DPD-MA92	Santos chemical selection procedure applied for chemicals planned to be discharged to the environment
DPD-MA95	Chemical storage areas designed to contain leaks and spills and inspected routinely
DPD-MA96	Spills will be managed in accordance with standard maritime practices as per vessel shipboard oil pollution emergency plan (SOPEP)
DPD-MA97	Spill clean-up kits available in high-risk areas
DPD-MA98	Bunding/secondary containment around hydrocarbon storage/transfer areas
Additional management actions	
Avoidance	
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA115	No PFAS or PFOS will be used in firefighting foam.

7.7.4.2 Demonstration of ALARP and residual impact

Storage and use of chemicals and hydraulic and lubricating oils or fluids for equipment and machinery, including for ROV operations, are required to undertake the DPD Project. While the use of hazardous chemicals cannot be avoided, the Santos chemical selection process will ensure that any project chemicals that will be discharged are risk assessed and selected with consideration of alternatives, so hazardous chemicals are not discharged.

Only volumes of hazardous materials as required for maintaining vessel capabilities or for project-specific purposes will be stored or handled on-board the vessels. The vessels will implement safeguards, as per relevant AMSA Marine Orders/MARPOL and Santos requirements which are applicable to other commercial vessels. Such safeguards include (but are not limited to) designated storage and handling areas, correct stowage, accurate labelling and marking, SDS information, spill clean-up equipment and containment.

Other management actions will be implemented including vessel maintenance systems, chemical management procedures, and shipboard marine pollution emergency plan (SMPEP)/spill response procedures included in shipboard oil pollution emergency plan (SOPEP). These actions will reduce the likelihood of an accidental release and reduce the residual impact if a release does occur.

Containment of small spills and use of spill containment kits on-board vessels will reduce the risk of spills reaching the marine environment. Bunding, drainage systems and spill response kits will be inspected and maintained so they can be used to contain potential spills. Hazardous liquids will be managed in accordance with relevant legislation, industry standards and Santos' procedures.

The management actions proposed are in line with applicable actions described in relevant recovery plans and conservation advice to reduce the risk of habitat degradation and deteriorating water quality (e.g., from pollution) to a low level, which is considered to be ALARP and acceptable by Santos.

7.7.5 Release of hydrocarbon (offshore vessel bunkering or vessel tank rupture)

7.7.5.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-38**.

Table 7-38: Hydrocarbon release (offshore vessel bunkering or vessel tank rupture) EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	**Performance Indicator/s**
No release of hydrocarbons to the marine environment as a result of the DPD Construction Activities	Zero incidents of unplanned discharge of hydrocarbons into the marine environment as a result of DPD construction activities	Number of recorded incidents
	Response to incident implemented as per the relevant emergency response plans (vessel SOPEP and DPD (NT waters) OPEP (BAS-210 0026))	Incident report including detail of response

These EPOs align with the following NT EPA Factor objectives (NT EPA, 2022):

- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions for this unplanned risk are shown in **Table 7-39**. Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-39: Management actions for hydrocarbon release (offshore bunkering incident or vessel fuel tank rupture)

MA reference	Management Actions
Standard management actions	
Avoidance	
DPD-MA65	Santos Marine Assurance Process
DPD-MA54	Vessels will adhere to Port of Darwin vessel speed limits
DPD-MA55	Maintenance of vessel, helicopter, vehicle and equipment combustions engines and vessel incinerators as per planned maintenance system
DPD-MA07	One vessel will act as a surveillance vessel within the Project Area during gas export pipeline installation and trenching activity
DPD-MA99	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements including: + Use of bulk hoses that have quick connect 'dry break' couplings + Correct valve line-up + Defined roles and responsibilities, and the specific requirement for bunkering to be completed by trained personnel only + Visual inspection of hoses prior to bunkering to confirm they are in good condition + Testing of the emergency shutdown mechanism on the transfer pumps + Assessment of weather/sea state + Maintenance of radio contact with Vessel during bunkering operations + Bunkering checklist + Visual monitoring during bunkering + Ensuring deck drainage bungs are in place prior to bunkering + Marine Order 91 – Marine Pollution Prevention: Oil + Bunkering to commence in daylight hours
DPD-MA100	Vessel equipped and crewed in accordance with Australian maritime requirements
DPD-MA101	Safety exclusion zone around DPD Project construction vessels (e.g., pipelay vessels), and a Notice to Mariners will be issued for offshore works formally advising all major shipping traffic. In addition, pipelay vessels will have attendant vessels that may act as guard vessels for work within the harbour.
DPD-MA102	No intermediate fuel oil (IFO) or heavy fuel oil (HFO) will be used in activity vessels working in the Project Area

MA reference	Management Actions
Mitigation	
DPD-MA97	Spill clean-up kits available in high-risk areas
DPD-MA96	Spills will be managed in accordance with standard maritime practices as per vessel shipboard oil pollution emergency plan (SOPEP)
DPD-MA103	Implement tiered spill response as per DPD Project specific OPEP in the event of an MDO spill
Additional management actions	
Avoidance	
DPD-MA108	HSE inductions will include environmental requirements and cultural values
DPD-MA113	Contractor cyclone management plans covering cyclone contingency actions
Monitoring	
DPD-MA104	Santos to make oil spill tracking buoys available on primary project vessel/s with Santos CSR/s and/or at local supply base for immediate deployment to assist with tracking of an oil spill

Table 7-40: Additional management actions not adopted for release of hydrocarbon (offshore bunkering incident or vessel fuel tank rupture)

Additional management actions considered		Reasoning for rejection
1	No bunkering of fuel during the pipeline installation activity	Vessels will routinely bunker when in port, as this is the safest and most cost effective means to refuel vessels. However due to the gas export pipeline installation method, the pipelay vessel cannot bunker alongside port facilities and requires bunkering within the Project Area to undertake the activity. Following implementation of the selected existing controls, the risk reduction associated with eliminating bunkering at sea is considered to be negligible. The potential impacts to schedule and associated cost of implementing the control is considered to be grossly disproportionate to the reduction in risk. The control has not been adopted.
2	Bunkering only during daylight hours	Bunkering only during daylight hours increases the likelihood of detecting a leak, as surface hydrocarbon sheens are typically more visible under sunlight. Bunkering operations are typically completed during daylight hours; however, circumstances may occur where bunkering is required during darkness (e.g., large volume transfers at slow rates or when bunkering is safer to perform at night due to prevailing metocean conditions). However, bunkering will typically commence in daylight hours.

Additional management actions considered		Reasoning for rejection
		Following implementation of the selected existing controls, the risk reduction associated with prohibiting bunkering during darkness is considered to be negligible. The cost of implementing the control is considered to be grossly disproportionate to the reduction in risk. The control has not been adopted.
3	Schedule activities to avoid coinciding with sensitive periods for marine fauna present in the Project Area	Project schedule is unable to avoid sensitive periods. Beaches closest to the Project Area are also not considered significant turtle nesting beaches. The cost of limiting the timing of activities would be excessive compared to the little to no reduction in risk of oil spill to significant turtle nesting beaches. Therefore, the impact to the Project schedule is greater than the environmental risk reduction.
4	Require all support vessels involved in the activity to be double hulled	Cost and availability of double hulled vessels make this control not feasible. In many instances Project vessel fuel tanks are located centrally (e.g. internal to vessel ballast tanks) which reduces the likelihood of fuel tank rupture in the event of a vessel collision.
Additional management controls considered specifically for *Seahorse* rock installation vessel		
5	Enforce additional vessel speed limitation of <6 knots	Whilst undertaking rock installation activities in the Project Area within Darwin Harbour the *Seahorse* vessel will be limited to ~ 1-2 knots. There will be Port of Darwin speed limits already in place. Additional speed restrictions will increase vessel time on water and potentially extend project activity time. Not considered warranted given low risk.
6	Limit the fuel inventory in *Seahorse* rock installation vessel largest fuel tank (capacity of 1269 m^3) thereby reducing the maximum volume that could be released in the event of collision and tank rupture.	Requires additional refuelling events which increases likelihood of refuelling incident and cost to project. Doesn't change likelihood of event but may decrease consequence. Potential increase in cost and risk not warranted based on unlikely likelihood risk.

7.7.5.2 Demonstration of ALARP and residual impact

The use of vessels is integral to activity and therefore risk of an unplanned hydrocarbon fuel releases cannot be eliminated completely.

Offshore vessel refuelling is standard industry practice and oil pollution legislation (*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and MARPOL Annex I) has been developed to safeguard against the risk of a hydrocarbon spill occurring during refuelling. Other hydrocarbon types such as HFO and IFO have specifically been prohibited as DPD Project vessel fuels. Only MDO/MGO and aviation fuel will be used in the Project Area to ensure potential environmental impacts are reduced to ALARP.

The combination of the standard prevention management actions (**Section 7.7.5**) (which reduce the likelihood of the event happening), the spill response strategies (which will reduce the consequence) together reduce the overall hydrocarbon spill risk. Management controls will be implemented, including pre-bunkering checklists, spill clean-up equipment and the SMPEP/SOPEP to minimise the risk of an accidental release, as well as reduce the impact if a release does occur. In addition to the vessel's SMPEP/SOPEP, Santos will provide support as required to a shipboard spill through the implementation of its DPD Project (NT Waters) OPEP (BAS-210 0026). Resources available to be deployed by Santos to support a vessel base spill include spill tracking buoys which will be located onboard primary project vessels.

Barriers in place to contain spills (e.g., ensuring deck drainage bungs are in place prior to start of bunkering, and spill containment kits) would prevent spills from reaching the marine environment. A vessel will act as a surveillance/guard vessel during pipeline installation, which will reduce the likelihood of collisions between other marine users and Project construction vessels. Santos will implement a safety exclusion zone around DPD Project construction vessels (e.g., pipelay vessels) and issue a Notice to Mariners for vessel-based construction work, further reducing the potential vessel collisions.

Given the controls detailed in **Table 7-40** and the additional controls identified, the residual risk for this impact is assessed to be Low and cannot be reduced further. It is considered that the impact of the activities conducted is reduced to ALARP and to an acceptable level.

A fuel spill risk review was specifically undertaken for proposed *Seahorse* rock installation vessel given this vessel has a relatively large fuel (MGO) tank (1,269 m^3) compared to other DPD Project vessels proposed for use in Darwin Harbour (tank sizes <600m^3). Limiting the fuel inventory of the largest tank and implementing a vessel-specific speed limit to this vessel were considered as potential additional management actions. Given the *Seahorse's* largest fuel tank is centrally located and protected by ballast tanks, the vessel will be operating at slow speeds (1-2 knots) when undertaking rock installation and the existing vessel restrictions and controls that exist with Darwin Port (including speed restrictions), these measures were not considered to offer a level of risk reduction that warranted their adoption. As part of this review, the management action of vessel cyclone contingency plans was highlighted, which is an existing measure in place for DPD Project during the cyclone season (November to April) but had not been previously listed. This is now included as DPD-MA113 for completeness.

The potential impacts from an MDO/MGO release from a vessel collision are acceptable based on the residual risk ranking.

Relevant requirements have been met including Santos' internal processes, the COLREGS (Convention on the International Regulations for Preventing Collisions at Sea), SOLAS (Safety of Life at Sea), and STCC (Standards of Training, Certification and Watchkeeping for Seafarers) Conventions, and related Marine Orders. Pollution, such as from a hydrocarbon spill, is identified as a threat in conservation advice for several marine species that may occur in the Project Area and as a threat in the North Marine Parks Network Management Plan (2018). Santos considers the selected controls are effective in managing the risk to these species to a level that is ALARP and acceptable.

7.7.6 Release of dry natural gas

7.7.6.1 Environmental performance objectives, performance criteria and management actions

The EPOs relevant to this impact, including performance criteria, are described in **Table 7-41**.

Table 7-41: Release of dry natural gas EPOs and associated performance criteria

EPO	Performance Criteria	
	Target/s	**Performance Indicator/s**
Avoid environmental impacts from the accidental release of dry natural gas from Bayu-Undan to Darwin pipeline	No releases of gas from the Bayu-Undan pipeline to the environment as a result of impact/drag or dropped object from the DPD construction activity	Number of recorded incidents
	Response to incident implemented as per the relevant emergency response plans	Incident report including details of response

These EPOs align with the following NT EPA Factor objectives (NT EPA, 2022):

- Air quality – Protect air quality and minimise emissions and their impact so that environmental values are maintained
- Marine environmental quality – Protect the quality and productivity of water, sediment and biota so that environmental values are maintained
- Marine ecosystems – Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

The management actions considered for this unplanned risk are shown in **Table 7-42.** Environmental performance standards and measurement criteria for these management actions are included in **Attachment 3**.

Table 7-42: Management actions for release of dry natural gas

MA reference	Management actions
Standard management actions	
Avoidance	
DPD-MA78	Implementation of Santos approved standards and procedures for outboard lifts (including lifts over live infrastructure)
DPD-MA82	No outboard lifting operations will be completed in Company defined “no lifting zones” which will be identified in navigational systems
DPD-MA83	Emergency response implemented to minimise potential for impacts in the event a dropped object causes a loss of containment from the existing Bayu-Undan GEP
DPD-MA105	Trenching will only occur within pre-programmed areas (using standard positional accuracy measures used in the industry)
DPD-MA106	Exclusion zones programmed on all primary vessels associated with the works to clearly indicate no entry zones and nearby pipelines – this will clearly identify areas for spud placement, anchor positioning and trenching activities
Additional management actions	
Avoidance	
DPD-MA81	Identification of no lift zones where relevant in proximity to subsea assets and infrastructure as documented in relevant lifting and operational procedure/s
DPD-MA108	HSE inductions will include environmental requirements and cultural values

7.7.6.2 Demonstration of ALARP and residual impact

The proposed DPD pipeline will typically be within 100 m of the existing Bayu-Undan Pipeline; therefore vessels will be operating in the vicinity of the Bayu-Undan pipeline. Damage to the Bayu-Undan pipeline may be caused by structure impact/drag or a dropped object with potential to result in a release of dry gas to the environment. The DPD pipeline route has been altered and optimised through consultation between Santos and the Regional Harbourmaster, which has resulted in approval of the pipeline route through Darwin Harbour under the *Ports Management Act 2015* (NT). A key outcome of these discussions was removing the pipeline route out of the shipping channel, where possible, to reduce the potential for future conflicts with any shipping channel modifications. By having the DPD Project pipeline in close proximity (<100 m) to the Bayu-Undan pipeline, incursion into the shipping channel is reduced and seabed disturbance is concentrated adjacent to a previously disturbed corridor.

The implementation of the management actions relating to Santos standard lifting procedures and no-lift zones over live infrastructure reduces the potential for direct impact to Bayu-Undan pipeline thereby avoiding a potential release of dry natural gas. The emergency response plans lower the consequence of an event by ensuring swift emergency response. All additional management actions that were deemed feasible have been adopted to reduce the impact to ALARP and an acceptable level (**Table 7-42**). There were no additional management actions that were identified and not adopted.

With the management actions in place to prevent an accidental release of dry natural gas the likelihood level of 'unlikely' for a release, and the minor impacts predicted from an unplanned release, the residual impact to sensitive receptors is reduced to very low and is environmentally acceptable.

8 Implementation strategy

This section, together with the environmental management framework provided in **Section 4** and the post-acceptance consultation implementation strategy provided in **Section 9.9**, presents the processes and procedures that will be implemented to ensure the environmental requirements within this Offshore CEMP will be met, including:

- Specific systems, practices and procedures that ensure both environmental impacts and risks are identified (and continue to be identified) and reduced to ALARP and acceptable levels and EPOs, Performance Criteria and Performance Standards of this Offshore CEMP are being met;
- A clear chain of command, outlining roles and responsibilities of personnel involved in the implementation, management and review of this Offshore CEMP;
- Measures to ensure that employees and/or contractors working in relation to this activity are aware of their responsibilities regarding the environment and have the appropriate skill and training;
- Auditing, review and revision processes;
- Incident recording and reporting in line with Santos and regulatory requirements;
- Maintenance of quantitative records of discharges and emissions; and
- Details of emergency response and oil spill arrangements.

This implementation strategy is consistent with the Barossa Health, Safety & Environment Management Plan for Execute (BAA-200 0003).

Stakeholder engagement is assessed separately for the requirements of the activity. Post-acceptance consultation implementation strategies are discussed in **Section 9**.

8.1 Leadership, accountability and responsibility

To enable the DPD Project to succeed in meeting environmental objectives as outlined within this Offshore CEMP, the following measures apply:

- Appropriately skilled and qualified DPD Project team is established with HSE accountabilities, responsibilities, and resources clearly defined;
- Setting of EPOs and Performance Criteria (including Targets and Performance Indicators) and establishment of the practices and tools used to measure performance and drive continual improvement (**Section 7** and **Attachment 3**); and
- Implementing HSE Leadership Teams with key contractors to discuss HSE performance and improvement.

The Barossa Project Director is responsible for delivery of the Barossa Development, including the DPD Project, and has responsibilities for:

- Accountability for project HSE performance
- Demonstrating strong and visible HSE leadership
- Endorsing HSE performance indicators and targets
- Communicating HSE performance and events to the Chief Operating Officer, Upstream Oil & Gas
- and Group Executive Committee.
- Providing HSE resources.
- Engaging with senior regulatory managers.

The Barossa Project Director is supported by the Barossa Project Management Team. The effective implementation of this Offshore CEMP requires collaboration and cooperation among Santos Barossa Team personnel and contractors. The accountabilities of key Santos and contractor personnel in relation to the implementation, management and review of the Offshore CEMP is outlined in **Table 8-1**. Santos' OPEP will outline the roles and responsibilities in an emergency.

Table 8-1: Chain of command, key leadership roles and responsibilities

Title (role)	Environmental responsibilities
Office-based personnel	
Santos Barossa Pipeline Delivery Manager	Accountable for implementation of this Offshore CEMP Responsible for communication of Santos' policies and standards to all employees and contractors for their adherence to the same Promotes HSE as a core value integral with how Santos does its business Empowers personnel to 'stop-the-job' due to HSE concerns Provides resources for management of offshore execution of the Activity Promotes a high level of HSE performance and drives improvement opportunities Accountable for ensuring development and implementation of contractor emergency response plans Maintains communication with Santos personnel Approves MoC documents, if acceptable and ALARP Provide sufficient resources to implement the management actions in this Offshore CEMP. Confirm Contractor personnel attend an environmental induction (**Section 8.2.1**) upon commencing work on the campaign. Confirm the Contractor meets the requirements of the Santos management system and relevant standards/procedures.
Santos Environment Manager	Provide adequate resources to support all environmental assurance activities associated with this Offshore CEMP. Develop an assurance program to implement and monitor Offshore CEMP commitments. Liaise with NT EPA, DME, DCCEEW and other regulators. Responsible for ensuring the environmental incident notification process meets Santos and regulatory requirements and confirming that investigations are completed to identify root causes Responsible for reviewing MoC documents Review and submit environmental performance reports and external environmental incident notification reports.
Santos Barossa Installation Engineer	Confirm the campaign is undertaken in accordance with this Offshore CEMP. Communicate any changes to the activity that may affect the risk and impacts assessment, EPOs, EPSs and MAs detailed in this Offshore CEMP to the Santos HSE team. Coordinate resources required to enable the commitments in this Offshore CEMP to be maintained. Confirm the reporting of environmental incidents meets both external and Santos' incident reporting requirements. Liaise with Santos Environmental Advisor on environmental incidents and what constitutes a reportable incident. Assists with the tracking and close out of any corrective actions raised from environmental audits as required by this Offshore CEMP.

Title (role)	Environmental responsibilities
	Empowers personnel to 'stop-the-job' due to HSE concerns Responsible for compliance with processes for HSE incident reporting, investigation, correction and communication Reviews MoC documents
Santos Marine Manager	Provides resources for marine assurance activities Responsible for maintaining Santos marine assurance processes and procedures
Santos Emergency Response Adviser	Provides overarching incident and crisis management responsibility Manages the crisis management team (CMT) and IMT personnel training program Reviews and assesses competencies for CMT, IMT, and field-based incident response team members Manages the duty roster system for CMT and IMT personnel Manages the maintenance and readiness of incident response resources and equipment
Santos Oil Spill Response Adviser	Provides ongoing guidance, framework, and direction on the DPD (NT Waters) OPEP (BAS-210 0026) Develops and maintains arrangements and contracts for incident response support from third parties Develops and defines objectives, strategies and tactical plans for response preparedness defined in the DPD (NT Waters) OPEP (BAS-210 0026) Undertakes assurance activities on arrangements outlined within the DPD (NT Waters) OPEP (BAS-210 0026)
Santos Environmental Advisor/s	Responsible for monitoring conformance with EPOs and environmental performance standards, and the implementation strategy in this Offshore CEMP Prepares, maintains and distributes the environmental compliance register Develop offshore environmental approval documents, including DPD Project EMPs and OPEP, for submission and acceptance by DME. Provide environmental inductions to contractor personnel. Ensure environmental inspections and audits are undertaken against Offshore CEMP commitments as per the Barossa Project Environmental Compliance Assurance Plan (BAA-200 0635). Review and approve chemical products that will be discharged to the marine environment and require assessment. Review biofouling risk assessments undertaken by Contractors. Prepare environmental performance reports. Report any environmental incidents or non-conformance with the EPOs, MA in this CEMP in accordance with Santos and statutory requirements. Advise on environmental incident reporting requirements, including what constitutes a reportable incident Collates environmental data and records Contributes to environment incident management and investigations Responsible for reviewing contractor procedures Provides operational environmental oversight and advice Facilitates the development and implementation of MoC documents Communicates Offshore CEMP requirements to subcontractors

Title (role)	Environmental responsibilities
Santos Barossa Consultation Coordinator	Prepare and implement the consultation program for the DPD activity. Maintains a contact and information database for consultation. Manage and report on any relevant consultation received in relation to the activity. Undertake ongoing engagement for the duration of the activity, as required. Undertakes notifications in accordance with **Table 8-3** Internally communicates new risks and (or) controls that are raised during post acceptance consultation Prepares quarterly updates
Contractor Project Manager	Responsible for ensuring implementation of the Activity in accordance with this Offshore CEMP. Provide the resources required to enable the commitments in this Offshore CEMP to be maintained. Confirm vessel management system and procedures are implemented and comply with the requirements detailed in this Offshore CEMP. Confirm personnel receive an environmental induction that meets the requirements outlined in this Offshore CEMP Responsible for ensuring invasive marine species risk assessments are undertaken for all vessels mobilised to the Project Area. Ensure that all crew attend HSE inductions and that attendance records saved. Ensure incidents are reported and investigated, as required.
Site and offshore based personnel	
Santos Senior Client Site Representative	Confirm contractors undertake the activity in a manner consistent with the EPOs and environmental management procedures detailed in this Offshore CEMP. Confirm the management measures detailed in this Offshore CEMP are implemented. Communicate any changes to the activity to the Santos Environmental Advisor. Confirm all subsea chemical components and other fluids that may be discharged to the marine environment are approved for use. Confirm that the Vessel Master and all crew adhere to the requirements of this Offshore CEMP. Advises the Santos Pipeline Delivery Manager of any activity changes that may lead to a non-conformance with the requirements with this Offshore CEMP Reports environmental incidents to the Santos Pipeline Delivery Manager Responsible for implementation requirements of the DPD Cultural Heritage Management Plan
Vessel Master (contractor personnel)	Responsible for compliance with all HSE laws, conventions and approvals Responsible for conformance with delegated environmental performance objectives and standards in this Offshore CEMP Responsible for adherence by crew to operational work systems and procedures Responsible for implementation of requirements that the vessel and equipment is being operated as intended and is maintained Empowers personnel to 'stop-the-job' due to HSE concerns Responsible for compliance with reporting requirements for all HSE incidents, hazards and non-conformances

Title (role)	Environmental responsibilities
	Facilitates HSE investigations and is responsible for the implementation of corrective actions Responsible for compliance with requirements for crew to be competent and prepared to respond to HSE incidents Confirm SOPEP drills are undertaken in accordance with the vessel's schedule. Comply with vessel entry and movement requirements within exclusion zones. Maintain ballast water management plan, valid ballast water management certificate, ballast water management records, and Antifouling System Certificate specific to the vessel. Maintain records of fuel use and vessel discharges/ transfers (including waste, sewage and oily water) as per MARPOL and Santos requirements Confirm vessel crew are provided with sufficient training to implement the SOPEP/SMPEP (as appropriate to vessel class). Ensure supervision of all bunkering/transfer operations to the vessel. Report any environmental incidents or non-conformance with this Offshore CEMP in accordance with Santos and statutory requirements.
Offshore Construction Superintendent (Contractor Personnel)	Responsible for ensuring that pipeline construction activities are performed in accordance with this Offshore CEMP.
Marine Fauna Observers (MFOs) (contractor personnel)	In addition to the requirements of vessel crew, the MFOs will: Undertake visual observations for marine fauna as per this Offshore CEMP Record all sightings of marine fauna Advise vessel master of sightings of marine fauna and vessel requirements
All Project personnel	Act in an environmentally responsible manner. Undertake work in accordance with accepted HSE systems and procedures. Comply with this Offshore CEMP and all regulatory requirements as applicable to assigned role. Report any unsafe conditions, near misses or environmental incidents immediately to supervisors. Attend environmental inductions and HSE meetings, and complete training as required. Report marine megafauna sightings as applicable to role in accordance with Project requirements

8.2 Workforce training and competency

This section describes the mechanisms that will be in place, so all Project personnel (including employee and contractor roles) are aware of his or her responsibilities in relation to the Offshore CEMP and has appropriate training and competencies.

8.2.1 Inductions

Santos and its contractors will develop a mandatory project induction, which will detail Offshore CEMP requirements. Project induction attendance will be logged. Santos personnel will be required to complete required contractor site and facility inductions, including DLNG facility inductions, including permitting requirements, as applicable for working in and around the DLNG facility.

All Project site roles will complete an induction that will include a component addressing their Offshore CEMP responsibilities. Induction attendance records for all personnel will be maintained. Inductions will include information about:

- Santos' Environment, Health and Safety Policy (**Attachment 1**)
- Regulatory regime
- Operating environment (for example, nearby marine protected areas, sensitive environmental periods)
- Activities with highest risk (e.g., IMS and hydrocarbon releases)
- EPOs, Performance Indicators and management commitments
- Incident reporting and notifications
- Regulatory compliance reporting
- Importance of marine communications regarding any potential interactions with other marine users
- Process for assessing changes to Offshore CEMP activities
- Oil pollution emergency response, e.g., DPD (NT Waters) OPEP (BAS-210 0026)
- Maritime and First Nations cultural heritage awareness
- Processes for managing potential cultural heritage finds
- MoC process.

8.2.2 Training and competency

The implementation of training requirements will ensure project personnel have the skills, knowledge and competencies to conduct work in a safe manner without harm to their health or the environment.

All members of the workforce will complete relevant training and/or hold relevant qualifications and certificates for their roles.

Santos and its contractors are individually responsible for ensuring that their personnel are qualified and trained. The systems, procedures and responsible persons will vary and will be managed using online databases, staff on-boarding process and training departments etc. Personnel qualification and training records will be sampled before and/or during an activity. Such checks may be performed during the procurement process, inductions, crew change, and operational inspections and audits.

Crew trained in marine fauna observation will ensure marine megafauna can be reliably identified to species during observation periods.

8.2.3 Workforce involvement and communication

Daily operational meetings will be held at which HSE will be a standing agenda item. It is a requirement that supervisors attend daily operational meetings and that all personnel attend daily toolbox or pre-shift meetings. Toolbox or pre-shift meetings will be held to plan jobs and discuss work tasks, including HSE risks and their controls.

HSE performance will be monitored and reported during the activity, and performance metrics (including environmental performance indicators and the number of environmental incidents) will be regularly communicated to the workforce. Workforce involvement and environmental awareness will also be promoted by encouraging offshore personnel to report marine fauna sightings and marine pollution (for example, oil on water, dropped objects). Findings, learnings and corrective actions identified from assurance activities and incident investigations will be communicated to project personnel to drive continuous improvement (e.g., through HSE Alerts, pre-shift / toolbox meetings).

8.3 Audits and inspections

Santos maintains a risk-based activity assurance and audit schedule which is reviewed and updated from time to time.

Assurance activities and audits will be undertaken in a manner consistent with Santos' Assurance Operating Standard (SMS-LRG-OS03). For this Offshore CEMP additional detail on the Santos Barossa environmental audit and inspection processes are described in the Barossa Project Environmental Compliance Assurance Plan (BAA-200 0635, referred to as ECAP).

The ECAP outlines a process that enables the planning, collection and verification of environmental assurance evidence across the life of the Activity to measure compliance against the EPOs and performance criteria for this CEMP. Table 8-2 lists the key assurance activities under the ECAP that will be undertaken prior to and during the Activity which includes contractor audits and inspections.

Table 8-2: Key assurance activities under the ECAP

ECAP activity	Timing / frequency	Details
Environmental compliance register development	Once, following acceptance of this Offshore CEMP and prior to commencement of the activities.	Identifies all applicable environmental requirements within the Offshore CEMP (EPOs, performance criteria, notifications) and apply verification controls, timing and tasks to each environmental performance and notification requirement.
Pre-start audit	Once, prior to commencement of the activities.	An audit of all stakeholders (project team, contractors) responsible for meeting the Offshore CEMP environmental requirements (EPOs, performance criteria, notifications). Allows Santos to communicate expectations for evidence provision, reporting frequencies and risk management controls.
Vessel pre-mobilisation inspection	All vessels, prior to mobilisation to the Project Area.	Environmental pre-mobilisation inspections examine a vessel's level of mobilisation readiness against environmental requirements within the Offshore CEMP (EPOs, performance criteria, notifications) prior to commencing work on the Activity.
Vessel execution inspection	Weekly/monthly during Project execution	Environmental execution inspections examine a vessel's performance against environmental requirements within the Offshore CEMP (EPOs, performance, criteria, notifications) that are either implemented continuously, repetitively or over a long period of time, or can only be assessed once the Activity has commenced.

Assurance and audit findings may include opportunities for improvement and non-conformances. Audit non-conformances are managed as described in Section 8.5.

An Environmental Assurance Activities Schedule (EAS) will be developed and maintained by the Barossa HSE Team which will align with the Barossa Project Integrated Audit Schedule. The EAS will provide an overview and schedule of assurance (verification) activities required to meet compliance for each activity

(e.g., inspections, audits, assessments, and reviews). Additionally, it will allow Santos and the Barossa HSE Team to plan and resource appropriately to ensure all environmental assurance requirements can be met.

Audit criteria, as included within a terms of reference, will typically include a selection of management actions and environmental performance standards and outcomes; however, may also include parts of the activity description, stakeholder consultation and implementation strategies.

In addition to Santos' own assurance activities, Santos must ensure that an independent audit of compliance with conditions of EPBC Act approval (EPBC 2022/09372) is conducted at three years after the commencement of the activity and at any other time at the direction of the Minister responsible for administering the EPBC Act (Minster for Climate Change, Energy, the Environment and Water). EPBC Act approval (EPBC 2022/09372) provides further detail on the requirements of this audit.

Other audits and inspections required by relevant regulators and approvals will be conducted as appropriate.

Audit findings may include opportunities for improvement and non-conformances (requirements not met). Audit non-conformances are managed as described in **Section 8.5**.

8.4 Environmental incident reporting

8.4.1 Internal incident reporting

All personnel will be informed through inductions and daily operational meetings of their duty to report HSE incidents and hazards. Reported HSE incidents and hazards will be shared during daily operational meetings and will be documented in the incident management systems as appropriate. HSE incidents will be investigated and reported in accordance with the Santos Incident Reporting and Investigation Procedure (SMS-HSS-OS07-PD01) and contractor procedures.

The incident reporting requirements will be provided to all crew on-board the facilities and support vessels with special attention to the reporting time frames to provide for accurate and timely reporting.

8.4.2 External incident reporting

Certain incidents will require notification to external Regulatory authorities under NT and Commonwealth legislation. This includes requirements below. Additional requirements may apply as conditions of approval of the DPD Project.

8.4.2.1 Reportable incident – Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations (Cth)

Any reportable incidents under the OPGGSER, defined as "for an activity, means an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage", that occur within NT Coastal Waters, will be reported to DME in accordance with Section 47(2) of the OPGGSER.

8.4.2.2 Recordable incident – Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations (Cth)

All recordable incidents, defined as a breach of an environmental performance objective (outcome) or environmental performance standard that is not a reportable incident, that occur within NT Coastal Waters, as defined within the DPD Coastal Waters CEMP (BAS-210 0310), must be reported to DME under Section 50 of the OPGGSER.

8.4.2.3 Reportable incident – Environment Protection Act 2019 (NT)

As per the DPD Project's Environmental Approval EP2022/022-001, notification of environmental incidents must be in accordance with Part 9 Division 8 of the *Environment Protection Act 2019* (NT) (EP

Act) and Part 10 of the *Environment Protection Regulations 2020* (EP Regulations). The *Waste Management and Pollution Control Act 1998* (NT) (WMPC Act) also stipulates the reporting requirements to the NT EPA. In an emergency, the NT EPA Pollution Response Hotline should be notified by telephoning 1800 064 567.

As per Division 5, Part 10, Section 255 of the EP Regulations notice is required to be given in the event of an environmental incident that occurs during activities causing or threatening material or significant environmental harm. The incident requires the following information to be provided to the CEO of the Department of Land Planning and Environment (DLPE):

- time, date, nature, duration and location of the incident
- the location of the place where the environmental harm is likely to occur
- the nature, the estimated quantity or volume and the concentration of any pollution involved
- the circumstances in which the incident occurred (including the cause of the incident, if known)
- the action taken or proposed to be taken to deal with the incident and any resulting environmental harm, if known

This information should be provided orally to the CEO, or nominated person, and then by giving the CEO a written notice containing the required information within 24 hours after the oral notice is given.

These details should also be provided to the DME within 24 hours of the incident occurring.

8.4.2.4 Reportable incident – EPBC Act Approval (EPBC 2022/09372)

As per the DPD Project's Environmental Approval under the EPBC Act (EPBC 2022/09372), notification of environmental incidents and/or potential non-compliance and/or actual non-compliance with the conditions or commitments made in a plan (including this Offshore CEMP) must be made to the DCCEEW. Santos must email the DCCEEW with two business days of becoming aware of any incident and/or potential non-compliance and/or actual non-compliance with details of:

- Any condition or commitment made in a plan which has been or may have been breached
- A short description of the incident and/or potential non-compliance and/or actual non-compliance
- The location (including co-ordinates), date and time of the incident and/or potential non-compliance and/or actual non-compliance.

Within 12 business days Santos must notify the DCCEEW in writing further details of that incident and/or potential non-compliance and/or actual non-compliance with the conditions or commitments made in a plan, including:

- Any corrective action or investigation which the approval holder has already taken
- The potential impacts of the incident and/or non-compliance
- The method and timing of any corrective action that will be undertaken by the approval holder.

8.4.2.5 Reportable incident – Fisheries Act Section 11 Permit (2023-2024/ S11/ 524)

Santos has a permit under Section 11 of the Fisheries Act (2023-2024/ S11/ 524) to cause shock, sound or other vibration during its DPD Project construction activities. In accordance with this permit Santos must notify the Director of Fisheries in writing if it detects, becomes aware of, is informed or notified by any person of any detrimental effects on fish or aquatic life in the Darwin Harbour including any disease, significant mortalities or signs of an outbreak of any diseases which are likely to have been or were actually caused directly by the activities or by exposure to the construction activities permitted by under the permit.

8.4.2.6 Wildlife incident reporting

Any incident resulting in a significant impact to a species listed as threatened or migratory under the EPBC Act is to be reported to the DCCEEW as soon as practicable (and in any case within 24 hours) of becoming aware of the event occurring. For the Project Area, marine species listed as threatened or migratory under the EPBC Act include marine turtles (all species), dolphins, dugongs and crocodiles.

The report will contain:

- time, location and description of the incident;
- a summary of the response being undertaken; and
- details of the relevant contact person.

Any instances of harm or mortality to EPBC Act listed species, whether attributable to the activity covered by this Offshore CEMP should also be reported by email within seven days of the observation.

Any occurrences of stranded, injured or entangled marine megafauna are also to be reported to NT Marine Wild Watch (1800 453 941) as soon as practicable after observing.

8.4.2.7 Hydrocarbon/ hazardous substance spill reporting

External reporting requirements will include reporting to Darwin Port (for incidents within Darwin Port limits), NT EPA (as above) and AMSA, including completion of a marine pollution report (POLREP). Oil spill reporting is to follow any additional reporting requirements outlined within the DPD Project (NT Waters) OPEP (BAS-210 0026).

8.5 Conformance

Non-compliances will be addressed and resolved by a systematic corrective action process as outlined in Santos' Compliance Operating Standard (SMS-LRG-OS04). Corrective actions identified from environmental assurance activities and incident investigations will be derived in collaboration with contractors. For this Offshore CEMP, corrective actions and contingency processes are described as per the Barossa Project Environmental Compliance Assurance Plan (BAA-200 0635) and Barossa Health, Safety & Environment Management Plan for Execute (BAA-200 0003).

Offshore CEMP non-conformances will be addressed and resolved by a systematic corrective action process as outlined in Santos' Management System. Santos' incident and action tracking management system (HSE Toolbox) will be used to track corrective actions in the following instances:

- Where there has been or potentially been a reportable incident
- Where there has been a non-compliance in accordance with a statutory plan, including a breach of an EPO or performance criteria
- Where any corrective action requires notification to an external regulatory or statutory body
- Where there are corrective actions from formal audits (Contractor Pre-Start Audit, external regulator audit etc.) and inspections.

Once entered, corrective actions, time frames and responsible persons (including action owners and event validators) will be assigned. Corrective action 'close out' will be monitored using a management escalation process.

Environmental corrective actions identified through compliance assurance activities are to be promptly managed to ensure timeframes for external reporting are met and that decision making is made visible.

8.6 Continuous improvement

For this Offshore CEMP, continuous improvement will be driven by the list below and may result in a review of the Offshore CEMP, with changes applied in accordance with **Section 8.10.2**.

- Improvements identified from the review of business-level HSE key performance indicators
- Actions arising from Santos and departmental HSE improvement plans
- Corrective actions and feedback from HSE audits and inspections, incident investigations and after-action reviews
- Opportunities for improvement and changes identified during pre-activity reviews and Management of Change (MoC) documents.
- Actions taken to address concerns and issues raised during the ongoing stakeholder management process (**Section 9**).

Identified continuous improvement opportunities will be assessed in accordance with the MoC process (**Section 8.10.2**) to ensure any potential changes to this Offshore CEMP are managed in a controlled manner and that any new or increased impacts and risks are identified and managed to ensure that they are reduced to ALARP and acceptable levels.

8.7 Emergency preparedness and response

Emergency preparedness and response arrangements, applicable to activities covered by this Offshore CEMP, including for oil spill response, will be included in Santos and Contractor procedures.

8.7.1 Contractor emergency and oil spill response plans

DPD Project contractors are responsible for having comprehensive Emergency Response Plans (ERPs) that address emergency response actions associated with all credible incidents for the activity. These will describe the interface arrangements between Contractor and Santos Incident Management structures and cover all aspects of emergency response including technical, logistical and medical support.

Contractor ERPs will outline roles and responsibilities of contractor personnel for emergency events. The ERPs are accepted by Santos and reviewed on an annual basis by the contractor or if a significant change has occurred to the incident management or emergency response arrangements.

Scenario-based drills are performed to test the emergency response arrangements and updates are made to improve the ERPs, if required.

Contractor vessels undertaking activities covered by this Offshore CEMP are required, where applicable to vessel class, to have SOPEP and/or SMPEPs outlining hydrocarbon/hazardous substance spill response arrangements, including response actions and equipment requirements. Vessels are required to conduct regular spill response drills as per arrangements detailed in these plans.

8.7.2 Santos incident management and oil spill response arrangements

Santos maintains Incident and Crisis Management Teams (IMT and CMT) and support arrangements to respond to all-hazard incidents, including oil spill incidents, at its sites and for activities under its control or influence, including activities covered under this Offshore CEMP. Santos' crisis and incident management arrangements are outlined within the Crisis, Incident Management & Emergency Response Procedure (SMS-HSS-OS05-PD01) and Incident Management Plan – Upstream Offshore (SO-00-ZF-00025). IMT and CMT training and exercise requirements, including spill response exercises, are included within an annual training and exercise plan and schedule.

Specific oil spill response support strategies and arrangements for hydrocarbon spill scenarios covered in this Offshore CEMP are outlined within the DPD Project (NT Waters) OPEP (BAS-210 0026), which forms part of this implementation strategy. The OPEP includes the following details:

- An outline of worst-case spill scenarios and associated modelling
- OPEP roles and responsibilities

- response strategies and control measures/resources applicable for responding to worst case spill scenarios
- a net environmental benefit analysis
- details of how response arrangements are tested
- arrangements for spill/impact monitoring
- Arrangements for testing the response arrangements
- arrangements for updating the OPEP.

The arrangements within the OPEP will provide support to, and interface with, response activities undertaken by onsite personnel (e.g., vessel oil spill response activities), as well as response activities coordinated by designated NT Control Agencies.

8.8 Reporting and notifications

Environmental reporting and notifications for the DPD Project construction activities will include reports and notifications between Subcontractors and Contractors, Contractors and Santos, and Santos and Stakeholders, including Regulatory authorities. Reports will be delivered within agreed upon timeframes. **Table 8-3** outlines reporting requirements relevant to this Offshore CEMP. Environmental incident reporting is also addressed in **Section 8.4** above.

Conditions within Environmental Approval EP2022/022-001 under the NT EP Act and conditions within Environmental Approval (EPBC 2022/09372) under the EPBC Act and Regulations of the OPGGSER require reporting on the environmental performance of the activity within this Offshore CEMP, and compliance with approval conditions or OPGGSER Regulations.

A detailed schedule of reporting requirements and submission dates for the DPD Project will be developed as per the Barossa Project Environmental Compliance Plan (BAA-200 0635).

Table 8-3: Summary of notification and reporting requirements

Report/ Notification	Responsibility	Content	Frequency and form	Recipient
Pre-start				
OVID inspection reports	Santos Marine Assurance Team	Provides a summary of the findings of the support vessel inspection which assesses compliance with relevant international (e.g., MARPOL 73/78), Australian and Santos requirements.	Written report to commencement of the activity	Santos
Pre-start contractor audit	Santos Barossa Team	Confirmation of compliance with Offshore CEMP commitments relating to operational procedures and processes that Santos require to be in place prior to the commencement of the activity.	Relevant section completed in Barossa Environmental Assurance Register (BEAR) prior to commencement of the activity	Santos
OPGGSER Section 54 (1) Notification	Santos Barossa Team	Notification of activity commencement in NT Coastal Waters (for which the OPGGSER applies)	Written notification no less than 10 days prior to the start of Offshore CEMP activities in NT Coastal Waters.	DME
EP Act Approval (2022/022-001), pre-trenching notification	Santos Barossa Team	Notification of trenching (as defined in EP Act Approval (2022/022-001)) commencement	Written notification within 5 business days of commencing trenching activities	Minister responsible for administering the NT EP Act (NT Minister for Lands, Planning and Environment). environmentalregulation@nt.gov.au
EPBC Act Approval (EPBC 2022/09373), activity start notification	Santos Barossa Team	Notification of activity commencement	Email notification within 5 business days of commencing the DPD Project.	Australian Government agency responsible for administering the EPBC Act (DCCEEW)
DPIRD – Fisheries (WA), pre-start notification	Santos Barossa Team	Prior notification of planned Activity commencement for the purpose of awareness of potential impacts to WA State fishery license holders.	Written notification no less than 4 weeks prior to the start of activities.	DPIRD Fisheries (WA)

Western Australian Fishing Industry Council (WAFIC)	Santos Barossa Team	Prior notification of planned Activity commencement for the purpose of awareness of potential impacts to WA State fishery license holders.	Written notification no less than 4 weeks prior to the start of activities.	WAFIC
DAFF – Biosecurity reporting	Santos Barossa Team / Contractors	+ Pursuant to the Commonwealth Biosecurity Act 2015 and the Biosecurity (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016, undertake a vessel biosecurity risk and be assessed as 'low' by DAFF before interacting with domestic vessels and aircraft + Undertake pre-arrival approval for vessels arriving from an international location (where applicable) using MARS to meet DAFF's biosecurity reporting obligations.	+ Where applicable, apply for biosecurity risk assessment at least one month before Activity begins. + MARS reporting at least 12 hours before arrival of international vessels	DAFF Biosecurity (vessels, aircraft and personnel). https://www.agriculture.gov.au/biosecurity-trade/aircraft-vessels-military/vessels/mars
DAFF – Fisheries, pre-start notification	Santos Barossa Team	Prior notification of planned activity commencement for the purpose of awareness of potential impacts to Commonwealth fishery license holders.	Written notification no less than 4 weeks prior to the start of activities.	DAFF - Fisheries
Department of Defence, pre-start notification	Santos Barossa Team	Prior notification of planned activity commencement, for the purposes of: + consideration of Defence activities	No less than 5 weeks prior to the start of activities.	Department of Defence

		+ consideration of restricted airspace		
DIPL, Regional Harbourmaster Notice to Mariners notifications	Santos Barossa Team / Contractors	Notification of proposed start and end dates and any other relevant information for the Notice to Mariners to be issued	Written notification no less than 3 weeks before vessel operations begin	Regional Harbourmaster
AMSA/AHO, pre-start and Notice to Mariners notifications	Santos Barossa Team / Contractors	Notification of proposed start and end dates and any other relevant information for the Notice to Mariners to be issued. AMSA's Joint Rescue Coordination Centre (JRCC) requires the: + vessel details (including name, callsign and maritime mobile service identity) + satellite communications details (including INMARSAT-C and satellite telephone numbers) + area of operation + requested clearance from other vessels + any other information that may contribute to safety at sea + when operations start and end.	Written notification at least 48 hours before vessel operations begin	AMSA's JRCC rccaus@amsa.gov.au
			Written notification no less than 3 weeks before vessel operations begin	AHO datacentre@hydro.gov.au

Tiwi Island clan groups and Tiwi Land Council	Santos Barossa Team	Prior notification of planned activity commencement	At least 10 days before the Activity begins	Tiwi Resources (on behalf of Tiwi Islands clan groups). Tiwi Resources will notify clan group representatives.
Other First Nations groups, as agreed through the post acceptance consultation implementation process and through the Northern Land Council (NLC)	Santos Barossa Team	Prior notification of planned activity commencement	At least 10 days before the Activity begins	As determined through the post-acceptance consultation implementation process.
Santos Quarterly Updates	Santos Barossa Team	The Activity will be included in the Quarterly Update until the Activity has ended.	Written notification provided quarterly to mailing list	Parties who have registered or subscribed for quarterly updates.
Marine user notifications to persons identified in Table 8-4 (as may be updated from time to time)	Santos Barossa Team	Prior notification to marine users of planned Activity commencement in Coastal Waters	Written notification 10 days before the Activity begins in Coastal Waters	As indicated in Table 8-4 by email
Execution and completion				
Regular Stakeholder updates	Santos Barossa Team	Regular updates on DPD Project during planning and execution as per Stakeholder Management Plan (refer **Section 9**)	Throughout planning and execution	Various stakeholders
Contractor environmental execution inspections	Santos Barossa Team	Confirmation of compliance with Offshore CEMP commitments relevant to execution of the activity	Relevant section completed in Barossa Environmental Assurance Register (BEAR) prior to completion of the activity	Santos
Vessel Daily Reports	Contractor Vessel Master	Update on day's activities, including any identified non-conformance against this Offshore CEMP, and any issues that may need addressing	Daily	Santos

Vessel Environmental Reports/Checklists	Contractor Vessel Master	Compliance against key regulatory and contractual commitments (including Offshore CEMP commitments). Reporting of fuel usage, vessel discharges and emissions etc.	Weekly/ Monthly[1]	Santos
HSE Meetings Records	Contractor and Santos Barossa Team	Monthly, dedicated HSE meetings are held with the offshore and Perth-based management (including contractor management) and advisors to address targeted health, safety and environment incidents and initiatives. Minutes of these meetings are produced and distributed as appropriate.	Monthly	Santos
Unexpected Finds Notification - *Heritage Act 2011* (NT) section 114	Santos Barossa Team	Notification of discovery of place or object known to be an Aboriginal or Macassan archaeological place or object. The report to include: • A description of the place or object • Its location • The person's name and address • If known, the name and address of the owner or occupier of the place where the object is located	Written notification as soon as reasonably practicable	CEO of Department of Lands, Planning and Environment
Unexpected Finds Notification -	Santos Barossa Team	Notification of discovery of any First Nations cultural heritage.	Written notification as soon as reasonably practicable	Wickham Point Deed liaison committee

Wickham Point Deed liaison committee				
Unexpected Finds Notification - *Underwater Cultural Heritage Act 2018* (UCH Act)	Santos Barossa Team	Notification of finds of underwater cultural heritage that appears to be of archaeological character. Notification to include a description of the article and a description of the place where the article is situated that is sufficient to enable the article to be located.	Written notice within 21 days after finding the article through the Australasian Underwater Cultural Heritage Database	Australasian Underwater Cultural Heritage Database https://www.dcceew.gov.au/parks-heritage/heritage/underwater-heritage/auchd
Environmental Monitoring Data	Santos Contractor and Santos Barossa Team /Environmental Monitoring Contractor	Monitoring data (including sensitive ecological data), surveys, maps, other spatial and metadata and all species occurrence record data (sightings and evidence of presence)	By email within 20 business days of each anniversary of the date of Environmental Approval (EP2022/022-001) under the EPBC Act	Australian Government agency responsible for administering the EPBC Act (DCCEEW)
Environmental Approval (EP2022/022-001 Condition 12) Performance Report	Independent Qualified Person (as defined in EP2022/022-001)	A report on the environmental performance of the actions, and compliance with conditions listed in Environmental Approval (EP2022/022-001) of the DPD Project under the NT EP Act.	A written report to be obtained by Santos within six months of completion of commissioning and provided to the Minister responsible for administering the NT EP Act (NT Minister for Lands, Planning and Environment) within 30 days of its completion.	Minister responsible for administering the NT EP Act (NT Minister for Lands, Planning and Environment). environmentalregulation@nt.gov.au
Environmental Approval (EPBC 2022/09372) Compliance Report	Santos Barossa Team	As per Environmental Approval (EPBC 2022/09372) the report must include: Accurate and complete details of compliance and any non-compliance with the conditions and the plans (including this Offshore CEMP), and any incidents.	Report to be published on the Santos public website within 60 business days following the end of the 12-month period for which that compliance report is required. Email notification of the report to DCCEEW within five business days of the date of	Australian Government agency responsible for administering the EPBC Act (DCCEEW)

		One or more shapefile showing all clearing of protected matters, and/or their habitat, undertaken within the 12-month period at the end of which that compliance report is prepared. A schedule of all plans in existence in relation to these conditions and accurate and complete details of how each plan is being implemented.	publication on the Santos public website. (refer Environmental Approval (EPBC 2022/09372) for additional detail)	
Environmental Approval (EPBC 2022/09372) Independent Audit Report	Independent Auditor (as defined in Environmental Approval (EPBC 2022/09372))	A report as defined in EPBC Act Environmental Approval (EPBC 2022/09372) outlining compliance with conditions of EPBC 2022/09372	Written report at three years after the commencement of the DPD Project, or at any other time as directed by the Minister responsible for administering the EPBC Act (Minster for Climate Change, Energy, the Environment and Water)	Australian Government agency responsible for administering the EPBC Act (DCCEEW)
OPGGSER Section 22 (7) & 51 Performance Report	Santos Barossa Team	Report must contain sufficient information to determine whether or not Environmental Performance Objectives (Outcomes) and Environmental Performance Standards in this Offshore CEMP have been met for activities in NT Coastal Waters	A written environmental performance report will be submitted to DME annually, as applicable to the NT Coastal Waters activity duration, from the date of acceptance of this Offshore CEMP	DME
Environmental Approval (EPBC 2022/09372) Revision of Action Management Plans	Santos Barossa Team	Condition 6 The approval holder may, at any time, apply to the Minister for a variation to an action management plan approved by the Minister, by submitting an application in accordance with the requirements of	For a RAMP under Condition 7: Written notice of the date on which the approval holder will implement the RAMP (RAMP implementation date), being at least 20 business days after the date of providing notice of	DCCEEW

		section 143A of the EPBC Act. If the Minister approves a revised action management plan (RAMP) then, from the date specified, the approval holder must implement the RAMP in place of the previous action management plan. Condition 7 The approval holder may choose to revise an action management plan approved by the Minister under conditions 4 and 5, or as subsequently revised in accordance with these conditions, without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the RAMP would not be likely to have a new or increased impact. Condition 8 If the approval holder makes the choice under condition 7 to revise an action management plan (RAMP) without submitting it for approval, the approval holder must: • Notify the department electronically that the approved action management plan has	the revision of the action management plan, or a date agreed to in writing with the department.	

		been revised and provide the department with: o An electronic copy of the RAMP. o An electronic copy of the RAMP marked up with track changes to show the differences between the approved action management plan and the RAMP. o An explanation of the differences between the approved action management plan and the RAMP. o The reasons the approval holder considers that taking the Action in accordance with the RAMP would not be likely to have a new or increased impact. o Written notice of the date on which the approval holder will implement the RAMP (RAMP implementation date), being at least 20 business days after the date of providing notice of the revision of the action management plan, or a date agreed to in		

		writing with the department. • Subject to condition 10, implement the RAMP from the RAMP implementation date. Condition 9 The approval holder may revoke its choice to implement a RAMP under condition 7 at any time by giving written notice to the department. If the approval holder revokes the choice under condition 7, the approval holder must implement the action management plan in force immediately prior to the revision undertaken under condition 7. Condition 10 If the Minister notifies the approval holder that the Minister is satisfied that the taking of the Action in accordance with the RAMP would be likely to have a new or increased impact, then: • Condition 7 does not apply, or ceases to apply, in relation to the RAMP. • The approval holder must implement the action management plan specified by the Minister in the notice.		

		Condition 11 At the time of giving the notice under condition 10, the Minister may also notify that for a specified period of time, condition 7 does not apply for one or more specified action management plans.		
End of the activity				
OPGGS(E)R 54 – Notifications DME must be given written notice that the Activity has ended.	Santos Barossa Team	Notification of Activity completion in NT Coastal Waters	Written notification within 10 days after completion of the Activity in NT Coastal Waters.	DME
OPGGS(E)R 46 – EP ends when titleholder notifies completion and the Regulator accepts the notification DME must be notified that the Activity has ended and all Coastal Waters CEMP obligations have been completed.	Santos Barossa Team	Notification that: The Activity to which the Coastal Waters CEMP relates has ended; and All of the obligations under the Coastal Waters CEMP have been completed.	Written notification at the completion of the Activity and all Coastal Waters CEMP obligations.	DME
OPGGS(E)R 22(7) & 51 – Environmental Performance DME must be notified of the environmental performance at the intervals provided for in the Coastal Waters CEMP	Santos Barossa Team	Report must contain sufficient information to determine whether or not Environmental Performance Outcomes and Environmental Performance Standards in the Coastal Waters CEMP have been met. Report will also address progress of Santos' identification and/or	An environmental performance report will be submitted to DME annually from the date of acceptance of the Coastal Waters CEMP.	DME

		implementation of sea country initiatives.		
AMSA (JRCC) consultation	Santos Barossa Team	Notification that activity has completed.	Written notification within 10 days of completion.	JRCC
AHO	Santos Barossa Team	Notification that activity has completed.	Written notification within 10 days of completion.	AHO
AHO/ DME	Santos Barossa Team	Provision of details of the final position of the pipeline.	Written notification within 90 days of completion of construction57F9.	AHO DME
DAFF		Notification that Activity has completed.	Written notification within 10 days of completion.	DAFF
DoD		Notification that Activity has completed.	Written notification within 10 days of completion.	DoD
DPIRD		Notification that Activity has completed.	Within 10 days of completion.	DPIRD
WAFIC		Notification that Activity has completed.	Written notification within 10 days of completion.	WAFIC
Marine user notifications to persons identified as in Table 8 3 (as may be updated from time to time).		Notification to the OA marine users that the Activity has completed.	Written notification within 10 days of completion.	As indicated in Table 8 3 by email.
Tiwi Islands clan groups		Notification that Activity has completed.	Written notification within 10 days of completion.	Tiwi Resources (on behalf of Tiwi Islands clan groups). Tiwi Resources will notify clan group representatives.
Other First Nations Groups, as agreed through the post acceptance consultation implementation process and through the NLC		Notification that Activity has completed.	Written notification within 10 days of completion.	As determined through the post acceptance consultation implementation process.
Incident reporting				
Incident Report – OPGGSER Section 24(c), 47, 48 (2)	Santos Barossa Team	Reporting of Reportable Incidents within NT Coastal	A verbal notification as soon as practicable, and in any case	DME

[9] Completion of construction of the pipeline is completion of installation and pre-commissioning activities and does not include the pipeline preservation period

Reportable Environmental Incident		Waters as per Section 47(2) of the OPGGSER. The initial verbal and subsequent written notification must contain: + all material facts and circumstances concerning the reportable incident known or that could be found out by reasonable search or enquiry + any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident. The written report must contain: + all material facts and circumstances concerning the reportable incident known or that could be found out by reasonable search or enquiry + any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident	not later than two hours after the first occurrence of a reportable incident, or if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident. A written record of the notification as soon as practicable after the verbal notification. A written report, as soon as practicable, and in any case not later than 3 days after the first occurrence of the reportable incident.	

		+ the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.		
Incident Report – OPGGSER Section 50 Recordable Environmental Incident	Santos Barossa Team	A record of all Recordable Incidents (a breach of an environmental performance objective (outcome) or environmental performance standard that is not a Reportable Incident) for the calendar months within NT Coastal Waters as per Section 50 of the OPGGSER.	A written record provided as soon as practicable after the end of the calendar month, and in any case, not later than 15 days after the end of the calendar month.	DME
Incident Report – Notifiable Incident (EP Act, EP Regulations, WMPC Act)	Santos Barossa Team	Notification of environmental incidents that cause or threaten significant or material environmental harm must be in accordance with Part 9 Division 8 of the EP Act 2019 and Part 10 of the EP Regulations. There is also a requirement for reporting of Reportable Incidents as per Part 3 of the WMPC Act.	A written report provided as soon as practicable and in any case within 24 hours after becoming aware of the incident. In an emergency a verbal notification should be made to the NT EPA pollution hotline	CEO of the Department of Lands, Planning and Environment environmentalregulation@nt.gov.au NT EPA pollution hotline: 1800 064 567
Incident Report – EPBC Act Approval (2022/09372)	Santos Barossa Team	Notification of any incident and/or potential non-compliance and/or actual non-compliance with the conditions or commitments made in a plan (including this Offshore CEMP). Notification must be first an initial email notification and then a written notification with notification requirements	Email notification within two business days of becoming aware of the incident/ non-compliance Written notification within 12 business days of becoming aware of the incident/ non-compliance	Australian Government agency responsible for administering the EPBC Act (DCCEEW)

		defined in EPBC Act Approval (2022/09372).		
Incident Report –Fisheries Permit (2023-2024/ S11/ 524)	Santos Barossa Team	Notification to the Director of Fisheries in writing if the permit holder detects, becomes aware of, is informed or notified by any person of any detrimental effects on fish or aquatic life in the Darwin Harbour including any disease, significant mortalities or signs of an outbreak of any diseases which are likely to have been or were actually caused directly by the activities or by exposure to the activities permitted by Fisheries Permit (2023-2024/ S11/ 524).	Written report	Director of Fisheries
Incident Report – EPBC Act listed species and cetaceans	Santos Barossa Team	Notification of any harm or mortality to an EPBC Act listed species of marine fauna whether attributable to the Activity or not. Notification if MNES are considered at risk from a spill or response strategy, or where there is death or injury to a protected species. Any vessel strike incident with a cetacean.	Email notification within seven days. Email notification as soon as practicable. As soon as practicable.	Secretary of DCCEEW: EPBC.permits@environment.gov.au Australian Marine Mammal Centre: https://data.marinemammals.gov.au/report/shipstrike.
Incident Report – marine megafauna	Santos Barossa Team	Notification of occurrences of stranded, injured or entangled marine megafauna	Verbal notification to Marine Wild Watch as soon as practicable after observing	Marine Wild Watch (1800 453 941)

Incident Report – hydrocarbon/ hazardous substance spill	Contractor and Santos Barossa Team	Reporting of NT oil spill incidents to Darwin Port (within port limits), AMSA and NT EPA. Additional oil spill reporting requirements as stated within the DPD Project OPEP (BAS-210 0026)	As per DPD Project OPEP (BAS-210 0026)	As per DPD Project OPEP (BAS-210 0026)
Incident Report – hydrocarbon spill – Northern Land Council (NLC)	Santos Barossa Team	Notification of all spills heading towards land	Verbal notification within 8 hours of incident	NLC
		Follow up notification outlining details of incident.	Email following verbal notification	
Incident Report – hydrocarbon spill – First Nations Consultative Committees and coastal clan groups, including the following: • Mulyurrud CC • Rak Badjalarr CC • Daly River/ Port Keats CC • Murrumiuk clan • Wulna clan • Agalda clan		Spills heading towards coastal areas relevant for each consultative committee or coastal clan group (refer Table 5-1 of the DPD (NT Waters) OPEP (BAS-21- 0026)	Verbal notification within 8 hours of incident being identified	Refer Table 5-1 of the DPD (NT Waters) OPEP (BAS-21-0026)
		Follow up email notification outlining details of incident.	Email following verbal notification	
Incident Report – hydrocarbon spill – other First Nations Groups, as agreed through the post acceptance consultation implementation process and through the NLC		Notification of all spills heading towards the relevant parties' interests.	Verbal notification within 8 hours of incident	As determined through the post acceptance consultation implementation process.
		Follow up email notification outlining details of incident.	Email following verbal notification	
Incident Report – hydrocarbon spill reaching WA waters.	Santos Barossa Team	Verbal notification of any hydrocarbon release reaching WA waters	Verbal notification as soon as reasonably practicable.	Department of Biodiversity Conservation Attractions (DBCA) – WA Kimberly regional office

Incident Report – spill or spill response in Australian Marine Park	Santos Barossa Team	The Director of National Parks (DNP) should be made aware of oil/gas pollution events that occur within a marine park or are likely to impact a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer. The notification should include: • titleholder details • time and location of the incident (including name of marine park likely to be affected) • proposed response arrangements as per the DPD (NT Waters) OPEP (BAS-210 0026) • confirmation of providing access to relevant monitoring and evaluation reports when available • contact details for the response coordinator. Note: The DNP may request daily or weekly situation reports, depending on the scale and severity of the pollution incident.	Verbal notification as soon as reasonably practicable.	DNP (Marine Park Compliance Duty Officer)
Incident Report – spill affecting Commonwealth managed fishery	Santos Barossa Team	Verbal notification if any spill may affect Commonwealth-managed fisheries	Verbal notification within 8 hours	Australian Fisheries Management Authority (AFMA)
Incident report - any hydrocarbon spill that has	Santos Barossa Team	Notification of a hydrocarbon spill that has entered or is	Verbal phone call notification within 8 hours, if the spill is	Department of Foreign Affairs and Trade (DFAT) (24-hour consular emergency centre)

entered or is likely to enter international waters		likely to enter international waters	likely to extend into international waters. Follow up with email outlining details of incident.	
Incident Report – Egress into wreck exclusion zone	Santos Barossa Team	Reporting of any egress into or disturbance of the exclusion zones of the Booya and Catalina 6 wrecks	Incident specific	Darwin Ports Harbour Master

1. As per the Barossa compliance assurance plan

Table 8-4: Marine user notification requests

Person to be issued marine user notifications	Notification Recipient
Aquarium Fishery licence-holders	NTSC and Department of Agriculture and Fisheries (DAFF)
Australian Border Force (ABF)	ABF
Australian Fisheries Management Authority (AFMA)	AFMA
Australian Institute of Marine Science (AIMS)	AIMS
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	ASBTIA
Demersal Fishery licence-holders	NTSC and DAFF
Department of Defence – Navy (DoD – Navy)	DoD – Navy
Eni Australia Ltd	Eni Australia Ltd
INPEX Ichthys Pty Ltd	INPEX Ichthys Pty Ltd
Northern Prawn Fishery commercial licence-holders	NPFI
Northern Prawn Fishing Industry Pty Ltd (NPFI)	NPFI
NT Department of Mining and Energy	DME
Department of Agriculture and Fisheries	DAFF
NT Guided Fishing Industry Association	NT Guided Fishing Industry Association
NT Seafood Council (NTSC)	NTSC
NT Timor Reef Fishery commercial licence holders	NTSC
Offshore Net and Line Fishery licence-holders	NTSC and DAFF
Pearl Oyster Fishery licence-holders	NTSC and Department of Agriculture and Fisheries
Small Pelagic (Development) Fishery licence-holders	NTSC and Department of Agriculture and Fisheries
Southern Bluefin Tuna Fishery licence-holders	ASBTIA and AFMA
Spanish Mackerel Fishery licence-holders	NTSC and Department of Agriculture and Fisheries

Person to be issued marine user notifications	Notification Recipient
Top End Tourism	Top End Tourism
Tourism NT	Tourism NT
Western Skipjack Tuna Fishery licence-holders	ASBTIA and AFMA
Western Tuna and Billfish Fishery licence-holders	ASBTIA and AFMA
Woodside Energy Ltd	Woodside Energy Ltd

8.9 Monitoring of emissions and discharges

Emissions and discharges to air and water, associated with activities under this Offshore CEMP will be monitored and maintained as per **Table 8-5** below.

Table 8-5: Monitoring of emissions and discharges

Discharge/emission	Parameter	Quantitative record
Contingency treated seawater discharge (wet buckle event)	Volume, concentration and location	Treated seawater dosage and discharge records
Atmospheric emissions	Fuel volume	GHG calculations based on measured fuel use in accordance with NGER reporting requirements
Ballast water	Volume and location	Ballast water log
Bilge water	Volume and location	Oil Record Book[1] or equivalent report
Garbage (including food scraps)[2]	Volume and location	Volumes recorded in Garbage Record Book[1]
Treated sewage effluent and greywater[3]	Volume and location	Estimated based on POB and days on location
Unplanned discharge of: + solid objects + hazardous liquids	Volume	As per non-compliance reporting detailed in **Section 8.5**
Unplanned hydrocarbon release	Volume	As per non-compliance reporting detailed in **Section 8.5**

[1]*Maintained as per vessel class in accordance with relevant Marine Orders.*

[2]*No garbage (including food scraps) to be discharged in NT waters*

[3]*Only effluent treated through a MARPOL approved sewage treatment plant may be discharged in NT waters*

8.10 Document management

Where further revisions are required to this Offshore CEMP, it will be submitted to the appropriate regulator, for review and approval as required.

8.10.1 Information management and document control

This Offshore CEMP, the DPD Project (NT Waters) OPEP (BAS-210 0026) as well as any approved MoC documents, are controlled documents and current versions will be available on Santos' document control system and made available to Project contractors.

All records associated with monitoring and reporting against Offshore CEMP commitments will be maintained for a period of five years. This includes revisions of the Offshore CEMP, and subordinate EMPs, written reports relating to environmental performance (monitoring, audit and review), records of emissions and discharges, records of calibration and maintenance of monitoring devices and records of reportable incidents.

All environmental monitoring data collected or obtained under the DPD Project Environmental Approval (EP2022/022-001) must be retained for a period not less than 10 years commencing from the date that the data was collected or obtained.

The management and transfer of environmental assurance evidence between Santos and the primary construction contractor will be undertaken as per the Barossa Project GEP Environmental Compliance Assurance Plan (ECAP) Evidence Management and Transfer Procedure (BAS-210 0050).

8.10.2 Management of change

Following regulatory review and original approval of this Offshore CEMP, inclusive of the DPD Project (NT Waters) OPEP, any changes to Project activities as described in this document, which have the potential to materially increase environmental impacts and risks, will be evaluated and controlled following the impact and risk assessment process followed in **Section 6**. The documentation and approval of MoC assessments will follow the process outlined within the Santos Management of Change Procedure (SMS-LRG-OS01-PD04). MoC records will be retained and details of MoCs outlined within Regulatory compliance/performance reports.

For activities in NT Coastal Waters the requirements of the OPGGSER (as governed by the PSL Act) apply to assessment of change. The OPGGSER requires that if a significant new environmental impact or risk is identified, or a significant increase in an existing environmental impact or risk is identified, which is not already provided for in the Offshore CEMP, a revision of the plan will be submitted to the DME before or as soon as practicable after the occurrence or identification of the significant impact or risk.

The MoC procedure also allows for the assessment of information that may become available after CEMP acceptance. When feedback is received from external stakeholders, consideration will be given as to whether it includes information concerning the environmental impacts or risks of Santos' activities, and if so, whether these impacts or risks were provided for in the relevant approval documentation (e.g., in this Offshore CEMP). If not provided for, the MoC process will be initiated in a timely manner in order for the significance of the new or increased impacts or risks to be assessed.

Accepted MoCs become part of the in-force CEMP or DPD OPEP, are tracked on a register and are made available on Santos' intranet. Where appropriate, the CEMP compliance register will be updated so that control measure or environmental performance standard changes are communicated to the workforce and implemented. Any MoC will be distributed to the relevant roles and the most relevant management position is responsible for communication and implementation of the MoC. This may include crew meetings, briefings or communications as appropriate for the change.

If there is a change in the petroleum instrument holder, or operator for the activity, a revision of the Offshore CEMP will be submitted to the DME as soon as practicable after the change.

8.11 Other measures

During the preparation of this Offshore CEMP, and other Barossa Gas Project environment plans, including as a result of consultation, Santos has identified additional measures which it considers are appropriate to implement. These measures are not management actions, because they are not intended to be used by Santos as a basis for managing environmental impacts and risks. Some measures are not properly characterized as 'management actions' in respect of the activity because they relate to operations outside of the Project Area, which are not regulated under this Offshore CEMP. Notwithstanding this, Santos considers it appropriate to adopt the following measures as part of its implementation strategy:

- Santos, through relevant Land Councils and others, will engage to identify and implement worthwhile First Nations initiatives that could include, but are not necessarily be limited to:
    - employment of cultural awareness community observers (CACOs), who will conduct cultural awareness inductions for field-based staff across Barossa Project activities
    - support of ranger programs and studies to help First Nations people preserve environmental and cultural features and values on their country

- seeking to facilitate employment opportunities for First Nations people as trainee HSE advisors for Barossa Gas Project activities, subject to the availability and participation of First Nations trainees, with a view to them obtaining HSE qualifications and competencies to enable future ongoing employment in HSE. Further, Santos plans to discuss the way in which it might be able to facilitate presentations by the trainee advisers to their communities about HSE management of the Barossa Gas Project activities.
- periodic community townhalls across regional locations relevant to the Barossa Gas Project, to provide Project updates and to provide an opportunity for feedback from CACOs to assist in the development of any potential improvement programs.

Santos to facilitate trips to the activity sites, at intervals (as necessary), taking into account cultural advice as to the most appropriate clan members to attend such trips.

9 Stakeholder consultation

9.1 Consultation objectives

Stakeholder engagement is an open dialogue that continues through the full project lifecycle. It is an essential process supporting environmental impact assessment as it provides affected and interested stakeholders with information about the Project's potential impacts and benefits.

It supports the identification of issues, addresses community concerns and expectations on decisions that may affect them and aids better decision-making and outcomes.

The objectives of the consultation strategy used for the Darwin Pipeline Duplication (DPD) Project are to:

- Maintain an ongoing dialogue with stakeholders, keeping them informed of the Project details and impacts;
- Update stakeholders on changes to the Project during each stage of engagement;
- Notify stakeholders of commitments being made by Santos as part of the Project approval process;
- Encourage stakeholders to provide comments and raise issues or concerns about the Project;
- Respond to stakeholder comments through the formal assessment process and directly as required;
- Continue to build on existing stakeholder relationships and trust to inform Santos' longer term-activities and community involvement; and
- Comply with Regulatory requirements, the Santos Management System (including relevant stakeholder consultation standards and procedures) and the DPD Relevant Persons Consultation Plan (BAA-200 0736).

9.2 Consultation overview

The Santos group has a long-standing presence in Darwin and the Northern Territory (NT) and has developed close relationships with a wide range of government, industry and community stakeholders. As Operator of the existing Darwin Liquified Natural Gas (DLNG) facility and the Bayu-Undan to Darwin gas export pipeline, Santos already has a strong understanding of the stakeholders and issues involved with developing and operating similar infrastructure.

Significant stakeholder engagement on the DPD Project has been undertaken from project inception in mid-2021 and will continue over the life-cycle of the Project. Engagement with stakeholders has been undertaken through a number of avenues, including face-to-face and online meetings with individuals, organisations and government authorities, community drop-in sessions, First Nations clan and consultative committee meetings, emails, phone calls and through statutory submission processes.

Stakeholder feedback on DPD Project activities in NT waters and associated environmental impacts/risks and controls (including those outlined within this Offshore CEMP), has been received through the statutory public and government authority submission processes under the *Environment Protection Act 2019* (NT) (EP Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). This has included public/government written submissions provided to the NT Environment Protection Authority (EPA) and Santos on the DPD Project NT EPA Referral (BAA-201 0003) and the subsequent DPD Project Supplementary Environmental Report (SER) (BAS-210 0020) (Santos, 2023), inclusive of this Offshore CEMP (provided in draft as an attachment to the SER), during formal submission periods of 18 January to 15 February 2022 and 24 May to 28 June 2023, respectively.

Stakeholder submissions on the NT EPA Referral have been specifically addressed by Santos within the DPD Project SER and both documents and all submissions received on these documents are publicly available on the NT EPA Darwin Pipeline Duplication Project webpage at the following link.

https://ntepa.nt.gov.au/your-business/public-registers/environmental-impact-assessments-register/completed-assessments/register/darwin-pipeline-duplication-project

Stakeholder feedback on DPD Project activities, across both NT and Commonwealth waters, and associated environmental impacts/risks and controls relevant to matters of national environmental significance (MNES) (including those outlined within this Offshore CEMP), has been received through public and government authority submissions invited through the EPBC Act assessment process. Submissions have been received on the DPD Project EPBC Act Referral (BAA-201 0006) / DPD Project EPBC Act Referral Supporting Information (BAA-201 0004) and the subsequent DPD Project Preliminary Documentation Report (PDR) (BAS-210 0115), inclusive of this Offshore CEMP (provided in draft as an attachment to the PDR), during submission periods of 7 to 21 November 2022 and 11 November to 15 December 2023, respectively.

Public submissions received on the EPBC Act Referral and subsequent public submissions received on the PDR (one submission) have been responded to within a table of comment responses. The PDR (addressing submissions on the EPBC Act Referral) and the PDR table of comment response (addressing the submission on the PDR) are both publicly available at the link below:

https://www.santos.com/barossa/dpd-preliminary-report/

In addition to the consultation undertaken under the NT EP Act and EPBC Act, specific consultation has been undertaken to meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGSER). This consultation, termed Relevant Persons consultation, is required for the DPD Project construction and pre-commissioning activities under the jurisdiction of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) (Commonwealth waters) and the *Petroleum Submerged Lands Act 1981* (NT Coastal Waters between the Territorial Sea Baseline and the boundary of NT and Commonwealth waters). Relevant Persons consultation for NT Coastal Waters activities was conducted at the same time as for Commonwealth waters activities. While not the focus of Relevant Persons consultation, information on the DPD Project construction and pre-commissioning activities in NT Internal Waters (i.e., under the jurisdiction of the *Energy Pipelines Act 1981*) was also provided for completeness and to provide the 'bigger picture' of the DPD Project activity, across all jurisdictions.

A full description of the Relevant Persons identification process, consultation methodology and summary of consultation records for DPD Project construction and pre-commissioning activities in NT Coastal Waters, has been provided in the DPD NT Coastal Waters CEMP (in particular Section 4) as required to meet OPGGSER requirements.

The DPD NT Coastal Waters CEMP is publicly available online at:

https://nt.gov.au/industry/energy/energy-pipelines/published-environment-plans

The description of Relevant Persons consultation undertaken to meet the requirements of the OPGSGER, and resultant summary of consultation feedback has not been repeated in this Offshore CEMP. However, information obtained from Relevant Persons consultation has been applied to this Offshore CEMP, where relevant, resulting in updates to the following sections:

- The description of First Nations cultural features within the EMBA (Section 14.5 of **Attachment 2**).
- Reporting and notifications requirements (**Section 8.8**).

9.3 Ongoing consultation strategy

Ongoing consultation activities relevant to construction and pre-commissioning activities under this Offshore CEMP will be principally supported by Santos' existing regional relationships with those organisations whose functions, interests and activities may be affected by the construction and pre-commissioning activities.

Santos recognises and respects the preference of relevant government authorities and other relevant interested persons and organisations to determine the frequency and method of updates, in addition to the written quarterly updates outlined in this strategy below.

9.3.1 First Nations people and groups

Santos will undertake consultation over the life of the construction and pre-commissioning activities under this Offshore CEMP with First Nations representative organisations.

Santos will provide quarterly written activity updates via land councils and Aboriginal Corporations, specifically to:

+ Gwalwa Daraniki Association (GDA)
+ Kimberley Land Council (KLC)
+ Larrakia Nation Aboriginal Corporation (LNAC)
+ Larrakia Development Corporation (LDC)
+ Northern land Council (NLC)
+ Tiwi Land Council (TLC)
+ Wickham Point Deed liaison committee

  Quarterly written Activity updates will also be provided to:

  + Tiwi Clan Trustees for each Clan via TLC
  + First Nations Consultative Committees via Committee Chairs

Having regard to Santos' experience consulting with First Nations groups, and feedback from First Nations persons, Santos considers that consultation through representative bodies provides an appropriate mechanism for ongoing consultation with First Nations persons.

Representative bodies provide for regular, culturally appropriate engagement, including processes for dissemination of information to First Nations Elders, cultural leaders and communities in a manner that is readily accessible and culturally appropriate.

9.3.2 Local governments, communities and industry

As part of Santos' community engagement efforts for the broader Barossa Gas Project, Santos will provide quarterly written activity updates to regional local government and associated communities.

Santos will also provide quarterly written activity updates to the commercial fishing industry, which is the industry most likely to be affected by proposed activities. Santos will provide quarterly written activity updates to those representative organisations whose membership are most likely to be affected, specifically to NPFI.

9.3.3 Consultation implementation strategy approach

Santos will provide to those organisations identified above quarterly written updates on the Barossa Gas Project including the construction and pre-commissioning activities covered by this Offshore CEMP. The updates will also be posted on Santos' website, with notifications to registered/subscribed interested parties.

Activity notifications and reports will also be made in accordance with **Table 8-3**. The notifications and reports are based on legislative requirements, standing arrangements with particular persons, requests for notification made during OPGGSER Section 25 consultation, or as otherwise deemed appropriate by Santos.

Santos will apply the regional engagement model to consider the preferences of relevant government authorities and other relevant interested persons and organisations when determining the frequency and method of additional updates.

A community lead for each region (e.g. NT Community Affairs Manager) oversees the development and implementation of engagement related plans, such as community investment plan and provision of information updates on Santos activities. A core aim is to build long term relationships with key local stakeholders through regular engagement.

The regional engagement model is bespoke for each area so it can incorporate the preferences of local stakeholders. For example, the NT model includes the use of a Darwin shopfront which is open to the public and a NT based First Nations Engagement Adviser. These plans also consider the community commitments (e.g. post Offshore CEMP engagement) for each region. For example, the NT model includes quarterly meetings with Larrakia people through the Wickham Point Deed liaison committee.

Santos will continue to accept, assess and respond to post-acceptance consultation feedback during the life of the Activity. Records of any post-acceptance consultation will be maintained in an appropriate Santos consultation database.

If, during the course of post-acceptance consultation, Santos receives information demonstrating a new or increased environmental impact or risk that is not provided for in this Offshore CEMP, as in force at the time, Santos will apply its MoC process outlined in **Section 8.10.2**.

Santos will maintain a database of relevant authorities, and other interested persons and organisations for this Activity. This includes updating its database in light of post acceptance consultation, including identification of new interested persons.

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Attachment 1 Santos Environment, Health and Safety Policy

Santos

Environment, Health and Safety

Policy

Our Commitment

Santos is committed to being the safest gas company wherever we have a presence and preventing harm to people and the environment

Our Actions

We will:

1. Integrate environment, health and safety management requirements into the way we work
2. Comply with all relevant environmental, health and safety laws and continuously improve our management systems
3. Include environmental, health and safety considerations in business planning, decision making and asset management processes
4. Identify, control and monitor risks that have the potential for harm to people and the environment, so far as is reasonably practicable
5. Report, investigate and learn from our incidents
6. Consult and communicate with, and promote the participation of all workers to maintain a strong environment, health and safety culture
7. Empower our people, regardless of position, to "Stop the Job" when they feel it necessary to prevent harm to themselves, others or the environment
8. Work proactively and collaboratively with our stakeholders and the communities in which we operate
9. Set, measure, review and monitor objectives and targets to demonstrate proactive processes are in place to reduce the risk of harm to people and the environment
10. Report publicly on our environmental, health and safety performance

Governance

The Environment Health Safety and Sustainability Committee is responsible for reviewing the effectiveness of this policy.

This policy will be reviewed at appropriate intervals and revised when necessary to keep it current.

Kevin Gallagher

Managing Director and CEO

Document Owner:	David Banks, Chief Operating Officer		
Approved by:	The Board		
Date Approved:	15 August 2022	Version:	3

Attachment 2 DPD Values & Sensitivities of the Marine Environment (BAS-210 0133)

DPD Values & Sensitivities of the Marine Environment

Rev	Owner	Reviewer	Approver
	Senior Environmental Advisor	Environmental Approvals Lead	Senior Manager Environmental Approvals
1			

Rev	Rev Date	Author / Editor	Amendment
A	30/11/2023	ECS	For Santos review
0	17/03/2024	Santos	For submission with DPD Offshore Construction Environmental Management Plan (BAS-210 0024)
1	27/11/2024	Santos	For submission with DPD Offshore Construction Environmental Management Plan (BAS-210 0024) Rev 1

ACRONYMS

Abbreviation	Description
°C	Degrees Celsius
3D	3-dimensional
AFANT	Amateur Fishers Association Northern Territory
AFMA	Australian Fisheries Management Authority (Cth)
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
ALARP	as low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
AUV	Autonomous Underwater Vehicle
BIA	Biological Important Area
cm	centimetre
CoA	Commonwealth of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry (Cth)
DAWE	Department of Agriculture, Water and the Environment (Cth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DEPWS	Department of Environment, Parks and Water Security (NT)
DEWHA	Department of the Environment, Water, Heritage and the Arts (Cth)
DFAT	Department of Foreign Affairs and Trade (Cth)
DISER	Department of Industry, Science, Energy and Resources (Cth)
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts (Cth)
DNP	Director of National Parks
DoEE	Department of the Environment and Energy (Cth)
DoEH	Department of the Environment and Heritage (Cth)
DPD	Darwin Pipeline Duplication
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Cth)
e.g.	for example
EEZ	exclusive economic zone
EMBA	Environment that May Be Affected
EP	environment plan

Abbreviation	Description
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
EPBC Regulations	Environment Protection and Biodiversity Regulations 2000
EPO	environmental performance objective
EPS	environmental performance standard
GDA 2020	Geocentric Datum of Australia 2020
h	hour
ha	hectare
i.e.	that is
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organization
ITF	Indonesian Throughflow
IUCN	International Union for Conservation of Nature
KEFs	Key Ecological Features
kg	kilogram
kHz	kilohertz
km	kilometre
km^2	square kilometre
LAT	Lowest astronomical tide
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
MEVA	moderate exposure value area
mg/L	milligrams per litre
MGA	Map Grid of Australia
mm	Millimetre
MNES	Matters of National Environmental Significance
MoU	Memorandum of Understanding
MPNMP	Marine Park Network Management Plan
MSL	mean sea level
N/A	Not Applicable
NGER Act	*National Greenhouse and Energy Reporting Act 2007 (Cth)*
Nm	nautical mile
NMR	North Marine Region
NOAA	National Oceanic and Atmospheric Administration (US)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority

Abbreviation	Description
NOPTA	National Offshore Petroleum Titles Administrator
NSW	New South Wales
NT	Northern Territory
NWMR	North-West Marine Region
OA (Cth)	Commonwealth Operational Area
OA (NT)	Northern Territory Waters Operational Area, has the same meaning as Northern Territory Project Area
OECD	Organisation for Economic Co-operation and Development
OPEP	oil pollution emergency plan
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)*
OPGGSER	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Cth)
OPP	Offshore Project Proposal
PMST	Protected Matters Search Tool
POB	persons on board
ppb	parts per billion
ppm	parts per million
Qld	Queensland
Ramsar	Convention on Wetlands of International Importance
ROV	Remote Operated Vehicle
RPS APASA	RPS Asia-Pacific Applied Science Associates (company)
t	tonne
TPWC Act	*Territory Parks and Wildlife Conservation Act 1976* (NT)
UK	United Kingdom
US	United States
UV	ultraviolet
WA	Western Australia
WAM	Western Australian Museum

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1. Introduction

As part of the Barossa Gas Project, Santos Ltd (Santos) proposes to install, pre-commission. operate and decommission the Darwin Pipeline Duplication (DPD) pipeline and supporting subsea infrastructure located in Commonwealth and NT waters. The Barossa DPD Environment Plan (DPD EP) (BAA-200 0074) provides for the installation and pre-commissioning of the DPD pipeline in Commonwealth waters. The DPD Offshore Construction Environmental Management Plan (CEMP) (BAS-210 0024) and DPD Coastal Waters Construction Environmental Management Plan (CEMP) (BAS-210 0310) provides for the installation and pre-commissioning of the DPD pipeline in Northern Territory (NT) waters (NT Internal Waters and NT Coastal Waters respectively).

This document supports the DPD Offshore CEMP and describes the existing environment that may be affected (EMBA) by the installation and pre-commissioning activity covered by the Offshore CEMP, herein referred to as the 'Activity', within an NT Operational Area (OA) (also referred to as the Project Area within the Offshore CEMP) (Figure 1-1), and includes details of the relevant values and sensitivities of that environment, including their proximity to the NT OA.

This document is informed by the protected matters report generated via the protected matters search tool (PMST) on 12 June 2024 (**Appendix A**), stated values in the Marine Bioregional Plans for the North Marine Region (NMR) and the North-West Marine Region (NWMR) (CoA, 2012a,b), Barossa environmental studies (Section 1.2), published scientific literature and studies and information obtained through consultation. Marine and coastal species identified in the PMST (**Appendix A**) are described, with a focus on protected species that are threatened and migratory. It is important to note that this document describes the environmental values and sensitivities that occur within the boundaries of the EMBA, whereas the PMST incorporates an in-built buffer and hence may report on matters that are actually outside the EMBA.

Within this document, the boundary of the EMBA is presented on maps illustrating key values and sensitivities that could potentially be contacted by a worst-case hydrocarbon spill (i.e. from a vessel collision and diesel fuel tank rupture scenario) at low exposure values. Additionally, the boundary of the moderate exposure values (MEVA) from the same modelling is also presented on maps for comparison. The MEVA represents potential contact of values and sensitivities at higher thresholds (concentrations) than that used to determine the EMBA (refer DPD Offshore CEMP Section 5.1) and is more representative of potential ecological impact.

1.1 Geographical extent

The EMBA is located within Australian Commonwealth and Northern Territory (NT) waters (Figure 1-1). Within Commonwealth waters, the EMBA intersects the NMR (CoA, 2012a) and the NWMR (CoA, 2012b; Figure 1-2).

A summary of the key characteristics of the NMR relevant to the EMBA is provided below (CoA, 2012a):

+ a wide continental shelf with water depths from 10 m to 357 m, averaging less than 70 m deep (Section 2.1.2).
+ currents driven predominantly by strong winds and tides, a monsoonal climate and complex weather patterns (Section 2.3).
+ limestone pinnacles, which forms part of a key ecological feature (KEF) — Pinnacles of the Bonaparte Basin (Section 12.1.3), valued for hard substrate in an otherwise soft sediment environment and so are important for sessile species.
+ banks, ridges and terraces of the Van Diemen rise, which forms part of a KEF — Carbonate bank and terrace system of the Van Diemen Rise (Section 12.1.2), valued for enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity.
+ cultural features including Sea Country (Section 14).

The key characteristics of the NWMR relevant to the EMBA include (CoA, 2012b):

+ the Indonesian Throughflow, a low-salinity water mass that is one of the major elements of the global transfer of heat and water between oceans and which plays a key role in initiating the Leeuwin Current (Section 2.3.1).

- a chain of carbonate banks and shoals, which forms part of a KEF — Carbonate bank and terrace system of the Sahul Shelf (Section 12.1.1), valued for enhancing biodiversity and local productivity relative to their surrounds.
- limestone pinnacles, which forms part of a KEF — Pinnacles of the Bonaparte Basin (Section 12.1.3), valued for hard substrate in an otherwise soft sediment environment and so are important for sessile species.
- cultural features including Sea Country (Section 14).

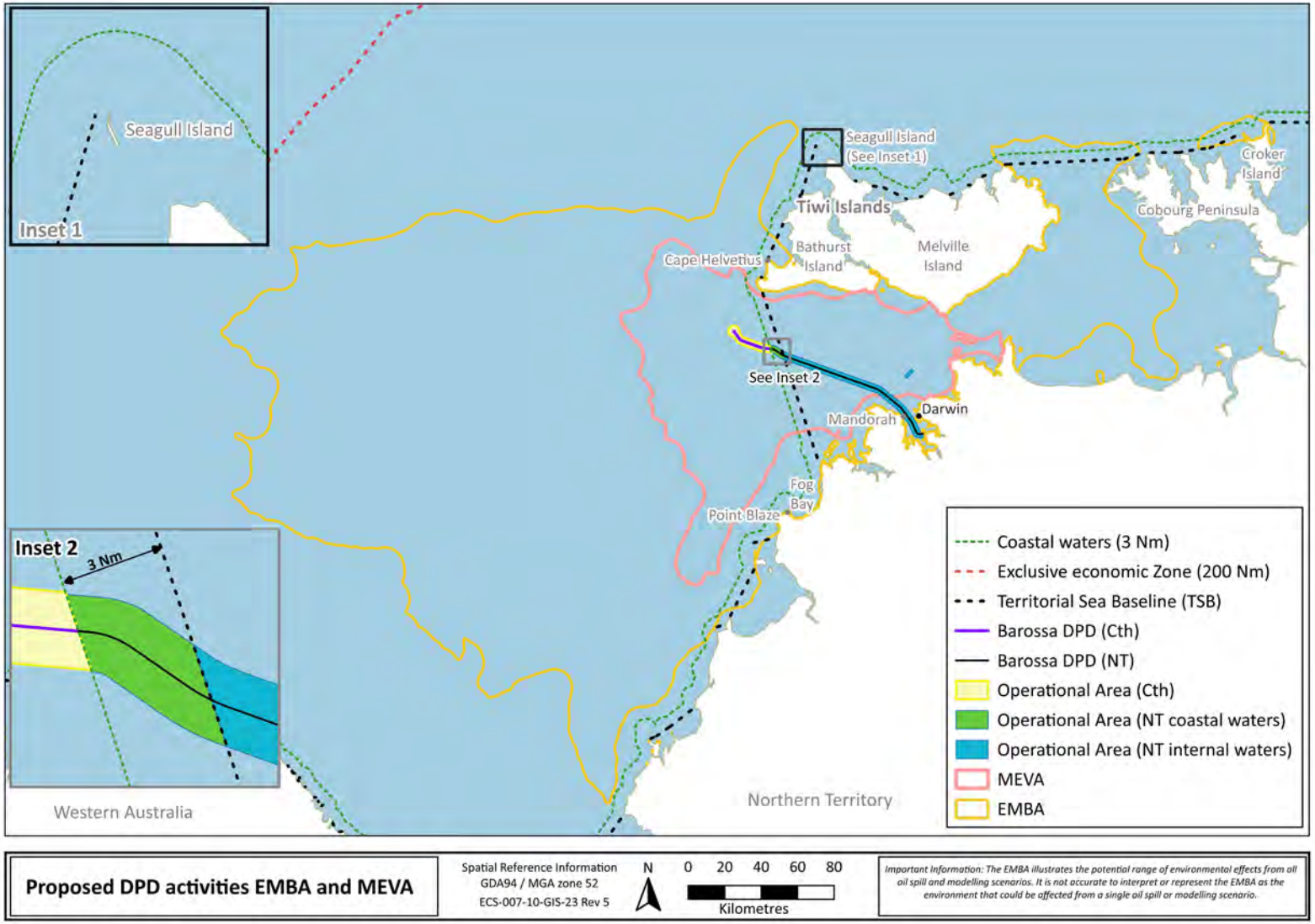


Figure 1-1: Location and extent of the EMBA

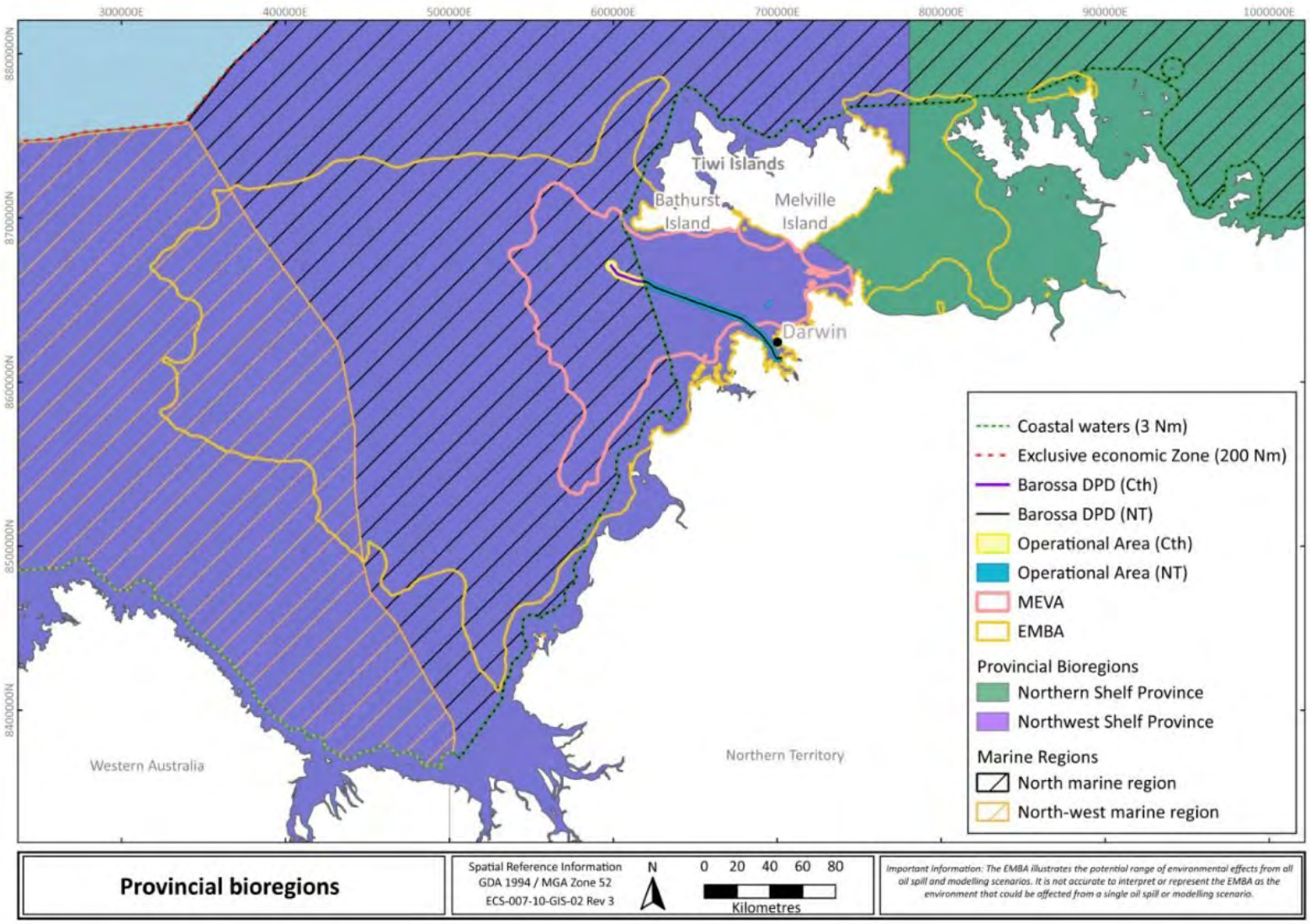


Figure 1-2: Provincial bioregions overlapping or proximal to the EMBA

1.2 Barossa marine studies program and additional studies

Extensive environmental and socioeconomic studies have been undertaken to characterise the existing environment within and adjacent to the Barossa development. Table 1-1 summarises the Barossa marine studies program which involved the collection of detailed baseline data from July 2014 to July 2015 to capture seasonal variability in the region, as well as supplementary surveys and desktop modelling studies to contribute to the understanding of the baseline environment. The Barossa marine studies program informed the approved Barossa development area Offshore Project Proposal (ConocoPhillips, 2018), which was prepared in accordance with the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (Cth) (OPGGSER). The Barossa development area overlaps part of the DPD Project EMBA and therefore has relevance to the Activity.

Table 1-2 summarises the additional relevant Barossa environmental, socioeconomic and cultural features studies undertaken to inform the understanding of the environment (including socioeconomic and cultural features) after the initial Barossa marine studies program including those done specifically for the DPD Project.

Table 1-1: Summary of Barossa marine studies

Study type	Description of study	Reference
Field-based studies		
Metocean data collection	Collection of metocean data on the surface and through the water column from July 2014 to March 2015, within and near the Barossa field, e.g., current, conductivity, wave and wind data.	Fugro, 2015
Water quality survey	Collection of baseline data on physical and chemical components of water quality near the Barossa field. The surveys were completed in June 2014, January 2015 and April 2015.	Jacobs, 2015a, 2015b, 2015c, 2016a
Sediment quality and infauna survey	Collection of baseline data on sediment quality and infauna communities near the Barossa development.	Jacobs, 2015c
Benthic habitat survey	Collection of baseline data to characterise topographic features, benthic habitats and macrofaunal communities near the Barossa field location and surrounding areas, including around Evans Shoal, Tassie Shoal and Lynedoch Bank by using a specialised remotely operated vehicle (ROV).	Jacobs, 2015c, 2016a
Underwater noise survey	Collection of baseline data on ambient underwater noise (physical, biological and anthropogenic sources) at three locations from July 2014 to July 2015 near the Barossa development and surrounding areas.	JASCO, 2015
Desktop or modelling studies		
Environmental literature review and gap analysis	Collection and collation of publicly available information about the marine environment near the Barossa field, and gap analysis were performed to determine if sufficient information were available to inform an environmental impact assessment and any future regulatory approvals for a potential full field development.	Jacobs SKM, 2014
Hydrodynamic model validation study	Data from both the metocean study and deployment of drifter buoys near the Barossa field and surrounding areas were used to validate the underlying hydrodynamic model utilised to develop the spill and discharge models.	RPS APASA, 2017

Table 1-2: Summary of Barossa additional studies

Study type	Description of study	Reference
Shoals and shelf survey 2015: benthic habitats and fish communities	A seabed biodiversity survey of three shoals to the west of the Barossa field (Evans Shoal, Tassie Shoal and Blackwood Shoal) and two mid-continental shelf regions relevant to the pipeline route corridor. The Australian Institute of Marine Science (AIMS) performed the survey in September/October 2015, which involved characterisation of the seabed habitats, associated biota and fish communities (shoals only).	Heyward et al., 2017
Geophysical survey	This was a preliminary geophysical survey of potential pipeline routes within the pipeline route corridor presented in the accepted offshore project proposal (OPP; ConocoPhillips, 2019).	Fugro, 2016
Oceanic shoals marine park benthic habitat and fish diversity assessment	An AIMS seabed and fish biodiversity survey conducted in September and October 2017. The survey focused on six key sites inside and outside of the Oceanic Shoals Marine Park, including in the Habitat Protection Zone, and Shepparton Shoal. The objective was to use this new data to update the predictive habitat model and statistically compare the proportion and spatial diversity of habitats within and outside the Oceanic Shoals Marine Park.	Radford et al., 2019
Tiwi Islands sensitivity mapping study	Collection of data on environmental, social, cultural and economic sensitivities for the Tiwi Islands. A desktop review of available data (spatial datasets) was followed by workshops with Traditional Owners to identify cultural and environmental sensitivities along the coast of the Tiwi Islands.	Jacobs, 2019
Treated seawater and MEG dispersion modelling	Treated seawater and MEG dispersion modelling for representative FCGT pipeline dewatering scenarios at the DPD pipeline PLET in Commonwealth waters	RPS, 2021a
Hydrocarbon spill modelling for Barossa GEP spill scenarios	Hydrocarbon spill scenario modelling for spill scenarios along the Barossa GEP route, including a spill scenario at the DPD pipeline intersection of the NT/Commonwealth waters boundary	RPS, 2021b
Treated seawater discharge dispersion modelling	Treated seawater dispersion modelling report including contingency pipeline dewatering within NT Waters following an unplanned wet-buckle event.	RPS, 2022, 2024
Benthic survey for Barossa DPD pipeline	Collection of baseline information on the benthic habitats, sediment composition (including contaminant concentrations), macroinvertebrate (infaunal) assemblages, and water quality along the pipeline route and potential spoil ground. The surveys were undertaken on 14–22 October 2022, 6–10 January 2022 and 6–10 June 2022 and involved sampling and videography.	RPS 2023b
Desktop study Tiwi turtle programs	This desktop report reviews publicly available literature and research relating to marine turtle activity occurring on, and around, the Tiwi Islands of northern Australia. A total of 19 satellite telemetry studies between 1994-2023 which tracked turtles passing through or foraging in waters near the Tiwi Islands were included in the review.	Pendoley, 2023
Maritime Heritage Assessment – Beagle Gulf and Darwin Harbour	A maritime archaeological study was conducted over the DPD pipeline route and associated anchoring areas to identify potential maritime archaeological sites which are defined as wrecks (ship or aircraft) and associated material, dumped material, maritime infrastructure, and associated deposits on or under the seabed below the highest astronomical tide.	Cosmos Archaeology, 2022
Barossa pipelay light modelling	Light modelling assessment of the proposed pipelay and construction vessels, including cumulative impacts to predict the potential light impacts to turtle nesting habitat on the Tiwi Islands and hatchling behaviours.	Pendoley, 2022a

Barossa pipelay Darwin Harbour lighting technical note	Desktop assessment of presence and significance of marine turtle nesting activity on beaches surrounding Darwin Harbour and likely level of impact DPD Project lighting would have on flatback turtles.	Pendoley, 2022b
First Nations spiritual and cultural values in relation to the Darwin Pipeline Duplication Project	This report reviewed available ethnographic, linguistic, and historical materials and consultations and interviews held with key First Nations persons and others identified as having cultural and spiritual knowledge and authority associated with the study area. The report identified and mapped First Nations spiritual and cultural values relevant to the DPD Project.	Corrigan, 2024
First Nations archaeological desktop assessment in relation to the Darwin Pipeline Duplication Project	This study was a First Nations archaeological assessment for the submerged DPD Project Area based on a detailed geomorphological assessment. This study focused on the likelihood for deposits associated with the Last Glacial Maximum (LGM) to be impacted by the DPD Project.	OzArk, 2024

2. Physical Environment

2.1 Geomorphology

2.1.1 Formation history

Around 550 to 160 million years ago, the northern and western parts of Australia formed part of the northern margin of Gondwana. Around 300 million years ago, crustal stretching, rifting and breakup initiated development of an extensive basin where sediments were deposited (Baker et al., 2008 in DEWHA, 2008a). About 135 million years ago the continent broke up, resulting in the separation of greater India and Australia.

2.1.2 Bathymetry and seabed

Generally, the environment that may be affected (EMBA) consists of a wide continental shelf with a variety of key ecological features (KEFs) (Section 12). Water depths within the majority (~80 %) of the EMBA range between 0 and 100 m, with a trench approximately 100 km wide in the north-western corner between 100 and 190 m deep (Figure 2-1). The seabed is generally flat or gently sloping, with an average depth change of 1 m over a distance of 10 m in waters less than 50 m deep, increasing to a depth change of 1 m over a distance of 20 m in waters over 50 m deep. Within the EMBA there are several submerged and emergent shoals and banks (Section 2.4).

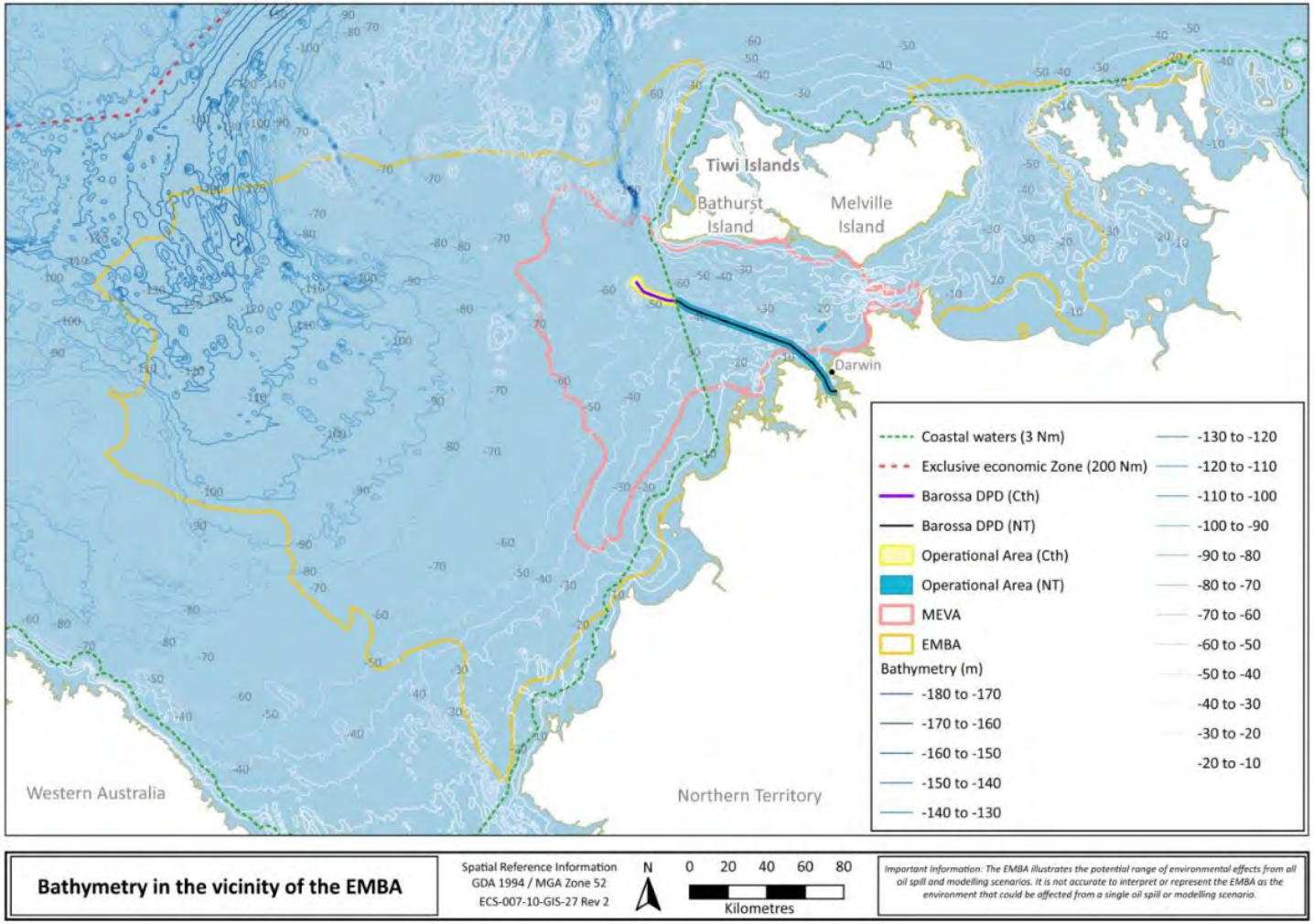


Figure 2-1: Bathymetry overlapping or proximal to the EMBA

2.2 Climate

Waters within the EMBA predominantly lie in the arid tropics. Monsoonal conditions usually occur from October to March (wet season), with cooler and drier conditions prevailing from April to September (dry season).

Meteorological data for the region, recorded at the Bureau of Meteorology weather station at Melville Island (the closest metrological station to the EMBA), shows small seasonal variation in air temperature. The mean maximum summer and winter air temperatures are 34 °C and 31 °C, respectively, with annual maximum temperature of 33 °C and minimum of 22 °C. The Timor and Arafura seas region averages one tropical cyclone annually, usually occurring between November and April (BoM, 2023; 2017).

2.3 Oceanography

2.3.1 Regional current system

Large-scale currents of the Timor and Arafura seas are dominated by the Indonesian Throughflow current system (Figure 2-2). The Indonesian Throughflow brings warm, low-salinity oligotrophic waters through a complex system of currents, linking the Pacific and Indian oceans via the Indonesian Archipelago (DSD, 2010). The strength of the system fluctuates seasonally, reaching maximum strength during the south-east monsoon, and weakening during the north-west monsoon.

The Holloway Current (Figure 2-2), a relatively narrow boundary current that flows along the north-west shelf of Australia between 100 and 200 m depth, also influences the seas in the EMBA. The direction of the current changes seasonally with the monsoon, flowing towards the north-east in summer and the south-west in winter (Fugro, 2015).

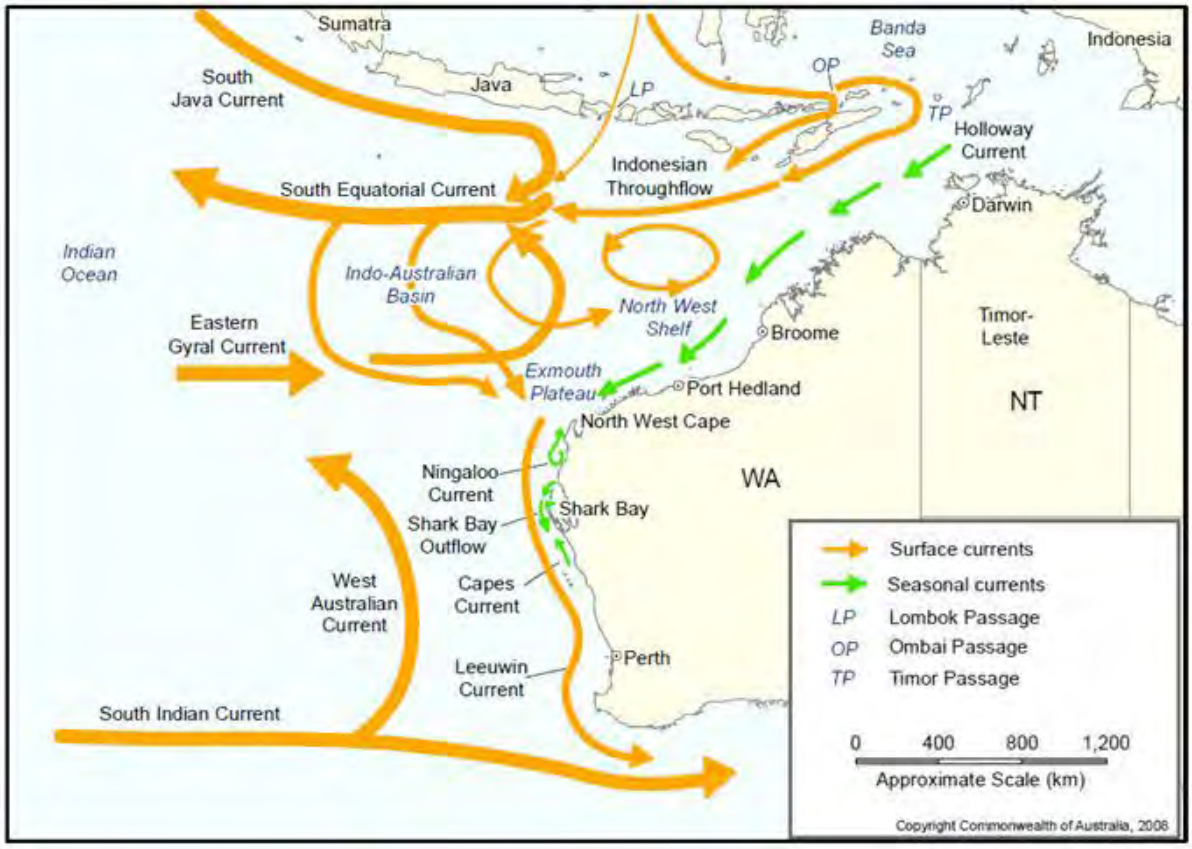


Figure 2-2: Surface currents proximal to the EMBA

2.3.2 Currents and tides

Water movement in the EMBA is influenced by wind and tidal activity and less by ocean currents. Smaller-scale surface currents reflect seasonal wind activity, flowing easterly to north easterly during the wet season and west to south-west during the dry season (Heyward et al., 1997).

Predicted average monthly surface current speeds are approximately 0.4 m/s within Beagle Bay just outside of Darwin Harbour (outside the Darwin Harbour Marine Management Area) and slightly less within Darwin Harbour (0.33 to 0.36 m/s in the mid-harbour) (RPS, 2023a). Predicted monthly maximum current speeds in these areas exceed 1 m/s (RPS, 2023a).

Tidal activity is typically dominated by semi-diurnal tides, with two daily high tides and two daily low tides. Tidal amplitude varies with location and distance offshore; in the Tiwi region it varies from 2 m offshore to 4 m inshore, 4–6m in Van Diemen Gulf, while in the Beagle and Bonaparte Gulf regions the tidal range is ~6–8 m and 2–4 m respectively (IMCRATG, 1998).

2.3.3 Waves

Waves in the EMBA are expected to be composed of locally generated sea waves in response to local wind activity and swell waves created by distant wind activity. Wave height is generally between 0.6 and 0.8 m, coming from the west in the wet season and from the east in the dry season.

Cyclones and tropical storms can greatly increase wave heights by up to 8 m in the outer Timor Sea during the cyclone season (Przeslawski et al., 2011).

The wave climate offshore of the north-west shelf of Australia is normally dominated by the passage of storms over the southern Indian Ocean (Fugro, 2015). However, between October and March, the wave climate is controlled by the south-westerly monsoon winds. This combination of wind directions may lead to concurrent swells approaching from different directions. The sea wave climate also reflects the seasonal wind regime, with waves predominantly from the south-west in summer and from the east in winter.

2.3.4 Temperature

Surface water temperatures in the Barossa offshore development area were recorded as generally ranging between 27 °C and 30 °C, while temperatures in the upper water column of the Barossa offshore development area were recorded as reaching a maximum of 30.9 °C in summer and a minimum of 24.7 °C in spring (Fugro 2015). Mean temperatures ranged from 28.1 °C at 34 m below MSL (summer) to 12.6 °C at 253 m below MSL (summer) (Fugro, 2015). Water temperatures within the EMBA are expected to be broadly within the ranges of those observed in the development area.

2.4 Shoals and banks

A number of shoals and banks occur within the EMBA (Table 2-1 and Figure 2-3). Few historic studies of these features exist, with most of the understanding of shoals and banks in the region derived from the ‘big bank shoals’ study (Heyward et al. 1997), PTTEP surveys initiated in response to the Montara incident (Heyward et al., 2010; Heyward et al., 2011) and studies undertaken by AIMS for the Barossa Development (Heyward et al., 2017; Radford et al., 2019).

Shoals and banks within the EMBA, display biological communities consistent with other similar areas in the broader region (Heyward et al., 2017). AIMS’ analysis of survey data showed that the most influential determinants of benthic community composition include depth and light intensity, substrate type and complexity, hydrodynamic environment and position on the continental shelf. ‘Mid-shelf’ locations, such as those within the EMBA, typically exhibit higher turbidity, resulting in greater light attenuation and the transition between primary producer dominated habitats (such as corals) to those featuring sessile filter feeders (e.g. sponges) is often observed at shallower depths. Consequently, coral reef communities are expected to only be associated with the shallower reefs, shoals and banks, particularly further away from the turbid coastal fringe where sponges, sea fans and to a lesser extent gorgonian soft corals are the dominant contributors to benthic communities (Heyward et al., 2017).

Table 2-1: Shoals and banks within the EMBA

Geomorphic feature[1]	Water depth range (m)[2]	Approximate distance/direction from NT Operational Area
Shepparton Shoal	30–50	16.3 km W
Afghan Shoal	30–50	19 km N
Flat Top Bank	60–70	62 km W
Jones Bank	10	22 km SW
Skottowe Shoal	20–30	24.4 km NE
Moresby Shoals	20	33.4 km NE
Lowry Shoal	20	29.2 km NE
Newby Shoal	30–70	100 km WNW
Parsons Bank	10–20	44 km NE
Hancox Shoal	10–30	38.8 km NE
Foelsche Bank	10	31.3 km NE
Marsh Shoal	10–20	36.7 km NE
Beagle Shoals	20–30	89.2 km NE
Taiyun Shoal	20–30	89.4 km NE
Bill Shoal	20	92 km NE
Abbott Shoal	20	101 km NE
The Boxers	40–100	180 km NW
Renard Shoals	20	112 km NE
Ommaney Shoals	20	120 km NE
Wells Shoal	20–30	115.2 km NE
Barbara Shoal	20	118 km NE
Giles Shoal	20–30	130 km NE
Deep Shoal 2	110-130	280 km W
Fitzpatrick Shoal	30–40	160 km NE
Howland Shoals	10	213 km SW
Mataram Shoal	20–40	148 km ENE

The shoals and banks within the EMBA are expected to support many common species, but to show variation in the abundance and diversity of substrate types and dominant benthic species, with subsets of species featuring more prominently on some shoals and banks than others (Heyward et al., 2017). Shepperton Shoal, approximately 16 km west of the NT OA, is dominated by filter feeder communities (Radford et al., 2019). Other shoals and banks within the EMBA for which there is data on benthic communities (e.g. Flat Top Bank) show a very high degree of similarity (>90%) to other banks located regionally but outside the EMBA (e.g. Goodrich Bank) that were surveyed by AIMS for the Barossa marine studies program. Lesser but still high (>80%) similarity was also reported for some shoals located further offshore, such as Evans Shoal (Heyward et al., 2017). A summary of the results from the 2015 Shoals and shelf survey (Section 1.2) for these sites is presented in Table 2-2.

[1] Bolded entries fall within the MEVA
[2] Note: water depth range provided applies to the entire feature and is not limited to the EMBA.

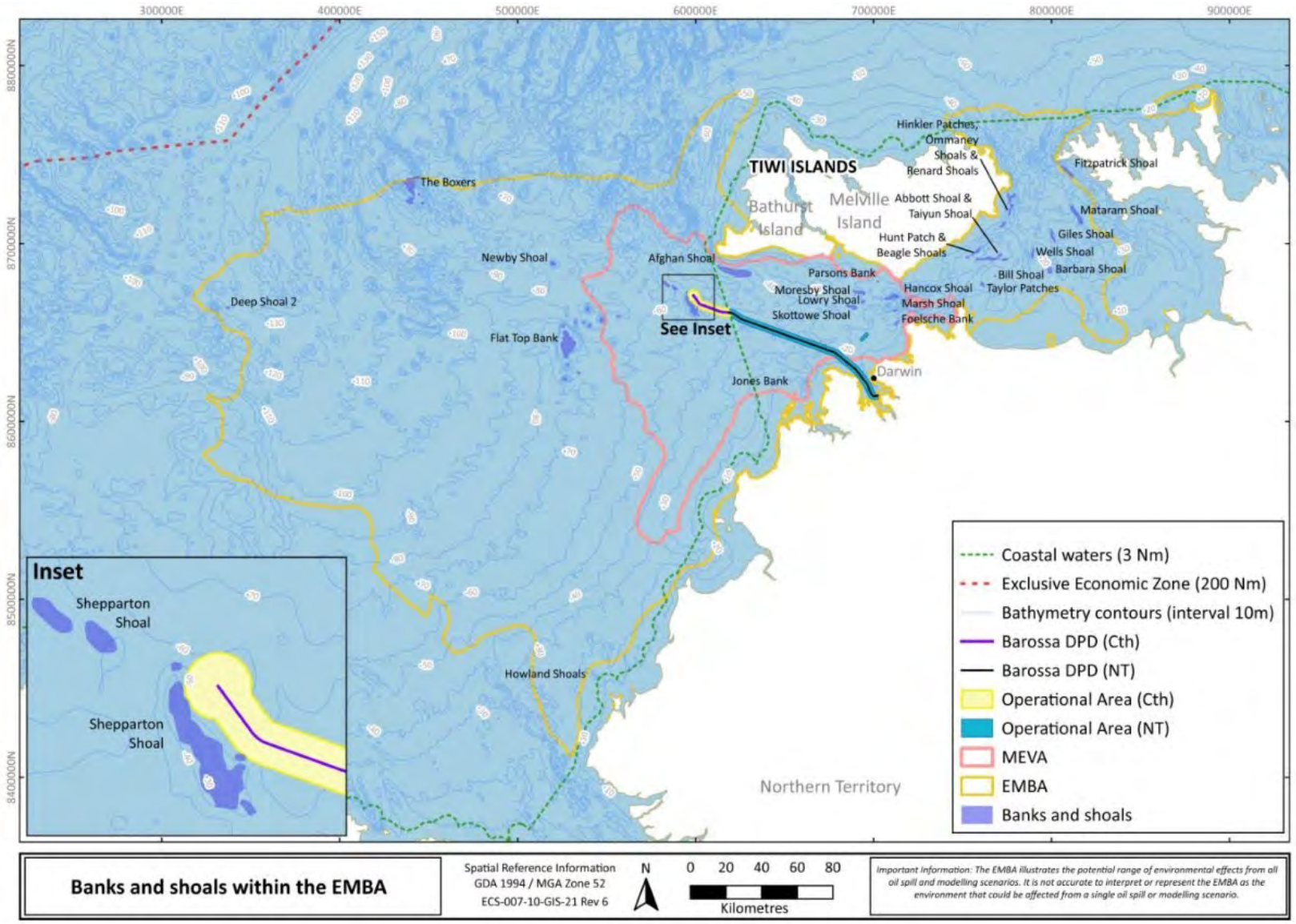
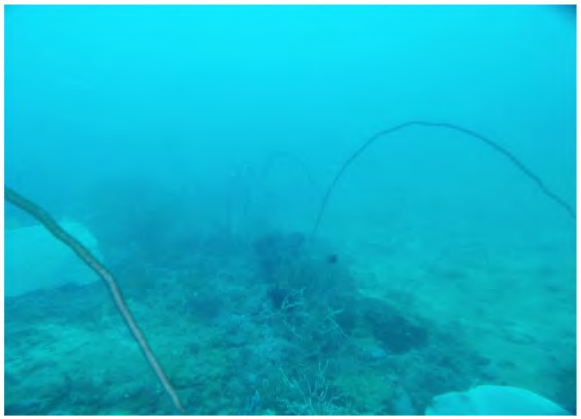
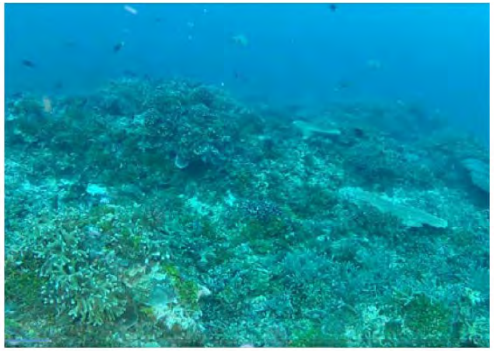


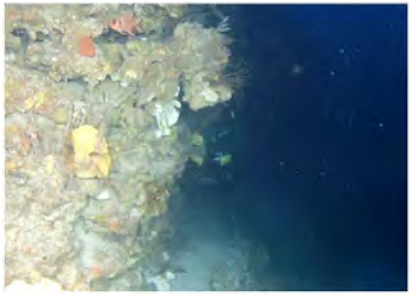
Figure 2-3: Banks, reefs and shoals overlapping or proximal to the EMBA

Table 2-2: Summary of the results of the marine studies program

Shoal/bank	Description
Goodrich Bank and Cape Helvetius	AIMS undertook a seabed biodiversity survey in 2015 that included two mid-shelf seabed locations, adjacent to Goodrich Bank, approximately 31 km north of the EMBA, and Cape Helvetius, in the EMBA approximately 46 km northeast of the NT OA (Heyward et al., 2017). Both sites were much more turbid than the offshore shoals that were also surveyed (Evans, Tassie, Blackwood), resulting in greatly reduced amount of light reaching the seabed and an associated shift from primary producer dominated habitats to those featuring sessile filter feeders. Initial review of a subset of water column light profiles indicated progressive drops in water clarity from the outer shelf shoals shoreward, with surface light (corrected PAR) attenuated to <5% at around 30 m at Goodrich Bank and 10m near Cape Helvetius (Heyward et al., 2017).  The benthic habitat at both sites supported sparse to moderate-density filter feeders (dominated by small sponges) on areas of bare rock or sand covered pavement, with larger organisms observed on outcropping low-relief reef or rocks. Various small to medium sized soft corals contributed less biomass. Hard corals were rare and only encountered at depths less than 30 m in the waters surrounding Goodrich Bank (see photo for example of habitat type) (Heyward et al., 2017). Analysis of benthic categorisations indicates a very high degree of similarity between shoals in the EMBA that have been previously surveyed and the survey data for Goodrich Bank and Cape Helvetius, and a high degree of similarity with Evans Shoal (Heyward et al., 2017). Therefore, it is anticipated that the ecological characteristics of the shoals and banks located within the EMBA will be consistent with those surveyed at similar depths and shelf position.
Oceanic Shoals	Surveys of benthic habitats and fish communities was undertaken by AIMS within and adjacent to the Oceanic Shoals AMP, in the proximity of the Bayu Undan pipeline, in 2017 (Radford et al., 2019). The benthic survey included six sites between Goodrich Bank and Bathurst Island as well as Shepperton Shoal (see below). Fish communities were surveyed at five of the sites. Benthic habitats at the six sites were dominated by extensive areas of seabed covered in unconsolidated sediments such as coarse sand and mud (see photo for example of habitat type). Epibenthic fauna were present at low densities, attached to areas of consolidated pavement covered in fine sediment, or on low relief rock outcropping, most commonly present around ridges or drop-offs. Light-dependent communities were absent from most sites and where present were typically sparse. Corals were very rare and outside of bare areas, non-photic filter-feeder communities (notably sponges) were the key habitat. However, these filter feeder communities were frequently sparse, with decreasing density with depth, and very little occurrence beyond 50 m water depth (Radford et al., 2019). 

Shoal/bank	Description
	Fish species richness recorded at the sites surveyed was low compared to other shoals on the north-west shelf of Australia, reflecting the greater proportions of bare biotic cover and sandy substrate. Fish communities were dominated by bony fish, with sharks and to a lesser extent rays also common. Relative abundances were less than half those recorded at shoals further offshore, such as Tassie and Evans Shoals. Richness, abundance and structure of fish communities across sites were strongly corelated with habitat characteristics, with greatest numbers linked to increased epibenthic cover (Radford et al., 2019).
Shepperton Shoal	Shepperton Shoal, approximately 16 km west of the NT OA, was surveyed by AIMS as part of the field study undertaken in 2017. The shoal is relatively shallow (~30 m) and differed from most other sites surveyed by having up to medium density filter-feeder communities (see photo for example of habitat type) predicted over most (86%) of the shoal (Radford et al., 2019).  No hard or soft corals, or Halimeda communities were recorded and areas not supporting non-photic filter feeders were expected to comprise bare substrates (Radford et al., 2019). Fish were not surveyed at this site, but given the depths and habitat types present can be expected to be dominated by bony fishes, likely including stripey snapper (*Lutjanus carponotatus*), rockcod (*Epinephelus* spp), sandperch (*Parapercis* spp), threadfin bream (*Pentapodus emeryii*) surgeonfish (*Acanthurus* spp) and angelfish (*Chaetodontoplus duboulayi*).
Evans Shoal	Evans Shoal, located approximately 240 km to the north of the NT OA (outside the EMBA), is a flat-topped shoal that reaches a plateau at 18 to 28 m below the sea surface. The infauna communities were reasonably diverse and abundant (3 to 63 individuals representing 3 to 42 taxa in the coarser sediments) and dominated by molluscs (e.g. laevidentaliidae), crustaceans (e.g. tanaids, amphipods, isopods, callianassids) and annelid worms (e.g. syllids, *Nematonereis* species, lumbrinerids; Jacobs, 2016b). The coarser sediments at Evans Shoal supported higher species diversity and abundance. The relationship between coarse sediments, high infaunal abundances and species richness has been previously identified in the north-west shelf with Huang et al. (2013) noting that greater species richness and total abundance were associated with coarse-grained, heterogeneous sediments (Jacobs, 2016b). The key benthic habitats and dominant fish species observed are discussed below (Jacobs, 2016c).

Shoal/bank	Description
	Reef flat (centre of the shoal) The transect was located at a water depth of about 28 m. The substrate was predominantly sand with patchy mixed beds of filter feeders (e.g. sponges and soft corals) and macroalgae. Hard corals were observed at a small bommie (Jacobs, 2016c). Heyward et al. (2017) noted that hard corals were generally sparse or absent across large areas of the plateau, but their density increased towards the outer edges of the plateau. Several taxa of fish including species from families Labridae, (wrasse), Pomacanthidae (damselfish and clownfish), Acanthuridae (surgeonfishes, tangs and unicornfishes), Zanclidae (Moorish idols), Balistidae (triggerfishes) and Monacanthidae (leatherjacket).   **Southern slope** Transects on this slope began on the reef flat in 18 m water depth. While the substrate of the reef flat was dominated by sand and rubble, some areas supported high-density coral cover (mostly plate and branching forms but also soft corals) and *Halimeda* species (calcareous algae). A diverse assemblage of reef-fish occurred in these areas and whitetip reef sharks were also observed. The reef crest of the shoal (about 32 m deep) was dominated by plate coral, whereas the upper slope was dominated by sand. As water depth increased the substrate changed from being dominated by plate corals (about 42 m depth) to macroalgae with scattered sponges and sea cucumbers (about 55 m depth).  

Shoal/bank	Description
	Eastern slope Transects on this slope began at about 83 m water depth. The reef flat was characterised by sandy substrate with occasional small macroalgae. Silvertip sharks were observed in this habitat. The crest of the shoal (about 88 m deep) supported a rocky overhang with various types of filter feeders. The slope was dominated by steep rock faces and rocky overhangs with small sandy ledges that supported filter feeders (such as gorgonians, feather stars, sea whips and sponges) and reef-fish.   **Northern slope** Transects on the northern slope began at about 45 m water depth. The reef flat on this slope alternated between areas dominated by plate coral, sub-massive coral and macroalgae (including Halimeda species) with sponges. Whitetip reef sharks and one tawny nurse shark were observed on the reef flat, as were individuals from the fish families Labridae, Pomacentridae and Pomacanthidae. Small discrete piles of rubble were also observed and were likely to be triggerfish nests. The crest of the shoal (about 80 m deep) was colonised by sponges, filter feeders and algae. The reef slope was characterised by rocky substrate with small sand-covered ledges and supported communities dominated by sponges and filter feeders (such as gorgonians, feather stars, sea whips and sponges). One moray eel (Muraenidae) and various species of fish (families Chaetodontidae (butterflyfish), Carangidae (queenfishes, runners, scads and trevallies), Caesionidae (fusiliers), Serranidae (groupers and reef cod) and Holocentridae (squirrelfish) were observed in the rocky overhangs of the reef slope.  

2.5 Offshore reefs and islands

The EMBA does not overlap any of the key offshore reefs and islands in Commonwealth waters of the region.

Several nearshore islands fall within the EMBA, most notably the Tiwi Islands where the EMBA approaches and/or intersects parts of the south-west, south and east coastlines.

The Tiwi Islands are situated about 30 km north-east of the NT OA, 80 km north of Darwin and are comprised of Melville Island, Bathurst Island and nine smaller uninhabited islands off the northern and southern shores. The islands cover an area of about 8,320 km^2 and support a number of important habitats, including extensive stands of mangroves, tidal mudflats, sandy beaches, seagrass meadows and fringing reef habitats (INPEX, 2010). Many species found on the islands are not recorded anywhere else in the NT, primarily due to their isolation and climatic extremes (high rainfall) (NRETAS, 2009a). The Tiwi Islands are Aboriginal freehold land owned by the Tiwi Aboriginal Land Trust (NRETAS, 2009a). A mapping exercise has been undertaken with the Tiwi Island Land Council (TLC) to identify environmental and socioeconomic values along the Tiwi Islands coastline (Jacobs, 2019).

The Tiwi Islands, and the small islands nearby, provide important nesting sites for marine turtles, internationally significant seabird rookeries, and some major aggregations of migratory shorebirds (DLRM, 2009). A number of BIAs for turtles are found along the coastlines of the Tiwi Islands (see Section 7.3). The sandy beaches on the Tiwi Islands, specifically the west coast of Bathurst Island and the north coast of Melville Island, are particularly important for marine turtle nesting. Nesting is dominated by flatback and olive ridley turtles (Chatto & Baker, 2008). However, green and hawksbill turtles also nest on the Tiwi Islands. Significant numbers of olive ridley turtles are known to nest on the beaches of Seagull Island and the north-west coast of Melville Island (Chatto & Baker, 2008), but these areas are not within the EMBA.

Five seabird breeding colonies have been reported on small offshore islands surrounding Melville and Bathurst islands (Chatto, 2001) that range in size from two to more than 30,000 birds (Chatto 2001). The colony on Seagull Island, off the north-west tip of Melville Island and outside the EMBA, supports a breeding BIA of about 60,000 crested terns (Woinarski et al., 2003). This is thought to be the largest breeding colony of this species and is considered an internationally significant colony (> 1% global population) (NRETAS, 2009a). A 20 km buffer has been designated around the BIA as a foraging zone for crested terns (see **Section 9.3).** The breeding period for the crested tern is from March to July, with most eggs being laid between from late April to early June (Chatto, 2001). In general, colonial seabird breeding in the NT occurs throughout most of the year, though mostly between May and November (Chatto, 2001). The extensive areas of tidal flats, particularly on the south-east of Melville Island, have also been noted as providing important wading and feeding habitats for shorebirds. The highest total count at this site was 40,000 shorebirds in 1993 with the most common species being great knots (Chatto, 2003). Other species recorded in high numbers include red-necked stints, greater and lesser sand plovers and bar-tailed godwits (Chatto, 2003).

2.6 Other seabed features of interest

2.6.1 Seamounts

Seamounts have been identified ~230km north of the NT OA and may be present sporadically within the EMBA. The Barossa environmental baseline studies program (Jacobs, 2016c) included sampling sites at seamounts to the west of the field. Seamounts are generally raised up from the seabed to water depths between 50 and 80 m and are characterised by predominantly sand and rubble (Jacobs, 2016). The hard substrate of the seamount slopes support epibenthic communities dominated by sponges and filter feeders such as gorgonians (e.g. sea whips, sea fans and soft corals) and feather stars. Other epibenthic species observed included holothurians (sea cucumbers), sea fans and algae (Jacobs, 2016c).

Triggerfish nesting areas were apparent at the seamounts. The triggerfish (family Balistidae) appeared to make depressions in the sand and rubble at the top of the southernmost seamount surveyed, as they were observed in and around these depressions (Jacobs, 2016c). The seamounts also appeared to support schools of fish (predominantly from the families Lutjanidae, Carangidae and Caesionidae, and including larvae or juveniles) both near the top of the seamount and at depth.

2.6.2 Scarps

The Barossa environmental baseline studies program (Jacobs, 2016c) included sampling sites at two scarps in water depths ranging between 160 and 190 m. The substrate of the scarps was similar and characterised by a hard bedrock pavement at the top, with a rocky profile along the ridge and sand habitats at the base (Jacobs, 2016c). The scarps provided habitat for gorgonians (e.g. sea whips), feather stars and other filter feeders, sponges, and hydroid/bryozoan turf. A deep-water snapper species (possibly goldband snapper) was also observed in a rocky overhang at the base of the slope and small silver fish and one ray were observed on the sand flat at one of the scarps (Jacobs, 2016c).

Scarps may be observed sporadically within the EMBA, if present likely supporting epibenthic communities, such as sponges and filter feeders and schools of fish.

3. Benthic habitats and communities

Benthic habitats predominantly refer to communities consisting of marine plants, such as seagrass and macroalgae, or invertebrates such as reef-building (hard) corals.

The distribution of benthic habitats and communities in the environment that may be affected (EMBA) has been found to be primarily driven by depth and seabed characteristics, notably the presence of hard substrates and benthic rugosity (RPS, 2023b; Heyward et al., 2017; Radford et al., 2019). A feature of the coastal and mid-shelf areas is a complex array of rises, depressions, banks, terraces and channels, giving rise to turbulence associated with tidal flows and resuspension of fine sediments causing elevated turbidity (Prezlawski et al., 2011; Radford et al., 2019). As a result, epibenthic biota is generally sparse and the dominant species present are consistent with what has been observed during other surveys of similarly turbid waters in the region (Radford et al., 2019).

The benthic habitats over part of the EMBA in offshore waters have been mapped by the Australian Institute of Marine Science (AIMS) based on data collected for the Barossa marine studies program (Heyward et al., 2017; Radford et al., 2019). Similarly, habitat mapping, most recently reviewed and revised in 2021, has been undertaken in Darwin Harbour by AIMS (Udyawer et al., 2021).

3.1 Benthic communities

Surveys in and adjacent to the EMBA indicate that the benthos consists mostly of soft, easily re-suspended sediments interspersed with areas of hard substrate (Heyward et al., 2017; Radford et al., 2019; RPS, 2023b; Smit et al., 2000; Prezlawski et al., 2011). In general, the soft sediment habitats support very sparse to sparse epibiota, and the consolidated substrates support sparse to medium density filter-feeder communities. Overall, the diversity and coverage of epibenthos is low and organisms present are predominantly sponges, gorgonians and soft corals (Heyward et al., 2017; Radford et al., 2019; RPS, 2023b; Kelly & Prezlawski, 2012)

Areas of soft sediment support infauna communities, with infauna species richness tending to decrease with distance offshore (Prezlawski et al., 2011). Sampling of nearshore sediments in the Beagle Gulf found the infauna to be dominated by crustaceans, molluscs and echinoderms (Smit et al., 2000), with crustaceans and annelids (polychaete worms) the predominant taxa in sediments along the pipeline route between the Commonwealth Operational Area and Darwin Harbour (RPS, 2023b).

3.2 Coral reefs

Hard corals in the EMBA are likely restricted to shallower areas of raised hard substrate, particularly offshore where the turbidity is reduced. Surveys of mid-shelf benthic habitats of the EMBA indicate that corals are generally rare, predominantly in areas of <30 m water depth and more likely to develop in areas of steeper bathymetry (Heyward et al., 2017; Radford et al., 2019). Assessment of habitats in/around the Oceanic Shoals AMP suggested that the vertical depth range increases by > 50 m over a 300 m horizontal distance (Radford et al., 2019).

Scattered areas of coral have been reported in Beagle Gulf and Darwin Harbour (Udyawer et al., 2021), Van Diemen Gulf/Cobourg Peninsula (NT Government, 2011) and some islands, reefs and other raised features in the inner Joseph Bonaparte Gulf may support isolated corals (Prezlawski et al., 2011). Corals in turbid waters are likely dominated by members of the genus *Turbinaria* (IMCRATG, 1998), while *Acropora* and *Montipora* species are reported to occur in clearer waters at the Vernon Islands (Smit et al., 2000; Calnan, 2006; IMCRATG, 1998). However, in general extensive hard coral reefs are unlikely to be present in the EMBA.

3.3 Seagrass

Within the coastal and shelf areas of the Northwest Shelf Transition, seagrass communities are confined to the intertidal area, with high turbidity restricting light penetration in the coastal shelf areas to waters of depths up to 20 m (DEWHA, 2008). No seagrasses were recorded during benthic surveys at mid-shelf locations in the EMBA (Heyward et al., 2017; Radford et al., 2019) or at Shepperton Shoal, approximately 16 km from the NT OA.

Seagrasses within NT waters are not well described (Butler and Jernakoff, 1999), but seagrass distribution in the region is disjointed, not common in large open bays and typically found in and around inshore islands, small bays and inlets (Roelof et al., 2005). As a result of large tidal ranges and high turbidities, seagrass

communities west of Nhulunbuy are considered most likely to occur in the intertidal–subtidal interface or in very shallow subtidal areas up to 5 m water depth (Smit et al., 2000). Species from the genera *Halophila*, *Enhalus*, *Halodule* and *Thalassia* are likely to dominate intertidal communities (Roelof et al., 2005).

Seagrasses have been mapped in Darwin Harbour (Udyawer et al., 2021) and eastern Van Diemen Gulf, notably around Field Island (Roelof et al., 2005), with patchy seagrasses also reported from Shoal Bay, south of Shoal Bay, Bynoe Harbour and north of North Perron Island (IMCRATG, 1998; Smit et al., 2000). Areas along the east coast of Cobourg Peninsula (NT Government, 2011; PWSNT, 2003) and the northern coast of the Tiwi Islands (PWSNT, 2003) are also reported to support seagrass communities important to dugongs, although these areas may be mostly or entirely outside the EMBA.

4. Shoreline habitats

Shoreline habitats are defined as those habitats that are adjacent to the water along the mainland and of islands that occur above the lowest astronomical tide (LAT) and most often in the intertidal zone. The environment that may be affected (EMBA) intersects shorelines on the NT mainland, notably between south of Point Blaze to Cape Hotham (and including Darwin Harbour), at some coastal islands, including the south, south-east and south-western coasts of the Tiwi Islands, and other scattered locations in the NT, including the western tip of Cobourg Peninsula and the north of Croker Island (Figure 1-1).

4.1 Mangroves

Mangroves are common and widely distributed along coastlines of the NT (Chatto & Baker, 2008), and extensive mangals occur at many, if not most, of the tidal flats, estuaries and tidal creeks along the mainland coast and on islands that fall within the EMBA.

Coastal habitat surveying undertaken following the Montara spill (Duke et al.,2010) estimated mangroves to cover ~90% of the shorelines in Darwin Harbour and ~73% between Darwin Harbour (Mandorah) and Point Blaze. Mangroves also occur less extensively in areas of the EMBA east of Darwin, including Cobourg Peninsula. At the Tiwi Islands, the southern shorelines within the EMBA do not support the more extensive mangroves that occur within tidal creeks that open to the north coast and in Apsley Strait.

Mangroves are important primary producers and have several ecological and economic values. For example, they play a key role in reducing coastal erosion by stabilising sediment with complex root systems (Kathiresan & Bingham, 2001). They are recognised for their capacity to help protect coastal areas from the damaging effects of erosion during storms and storm surge. Mangroves are important in the filtration of runoff from land, which helps maintain water clarity for the coral reefs that are often found offshore in tropical locations (NOAA, 2010).

The muddy sediments that occur in mangrove forests are home to a variety of epibenthic, infaunal and meiofaunal invertebrates (Kathiresan & Bingham, 2001). Crustaceans known to inhabit the mud in mangrove systems include fiddler crabs, mud crabs, shrimps and barnacles. Within the water channels of the mangrove systems, various finfish are found from the smaller fish such as gobies and mudskippers (which are restricted to life in the mangroves) through to larger fish such as barramundi (*Lates calcarifer*) and the mangrove jack (*Lutjanus argentimaculatus*). Mangroves and their associated invertebrate-rich mudflats are 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 & Crowley, 2000).

4.2 Intertidal mud/sand flats

Intertidal mud/sand flats form when fine sediment carried by rivers and/or the ocean is deposited in a low-energy environment. Due to the large tidal ranges, intertidal flats are common along NT coastlines and often extensive at low tide, frequently occurring adjacent to, or in conjunction with, mangrove communities in the EMBA. Duke et al (2010) indicates that intertidal mud/sand flats occur along >75% of the shore within the Darwin Harbour region and >66% of the coast between Mandorah and Point Blaze. The south-eastern coast of Melville Island also contains reasonably large areas of mud and sand flats that are exposed at low tides (Chatto & Baker, 2008). There is a large amount of intertidal mudflat, backed by extensive mangroves and open saline wetlands, in Fog Bay (southern section) and around parts of the Perron Islands (AMOSC, 2019), with this area of Fog Bay and Darwin Harbour both listed as Nationally Important Wetlands. Further description of the important wetlands intersected by the EMBA is provided in Section 11.2.

Intertidal flats are highly productive components of shelf ecosystems, responsible for recycling organic matter and nutrients through microbial activity. This microbial activity helps stabilise organic fluxes by reducing seasonal variation in primary productivity which ensures a more constant food supply. Intertidal sand and mudflats support a wide range of benthic infauna and epifauna which graze on microscopic algae and bivalves, molluscs, polycheate worms and crustaceans (Zell, 2007).

The high abundance of invertebrates found in intertidal sand and mudflats provides an important food source for finfish and rays which swim over the area at high tide. Mudflats have also been shown to be nursery areas for flatfish. During low tide, these intertidal areas are important foraging areas for resident and migratory shorebirds (Section 9).

4.3 Sandy beaches

Sandy beaches are those areas within the intertidal zone where unconsolidated sediment has been deposited and eroded by wave and tidal action. Sandy beaches can vary from low to high energy zones, the energy experienced influences the beach profile due to varying rates of erosion and accretion.

Sandy habitats are important for both resident and migratory seabirds and shorebirds (see Section 9). While sand flats and beaches generally support fewer species and numbers of birds than mudflats of similar size; some species such as the beach thick knee (*Esacus giganteus*) are commonly associated with sandy beaches (Garnet & Crowley, 2000). Sandy beaches can also provide important habitat for turtle nesting (Section 7.1), with female turtles traversing the intertidal beach to lay eggs in the supra-tidal zone (outside the EMBA).

Sandy beaches intersected by the EMBA include part of the extensive stretches along northern Fog Bay up to Point Paterson, at Point Blaze and on many of the islands, including the Tiwi Islands. Turtle nesting on Fog Bay and Tiwi Islands beaches within the EMBA is dominated by flatback and to a lesser extent olive ridley turtles, with the southern beaches of the Tiwi Islands supporting less activity than south-west and northern beaches (Chatto & Baker, 2008).

4.4 Rocky shorelines

Rocky shores can include pebble/cobble, boulders and rocky cliffs (often at the landward edge of reef platforms). Within the EMBA, rocky shores occur along ~12% of the coastline in the Darwin Harbour and ~30% of the mainland coast between Mandorah and Point Blaze (Duke et al.,2010), as well as a number of islands. Rocky shorelines can vary from habitats where there is bedrock protruding from soft sediments to cliff-like structures that form headlands. The Cobourg Peninsula coastlines include numerous rocky headlands and there are intermittent scattered low lateritic cliffs in the Anson-Beagle bioregion (IMCRATG, 1998).

Rocky shorelines are an important foraging area for seabirds and habitat for invertebrates found in the intertidal splash zone.

5. Plankton

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans et al., 2016). Fluctuations in abundance and distribution occur both vertically and horizontally in response to tidal cycles, seasonal variation (light, water temperature and chemistry, currents and nutrients) and cyclonic events.

In northern Australia, nutrients and detritus (debris) carried by large river outflows combine with sediments and particulate organic matter resuspended by the tides and generally remain trapped within coastal areas to depths of up to~ 20 m (or up to 45 nautical miles offshore). The coastal waters within this zone generally do not mix with adjacent offshore waters, and as a result support distinctly different and more productive phytoplanktonic communities (made up of small, often microscopic, free-floating plants) than offshore waters, where nutrients are derived primarily from the ocean and atmosphere (DEWHA, 2008b).

Within the environment that may be affected (EMBA), plankton communities are likely to reflect this regional pattern, varying with depth and distance offshore. Communities of phytoplankton in coastal waters bloom and decay in response to seasonal changes in water flows, resuspension of sediments by cyclones, strong tidal currents, monsoon winds and wind-generated waves (DEWHA, 2008b). In deeper offshore areas, productivity is likely to be more dependent on internal nutrient cycling and upwellings of productive oceanic waters, such as around the shoals and pinnacles associated with key ecological features (KEFs) of the region (Section 12).

6. Bony fish, sharks and rays

The environment that may be affected (EMBA) supports a variety of fish species of conservation value, as well as fisheries of commercial and recreational importance (DSEWPaC, 2012c).

Fish species listed under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) that may occur in the EMBA were identified with the online protected matters search tool (PMST) (Appendix A) and these species are shown in Table 6-1. The PMST did not indicate that the grey nurse shark (listed as Vulnerable) may occur in the area, but this species was observed at a seamount near the Barossa field during the marine studies program and although this site is not within the EMBA it has been included for completeness. Table 6-1 also lists the threatened species protected under the *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act) that have the potential to occur within the EMBA.

Threatened and migratory shark and ray species are further discussed in Section 6.1 and Section 6.2. The scalloped hammerhead shark is listed as conservation dependent under the EPBC Act and has been included here as its listing status may be revised to threatened during the Activity.

Table 6-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed fish species including sharks and rays

Common name	Scientific name	EPBC Act status	TPWC Act status	Particular values or sensitivities
Threatened and migratory species				
Grey nurse shark	*Carcharias taurus*	Vulnerable	Not listed	Reported as occurring at seamounts to the north of the EMBA as part of the Barossa marine studies program
Longfin mako	*Isurus paucus*	Migratory Marine	Not listed	Species or species habitat likely to occur within area
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory Marine	Not listed	Species or species habitat may occur within area
Scalloped hammerhead	*Sphyrna lewini*	Conservation Dependent	Not listed	Species or species habitat known to occur within area
Shortfin mako, mako shark	*Isurus oxyrinchus*	Migratory Marine	Not listed	Species or species habitat likely to occur within area
Speartooth shark	*Glyphis glyphis*	Critically Endangered	Vulnerable	Species or species habitat known to occur within area
Whale shark	*Rhincodon typus*	Vulnerable, Migratory Marine	Not listed	Species or species habitat may occur within area
White shark, great white shark	*Carcharodon carcharias*	Vulnerable, Migratory Marine	Not listed	Species or species habitat may occur within area
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable, Migratory Marine	Vulnerable	Species or species habitat known to occur within area
Freshwater sawfish, largetooth sawfish, river sawfish, Leichhardt's sawfish, northern sawfish	*Pristis pristis*	Vulnerable, Migratory Marine	Vulnerable	Species or species habitat known to occur within area
Giant manta ray	*Mobula birostris*	Migratory Marine	Not listed	Species or species habitat likely to occur within area

Common name	Scientific name	EPBC Act status	TPWC Act status	Particular values or sensitivities
Green sawfish, dindagubba, narrowsnout sawfish	*Pristis zijsron*	Vulnerable, Migratory Marine	Vulnerable	Species or species habitat known to occur within area
Narrow sawfish, knifetooth sawfish	*Anoxypristis cuspidata*	Migratory Marine	Not listed	Species or species habitat known to occur within area
Northern river shark	*Glyphis garricki*	Endangered	Endangered	Breeding known to occur within area
Reef manta ray, coastal manta ray	*Mobula alfredi*	Migratory Marine	Not listed	Species or species habitat likely to occur within area
Southern Bluefin Tuna	*Thunnus maccoyii*	Conservation dependent	Not listed	Species or species habitat may occur within area
Listed marine species				
Australian Messmate Pipefish, Banded Pipefish	*Corythoichthys intestinalis*	Listed marine	Not listed	Species or species habitat may occur within area
Banded Pipefish, Ringed Pipefish	*Doryrhamphus dactyliophorus*	Listed marine	Not listed	Species or species habitat may occur within area
Beady Pipefish, Steep-nosed Pipefish	*Hippichthys penicillus*	Listed marine	Not listed	Species or species habitat may occur within area
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish	*Trachyrhamphus bicoarctatus*	Listed marine	Not listed	Species or species habitat may occur within area
Blue-speckled Pipefish, Blue-spotted Pipefish	*Hippichthys cyanospilos*	Listed marine	Not listed	Species or species habitat may occur within area
Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish	*Doryrhamphus excisus*	Listed marine	Not listed	Species or species habitat may occur within area
Brock's Pipefish	*Halicampus brocki*	Listed marine	Not listed	Species or species habitat may occur within area
Cleaner Pipefish, Janss' Pipefish	*Doryrhamphus janssi*	Listed marine	Not listed	Species or species habitat may occur within area
Corrugated Pipefish, Barbed Pipefish	*Bhanotia fasciolata*	Listed marine	Not listed	Species or species habitat may occur within area
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish	*Syngnathoides biaculeatus*	Listed marine	Not listed	Species or species habitat may occur within area
Fijian Banded Pipefish, Brown-banded Pipefish	*Corythoichthys amplexus*	Listed marine	Not listed	Species or species habitat may occur within area
Flat-face Seahorse	*Hippocampus planifrons*	Listed marine	Not listed	Species or species habitat may occur within area
Girdled Pipefish	*Festucalex cinctus*	Listed marine	Not listed	Species or species habitat may occur within area
Gunther's Pipehorse, Indonesian Pipefish	*Solegnathus lettiensis*	Listed marine	Not listed	Species or species habitat may occur within area

Common name	Scientific name	EPBC Act status	TPWC Act status	Particular values or sensitivities
Hedgehog Seahorse	*Hippocampus spinosissimus*	Listed marine	Not listed	Species or species habitat may occur within area
Mud Pipefish, Gray's Pipefish	*Halicampus grayi*	Listed marine	Not listed	Species or species habitat may occur within area
Pacific Short-bodied Pipefish, Short-bodied Pipefish	*Choeroichthys brachysoma*	Listed marine	Not listed	Species or species habitat may occur within area
Pallid Pipehorse, Hardwick's Pipehorse	*Solegnathus hardwickii*	Listed marine	Not listed	Species or species habitat may occur within area
Pig-snouted Pipefish	*Choeroichthys suillus*	Listed marine	Not listed	Species or species habitat may occur within area
Red-hair Pipefish, Duncker's Pipefish	*Halicampus dunckeri*	Listed marine	Not listed	Species or species habitat may occur within area
Reef-top Pipefish	*Corythoichthys haematopterus*	Listed marine	Not listed	Species or species habitat may occur within area
Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish	*Corythoichthys flavofasciatus*	Listed marine	Not listed	Species or species habitat may occur within area
Ribboned Pipehorse, Ribboned Seadragon	*Haliichthys taeniophorus*	Listed marine	Not listed	Species or species habitat may occur within area
Robust Ghostpipefish, Blue-finned Ghost Pipefish	*Solenostomus cyanopterus*	Listed marine	Not listed	Species or species habitat may occur within area
Roughridge Pipefish	*Cosmocampus banneri*	Listed marine	Not listed	Species or species habitat may occur within area
Schultz's Pipefish	*Corythoichthys schultzi*	Listed marine	Not listed	Species or species habitat may occur within area
Short-keel Pipefish, Short-keeled Pipefish	*Hippichthys parvicarinatus*	Listed marine	Not listed	Species or species habitat may occur within area
Spiny Seahorse, Thorny Seahorse	*Hippocampus histrix*	Listed marine	Not listed	Species or species habitat may occur within area
Spiny-snout Pipefish	*Halicampus spinirostris*	Listed marine	Not listed	Species or species habitat may occur within area
Spotted Seahorse, Yellow Seahorse	*Hippocampus kuda*	Listed marine	Not listed	Species or species habitat may occur within area
Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish	*Trachyrhamphus longirostris*	Listed marine	Not listed	Species or species habitat may occur within area
Three-keel Pipefish	*Campichthys tricarinatus*	Listed marine	Not listed	Species or species habitat may occur within area
Tidepool Pipefish	*Micrognathus micronotopterus*	Listed marine	Not listed	Species or species habitat may occur within area
Tiger Pipefish	*Filicampus tigris*	Listed marine	Not listed	Species or species habitat may occur within area

6.1 Sharks

6.1.1 Grey nurse shark

The grey nurse shark (*Carcharias taurus*; Vulnerable under the EPBC Act) has a wide but patchy tropical and temperate distribution in the Indo-West Pacific and Atlantic oceans. There are two distinct subpopulations in Australia on the east and west coast. The west coast population inhabits coastal and continental shelf waters from south west Western Australia (WA) (Albany) up to the North West Shelf (DoE, 2023b; FRDC, 2019) and although one aggregation site has been documented, data on their distribution along the WA and NT coastline is lacking (Hoschke et al., 2023). Grey nurse sharks undertake large-scale movements to potentially capitalise on seasonal prey aggregations, with individuals migrating 1,294 km along the WA coast from SW WA to Ningaloo, and 1,500 km on the east coast (Dwyer et al., 2023; DoE, 2023b; Jakobs et al., 2019). Grey nurse sharks are thought to move further north along the coast during May to December. Individuals have been caught near Browse Island and off Bali, Indonesia (Hoschke et al., 2023; Momigliano & Jaiteh 2015). During the Barossa marine studies program, four grey nurse sharks were observed at seamounts in waters 130 m deep, one possibly pregnant (Jacobs, 2016). This was considered unusual as neither of the subpopulations are known to extend that far north and are generally associated with shallower, more coastal waters (DoE, 2023b). Given grey nurse sharks have been observed at seamounts and oceanic coral reefs in the Timor Sea, the species may be present around reefs, banks and seamounts in the EMBA.

6.1.2 Mako sharks

Shortfin mako (*Isurus oxyrinchus*; Migratory) and longfin mako (*I. paucus*; Migratory) sharks are both highly migratory epipelagic species. The shortfin mako is a common shark in tropical and temperate waters above 16 °C (DoE, 2023c; Groeneveld et al., 2014), and as such widespread throughout Australian waters except for the Torres Strait, Arafura Sea and Gulf of Carpentaria (FRDC 2019; Birkmanis et al., 2020; Kyne et al., 2021a). Shortfin mako sharks exhibit sexual and developmental segregation; juveniles spend 90% of their time near the surface whereas adults dive much deeper (Groeneveld et al., 2014). In contrast, the wide but patchy distribution and biology of the rarely encountered longfin mako is less well documented (DoE, 2023d; Kyne et al., 2021a). This epipelagic shark also inhabits tropical and warm-temperature waters. In Australia, longfin mako sharks are found from Geraldton in WA across the NT and Queensland down to Port Stevens in NSW (FRDC, 2019; Rigby et al., 2019). These species may be rarely encountered within the EMBA.

6.1.3 Oceanic whitetip shark

The oceanic whitetip shark (*Carcharhinus longimanus*; Migratory) is a highly mobile globally widespread species found in tropical and warm temperate waters between 18 to 28°C from the surface to at least 180 m, venturing close to shore where the continental shelf is narrow (DoE, 2023e; Kyne et al., 2021a). Within Australian waters, this rarely encountered species is found in warmer waters from Cape Leeuwin in WA across northern Australia down to Sydney (DoE, 2023e; Kyne et al., 2021a). Oceanic whitetip sharks have been globally assessed as Critically Endangered by the IUCN, Overfished by SAFS and listed on CITES Appendix II (FRDC, 2019). It is possible that individuals of this species may be encountered within the EMBA.

6.1.4 River sharks

6.1.4.1 Northern river shark

Northern river sharks (*Glyphis garricki*; Endangered under the EPBC Act and TPWC Act) are rare and although their distribution is uncertain, they are known to occur in the Ord and King Rivers, King Sound and Joseph Bonaparte Gulf in WA, along with the South and East Alligator Rivers and the Wessel islands in NT (Udyawer et al., 2021; FRDC, 2019; DSEWPaC, 2010a). These sharks are thought to segregate during various life stages, occupying rivers, estuarine systems, macrotidal embayments as well as inshore marine habitats (Kyne et al., 2021a; FRDC, 2019; DSEWPaC, 2010a). Although the northern river shark has been recorded in offshore waters, the frequency of this occurrence is unknown.

The Sawfish and River Shark Multispecies Recovery Plan (DoE, 2015a) recorded observations of adults and juveniles in marine waters north of Derby, WA while pupping and juveniles occur in King Sound and Cambridge Gulf. Under the recovery plan, all aggregations and areas of biologically important behaviours such as

breeding, foraging, resting or migrating are considered critical to the survival of the species. Individuals may be encountered in low numbers within the EMBA.

6.1.4.2 Speartooth shark

The speartooth shark (*Glyphis glyphis*; Critically Endangered under the EPBC Act; Vulnerable under the TPWC Act) has been recorded as occurring in macrotidal rivers and estuary environments, with juveniles and sub-adults utilising large tropical river systems as their primary habitat (Kyne et al., 2021b; DSEWPaC, 2010b Stevens et al., 2005). It is thought that their marine distribution may be limited to the coastal marine environment outside of rivers (Udyawer et al., 2021; FRDC, 2019; DSEWPaC, 2010b). While the speartooth shark is known to inhabit the Wenlock/Ducie/Port Musgrave river system in Qld and various rivers of the Van Diemen Gulf in the NT, new populations of this species were recently discovered in the Daly River, NT and the Ord River, WA (Kyne et al., 2021b). It has been recorded in tidal rivers and estuaries with turbid waters with fine muddy substrates in temperatures ranging from 27 to 33 °C (Pillans et al., 2009). Individuals may be encountered in low numbers within the EMBA.

6.1.5 Scalloped hammerhead shark

The scalloped hammerhead shark (*Sphyrna lewini*; conservation dependent under the EPBC Act) is a coastal and semi-oceanic species globally distributed in tropical and warm-temperate waters from the intertidal zone to at least 275 m in depth, with newborns found in coastal zones (Kyne et al., 2021; FRDC, 2019). Recent studies suggest that the Indo-Pacific population (including Australia) is genetically distinct from the Atlantic and Caribbean populations. There is likely to be two subpopulations in Australian waters (WA and the rest of Australia), with the non-WA subpopulation connected to Papua New Guinea and Indonesia by shallow water habitats along northern Australia (Green et al., 2022). Across northern Australia, the pupping season peaks from October to January (TSSC, 2018a). This mobile species has a broad Australian range from NSW and Qld across the NT to WA (DoE 2023o; Bartes et al., 2021; Kyne et al., 2021; FRDC, 2019). Scalloped hammerhead sharks are known to occur within the EMBA.

6.1.6 Whale shark

The whale shark (*Rhincodon typus*; Vulnerable under the EPBC Act, Migratory) is globally distributed in tropical and warm temperate seas, except the Mediterranean. There are two distinct subpopulations, with approximately 75% of the global population in the Indo-Pacific, and the remaining 25% in the Atlantic Ocean (Vignaud et al., 2014 in FRDC, 2019). Ningaloo Reef in WA is a known aggregation site, and whale sharks congregate off Christmas Island from December to January. These aggregations are thought to be linked to seasonal prey fluctuations (DoE, 2015l; DEH, 2005a). The species is an epipelagic filter feeder with a diet of planktonic and nektonic species, including small crustaceans and smaller schooling fish species (DoE, 2023f). Whale sharks are known to be highly migratory with migrations of over 20,000 km recorded (Guzman et al., 2018). Migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (DoE, 2015b).

Wilson et al. (2006) recorded six whale sharks departing Ningaloo Reef and traveling north-east into the Indian Ocean. Meekan and Radford (2010) showed that whale sharks migrated up the coast from Ningaloo Reef and individually dispersed over a broad area; either north-west into the open Indian Ocean, northward towards Sumatra and Java, or north-east towards the Timor Sea; and Thomson et al., (2021) more recently recorded whale sharks tagged in Ningaloo Reef traveling to the North West Shelf. Due to their widespread distribution, highly migratory whale sharks may occur within the EMBA.

6.1.7 White shark

The white shark (*Carcharodon carcharias*; Vulnerable under the EPBC Act, Migratory) is a rare, primarily temperate species with a wide Australian range and two subpopulations; eastern Australasia (from Papua New Guinea along Australia's east coast and Macquarie Island to the south-western Pacific, including waters off New Caledonia, Vanuatu and Tonga) and a southern-western population (from western Victoria across southern Australia and up the WA coast; DSEWPaC, 2013a; FRDC, 2019; Kyne et al., 2021a). Although the species has been recorded south from central Qld to up to Ningaloo Reef and may occur further north on both coasts (McAuley et al 2017), white sharks are not known to aggregate within the NWMR or NMR and are most likely to be found south of North West Cape (DSEWPaC, 2012a; 2012d). The reasons for movements to north-

western WA are unknown and little information is available on their reproduction in Australian waters (McAuley et al., 2016; DSEWPaC, 2012d). White sharks are unlikely to be seen in the EMBA.

6.2 Rays

6.2.1 Manta rays

The giant manta ray (*Mobula birostris*; Migratory) and reef manta ray (*Mobula alfredi*; Migratory) are globally distributed in both tropical and temperate waters. Giant manta rays are considered to be the more migratory and oceanic species of the two, and individuals of this highly mobile species are not expected to be resident in Australian waters (Kyne et al., 2021a; Couturier et al., 2015). While considered more solitary and less frequently sighted than reef manta rays, giant manta rays can be found in large numbers engaging in foraging, mating or cleaning activities and exhibit seasonal habitat preferences frequenting offshore seamounts and islands (Marshall et al., 2022a).

The reef manta ray typically utilises productive nearshore habitats, including island groups, atolls and continental coastlines (Marshall et al., 2022b), and is coastally distributed across the north of Australia to approximately 30°S on both coasts (Armstrong et al., 2020). While reef manta rays demonstrate a high degree of site fidelity in tropical and subtropical waters, this species has also been shown to travel up to 700 km, undertake seasonal migrations and traverse international waters (Couturier et al., 2015). Reef manta rays are often sighted in high numbers, predominantly when undertaking foraging activities or migrating. There are no known foraging or breeding aggregation areas for these species within the EMBA. Based on the habitat preferences of these rays, it is unlikely that either species would occur in large numbers within the EMBA although individuals may transit through the area.

6.2.2 Sawfish

The three EPBC Act and TPWC Act listed threatened (Vulnerable) sawfish species that may occur in the EMBA, dwarf sawfish (*Pristis clavata*), green sawfish (*P. zijsron*) and largetooth sawfish (*P. pristis*), occur mainly in inshore coastal waters and riverine environments in northern Australia. Adults of both green and largetooth sawfish are thought to use deepwater habitats, but this has not been confirmed for dwarf sawfish (DoE, 2015c). Considering the declining global populations of these sawfishes, northern and north-west Australia may contain the last significant populations of these species (Yan et al., 2021; DoE, 2015c; DSEWPaC, 2012d). Sawfishes feed on a variety of teleost fishes and benthic invertebrates, including cephalopods, crustaceans and molluscs (Lear et al., 2023; Thorburn et al., 2007; 2008; Pogonoski et al., 2002). Based on their habitat preferences, it is considered highly unlikely that these sawfish would occur within the deeper offshore waters of the EMBA. A fourth species, the narrow sawfish (*Anoxypristis cuspidate*; Migratory), is currently being assessed for EPBC threatened species listing (DoE, 2023g), and may be found within the EMBA.

6.2.2.1 Dwarf sawfish

The dwarf sawfish (*Pristis clavata*; Vulnerable under the EPBC Act and TPWC Act; Migratory) is primarily found in shallow coastal and estuarine areas, from Cairns in Queensland around the north of Australia to the Pilbara coastline in WA, with juveniles thought to remain in estuarine waters (FRDC, 2019; DEWHA, 2009a).

6.2.2.2 Green sawfish

The green sawfish (*Pristis zijsron*; Vulnerable under the EPBC Act and TPWC Act; Migratory) is most common in shallow coastal and estuarine areas, but this species has been recorded in water depths of up to 70 m from Cairns in Queensland across to Broome in WA (FRDC, 2019; DEWHA, 2008a). Green sawfish appear to have limited tidally influenced movements, occupying only a few square kilometres within the coastal fringe, and strongly associated with mangroves and adjacent mudflats (Lear et al., 2023). Although their spatial and temporal distribution in these creeks is variable with changing tidal and environmental conditions, they typically return to inshore waters to breed and pup during the wet season (i.e. January; Chevron, 2011).

6.2.2.3 Largetooth sawfish

Largetooth sawfish (*Pristis pristis*; Vulnerable under the EPBC Act; Migratory) inhabit the sandy or muddy bottoms of river, estuarine and marine environments within north-west Australia and has a patchy distribution

including the Fitzroy, Durack, Robinson and Ord rivers in WA. Newborns and juveniles occur primarily in the freshwater areas of rivers and in estuaries, while adults mostly occupy marine and estuarine environments (FRDC, 2019; DoE, 2015d; DSEWPaC, 2012d).

6.2.2.4 Narrow sawfish

The narrow sawfish (*Anoxypristis cuspidata*; Migratory), is currently being assessed for EPBC threatened species listing (DoE, 2023g). Narrow sawfish are a bentho-pelagic species found throughout the Indo-West Pacific and are still found throughout much of their historic range, albeit in substantially reduced numbers (FRDC, 2019). Narrow sawfish occur across northern Australia from the Pilbara Coast in WA to Broad Sound in Queensland in waters up to 40 m deep on the continental shelf and in estuaries (Kyne et al., 2021a; FRDC, 2019). Juveniles and pupping females require inshore and estuarine habitats, while adults predominantly occur offshore (FRDC, 2019). Narrow sawfish may be found within the EMBA.

6.2.3 Other fish

6.2.3.1 Southern bluefin tuna

The southern bluefin tuna (*Thunnus maccoyii*; conservation dependent – under threatened listing assessment, Migratory) are a highly migratory teleost fish species mainly found in the eastern Indian ocean and in the south-west Pacific Ocean. With a varied diet including crustaceans, cephalopods, fishes and other marine animals, these fish can be found to depths of 500 m (Caton, 1991). Breeding takes place in tropical waters between Java, Indonesia, and northern WA (7 to 20°S) from September to April, and the young move down the WA coast from the spawning grounds (CCBST, 2023). Southern bluefin tuna school by size, with juveniles under two years of age found in WA and SA inshore waters (Honda et al., 2010). Adults inhabit offshore waters from northern WA across southern Australian, including Tasmania, to northern New South Wales

6.3 Biologically Important Areas and Critical habitat for bony fish, sharks and rays

There are no BIAs for sharks or rays within the EMBA listed in the PMST report.

7. Marine reptiles

The environment that may be affected (EMBA) supports a variety of marine reptile species of high conservation value (DSEWPaC, 2012a; 2012b; 2012e). Threatened and migratory species as well as marine reptile species listed under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) that may occur in the EMBA were identified with the protected matters search tool (PMST) (Appendix A). These species are shown in Table 7-1, with threatened and migratory species discussed in Section 7.1 and Section 7.2. Note that terrestrial or inland species without habitat along shorelines have been excluded. Table 7-1 also lists the threatened species protected under the *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act) that have the potential to occur within the EMBA.

Table 7-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine reptiles

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Turtles				
Flatback turtle	*Natator depressus*	Listed, Vulnerable, Migratory Marine	Not listed	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Listed, Vulnerable, Migratory Marine	Not listed	Breeding known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Listed, Vulnerable, Migratory Marine	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Leatherback turtle, leathery turtle, luth	*Dermochelys coriacea*	Listed, Endangered, Migratory Marine	Critically endangered	Foraging, feeding or related behaviour known to occur within area
Loggerhead turtle	*Caretta caretta*	Listed, Endangered, Migratory Marine	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Olive ridley turtle, Pacific ridley turtle	*Lepidochelys olivacea*	Listed, Endangered, Migratory Marine	Vulnerable	Breeding known to occur within area
Crocodiles				
Salt-water crocodile, estuarine crocodile	*Crocodylus porosus*	Migratory marine	Not listed	Species or species habitat likely to occur within area
Other listed species				
Australian Beaked sea snake	*Enhydrina schistosa*	Listed (as *Hydrophis zweiffei*)	Not listed	Species or species habitat may occur within area
Black-headed sea snake, Slender-necked seasnake	*Leioselasma coggeri*	Listed (as *Hydrophis coggeri*)	Not listed	Species or species habitat may occur within area
Black-headed seasnake	*Hydrophis atriceps*	Listed	Not listed	Species or species habitat may occur within area
Black-ringed seasnake	*Hydrelaps darwiniensis*	Listed	Not listed	Species or species habitat may occur within area

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Dubois' seasnake	*Aipysurus duboisii*	Listed	Not listed	Species or species habitat may occur within area
Eastern turtle-headed seasnake	*Emydocephalus annulatus*	Listed	Not listed	Species or species habitat may occur within area
Elegant seasnake	*Hydrophis elegans*	Listed	Not listed	Species or species habitat may occur within area
Horned seasnake	*Acalyptophis peronii*	Listed (as *Hydrophis peronii*)	Not listed	Species or species habitat may occur within area
Large-headed seasnake, Pacific seasnake	*Leioselasma pacifica*	Listed (as *Hydrophis pacificus*)	Not listed	Species or species habitat may occur within area
Mosaic seasnake	*Aipysurus mosaicus*	Listed	Not listed	Species or species habitat may occur within area
Northern Mangrove seasnake	*Parahydrophis mertoni*	Listed	Not listed	Species or species habitat may occur within area
Olive seasnake	*Aipysurus laevis*	Listed	Not listed	Species or species habitat may occur within area
Olive-headed seasnake	*Disteira major*	Listed (as *Hydrophis major*)	Not listed	Species or species habitat may occur within area
Plain seasnake	*Chitulia inornata*	Listed (as *Hydrophis inornatus*)	Not listed	Species or species habitat may occur within area
Small-headed seasnake	*Hydrophis macdowelli*	Listed (as *Hydrophis mcdowelli*)	Not listed	Species or species habitat may occur within area
Spectacled seasnake	*Disteira kingii*	Listed (as *Hydrophis kingii*)	Not listed	Species or species habitat may occur within area
Spine-bellied seasnake	*Lapemis hardwickii*	Listed (as *Hydrphophis hardwickii*)	Not listed	Species or species habitat may occur within area
Spotted seasnake	*Hydrophis ornatus*	Listed	Not listed	Species or species habitat may occur within area
Stoke's seasnake	*Hydrophis stokesii*	Listed	Not listed	Species or species habitat may occur within area
Yellow-bellied seasnake	*Hydrophis platura*	Listed	Not listed	Species or species habitat may occur within area

7.1 Marine turtles

7.1.1 Flatback turtle

Flatback turtles (*Natator depressus*; Vulnerable under the EPBC Act; Migratory) are known to occur along the WA, NT and Queensland coastlines, and forage widely across the Australian continental shelf and into the continental waters off Indonesia and Papua New Guinea (Commonwealth of Australia, 2017). Flatback turtles are primarily carnivorous, predominantly feeding on soft-bodied invertebrates. This species breeds in the region, with the highest density rookeries found to be winter at Cape Domett and summer at Eighty Mile Beach, while moderate to lesser density nesting in winter occurred in the North Kimberley offshore islands (Tucker et al., 2021). Flatback turtles that nest within the Pilbara region typically migrate along the continental shelf to foraging grounds as far north as Darwin at the end of the nesting season, returning to breed at varying intervals of a year or more (Thums et al., 2020; Commonwealth of Australia, 2017). Tracking studies have shown individuals migrating from northern WA into Queensland waters and (conversely) from Deliverance Island in Queensland to Kimberley waters, with the waters around the Tiwi Island supporting migrating and foraging flatbacks (Pendoley, 2023).

Flatback turtles nesting within the NT are from the Arafura Sea breeding and genetic stock, with unknown long-term trends for this stock (Commonwealth of Australia, 2017). Nesting has been recorded on the Tiwi Islands, with flatback turtles the predominant nesting species on the southern and south-western beaches that fall within the EMBA (Pendoley, 2023). The greatest proportion of activity occurs on the west coast of Bathurst Island (Chatto & Baker, 2008) with nesting females numbering around 11 to 100 per year, which is comparable to or smaller than other nesting sites of the Arafura Sea genetic stock. Nesting and internesting occurs year-round with a peak during June to September, and hatchling emergence peaking between July and September (Commonwealth of Australia, 2017).

The Recovery plan for marine turtles in Australia defines a 60 km internesting buffer around the Tiwi Islands (Commonwealth of Australia, 2017). Whittock et al. (2016) defined suitable internesting habitat as waters up to 16 m deep within 5 to 10 km of the coastline, and unsuitable internesting habitat as waters over 25 m deep and more than 27 km from the coastline. They also tracked inter-nesting flatback turtles from five different mainland and island rookeries and found that these turtles not only stayed in waters less than 44 m deep, but were associated with a mean depth of under 10 m (Whittock et al., 2016). To date there is no evidence indicating flatback turtles in deep offshore waters during the inter-nesting period (Pendoley, 2019). There are BIAs for flatback turtle foraging and internesting within the EMBA (Figure 7-1).

7.1.2 Green turtle

Green turtles (*Chelonia mydas*; Vulnerable under the EPBC Act; Migratory) are predominately found off the WA, NT and Queensland coastlines (Commonwealth of Australia, 2017). The green turtle is the most common marine turtle breeding in the NWMR, with WA supporting one of the largest remaining populations worldwide (DSEWPaC, 2012e). Green turtles travel up to 3,100 km between nesting and feeding areas (Ferreira et al., 2021; DSEWPaC, 2012e) and forage on algae, seagrass and mangroves, including on offshore coral reefs across northwestern Australia (Ferreira et al., 2021; Commonwealth of Australia, 2017).

In the NT, nesting sites occur mostly from the western end of Melville Island to near the Queensland border (NT Government, n.d). The Cobourg Peninsula green turtle genetic stock is the closest to those on the Tiwi Islands and they nest between October and April, with peak nesting period between December and January. Nesting in the Tiwi Islands includes the beaches within the EMBA on the south-west of Bathurst Island (Chatto & Baker, 2008; Pendoley, 2023). Nesting sites for the species in the Bonaparte or Van Diemen bioregions are Black/Smith Point and Lawson Island, east of the Tiwi Islands near Cobourg Peninsula (Chatto & Baker, 2008).

Green turtles are likely to be encountered within the EMBA, mainly within reef areas, and inter-nesting is expected between October and April (Commonwealth of Australia, 2017). There are BIAs for green turtle foraging and internesting within the EMBA and critical habitat for green turtles are located in the waters of the EMBA (Figure 7-2).

7.1.3 Hawksbill turtle

Hawksbill turtles (*Eretmochelys imbricata*, Vulnerable under the EPBC Act and TPWC Act; Migratory) predominantly occur along northern Australian coastlines (WA, NT and Queensland), with three recognised stocks: north Queensland stock located in the north Great Barrier Reef and Torres Strait; north-east Arnhem

Land stock in the NT; and WA stock located on the North West Shelf.. Hawksbill turtles are omnivorous and feed on algae, sponges, soft corals and soft bodied invertebrates foraging in waters ranging from 1.5 to 84 m deep (Fossette et al., 2021). This species is typically associated with rocky and coral reef habitats, often returning to a small foraging area, and is expected to be found within these habitats along the WA coastline, from Shark Bay to the northern extent of the NWMR, migrating over 4,600 km from their nesting site (Crommenacker et al., 2022; Barr et al., 2021; Commonwealth of Australia, 2017). Unlike green turtles, there is little evidence that hawksbill turtles nesting elsewhere in WA, NT, or Queensland migrate to the Tiwi Islands to forage (Pendoley, 2023) and the islands are not listed as an important nesting, foraging, or inter-nesting site for this species (Commonwealth of Australia, 2017).

In the NT, nesting occurs on islands concentrated around north-eastern Arnhem land and Groote Eylandt (Northern Territory Government, n.d) and is reported to occur from July to December (Chatto, 1997; 1998; DSEWPaC, 2012d). Nesting on the Tiwi Islands has been recorded at Seagull Island and northern Melville Island (Chatto & Baker, 2008), outside the EMBA.

Hawksbill turtles may forage on banks and shoals within the EMBA, and BIAs for hawksbill turtle internesting overlap the waters of the EMBA (Figure 7-3).

7.1.4 Leatherback turtle

Leatherback turtles (*Dermochelys coriacea*; Endangered under the EPBC Act; critically endangered under the TPWC Act; Migratory) are known to forage and migrate throughout the open offshore waters of Australia, with foraging more common along the east coast and Bass Strait. Leatherback turtles are pelagic throughout their life and feed almost exclusively on jellyfish. Records of leatherback turtles nesting in Australia are sparse, and limited to Queensland, NSW and NT (DoE, 2023h; Commonwealth of Australia, 2017), with scattered isolated nesting (one to three nests per year) in Qld and the NT (Limpus & McLachlin, 1994). Due to the lack of significant nesting sites in Australian waters, leatherback turtles are likely migrants from neighbouring countries foraging in Australia (Limpus, 2009c). Habitat critical to the survival of the leatherback turtle (nesting) and a leatherback turtle BIA for internesting intersects the EMBA near the Cobourg Peninsula (Figure 7-4).

7.1.5 Loggerhead turtle

Loggerhead turtles (*Caretta caretta*; Endangered under the EPBC Act; Vulnerable under the TPWC Act, Migratory) range along most of the Australian coastline and throughout the NWMR (Commonwealth of Australia, 2017). This species is carnivorous and mainly feeds on benthic invertebrates in a wide range of habitats from nearshore to waters 55 m deep (Commonwealth of Australia, 2017). Breeding aggregations occur on Australia's east (Queensland, NSW) and west coasts. Loggerhead turtles have one genetic breeding stock within WA, with approximately 3,000 females supporting the third-largest population in the world (Commonwealth of Australia, 2017; Limpus, 2009; Baldwin et al., 2003).

Capable of large migrations, individual loggerhead turtles from both WA and eastern Australian have been recorded foraging in the NT, and further afield in Indonesia and Papua New Guinea (Perez et al., 2022; Pendoley, 2023). In the Kimberley region, loggerhead turtles are thought to be transient or end-of-migration foragers with no documented nesting sites in the area (Tucker et al., 2021). Although loggerhead turtles forage in the Oceanic Shoals Marine Park, the Arafura Sea and the Gulf of Carpentaria, they are not known to breed in the region. Loggerheads found within the EMBA most likely come from the WA population, nesting outside the EMBA (Commonwealth of Australia, 2017). A BIA for loggerhead turtle foraging intersects the EMBA (Figure 7-5).

7.1.6 Olive ridley turtle

Olive ridley turtles (*Lepidochelys olivacea*; Endangered under the EPBC Act; Vulnerable under the TPWC Act; Migratory) are known to nest in the NT and on western Cape York (Queensland), with low density nesting recorded on the Kimberley coast, in the Dampier Peninsula and along Camden Sound (Tucker et al., 2021; Commonwealth of Australia, 2017b). This species is primarily carnivorous and feeds on soft-bodied invertebrates in waters between 15 m and 200 m in depth. Olive ridley turtles migrate through oceanic waters, travelling up to 1,130 km between their nesting and foraging grounds (Cáceres-Farias et al., 2022; Commonwealth of Australia, 2017; Whiting et al., 2005). All reported olive ridley movements were largely restricted to within the 100 m depth contour (Pendoley, 2023).

Olive ridley turtles are known to nest on the Tiwi Islands on the west coast of Bathurst Island and the north coast of Melville Island. These turtles are part of the NT genetic stock, significant at both a national and international level (Commonwealth of Australia, 2017). The NT genetic stock nests throughout the year, with peaks between April and June, and most hatchlings emerge between June and August (Commonwealth of Australia, 2017).

Internesting habitat for this species encompasses nearshore waters along the north, west and east coasts of the Tiwi Islands. Tracking studies showed these turtles remain close to shore in waters less than 55 m deep within 37 km of the nesting beach during the internesting interval (Whiting et al., 2007a; 2005). Migrating olive ridley turtles tracked from the Tiwi Islands typically moved in a north-east and west/south-westerly direction, to foraging grounds ~ 300 – 400 km to the west in the Joseph Bonaparte Gulf or up to 1,200 km away in the Arafura Sea and Gulf of Carpentaria (Pendoley, 2023). Olive ridley turtles may be encountered in the shallow waters of the Tiwi Islands, with BIAs for foraging, nesting and internesting intersecting the EMBA (Figure 7-6).

7.2 Crocodiles

The EPBC Protected Matter search identified one species of crocodile likely to occur in the EMBA, the salt-water crocodile (*Crocodylus porosus*; Migratory). Salt-water crocodiles were originally listed under the EPBC Act to regulate commercial hunting which caused significant population declines (DoE, 2023i).

Salt-water crocodiles are found across northern Australia from Rockhampton in Queensland across the NT to Broome in WA and occur within the nearshore marine and estuarine waters of the Kimberley coast (DoE, 2023i). Larger populations within the major river systems of the Kimberley occur in the rivers draining into the Cambridge Gulf, the Prince Regent and Roe River systems of the east and northwest Kimberley (DEC, 2009). The nesting habitat for this species predominantly occurs within the Ord, King and Roe River (DEC, 2009). There are no BIAs for the salt-water crocodile within the EMBA, but given their widespread distribution, they are likely to be present within the EMBA.

7.3 Biologically Important Areas and critical habitat for marine reptiles

Known BIAs for marine turtles are summarised in Table 7-2, and shown in Figure 7-1 to Figure 7-6.

Table 7-2: Biological Important Areas and critical habitat for marine reptiles within the EMBA

Species	BIA behaviour	Distance to Northern Territory Waters Operational Area (km)	Habitat critical to the survival of marine turtles within EMBA and distance to Northern Territory Waters Operational Area
Flatback turtle	Foraging	207	✓Overlaps
	Internesting	Overlaps	
	Internesting buffer	267	
Green turtle	Foraging	90	✓ 183 km
	Internesting	89	
Hawksbill turtle	Internesting	160	
Loggerhead turtle	Foraging	207	
Leatherback turtle	Internesting	206	✓ 149 km
Olive ridley turtle	Foraging	51	✓ 9.5 km
	Internesting	9.5	

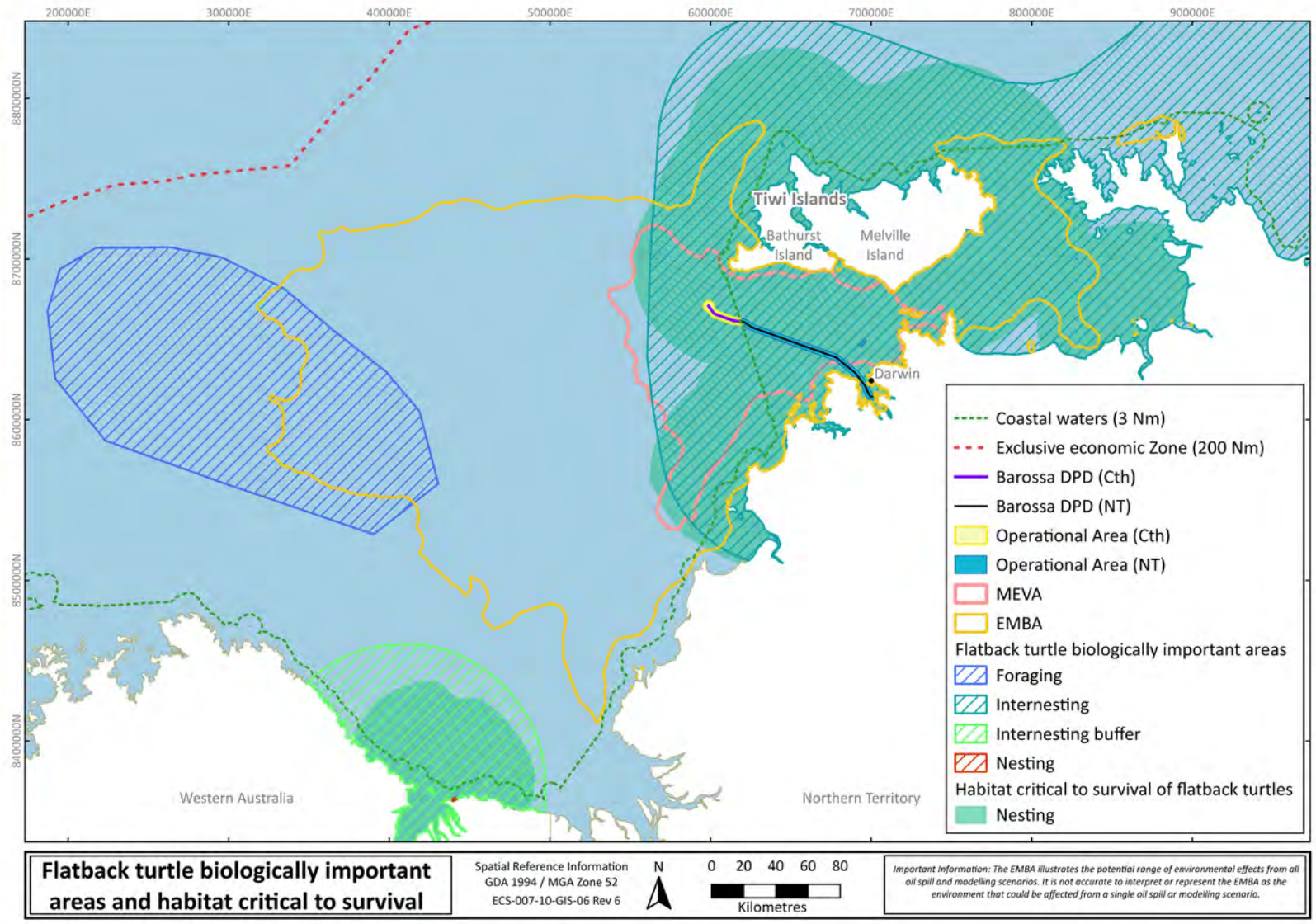


Figure 7-1: Flatback turtle critical habitat and BIAs overlapping or proximal to the EMBA

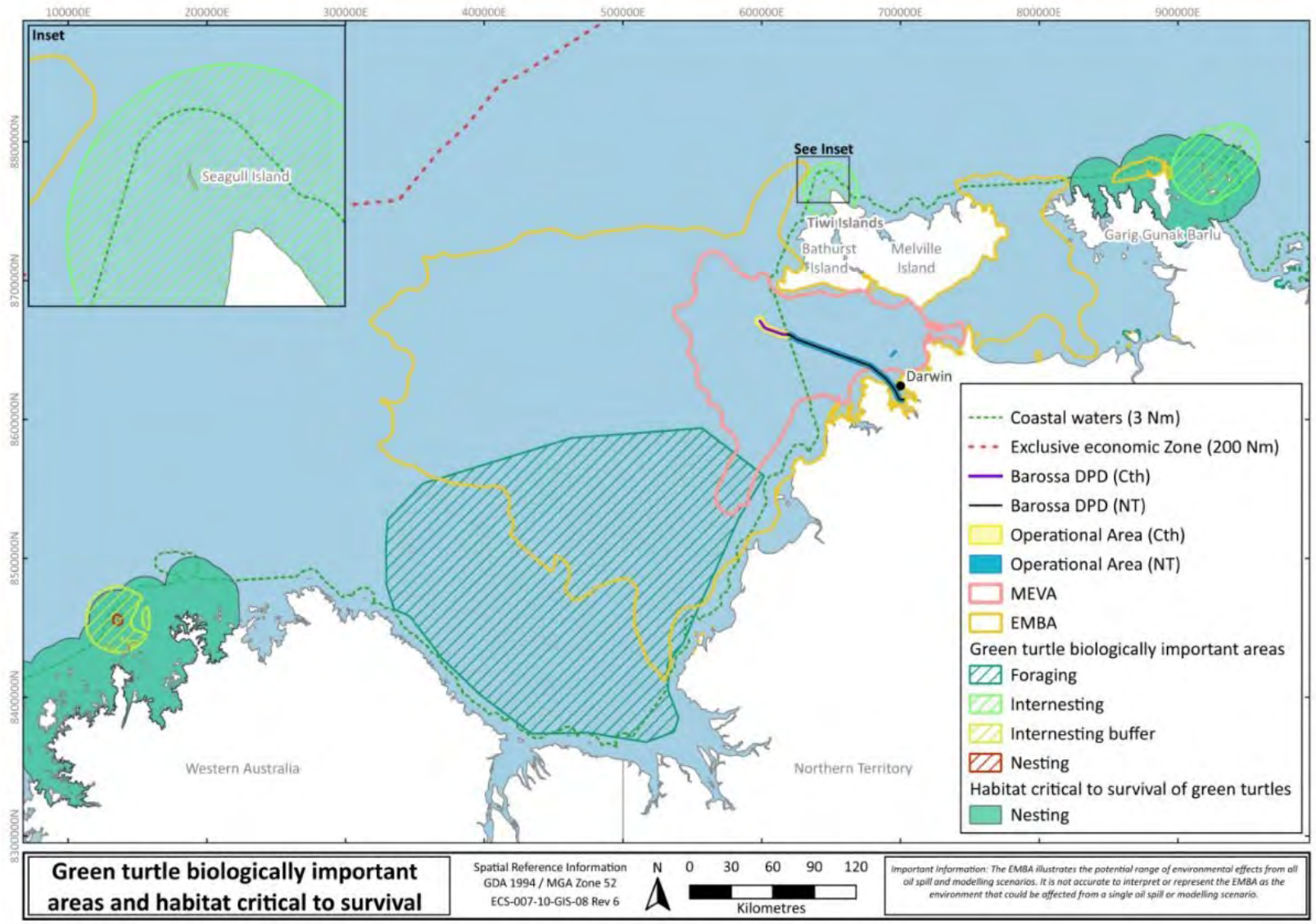


Figure 7-2: Green turtle critical habitat and BIAs overlapping or proximal to the EMBA

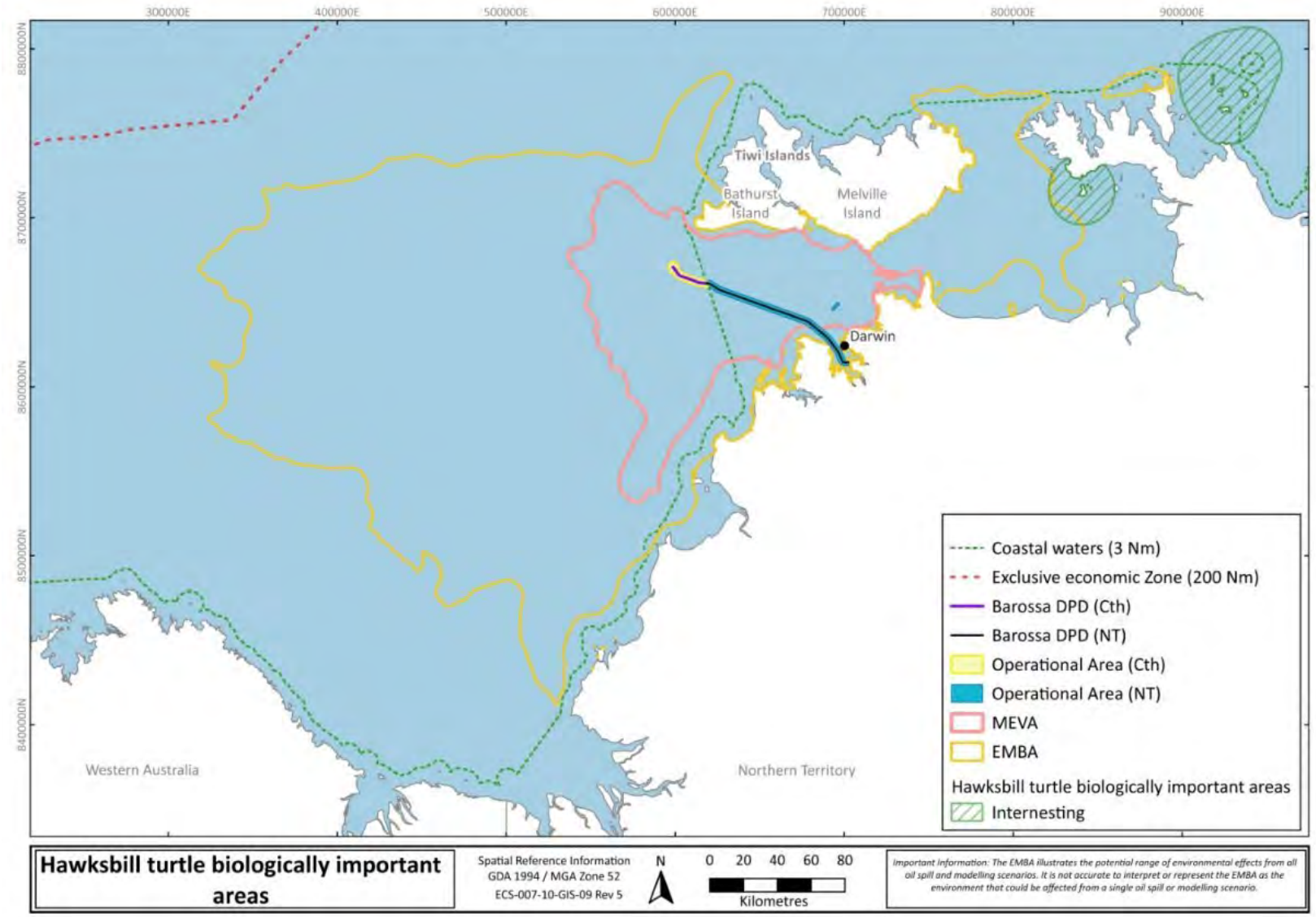


Figure 7-3: Hawksbill turtle critical habitat and BIAs overlapping or proximal to the EMBA

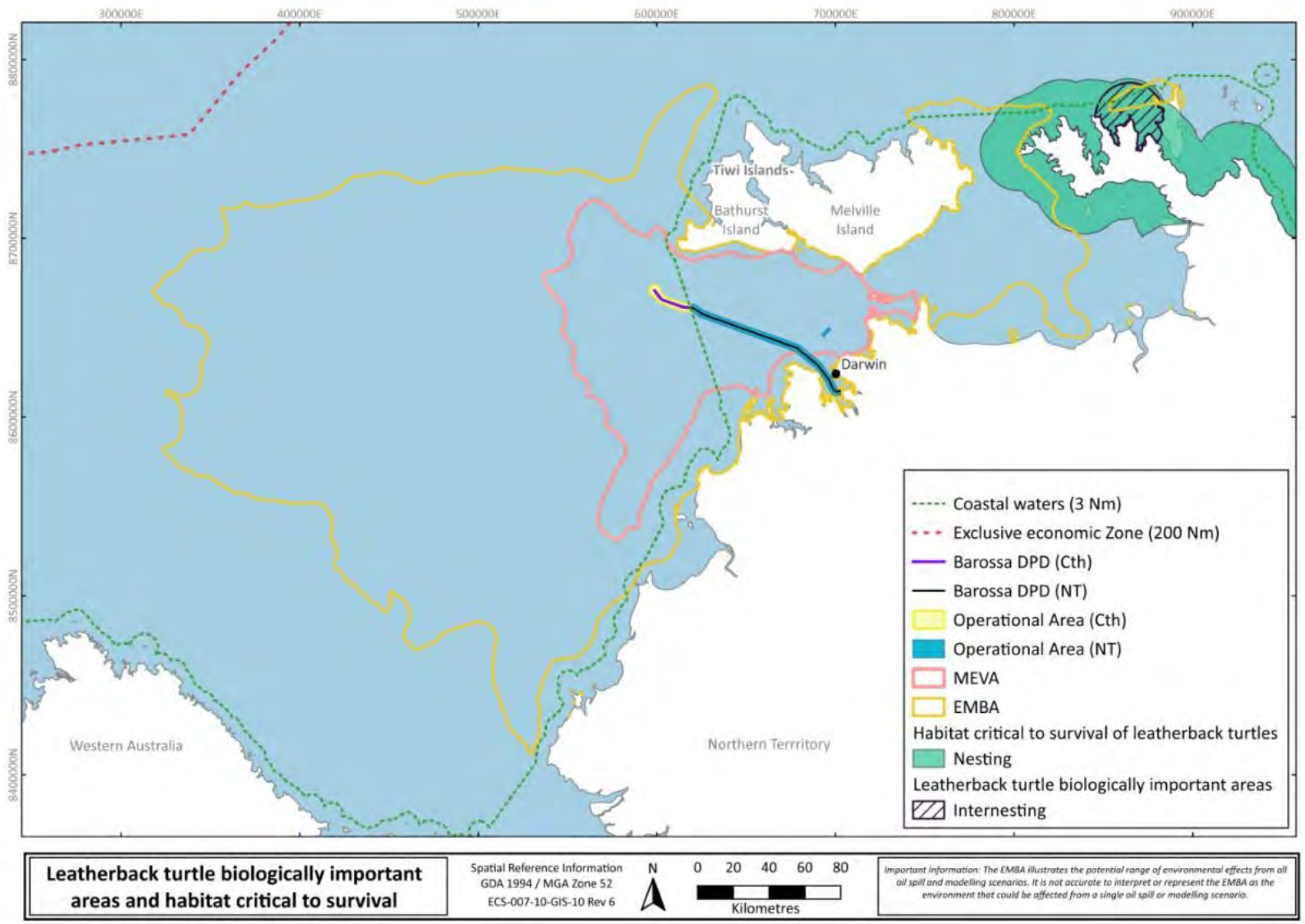


Figure 7-4: Leatherback turtle critical habitat and BIAs overlapping or proximal to the EMBA

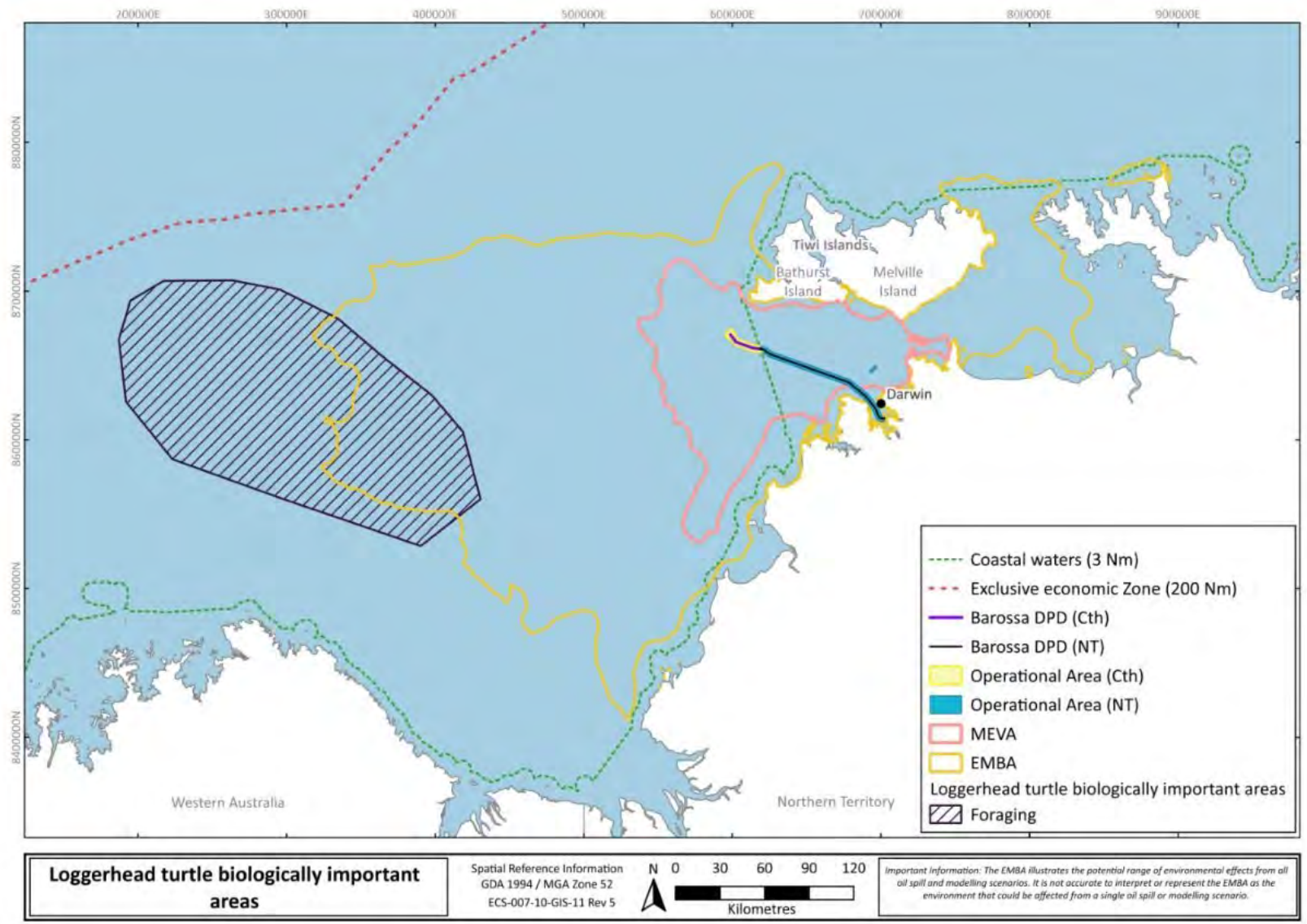


Figure 7-5: Loggerhead turtle critical habitat and BIAs overlapping or proximal to the EMBA

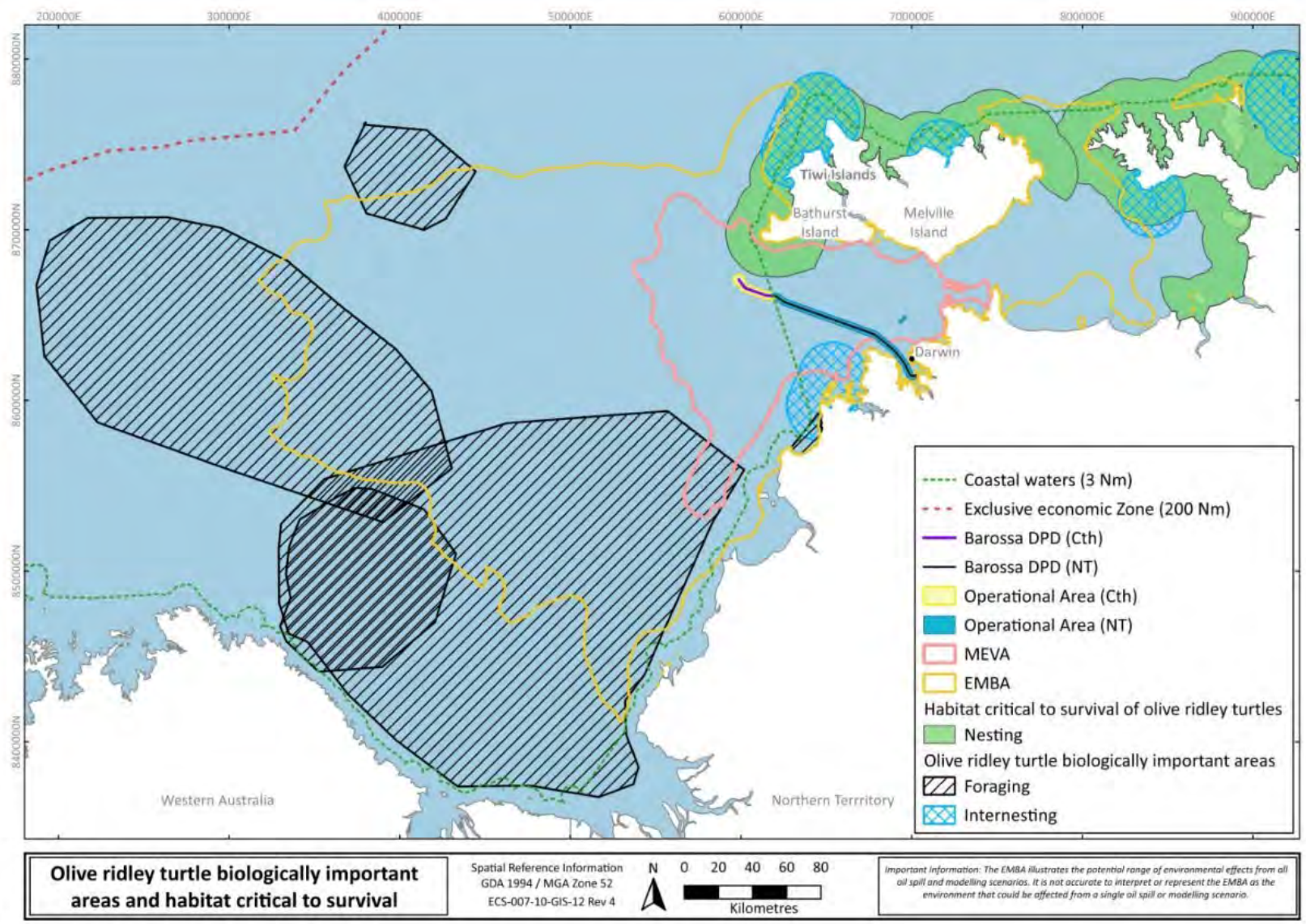


Figure 7-6: Olive ridley turtle critical habitat and BIAs overlapping or proximal to the EMBA

8. Marine mammals

Threatened and migratory marine mammals as well as cetaceans listed under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) that may occur in the environment that may be affected (EMBA) were identified with the protected matters search tool (PMST) (Appendix A). These species are shown in Table 8-1, with threatened and migratory species discussed in Section 8.1, Section 8.2 and Section 8.3. None of these species are listed under the *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act).

Table 8-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine mammals

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Whales				
Blue whale	*Balaenoptera musculus*	Endangered, Migratory	Not listed	Species or species habitat likely to occur within area
Bryde's whale	*Balaenoptera edeni*	Migratory	Not listed	Species or species habitat likely to occur within area
Fin whale	*Balaenoptera physalus*	Vulnerable, Migratory	Not listed	Species or species habitat may occur within area
Humpback whale	*Megaptera novaeangliae*	Migratory	Not listed	Species or species habitat likely to occur within area
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory	Not listed	Species or species habitat may occur within area
Dolphins				
Australian Humpback Dolphin (previously referred to as the Indo-Pacific Humpback Dolphin)	*Sousa sahulensis*	Migratory (as *Sousa chinensis*)	Not listed	Breeding known to occur within area
Australian snubfin dolphin	*Orcaella heinsohni*	Migratory	Not listed	Breeding known to occur within area
Killer whale, orca	*Orcinus orca*	Migratory	Not listed	Species or species habitat may occur within area
Spotted bottlenose dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus*	Migratory	Not listed	Species or species habitat known to occur within area
Dugong				
Dugong	*Dugong dugon*	Migratory	Not listed	Species or species habitat known to occur within area
Listed cetacean species (not included above)				
Bottlenose Dolphin	*Tursiops truncatus s. str.*	Cetacean	Not listed	Species or species habitat may occur within area
Common Dolphin, Short-beaked Common Dolphin	*Delphinus delphis*	Cetacean	Not listed	Species or species habitat may occur within area
False Killer Whale	*Pseudorca crassidens*	Cetacean	Not listed	Species or species habitat likely to occur within area
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	*Tursiops aduncus*	Cetacean	Not listed	Species or species habitat likely to occur within area

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Risso's Dolphin, Grampus	*Grampus griseus*	Cetacean	Not listed	Species or species habitat may occur within area
Spotted Dolphin, Pantropical Spotted Dolphin	*Stenella attenuata*	Cetacean	Not listed	Species or species habitat may occur within area

8.1 Whales

8.1.1 Blue whale

The blue whale (*Balaenoptera musculus*; Endangered under the EPBC Act, Migratory) has four distinct sub-species, two are found in the southern hemisphere; the pygmy blue whale (*B. m. brevicauda*; Indo-Australian and Tasman-Pacific populations) and the Antarctic blue whale (*B. m. intermedia*; DoE, 2015e). As southern blue whales occur in waters south of 60°S and pygmy blue whales north of 55°S (DEWHA, 2008), only pygmy blue whales are discussed below.

The pygmy blue whale is known to migrate along the WA shelf edge at depths between the 500 m and 1,000 m depth contours from the NW Cape south to Geographe Bay (DoE, 2023j; 2015e). A biologically important migration corridor is recognised in the deep offshore waters off WA (IUCN-MMPATF, 2023a; DCCEEW, 2023a). The northerly migration toward the calving grounds near the equator occurs in March/April to June (Thums et al., 2021; DoE, 2023j; 2015e). Noise modelling for the Barossa project in the Timor Sea detected the presence of blue whales over 400 km north-east of the migration BIA for the species in the months of May to August during their north-bound seasonal migration. No detections of the species were made during the period of their southward migration (McPherson et al., 2016). The southerly migration to the feeding grounds in the high latitudes of the southern hemisphere occurs from September/ to December (DoE, 2023j; 2015e). Pygmy blue whales appear to travel as individuals or in small groups when making their migrations (Woodside, 2014).

Generally, this species travels alone or in small groups based on acoustic data. Pygmy blue whale calls from noise loggers deployed around Scott Reef from 2006 to 2009 for the Woodside Browse project found 78% of calls to be from single whales, 18% from whale pairs and 4% from three or more whales (McCauley, 2011; Woodside, 2014).

There are no BIAs for pygmy blue whales identified within the EMBA and, if present, are likely to be transient and in low numbers.

8.1.2 Bryde's whale

Bryde's whales (*Balaenoptera edeni*; Migratory) are distributed across tropical and warm temperate waters with individuals recorded in all Australian states, except the NT (Ceccarelli et al., 2011). The species typically moves between 40 °N and 40 °S, with these movements seeming to be primarily linked to prey availability (DoE, 2023k). Bryde's whales are thought to be divided into offshore and onshore forms with the distinction between the two based on prey preference (DoE, 2023k; Ceccarelli et al., 2011). The offshore form is found in deeper waters (500 to 1,000 m) and is thought to migrate seasonally in favour of warmer waters in winter months. The onshore form generally inhabits waters over 200 m and displays no distinct migratory movements (DoE, 2023k). A noise monitoring study undertaken for the Barossa project detected Bryde's whales almost year-round from January to October (McPherson et al., 2016) and this species has been encountered off Browse Island (Ceccarelli et al., 2011). Bryde's whales may occasionally transit through the EMBA in small numbers.

8.1.3 Fin whale

Fin whales (*Balaenoptera physalus*; Vulnerable under the EPBC Act, Migratory) are widely distributed from polar to tropical waters and have been recorded in all Australian states, other than NSW and the NT(Bannister et al. 1996). Fin whales feed on planktonic crustacea, such as Antarctic krill, and primarily forage in high latitudes.

The species rarely occupies inshore waters and displays well defined migratory movements (essentially north south) between polar, temperate and tropical waters (DoE 2023l; Ceccarelli et al 2011; Bannister et al. 1996). Research by Aulich et al. (2022; 2019) found that fin whales travel up the WA coast as far north as Dampier (19°S). After arriving at Cape Leeuwin in April, the species migrates north along the coast to feed in Perth Canyon from May to October. This is thought to be a migratory pathway from Antarctica, and it has been suggested that there are separate fin whale sub-populations on the east and west coasts of Australia (Aulich et al., 2022; 2019). Within Australian waters, the Bonney Upwelling is thought to be an important foraging ground for this species (DoE, 2023l; DoE, 2015f; Bannister et al., 1996).

The Australian fin whale distribution is unclear due to limited observations, but the species is thought to be present from Exmouth along the southern coastline to Qld. There are no known mating or calving areas in Australian waters and no BIAs have been developed for fin whales (DoE, 2023l; 2015f). Given their distribution and movements, fin whales are considered unlikely to occur in the EMBA.

8.1.4 Humpback whale

The humpback whale (*Megaptera novaeangliae*; Migratory) has a wide distribution with recordings throughout Australian Antarctic waters and offshore from all Australian states (IUCN-MMPATF, 2023b; Bannister et al., 1996). These whales migrate between summer feeding grounds in Antarctica and winter breeding and calving grounds in the sub-tropical and tropical inshore waters of north-west Australia (Jenner et al., 2001). Although the exact timing of migration varies annually due to a number of factors including water temperature, the northbound migration peaks between late July and early August, and the southbound migration peaks between late August and early September (DoE, 2023m; Jenner et al., 2001).

There has been a steady recovery in the humpback whale population that migrates along the WA coast since the closure of commercial whaling, and as a result the species was removed from the EPBC Act threatened species list in 2022 (DAWE, 2022).

Humpback whales breed and calve in the NWMR between Broome and the northern end of Camden Sound in the months of June to September each year (DoE, 2023m; 2015g) and a breeding and calving BIA for humpback whales is recognised in nearshore waters adjacent to the northern half of the Dampier Peninsula and encompasses Camden Sound (DoE, 2023m).

Relatively few humpback whales have been known to travel north of Camden Sound (Jenner et al., 2001) and Barossa Development baseline studies did not detect any humpback whale calls in the Timor Sea (McPherson et al., 2016).

There are no BIAs for this species within the EMBA and given the available information on its distribution, it is considered unlikely to occur within the EMBA.

8.1.5 Sei whale

Sei whales (*Balaenoptera borealis*; Vulnerable under the EPBC Act, Migratory) are thought to have a wide distribution, but their distribution limits are unclear as this species is often confused with Bryde's whales. Sightings are rare, but the species may be seen in coastal and offshore waters throughout Australia (DoE, 2023n; Bannister et al., 1996). The species is able to utilise a diverse range of marine habitats, which has been attributed to a combination of dynamic physical and prey processes (DoE, 2023n).

Sei whale migratory movements are well defined with distinct north-south movements as the species migrates between polar, temperate and tropical waters for foraging and breeding. The species feeds intensively between the Antarctic and sub-tropical convergences on planktonic crustacea (DoE, 2023n; Ceccarelli et al., 2011; Bannister et al., 1996). There are no known mating or calving areas in Australian waters and the species is thought to infrequently occur in the NW region (Ceccarelli et al., 2011).

There are no BIAs for this species in Australian waters (DCCEEW, 2023a; 2023b). However, it is possible that individual sei whales may occasionally occur within the EMBA.

8.2 Dolphins

8.2.1 Australian snubfin dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*; Migratory), previously known and only recently differentiated from the closely related Irrawaddy dolphin (*O. brevirostris*), is a poorly known species inhabiting shallow coastal and estuarine waters and tidal rivers. The species typically occurs in water depths of less than 20 m in the vicinity of freshwater outflows, but has been recorded up to 23 km offshore (DoE, 2023p; Bouchet et al., 2021). The Australian snubfin dolphin is likely to occur in higher densities in areas of complex habitat type which provide a variety of prey types (Palmer et al., 2014; DSEWPaC, 2012f).

In Australia, this species occurs in coastal waters of Qld, NT and north-western Australia. The population in Australian waters is thought to be continuous with the Papua New Guinea species but separate from populations in Asia. Breeding is thought to occur throughout the year for this species and there are breeding BIAs that overlap the EMBA in Darwin Harbour and at Cobourg Peninsula.

8.2.2 Australian humpback dolphin

The Australian humpback dolphin (*Sousa sahulensis*; Migratory, previously/also known as the Indo-pacific humpback dolphin, *S. chinensis*) occurs in waters of the Sahul Shelf, from northern Australia to the Kikori Delta in Papua New Guinea, and Bird's Head Seascape in West Papua (Jefferson & Rosenbaum, 2014 in DoE, 2023q; Beasley et al., 2016). Although distribution, life history and habitat preferences of this species are poorly understood, the Australian humpback dolphin is thought to be associated with shallow coastal, estuarine and tidal river waters less than 20 m in depth (DoE, 2023q; Hanf et al., 2016; Palmer et al., 2014).

In Australia, humpback dolphins occur along the northern Australian coastline from Shark Bay in WA to southern Queensland (DoE, 2023q; Raudino et al., 2018; Hanf et al., 2016). In the NWMR, this species is thought to inhabit coastal waters up to the 30 m isobath (Hanf et al., 2016), but Australian humpback dolphins have been recorded up to 60 km offshore near Barrow Island, the Montebello Islands (approximately 80 km from the mainland coast and 20 km from Barrow Island), and the western Lowendal Islands (Raudino et al., 2018). Available abundance estimates indicate that this species occurs in small populations with an average of up to 89 individuals and a maximum of 0.19 individuals per km² (Parra & Cagnazzi 2016).

There are breeding BIAs for Australian humpback dolphins in Darwin Harbour and at Kakadu National Park that overlap the EMBA (Figure 8-1).

8.2.3 Killer whale

The largest member of the dolphin family, killer whales or orca (*Orcinus orca*; Migratory) are a cosmopolitan species with a vast global distribution across a wide range of habitats. However, they appear to be primarily concentrated in coastal waters and cooler regions of high productivity as they are carnivores with a diet that varies seasonally and regionally (DoE, 2023r; Bannister et al., 1996). Globally, killer whales are known to migrate; however, specific routes and seasonal movement patterns are not known in detail and are thought to relate to prey availability (Bannister et al., 1996).

Killer whales are distributed throughout Australian waters, typically observed moving along the continental slope and shelf, and near seal colonies (Bannister et al., 1996). Migration movements within Australian waters include a summer migration from subantarctic islands to Macquarie Island (DoE, 2023r). While killer whales are known to undertake seasonal migrations and follow regular migratory routes, little is known about these movements (DoEE, 2019).

Killer whales are often observed around seal colonies and may be associated with humpback whale migrations, neither of which occur in the vicinity of the EMBA. No BIAs or migration routes have been identified for this species within the EMBA, although they may occur in low numbers.

8.2.4 Spotted bottlenose dolphin (Indo-pacific bottlenose dolphin)

The spotted bottlenose dolphin (Arafura/Timor Sea populations; *Tursiops aduncus*; Migratory) is primarily found in nearshore continental shelf waters less than 200 m deep, with rocky or coral reefs, sandy, soft sediments, or seagrass beds (DSEWPaC, 2012f). Small populations also occur in the inshore waters of some oceanic islands (Ceccarelli et al 2011).

In Australia, migration patterns for the species are variable, including year-round residency in small areas, long-range movements and migration (DoE, 2023s). The species occurs in NT open coastal waters, primarily within the continental shelf and around oceanic islands. Spotted bottlenose dolphins forage in a wide range of habitats and in deeper waters than most dolphins. Groups are resident at Browse Island, Rowley Shoals and other island and reef complexes in offshore waters (Allen et al., 2012; Ceccarelli et al., 2011).

There is a breeding/calving BIA located in Darwin Harbour for the Indo-Pacific bottlenose dolphin that overlaps the EMBA (Figure 8-1). Given spotted bottlenose dolphin use relatively deeper waters and potentially travel large distances, it is likely this species will also transit through other parts of the EMBA.

8.3 Dugong

Dugongs (*Dugong dugon*; Migratory) occur in tropical and sub-tropical coastal and island waters. They are commonly found in shallow areas to 25 m depth, but have been observed in waters up to 37 m deep (DoE, 2023ab; DEWHA, 2008b). Dugong feeding aggregations tend to occur in large seagrass meadows within wide shallow protected bays, shallow mangrove channels and in the lee of large inshore islands. Although the movements of most individuals are limited to tens of kilometres in the vicinity of seagrass beds some individuals travel up to 1,000 km (Hobbs & Willshaw, 2015; Whiting, 2008).

Dugongs in the Torres Strait have large home-range sizes when compared to other regions, likely due to the vast areas of seagrass, including over 13,000 km^2 of deep-water seagrass, the largest continuous area in Australia (Deutsch et al., 2022). This, along with large seagrass beds in shallow water around reefs, enables dugongs to travel long distances while staying relatively close to accessible food sources (Deutsch et al., 2022).

In northern Australia, the Darwin region supports a dugong population travelling over 300 km between rocky reef habitats (Whiting, 2008), and key sites for dugong conservation have been identified around Cobourg Peninsula, Croker Island and the north coast of the Tiwi Islands (PWSNT, 2003) which all partly overlap the EMBA. Aggregations at these sites rank in the top eight dugong populations in Australia (PWSNT, 2003). Dugongs tracked in the INPEX Ichthys Project baseline surveys were recorded around the Vernon Islands, south of Melville Island, and spent time in Darwin Harbour and around the Tiwi Islands (INPEX, 2010).

There are no BIAs for dugong in the EMBA, but the species are known to occur in suitable habitats (e.g. seagrass meadows) within the EMBA.

8.4 Biologically Important Areas and critical habitat for marine mammals

Known BIAs for marine mammals that are intersected by the EMBA are summarised in Table 8-2 and shown in Figure 8-1. These BIAs overlap with the NT OA.

Table 8-2: Biological Important Areas and critical habitat for marine mammals within the EMBA

Species	BIA behaviour
Australian snubfin dolphin	Breeding
Australian humpback dolphin (previously referred to as the Indo-Pacific humpback dolphin)	Breeding
Spotted bottlenose dolphin	Breeding

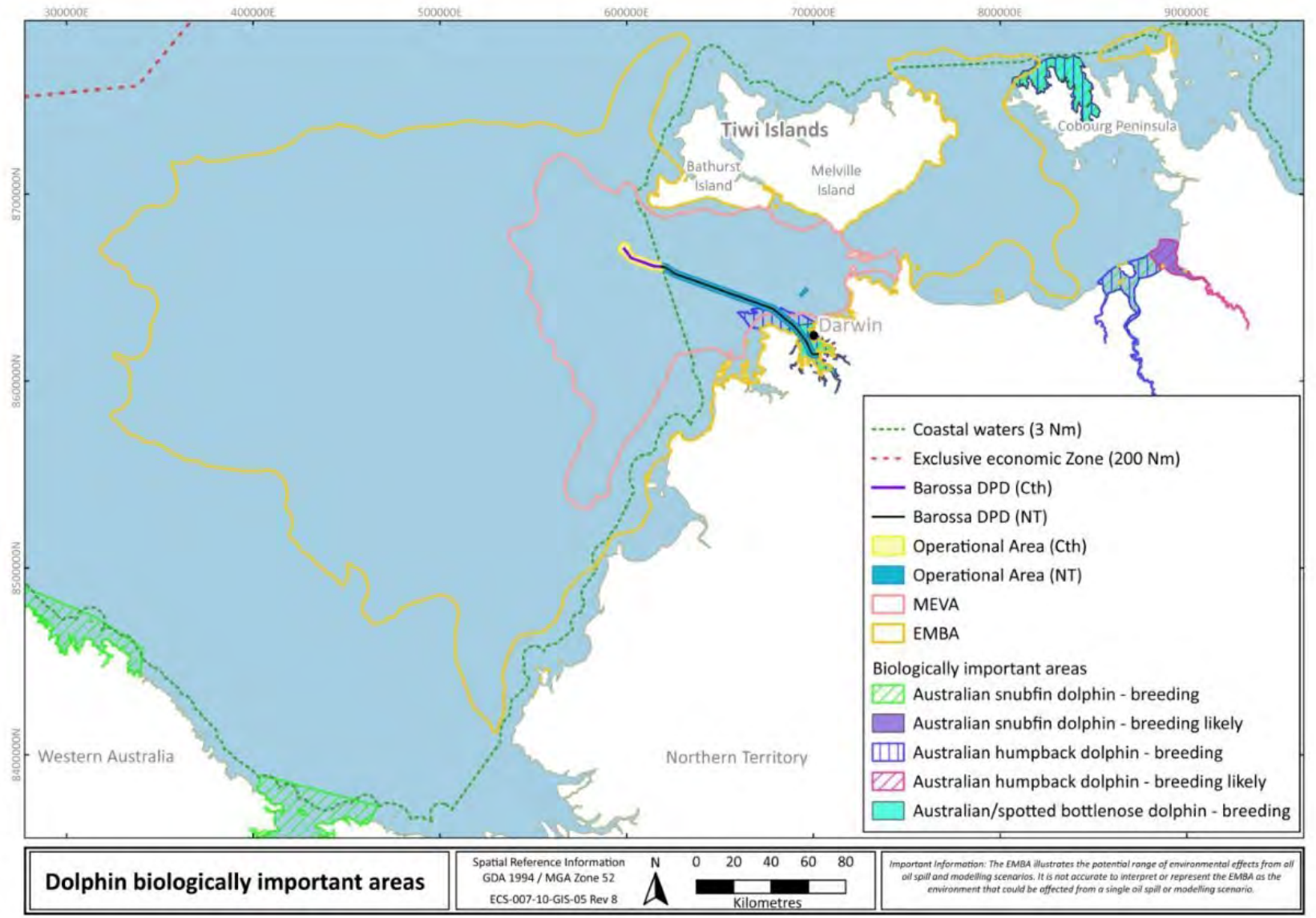


Figure 8-1: Marine mammal critical habitat and BIAs overlapping or proximal to the EMBA

9. Birds

A number of marine bird species are known to occur within the region, foraging large distances over the open ocean (DSEWPaC, 2012g). See the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) protected matters search tool (PMST) (Appendix A) for the full list of birds that may occur in the environment that may be affected (EMBA). Species that are not expected to occur in significant numbers within the marine and coastal environments of the EMBA, due to their terrestrial or southern distributions according to the Species Profile and Threats database and The Action Plan for Australian Birds (Garnet, 2011), are not discussed further. Species listed under the EPBC Act as migratory and/or threatened that may occur in the EMBA are outlined in Table 9-1, with species listed as threatened further described in the following sections. Species listed under the *Territory Parks and Wildlife Conservation Act 1976* (NT) (TPWC Act) are also shown in Table 9-1.

Table 9-1: Environmental values and sensitivities within the EMBA for threatened, migratory and listed marine birds

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Threatened and migratory species				
Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers)	*Epthianura crocea tunneyi*	Endangered	Endangered	Species or species habitat likely to occur within area
Asian Dowitcher	*Limnodromus semipalmatus*	Vulnerable, Migratory wetlands, Overfly marine	Not listed	Species or species habitat known to occur within area
Australian Painted Snipe	*Rostratula australis*	Endangered	Endangered	Species or species habitat may occur within area
Black-tailed Godwit	*Limosa limosa*	Vulnerable, Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Common Greenshank, Greenshank	*Tringa nebularia*	Endangered, Migratory wetlands, Overfly marine	Not listed	Species or species habitat known to occur within area
Curlew Sandpiper	*Calidris ferruginea*	Critically Endangered, Migratory wetlands, Overfly marine	Critically endangered	Species or species habitat known to occur within area
Eastern Curlew, Far Eastern Curlew	*Numenius madagascariensis*	Critically Endangered, Migratory wetlands, Marine	Critically endangered	Species or species habitat known to occur within area
Great Knot	*Calidris tenuirostris*	Vulnerable, Migratory wetlands, Overfly marine	Critically endangered	Roosting known to occur within area
Greater Sand Plover, Large Sand Plover	*Charadrius leschenaultii*	Vulnerable, Migratory wetlands, Marine	Vulnerable	Species or species habitat known to occur within area

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Grey Falcon	*Falco hypoleucos*	Vulnerable, Migratory wetlands, Marine	Vulnerable	Species or species habitat known to occur within area
Grey Plover	*Pluvialis squatarola*	Vulnerable, Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Lesser Sand Plover, Mongolian Plover	*Charadrius mongolus*	Endangered, Migratory wetlands	Endangered	Roosting known to occur within area
Masked owl (northern)	*Tyto novaehollandiae kimberli*	Vulnerable	Vulnerable	Species or species habitat known to occur within area
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	Vulnerable	Not listed	Species or species habitat known to occur within area
Partridge pigeon (eastern)	*Geophaps smithii smithii*	Vulnerable	Vulnerable	Species or species habitat known to occur within area
Red goshawk	*Erythrotriorchis radiatus*	Vulnerable	Vulnerable	Species or species habitat known to occur within area
Red Knot, Knot	*Calidris canutus*	Vulnerable, Migratory wetlands, Overfly marine	Endangered	Species or species habitat known to occur within area
Ruddy Turnstone	*Arenaria interpres*	Vulnerable, Migratory wetlands	Not listed	Roosting known to occur within area
Sharp-tailed Sandpiper	*Calidris acuminata*	Vulnerable, Migratory wetlands	Not listed	Roosting known to occur within area
Terek Sandpiper	*Xenus cinereus*	Vulnerable, Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Tiwi Islands hooded robin	*Melanodryas cucullata melvillensis*	Critically Endangered	Critically Endangered	Species or species habitat likely to occur within area
Tiwi Masked Owl, Tiwi Islands Masked Owl	*Tyto novaehollandiae melvillensis*	Endangered	Endangered	Species or species habitat known to occur within area
Barn Swallow	*Hirundo rustica*	Migratory Terrestrial, Overfly Marine	Not listed	Species or species habitat known to occur within area
Bar-tailed Godwit	*Limosa lapponica*	Endangered, Migratory wetlands	Critically Endangered	Species or species habitat known to occur within area
Broad-billed Sandpiper	*Limicola falcinellus*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Common Noddy	*Anous stolidus*	Migratory marine	Not listed	Species or species habitat likely to occur within area
Common Sandpiper	*Actitis hypoleucos*	Migratory wetlands	Not listed	Species or species habitat known to occur within area
Fork-tailed Swift	*Apus pacificus*	Migratory marine, Overfly marine	Not listed	Species or species habitat likely to occur within area
Great Frigatebird, Greater Frigatebird	*Fregata minor*	Migratory marine	Not listed	Species or species habitat known to occur within area
Greater Crested Tern	*Thalasseus bergii*	Migratory marine	Not listed	Breeding likely to occur within area
Grey Wagtail	*Motacilla cinerea*	Migratory	Not listed	Species or species habitat known to occur within area
Grey-tailed Tattler	*Tringa brevipes*	Migratory wetlands	Not listed	Roosting known to occur within area
Lesser Frigatebird, Least Frigatebird	*Fregata ariel*	Migratory marine	Not listed	Species or species habitat known to occur within area
Little Curlew, Little Whimbrel	*Numenius minutus*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Little Ringed Plover	*Charadrius dubius*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Little Tern	*Sternula albifrons*	Migratory marine	Not listed	Breeding known to occur within area
Long-toed Stint	*Calidris subminuta*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Marsh Sandpiper, Little Greenshank	*Tringa stagnatilis*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Oriental cuckoo, horsfield's cuckoo	*Cuculus optatus*	Migratory terrestrial	Not listed	Species or species habitat known to occur within area
Oriental Plover, Oriental Dotterel	*Charadrius veredus*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Oriental Pratincole	*Glareola maldivarum*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Oriental Reed-Warbler	*Acrocephalus orientalis*	Migratory wetlands	Not listed	Species or species habitat may occur within area
Osprey	*Pandion haliaetus*	Migratory wetlands	Not listed	Breeding known to occur within area
Pacific Golden Plover	*Pluvialis fulva*	Migratory wetlands	Not listed	Roosting known to occur within area
Pectoral Sandpiper	*Calidris melanotos*	Migratory wetlands	Not listed	Species or species habitat known to occur within area

Common name	Scientific name	EPBC Act status	TWPC Act status	Particular values or sensitivities
Pin-tailed Snipe	*Gallinago stenura*	Migratory wetlands, Overfly marine	Not listed	Roosting likely to occur within area
Red-necked Stint	*Calidris ruficollis*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Red-rumped Swallow	*Cecropis daurica*	Migratory terrestrial, Overfly marine	Not listed	Species or species habitat known to occur within area
Rufous Fantail	*Rhipidura rufifrons*	Migratory terrestrial, Overfly marine	Not listed	Species or species habitat known to occur within area
Sanderling	*Calidris alba*	Migratory wetlands	Not listed	Roosting known to occur within area
Streaked Shearwater	*Calonectris leucomelas*	Migratory marine	Not listed	Species or species habitat known to occur within area
Swinhoe's Snipe	*Gallinago megala*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Wandering Tattler	*Tringa incana*	Migratory wetlands	Not listed	Roosting known to occur within area
Whimbrel	*Numenius phaeopus*	Migratory wetlands	Not listed	Roosting known to occur within area
White-tailed Tropicbird	*Phaethon lepturus*	Migratory marine	Not listed	Species or species habitat may occur within area
Wood Sandpiper	*Tringa glareola*	Migratory wetlands, Overfly marine	Not listed	Roosting known to occur within area
Yellow Wagtail	*Motacilla flava*	Migratory terrestrial, Overfly marine	Not listed	Species or species habitat known to occur within area
Listed marine species (not included above)				
Pied Stilt, Black-winged Stilt	*Himantopus himantopus*	Marine	Not listed	Roosting known to occur within area
Rainbow Bee-eater	*Merops ornatus*	Marine	Not listed	Species or species habitat may occur within area
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Marine	Not listed	Species or species habitat known to occur within area
Black-eared Cuckoo	*Chalcites osculans*	Marine	Not listed	Species or species habitat known to occur within area
Cattle Egret	*Bubulcus ibis*	Marine	Not listed	Species or species habitat may occur within area
Red-capped Plover	*Charadrius ruficapillus*	Marine	Not listed	Roosting known to occur within area
Magpie Goose	*Anseranas semipalmata*	Marine	Not listed	Species or species habitat may occur within area
Australian Pratincole	*Stiltia Isabella*	Marine	Not listed	Roosting known to occur within area

9.1 Threatened species

9.1.1 Alligator Rivers yellow chat

The Alligator Rivers Yellow Chat (Endangered) is a small insectivorous bird that now occurs mostly within Kakadu National Park. The species' range and numbers are thought to have declined after habitat loss from cattle grazing, and habitat degradation caused by feral pigs and water buffalo. Its total population size is now very small, only around 100 individuals. (National Environmental Science Program Threatened Species Research Hub, 2019). Historically this species inhabits coastal grassy floodplains, however sightings have become rare and anecdotal. It is thought likely that there are small, undiscovered groups of chats, but that the overall population is still likely to be very small and to have suffered decline over time (National Environmental Science Program Threatened Species Research Hub, 2019). Given the areas historically observed to be inhabited by this species are terrestrial, it is unlikely to occur within the EMBA.

9.1.2 Asian dowitcher

The Asian dowitcher (*Limnodromus semipalmatus*; Vulnerable, Migratory) is a large, distinctive wader with a long neck, long legs, and a long, straight, snipe-like bill (DoE, 2024a). In Australia, this bird is only a regular visitor to coastal areas between Broome and Port Hedland and the Port McArthur tidal wetlands in the Gulf of Carpentaria, arriving from August (DCCEEW, 2024a). It roosts in sheltered coastal environments such as estuarine and intertidal mudflats, lagoons, creeks and saltworks, and feeds on inter-tidal mudflats (DCCEEW, 2024a). Only a small proportion of the non-breeding population arrive in Australia, occasionally recorded in the Northern Territory and rarely in western and eastern Australia (DoE, 2024a). In the NT, the Asian dowitcher is found in Darwin and Arnhem Land (DoE, 2024a). No sites of international significance are listed in the NT for this species (Birdlife Australia, 2020). The Asian dowitcher typically leaves north-west Australia by the end of April to return to northern hemisphere breeding grounds (DoE, 2024a; DCCEEW, 2024a). The PMST report states that this species or habitat is known to occur within the area and individuals may occasionally be seasonally present within the EMBA based on their known NT distribution.

9.1.3 Australian painted snipe

The Australian painted snipe (*Rostratula australis*; Endangered) is a wading bird that has been recorded in wetlands of all Australian states, most frequently recorded in the Murray-Darling Basin and in smaller numbers and less frequently at scattered locations in WA and NT (DoE, 2023v; DEPWS, 2021; DoE, 2013). The most northerly breeding records are from near Derby and Taylor's Lagoon, near Broome and at Tarrabool Lake on the Barkly Tablelands. Although this species is only occasionally recorded in northern Australia, it has been recorded in northern WA and NT from McMinns Lagoon near Darwin and Yellow Waters in Kakadu (DoE 2023v; DEPWS, 2021; Trainor et al., 2017; Knuckey et al., 2013). While this species generally inhabits shallow terrestrial freshwater and occasionally brackish wetlands and other waterlogged areas, the Australian painted snipe requires shallow wetlands with areas of bare wet mud and canopy cover nearby for breeding (DoE, 2023v; DCCEEW, 2022). The PMST report states that this species or habitat may occur within the area. However, as the Australian painted snipe primarily inhabits freshwater wetlands, it is unlikely to occur in the EMBA.

9.1.4 Bar-tailed godwit (Western Alaskan and Northern Siberian subspecies)

The bar-tailed godwit (*Limosa lapponica baueri*; Endangered) breeds in the northern hemisphere and migrates southwards for the boreal winter. The majority of breeding individuals leave south-eastern Australia by the end of the first week of April, with mostly immature individuals remaining (Bamford et al., 2008). This species has been recorded along the coastline of all Australian states and mainly occurs along Australia's north and east coasts. This species is widespread from Eyre to Derby in WA and from Darwin east to the Gulf of Carpentaria (DoE, 2023w; Clarke, 2011). Nunivak bar-tailed godwits eat molluscs, worms, crustaceans and insects caught when foraging in shallow water or along the edge of water with a preference for exposed sandy or soft mud substrates on intertidal flats, banks and beaches (Chan et al., 2022; DoE, 2023w; TSSC, 2016). The PMST report states that this species or habitat may occur within the area and are likely to fly over and feed in coastal zones within the EMBA.

9.1.5 Black-tailed godwit

Black-tailed godwits (*Limosa limosa*; Vulnerable, Migratory) are found in all states and territories of Australia during the non-breeding (austral summer) season, with coastal regions supporting the highest densities of the species. This bird usually first arrives in north-west Australia from late August and most have departed the NT by mid April (DCCEEW, 2024b). The largest populations are found on the north coast between Darwin and Weipa (DoE, 2024b). Roosting usually occurs in sheltered bays, estuaries, and lagoons with large intertidal mudflats and/or sandflats. Feeding habitat includes areas of mud or soft, wet sand within sandflats, intertidal mudflats, saltmarshes, and the beaches of oceanic coastlines, bays, and estuaries. (DCCEEW, 2024b). Areas of importance to the species in the NT include Darwin Harbour, North Darwin (the Beagle Gulf coastline), Legune Wetlands and Milingimbi Coast, but none of these are considered to have international significance (Birdlife Australia, 2020). The PMST report states that this species is known to occur (roost) within the area and it is likely to seasonally occur within those parts of the EMBA that overlap NT coastlines.

9.1.6 Common greenshank, greenshank

The common greenshank (*Tringa nebularia*; Endangered, Migratory) is widespread in coastal regions, occurs in all types of wetlands and has the widest distribution of any shorebird in Australia (DCCEEW, 2024c; DoE, 2024c). The species is sparsely scattered through most of the NT (DCCEEW, 2024c), with important areas in the Kakadu National Park, Milingimbi coast, and the south west coastline of the Gulf of Carpentaria, but no sites of international significance in the NT (Birdlife Australia, 2020). The common greenshank roosts around wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets (DoE, 2024c). They occur in estuaries and mudflats, mangrove swamps and lagoons (DCCEEW, 2024c). During feeding, the birds pick from the surface (DCCEEW, 2024c) while wading in shallow water along the edge of tidal estuaries, muddy claypans, saltworks and saltpans (DoE, 2024c). The species arrives in Australia from August, with most leaving by March and April, but some overwintering also occurs (DCCEEW, 2024c). The PMST report states that this species or habitat is known to occur within the area and individuals may occasionally be seasonally present within the EMBA based on their known NT distribution.

9.1.7 Curlew sandpiper

The curlew sandpiper (*Calidris ferruginea*; Critically Endangered, Migratory) has a broad distribution and has been recorded along the coasts of all Australian states and territories (DoE, 2023x). In WA, curlew sandpipers occur in large numbers at Port Hedland Saltworks, 80 Mile Beach, Roebuck Bay and Lake Macleod, but is rarely recorded in the north-west Kimberley. In NT, curlew sandpipers mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island (DoE, 2023x; TSSC, 2016). Although the species prefers intertidal mudflats in sheltered coastal areas to forage in nearshore waters or mud at the edge of wetlands, they are also widespread inland in smaller numbers (DoE, 2023x). The curlew sandpiper migrates along the East Asian-Australasian Flyway (Flyway) from their breeding grounds in Siberia to Australia, generally arriving from late August/early September and departing by mid-April. Some non-breeding individuals may stay in Australia (DoE, 2023x). The PMST report states that this species or habitat may occur within the area and individuals may be seasonally present within the EMBA based on their known NT distribution.

9.1.8 Eastern curlew

The eastern curlew (*Numenius madagascariensis*; Critically Endangered, Migratory) is the world's largest species of shorebird (DoE, 2023y; Menkhorst et al., 2017). Eastern curlews migrate annually to breeding grounds in Russia and north-eastern China before returning to Australia in August to forage primarily on crabs in intertidal mudflats (DoE, 2023y; Menkhorst et al., 2017; Bamford et al., 2008). In Australia, the species has a continuous distribution from Barrow Island and Dampier Archipelago in WA through the Kimberley and along the NT, Qld, NSW coasts including the Torres Strait islands (TSSC, 2015a). There has been an increase at two sites in the Darwin region between 2009 and 2015, at Lee Point numbers have increased by 9 % per year and 17 % per year at East Arm Wharf in Darwin Harbour (Lilleyman et al., 2016). This local increase may be due to changes in roosting behaviour and an increase in suitable high tide roosting habitat. The PMST report states that this species or habitat may occur within the area, and individuals may fly over and be seasonally present within the EMBA.

9.1.9 Great knot

The great knot (*Calidris tenuirostris*; Vulnerable, Migratory) is a medium-sized migratory shorebird with relatively short legs, a slender medium-length bill and a wingspan of about 58 cm (DoE, 2024i). The species breeds in north-east Siberia and far north-east Russia and migrates along the East Asia-Australasian Flyway to overwinter in the southern hemisphere (DEPWS, 2021). Most that reach Australia settle along the northern coastline between north-west Western Australia and the Gulf of Carpentaria, but significant numbers reach eastern Queensland and there are reports of great knots from most Australian coastal areas. The species is common in the NT from Darwin to the south-east Gulf of Carpentaria (DCCEEW, 2024i) with internationally significant numbers recorded in North Darwin (Beagle Gulf coastline) and the Milingimbi Coast (Birdlife Australia, 2020). It prefers sheltered coastal habitats with extensive tidal mudflats or sandflats, including estuaries, lagoons, inlets and bays. Great knots are gregarious and frequently occur in large flocks with other shorebirds (including red knots), especially when roosting during high tides. They specialise on feeding on bivalves, but also consume other marine invertebrates. Prey are captured on or just below the surface of wet mud or sand (Garnet et al., 2011, DEPWS, 2021). Given the areas historically observed to be inhabited by this species, individual birds may fly over and feed in coastal zones within the EMBA.

9.1.10 Greater sand plover, large sand plover

Greater sand plovers (*Charadrius leschenaultia*, Vulnerable, Migratory) are shorebirds that migrate from breeding areas in Mongolia, Siberia and China to coastal areas of all Australian states with the area around Darwin an internationally important site. This species occurs in the greatest numbers in northwestern Australia and is widespread between Northwest Cape and Roebuck Bay in WA, with scattered records between Roebuck Bay and Darwin. Greater sand plovers are recorded from most of the coastline of the NT, with significant areas around the Joseph Bonaparte Gulf, from Anson Bay to Murgenella Creek (including the south coast of the Tiwi Islands), the northern Arnhem coast, and the Port McArthur area (DoE, 2023z; TSSC, 2016). In Australia, greater sand plovers are almost entirely coastal, inhabiting sheltered muddy, sandy or shelly beaches, large intertidal mudflats, saltmarshes, estuaries, sandbanks, coral reefs, rocky islands rock platforms, tidal lagoons and coastal dunes. Greater sand plovers feed on molluscs, worms, crustaceans and insects they find in wet sand or mud on open intertidal flats (DoE 2023z; TSSC, 2016). The PMST report states that this species or habitat is likely to occur within the area, and individuals may fly over and be present within the EMBA.

9.1.11 Grey falcon

Grey falcon (*Falco hypoleucos*; Vulnerable under the EPBC Act and TPWC Act; Migratory) occur throughout much of the arid and semi-arid zones of Australia, in areas of sparsely timbered lowland plains, typically on inland drainage systems. The species has been recorded across the NT, including on the Tiwi Islands (DEPWS, 2021). Grey Falcons use nests built by other bird species and prefer those in the tallest trees along watercourses. The Grey Falcon is a specialist predator of birds, particularly parrots and pigeons (TSSC, 2020). Given the areas historically observed to be inhabited by this species, it is considered unlikely to be present within the EMBA.

9.1.12 Grey plover

Grey plovers (*Pluvialis squatarola;* Vulnerable, Migratory) have been recorded along the coast in all states of Australia, with small numbers regularly recorded in the NT (DoE, 2024d). Migrating birds arrive in northern Australia between August and October with many continuing their migration to southern regions. Plovers which have remained along the northern coastline for the non-breeding season leave between February and April (DCCEEW, 2024d). Some non-breeding individuals may stay in Australia. The species usually roosts in sheltered, sandy areas including unvegetated sandbanks or sand-spits, or other sheltered environments such as estuaries or lagoons, and are often seen in small numbers on mangrove mudflats (DCCEEW, 2024d). Kakadu National Park, Milingimbi coast, and the south west coastline of the Gulf of Carpentaria have been identified as areas of importance to this species in the NT, but they do not represent sites of international significance (Birdlife Australia, 2020). In Australia, grey plovers feed by pecking and probing for worms, molluscs, and crustaceans mostly in mud or soft, wet sand of sandflats, intertidal mudflats, saltmarshes, and beaches (DCCEEW, 2024d). The PMST report states that this species is known to occur (roost) within the area, and individuals may seasonally fly over and be present in coastal zones within the EMBA.

9.1.13 Lesser sand plover, Mongolian plover

The Lesser Sand, or Mongolian Plover (*Charadrius mongolus*: Endangered, Migratory), is a small to medium sized shorebird with a short stout bill and short grey legs. The lesser sand plover breeds in central Asia and eastern Russia. Two subspecies occur in Australia as seasonal migrants: *Charadrius mongolus mongolus* and *C. m. stegmanni*. In Australia, *C. m. stegmanni* is more common in northern Australia, while *C. m. mongolus* is more common in eastern Australia (DEPWS, 2021). After breeding during the northern summer on mountain steppes and tundras of inland eastern Russia (*C. m. mongolus*) or sand dunes, shingle and other open habitats of eastern Siberia (*C. m. stegmanni*), those that overwinter in Australia migrate southwards along the East Asian-Australasian flyway. These non-breeding birds occur almost exclusively along the coast, where they forage on sheltered intertidal mudflats and sandflats, sandy beaches, estuaries and mangroves. Inland saline wetlands close to the coast are also used occasionally. They feed on marine worms, molluscs, crustaceans and insects, which are captured on or just below the surface of sand or mud. Given the areas historically observed to be inhabited by this species, individual birds may fly over and feed in coastal zones within the EMBA.

9.1.14 Masked owl (northern)

Masked owl (northern) (*Tyto novaehollandiae kimberli;* Vulnerable under the EPBC Act and TPWC Act) is distributed widely across northern Australia in tall open eucalypt forests (DEPWS, 2021). The masked owl (northern) roosts in monsoon rainforests, and also forages in more open vegetation types, including grasslands. Individuals typically roost in tree hollows and may also roost among dense foliage (DCCEEW, 2024j). The diet of the masked owl (northern mainland) mostly comprises mammals up to the size of possums (Garnett & Crowley 2000). Due to their habitat and prey preferences, and their restriction to the Tiwi Islands, it is unlikely that they will be present within the EMBA

9.1.15 Partridge pigeon (eastern)

Partridge pigeon (eastern) (*Geophaps smithii smithii;* Vulnerable under the EPBC Act and TPWC Act) occur across northern Australia in lowland eucalypt open forests and woodlands, with grassy understoreys. Their diet comprises seeds, mostly of grasses but also from Acacia and other woody plants. The species forages entirely on the ground, and flies infrequently (DEPWS, 2021). Due to their terrestrial habitat and diet preferences, it is unlikely that they will be present within the EMBA.

9.1.16 Red goshawk

The red goshawk (*Erythrotriorchis radiatus*; Vulnerable under the EPBC Act and TPWC Act) occur across northern Australia, from near Broome in the south-west Kimberley to south-eastern Queensland. Within this range it generally occurs in taller forests characteristic of higher rainfall areas, but there are some isolated recent records from central Australia. It appears to be unusually common on the Tiwi Islands (DEPWS, 2021). The preferred habitat is tall open eucalypt forest and riparian areas (including paperbark forest and gallery forests). The conspicuous basket–shaped stick nest is typically placed in large trees near watercourses (Aumann and Baker-Gabb, 1991). Red goshawks eat mostly birds, especially parrots and pigeons; rarely they also prey on mammals, reptiles, and large insects (Debus et al., 2020). Given the areas historically observed to be inhabited by this species, individuals may fly over and feed in coastal zones within the EMBA.

9.1.17 Red knot (New Siberian Islands and north-eastern Siberia)

The red knot (*Calidris canutus*; Vulnerable, Migratory) is a migratory omnivorous shorebird which utilises the intertidal mudflats, sandflats and sandy beaches of sheltered coastal areas, estuaries, bays and other similar marine habitats (DoE, 2024h; DCCEEW, 2024h). The red knot is present throughout coastal and offshore Australia, with large numbers regularly recorded in the north-west of Australia (DoE, 2024h; Clarke, 2011; Bamford et al., 2008). The red knot breeds in Siberia and spends the non-breeding season in Australia and New Zealand, arriving in northern Australia in late August to early September and also settles in eastern Australia and New Zealand (DCCEEW, 2024h; Watkins, 1993). During the non-breeding season, the red knot occurs on tidal mudflats or sandflats feeding on invertebrates, especially shellfish (Garnet et al., 2011). Both north-western and south-eastern Australia are key areas for red knots. The Gulf of Carpentaria is an important staging area for migrating birds headed to south-eastern Australia and New Zealand. The NT region between the Daly River and Bynoe Harbour, along with the northern Arnhem Land coast from Boucaut Bay to

Buckingham Bay are important areas (Chatto, 2003), with North Darwin (Beagle Gulf coastline) considered to have international significance (Birdlife Australia, 2020). Given the areas historically observed to be inhabited by this species, individual birds may fly over and feed in coastal zones within the EMBA.

9.1.18 Ruddy turnstone

Ruddy turnstones (*Arenaria interpres*; Vulnerable, Migratory) are a migratory shorebird that leaves its breeding grounds in the northern hemisphere from mid-July to early September (DCCEEW 2024e) and has an almost cosmopolitan non-breeding distribution, common throughout Australasia and widespread within Australia (DoE, 2024e). This species tends to arrive in the NT and WA from August onwards (DCCEEW, 2024e). Ruddy turnstones typically roost along platforms and shelves of rock, shingle, or gravel beaches, but can also be found along sand, coral, or shell beaches, and along shoals, cays, and dry ridges of sand or coral beaches. In north Australia, they are known to occur in a wide variety of habitats and may prefer wide mudflats (DCCEEW, 2024e). The species feeds mainly on maggots from rotting seaweed in the upper intertidal (DCCEEW, 2024e). Bynoe Harbour and Castlereagh Bay in the NT are reported to be important areas (DoE, 2024e) with the Milingimbi Coast considered to have international significance for this bird (Birdlife Australia, 2020). The PMST report states that this species is known to occur (roost) within the area, and individuals may seasonally fly over and be present in coastal zones within the EMBA.

9.1.19 Sharp-tailed sandpiper

The sharp tailed sandpiper (*Calidris acuminata*; Vulnerable, Migratory) is a small-medium size wader that is widely distributed throughout Australia (DoE, 2024f). The majority (>90%) of the non-breeding population migrates to Australia (DCCEEW, 2024f). They arrive in Australia from mid-August/early September with most birds then moving slowly south to southeast Australia (DCCEEW, 2024f). In the NT, the species mostly occurs in the northern coastal regions (DCCEEW, 2024f), with Darwin Harbour, North Darwin (Beagle Gulf coastline), Kakadu National Park, the Legune Wetlands, Milingimbi coast and Nhulunbuy (Gove Peninsula) considered to be important areas (Birdlife Australia, 2020). Internationally significant numbers have been recorded at Kakadu National Park and Milingimbi coast (Birdlife Australia, 2020). Sharp tailed sandpipers often roost at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse grass or saltmarsh, but also occasionally on sandy beaches, stony shores or rocks (DoE, 2024f). They typically feed on seeds, worms, molluscs, crustaceans and insects (DoE, 2024f), foraging at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water (DCCEEW, 2024f). The PMST report states that this species is known to occur (roost) within the area and it is likely to seasonally occur and feed in coastal zones within in the EMBA.

9.1.20 Terek sandpiper

The terek sandpiper (*Xenus cinereus*; Vulnerable, Migratory) is primarily a coastal species, more common in northern and eastern parts of Australia than southern regions (DoE, 2024g). It is one of the commoner shorebird species in tropical mangrove-lined estuaries, often occurring in small numbers among much larger flocks of other migratory shorebirds (DCCEEW, 2024g). They feed primarily on crustaceans and insects, in the supralittoral or upper littoral zone, where a film of water covers the sand, but may also forage in the lower littoral zone on exposed rock platforms (DCCEEW, 2024g). In the NT, widespread records occur from Darwin, north to Melville Island, and east to the western section of the Gulf of Carpentaria, around Gove Peninsula, Groote Eylandt, Sir Edward Pellew Island and the mouth of the McArthur River (DoE, 2024g). Important areas are considered to include Darwin Harbour, North Darwin (Beagle Gulf coastline), Kakadu National Park, the Legune Wetlands and Milingimbi Coast, with the Kakadu and Milingimbi Coast identified to have international significance (Birdlife Australia, 2020). The preferred roosting habitat for this bird is in or among mangroves (DoE, 2024g). Terek sandpipers migrate south from their Arctic breeding grounds, passing through the Torres Strait and arriving around Cairns and Darwin in August. Most individuals visiting Australia seem to remain on the north coast, leaving by late April (DCCEEW, 2024g). This species is likely to seasonally occur in the EMBA.

9.1.21 Tiwi Islands hooded robin

The Tiwi Islands hooded robin (*Melanodryas cucullata melvillensis,* Critically Endangered under the EPBC Act and TPWC Act) distribution is restricted to the Tiwi Islands. Tiwi Islands hooded robin inhabit more open forests and woodlands and forages on ground-dwelling invertebrates in areas of thinner ground-cover (DEPWS, 2021). The breeding season (of other subspecies) is spring–summer. The nests are typically placed in the

forks of trees, mostly <3 m above ground. The typical foraging behaviour of Tiwi Islands hooded robin is by quietly perching on tree branches, or trunks, and then suddenly pouncing to take prey on the ground (Fitri & Ford 2003; Higgins & Peter 2002). Due to their habitat and prey preferences, and their restriction to the Tiwi Islands, it is unlikely that they will be present within the EMBA.

9.1.22 Tiwi masked owl, Tiwi Islands masked owl

The Tiwi masked owl (*Tyto novaehollandiae melvillensis*: Endangered) is a subspecies of the masked owl (*Tyto novaehollandiae*) that occurs only on Bathurst and Melville Islands. Tiwi masked owls occur mainly in the forests and woodlands but may roost in monsoon forests or mangroves and may forage over the treeless plains and grasslands (Ward, 2010). Individuals typically roost in tree hollows but may also roost among dense foliage. Masked Owls breed in large tree hollows, which usually form in large rainforest trees. It is likely that individual home ranges are large. The diet of the Masked Owl (Tiwi) mostly comprises mammals up to the size of possums (DEPWS, 2021). Due to their habitat and prey preferences, and their restriction to the 2 islands, it is unlikely that they will be present within the EMBA.

9.2 Migratory species

Most migrant birds are expected to fly over the regional area as part of their large-scale transitory movements and are unlikely to land on the sea for significant periods of time (ConocoPhillips, 2018). Considering this, and the general absence of landing areas at a regional offshore scale, the majority of seabird activity is likely to comprise foraging and migration pathways. While seabirds spend much of their lives at sea, migratory shorebirds overfly offshore areas during migratory periods and typically do not interact with the sea surface (ConocoPhillips, 2018; DSEWPaC, 2012g; 2012h). Migratory wetland species do not interact with open offshore waters but may land on offshore infrastructure while flying between land masses (ConocoPhillips, 2018).

Shorebird migration patterns are seasonal and vary according to species (DSEWPaC, 2012h), but generally shorebirds migrate to northern Australia from August to November. The majority of birds remain in northern Australia, while others disperse southwards (Bennelongia, 2011). On northern beaches migratory shorebirds peak in November then again in March as the majority of birds begin their return to the northern hemisphere between March and May. Most migratory shorebirds do not breed in Australia and juvenile birds may spend several years in Australia before reaching maturity and returning north to breed (DEWHA, 2008a). Species listed as migratory under the EPBC Act that may occur in the EMBA are outlined in Table 9-1.

9.3 Biologically Important Areas and Critical Habitat for birds

There are BIAs for two species of tern that overlap the EMBA, with the species, behaviour and distance to the NT OAs summarised in **Table 9-2**, and presented in **Figure 9-1**.

Table 9-2: Biologically important Areas for seabirds within the EMBA

Species	BIA behaviour	Distance to Northern Territory Operational Area (km)
Bridled tern	Breeding	209
Crested tern	Breeding	202
	Breeding (high numbers)	90

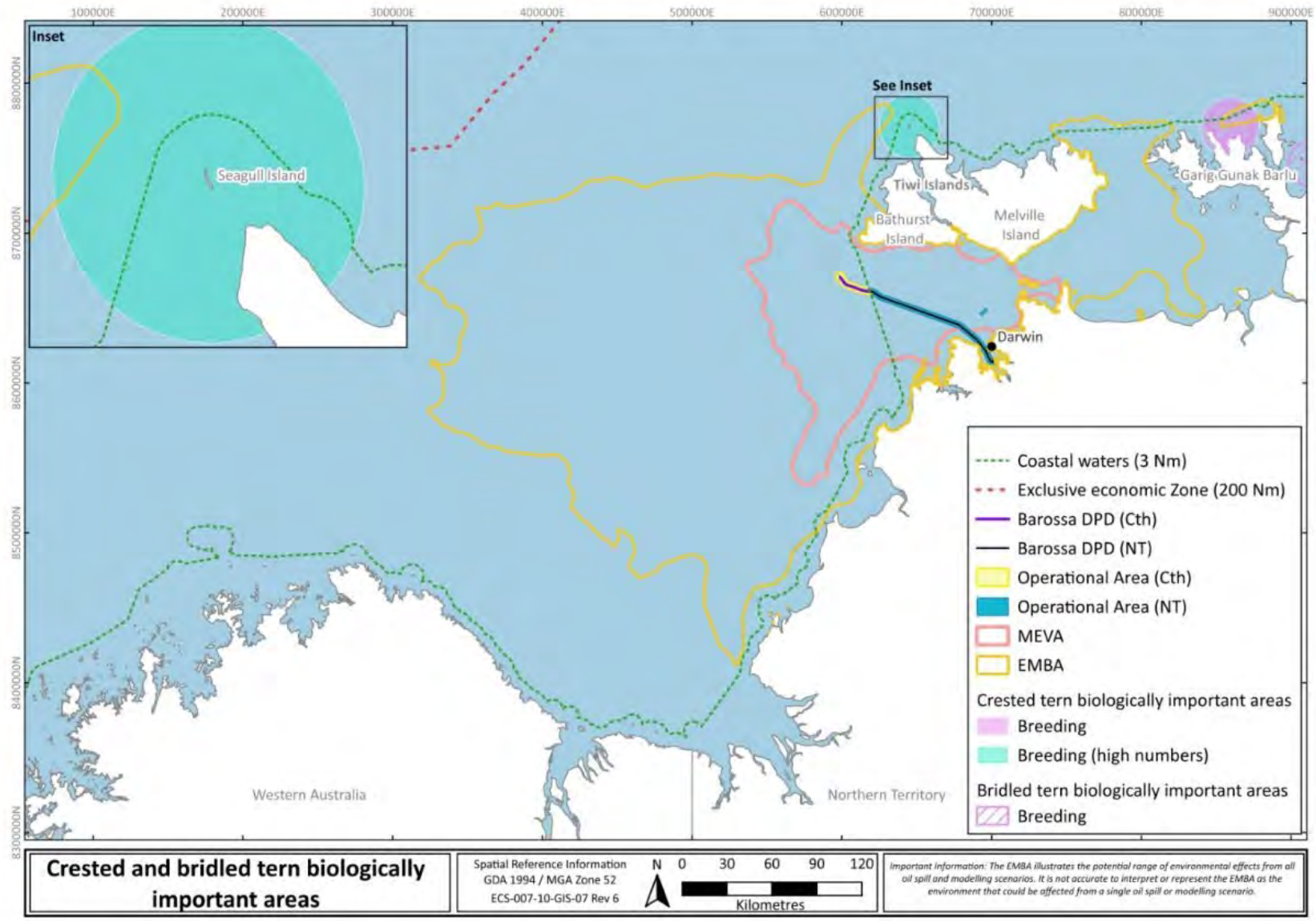


Figure 9-1: Crested and bridled tern critical habitat and BIAs overlapping or proximal to the EMBA

10. Conservation advice and Recovery plans

To protect, maintain and enhance the recovery of threatened species and ecological communities, the Department of Climate Change, Energy, the Environment and Water (DCCEEW) may prepare conservation management plans in the form of conservation advice or recovery plans.

When a native species or ecological community is listed as threatened under the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act), conservation advice is developed to assist its recovery. Conservation advice provides guidance on the immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a listed species or ecological community.

The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community. The Commonwealth Minister for the Environment may make or adopt and implement recovery plans for threatened fauna, flora (other than conservation dependent species) and ecological communities listed under the EPBC Act. Recovery plans set out the research and management actions necessary to stop the decline and support the recovery of listed threatened species or ecological communities.

The DPD EP and DPD Offshore CEMP summarise the actions relevant to the DPD activities with more information on the specific requirements of the relevant plans of management (including conservation advice, recovery plans and management plans for marine fauna) that would be applicable and demonstrates where current management requirements have been considered.

The EPBC Management/Recovery Plans and Conservation Advice for the species identified in the EPBC protected matters report are summarised in Table 10-1.

Table 10-1: Relevant recovery plans, conservation advice and management plans for species that may occur within the EMBA

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
All		
All vertebrate fauna	Threat Abatement Plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	There are 4 main objectives: + contribute to the long-term prevention of the incidence of harmful marine debris + remove existing harmful marine debris from the marine environment + mitigate the impacts of harmful marine debris on marine species and ecological communities + monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.
Bony fish, sharks and rays		
All sawfish and river sharks including: + dwarf sawfish + green sawfish + largetooth sawfish + speartooth shark + northern river shark	Sawfish and River Sharks Multispecies Recovery Plan (CoA, 2015b)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks with a view to: + improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act + ensuring that anthropogenic activities do not hinder recovery in the near future or impact the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: + Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species + 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 (DoEE, 2018).
Dwarf sawfish	Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish) (DEWHA, 2009)	No explicit relevant objectives
Green sawfish	Approved Conservation Advice for Green Sawfish (DEWHA, 2008a)	No explicit relevant objectives
Largetooth sawfish	Approved Conservation Advice for *Pristis pristis* (Largetooth Sawfish) (TSSC, 2014b)	No explicit relevant objectives

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (TSSC, 2014a)	No explicit relevant objectives
Speartooth shark	Approved Conservation Advice for *Glyphis glyphis* (speartooth shark) (DoE, 2014)	No explicit relevant objectives
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE, 2014a)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild with a view to: + improving the population status + ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark.
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range with a view to: + improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act + ensuring that anthropogenic activities do not hinder recovery in the near future or impact the conservation status of the species in the future. + The specific objective of the recovery plan (relevant to industry) is: + Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.
Whale shark	Conservation Advice for *Rhinocodon typus* (whale shark) (TSSC, 2015g)	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.
Marine mammals		
Cetaceans and other marine megafauna	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. The specific objective of the strategy (relevant to industry) is: + Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Blue whale (includes pygmy blue whale)	Conservation Management Plan for the Blue Whale 2015–2025 (CoA, 2015a)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the blue whale to improve so that it can be removed from the threatened species list under the EPBC Act.
Fin whale	Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015c)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program.
Sei whale	Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015b)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program.
Water Mouse	Conservation Advice for *Xeromys myoides* (Water Mouse) (DAWE, 2021)	No explicit relevant objectives
Reptiles		
All marine turtles (flatback, green, hawksbill, leatherback, loggerhead, olive ridley)	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023d)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.
	Recovery Plan for Marine Turtles in Australia 2017–2027 (CoA, 2017b)	Long-term recovery objective: + minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: anthropogenic threats are demonstrably minimised.
Leatherback turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008b)	No explicit relevant objectives
Short-nosed sea snake	Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seas snake) (DSEWPaC, 2011a)	No explicit relevant objectives
Leaf-scaled sea snake	Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled sea snake) (DSEWPaC, 2011b)	No explicit relevant objectives

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Seabirds and shorebirds		
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023d)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark, either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.
Black noddy Bridled tern Brown booby Caspian tern Common noddy Great frigatebird Greater crested tern Lesser crested tern Lesser frigatebird Little tern Masked booby Osprey Red-footed booby Red-tailed tropicbird Roseate tern Streaked shearwater Wedge-tailed shearwater White-tailed tropicbird	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Seabirds and their habitats are protected and managed in Australia.

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Bar-tailed godwit Broad-billed sandpiper Common sandpiper Grey-tailed tattler Little curlew Little ringed plover Long toed stint Marsh sandpiper Oriental plover Oriental pranticole Pacific golden plover Pectoral sandpiper Pin-tailed snipe Red-necked stint Sanderling Swinhoe's snipe Wandering tattler Whimbrel Wood sandpiper	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015c)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.
Asian dowitcher[3]	Conservation Advice for *Limnodromus semipalmatus* (Asian dowitcher) (DCCEEW, 2024a)	No explicit relevant objectives
Australian painted snipe[3]	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (TSSC, 2013)	No explicit relevant objectives
Black-tailed godwit[3]	Conservation Advice for *Limosa limosa* (black-tailed godwit) (DCCEEW, 2024b)	No explicit relevant objectives
Common greenshank[3]	Conservation Advice for *Tringa nebularia* (common greenshank) (DCCEEW, 2024c)	No explicit relevant objectives

[3] Species or species habitat is not known to be present within planned impact areas (e.g. OA and light assessment boundary), or threats identified are not relevant to the Activity. Therefore, conservation advice or recovery is not evaluated within the EP

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (TSSC, 2015e)	Australian objective: + reduce disturbance at key roosting and feeding sites.
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (TSSC, 2015f)	Australian objectives: + achieve a stable or increasing population + maintain and enhance important habitat + reduce disturbance at key roosting and feeding sites.
Great knot[3]	Conservation Advice for *Calidris tenuirostris* (great knot) (DCCEEW, 2024i)	No explicit relevant objectives
Greater sand plover[3]	Conservation Advice *Charadrius leschenaultii* (Greater sand plover) (TSSC, 2016)	No explicit relevant objectives
Grey falcon	Conservation Advice *Falco hypoleucos* (Grey Falcon) (TSSC, 2020)	No explicit relevant objectives.
Grey plover[3]	Conservation Advice for *Pluvialis squatarola* (grey plover) (DCCEEW, 2024d)	No explicit relevant objectives
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit[3]	Conservation Advice *Limosa lapponica baueri* (Bar-tailed godwit [western Alaska]) (TSSC, 2016)	No explicit relevant objectives
Lesser Sand Plover, Mongolian Plover[3]	Conservation Advice *Charadrius mongolus* (Lesser Sand Plover, Mongolian Plover) (TSSC, 2016)	No explicit relevant objectives
Partridge Pigeon (eastern)	Conservation Advice *Geophaps smithii smithii* (Partridge Pigeon [eastern]) (TSSC, 2015b)	No explicit relevant objectives.
Masked Owl (northern)	Conservation Advice *Tyto novaehollandiae kimberli* (masked owl [northern]) (TSSC, 2015c)	No explicit relevant objectives.
Red Goshawk	Conservation Advice *Erythrotriorchis radiatus* (Red goshawk) (TSSC, 2015d)	No explicit relevant objectives.
Red knot[3]	Conservation Advice for *Calidris canutus* (Red knot) (DCCEEW, 2024h)	No explicit relevant objectives
Ruddy turnstone[3]	Conservation Advice for *Arenaria interpres* (ruddy turnstone) (DCCEEW, 2024e)	No explicit relevant objectives
Sharp-tailed sandpiper	Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW, 2024f)	No explicit relevant objectives

Name	Recovery plan/ Conservation advice/ Management plan	Relevant objectives
Terek sandpiper[3]	Conservation Advice for *Xenus cinereus* (terek sandpiper) (DCCEEW, 2024g)	No explicit relevant objectives
Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands)	Conservation Advice *Melanodryas cucullata melvillensis* (hooded robin [Tiwi Islands]) (TSSC, 2018b)	No explicit relevant objectives.
Tiwi Masked Owl, Tiwi Islands Masked Owl[3]	Conservation Advice Tyto *novaehollandiae melvillensis* (masked owl [Tiwi Islands]) (TSSC, 2015i)	No explicit relevant objectives

11. Protected areas

The environment that may be affected (EMBA) overlaps with areas protected under state and federal legislation. Protected areas include declared World Heritage Properties, wetlands of international importance (Ramsar), wetlands of national importance, and places of national and Commonwealth heritage significance. The areas intersected by the EMBA are listed in Table 11-1, and shown on Figure 11-1 and Figure 11-2. Further detail is provided in Sections 11.1 and 11.2. Key ecological features (KEFs) are described in Section 12, and marine parks/reserves discussed in Section 13.

Table 11-1: Summary of protected areas in waters within the EMBA

Area type	Title
World Heritage Properties	Kakadu National Park
Wetlands of international importance (Ramsar)	Kakadu National Park
	Cobourg Peninsula
Wetlands of national importance	Adelaide River Floodplain System
	Cobourg Peninsula System
	Finniss Floodplain and Fog Bay Systems
	Kakadu National Park
	Mary Floodplain System
	Port Darwin
National heritage place	Kakadu National Park
Commonwealth heritage place	None
Threatened ecological communities	None

11.1 National heritage places and World Heritage properties

The EMBA intersects the outer boundary of Kakadu National Park (IUCN II) (Figure 11-1). Kakadu National Park was included on the World Heritage List in 1981 and was subsequently expanded and re-inscribed in 1987 and 1992 (DNP, 2016). The Park is inscribed on the world heritage list for both cultural and natural universal values (DCCEEW, 2023) as follows:

- criterion (I) – masterpiece of human creative genius
- criterion (VI) – directly associated with events or living traditions
- criterion (VII) – contains superlative natural phenomena
- criterion (IX) – outstanding examples of on-going evolution
- criterion (X) – important habitats for conservation of biological diversity.

Kakadu National Park was added to the national heritage list in 2007 (DCCEEW, 2023). The majority of the National Park encompasses the NT mainland, however the site includes the mangrove-fringed coast from Wildman River to East Alligator River and offshore islands of Barron Island (Djidbordu) and Field Island (Gardangarl) in the Van Diemen Gulf.

Kakadu National Park is jointly managed with the Bininj/Mungguy peoples in accordance with the Kakadu National Park Management Plan 2016–2026 (KNPMP) (DNP, 2016). Bininj are the traditional custodians of the land in the northern section of Kakadu National Park.

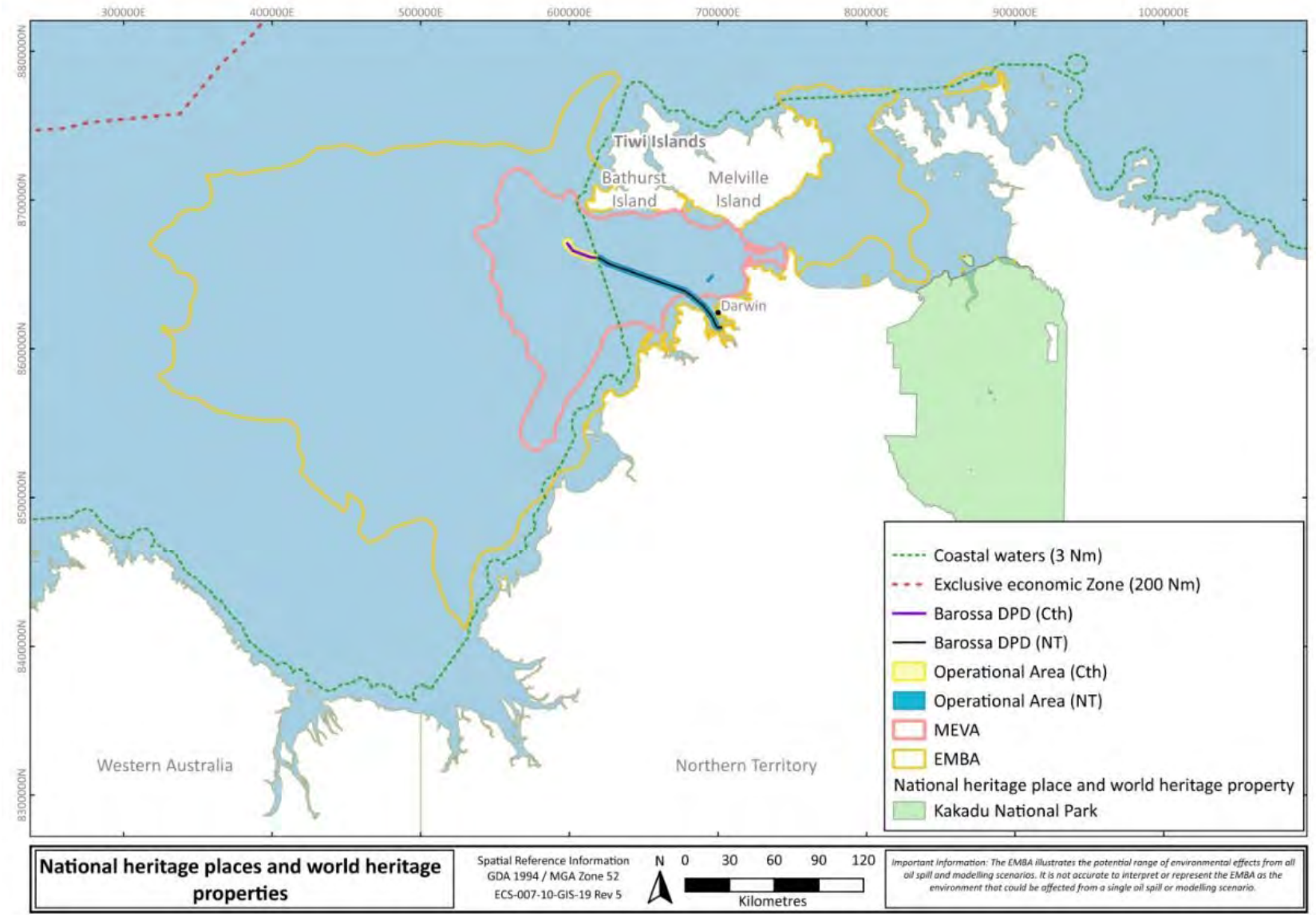


Figure 11-1: National Heritage Places and World Heritage Properties overlapping or proximal to the EMBA

The EPBC Regulations (Schedule 8) prescribe the Australian International Union for Conservation of Nature [IUCN] management principles for each IUCN category. The Australian management principles for IUCN protected area category II require taking account of the needs and aspirations of traditional owners and other Indigenous people in the park, specifically:

- the needs of Indigenous people, including subsistence resource use, to the extent that they do not conflict with the Australian IUCN management principles
- the aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with Australian IUCN management principles should be recognised and taken into account (DNP, 2016).

The KNPMP identifies the cultural and country values of the Kakadu National Park as:

- cultural values – the park is an internationally significant cultural landscape inscribed with the signs of an ancient and continuing Bininj/Mungguy presence.
- country values – the park is an internationally significant natural landscape (including landforms and biota of great antiquity) comprising outstanding representation of interconnected ecosystems whose extent, intactness and integrity provides for a distinctive and rich biodiversity including viable populations of threatened, endemic and culturally significant species.

11.2 Wetlands of national and international importance

11.2.1 Wetlands of international importance

The Ramsar Convention on Wetlands is an intergovernmental treaty that aims to conserve wetlands of international importance. Ramsar wetlands are recognised as matters of national environmental significance (MNES) under the EPBC Act (DSEWPaC, 2010). The EMBA is adjacent to or intersects 2 Ramsar wetlands—Cobourg Peninsula and Kakadu National Park (Figure 11-2).

11.2.1.1 The Cobourg Peninsula Ramsar site

Declared a Ramsar site in 1974, the Cobourg Peninsula system encompasses all coastal and inland wetlands of Cobourg Peninsula and nearby islands. This includes freshwater and extensive intertidal areas, but excludes subtidal areas (DCCEEW, 2023b). It consists of intertidal forested wetlands and mudflats, seasonal freshwater marshes and permanent freshwater pools. Garig Gunak Barlu National Park (Section 13.2.1) includes the marine waters surrounding the peninsula, but these are not included in the Ramsar site (BMT WBM, 2011). This Ramsar site does not include marine waters as a value and modelling predicts no shoreline or surface oil contact at or above low threshold values.

11.2.1.2 Kakadu Ramsar site

In 2010, 2 Ramsar sites were combined to form a single Ramsar site encompassing the entire Kakadu National Park, covering 19,810 km^2. The site meets all 9 criteria for identifying wetlands of international importance under the Ramsar Convention (DCCEEW, 2023b).

This wetland protects the following conservation values (DCCEEW, 2023b):

- BIAs for dolphins and turtles
- habitat critical to the survival of flatback and olive ridley turtles
- tidally influenced mudflats and mangroves provide important habitat and refuge for birds supporting more than 1% of the East Asian-Australasian Flyway population
- important habitat for sawfish, river sharks, crocodiles and dugongs.

11.2.2 Nationally important wetlands

In addition to the two Ramsar wetlands described above, the EMBA intersects six nationally important wetlands, the Adelaide River Floodplain System, Coburg Peninsula System, Finniss Floodplain and Fog Bay Systems, Kakadu National Park, Mary Floodplain System and the Port of Darwin (Figure 11-2).

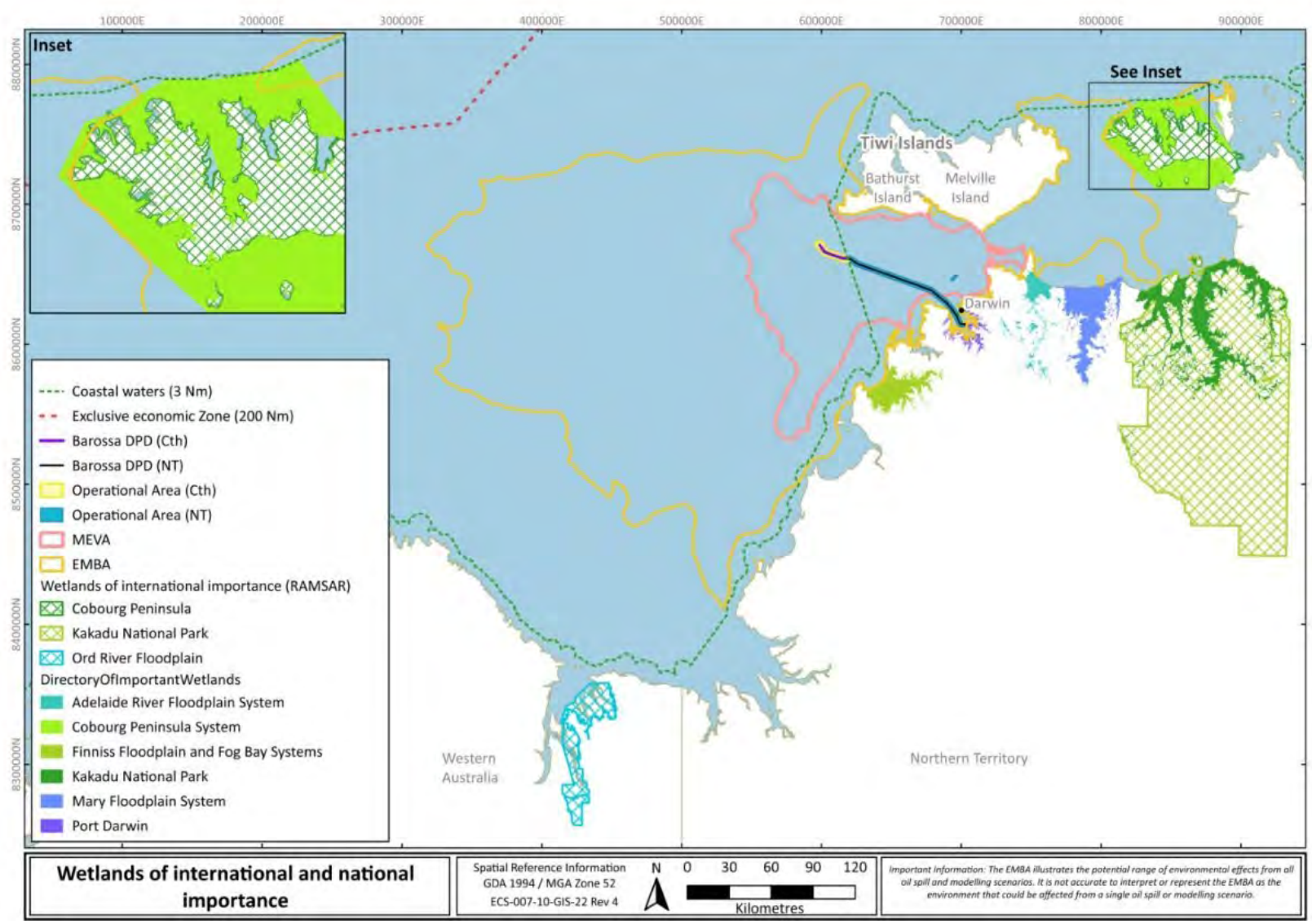


Figure 11-2: Wetlands of national and international importance overlapping or proximal to the EMBA

11.2.2.1 Adelaide River Floodplain System

The Adelaide River Floodplain System is an irregular floodplain and tidal wetland system consisting of several swamps, lakes, lagoons, mudflats, rivers and dams, covering 1,350 km^2 (Jaensch, 1993) and contains the following conservation values:

- nationally significant mangrove habitats
- significant migration stop-over area for shorebirds.

11.2.2.2 Coburg Peninsula System

The Cobourg Peninsula system is comprised of intertidal forested wetlands and mudflats, seasonal freshwater marshes and permanent freshwater pools. The site covers 2,207 km^2 (BMT WBM, 2011) and provides BIAs for dolphins, seabirds and marine turtles such as habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish and crustacean species of fisheries significance.

11.2.2.3 Finniss Floodplain and Fog Bay System

Finniss Floodplain and Fog Bay Systems consist of a beach-fringed bay with intertidal mudflats and a floodplain with paperbark swamps. The wetland supports the breeding and migration of various bird species and significant populations of marine turtles and mammals, such as the dugong and Indo-Pacific humpback dolphin. The site covers 813 km^2 (Jaensch, 1993).

11.2.2.4 Mary Floodplain System

Mary Floodplain System consists of the entire floodplain of the Mary River, covering 1276 km^2. There are three principal plant formations and the largest wooded swamp areas in the NT. The wetland supports a major breeding area for the magpie goose, a refuge for waterbirds and saltwater crocodiles during the dry season and supports at least several thousand migrant shorebirds at a time.

11.2.2.5 Port Darwin

The Port Darwin wetland site is entirely tidal, covering ~ 48,400 ha (inclusive of deep-water areas) and with mangrove forests covering 16,000 ha (DCCEEW, 2023b). It is one of the NT's largest areas of mangrove swamps and features a shallow branching embayment (Jaensch, 1993).

The wetland contains the following conservation values (Jaensch, 1993):

- major nursery area for estuarine and offshore fish and crustaceans
- mangrove communities are the most extensive and species–rich of any NT embayment
- provides BIAs for dolphins (Australian snubfin, Indo-Pacific humpback and spotted bottlenose) and turtles (flatback).

12. Key Ecological Features

12.1.1 Carbonate bank and terrace system of the Sahul Shelf

The Carbonate Bank and Terrace System of the Sahul Shelf is located in the western Joseph Bonaparte Gulf, north of Cape Bougainville and Cape Londonderry (Figure 12-1). The banks consist of a hard substrate with flat tops at depths of 150 to 300 m. Each bank occupies an area generally less than 10 km^2 and is separated from the next bank by narrow sinuous channels up to 150 m deep. The area contains predictably high levels of productivity especially when compared to the generally low productivity of the region (DSEWPaC, 2012a).

The banks are foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales, as well as green and freshwater (largetooth) sawfish (Donovan et al., 2008 in DSEWPaC, 2012a). The hard substrate of the banks is thought to support diverse organisms including sessile benthic invertebrates such as sponges, soft and hard corals, gorgonians, bryozoans, ascidians along with associated reef fish and elasmobranchs (Brewer et al. 2007). Cetaceans, green and freshwater (largetooth) sawfish are also likely to occur in the area, as well as possibly the Australian snubfin dolphin, a migratory species occurring mostly on the northern extent of the Sahul Shelf (DSEWPaC, 2012a).

According to DSEWPaC (2012a), the carbonate banks and terrace system of the Sahul Shelf are regionally important because of their role in enhancing productivity. Although little is known about the banks, terraces and associated channels, they are believed to be areas of enhanced productivity and biodiversity due to the upwellings of cold nutrient-rich water at the heads of the channels and the availability of hard substrate (Brewer et al., 2007).

The EMBA overlaps approximately 3.5% of this KEF.

12.1.2 Carbonate bank and terrace system of the Van Diemen Rise

The Carbonate Bank and Terrace System of the Van Diemen Rise covers about 31,278 km^2 and forms part of the larger system associated with the Shaul Banks to the north and Londonderry Rise to the east (Figure 12-1). The value of this KEF is ‘unique seafloor feature with ecological properties of regional significance’ (DEWHA, 2012a) and it is considered important both for its role in enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity. The KEF is characterised by carbonate terrace, banks, channels and valleys, with variability in water depth and substrate composition contributing to unique ecosystems in the channels.

The carbonate banks and shoals found within the Van Diemen Rise make up 80% of the banks and shoals, 79% of the channels and valleys, and 63% of the terrace found across the NMR. The carbonate banks and shoals rise from depths of 100 to 200 m to within 10 m of the surface (Anderson et al., 2011).

A 2010 survey by Geoscience Australia and AIMS mapped the seabed environments of the Van Diemen Rise (Anderson et al., 2011). The study surveyed 784 km² towed video transects at 77 sites including banks, terraces, valleys and plains within the Van Diemen Rise. The shallow banks sampled contained complex benthic features with diverse and often dense epibenthic assemblages. A total of 175 video characterisations were recorded from 13 bank sampling sites in the study area from depths of 11 to 54 m (mean depth of 34 m). The sites were characterised by mostly low-lying rock outcrops with hard corals and octocorals (18% and 99% occurrence, respectively) along with smaller colonies of bryozoa and ascidians. The rocky outcrops were interspersed by small areas of relatively barren coarse-grained soft sediments (Anderson et al., 2011).

The KEF provides habitat for a high diversity of sponges, soft corals and other sessile filter feeders, epifauna and infauna, along with olive ridley turtles, sea snakes and sharks. Rich sponge gardens and octocorals have been identified on the eastern Joseph Bonaparte Gulf along the banks, ridges and some terraces. Plains in deep hole/valleys are characterised by scattered epifauna and infauna that include polychaetes and ascidians. Epibenthic communities such as the sponges found in the channels are likely to support fish and second-order consumers. Pelagic fish such as mackerel, red snapper and a distinct gene pool of gold band snapper are found in the Van Diemen Rise.

The EMBA overlaps approximately 15.7% of this KEF.

12.1.3 Pinnacles of the Bonaparte Basin

A very small part (approximately 0.22%) of the EMBA overlaps the Pinnacles of the Bonaparte Basin KEF (Figure 12-1). The limestone pinnacles of the Bonaparte Basin are located in the mid-outer shelf of the western Joseph Bonaparte Gulf and comprise of 61% of the limestone pinnacles in the Northwest Marine Region and 8% of the total limestone pinnacles found within the Australian Exclusive Economic Zone (EEZ; Baker et al., 2008). The pinnacles are found in waters 30 to 80 m and provide hard substrate for sessile species. The pinnacles are thought to be remnants of the calcareous shelf and coastal features from previous low sea-level stands and have been recorded to be up to 50 m in height and range from 50 to 100 km long (Baker et al., 2008; Heyward et al., 1997).

Diverse communities of sessile benthic invertebrates including hard and soft corals, sponges, whips, fans, bryozoans and aggregations of demersal fish species such as snappers, emperors and groupers have been recorded (Brewer et al., 2007). Foraging and general use has been recorded within the pinnacles by marine turtles and the area has also been suggested to be used by freshwater and green sawfish as well as humpback whales (Donovan et al., 2008). The pinnacles have been recognised as a sponge biodiversity hotspot supporting greater diversity and communities than the surrounding seafloor (NERP MBH, 2014).

The Pinnacles of the Bonaparte Basin are defined as a KEF as they are a unique seafloor feature with ecological properties of regional significance. Their biodiversity value relates to both the benthic and pelagic habitats (DSEWPaC, 2012a). The hard substrate of the pinnacles is likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required. The overlaps approximately of the EMBA

The EMBA overlaps approximately 36.4% of this KEF.

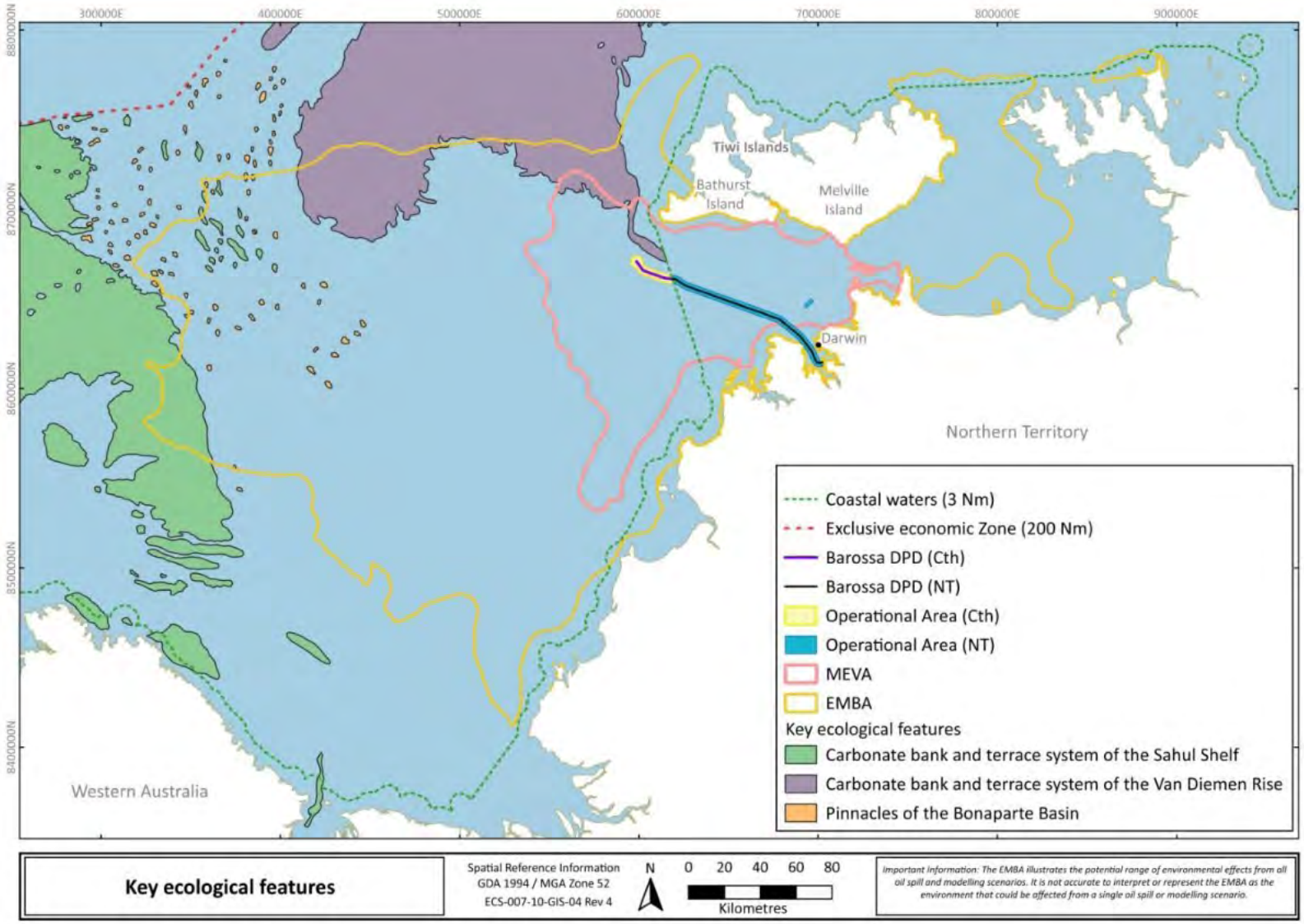


Figure 12-1: Key Ecological Features overlapping or proximal to the EMBA

13. Conservation Reserves

The environment that may be affected (EMBA) overlaps two Australian Marine Parks and one Northern Territory (NT) marine conservation reserve (Figure 13-1). There are no international marine parks that intersect or are located in close proximity to the EMBA.

13.1 Australian Marine Parks

In agreement with the states and NT governments, the Australian Government has committed to establish Commonwealth marine parks as a component of the National Representative System of Marine Protected Areas (Director of National Parks, 2012). In November 2012, the Commonwealth Marine Reserves Network was proclaimed with the purpose of protecting the biological diversity and sustainable use of the marine environment. Commonwealth marine reserves were renamed as Australian Marine Parks in October 2017 and there are six marine regions in the Australian Marine Parks Network, namely the Coral Sea, South-west, Temperate East, South-east, North and North-west. Management plans for AMPs were developed and enacted on 1 July 2018 (except for the South-east which was originally enacted in 2013). Under these plans, AMPs are allocated conservation objectives (International Union for Conservation of Nature [IUCN] Protected Area Category) based on the Australian IUCN Reserve Management Principles in Schedule 8 of the EPBC Regulations 2000. The management plans establish the management and zoning of the designated marine parks and present what activities are acceptable within the different zones of the AMP network. The EMBA overlaps with the boundaries of two marine parks, both within the North Marine Parks Network.

13.1.1 Oceanic Shoals

The Oceanic Shoals Marine Park encompasses 71,743 km^2, predominantly comprising a Multiple Use Zone (IUCN Category VI, 39,964 km^2) and a Special Purpose Zone for Trawling (IUCN VI, 24,444 km^2). The marine park also includes a National Park Zone (IUCN Category II, 406 km^2) and Habitat Protection Zone (Category IV, 6,929 km^2). The EMBA overlaps sections of all 4 zones (**Figure 13-1**).

The marine park protects the following natural values (Director of National Parks, 2018):

- a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act
- BIAs that include foraging, nesting and internesting habitat for marine turtles
- examples of the ecosystems of two provincial bioregions: the Northern Shelf Province (which includes the Bonaparte, Oceanic Shoals and Tiwi meso-scale bioregions) and the Timor Transition Province.

KEFs represented in the park (Director of National Parks, 2018) are:

- Carbonate bank and terrace system of the Van Diemen Rise (unique sea-floor feature)
- Carbonate bank and terrace system of the Sahul Shelf (unique sea-floor feature)
- Pinnacles of the Bonaparte Basin (enhanced productivity, unique sea-floor feature)

Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country across Australia for tens of thousands of years. No heritage listings apply to the marine park. Commercial fishing and mining are important socio-economic values for the park (Director of National Parks, 2018).

13.1.2 Joseph Bonaparte Gulf

The Joseph Bonaparte Gulf marine park covers 8,597 km^2 and is comprised of a Multiple Use Zone (IUCN Category VI, 6,345 km^2) and a Special Purpose Zone (IUCN Category VI, 2,251 km^2. Approximately 23% of this marine park falls within the EMBA (Figure 13-1). It is located around 190 km from Darwin and has water depths ranging from 15 to 100 m (Director of National Parks, 2018).

The marine park protects the following natural values (Director of National Parks, 2018):

- habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion – a dynamic environment influenced by strong tidal currents, monsoonal winds, cyclones and wind generated waves
- a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act
- large tidal ranges and wide intertidal zones that create a physically dynamic and turbid marine environment
- BIAs that include foraging habitat for marine turtles and the Australian snubfin dolphin.

KEFs represented in the park (Director of National Parks, 2018) are:

- Carbonate bank and terrace system of the Sahul Shelf (unique sea-floor feature)

Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country across Australia for tens of thousands of years. No heritage listings apply to the marine park. Tourism, commercial fishing, mining, and recreation including fishing, are important socio-economic values for the Marine Park (Director of National Parks, 2018).

13.2 State and Territory Marine Reserves

13.2.1 Garig Gunak Barlu

Garig Gunak Barlu is a national park that encompasses the entire Cobourg Peninsula, the surrounding waters of the Arafura Sea and Van Diemen Gulf, and some of the neighbouring islands (PWCNT 2023). It was established by joining the former Gurig National Park and the Cobourg Marine Park. The Cobourg Marine Park Plan of Management (NT Government, 2011) expired in 2021.

Garig Gunak Barlu National Park covers about 4,500 km^2 including ~2,233 km^2 of marine reserve, of which ~6.4% (143 km^2) intersects with the EMBA (Figure 13-1). The National Park is jointly managed by a Board consisting of traditional land owners and the NT Parks and Wildlife Commission (PWCNT 2023).

Values of the park include:

- Multiple Use A and B zones provide for multiple use of the park's resources, including commercial fishing activities. Multiple Use A zone has more intensive fishing, such as prawn trawling and netting. These zones also provide protection of important conservation and scientific values
- provides BIAs for dolphins, seabirds and marine turtles
- habitat critical to the survival of flatback, green and olive ridley turtles
- habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish and crustacean species of fisheries significance.

Management of the (former) Cobourg Marine Park aimed to protect and maintain values related to the following (NT Government, 2011):

- conservation and science
- Aboriginal culture
- historical values
- tourism and recreation
- economic and educational values.

The EMBA intersects the perimeter of the marine park with no predicted shoreline or surface oil contact at or above low threshold values.

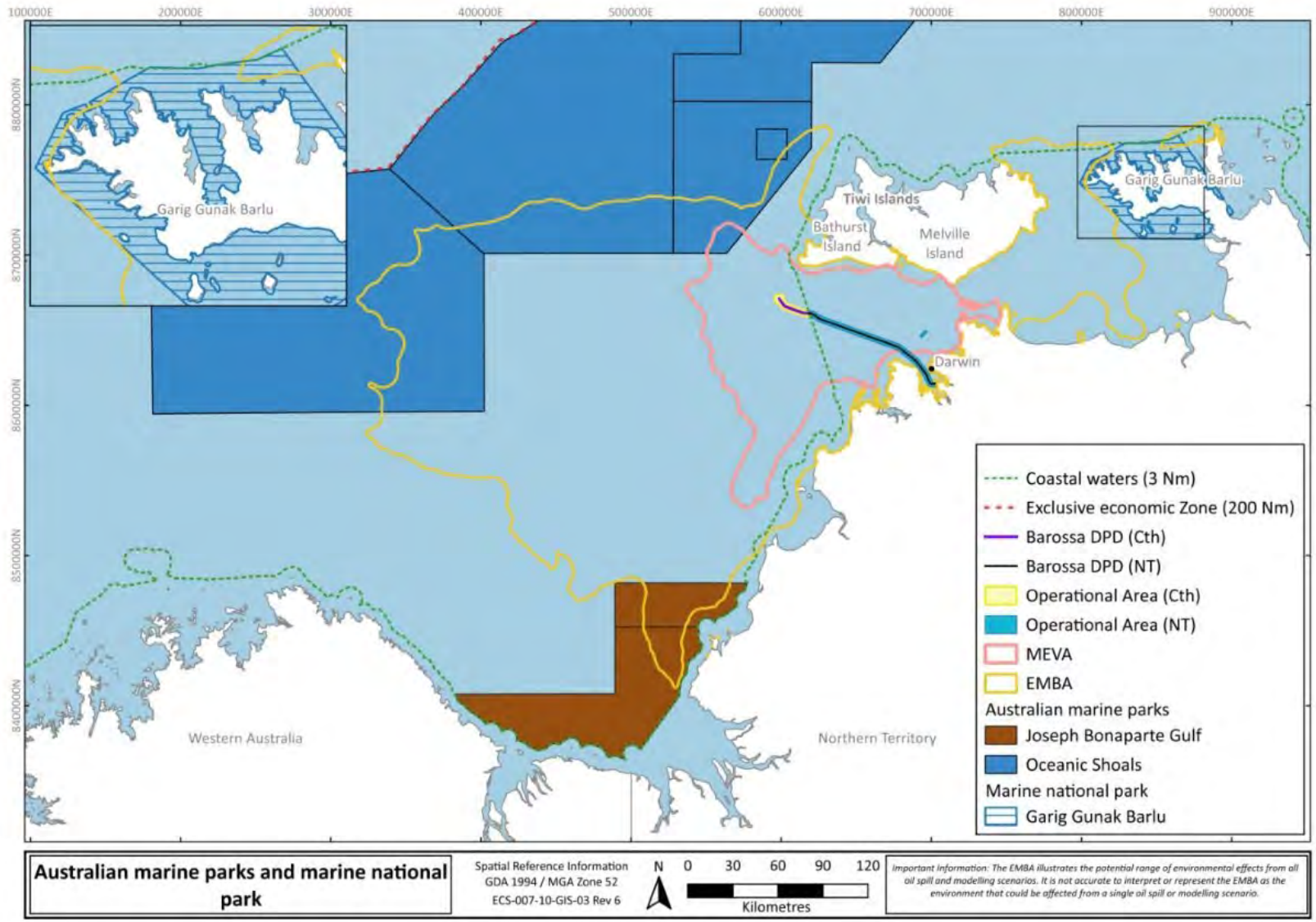


Figure 13-1: Australian marine parks and marine national parks

14. Social, economic and cultural features

14.1 Energy Industry

A number of energy companies hold petroleum permits in and around the environment that may be affected (EMBA). The closest operational production subsea infrastructure to the NT OA is the Santos operated Bayu-Undan to Darwin gas pipeline which lies within the Commonwealth and Northern Territory (NT) OAs and the INPEX operated Ichthys pipeline which lies within the NT OA (Figure 14-1). The Santos operated Darwin LNG (DLNG) facility and the INPEX operated Ichthys LNG facility are situated in Darwin Harbour and are within (in the case of DLNG) or adjacent to (in the case of Ichthys LNG) the NT OA. The Petroleum retention leases and exploration permit leases within and near to the EMBA are currently held by various energy operators, summarised in Table 14-1. None of these overlap the Commonwealth or NT OAs.

Table 14-1: Petroleum permits overlapping the EMBA

Operator	Basin	Permit type	Status
Arafura Oil P/L	Daly River	Exploration Permit	Under Application
Bonaparte Oil P/L	Bonaparte	Exploration Permit	Under Application
Good H2 Darwin P/L	Money Shoal	Exploration Permit	Under Application
Good H2 Darwin P/L	Money Shoal	Exploration Permit	Granted
INPEX Browse E&P P/L	Bonaparte	Exploration Permit	Granted
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MBS Oil P/L	Money Shoal	Exploration Permit	Under Application
MEO International P/L	Bonaparte	Exploration Permit	Granted
Neptune Energy Bonaparte P/L	Bonaparte	Retention Licence	Renewing
Neptune Energy Bonaparte P/L	Bonaparte	Retention Licence	Renewing
Neptune Energy Bonaparte P/L	Bonaparte	Exploration Permit	Granted
Neptune Energy Bonaparte P/L	Bonaparte	Exploration Permit	Granted
NT Gas Aust P/L	Pine Creek Geosyn	Exploration Permit	Under Application
NT Gas Aust P/L	Money Shoal	Exploration Permit	Under Application
NT Gas Aust P/L	Money Shoal	Exploration Permit	Under Application
NT Gas Aust P/L	Money Shoal	Exploration Permit	Under Application
Santos Offshore P/L	Bonaparte	Exploration Permit	Granted
Santos Offshore P/L	Bonaparte	Exploration Permit	Granted
Santos Offshore P/L	Bonaparte	Exploration Permit	Granted

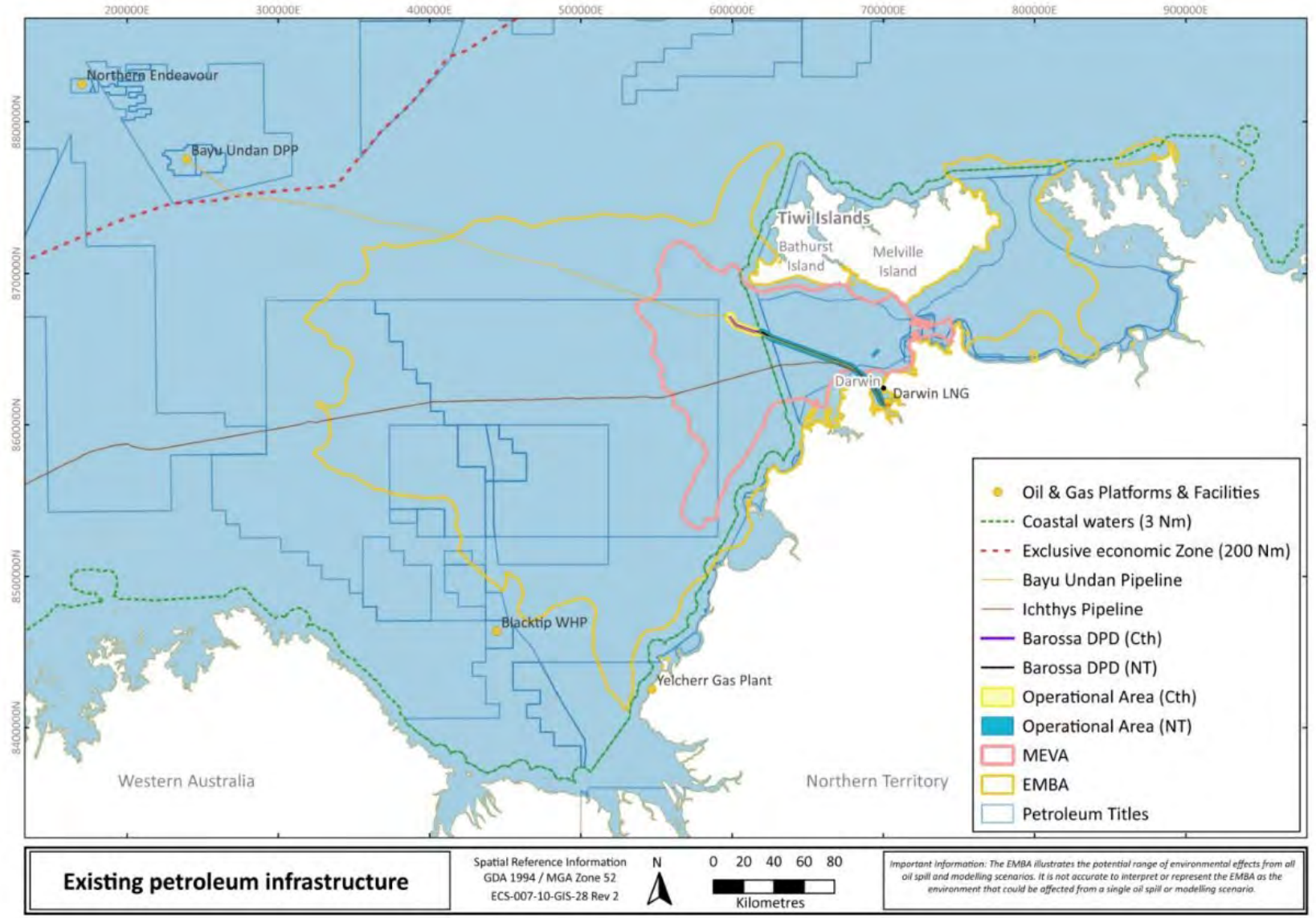


Figure 14-1: Existing petroleum infrastructure overlapping or proximal to the EMBA

14.2 Shipping

Commercial shipping traverses the EMBA with traffic generally concentrated along shipping channels associated with major State and Territory ports, or within transit routes used by supply vessels supporting offshore developments. The closest major commercial port to the EMBA is Darwin and the primary shipping channels within the EMBA are between Darwin and Southeast Asian ports. Darwin Port services both commercial and non-commercial vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels. In 2022–2023, there were 1,569 vessel calls to port (Landbridge Darwin Port, 2024).

While the Darwin Port remains the primary active port in the region, there is small-scale port activity to the north and east of the project area, at the Tiwi Islands. Port Melville is located on Melville Island and is situated on the Apsley Strait, immediately south of Barlow Point and the community of Pirlangimpi. Port Melville provides for the export of woodchips for Tiwi Plantations Corporation, and the shipment of equipment and supplied for other projects. The facility is capable of 24-hour operation, although most operations are undertaken during daylight hours. Most vessels enter and exit the Apsley Strait from its northern entrance. This is except for barges travelling between Darwin and Port Melville, which enter and exit the Apsley Strait from its southern entrance (AMSA, 2023) (Figure 14-2).

Average vessel displacements and speeds for shipping vessels transiting the EMBA and Cth and NT OAs include:

- bulk carriers averaging 55,300 t with speeds of 14 knots
- livestock carriers averaging 2,800 t with speeds of 12 knots
- general cargo vessels averaging 4,900 t with speeds of approximately 12 knots.

The Australian Maritime Safety Authority (AMSA) has established a network of shipping fairways off the north-west coast of Australia to manage traffic patterns. The Shipping Fairways are designed to keep shipping traffic away from offshore infrastructure and aim to reduce the risk of collision.

Use of the fairways is strongly recommended but not mandatory. The International Regulations for Preventing Collisions at Sea 1972 apply to all vessels navigating within or outside the shipping fairways. The use of these fairways does not give vessels any special right of way.

Under the Commonwealth Navigation Act 2012, certain vessels operating in Australian waters are required to report their location on a daily basis to the Rescue Coordination Centre (RCC) in Canberra. This Australian Ship Reporting System (AUSREP) is an integral part of the Australian Maritime Search and Rescue system and is operated by AMSA through the RCC.

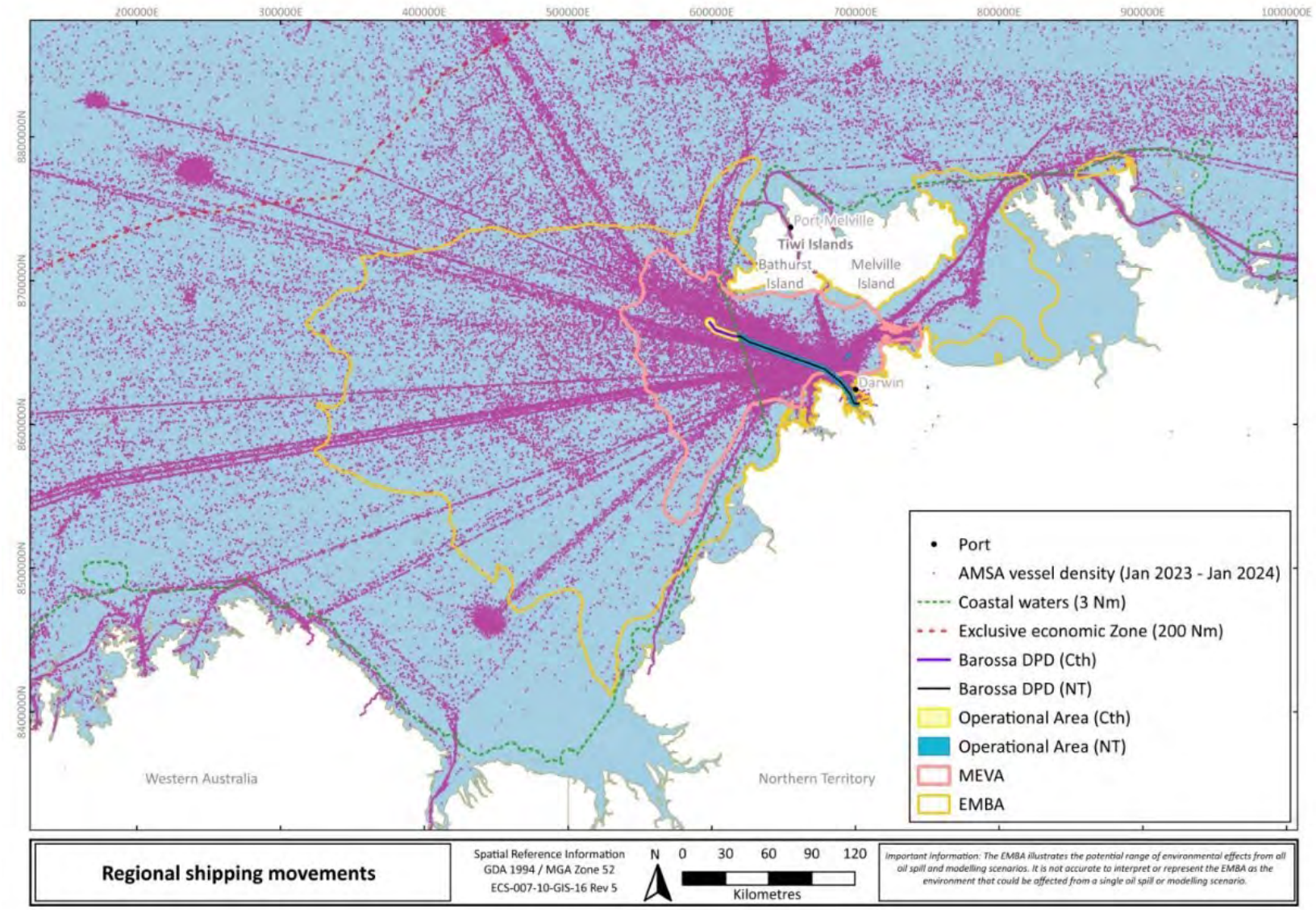


Figure 14-2: Regional shipping overlapping or proximal to the EMBA

14.3 Defence activities

The EMBA intersects parts of the North Australian Exercise Area (NAXA), a maritime military zone administered by the Department of Defence (Figure 14-3). The NAXA comprises practice and training areas and extends about 300 km offshore in two arcs east and west from Darwin into the Arafura Sea. The area is used for offshore naval exercise and onshore weapon-firing training.

The Australian Border Force also undertake civil and maritime surveillance (and enforcement) in Australian offshore maritime waters, which include the EEZ. During their surveillance, Australian Border Force vessels may transit the EMBA.

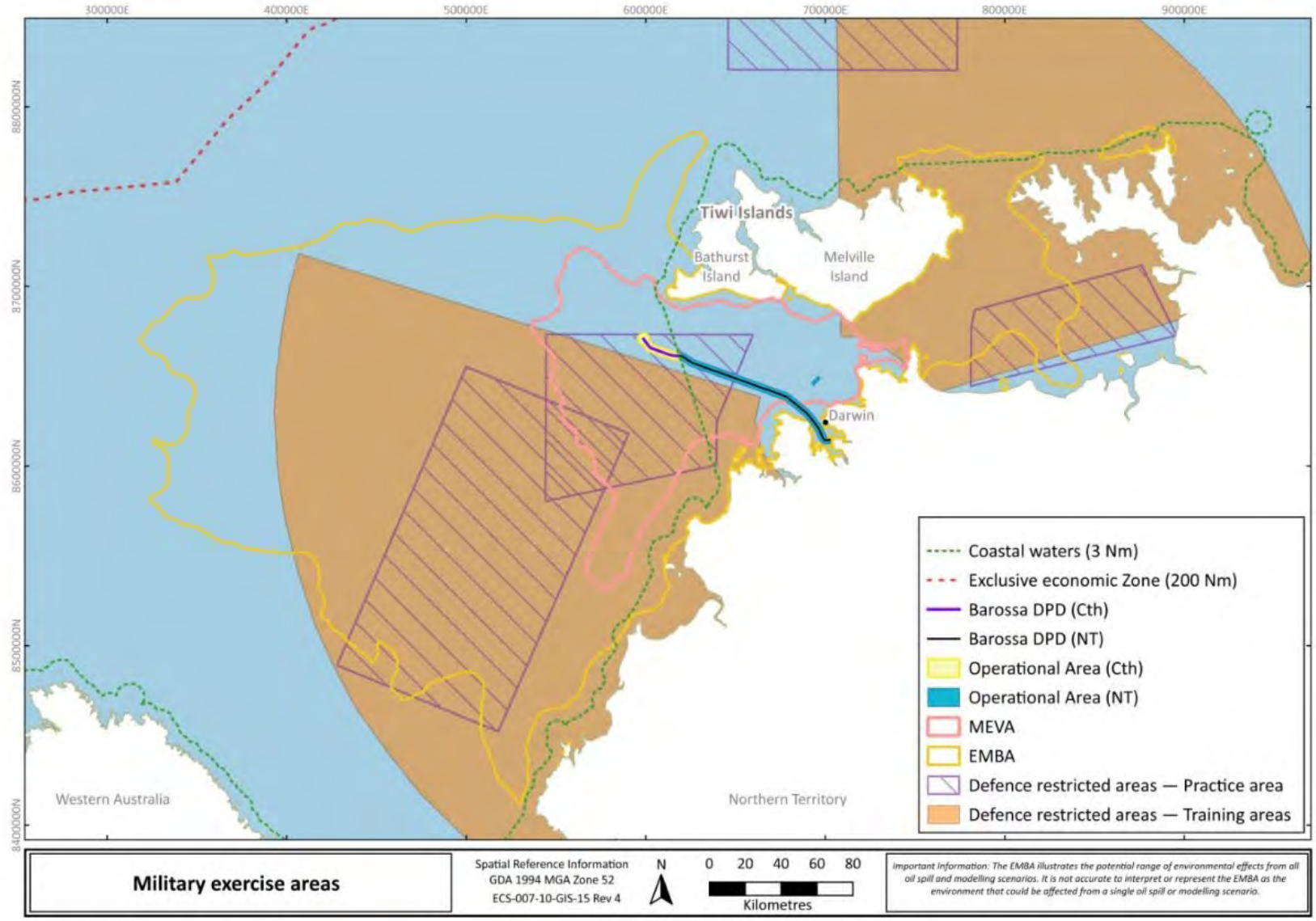


Figure 14-3: Defence training and exercise areas overlapping or proximal to the EMBA

14.4 Recreation and Tourism

Water-based recreation and tourism activities within the EMBA include fishing, boating, diving and wildlife watching. International cruise ships also traverse the EMBA en-route to/from Darwin Port and a number of small, luxury expedition cruise ships use Darwin as a base to explore the remote Northern Australian coastline (NT Tourism, 2023a). Recreation and tourism activities are likely to be more concentrated within coastal waters of the EMBA, but activities such as deep-water fishing and scuba diving around offshore shoals/reefs or on shipwrecks may take place in offshore areas of the EMBA.

There were 817,000 domestic and international visitors to the NT for the purposes of tourism during the year ending June 2023, with a combined ~ $1.4 billion spend (NT Tourism, 2023b). The Greater Darwin and Kakadu Arnhem regions adjacent the EMBA are popular visitor destinations.

Recreational fishing, both from shore and boat based, is a popular activity in marine waters for residents and visitors to the NT. During 2018-2019, over 85% of recreational fishing occurred in marine waters with 95% in areas <5 km from the coastline, primarily estuaries, followed by inshore and offshore waters (West et al., 2022). Darwin Surrounds attracted approximately 21% of the NT-wide fishing effort, with the north coast attracting 8% of the effort (West et al., 2022). The peak fishing effort occurs between October to December and April to June (West et al., 2022). Recreational fishers and charter vessels tend to target fish inhabiting shallower features such as banks and shoals.

Scuba diving, snorkelling and other charter vessels are also a significant tourist attraction, with operators visiting the numerous shipwrecks, coral reefs and artificial reefs and embarking on day or multiday trips out to offshore islands and shoals (INPEX Browse, 2010). The peak tourism period occurs between May to October.

The Tiwi Islands are a popular tourist destination offering cruises, fishing, sailing and water tours among other cultural activities. Kakadu National Park is also an important visitor attraction.

14.5 First Nations cultural heritage

14.5.1 Meaning of 'cultural features'

In its evaluation, Santos has had close regard to the Court's guidance and findings in *Munkara v Santos NA Barossa Pty Ltd (No 3)* [2024] FCA 9 (*Munkara*) in identifying the cultural features of the environment. In *Munkara*, the Court clarified the meaning of 'cultural features' in the definition of 'environment' in section 4 (now section 5) of the OPGGS(E)R:

+ The phrase cultural features has a 'communal aspect' to it. This necessitates that individual beliefs are broadly representative of the beliefs of other members of the group, although there does not need to be consensus[4]. An idiosyncratic view or belief of an individual may be a manifestation of the culture of that person's society, but if it is not broadly representative of the beliefs of a group, then it will not constitute a cultural feature[5].

In the context of limb (a) of the definition of 'environment', 'cultural features' attaches to the word 'ecosystem' with all of its constituent parts, including people and communities. The focus must remain on the ecosystem, of which people form a part. This focus is not upon an individual person devoid of the context of the ecosystem[6].

+ In the context of limb (c) of the definition of 'environment', each of the circumstances that:
  - an area is the subject of a spiritual connection to Aboriginal people, provided that the connection is by the laws and customs of *a people*[7];
  - an 'area' is the country of an Aboriginal person in accordance with Aboriginal traditional laws and customs[8]; and

[4] *Munkara* at [922], and see also at [194]-[199].

[5] *Munkara* at [204].

[6] *Munkara* at [204].

[7] *Munkara* at [201].

[8] *Munkara* at [855].

- there exists in those areas, locations or places cultural heritage in the form of artefacts or other objects evidencing human occupation and activities over the course of human history[9] that may readily be described as a 'cultural feature' of that location, place or area.

+ In order for there to be a 'cultural feature' of the environment, there must be a 'sufficiently cogent or coherent belief' that is 'sufficiently accepted' so that it can be described as having normative content for the people or community viewed as a constituent part of an ecosystem, such that a singular perspective will not suffice[10]. The beliefs and values must be held by the relevant people as a people[11]. Further, the question of whether a view is sufficiently cogent or coherent may be answered by reference to the customs and practices of the relevant people, including relevant customs and practices concerning the authority to speak on a topic or relevant customs and practices (if any) concerning the resolution of division[12].
+ The inquiry as to what is 'broadly representative' must be undertaken in the proper cultural context, including by assessing which persons are generally accepted as having authority to speak on the particular topic and excluding those persons who are culturally irrelevant[13].
+ Evidence of dissenting views cannot be ignored, because they tend against a finding that beliefs have broad acceptance[14].
+ Proof that beliefs are broadly representative will be more difficult in the face of discord within the relevant group, and even more so when the discord is among persons of equivalent authority and persons having the same lineage[15].

14.5.2 Introduction

First Nations people have occupied the Australian continent for at least 65,000 years, making them the oldest continuous culture in the world. First Nations Australians' *connection to land is essential to the continued cultural survival of Australia's First Peoples as well as their economic and social development* (AIATSIS, 'Land Rights', Reuters).

Santos acknowledges the tradition of the First Nations people of Australia includes a cultural and spiritual connection to their land and waters, including sea country. These connections are rooted in their traditional communal beliefs and practices. First Nations people view their land and waters as integral to their identity, culture, and spirituality and they have a deep respect for the natural world. First Nations persons and groups that identify as saltwater people/groups have a complex relationship with sea country, based, for the most part, on inherited rights, including totemic affiliation, and ceremonial duties. Santos understands that First Nations groups of Northern Australia are generally aware of the nature and geographic extent of their areas of responsibilities over sea country.

The cultural heritage of First Nations people is defined by Indigenous tradition through traditional laws and customs amongst themselves.

It includes a vast array of cultural artifacts, practices and beliefs. The protected heritage of First Nations peoples is also of cultural value to Australia and the global community. The cultural value of First Nations protected heritage to Australia is evidenced and given force by a range of factors, including the laws, regulations and institutions established across Australia that are designed specifically to protect First Nations rights and interests in relation to sacred sites and other aspects of First Nations cultural heritage, including the *Native Title Act 1993* (Cth) (NT Act), *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIHP Act), UCH Act, *Aboriginal Land Rights (Northern Territory) Act 1976* (Cth) (ALR Act) and *Northern Territory Aboriginal Sacred Sites Act 1989* (NT) (NTASS Act) (see Sections 14.5.2.1 to 14.5.6).

In identifying the cultural features of the NT OA and EMBA, Santos has considered:

[9] *Munkara* at [200].

[10] *Munkara* at [206].

[11] *Munkara* at [208].

[12] *Munkara* at [206].

[13] *Munkara* at [923].

[14] *Munkara* at [923].

[15] *Munkara* at [924].

1. information shared during consultation on its proposed DPD activities under the Barossa DPD Environment Plan (DPD EP) and DPD Coastal Waters Construction Environmental Management Plan (Coastal Waters CEMP) under s 21 of the OPGGSER, and during public engagement on its proposed DPD activities under the DPD Offshore Construction Environmental Management Plan (Offshore CEMP);
2. information shared during consultation/engagement relevant to other Barossa EPs;
3. lay and expert evidence adduced in the *Munkara* Federal Court proceeding (see *Munkara v Santos NA Barossa Pty Ltd (No 3)* [2024] FCA 9), which concerned allegations about cultural heritage in the context of the GEP EP (defined below), as well as the court's reasoning and findings;
4. expert anthropological advice provided by Santos' consultants (some of which was considered by the Court in *Munkara*); and
5. other publicly available information.

Information about potential cultural features obtained during consultation/engagement for other Barossa Gas Project Environment Plans (EPs), namely the Barossa Drilling and Completions EP (D&C EP), Barossa Subsea Umbilical Risers and Flowlines EP (SURF EP) and Barossa Gas Export Pipeline EP (GEP EP) has been considered and included in this document where potentially relevant.

Further to point 2 above, Santos was provided with information by First Nations people during consultation meetings for the D&C EP and by NOPSEMA in the course of preparing the D&C EP. NOPSEMA provided Santos with 4 separate letters from 4 Tiwi clan members to NOPSEMA in April 2022 requesting the statement of reasons for NOPSEMA's decision to accept Revision 3 of the D&C EP (2022 Statement of Reasons Requests[16]), and asked Santos to consider the relevance of the information provided in the letters to the D&C EP. Items raised in the letters from the Tiwi clan members include traditional hunting of marine species, totem species, dreamings, songlines and sacred sites, as well as broad concerns about potential impacts from other Barossa Gas Project activities (e.g. noise and light emissions) on the environment. Where relevant, Santos has considered this information below.

Further to point 4 above, Santos commissioned an independent expert assessment by Dr Brendan Corrigan for the purpose of identifying underwater cultural heritage (UCH) places along the route of the Barossa GEP west and north-west of the Tiwi Islands ("Corrigan 2023 Report"). As part of his work, Dr Corrigan reviewed extensive ethnographic studies of the Tiwi people in order to gain an historical understanding of their society, culture and hierarchy, and conducted extensive interviews amongst the communities.

In addition, Dr Corrigan has also prepared an anthropological survey report ("Corrigan 2024 Report") (Corrigan, 2024) on cultural and spiritual values in relation to the DPD Project (inclusive of the NT OA). The Corrigan 2024 Report is based on a review of all relevant available ethnographic, linguistic and historical materials and consultations with key First Nations persons identified as having cultural and spiritual knowledge and authority associated with the study area. As far as possible, all persons understood to hold cultural and spiritual rights and interests in the study area, including those who assert relevant cultural knowledge, were identified and invited to participate.

Dr Corrigan concluded that a precise boundary which captures the extent of interests of both the Tiwi Islanders and Larrakia Peoples' cultural and spiritual values in the context of the DPD and GEP activities is unclear. However, cultural and spiritual values of these groups are understood as extending out into the seas for an indeterminate distance. For example, the spiritual beings Jirukupai (crocodile man) and Ampitji) are thought by Tiwi Islanders to travel in the surrounding sea, but it is unclear precisely how far. This is also consistent with a range of views put to the Federal Court more recently, in the context of the GEP EP (see for example, Corrigan 2023). Similarly, Tiwi Islanders routinely travel large distances at sea for the purpose of fishing and hunting turtle and dugong. However, there is no settled evidentiary data on the actual extent of these cultural and economic activities in the context of a sea country claim or the like.

There are no native title claims or determinations registered, or sites recorded under the NTASS Act or sites protected under the ATSIHP Act, UCH Act or ALR Act, Aboriginal land rights claimed or granted under the ALR Act or Indigenous Protected Areas (IPAs) within the NT OA.

14.5.2.1 Native title

Native title was first recognised in Australia in *Mabo v Queensland (No 2)* (1992) 175 CLR 1 (*Mabo*). Consequent to that decision, the NT Act was enacted to provide a statutory mechanism for the recognition of claims for, and protection of, native title.

[16] 2022 Statement of Reasons Requests asked for copies of statement of reasons to be sent to EDO email addresses.

Native title claims are applications made to the Federal Court under the NT Act for a determination, or decision about native title in a particular area. A claimant application is made by a native title claim group which asserts it holds native title rights and interests in an area of land and/or water, according to its traditional laws and customs. By making a claimant application, the native title claim group seeks a decision that native title exists, so its physical and spiritual rights and interests are recognised by the common law of Australia. This is called a native title determination. A determination is a decision by a recognised body, such as the Federal Court or High Court of Australia, that native title either does or does not exist in relation to a particular area.

A native title claim group must demonstrate that the acknowledgement and observance of traditional laws and customs have continued substantially uninterrupted since sovereignty (capable of being recognised by the common law of Australia) (section 223(1) NT Act). Native title rights and interests are determined as a question of fact. For example, in *Western Australia v Ward* (2000) 99 FCR 316, [243], the Full Federal Court stated that:

Acknowledgment and observance may be established by evidence that traditional practices and ceremonies are maintained by the community, insofar as that is possible, off the land, and that ritual knowledge including knowledge of the Dreamings which underlie the traditional laws and customs, continue to be maintained and passed down from generation to generation. Evidence of present members of the community, which demonstrates knowledge of the boundaries to their traditional lands, in itself provides evidence of continuing connection through adherence to their traditional laws and customs.

A requirement for obtaining a positive determination of native title in court is proving that there is an organised group that occupied the claimed land and waters at the time of British annexation. The requirement of an 'organised society' is set out in *Mabo*.

From this, it is considered that it is a group of native titleholders that hold communal native title and that native title claims are understood to apply to the area over which First Nations groups are claiming their rights and interests.

A native title determination is where native title has been determined to exist, which may include only part of a native title claim and represents the lands and waters over which the native title group has been recognised to have rights and interests. Where a Court has determined that native title exists, those native title rights and interests will be held (often but not always) in trust by a Registered Native Title Body Corporate designated by the Native Title holders (section 57 NT Act).

Native title is, in any particular case, a collection of rights and interests the content of which varies according to the traditional laws and customs from which they are, in each particular case, derived. For example, these rights may include the right to have access, to camp, hunt, fish, use water, hold meetings, perform ceremony and/or protect cultural sites (see for example, *Akiba v The Commonwealth* (2013) 250 CLR 209).

The NT OA overlaps the Larrakia native title determination (DCD2006/001) (Figure 14-4), the outcome of which was that native title does not exist. The EMBA intersects the Croker Island native title determination (DCD1998/001) and Larrakia native title determination (DCD2006/001). The areas of responsibility for regional native title representative bodies that overlap the EMBA are shown in Figure 14-5**.**

14.5.3 Indigenous land use agreements

An Indigenous land use agreement (ILUA) is a voluntary agreement between native title parties and other people or bodies about the use and management of areas of land and/or waters. An ILUA can be made over areas where:

+ native title has been determined to exist in at least part of the area
+ a native title claim has been made
+ no native title claim has been made.

While registered, ILUAs bind all native title holders to the terms of the agreement. ILUAs also operate as a contract between the parties. A register of ILUAs is maintained by the Native Title Registrar. The register of ILUAs does not disclose the existence of any ILUA which overlaps with the NT OA; however, the EMBA does overlap the areas of land and tidal waters (between the low water mark and the high water mark) of the Kenbi ILUA and a small coastal portion of the Mary River National Park ILUA (refer to Figure 14-4).

The Northern Land Council (NLC) is a party to the Kenbi ILUA and NLC, and members of the Wulna Clan (refer Table 4-7 of the Offshore CEMP) are parties to the Mary River National Park ILUA.

14.5.4 Indigenous protected areas

IPAs are areas of land and sea managed by First Nations groups as protected areas for biodiversity conservation through voluntary agreements with the Australian Government. IPAs are an essential component of Australia's National Reserve System, which is the network of formally recognised terrestrial parks, reserves and protected areas across Australia's landmass. There are currently 82 dedicated IPAs over 87 million hectares of land. There is also around 5 million hectares of Australia's sea areas in dedicated IPAs. Managing IPAs helps First Nations communities protect the cultural features of their country for future generations.

There are no IPAs that overlap the NT OA, or the EMBA (Figure 14-4).

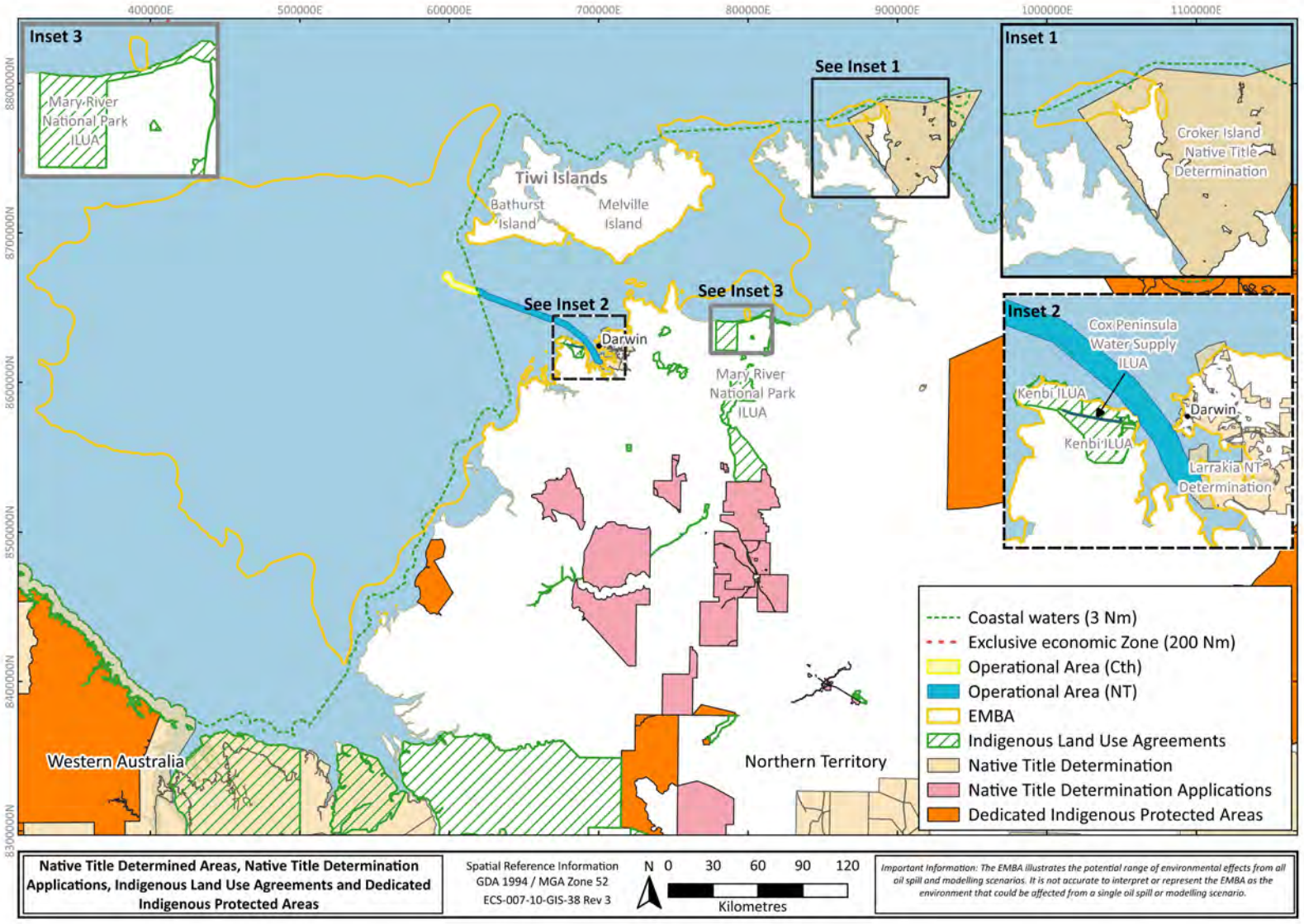


Figure 14-4 Native Title Determined Areas and Applications, ILUAs and IPAs

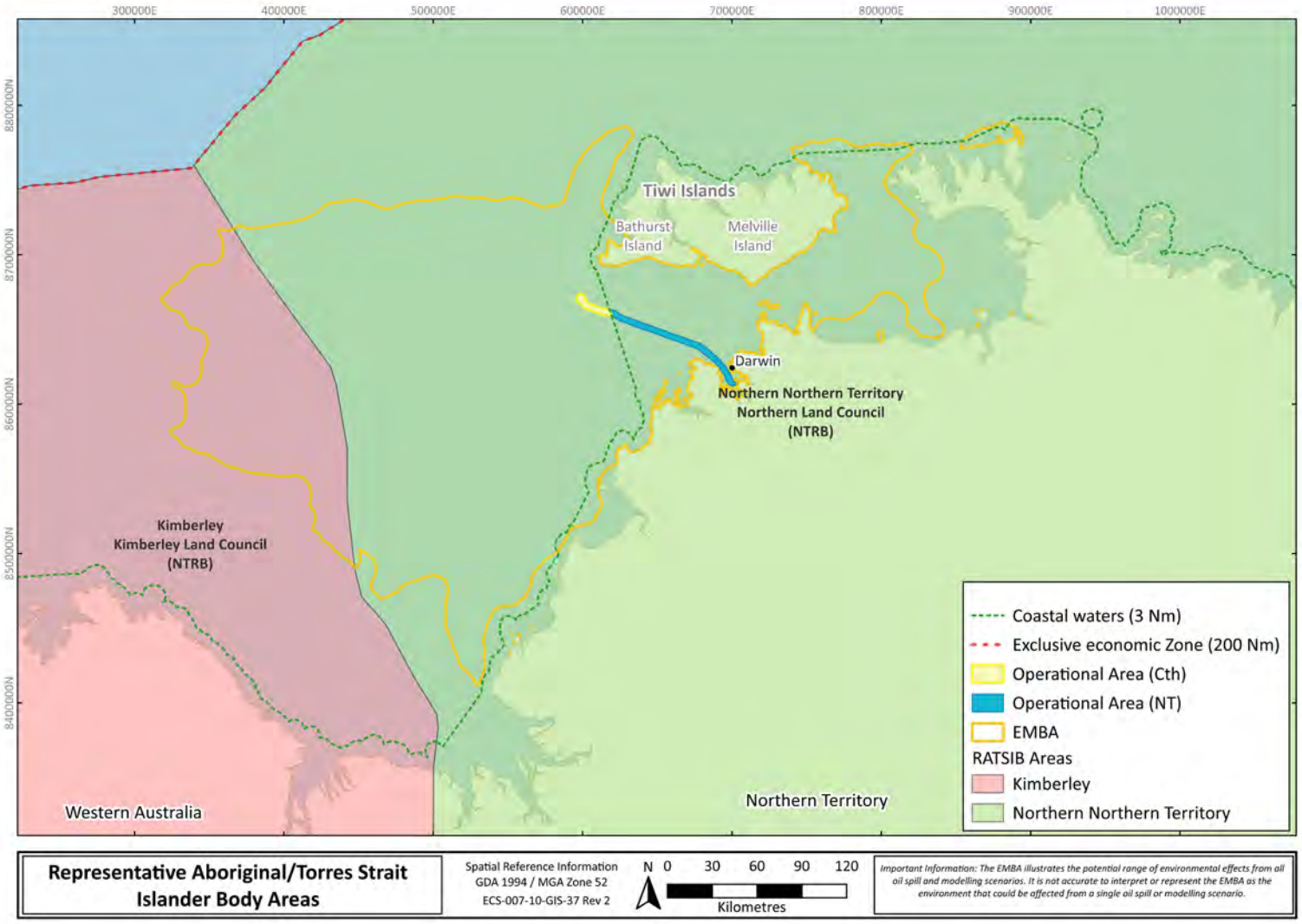


Figure 14-5 Representative Aboriginal/ Torres Strait Islander Body Areas

14.5.5 Sacred sites

The Kenbi (Cox Peninsula) Land Claim No. 37 (CoA, 2000) publishes detail on the location and significance of culturally significant First Nations sites within Darwin Harbour and Bynoe Harbour to the east (which are separated by the Cox Peninsula), including registered sacred sites. These sites and areas include those used for hunting, fishing, gathering, camping, ceremonies and associated with dreamings. There are numerous sites identified in this report on the western side of Darwin Harbour, including those associated with dreamings of totemic marine fauna species, including Ngalwatnyini (manta ray dreaming), Memarrandjamul-nyini (dugong dreaming), Iyn.garrayn-nyini (sea turtle dreaming) (CoA, 2000). The report also identifies 3 sites on the north-eastern side of Darwin Harbour.

There are many sacred sites associated with mainland coastline and islands of the NT. Sacred sites may include features which lie both above and below the water (AAPA, 2022). Members of the Agalda clan, representing western parts of the Cobourg Peninsula, including coastal areas and adjacent sea country, raised with Santos during consultation on the DPD EP and Coastal Waters CEMP that there are sacred sites around the west and south of Coburg and Croker Island. During consultation meetings for the SURF EP, Santos was also provided with sacred site locations within the EMBA by some members of the Tiwi Island clans. These sacred sites are located on the western coast of Bathurst Island that may also potentially intersect the outer boundary of the EMBA for this Activity.

All sacred sites in the NT are protected in accordance with the NTASS Act. Sacred sites may also be protected under the ATSIHP Act, *Heritage Act 2011* (NT), the UCH Act, the ALR Act or the EPBC Act.[17]

The Aboriginal Areas Protection Authority (AAPA) is an independent statutory authority established under the NTASS Act (AAPA, 2022). AAPA is responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the whole of Australia's Northern Territory. AAPA protects Aboriginal sacred sites through:

- Sacred site avoidance surveys and issuing of Authority Certificates for any proposals of development.
- The provision of information to the public about existing sacred sites data through abstracts of Authority records and access to the Registers maintained by the Authority.
- The registration of Aboriginal sacred sites (AAPA, 2022).

Authority Certificates are based on consultations between AAPA and custodians and provide clear instructions on what can and cannot be done in and around sacred sites (AAPA, 2022). An Authority Certificate provides a statutory indemnity against prosecution in relation to the works or uses covered by the Certificate, provided the applicant complies with any conditions imposed to protect sacred sites (AAPA, 2022). Certificates are voluntary and are considered to provide an effective risk management tool for developers and act as site protection measures for custodians (AAPA, 2022).

Santos has applied for and received an Authority Certificate (C2022-098) from AAPA on 23 December 2022, which covers potential land/seabed disturbance areas (termed 'subject land areas' and representing for the most part, a 1,000m buffer each side of the pipeline route, the spoil disposal ground and an onshore area within the DLNG facility disturbance footprint) from Wickham Point to the boundary of NT and Commonwealth waters.

The certificate identified a registered sacred site where work restrictions will apply.

Santos also applied for, and received on 22 May 2024, a second Authority Certificate (C2024-034) from AAPA to cover additional areas of seabed disturbance outside of certificate C2022-098, associated with nearshore pipelay barge anchoring in Darwin Harbour, water quality logger installation in Darwin Harbour (for monitoring water quality during trenching and spoil disposal operations) and additional small areas of onshore disturbance within the existing DLNG Facility disturbance footprint. The certificate identified a restricted works area and imposed certain conditions on Project activities to avoid impacts to the area.

Santos will ensure that the conditions of AAPA Authority Certificates and requirements of the *Northern Territory Aboriginal Sacred Sites Act 1989* and the *Heritage Act (2011)* (NT) will be adhered to.

No sacred sites have been found to be directly impacted by the DPD Project footprint (Corrigan 2024).

[17] For completeness Santos notes that on 23 October 2023 it was informed by the DCCEEW that applications had been received under the ATSIHP Act in relation to certain areas of the sea. Santos understands that these areas are at least 200 km from the Project Area but overlap a small portion of the outer limits of the EMBA. Santos understands that no decisions have been made by the Minister in relation to the applications at the time of writing.

14.5.6 Land rights

The ALR Act governs Aboriginal land (not native title claims) in the NT. Land that has been granted or recommended for grant under the ALR Act is determined to be held communally by the "traditional Aboriginal owners" of that land. The ALR Act has enabled the establishment of Aboriginal Land Trusts to hold title to Aboriginal land granted in the NT under that Act.

Aboriginal land rights governed under the ALR Act do not extend past the low water mark of tidal waters overlaying the NT coastline. In coastal areas, grants of Aboriginal land under the ALR Act are made to the low water mark. *Northern Territory v Arnhem Land Aboriginal Land Trust* (2008) 236 CLR 24 confirmed that Traditional Owners of First Nations-owned NT coastline have exclusive access rights to the tidal waters overlying their land.

There is no Aboriginal land either claimed or granted under the ALR Act, or sea closures put into effect in accordance with that Act, that overlap with the NT OA. The EMBA does overlap areas of land and tidal waters (between the low water mark and the high water mark) granted under the ALR Act. This Aboriginal land is held by the Arnhem Land ALT, the Cobourg Peninsula Sanctuary ALT, the Tiwi ALT, the Kenbi ALT, and the Delissaville/ Wagait/ Larrakia ALT (CoA, 2023).

Section 5(2) of the ALR Act provides that ALTs cannot exercise their functions in relation to land they hold except in accordance with directions given to them by the Land Council for the area in which the relevant land is situated. Where any such directions are given, ALTs must comply with them. Accordingly, ALTs cannot act independently of Land Councils. Under the ALR Act, the functions of Land Councils with respect to ALTs involve administering ALTs in their area, including storing their common seals and deeds of grant, maintaining a register of ALT membership, negotiating agreements on behalf of ALTs and receiving moneys on behalf of ALTs.

The NLC is the relevant Land Council for the Arnhem Land, Cobourg Peninsula Sanctuary, Kenbi and Delissaville/Wagait/Larrakia ALTs, while the Tiwi Land Council (TLC) is the relevant Land Council for the Tiwi ALT.

14.5.7 Australian marine parks

The EMBA for the Activity overlaps with features of the North MPNMP and the North-West MPNMP, which identify natural, cultural and spiritual values associated with AMP's, specifically the Oceanic Shoals AMP and the Arafura AMP.

Santos acknowledges that Commonwealth and State Marine Park Management Plans have sought to recognise cultural interests of First Nations groups. Australian Marine Parks has described this framework as taking 'values into account' when making decisions and taking action in relation to marine parks. Australian Marine Parks summarises these values into natural, cultural, heritage and socioeconomic categories. Additionally, the Commonwealth and State Marine Park Management Plans state that there could be First Nations groups or native title representative groups who may have responsibility for sea country within marine park areas.

14.5.8 Cultural fishing, hunting and gathering activities

First Nations fishing activity in NT waters predominately occurs within inshore tidal waters. Approximately 80% of NT's coastline is recognised as being under Aboriginal land and sea ownership under the *Aboriginal Land Rights Act 1976* (NT) (NT Government, 2022). Almost all traditional fishing effort (~93%) is concentrated within NT Internal and Coastal waters (up to 3 Nm beyond the territorial baseline) and Tiwi Islands (NT Government, 2017).

Darwin Harbour is utilised by Larrakia people for collecting marine resources, including fishing, hunting, crabbing and the collection of shellfish (Corrigan, 2024).

On the Tiwi Islands, traditional fishing effort is greatest near the larger communities of Wurrumiyanga on Bathurst Island, and Pirlangimpi and Milikapiti on Melville Island (these communities are located outside the EMBA) for the Tiwi Island people (DPIF, 2014). Traditional subsistence food sources include fish (mullet, mackerel, barramundi, trevally), mud mussels, mud crabs, long bums shellfish, oysters, yams, eggs (turtle and bird), chilli worms, mangrove worms, turtles, stingrays, and dugongs. Green turtles are the main species harvested in the water, while eggs of all turtle species are taken periodically (Tiwi Land Council, 2022). Information provided during Tiwi Clan meetings during consultation for the D&C EP indicated that some Tiwi people have a particular interest in turtles as a traditional food source. Santos was also provided with information during the preparation of the D&C EP from Croker Island members of the community in Minjilang (located outside the EMBA) rely on fish, turtles, dugong, oysters and other marine food sources. During consultation for D&C and engagement on the DPD Project, Santos was not provided details about the locations of traditional fishing, hunting and gathering activities.

Feedback from the 2022 Statement of Reasons letters (for the D&C EP) identified the following First Nations people's use of country for fishing/gathering food (fish, shellfish, turtle/turtle eggs, (mud) mussels, (mud) crabs, yams, mullets, mangrove worm, mackerel, barramundi, trevally, (black lip) oysters, chilli worm, stingray, dugong and seagull eggs.

Traditional subsistence food sources are captured in a culturally appropriate manner learnt from ancestral generations and taught to emerging descendants. This occurs in normal family and community circumstances as well as within the practices of the First Nations groups (Corrigan, 2024).

With the support of the NT Government, Darwin Aquaculture Centre is working with Tiwi People to develop aquacultural enterprises that provide employment and business opportunities (Land Development Corporation, n.d.). Aquacultural options include Barramundi, Trepang, Mud Crab, Prawns, Oysters and Clams (Tiwi Land Council, 2021).

14.5.9 Culturally significant marine species

In consultations with Tiwi Clans for the D&C EP, some Tiwi people emphasised that marine turtles are regarded by Tiwi people as totemic and culturally significant species. Therefore, environmental protection measures for marine turtles are important to Tiwi people.

The 2022 Statement of Reasons requests indicated that Tiwi people also consider fish, dugong and whales to hold cultural significance as totemic species (in addition to marine turtles), although the significance of these species was not raised with Santos in its communal consultation sessions with Tiwi people for any of the Barossa EPs.

The Northern Land Council (NLC) in a submission as part of the consultation for the D&C EP also indicated a number of marine species that are significant to Aboriginal dreamings including birds, crocodiles, whales, manta rays, crabs, dugong, sea turtle, gropers, sea-eagles, octopus and other turtles. Corrigan (2024) also confirmed that turtle, dugong, and sting ray dreamings were close to Talc Head in Darwin Harbour (within the EMBA), noting these have significant importance regarding resources and the spiritual dimensions of Larrakia life. Dreamings were identified as being associated with the sea, winds and stars and regarding the moon and the seasons, mermaid dreaming and dreamings near the Charles Point lighthouse. The term dreaming is used throughout Corrigan (2024) to denote knowledge, songs and narratives associated with Aboriginal religious understandings which set out the origins of the social and physical world and expected behaviours within it. Corrigan (2024) also identified species important for protection including turtles, crocodiles, dugong, dolphins and the seagrass beds near Kings Table (within the EMBA).

14.5.10 Sea country connection

As outlined in Section 14.5.1, Santos acknowledges that the cultural features of the environment include the circumstance that First Nations people have spiritual connections to a particular place within that environment, or that the place forms part of the country of a First Nations group, in accordance with the traditional laws and customs of that group. As such, the circumstance that an area of the environment is part of the sea country of a First Nations group, to which members of that group have a spiritual connection, is a cultural feature of that area of the environment.

The North MPNMP (DNP, 2018a) states:

Sea country refers to the areas of the sea that Aboriginal people are particularly affiliated with through their traditional lore and customs. Sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years.

The nature of sea country was the subject of extensive lay and expert evidence in the *Munkara* proceeding, to which Santos has had regard in its consideration of cultural features of the environment. Based on this evidence, Santos understands that:

+ the concept of country is intimately connected with questions of cultural authority. The First Nations group who is responsible for that area of country has authority to speak in relation to that country and has custodian responsibilities in respect of that country. One group's area of sea country will end where the next group's begins, although groups may share responsibility for particular dreamings which traverse different areas of country; and
+ sea country connections may manifest in the telling of stories about foundational creation myths explaining features of the landscape or particular species[18].

[18] *Munkara* at [866].

In order to identify areas of sea country which may be affected by the Activity, Santos engaged broadly with First Nations groups and representative organisations in respect of the Activity covered by the DPD EP, Offshore CEMP and Coastal Waters CEMP, as well as taking into consideration consultation provided by First Nations groups in respect of its other Barossa EPs. Based on this engagement and Santos' review of publicly available information, Santos has identified that EMBA likely intersects with sea country, although the geographical extent of sea country interests is inherently indeterminate at this time.

14.5.10.1 Features of sea country

In the course of engagement for the Activity under the DPD EP, Offshore CEMP and Coastal Waters CEMP and previous Barossa EPs, some First Nations persons provided additional context as to the manifestation of their sea country connection, being particular stories and creation myths which they believe to be present within the EMBA. Santos acknowledges that expressions of sea country connection may be particular to families and individuals within groups and that there is accordingly divergence in the details of such stories within groups. Notwithstanding this, the information provided is summarised below and has been considered by Santos herein, including with the benefit of expert anthropological advice.

Dr Corrigan documented a range of views on Tiwi clans' connection with sea country and considered claims for several items to be protected in accordance with Tiwi law and custom (Corrigan 2023). This included:

+ the travels of the Crocodile Man
+ the locationand existence of a 'Mother Ampitji'
+ the travels of Ampitji
+ the necessity to look after country in a manner that seeks to ensure no industrial accidents occur which might affect sea country and marine resources (including spiritual connections to the same)
+ the Imunka force present in the seas
+ the location of a place under the sea where spirits go to upon people's death and then being moved on from the world of the living through Pukamani ceremony.

Tiwi Islanders interviewed by Dr Corrigan about the location of the above items expressed a variety of views. This is supported by the observations and findings of the Court in *Munkara*[19].

Corrigan (2024) also documents input from Larrakia people and relevant First Nations persons from Belyuen and Wagait, who also advise the presence of a range of ancestral beings and dreaming stories of relevance to the Darwin Harbour and surrounding seas. None of these cultural features are known to be associated with any specific or particular places in the DPD Project footprint, but rather have a more general association with the wider area, as well as having associations with particular and specific places outside of the DPD Project footprint.

14.5.10.2 Spiritual beings

As part of consultation in the course of preparing the D&C EP some First Nations Relevant Persons expressed cultural connections with sea country in terms of spiritual beings. Information about First Nations cultural beliefs and connection with their sea country, within and adjacent to the D&C EP EMBA, was provided during First Nations consultation meetings for the D&C EP and from other information provided by NOPSEMA to Santos (2022 Statement of Reasons requests).

During Tiwi Clan consultation meetings for the D&C EP, Tiwi people spoke about the importance of their spiritual dreaming which protects the Tiwi Islands from man-made and natural disasters. Santos recognises that some First Nations persons fear sickness or other adverse effects from the actions of spiritual beings in response to impacts on the environment of sea country itself. A key Tiwi creation story concerns a spiritual being (or spiritual beings) called Ampitji (sometimes known as a Rainbow Serpent). The Court in *Munkara* considered lay and anthropological evidence about this creation story at [78]-[81], noting that while there was significant divergence in spiritual beliefs concerning Ampitji, it was not disputed that the spiritual belief in one or more Ampitji is a feature of Tiwi spiritual life and that Ampitji may have a role to play in ensuring compliance with Tiwi law.

During Croker Island consultation meetings in Darwin, Croker Islanders conveyed their affiliation to their land and sea. They advised that their culture is at the coast and includes everything in the water including the marine life. Croker Island people informed Santos during D&C EP consultation about their connections to sea country. Sea

[19] See *Munkara* at [871], [1003], [1011]–[1014], [1027] and [1212].

country was defined as to the north of Cape Croker out to the deep water (referred to as Inigarrka). Inigarrka is considered the most sacred place in the ocean and the Croker Island people are prohibited from the sacred area. Santos recognises the potential for sea country and songlines to extend into the EMBA for the Activity.

In relation to the GEP EP project footprint, Dr Corrigan concluded that, in accordance with Indigenous tradition, there were no specific underwater cultural heritage places along the GEP route that may be affected by the activities under the GEP EP: that there are no known sacred sites or some other specific places that are part of well-known sets of ancestral creation stories amongst the Tiwi people.

The Court in *Munkara* reached a similar conclusion on tangible cultural heritage, finding that the evidence was insufficient to show anything other than a negligible chance that there exists one or more objects of archaeological value along the GEP route[20]. Regarding intangible cultural heritage, the Court found that the evidence before the Court was insufficient to prove that the accounts given by the Applicant's witnesses in relation to Ampitji and the Crocodile Man were broadly representative of a belief held by the Relevant People as people, such that the belief would constitute a cultural feature[21]. The Court also found that there was insufficient evidence in relation to Imunka [22] to establish that the belief constituted a cultural feature[23].

Whilst these conclusions of the Court and Dr Corrigan were made in relation to activities covered by the GEP EP, the conclusions are also relevant to the Activity covered by the DPD EP, Offshore CEMP and Coastal Waters CEMP due to the spatial proximity with the GEP activities. That is, no intangible cultural heritage values and sensitivities constituting a cultural feature have been identified at specific places along the GEP and DPD route (on DPD, see Corrigan, 2024).

In its correspondence to Santos of 25 August 2023 in relation to the D&C EP, NOPSEMA drew Santos' attention to 2 reports provided to NOPSEMA by the EDO on behalf of 7 Tiwi Islander clients on 21 July 2023. These reports relate to the GEP, which is the subject of a separate Environment Plan, for the Barossa Development (EDO GEP Reports) and these were considered in relation to the Activity covered under this plan. One of the EDO GEP Reports was prepared by Mr Lewis. The Court in *Munkara* doubted the rigor of Mr Lewis' anthropological work and, as referred to above, ultimately found that his opinions constituted him acting as an advocate rather than assisting the Court to arrive at the correct answer[24]. The other EDO GEP Report was prepared by Dr O'Leary. The Court ultimately placed no weight on this report and dismissed it, along with the subsequent reports prepared by Dr O'Leary, for all purposes[25].

The EDO GEP Reports claim to provide an assessment of the locations of potential impacts to Indigenous underwater cultural heritage sites along the Barossa GEP route. While the locations of these claimed sites of significance are partially within the EMBA, the locations and significance of these claimed sites as put forward in the EDO GEP Reports is disputed by Corrigan (2023).

Corrigan (2023) included consideration of detailed expert reports on archaeology and sedimentology along the GEP route conducted by Wessex Archaeology and Dr Posamentier; and the EDO GEP reports. Dr Corrigan concluded there are no specific underwater cultural heritage places along the GEP to which people, in accordance with Indigenous tradition, may have spiritual and cultural connections that may be affected by the GEP EP activities (Corrigan, 2023). As the southern section of the GEP extends to the EMBA, this conclusion extends to the Activity.

Corrigan (2023) provided the following independent expert comments on the EDO Reports:

+ The EDO Reports come to dramatic conclusions about cultural heritage elements in the vicinity of the GEP which overestimate the consistency of the views of the EDO clients with those held by the wider jural public of the Tiwi Islanders;
+ Some Tiwi Islanders express views consistent with the EDO Reports, but the authors of those reports failed to consider and take account of other alternative expression;
+ The narratives contained in the EDO Reports are not anything like the narratives described to Dr Corrigan in the interviews he undertook;

[20] *Munkara* at [1306].

[21] *Munkara* at [1003] and [1014].

[22] Referred to in *Munkara* as Yiminga.

[23] *Munkara* at [946].

[24] *Munkara* at [1136]-[1139].

[25] *Munkara* at [879] and [1198].

- The location or even the existence of mother Ampitji is not agreed by all relevant parties;
- Dr O'Leary (the author of one of the EDO Reports) does not mention any qualification he holds for which he might rely upon to undertake detailed and nuanced ethnographic enquiries in the context of a controversial industrial project;
- Dr O'Leary incorrectly assumes an accuracy of the advice he received about the location of paleo sub-sea burial places;
- The EDO Reports do not correctly identify any specific underwater cultural heritage places along the Barossa GEP Route.

Dr Corrigan also identified a constant theme in his interviews with the Tiwi Islanders that Ampitji travel within the waterholes of the Tiwi Islands and surrounding the Tiwi Islands and the crocodile man, Jirukupai, is also said by some to traverse the seas towards the Commonwealth and NT OAs. Dr Corrigan accepts, this is offset where some senior Tiwi people make the point that these OA is, in their view, a long way away from the Tiwi islands and that Jirukupai and Ampitji do not go out that far into the water. Of direct relevance these sorts of Tiwi cultural and spiritual values were tested in the Federal Court and were found not to be consistently spread amongst relevant Tiwi Islanders and in any event did not represent a particular 'place' of cultural and spiritual significance.

An important outcome of Dr Corrigan's research is that no sacred sites or dreamings are shown to be directly impacted by the proposed DPD Project footprint, although this is not to say that some persons do not have fears that this could be the case in the event of an unplanned event (Corrigan, 2024).

Santos recognises the importance of cultural and spiritual beliefs to First Nations people. Santos recognises that some First Nations remain concerned about the potential for adverse consequences to First Nations people and natural environment, that may arise as a result of disturbance from the Barossa Gas Project to spiritual dreaming and culturally important spiritual beings. In this regard, Dr Corrigan identified the following recommendation, as put to him by First Nations:

"*that Santos consider engaging cultural monitors to provide guidance and advice on the protection and maintenance of the cultural and spiritual places and activities throughout the DPD construction process and that a discussion on this topic be held with the Wickham Point Deed Reference Group in the first instance...*" (Corrigan, 2024)

Dr Corrigan's recommendation is considered further when evaluating impacts and risks to intangible cultural features and adoption of appropriate measures to reduce associated impacts and risks to ALARP and acceptable levels.

14.5.11 Summary of cultural features

Cultural features relevant to the Activity—as presented in Sections 14.5.1 to 14.5.10.2 —are summarised in Table 14-2 including a description of the cultural feature, sourced information and an assessment of relevance to the EMBA or OA (if known). Context for these features is described below:

- Cultural heritage protected areas (including Native Title determinations, indigenous land use agreements, indigenous protected areas and Aboriginal land rights claims) – cultural knowledge and the passing down of cultural education to children can occur from performing of ceremonies and rituals and through dreaming narratives and songlines. Traditional laws and customs amongst a group or groups can define indigenous traditions amongst the group or groups. For example, laws and customs can provide a format for social life and ceremonial matters. The transfer of knowledge of traditional law and customs may be integral to a group's[26] intangible cultural heritage (UNESCO, 2003) There may be implications to the transfer of First Nations knowledge if, for example, relevant aspects of the environment disappear. Ongoing observance of First Nations traditional laws and customs can also be recognised through Native Title determinations, and knowledge of and connection with country (land and sea) can be recognised through a range of mechanisms including indigenous land use agreements, indigenous protected areas and Aboriginal land rights claims.
- Sacred sites – areas that are traditionally accessed by First Nations people, such as sea country and sacred sites, are important for transferring traditional knowledge and for caring for country. If physical landscapes are altered this could impact the values of sacred sites. Sacred sites and protection of these is a known cultural heritage concern.

[26] As noted in Munkara v Santos NA Barossa Pty Ltd (No 3) [2024] FCA 9, this cultural heritage must be held communally by the group, although need not be the subject of consensus.

- Cultural fishing, hunting and gathering – Through consultation and engagement with First Nations persons it was identified that a number of marine species provide sustenance to some First Nations people and are obtained through cultural fishing, customary hunting (turtles and dugongs) and gathering (turtle eggs and bird eggs).
- Culturally significant marine species – A range of marine species (such as marine turtles, fish, dugongs, whales, sea-eagle, crocodile and manta rays) were raised during consultation / community engagement as being important for Aboriginal dreaming, or as having totemic status and significance culturally. The First Nations people maintain a continuing spiritual connection with sea country, through caring for sea country and access to cultural food sources.
- Marine Parks – Commonwealth and State Marine Park Management Plans have sought to recognise cultural interests of First Nations groups within Marine Parks, and the sea country value of Marine Parks to First Nations people.
- Sea country connection through songlines – Cultural stories and songlines can extend from the shoreline to deep water areas and they tell an important cultural story (Corrigan, 2023). If spiritual injury occurs from an activity, some First Nation people believe that songlines can be damaged. It is believed that damaging songlines may have the potential to interfere with ability for First Nation people to reproduce cultural knowledge and continue to provide cultural education of their children.
- Sea country connection through dreaming sites and stories, and spiritual beings – Some First Nations people believe dreamings relate to powerful creative ancestors who left much of the natural and human world behind them as they travelled (Corrigan, 2023). It is believed ancestors can travel to areas such as in the water or land below the seas, where these ancestors continue to use these areas. Some First Nations people are of the opinion that if spiritual injury is caused it can damage dreaming tracks. They believe it is their responsibility to look after these dreaming sites to protect the known travels of the spiritual beings. Information provided to Santos by First Nations communities during consultation / community engagement, also highlighted the importance of cultural spiritual beings, such as Ampitji, as protectors of First Nations communities, and that if spiritual beings are upset or offended it can result in natural disasters or sickness among First Nations communities.

Table 14-2: Summary of First Nations cultural features and heritage values

Identified cultural feature	Description	Source	NT OA presence	EMBA presence
Archaeological heritage				
First Nations UCH	A First Nations archaeological assessment for the DPD Project Area (both Commonwealth and NT OAs) was based on a detailed geomorphological assessment. This study focussed on the likelihood for deposits associated with the Last Glacial Maximum (LGM) to be impacted by the DPD Project. Only one location where potential sediments associated with the LGM were indicated was in the vicinity of KP36.4 to 37.9. At this location, potential sediments are assessed likely to be at a depth of approximately 18 m below the sea floor. At this depth, no activities related to the construction of the DPD Project will have any direct or indirect impact on these potential sediments. There are no declared protected First Nations UCH sites within the DPD Commonwealth and NT OAs.	Desktop First Nations Archaeological Assessment Report: Darwin Pipeline Duplication Project, (OzArk, 2024)	No	Possible (not declared or spatial extent undefined)
Tangible values				
Native title	First Nations people have interests in an area of land and/or water according to its traditional laws and customs, as recognised through cultural heritage legal and regulatory frameworks. There are no native title claims or determinations that overlap with the Commonwealth OA (Figure 14-4). In NT internal waters, the NT OA does overlap the Larrakia native title determination	Spatial datasets were downloaded from the National Native Title Tribunal website[27] and confirmed during consultation with First Nations people and representative groups (Sections 14.5.2 to 14.5.6).	No	Yes

[27] Source: http://www.nntt.gov.au/assistance/Geospatial/Pages/Spatial-aata.aspx

Identified cultural feature	Description	Source	NT OA presence	EMBA presence
	(DCD2006/001) (Figure 14-4), the outcome of which was that native title does not exist. The EMBA intersects the Croker Island native title determination (DCD1998/001) and Larrakia native title determination (DCD2006/001). The areas of responsibility for regional native title representative bodies that overlap the EMBA are shown in Figure 14-5.			
Indigenous land use agreements	There are no ILUAs within the Commonwealth or NT OAs; however the EMBA does overlap the areas of land and tidal waters (between the low water mark and the high water mark) of the Kenbi and Mary River ILUAs (refer to Figure 14-4).		No	Yes
Indigenous protected areas	There are no IPAs that overlap the Commonwealth or NT OAs or the EMBA (refer to Figure 14-4).		No	No
Sacred Sites	There are no known registered sacred or First Nations UCH sites within the Cth OA. There is overlap of sacred sites in Darwin Harbour with the NT OA. Nominated Subject Land Areas within the NT OA, where seabed disturbance may occur are subject to AAPA Authority Certificates (C2022-098 and C2024-034) and restricted works areas in Darwin Harbour. The DPD Project infrastructure footprint does not intersect any sacred sites, as acknowledged in Corrigan (2024). There are many NT coastal sites along the mainland and island coastlines and potentially the surrounding waters that overlap the EMBA. Refer to Section 14.5.5 for further information.	AAPA Authority Certificates (C2022-098 and C2024-034). Consultation feedback and Corrigan 2024 Report including a view of extensive ethnographic studies (Section 14.5.5).	Yes	Yes

Identified cultural feature	Description	Source	NT OA presence	EMBA presence
Land rights	There is no Aboriginal land either claimed or granted under the ALR Act, or sea closures put into effect in accordance with that Act, that overlap with the Commonwealth or NT OAs. The EMBA does overlap areas of land and tidal waters (between the low water mark and the high-water mark) granted under the ALR Act. This Aboriginal land is held by the Arnhem Land ALT, the Cobourg Peninsula Sanctuary ALT, the Tiwi ALT, the Kenbi ALT, and the Delissaville/ Wagait/ Larrakia ALT.	ALC, 2023, Section 14.5.6	No	Yes
Marine Parks	The North MPNMP and the North-West MPNMP identify natural, cultural and spiritual values associated with AMPs, specifically the Oceanic Shoals AMP and the Arafura AMP.	DNP, 2018a; 2018b., Section 14.5.7	No	Yes
Cultural fishing, hunting and gathering	Cultural fishing, hunting and gathering of marine species such as fish, shellfish, turtles, dugongs, eggs (turtle and seagull). Cultural fishing, hunting and gathering is unlikely to occur in the Commonwealth OA but does occur in Darwin Harbour and therefore may occur in the NT OA.	Corrigan 2024 Report and consultation with First Nations people and representative groups (Section 14.5.8).	Yes	Yes
Culturally significant marine species	First Nations persons and groups that have a deep connection with the sea through totems and dreamings such as marine fauna (marine turtles, whales, dugong) and consider them to be of cultural significance.	2022 Statement of Reasons requests and NLC consultation feedback in relation to the D&C EP. Corrigan 2024 Consultation feedback and Dr Corrigan reports (2023, 2024) including a view of extensive ethnographic studies (Section 14.5.9).	Yes	Yes
Intangible values				
Sea country connection through songlines	Songlines can go from land to sea and were identified as important by the Croker Island and Tiwi Islands people, as well as Larrakia people and other First Nations peoples with	Consultation feedback and Dr Corrigan reports (Corrigan 2023, 2024) including	Possible (spatial extent undefined)	Possible (spatial extent undefined)

Identified cultural feature	Description	Source	NT OA presence	EMBA presence
	interests in the DPD Project route. They ordinarily traverse areas in a manner of travelling from named places to named places.	a view of extensive ethnographic studies (Section 14.5.10).		
Sea country connection through dreaming sites and stories and spiritual beings	Dreaming Dreamings were identified as being associated with the sea, winds and stars and regarding the moon and the seasons, mermaid dreaming and dreamings near the Charles Point lighthouse. A number of marine species are significant to Aboriginal dreaming such birds, crocodiles, shellfish, whales, manta rays, crabs, dugong, sea turtle, gropers, sea-eagles and octopus.	Consultation feedback and Dr Corrigan reports (2023, 2024) including a view of extensive ethnographic studies. NLC consultation feedback in relation to the D&C EP. (Section 14.5.9 and 14.5.10).	Possible (spatial extent undefined)	Possible (spatial extent undefined)
	Spiritual beings Spiritual beings are important to Croker Island people and Tiwi Island people, as well as Larrakia people and other First Nations peoples with interests in the DPD project route for their role as protectors of First Nations people and the natural environment. Spiritual beings are believed to be present in the vicinity of the islands.	Consultation feedback and Dr Corrigan reports (2023, 2024) including a review of extensive ethnographic studies (Section 14.5.10.2).	Possible (spatial extent undefined)	Possible (spatial extent undefined)

14.6 Non-indigenous and maritime heritage

A search of the Commonwealth Protected Matters Search Tool (PMST) within the EMBA identified the following Commonwealth Heritage Areas:

- Larrakeyah Barracks Headquarters Building
- Larrakeyah Barracks Sergeants Mess
- Larrakeyah Barracks Precinct
- RAAF Base Precinct
- RAAF Base Commanding Officers Residence
- RAAF Base Tropical Housing Type 2
- RAAF Base Tropical Housing Type 3

The Larrakeyah Barracks (Headquarters Building, Precinct and Sergeants Mess) are located in Darwin and are listed due to their architectural significance and association with a notable architect (B. C. G. Burnett) (DAWE, 2022). While they are located on the Darwin foreshore and were picked up in the PMST search, the Project is not considered to have any direct or indirect impacts relevant to the heritage (architectural) values of this area.

The RAAF Base Commonwealth Heritage Areas are also located in Darwin and while picked up in the PMST search they are located well inland from the coastline (and therefore the edge of the EMBA) and are not discussed further.

There are multiple known shipwrecks, sunken aircraft, and historic (more than 75 years old) aircraft and shipwrecks and other sites within the EMBA (see Appendix A). The historic shipwrecks and sunken aircraft, including associated artefacts, are subject to automatic protection under the UCH Act. Shipwrecks, sunken aircraft and other types of underwater cultural heritage that have been underwater less than 75 years can be protected through an individual declaration by DCCEEW based on an assessment of heritage significance. Underwater heritage artefacts continue to be protected after removal from the water.

The UCH Act may declare a protected zone around wrecks which require a permit to enter, there are currently three protected zones having closed water orders in NT. These are the Japanese submarine I-124 (1942), Florence D (1942) and Sanyo Maru (1937) The Regional Harbourmaster has also ordered the Booya and Catalina 6 wrecks to have closed water controls over them and permission from the Heritage Branch is needed to enter the zones. There is an additional site in the EMBA that has a declared protected zone, the SS Macumba.

Darwin Harbour is host to several shipwrecks and sunken aircraft, some of which are protected under the *Heritage Act 2011* (NT) and/or the UCH Act. Most wrecks are associated with either, the bombing of Darwin in 1942 or Cyclone Tracy in 1974.

The Australian National Shipwrecks Database has identified five historic wrecks that overlap the NT OA, all of which are listed under the UCH Act. These wrecks are the Japanese submarine I-124 (1942) 800 m radial protection zone, Yu Han 22 unlisted protection zone, Song Saigon (1982) unlisted protection zone, Mauna Loa USAT (1942) 100 m radial protection zone and Meigs USAT (1942) unlisted protection zone (DCCEEW, 2022b). The pipeline route has been deliberately altered to avoid the I-124 and Mauna Loa USAT wrecks. These sites are protected under the *NT Heritage Act 2011*.

No European heritage is currently listed at Wickham Point, with the remnants of artefacts documented and removed prior to the construction of the DLNG facility. There are no World, National or Commonwealth Heritage places within or near the Project Area.

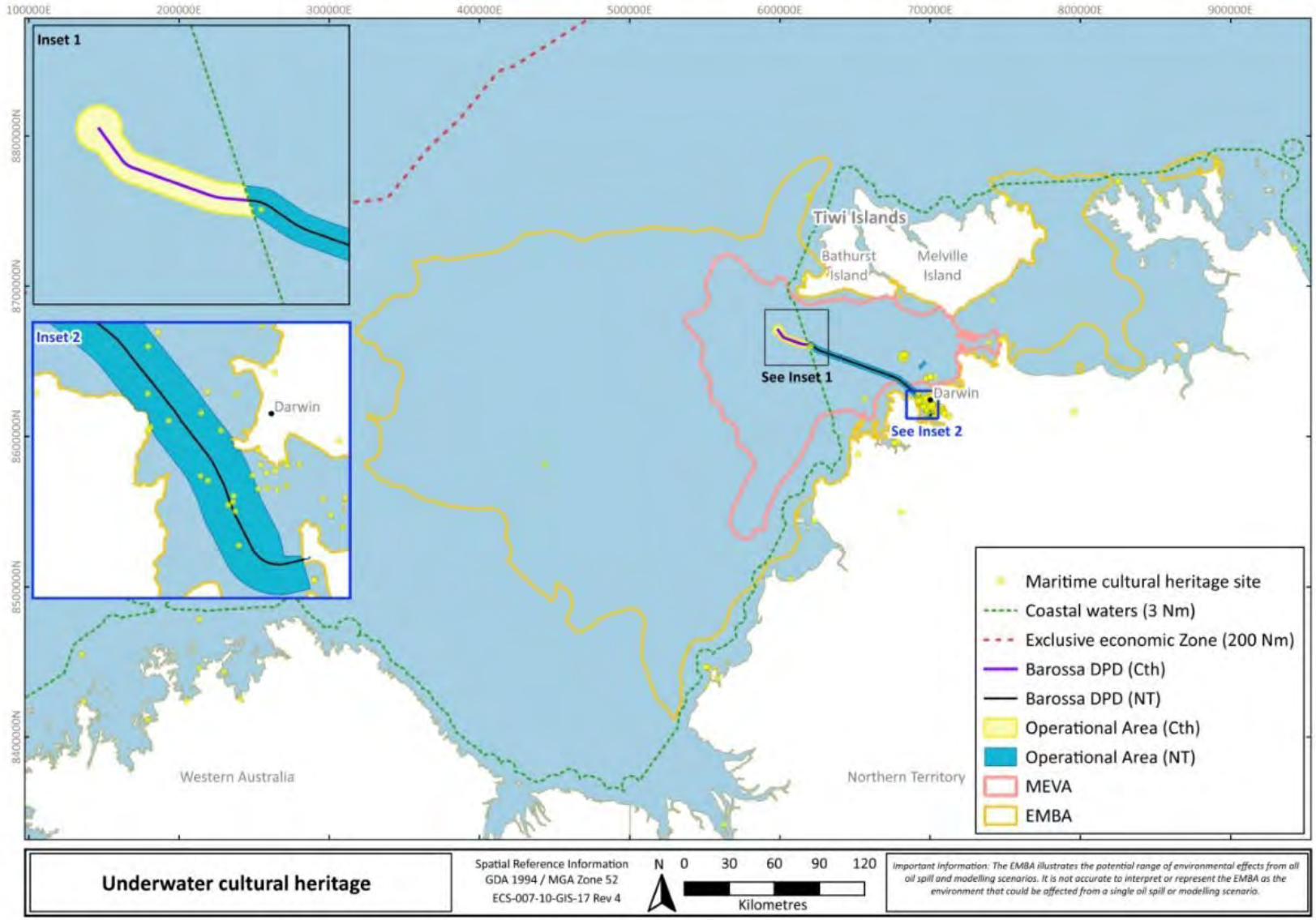


Figure 14-6: Underwater maritime cultural heritage overlapping or proximal to the EMBA

14.7 Commercial fisheries

The NWMR and NMR support Commonwealth and state (NT and WA) managed commercial fisheries. The Timor and Arafura seas support various shark, demersal and pelagic finfish and crustacean species of commercial importance. The permitted fishing areas for the commercial fisheries overlapping the EMBA are shown in Figure 14-7, Figure 14-8 and Figure 14-9. Table 14-3 summarises Santos' understanding of these commercial fisheries and the likelihood of fishing effort within the Operational Areas (OAs) and EMBA.

Table 14-3: Commonwealth and state fisheries that overlap the EMBA and/or the NT OA

Commercial fishery	NT OA	EMBA	Description	Likelihood of interaction with fishers
Commonwealth-managed				
Northern Prawn Fishery	✓	✓	**Area**: extends from Joseph Bonaparte Gulf across the top end to the Gulf of Carpentaria. Most of the Northern Prawn Fishery effort lies in the Gulf of Carpentaria, Joseph Bonaparte Gulf and along the Arnhem Land coast (DoA, 2014). **Gear**: trawl. **Key target species**: The key target species are banana prawns, tiger prawns and endeavour prawns. There are 2 fishing seasons—the season end date depends on catch rates: Season 1 (mainly banana prawns caught): 1 April to 15 June. Season 2 (mainly tiger prawns caught): 1 August to 30 November. Fishing for scampi also occurs in deeper waters, with fishing effort spread across 2–3 months of the year (December to February). **Effort** (2020): 52 active vessels; around 4,767 t (Patterson et. Al., 2021).	Interaction with this fishery is possible. Fishing effort occurs within the EMBA. Areas of high fishing effort occur 113 km NE of the NT OA. Medium fishing effort occurs 28 km S and 103 km NE of the NT OA. Due to these distances, interaction is not deemed likely to occur. Two other areas of medium effort intersect portions of the EMBA in the far east of its extent.
Southern Bluefin Tuna Fishery	✓	✓	**Area**: The Southern Bluefin Tuna Fishery spans the Australian Fishing Zone. However, it is only active in the south and south eastern Australian water. **Gear**: purse seine and pelagic long line. **Key target species**: southern bluefin tuna. **Effort** (2020): 30 active vessels; around 5,429 t (Patterson et al., 2021).	No active commercial fishing effort reported in the NT OA or EMBA; therefore, interaction with this fishery is unlikely.
Western Skipjack Tuna Fishery	✓	✓	**Area**: The Western Skipjack Tuna Fishery spans the Australian EEZ and adjacent high seas, from Cape York to the Victoria–South Australia border, including waters around Tasmania and the high seas of the Pacific Ocean. **Gear**: purse seine **Key target species**: skipjack tuna **Effort** (2020): None. There has been no fishing effort since the 2008–2009 season, and in that season, activity was concentrated	No active commercial fishing effort reported in the NT OA or EMBA, therefore interaction with this fishery is unlikely.

Commercial fishery	NT OA	EMBA	Description	Likelihood of interaction with fishers
			off South Australia (Patterson et. Al., 2021).	
Western Tuna and Billfish Fishery	✓	✓	**Area**: Operates in Australia's EEZ and high seas of the Indian Ocean. In recent years, fishing effort has concentrated off south-west WA, with occasional activity off South Australia. **Gear**: pelagic longline. **Key target species**: bigeye tuna, yellowfin tuna, striped marlin, swordfish. **Effort** (2020): 3 active vessels; around 161 t (Patterson et. Al., 2021).	No active commercial fishing effort reported in the NT OA or EMBA, therefore interaction with this fishery is unlikely.
NT-managed				
Aquarium Fishery	✓	✓	**Area**: Includes freshwater, estuarine and marine habitats to the outer boundary of the Australian Fishing Zone. Most marine species are collected within 100 km of Nhulunbuy and Darwin. A specimen shell collection enterprise occurs around Ashmore Reef and Cartier Island (outside the EMBA). **Gear**: handheld, nets and pots (dive-based). **Key target species**: fish, invertebrates and plants for aquariums. **Effort**: unknown – no restriction on number of licences (NT Government, 2023).	No active commercial fishing effort reported in the NT OA but some effort in the EMB is possible for very limited periods of the year..
Baitfish Fishery	✓	✓	**Area**: Commercial fishing for bait is allowed from the high water mark to three nautical miles seaward of the low water mark but does not include Darwin Harbour and Shoal Bay. **Gear**: bait net, cast net or scoop net **Key target species**: all fish species except barramundi, threadfin salmon, Spanish mackerel or mud crab. **Effort**: 2 licenses allowed. (NT Government, 2023).	Fishery overlaps the NT OA. Effort is expected within parts of the EMBA in NT waters and may occur in the NT OA.
Spanish Mackerel Fishery	✓	✓	**Area**: Commercial fishing for Spanish mackerel is allowed from the high-water mark to the outer boundary of the Australian Fishing Zone, which is 200 Nm offshore. Most fishing effort occurs near reefs, headlands and shoals and includes waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts.	Interaction with this fishery in the NT OAs is possible with fishers transiting within the area. Effort is expected within the EMBA at nearby shoals and banks, particularly in waters off Bathurst Island.

Commercial fishery	NT OA	EMBA	Description	Likelihood of interaction with fishers
			Fishing generally takes place around reefs, headlands and shoals. **Gear**: trolling, handline. **Key target species**: Spanish mackerel. **Effort**: 15 licences allowed (NT Government, 2023).	
Offshore Net and Line Fishery	✓	✓	**Area**: Operates in NT waters from the low water mark to the boundary of the Australian Fishing Zone. Most fishing is done in the coastal zone within 12 Nm of the coast, and immediately offshore in the Gulf of Carpentaria. The fishery has an area of approximately 522,000 km^2. **Gear**: longlines or pelagic nets (there are restrictions on where certain gear can be used). **Key target species**: blacktip sharks, grey mackerel. **Effort**: Unknown – no restriction on number of licences (NT Government, 2023).	Interaction with this fishery in the NT OAs is possible but unlikely due to the concentration of fishing effort in near coastal areas and the distribution of the targeted species. Consultation indicates one licence holder may fish off the south-west end of the Tiwi Islands for small pelagic fish.
Pearl Oyster Fishery	✓	✓	**Area**: The fishery extends from the high-water mark in NT waters to the outer boundary of the Australian Fishing Zone, 200 nautical miles offshore in Commonwealth waters. There are five active fishing licence holders currently operating in the fishery which can be active throughout the year. **Gear:** farming by hand only. **Effort:** 5 licences allowed.	High effort is expected within the shallower areas of the EMBA and could occur in the NT OA.
Demersal Fishery	✓	✓	**Area**: Demersal fishing is allowed from 15 nautical miles to the outer boundary of the Australian Fishing Zone, excluding the area of the Timor Reef Fishery. **Gear**: lines, fish traps and semi-demersal trawl nets. **Key target species**: snapper (various species). **Effort**: Unknown – 18 licences currently issued (NT Government, 2023).	Interaction with this fishery in the NT OA is considered highly unlikely as it is even further away from the Timor Reef fishery area than the Commonwealth waters OA.
Trepang Fishery	✓	✓	**Area**: Trepang fishing is allowed from the high-water mark to 3 nautical miles seaward of the coast. Predominately along the Arnhem Land coast, mainly around the Cobourg Peninsula and Groote Eylandt. **Gear**: harvested by hand either on foot or by diving, usually on neap tides during the dry season. **Key target species**: sea cucumber **Effort**: 6 licences currently issued (NT Government, 2023).	Effort is expected within some nearshore areas of the EMBA and may occur within the NT OA.

Commercial fishery	NT OA	EMBA	Description	Likelihood of interaction with fishers
Barramundi	✗	✓	**Area**: Barramundi fishing is allowed from the high-water mark to 3 nautical miles seaward of the coast (with exclusion zones and restrictions). **Gear**: nets are set and retrieved from dinghies and fish are processed onboard motherships. **Key target species**: barramundi and king threadfin **Effort**: 14 licences currently issued. Fishing effort spread across 8 months of the year (February to 30 September; NT Government, 2023).	No fishery overlaps the NT OA. Some effort is expected within the EMBA within 3 nm of shorelines.
Coastal Line	✓	✓	**Area**: Fishery is allowed from the high-water mark to 15 nautical miles seaward of the coast. **Gear**: lines, hooks, cast nets, scoop nets or gaffs. **Key target species**: black jewfish and golden snapper **Effort**: 52 licences currently issued. (NT Government, 2023).	There is a very small overlap of this fishery with the NT OA, therefore effort may occur within the OA but is very unlikely. Effort may occur within the EMBA.
WA-managed				
Mackerel Fishery	✗	✓	**Area**: Commercially fished between Geraldton and the WA/NT border. **Gear**: trolling. **Key target species**: Spanish mackerel. **Effort**: active vessels: (unknown); around 300 t (Gaughan & Santoro, 2021).	No fishery overlaps the NT OA. Effort is expected within the EMBA.
Northern Demersal Scalefish	✗	✓	**Area**: Operates off WA's coast in waters east of 120°E longitude. **Gear**: handline, dropline and fish traps, although the fishery has essentially operated as a trap-based fishery since 2002. **Key target species**: goldband snapper and red emperor. **Effort**: active vessels: (unknown); around 1,500 t (Gaughan & Santoro, 2021).	No fishery overlaps the NT OA. Effort is expected within the EMBA.
Southwest Coast Salmon	✗	✓	**Area**: Perth metropolitan area extending to Cape Beaufort (WA/NT border). No fishing takes place north of the Perth metropolitan area. **Gear**: beach seine nets. **Key target species**: Western Australian salmon. **Effort**: Insufficient information.	No fishery overlaps the NT OA. No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/NT border) – no interaction with this fishery expected in the EMBA.

Commercial fishery	NT OA	EMBA	Description	Likelihood of interaction with fishers
Abalone	✗	✓	**Area**: Operates in all WA waters (between the NT and SA borders). **Gear**: unknown. **Key target species**: abalone. **Effort** (2020): 0 diver days; total catch 0 t. Closed since 2012 due to environmentally induced mortality (Newman et al., 2021).	Fishery closed – no interaction with this fishery expected in the NT OA or EMBA.
Kimberley Crab Fishery	✗	✓	**Area**: Operates off the north-west coast of WA in WA waters. **Gear**: crab traps. **Key target species**: green and brown mud crab. **Effort** (2020): effort occurring between April and September with a catch of 1.5 t (Newman et al., 2021).	No fishery overlap with the NT OA; the EMBA intersects the outer limits of the fishing licence boundary. Interaction with this fishery is highly unlikely.
Marine Aquarium	✗	✓	**Area**: Operates in all WA waters (between the NT and SA borders). Typically more active in waters south of Broome with higher levels of effort around the Capes region of south-west WA, Perth, Geraldton, Exmouth, Dampier and Broome. **Gear**: unknown. **Key target species**: coral, live rock, algae, seagrass and invertebrates. **Effort** (2020): 32.12 t (Newman et al., 2021).	No fishery overlap with the NT OA; the EMBA intersects the outer limits of the fishing licence boundary, which extends the entire WA coastline. Interaction with this fishery is highly unlikely.
Specimen Shell	✗	✓	**Area**: Operates in all WA waters (between the NT and South Australian borders) **Gear**: unknown. **Key target species**: cowries, cones, murexes and volutes. **Effort**: 375 days with 30 licences (15 fished in 2020; Newman et al., 2021).	No fishery overlap with the NT OA. The EMBA intersects the outer limits of the fishing licence boundary, which extends the entire WA coastline. Interaction with this fishery is highly unlikely.
West Coast Deep Sea Crustacean	✗	✓	**Area**: Operates primarily in the Gascoyne bioregion in WA. **Gear**: unknown. **Key target species**: champagne, giant and crystal crab. **Effort** (2020): 153 t (Newman et al., 2021).	No fishery overlap with the NT OA. The EMBA intersects the outer limits of the fishing licence boundary. The concentration of fishing occurs in the Gascoyne bioregion. Interaction with this fishery is highly unlikely.

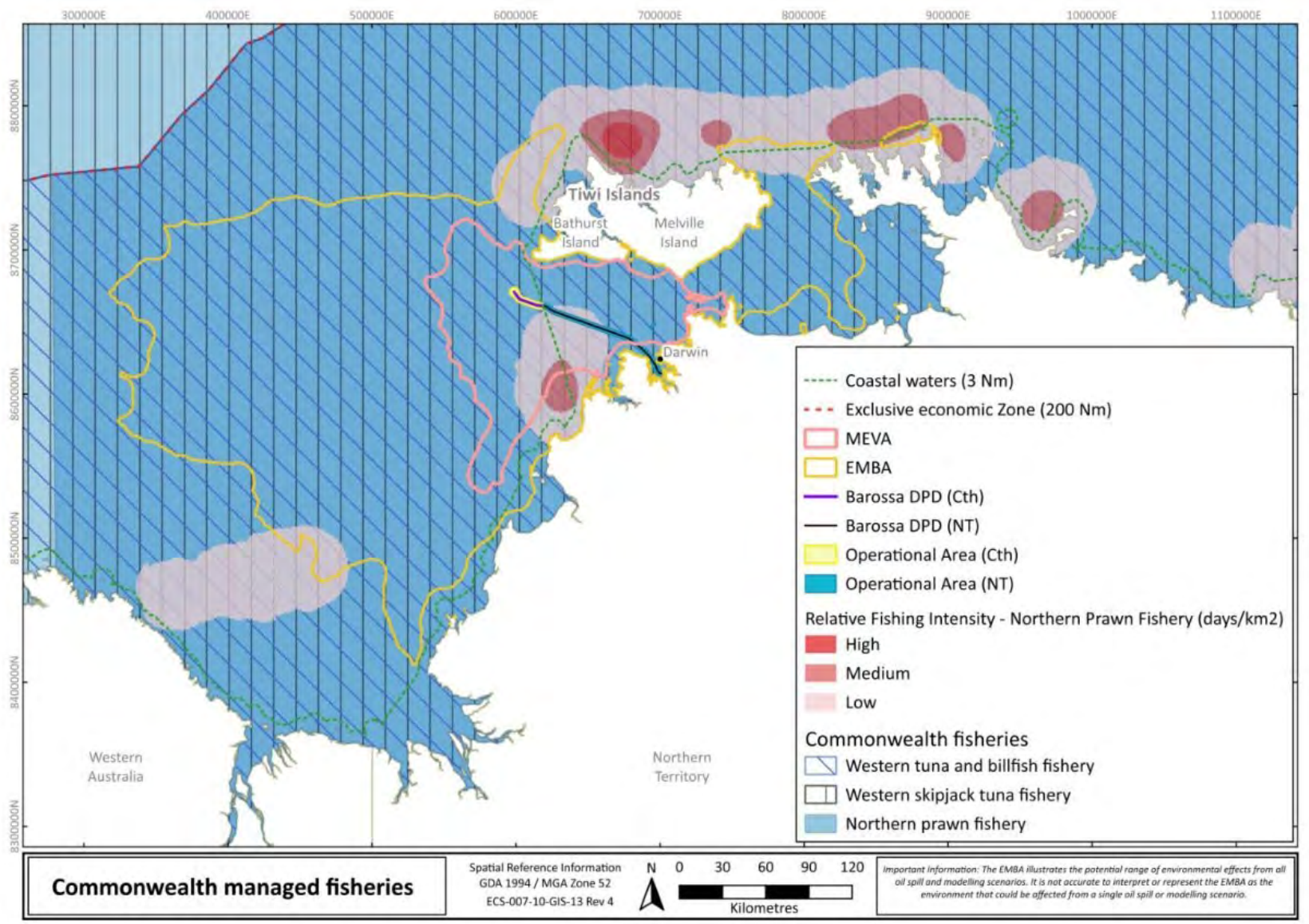


Figure 14-7: Commonwealth managed fisheries overlapping or proximal to the EMBA

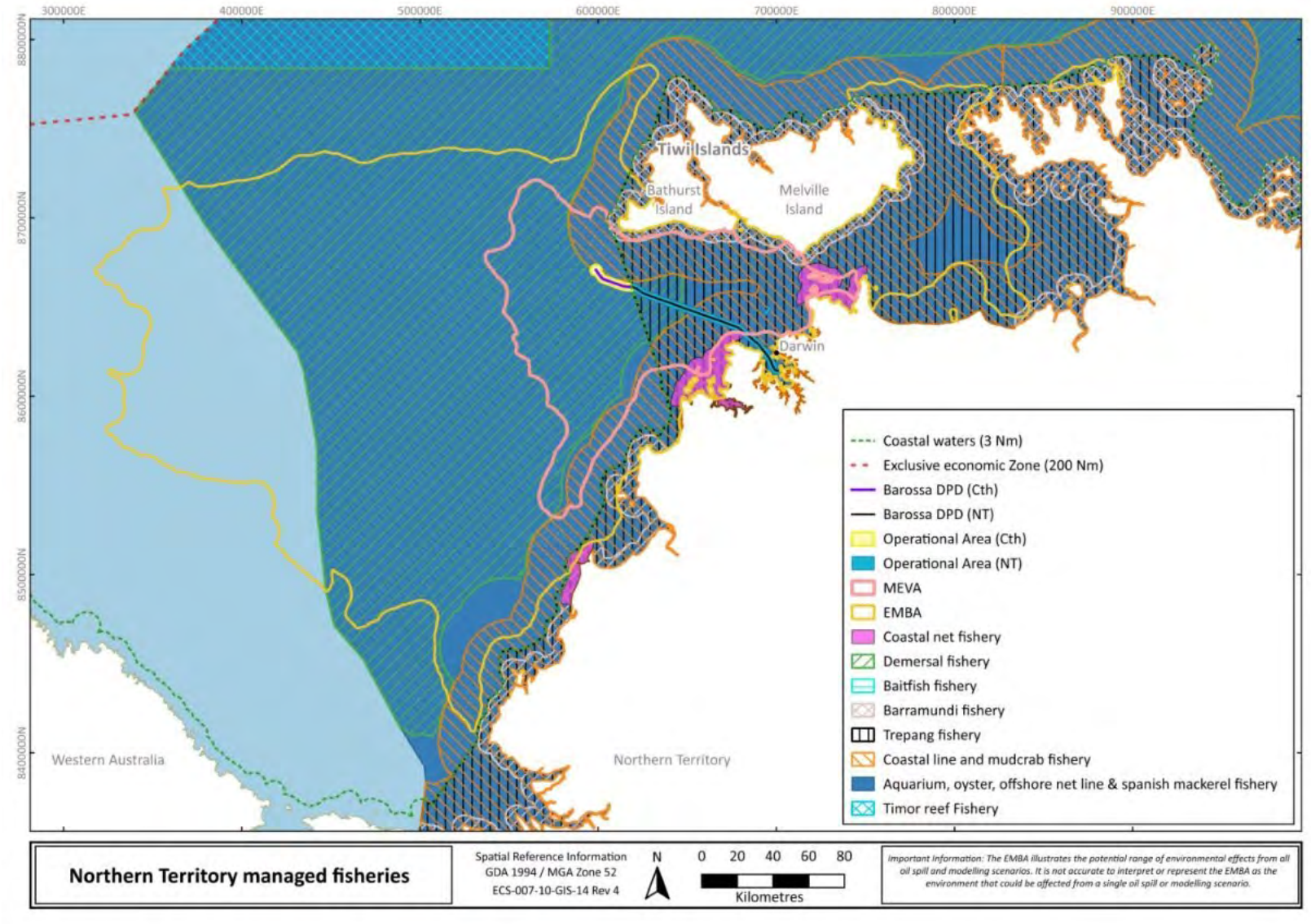


Figure 14-8: Northern Territory managed fisheries overlapping or proximal to the EMBA

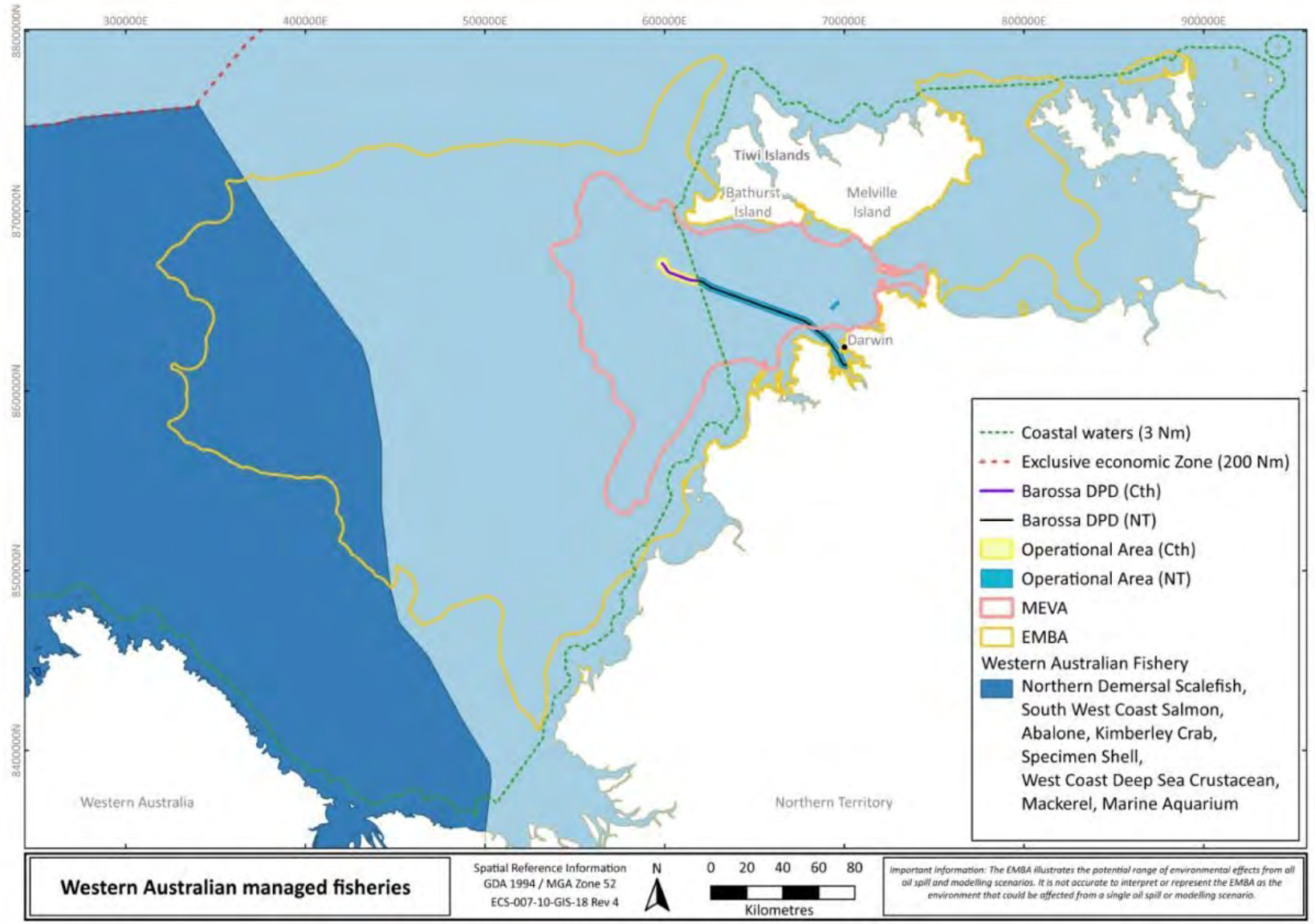


Figure 14-9: Western Australian managed fisheries overlapping or proximal to the EMBA

14.8 Aquaculture

Marine aquaculture (mariculture) in the EMBA is mostly associated with pearl oyster (*Pinctada maxima*) production in NT waters, which is focused in four main areas (NT Government, 2023):

- Bynoe Harbour
- Beagle Gulf
- Cobourg Peninsula and Croker Island
- around the islands north west of Nhulunbuy.

The NT Government, via the Darwin Aquaculture Centre (DAC), is also encouraging the development of aquaculture of other species, including barramundi, sea cucumber, blacklip oysters, and giant clams. The DAC is based on Channel Island in Darwin Harbour, approximately 3.5 km south of the DLNG facility and 1.5 km south of the NT OA. Barramundi is currently grown in ponds on the Adelaide River, and trials on Groote Eylandt and Goulburn Island are looking at growing clams in sea-based cages (NT Government, 2023).

15. Document review

This document will be reviewed and updated as required. The review will consider any changes to the values and sensitivities associated with the Activity as well as any changes to matters of national environmental significance (MNES) within the environment that may be affected (EMBA). A review of changes to MNES shall consider any changes to the EPBC Act species lists, species management/recovery plans and MNES spatial layers.

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Appendix A Protected Matters Search Tool Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Jun-2024

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	69
Listed Migratory Species:	76

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	45
Commonwealth Heritage Places:	7
Listed Marine Species:	119
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	1
Australian Marine Parks:	6
Habitat Critical to the Survival of Marine Turtles:	4

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	6
Regional Forest Agreements:	None
Nationally Important Wetlands:	6
EPBC Act Referrals:	80
Key Ecological Features (Marine):	4
Biologically Important Areas:	17
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status
Kakadu National Park	NT	Declared property

National Heritage Places [Resource Information]

Name	State	Legal Status
Natural		
Kakadu National Park	NT	Listed place

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Cobourg peninsula	Within Ramsar site
Kakadu national park	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Arenaria interpres		
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Phaethon rubricauda westralis Red-tailed Tropicbird (Indian Ocean), Indian Ocean Red-tailed Tropicbird [91824]	Endangered	Species or species habitat likely to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat known to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area
FISH		
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat may occur within area
FROG		

Scientific Name	Threatened Category	Presence Text
Uperoleia daviesae		
Howard River Toadlet, Davies's Toadlet [85375]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
Antechinus bellus		
Fawn Antechinus [344]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Conilurus penicillatus		
Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Mesembriomys gouldii gouldii		
Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat known to occur within area
Mesembriomys gouldii melvillensis		
Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Petrogale concinna canescens		
Nabarlek (Top End) [87606]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area
PLANT		
Burmannia championii listed as Burmannia sp. Bathurst Island (R.Fensham 1021) [93461]	Endangered (listed as Burmannia sp. Bathurst Island	Species or species habitat likely to occur within area
Elaeocarpus miegei [65147]	Endangered	Species or species habitat may occur within area
Hoya australis subsp. oramicola a vine [55436]	Vulnerable	Species or species habitat known to occur within area
Stylidium ensatum a triggerplant [86366]	Endangered	Species or species habitat known to occur within area
Tarennoidea wallichii [65173]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat likely to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat likely to occur within area
REPTILE		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Lucasium occultum Yellow-snouted Gecko, Yellow-snouted Ground Gecko [82993]	Endangered	Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Tiliqua scincoides intermedia Northern Blue-tongued Skink [89838]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Varanus mertensi		
Mertens' Water Monitor, Mertens's Water Monitor [1568]	Endangered	Species or species habitat known to occur within area
Varanus mitchelli		
Mitchell's Water Monitor [1569]	Critically Endangered	Species or species habitat known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding known to occur within area
Glyphis glyphis		
Speartooth Shark [82453]	Critically Endangered	Species or species habitat known to occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
[Tursiops aduncus (Arafura/Timor Sea populations)](#)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
[Cecropis daurica](#)		
Red-rumped Swallow [80610]		Species or species habitat known to occur within area
[Cuculus optatus](#)		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
[Hirundo rustica](#)		
Barn Swallow [662]		Species or species habitat known to occur within area
[Motacilla cinerea](#)		
Grey Wagtail [642]		Species or species habitat known to occur within area
[Motacilla flava](#)		
Yellow Wagtail [644]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#)		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Acrocephalus orientalis](#)		
Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
[Actitis hypoleucos](#)		
Common Sandpiper [59309]		Species or species habitat known to occur within area
[Arenaria interpres](#)		
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
[Calidris acuminata](#)		
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area

Scientific Name	Threatened Category	Presence Text
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding likely to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Attorney-General - Australian Government Solicitor	
Commonwealth Land - Australian Government Solicitor [70089]	NT
Commonwealth Land - Australian Government Solicitor [70450]	NT
Commonwealth Land - Australian Government Solicitor [70332]	NT
Commonwealth Land - Australian Government Solicitor [70996]	NT
Commonwealth Land - Australian Government Solicitor [70092]	NT
Commonwealth Land - Australian Government Solicitor [71135]	NT
Commonwealth Land - Deputy Crown Solicitor [70334]	NT
Commonwealth Land - Deputy Crown Solicitor [70994]	NT
Commonwealth Land - Deputy Crown Solicitor [70333]	NT
Defence	
Defence - AUSTRALIAN ARMY BAND - DARWIN [70042]	NT
Defence - DARWIN - AP10 RADAR SITE - LEE POINT [70021]	NT

Commonwealth Land Name	State
Defence - DARWIN - AP3 RECEIVING STATION - LEE POINT [70044]	NT
Defence - DARWIN RELOCATIONS CENTRE [70045]	NT
Defence - DEFENCE FORCE CAREERS REFERENCE CENTRE [70046]	NT
Defence - Esanda Builidng [70048]	NT
Defence - LARRAKEYAH BARRACKS [70061]	NT
Defence - LEANYER BOMBING RANGE [70022]	NT
Defence - LEANYER BOMBING RANGE [70023]	NT
Defence - MT GOODWIN RADAR SITE [70063]	NT
Defence - Patrol Boat Base (DARWIN NAVAL BASE) [70041]	NT
Defence - QUAIL ISLAND BOMBING RANGE [70003]	NT
Defence - RAAF BASE DARWIN [70073]	NT
Defence - SHOAL BAY RECEIVING STATION [70037]	NT
Defence - STOKES HILL OIL FUEL INSTALLATION [70035]	NT
Defence - WINNELLIE TWO [70077]	NT
Defence - Defence Housing Authority	
Commonwealth Land - Director of Property Services Defence Estate [70856]	NT
Commonwealth Land - Director of Property Services Defence Estate [70855]	NT
Environment and Heritage	
Commonwealth Land - Kakadu National Park [70850]	NT
Finance and Administration	
Commonwealth Land - Department of Administrative Services [70091]	NT
Commonwealth Land - Department of Administrative Services [70590]	NT
Immigration and Multicultural and Indigenous Affairs - Department of Immigration Local Government and Ethnic Affairs	
Commonwealth Land - Department of Immigration Local Government & Ethnic Affairs [70336]	NT
Transport and Regional Services	
Commonwealth Land - Department of Transport & Regional Development [70207]	NT
Unknown	

Commonwealth Land Name	State
Commonwealth Land - [70335]	NT
Commonwealth Land - [70337]	NT
Commonwealth Land - [70995]	NT
Commonwealth Land - [70993]	NT
Commonwealth Land - [70090]	NT
Commonwealth Land - [70593]	NT
Commonwealth Land - [70203]	NT
Commonwealth Land - [70591]	NT
Commonwealth Land - [70327]	NT
Commonwealth Land - [70204]	NT
Commonwealth Land - [70205]	NT
Commonwealth Land - [70206]	NT
Commonwealth Land - [70447]	NT

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Historic		
Larrakeyah Barracks Headquarters Building	NT	Listed place
Larrakeyah Barracks Precinct	NT	Listed place
Larrakeyah Barracks Sergeants Mess	NT	Listed place
RAAF Base Commanding Officers Residence	NT	Listed place
RAAF Base Precinct	NT	Listed place
RAAF Base Tropical Housing Type 2	NT	Listed place
RAAF Base Tropical Housing Type 3	NT	Listed place

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area overfly marine area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting known to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area overfly marine area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area
Limnodromus semipalmatus Asian Dowitcher [843]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area overfly marine area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area overfly marine area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding likely to occur within area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa incana as Heteroscelus incanus Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area overfly marine area
Fish		

Scientific Name	Threatened Category	Presence Text
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
[Trachyrhamphus longirostris](#) Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammal		
[Dugong dugon](#) Dugong [28]		Species or species habitat known to occur within area
Reptile		
[Aipysurus duboisii](#) Dubois' Sea Snake, Dubois' Seasnake, Reef Shallows Sea Snake [1116]		Species or species habitat may occur within area
[Aipysurus laevis](#) Olive Sea Snake, Olive-brown Sea Snake [1120]		Species or species habitat may occur within area
[Aipysurus mosaicus as Aipysurus eydouxii](#) Mosaic Sea Snake [87261]		Species or species habitat may occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Breeding known to occur within area
[Crocodylus johnstoni](#) Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
[Crocodylus porosus](#) Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
[Emydocephalus annulatus](#) Eastern Turtle-headed Sea Snake [1125]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrelaps darwiniensis Port Darwin Sea Snake, Black-ringed Mangrove Sea Snake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Sea Snake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Cogger's Sea Snake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area
Hydrophis hardwickii as Lapemis hardwickii Spine-bellied Sea Snake [93516]		Species or species habitat may occur within area
Hydrophis inornatus Plain Sea Snake [1107]		Species or species habitat may occur within area
Hydrophis kingii as Disteira kingii Spectacled Sea Snake [93511]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli MacDowell's Sea Snake, Small-headed Sea Snake, [75601]		Species or species habitat may occur within area
Hydrophis major as Disteira major Olive-headed Sea Snake [93512]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Sea Snake, Ornate Reef Sea Snake [1111]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hydrophis pacificus Pacific Sea Snake, Large-headed Sea Snake [1112]		Species or species habitat may occur within area
Hydrophis peronii as Acalyptophis peronii Horned Sea Snake [93509]		Species or species habitat may occur within area
Hydrophis platura as Pelamis platurus Yellow-bellied Sea Snake [93746]		Species or species habitat may occur within area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area
Hydrophis zweiffei as Enhydrina schistosa Australian Beaked Sea Snake [93514]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Arafura Smooth Sea Snake, Northern Mangrove Sea Snake [1090]		Species or species habitat may occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa sahulensis Australian Humpback Dolphin [87942]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Commonwealth Reserves Terrestrial [Resource Information]

Name	State	Type
Kakadu	NT	National Park (Commonwealth)

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles [Resource Information]

Scientific Name	Behaviour	Presence
Aug - Sep		
Natator depressus		
Flatback Turtle [59257]	Nesting	Known to occur
Dec - Jan		
Chelonia mydas		
Green Turtle [1765]	Nesting	Known to occur
Dermochelys coriacea		
Leatherback Turtle [1768]	Nesting	Known to occur
May - Jul		
Lepidochelys olivacea		
Olive Ridley Turtle [1767]	Nesting	Known to occur

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Casuarina	Coastal Reserve	NT
Charles Darwin	National Park	NT
Djukbinj	National Park	NT

Protected Area Name	Reserve Type	State
Garig Gunak Barlu	National Park	NT
Garig Gunak Barlu	Marine Park	NT
Mary River	National Park	NT

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Adelaide River Floodplain System	NT
Cobourg Peninsula System	NT
Finniss Floodplain and Fog Bay Systems	NT
Kakadu National Park	NT
Mary Floodplain System	NT
Port Darwin	NT

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Bayview, The Boulevarde, Darwin, NT	2015/7466		Assessment
Berrimah Freight Terminal Expansion Project	2024/09847		Referral Decision
Clarence Strait Offshore Tidal Energy Project	2008/4660		Assessment
Darwin Pipeline Duplication (DPD) Project	2022/09372		Post-Approval
Darwin Pipeline Duplication DPD Project	2022/9166		Completed
Darwin Ship Lift Project	2021/9068		Post-Approval
East Arm Marine Industry Park, Darwin, NT	2014/7318		Completed
Establishment and operation of a refinery at Darwin, NT	2015/7604		Assessment
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia West	2024/09826		Referral Decision
Proposed City of Weddell	2011/6090		Assessment

Controlled action

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Augmentation of the East Point Effluent Rising Main and Extension of East Point Outfall	2009/5113	Controlled Action	Post-Approval
Barramundi Nursery Farm	2005/2378	Controlled Action	Completed
Bonaparte Liquified Natural Gas Project	2011/6141	Controlled Action	Post-Approval
Condensate Processing Facility, East Arm	2006/2734	Controlled Action	Proposed Decision
Darwin to Moomba Gas Pipeline	2001/213	Controlled Action	Completed
Development of Blacktip Gas Field	2003/1180	Controlled Action	Post-Approval
East Arm Wharf Expansion Works	2010/5304	Controlled Action	Post-Approval
Glyde Point and Middle Arm Peninsula Infrastructure Support	2001/334	Controlled Action	Completed
Glyde Point Industrial Estate	2001/336	Controlled Action	Completed
Glyde Point Industrial Estate and Associated Infrastructure	2004/1506	Controlled Action	Completed
Hardwood Plantation	2001/229	Controlled Action	Post-Approval
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Kilimiraka Mineral Sands and Associated Infrastructure (Bathurst Island), NT	2012/6587	Controlled Action	Assessment Approach
Lee Point Master-planned urban development, Darwin, NT	2015/7591	Controlled Action	Post-Approval
Methanol Plant	2001/195	Controlled Action	Completed
Middle Arm Peninsula Industrial Area Development	2001/339	Controlled Action	Completed
Mt Peake iron, vanadium and titanium mining project & assoc infrastructure, 280kms NNW Alice Springs	2013/7027	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Muirhead Subdivision	2010/5525	Controlled Action	Post-Approval
Operation of 17 Tiger Helicopters at Robertson Barracks	2004/1459	Controlled Action	Post-Approval
Port Patterson Barramundi Sea Cage Farm	2005/2149	Controlled Action	Completed
Replacement of the East Point Outfall	2011/6099	Controlled Action	Assessment Approach
Residential subdivision of Lot 9793 (formerly Lots 9774 and 9779) Lee Point Road	2005/2108	Controlled Action	Post-Approval
Shipping Channel Enhancement	2010/5431	Controlled Action	Completed
Talisman Saber 2005 Military Exercise	2004/1819	Controlled Action	Post-Approval
Trans-territory Gas Pipeline	2003/1186	Controlled Action	Completed
Tropical Tidal Testing Centre, Clarence Strait, 50km NE Darwin	2014/7299	Controlled Action	Guidelines Issued
Not controlled action			
2D seismic survey, exploration permit NT/P67	2004/1587	Not Controlled Action	Completed
2D Seismic Survey in Permit Areas WA-318-P & WA-319-P, near Cape Londonderry	2004/1687	Not Controlled Action	Completed
Channel Island Bridge Pipeline Replacement Project	2020/8672	Not Controlled Action	Completed
Construction and operation of Radar Infrastructure	2004/1406	Not Controlled Action	Completed
Cox Peninsular Remediation Project, NT	2015/7587	Not Controlled Action	Completed
Crowley Government Services Inc Bulk Fuel Storage Facility	2021/9015	Not Controlled Action	Completed
Darwin Port Maintenance Dredging, Darwin Harbour, NT	2017/8122	Not Controlled Action	Completed
Darwin ship lift facility and marine industries project, Darwin Harbour NT	2018/8195	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Nexus Drilling Program NT-P66	2007/3745	Not Controlled Action	Completed
Project Sea Dragon Stage 1 Hatchery - Gunn Point, NT	2017/8092	Not Controlled Action	Completed
Residential Complex - Lots 6575 and 6576	2001/163	Not Controlled Action	Completed
Waterfront Redevelopment	2003/1256	Not Controlled Action	Completed
Wickham Point Interconnect Gas Pipeline	2008/4309	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D and 3D Seismic Survey	2011/6197	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2008/4133	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2009/5104	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey within permit area WA-318-P	2007/3879	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2009/4681	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 2D & 3D marine seismic survey	2011/5962	Not Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		(Particular Manner)	
Bonaparte Basin Seabed Mapping Survey	2009/4951	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Seismic and Bathymetric Survey	2012/6295	Not Controlled Action (Particular Manner)	Post-Approval
Dredging the outer shipping channels of Darwin Harbour	2013/6988	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval
Fishburn2D Marine Seismic Survey	2012/6659	Not Controlled Action (Particular Manner)	Post-Approval
Floyd 3D and Chisel 3D Seismic Surveys	2011/6220	Not Controlled Action (Particular Manner)	Post-Approval
Gold 2D Marine Seismic Survey Permit Areas WA375P and WA376P	2009/4698	Not Controlled Action (Particular Manner)	Post-Approval
Joseph Bonaparte Gulf Seabed mapping survey	2010/5517	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Marine Environmental Survey 2012	2012/6310	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
NT/P77 3D Marine Seismic Survey	2009/4683	Not Controlled Action (Particular Manner)	Post-Approval
NT/P80 2010 2D Marine Seismic Survey	2010/5487	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Petrel MC2D Marine Seismic Survey	2010/5368	Not Controlled Action (Particular Manner)	Post-Approval
Removal of Potential Unexploded Ordnance within NAXA	2012/6503	Not Controlled Action (Particular Manner)	Post-Approval
Santos Petrel-7 Offshore Appraisal Drilling Programme (Bonaparte Basin)	2011/5934	Not Controlled Action (Particular Manner)	Post-Approval
Sonar and Acoustic Trials	2001/345	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
Phillips Petroleum Wickham Point LNG facility	2001/391	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Sahul Shelf	North-west

Name	Region
Carbonate bank and terrace system of the Van Diemen Rise	North
Pinnacles of the Bonaparte Basin	North-west
Pinnacles of the Bonaparte Basin	North

Biologically Important Areas		[Resource Information]
Scientific Name	Behaviour	Presence
Dolphins		
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Breeding	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Breeding	Known to occur
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Breeding	Known to occur
Marine Turtles		
Caretta caretta Loggerhead Turtle [1763]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Internesting	Likely to occur
Dermochelys coriacea Leatherback Turtle [1768]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting	Likely to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Likely to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Natator depressus Flatback Turtle [59257]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Internesting buffer	Known to occur
Seabirds		
Onychoprion anaethetus Bridled Tern [82845]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding (high numbers)	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Attachment 3 Summary of management actions, performance standards and measurement criteria

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA01	Intertidal and shoreline construction is in pre-disturbed area (DLNG footprint) with no public access	Contractor provides post-construction survey / out-survey showing all intertidal and shoreline construction was completed within the pre-disturbed area (DLNG footprint, as provided by Santos)	Post-construction survey / out-survey record
DPD-MA02	Installation of the pipeline within pre-agreed route, with no incursions into the shipping channel (as defined in consultation with the regional harbour master)	Vessel masters and relevant crew from relevant vessels (those engaged in construction) complete the vessel Masters Awareness training to make them aware of the requirement for no incursions into the shipping channel.	Record of completed vessel Masters Awareness training
		Vessel navigation systems (those engaged in construction) show the shipping channel.	Record of compliant Vessel navigation systems
		Contractor to provide Out-Survey or Post-construction survey to show no excursions outside of the defined pipeline route (except in an emergency)	Out-Survey or Post-construction survey record
DPD-MA03	Anti-snag protection for mechanical support structures	Engineering Records and Figures / Design drawings and reports showing anti-snag protection on mechanical support structures	Engineering Records and Figures / Design drawings and reports
DPD-MA04	Activity vessels equipped and crewed in accordance with Australian maritime requirements	Records or pre-mob inspection showing: • a valid (in-date) Minimum Safe Manning Certificate that shows all master, mate and watchkeeper officer duties undertaken by crew meet the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requirements.	Records or pre-mob inspection
		Records or pre-mob inspection showing:	Records or pre-mob inspection

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		•A Vessel Cargo Ship Safety Equipment Certificate to demonstrate lights and signals as applicable to vessel class per COLREGS requirements.	
		Records or pre-mob inspection showing: •Global Maritime Distress and Safety System (GMDSS) radio logbook as required by Marine Order 27 •radio equipment available, working and tested at regular intervals? •electronic and paper based charts are available on the bridge?	Records or pre-mob inspection
		Records or pre-mob inspection showing: •records of crew STCW qualifications, or •a copy of the Masters Standing Orders demonstrating safe manning	Records or pre-mob inspection
DPD-MA05	Development and implementation of communication plan (including applicable notifications) for relevant stakeholders (including recreational and commercial fishing bodies and tourism operations) to minimise adverse impacts on other marine users	Stakeholder Consultation Records, in accordance with the communication plan	Stakeholder Consultation Records
DPD-MA06	Implementation of cautionary zones around DPD Project vessel to mitigate against adverse interactions	Records show that a Notice to Mariners is issued prior to construction commencing and includes information outlining that a cautionary/safety exclusion zone is in place around all construction vessels.	Records of Notice to Mariners
DPD-MA07	One vessel will act as a surveillance vessel within the Project Area during gas export pipeline installation and trenching activity	Evidence (DPRs or other method) to demonstrate there is always at least one vessel acting as a surveillance vessel to implement the cautionary/safety exclusion zone around construction vessels (dredging and pipelay vessels only)	DPRs or other method
DPD-MA08	The proposed pipeline route will be marked on marine charts, in the same way that the existing pipelines are gazetted and marked on marine charts	Evidence that pipeline as-built transmitted to AHO for inclusion on Marine Charts	Record of transmittal to AHO

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA09	Construction activities undertaken in accordance with Santos HSE management and marine vessel vetting processes	Evidence that a Santos approved HSEMP (or equivalent) is in place	Santos approved HSEMP
DPD-MA10	Causeway/s will be temporary structure/s and will be removed following trenching and pipeline installation	Pre-construction survey of causeway areas is conducted. Out-Survey or Post- construction survey demonstrating the seabed profile has been returned to its original state following removal of causeways.	Pre-construction survey and out-survey or post-construction survey reports
DPD-MA11	Pipeline will not be installed in the vicinity of the jewfish aggregation area within the Charles Point Wide RFPA	Santos to demonstrate that they have provided DVO/Allseas with the necessary shapefiles and drawings to ensure all requirements related to exclusion zones, sensitive areas, the Project Area and other key project info are available	Transmittal records to DVO/ Allseas
FDPD-MA12	Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry)	Evidence that vessels engaged in construction (Trenching, stabilisation and freespan correction/ prevention) have a means of maintaining positional accuracy measures (e.g., DGPS, survey capability).	Record demonstrating means of maintaining positional accuracy
DPD-MA13	Overflow from the TSHD will be undertaken through the adaptive management processes There will be 'environmental valve', 'green valve' where available (attached to O/F to reduce air entrained, to reduce billowing and facilitates sediment sinking) as standard which will be used as a first step	Evidence that Contractor has either developed or adopted an adaptive management processes that aligns with the TSDMMP for overflow.	Evidence of adaptive management process
DPD-MA14	Standard operating procedure for spoil disposal will be used	Evidence of a Spoil Disposal SOP Spoil disposal logs demonstrate that disposal occurred as per SOP for spoil disposal - e.g. sample of daily reports	Spoil disposal SOP and spoil disposal logs

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA15	Spoil will not be disposed of in a single location, to avoid developing a single large mound	Spoil disposal logs demonstrate that disposal did not occur in a single location	Spoil disposal logs
DPD-MA16	Spoil will only be placed *in situ* within a short section of trenching within intertidal zones to keep wet under most tidal conditions and will be removed subsequently where accessible by BHD and SHB for offshore disposal	Spoil disposal logs demonstrate that disposal in the intertidal areas removed by the BHD and SHB, if not removed via natural processes	Spoil disposal logs
DPD-MA17	When available, the base case is for the DP pipelay vessel to be used to install as much of the pipeline as depth allows. DP vessel can be used in deeper water from KP23 (Territorial water boundary) to ~KP91.5 where the shallow water pipelay (<20 m) and associated anchoring will begin	Installation procedures base case for DP vessel use in deeper waters from KP91.5 to KP23.	Installation procedures
DPD-MA18	Anchor management plans will be developed to allow safe anchoring of vessels undertaking pipelay, trenching, rock installation and other support activities in the vicinity of sensitive habitats and nearshore heritage or sacred sites	Anchor management plans are developed by Contractor that includes restriction zones and areas identified as sensitive habitats and nearshore heritage or sacred sites	Anchor management plans
DPD-MA19	Trained and competent anchor handling operators will be used	Evidence (e.g., training records) that anchor handling operators are trained in accordance with industry standards.	Evidence (e.g., training records)
DPD-MA20	Anchors exclusion areas will be implemented to avoid sensitive habitats and heritage sites	Evidence that drawings and shapefiles (showing anchor exclusion zones and sensitive habitats and nearshore heritage or sacred sites) provided by Santos are included on primary construction vessel navigation systems	Evidence from primary construction vessel navigation systems

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		Vessel masters and relevant crew from relevant vessels complete the Vessel Masters Awareness training to make them aware of the anchor exclusion zones and anchoring restrictions	Vessel Masters Awareness training records
DPD-MA21	Objects identified as cultural heritage objects that cannot be avoided will be managed as per NT Heritage Branch requirements	In the event that any cultural heritage objects are identified within the Project Area, evidence is to be provided that Contractor managed them in accordance with the Unexpected Finds Protocol (BAS-201-0051) and NT Heritage Branch requirements.	Contractor evidence of compliance
DPD-MA22	Differential global positioning system (DGPS) will be used on the pipelay vessels to maintain accurate vessel position during installation	Factual Statement or similar for the Pipelay vessel (Audacia) demonstrates that the vessel passed tests for operating on DP and DGPS.	Factual Statement or similar
DPD-MA23	DGPS used to confirm ILT foundation structure position during installation Underwater positioning system (USBL/ transponders) and ROV to confirm installation location and positioning (within required location accuracy to reduce disturbance to the seabed)	Confirmation that construction vessels installing the ILT structure has DGPS, survey capability and ROV equipment spreads	Confirmation of DGPS, survey capability and ROV equipment spreads
		As built records demonstrate the ILT foundation structure was installed as designed	As built records
DPD-MA24	Installation plan will be developed and include: + requirement for trained and experienced vessel crews + pipe to be installed in trench as per approved design	An approved Installation Plan that includes the following two requirements: requirement for trained and experienced vessel crews pipe to be installed in trench as per approved design	Approved Installation Plan
DPD-MA25	Span-specific rectification plans developed that include: + pre-span method selection	Span-specific rectification plans in place and include : + Pre-span method selection + Real-time monitoring of span-rectification	Span-specific rectification plans

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	+ real-time monitoring of span rectification + post-rectification inspections	+ Post-rectification inspections	
DPD-MA26	Permanent rock installation will be limited to only those pipeline sections requiring stabilization and/or anchor protection, as informed by a quantitative risk assessment	Evidence (post-construction surveys) provided to determine that permanent rock installation was limited to only those pipeline sections requiring stabilization and/or anchor protection, as determined by the quantitative risk assessment carried out by Santos.	Post-construction survey report
DPD-MA27	Causeway/s will be temporary structure/s and will be removed following trenching and pipeline installation	Pre-construction survey of causeway areas Out-Survey or Post- construction survey demonstrating the seabed profile has been returned to its original state following removal of causeways	Pre-construction survey and out-Survey or post-construction survey report
DPD-MA28	Adaptive management process will be implemented as defined within the TSDMMP (BAS-210 0023) which will include environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels	If Level 2 water quality triggers are exceeded, or if coral temperature triggers are exceeded, evidence is to be provided illustrating Contractor implemented the Adaptive Management Process as defined within the TSDMMP (BAS-210 0023), Table 8-6. Specifically, implementation of the requirements in DPD-RMA04 need to be documented	Contractor evidence demonstrating compliance
		If Level 3 water quality triggers are exceeded, evidence is to be provided illustrating Contractor implemented the Adaptive Management Process as defined within the TSDMMP (BAS-210 0023), Table 8-6. Specifically, implementation of the requirements in DPD-CMA01 need to be documented	Contractor evidence demonstrating compliance
DPD-MA29	Continuous monitoring of anchor wire tensions to prevent anchor drag on seabed and wire length measurement of the winch will be monitored to prevent anchor drag	Anchor wire calibration records are provided for each vessel using anchors for installation	Anchor wire calibration records
		Evidence (system report or otherwise) demonstrating that anchor wire tension and measurements of exact wire length are continuous	Contractor evidence (system report or

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		throughout construction activities for each vessel using anchors for installation.	otherwise) demonstrating compliance
DPD-MA30	Pre-lay surveys will confirm the nature of the seabed within the ILT foundation location to ensure the structure is installed on bare area of the seabed. Post-lay surveys will allow verification of the impact assessment.	Evidence of pre-lay survey been completed prior to ILT foundation structure installation to confirm seabed nature	Pre-lay and post-lay survey records
		Evidence of post-lay survey been completed following ILT foundation structure installation to confirm structure was installed on a bare area of seabed	
DPD-MA31	Where practicable rock installation will not exceed seabed level within practical installation tolerances.	Evidence (pre-construction surveys) show natural seabed level with vicinity of areas planned for rock installation	Pre-construction survey records
		Evidence (system report or otherwise) demonstrating that anchor wire tension and measurements of exact wire length are continuous throughout construction activities for each vessel using anchors for installation	Contractor evidence (system report or otherwise)
DPD-MA32	Restrict disturbance to within the onshore Project Area and existing DLNG site area	Excavation logs demonstrate that all disturbance is in previously disturbed areas within the DLNG site	Excavation logs
DPD-MA33	Establish appropriate access restrictions into the onshore Project Area	Contractor to provide evidence (site plans/layout drawings, management plans, security / access management plans and/or records) to demonstrate that public access is restricted within the intertidal and shoreline construction pre-disturbed area (DLNG footprint, as provided by Santos)	Contractor evidence (site plans/layout drawings, management plans, security / access management plans and/or records)
DPD-MA34	Direct stormwater runoff from the open trench to filter through the rock causeway, when present	Completed Contractor Onshore Environmental Checklists that demonstrate that stormwater runoff was directed from the open trench to filter through the rock causeway, when present	Completed Contractor Onshore Environmental Checklists
DPD-MA35	Install geotextiles under primary construction area (i.e., site pad)	Site pad design drawings or construction records demonstrating geotextiles were installed under primary construction area.	Site pad design drawings or construction records

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA36	Return area to natural grade to match existing topography	Evidence (onshore pre-construction surveys) show natural grade and topography on DLNG onshore site.	Contractor evidence (onshore pre-construction surveys)
		Evidence (onshore post-construction surveys) provided to determine that the DLNG onshore site was returned natural grade and topography (within practical installation tolerances).	Contractor evidence (onshore post-construction surveys)
DPD-MA37	All personnel to complete the DLNG HSE site induction	Evidence that DVO develop a mandatory project induction, which will detail CEMP requirements, including DLNG HSE requirements	Project induction records
		Induction records matched against DLNG personnel manifest/register that demonstrates all personnel have completed the induction	DLNG personnel manifest/register
DPD-MA38	Maintain batters or install fauna ladders on trench entry and exit to allow fauna to exit the trench	Completed Contractor Onshore Environmental Checklists that demonstrate that batters were maintained, trenches allowed for escape via open ends or fauna ladders were installed on trench entry and exit to allow fauna to exit the trench	Completed Contractor Onshore Environmental Checklists
DPD-MA39	Implement ASS and groundwater management and monitoring requirements within the Acid Sulphate Soils and Dewatering Management Plan (BAS-210-0049). The ASSDMP includes requirements for: + Soil stockpiling, laboratory testing and treatment, dependent upon location of work and encountering of ASS + Groundwater laboratory testing and treatment, if groundwater is reached + Maintenance of testing and inspection records	Evidence that Contractor have meet the performance indicators outlined in Table 9-1 of ASSDMP (BAS-210-0049). This needs to be documented throughout the treatment process	Contractor evidence

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA40	Plan onshore works to minimise the amount of time soil is exposed to the air	Contractor correspondence evidence that the time soil is exposed to air has been considered and minimised during-onshore works	Contractor correspondence records
DPD-MA41	Trench inspections to be performed daily to check for trapped wildlife	Completed Contractor Onshore Environmental Checklists that demonstrate that daily checks for trapped wildlife were completed	Completed Contractor Onshore Environmental Checklists
DPD-MA42	Insert caps on ends of pipe if the pipe is to be unattended for periods >12 hours; to prevent fauna ingress	Completed Contractor Onshore Environmental Checklists that demonstrate end caps were inserted on the ends of Barossa pipe if the pipe is to be unattended for periods >12 hours to prevent fauna ingress	Completed Contractor Onshore Environmental Checklists
DPD-MA43	Ensure any native vertebrates injured by DPD construction activities are referred to an appropriate wildlife carer group or veterinarian	Injured/deceased fauna register that provides a register of all project related incidents involving native fauna and any actions taken (including referring reporting to DLNG for referral to an appropriate wildlife carer group or veterinarian)	Injured/deceased fauna register
DPD-MA44	Limit vehicles to access roads, prepared site pad or defined boundaries within the onshore Project Area/DLNG disturbance	Evidence (induction content, site safety management plans) demonstrate that vehicles are limited to access roads, prepared site pad or defined boundaries within the onshore Project Area/DLNG disturbance	Contractor evidence (induction content, site safety management plans)
DPD-MA45	Use water truck for dust suppression	Completed Contractor Onshore Environmental Checklists that demonstrate that water trucks were used for dust suppression	Completed Contractor Onshore Environmental Checklists
DPD-MA46	Establish and implement vehicle speed controls	Evidence (induction content, site safety management plans) demonstrate that a speed limit for vehicles has been established	Contractor evidence (induction content, site safety management plans)
		Evidence (IVMS or similar) to demonstrate that speed limit requirements were implemented.	Contractor evidence (IVMS or similar)

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA47	Wet parking area will be monitored daily, with photographs taken	Completed Contractor Onshore Environmental Checklists that demonstrate that wet parking area was monitored daily, and photographs were taken	Completed Contractor Onshore Environmental Checklists
DPD-MA48	Observation and shut-down zones for marine fauna have been developed based on noise modelling results and standard protocols	DPD Project Marine Megafauna Noise Management Plan (BAS-210 0045) shows how underwater noise modelling results have informed observation and shutdown zones.	DPD Project Marine Megafauna Noise Management Plan (BAS-210 0045)
DPD-MA49	Vessel inductions for all crew will address marine fauna risks and the required management controls	Evidence that Contractor has developed a mandatory project induction, which will detail CEMP requirements, including marine fauna risks and the required management controls	Contractor mandatory project induction
		Induction records matched against crew lists that demonstrates all personnel have completed the induction	Induction records
DPD-MA50	Vessel and helicopter contractor procedures will comply with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interaction with marine fauna	Contractor HSEMP (or similar) details the management measures for interactions, which comply with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000	Contractor HSEMP (or similar)
DPD-MA51	Personnel trained in MFO will be present on pipelay, dredge and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times	Vessel masters and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the requirement to have one crew member with MFO training on the bridge at all times, during daylight hours	vessel Masters Awareness training records
		Evidence to demonstrate at least one crew with MFO is always onboard a relevant vessel (e.g., MFO training records and crew lists)	MFO training records and crew lists
		MFO records with MFO sign-on log that clearly demonstrate the MFO was on the bridge at all times during daylight hours	MFO records with MFO sign-on log

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA52	All marine fauna interactions and observations will be appropriately recorded and reported to DEPWS/NT EPA and DCCEEW as required	Evidence of completed MFO record keeping (logs) including fauna observations and interactions provided to DPEWS/NT EPA and DCCEEW.	MFO record keeping (logs)
DPD-MA53	Soft-start procedures for rock breaking (BHD) for night-time activities where observation is not possible	Evidence that Soft-start procedures for rock breaking (BHD) were implemented for night-time activities where observation is not possible	Evidence of soft-start procedures implemented
DPD-MA54	Vessels will adhere to Port of Darwin vessel speed limits	Vessel masters, and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the Port of Darwin vessel speed limits	Vessel Masters Awareness training records
DPD-MA55	Maintenance of vessel, helicopter, vehicle and equipment combustions engines and vessel incinerators as per planned maintenance system	A Vessel Environmental Pre-mobilisation Inspection for each vessel that confirms a planned maintenance system (PMS) is in place and that it is accurate, up to date, effective and maintained in accordance with the requirements of the ISM Code and the Operator's procedures.	Vessel Environmental Pre-mobilisation Inspection record demonstrates that the performance standard is being met.
		Documented maintenance program is in place for helicopters used on the Activity.	Records confirm a maintenance program is in place and adhered to for helicopters used on the Activity.
DPD-MA56	Observation and shut-down zones for marine fauna have been developed based on noise modelling results for trenching and standard protocols and include: + Observation (150 m) and exclusion (50 m) zones for marine mammals and turtles.	Vessel masters, MFOs and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the Marine Megafauna Observation and Adaptive Management Protocols as outlined within the Marine Megafauna Noise Management Plan (BAS-210 0045).	Vessel Masters Awareness training records
		Evidence that the Marine Megafauna Observation and Adaptive Management Protocols are clearly displayed on the vessel bridge.	Evidence of Adaptive Management Protocols display

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	+ Observation zone monitored for 10 minutes prior to commencing trenching during daylight only. + A Marine Megafauna Observation and Adaptive Management Protocol for routine trenching operations, including the use of Xcentric Ripper tool, is to be followed as per the MMNMP (BAS-210 0045)	For routine trenching activities, including the use of Xcentric Ripper tool, evidence that the Marine Megafauna Observation and Adaptive Management Protocols were followed.	Evidence of Marine Megafauna Observation and Adaptive Management Protocol compliance
DPD-MA57	Soft start (ramp-up) of hydraulic tools (rock breaking) by BHD Soft start (ramp-up) of trenching equipment, where practicable, will apply to the BHD, CSD and TSHD	For routine trenching activities, evidence that the soft start procedures were implemented, where practicable. For rock breaking tools, evidence that soft start procedures were implemented.	Evidence of soft-start procedures implemented
DPD-MA58	Pipelay vessels will have enclosed pipe welding decks	Vessel specs or photograph that can demonstrate that the pipelay vessel has an enclosed pipe welding deck.	Vessel specs or photograph
DPD-MA59	Shielding, where practicable, and/or orienting operational lights (excluding navigational lighting) on vessels to limit light spill to the environment	Vessel Masters, and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the Project lighting requirements	Vessel Masters Awareness training records
		Induction records matched against crew lists that demonstrates all personnel have completed the induction	Induction records and crew lists
		Vessel premobilisation inspections confirm that lighting orientation has been adjusted to face inward toward the vessel and shields installed within limitations.	Vessel premobilisation inspection records
DPD-MA60	Housekeeping measures will be adopted, including requiring all crew to keep shutters on windows closed at night, to limit light emissions from vessels	Vessel Masters, and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the Project lighting requirements	Vessel Masters Awareness training records
		Induction records matched against crew lists that demonstrates all personnel have completed the induction	Induction records and crew lists

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		Vessel execution inspections confirm that housekeeping to limit light emissions from vessels, such as shutters on windows being closed at night, are in place to minimise light spill from vessels	Vessel execution inspections records
DPD-MA61	Vessel searchlights will only be operated in an emergency situation	Vessel Masters, and relevant crew from relevant vessels complete the vessel Masters Awareness training to make them aware of the Project lighting requirements	Vessel Masters Awareness training records
		Induction records matched against crew lists that demonstrates all personnel have completed the induction	Induction records and crew lists
		Vessel execution inspections confirm that search lights were not used during routine operations.	
DPD-MA62	Santos will document vessel light spill on Darwin Harbour turtle nesting beaches as part of the DPD Project's environmental monitoring program	Monitoring reports evidence that Project vessel light spill on Darwin Harbour turtle nesting beaches has been documented.	Vessel execution inspections records
DPD-MA63	Vessels will comply with relevant regulatory requirements under *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and *Navigation Act 2012* with respect to planned discharges and waste management, including: Marine Order 91 – Marine Pollution Prevention: Oil, which implements Annex I of the MARPOL Marine Order 95 – Marine Pollution Prevention: Garbage, which implements Annex V of the MARPOL Marine Order 96 – Marine Pollution Prevention: Sewage, which implements Annex IV of the MARPOL Vessels will comply with Port of Darwin requirements for discharges.	For vessels >400GT, evidence of a valid (in-date) International Oil Pollution Prevention (IOPP) Certificate	Valid (in-date) International Oil Pollution Prevention (IOPP) Certificate
		For vessels >400GT, evidence that the IOPP Certificate includes a Supplement to the IOPP that indicates that the vessel has an approved oil / water separator (OWS) with online monitoring calibrated to discharge at less than 15 ppm oil in water (OIW)	IOPP Certificate
		Evidence the vessel maintained an oil record book, and discharge of bilges or transfer from a bilge holding tank to overboard through the OWS this equipment should be recorded in the oil record book	Oil record book
		For vessels >400GT, evidence of a valid (in-date) International Sewage Pollution Prevention (ISPP) Certificate. ISPP confirms a MARPOL approved STP is in use	Valid (in-date) International Sewage

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	Vessel will comply with *Marine Pollution Act 1999* (NT) and the *Waste Management and Pollution Control Act 1998* (NT) with respect to planned discharges		Pollution Prevention (ISPP) Certificate
		If the vessel doesn't have a MARPOL approved STP and instead uses a comminuted and disinfecting system: During execution checks of the official Log Book (or similar) to demonstrate that discharge locations and volumes recorded and verifies that discharge occurred at a distance of more than 3 NM from 'nearest land' (territorial sea baseline)(i.e. outside of NT waters)	Official Log Book (or similar)
DPD-MA64	Vessels will comply with relevant Marine Orders, including Marine Order 95 – Marine Pollution Prevention: Garbage, and any other applicable regulatory requirements relevant to garbage management	If the vessel is >400 GT (or vessels certified to carry 15 or more people engaged in international voyages), evidence that a garbage record book is maintained, current and includes the types and volumes of waste incinerated, discharged or disposed of onshore	Garbage record book
		If the vessel is >100 GT, or vessels certified to carry 15 or more people, evidence that a garbage management plan is in place that includes procedures for handling, storage segregation and disposal of wastes.	Garbage management plan
		For vessels of 12 metres or more in length, evidence that placards (or stickers) advise the crew and passengers of the rules related to the discharge of garbage into the sea and are displayed on the vessel where they are visible for both crew and passengers.	Placards (or stickers)
		If a macerator is in use, the vessel Execution Inspection confirms: • Macerator specifications confirm food scraps are passed through a screen with no opening wider than 25 mm	Vessel Execution Inspection record
		If a macerator is in use, the vessel Execution Inspection confirms: • the Garbage Record Book confirms food waste comminuted or ground is discharged no greater than 3 NM to 'nearest land' (territorial sea baseline)(i.e. outside of NT waters)	Vessel Execution Inspection record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA65	Santos Marine Assurance Process	Completed Santos marine assurance process for all vessels on the project to ensure all contracted vessels are operated, maintained and crewed in accordance with Santos and industry standards, and regulatory requirements	Santos marine assurance process records
DPD-MA66	Protection/screening of abstraction hose end to prevent fauna entrainment during water winning activities	Evidence (design drawings / photographs) demonstrate that protection/screening is installed on abstraction hose end	Evidence (design drawings / photographs)
DPD-MA67	Backflush water will be discharge onto existing disturbed shore crossing construction site so that it drains into the intertidal area and solids disperse with tidal movement, minimising turbidity effects	Evidence that backflush water will be discharged onto existing disturbed, shore crossing construction site during pipeline pre-commissioning	Evidence showing backflush water discharge location
DPD-MA68	Where possible, and dependant on the progress of shore crossing rock installation at time of FCGT activities, backflush water will be discharged onto installed rock, to baffle the flow of discharged backflush water	If possible, evidence that backflush water will be discharged onto installed rock during pipeline pre-commissioning	Evidence showing backflush water discharge location
DPD-MA69	Atmospheric emissions from combustion, incinerators and ODS managed in accordance with standard maritime practice (MARPOL). MARPOL standards include no incineration in harbour.	If the vessel is > 400 GT, records or evidence of a valid (in-date) International Air Pollution Prevention (IAPP) Certificate	Valid (in-date) International Air Pollution Prevention (IAPP) Certificate
		An Engine International Air Pollution Prevention (EIAPP) certificate(s) and supporting technical file for all of its applicable diesel engines. This may be included on the IAPP or be standalone.	Engine International Air Pollution Prevention (EIAPP) certificate(s)
		If the vessel is > 400 GT, records or evidence of a valid (in-date) International Energy Efficiency Certificate	Valid (in-date) International Energy Efficiency Certificate

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		If the vessel is >400 GT and has an IEE certificate issued, a SEEMP is maintained onboard the vessel Note: ships without means of propulsion (such as barges, rigs) are excluded from the ships required to keep on board a SEEMP	Ship Energy Efficiency Management Plan (SEEMP)
		If the ship has ozone depleting substances (e.g., Halons and CFCs) equipment onboard (e.g., air conditioners, fire suppression systems, refrigeration systems) evidence to be supplied showing the vessel maintains adequate records on the ODS recharge, discharge (accidental and planned) and maintenance and repair in the ODS Record Book	ODS Record Book
		During the Vessel Environmental Pre-mobilisation inspection: IMO type approval certificate for each incinerator in use. Note this info is also contained on the Supplement to International Air Pollution Prevention Certificate	Vessel Environmental Pre-mobilisation inspection record
		During the Vessel Environmental Execution inspection: Evidence of the completed Garbage Record Book or official recording system that captures incinerate waste records, and demonstrates wastes are managed in accordance with Regulation 16 of MARPOL Annex VI	Vessel Environmental Execution inspection record
		During the Vessel Environmental Execution inspection: Evidence of the completed Garbage Record Book or official recording system that captures incinerate waste records, and demonstrates no incineration within Darwin Harbour	Vessel Environmental Execution inspection record
		Evidence that relevant crew complete the Vessel Masters Awareness training to make them aware of the restrictions on incineration in Darwin Harbour	Vessel Masters Awareness training records

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA70	Monitoring and reporting of fuel consumption and calculated GHG emissions	Reporting of fuel consumption and calculated GHG emissions provided to Santos at the agreed frequency	Fuel consumption and calculated GHG emissions report
DPD-MA71	Use of low sulphur diesel	Bunker Delivery Notes showing the fuel sulphur level less than 0.5%	Bunker Delivery Notes
DPD-MA72	Pipeline installation procedures Maintenance requirements for pipelaying equipment to minimise risk of operational failure. Redundancy in nearshore pipelay vessel anchors. Deepwater pipelay vessel will have redundancy in station keeping capabilities in operating in DP2 (as a minimum).	Pipeline installation procedures - As per DPD-MA24	Pipeline installation procedures
		PMS records demonstrate that pipelay equipment is maintained in accordance with system requirements	Planned Maintenance System records
		Mooring analysis completed to demonstrate redundancy in nearshore pipelay vessel anchors	Mooring analysis record
		Evidence demonstrating that Audacia has DP2 as a minimum (As per DPD-MA12, DPD-MA22)	Evidence of Audacia DP2 system
DPD-MA73	Chemical selection procedure for all chemicals planned to be release to the marine environment	SDS's / OCNS information for all chemicals planned to be discharged (e.g. deck wash) provided to Santos and (if required) chemical assessments returned showing selected chemicals are environmentally acceptable	SDS and OCDN information, chemical assessment records
DPD-MA74	Calibrated chemical dosing system in place to ensure accuracy of chemical dosing	If required, evidence that chemical injection was carried out using calibrated and functional meters (Hydrotest / Dosing Records or similar) and chemical injection was at planned dosing rates	Records of calibrated and functional meters (Hydrotest / Dosing Records or similar) and chemical injection records
DPD-MA75	If contingency use and discharge of treated seawater is required, the lowest required concentration of treated chemical will be evaluated and used (up to a	If required, a contingency treated seawater discharge procedure and post-discharge report is produced by Contractor	Contingency treated seawater discharge procedure and post-discharge report

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	maximum discharge of 400 ppm) in order to meet pipeline preservation requirements	If required, records demonstrate that an evaluation of lowest required concentration of chemically treater seawater in order to meet pipeline preservation requirements was carried out	Records of chemical concentration
		If required, records demonstrate that the lowest evaluated concentration (up to a maximum discharge of 400 ppm) was used	Records of chemical concentration
DPD-MA76	Pipeline dewatering of treated seawater will be through valve orientated to promote dispersion and direct discharge away from seabed	If required, evidence that Pipeline dewatering of treated seawater was through arrangement orientated to promote dispersion and direct discharge away from seabed	Evidence of valve orientation
DPD-MA77	In the unlikely event that the pipeline requires contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair, water quality monitoring at the discharge location will be conducted to confirm the concentration and dispersion of treatment chemicals as required under Environmental Approval (EP2022/022-001)	Records of water quality monitoring following contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair	Water quality monitoring records
DPD-MA78	Implementation of Santos approved standards and procedures for outboard lifts (including lifts over live infrastructure)	Evidence of Santos approved vessel lifting procedures, which includes lifts over live infrastructure	Santos approved vessel lifting procedures
DPD-MA79	All lifting and winching equipment will undergo inspection, testing and certification as per applicable Laws, Codes and Standards	Vessel Environmental Pre-mobilisation Inspection confirming: • lifting equipment is certified • Copy of lifting equipment register • Certification of vessel cranes/ hiabs.	Vessel Environmental Pre-mobilisation Inspection record
DPD-MA80	Dropped object recovered where safe and practicable to do so	In the event of a dropped object, the incident report demonstrates that where safe to do so, the dropped object was recovered	Incident report

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA81	Identification of no lift zones where relevant in proximity to subsea assets and infrastructure as documented in relevant lifting and operational procedure/s	Evidence that drawings and shapefiles (showing no lift zones) provided by Santos are included on the navigation systems of all vessels conducting overboard lifts.	Evidence demonstrating navigation system compliance
DPD-MA82	No outboard lifting operations will be completed in Company defined “no lifting zones” which will be identified in navigational systems	Vessel masters and relevant crew from relevant vessels (those engaged in construction) complete the vessel Masters Awareness training to make them aware of the no lifting zones	Vessel Masters Awareness training records
DPD-MA83	Emergency response implemented to minimise potential for impacts in the event a dropped object causes a loss of containment from the existing Bayu-Undan GEP	Evidence of an emergency response in the event a dropped object causes a loss of containment from the existing Bayu-Undan GEP	Emergency response record
DPD-MA84	Pipeline installed along pre-approved route, which is designed where practicable to avoid the potential for impact to habitat / cultural seabed features or assets from a dropped object	Evidence (Construction activity logs, vessel logs, Post-construction survey, Trenching out-survey reports) that no installation activities (pipelay, and causeway construction, trench backfill etc.) outside of the proposed footprint	Evidence (Construction activity logs, vessel logs, Post-construction survey, Trenching out-survey reports)
DPD-MA85	Vessels equipped with effective anti-fouling coatings as required for class	Valid (in-date) International Anti-fouling Systems Certificates for every vessel engaged and used on the Project by Contractor, as applicable to class	International Anti-fouling Systems Certificates
DPD-MA86	Ballast water management will comply with MARPOL requirements (as applicable to class), Australian Ballast Water Management Requirements and *Biosecurity Act 2015*	A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • vessels equipped with a Ballast Water Management Plan	Vessel Environmental Pre-mobilisation Inspection record or other record
		A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • vessels maintains ballast water discharge logs.	Vessel Environmental Pre-mobilisation Inspection record or other record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • The vessel has a Ballast Water Treatment System and an International Ballast Water Management Certificate certifying the BWTS meets Regulation D2 discharge standard	Vessel Environmental Pre-mobilisation Inspection record or other record
		A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • If the vessel cannot demonstrate that it meets D2 standard, it can produce records of ballast water discharge logs confirming no discharge within 12 nautical miles of coastlines including any ports.	Vessel Environmental Pre-mobilisation Inspection record or other record
		A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • vessels equipped with a Biofouling Management Plan	Vessel Environmental Pre-mobilisation Inspection record or other record
		A Vessel Environmental Pre-mobilisation Inspection or records demonstrates that: • vessels maintain records of biofouling application (Biofouling record book) In the absence of a Biofouling Record Book, a combination of other evidence ,can be used: • IMS Inspection Report • Anti-foul Certificate • Biosecurity Status document with GREEN status for Biofouling and Ballast category • Low risk vessel Risk Assessments	Vessel Environmental Pre-mobilisation Inspection record or other record
DPD-MA87	Apply risk-based IMS management for vessels and immersible equipment – vessel and immersible	A completed vessel IMS Risk Assessment demonstrating that the overall classification of the vessel low-risk.	Vessel IMS Risk Assessment record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	equipment mobilised from outside of the Project Area/Darwin Harbour must be assessed as having a low risk of IMS prior to entering the Project Area/Darwin Harbour	A completed ROV IMS Risk Assessment demonstrating that the overall classification of the vessel low-risk.	ROV IMS Risk Assessment record
DPD-MA88	Vessels having suitable anti-fouling coating (marine growth prevention system) in accordance with the *Protection of the Sea Act 2006*	Evidence (e.g. a Vessel Environmental Pre-mobilisation Inspection) for each vessel that demonstrates vessels have a marine growth prevention system.	Evidence (e.g. a Vessel Environmental Pre-mobilisation Inspection record)
DPD-MA89	Inductions to include observing marine fauna	Evidence that Contractor has developed a mandatory project induction, which will detail CEMP requirements, including marine fauna risks and the required management controls	Evidence of contractor mandatory project induction
		Induction records matched against crew lists that demonstrates all personnel have completed the induction	Induction records and crew lists
DPD-MA90	The TSHD shall be fitted with pre-sweeping mechanisms / chain curtains to mitigate turtle entrainment	Evidence (design drawings / installation records) of pre-sweeping mechanisms / chain curtains to mitigate turtle entrainment on the TSHD	Design drawings / installation records
DPD-MA91	Inspection and maintenance for all equipment containing chemicals/ hydrocarbons and chemical/ hydrocarbon storage areas	A Vessel Environmental Pre-mobilisation Inspection demonstrating that all potential spill sources have appropriate secondary containment capable of controlling discharges of hazardous liquids, particularly high risk areas where of fuel/oil/grease or hazardous chemicals have the potential to enter the marine environment.	Vessel Environmental Pre-mobilisation Inspection record
		A Vessel Environmental Pre-mobilisation Inspection and Execution Inspection for each vessel that demonstrates: • The vessel implements procedures that outline the correct and safe storage, segregation, handling and labelling of hydrocarbons and hazardous materials.	Vessel Environmental Pre-mobilisation Inspection record and Execution Inspection record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA92	Santos chemical selection procedure applied for chemicals planned to be discharged to the environment	SDS's / OCNS information for all chemicals planned to be discharged (e.g. deck wash) provided to Santos and (if required) chemical assessments returned showing selected chemicals are environmentally acceptable	SDS and OCDN information, chemical assessment records
DPD-MA93	ROV operations undertaken in accordance with good industry practice (in relation to hydraulic fluid control)	For each vessel where there is an ROV operating from the vessel, evidence is to be provided that confirms ROVs are maintained as per the ROV PMS to reduce the risk of hydraulic fluid releases to the sea. This should include the ROV itself and the key support equipment, such Launch and Recovery Systems (LARS), hydraulic power systems, winches and tether management systems	ROV maintenance records
		For each vessel where there is an ROV operating from the vessel, evidence is to be provided that confirms pre-dive inspections and audits are carried out prior to use of the ROV.	ROV pre-dive inspection/ audit records
DPD-MA94	Procedures for helicopter refuelling	Evidence of helicopter refuelling procedures to all DPD activities within NT waters	Evidence of helicopter refuelling procedures
		Evidence that helicopter procedures were implemented for all helicopter refuelling events	Evidence of compliant refuelling
DPD-MA95	Hydrocarbon/chemical storage areas designed to contain leaks and spills and inspected routinely	A Vessel Environmental Pre-mobilisation Inspection demonstrating that all potential spill sources have appropriate secondary containment capable of controlling discharges of hazardous liquids, particularly high risk areas where of fuel/oil/grease or hazardous chemicals have the potential to enter the marine environment.	Vessel Environmental Pre-mobilisation Inspection record
		A Vessel Environmental Pre-mobilisation Inspection and Execution Inspection for each vessel that demonstrates: • The vessel implements procedures that outline the correct and safe storage, segregation, handling and labelling of hydrocarbons and hazardous materials.	Vessel Environmental Pre-mobilisation Inspection record and Execution Inspection record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA96	Spills will be managed in accordance with standard maritime practices as per vessel shipboard oil pollution emergency plan (SOPEP)	If the vessel is > 400GT, evidence there is the SOPEP on board. If the vessel is < 400GT, evidence there is a vessel specific spill contingency plan on board>	Shipboard Oil Pollution Emergency Plan or spill contingency plan
DPD-MA97	Spill clean-up kits available in high-risk areas	A Vessel Environmental Pre-mobilisation Inspection / Vessel Environmental Execution Inspections for each vessel that demonstrates spill kits are available, accessible, in appropriate locations and fully stocked.	Vessel Environmental Pre-mobilisation Inspection record and Execution Inspection record
DPD-MA98	Bunding/secondary containment around hydrocarbon storage/transfer areas	A Vessel Environmental Pre-mobilisation Inspection demonstrating that all potential spill sources have appropriate secondary containment capable of controlling discharges of hazardous liquids, particularly high risk areas where of fuel/oil/grease or hazardous chemicals have the potential to enter the marine environment.	Vessel Environmental Pre-mobilisation Inspection record
		A Vessel Environmental Pre-mobilisation Inspection and Execution Inspection for each vessel that demonstrates: • The vessel implements procedures that outline the correct and safe storage, segregation, handling and labelling of hydrocarbons and hazardous materials.	Vessel Environmental Pre-mobilisation Inspection record and Execution Inspection record
DPD-MA99	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements including: + Use of bulk hoses that have quick connect 'dry break' couplings + Correct valve line-up + Defined roles and responsibilities, and the specific requirement for bunkering to be completed by trained personnel only + Visual inspection of hoses prior to bunkering to confirm they are in good condition	Project Bunkering procedures or vessel specific bunkering procedures/checklist that include all the requirements outlined in DPD-MA99. This procedure is to be verified to be on and available on each vessel.	Project bunkering procedures or vessel specific bunkering procedures/checklist

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	+ Testing of the emergency shutdown mechanism on the transfer pumps + Assessment of weather/sea state + Maintenance of radio contact with Vessel during bunkering operations + Bunkering checklist + Visual monitoring during bunkering + Ensuring deck drainage bungs are in place prior to bunkering + Marine Order 91 – Marine Pollution Prevention: Oil + Bunkering to commence in daylight hours		
DPD-MA100	Vessel equipped and crewed in accordance with Australian maritime requirements	Marine Order 21 (Safety and emergency procedures), including: Safety measures such as manning and watchkeeping Records or pre-mob inspection showing: • of a valid (in-date) Minimum Safe Manning Certificate that shows all master, mate and watchkeeper officer duties undertaken by crew meet the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) requirements	Vessel Pre-mobilisation Inspection record or other record
		Marine Order 27 (Safety of navigation and radio equipment), including: + radio equipment and communications + navigation safety measures and equipment + danger, urgency and distress signals and messages. Records or pre-mob inspection showing:	Vessel Pre-mobilisation Inspection record or other record

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
		• Global Maritime Distress and Safety System (GMDSS) radio logbook as required by Marine Order 27 • radio equipment available, working and tested at regular intervals • electronic and paper based charts are available on the bridge	
		Marine Order 30 (Prevention of Collisions), including: Lights and signals as applicable to vessel class per COLREGS requirements. Records or pre-mob inspection showing: • A Vessel Cargo Ship Safety Equipment Certificate to demonstrate lights and signals as applicable to vessel class per COLREGS requirements.	Vessel Pre-mobilisation Inspection record or other record
		Marine Order 71 (Masters and Deck Officers), including: All master, mate and watchkeeper officer duties undertaken by crew certified as applicable to vessel class per STWC requirements. Records or pre-mob inspection showing: • records of crew STCW qualifications, or • a copy of the Masters Standing Orders demonstrating safe manning	Vessel Pre-mobilisation Inspection record or other record
DPD-MA101	Safety exclusion zone around DPD Project construction vessels, e.g. pipelay vessels, and a Notice to Mariners will be issued for offshore works formally advising all major shipping traffic. In addition, pipelay vessels will have attendant vessels that may act as guard vessels for work within the harbour	Evidence that Notice to Mariners was issued prior to construction commencing and includes information outlining that a cautionary/safety exclusion zone is in place around all construction vessels.	Evidence of Notice to Mariners
		Evidence (DPRs or other method) to demonstrate there is always at least one vessel acting as a surveillance vessel to implement the cautionary/safety exclusion zone around construction vessels	Surveillance vessel evidence (DPRs or other method)

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA102	No intermediate fuel oil (IFO) or heavy fuel oil (HFO) will be used in activity vessels working in the Project Area	Statement of conformance from each individual vessel coming into the Project Area that no HFO/IFO is carried onboard in any tank	Statement of conformance
DPD-MA103	Implement tiered spill response as per DPD Project specific OPEP in the event of an MDO spill	Incident reports demonstrating the DPD Project OPEP (BAS-210 0026) was followed	Incident reports
DPD-MA104	Santos to make oil spill tracking buoys available on primary project vessel/s with Santos CSR/s and/or at local supply base for immediate deployment to assist with tracking of an oil spill	Santos freight and logistics - email confirming tracker buoys are on the primary vessel/s and/or at supply base.	Email from Santos freight and logistics
DPD-MA105	Trenching will only occur within pre-programmed areas (using standard positional accuracy measures used in the industry)	Evidence that vessels engaged in construction (Trenching, stabilisation and freespan correction/ prevention) have a means of maintaining positional accuracy measures (e.g., DGPS, survey capability)	Evidence of positional accuracy measures (e.g., DGPS, survey capability)
		Evidence (Construction activity logs, vessel logs, Post-construction survey, Trenching out-survey reports) that no installation activities (pipelay, and causeway construction, trench backfill etc.) outside of the proposed footprint	Evidence (Construction activity logs, vessel logs, Post-construction survey, Trenching out-survey reports)
DPD-MA106	Exclusion zones programmed on all primary vessels associated with the works to clearly indicate no entry zones and nearby pipelines – this will clearly identify areas for spud placement, anchor positioning and trenching activities	Evidence that drawings and shapefiles (showing pipeline route, construction footprints and any associated exclusion zones and restricted and sensitive areas) provided by Santos are included on primary construction vessel navigation systems	Evidence of primary construction vessel navigation system compliance
		Vessel masters and relevant crew from relevant vessels (those engaged in construction) complete the vessel Masters Awareness training to make them aware of the exclusion zones, restricted and sensitive areas within or adjacent to the Project Area	Vessel Masters Awareness training records
DPD-MA107	A Cultural Heritage Management Plan (CHMP) will be in place for the activity and include:	A Cultural Heritage Management Plan (CHMP) in place prior to activity commencement and includes:	Cultural Heritage Management Plan (CHMP)

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
	+ Cultural heritage induction requirements for site personnel + An internal heritage clearance process prior to construction activities + Procedures for anchoring and establishment of exclusions zones Procedures to mitigate risks to unexpected maritime heritage objects, including a stop work protocol	+ Cultural heritage induction requirements for site personnel + An internal heritage clearance process prior to construction activities + Procedures for anchoring and establishment of exclusions zones + Procedures to mitigate risks to unexpected maritime heritage objects, including a stop work protocol Procedures to mitigate risks to unexpected maritime heritage objects, including a stop work protocol (i.e. an Unexpected Finds Protocol)	
DPD-MA108	HSE inductions will include environmental requirements and cultural values.	Project personnel will attend HSE inductions which will include environmental and cultural values as required by this Offshore CEMP.	Records demonstrate all project personnel have attended the Activity environmental and cultural heritage induction.
DPD-MA109	Cultural heritage training and cultural ceremony	Cultural training completed by all site-based workforce (Santos employees and contractors) by end of their first rotation offshore.	Records demonstrate site-based workforce have completed cultural heritage training.
		Cultural heritage monitors to provide an introduction to the Activity to the seas and any First Nations spiritual beings at commencement of the Activity.	Annual Environmental Performance Report.
DPD-MA110	First Nations cultural heritage monitor in the field, subject to availability of the cultural heritage monitor	A First Nations cultural heritage monitor in the field to provide guidance and advice on the protection and maintenance of cultural and spiritual places and activities throughout the pipelay and pre-commissioning activities (subject to the availability of a cultural heritage monitor).	Records of correspondence with relevant First Nations groups that the opportunity has been provided.

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
			Annual Environmental Performance Report.
DPD-MA111	Establish a subsea infrastructure inventory	Establish and maintain a comprehensive and accurate inventory of subsea infrastructure and locations.	Subsea infrastructure inventory records.
			Survey reports with installed infrastructure locations.
DPD-MA112	Contractor contingency pipeline preservation procedure and specification	Contractor contingency pipeline preservation procedure and specification will include: + treatment chemicals selected will be Gold (OCNS) or pseudo CHARM rated Gold + calculate the chemical treatment dosage to result in the discharge concentration not exceeding 400ppm + metering of water and chemical injection volumes during flooding and dewatering activities.	A copy of the contractor contingency pipeline preservation procedure and specification are aligned with performance standard requirements for DPD-MA112
			Records demonstrate the chemical selection procedure was implemented for all relevant chemicals.
			Records demonstrate that the chemical treatment product selected is a Gold (OCNS) or pseudo CHARM rated Gold.
			Records demonstrate that water and chemical injection volumes are measured for flooding and dewatering activities.

Management Action Reference	Management Actions	Performance Standards	Measurement Criteria
DPD-MA113	Contractor cyclone management plans covering cyclone contingency actions	Project vessels operating during cyclone season (1 November to 30 April) have weather management plans covering cyclone contingency actions	Weather management plans
DPD-MA114	Vessel speed restrictions in NT Coastal Waters	Vessel speeds within the NT Coastal Waters operational area will be limited to 8 knots or less.	Induction material includes details speed limit requirements.
			Induction records confirm relevant vessel masters are aware of speed restriction requirements
DPD-MA115	No PFAS or PFOS will be used in firefighting foam.	Fire-fighting foams shall be free of PFAS and PFOS.	SDS for firefighting foam to confirm no PFAS or PFOS.

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DPD Project Offshore Construction Environmental Management Plan (BAS-210 0024) - Revision 1 update table

Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
Global	Better differentiation of activities in NT Coastal Waters and NT Internal Waters (which have different regulatory requirements under NT energy legislation). Update to NT Government department names and Minister titles, as required, as per Administrative Arrangements Order (No. 3) 2024 (NT). There may be some very minor variation in pagination between the 'tracked changes' and 'clean' versions of the document (e.g., order of a figure or table) as some were shifted before/after text to improve pagination of the 'clean' document.	Accuracy and clarity of document	NA
Table of Contents, Tables and Figures	Updated (without track changes) to reflect changes made.	Accuracy and clarity of document	NA
Abbreviations, acronyms, glossary and units of measurement	Updates to these sections as required for accuracy and clarity, including changes required as a result of other changes throughout the document. Update NT Minster's title as per Administrative Arrangements Order (No. 3) 2024 (NT)	Accuracy and clarity of document	NA
1.1 Project overview	Updated to more clearly present the project overview, including location and activities, and the regulatory jurisdictions and the environmental approvals sought and gained. Update Figure 1-1 to label 'Darwin Pipeline Duplication (DPD) Project Areas across the different jurisdictions, e.g., Commonwealth, NT Coastal and NT Internal Waters. No changes required in response to having separate DPD Project Coastal Waters Construction Environmental Management Plan (Coastal Waters CEMP) for *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGSER) acceptance.	Accuracy and clarity of document	NA
1.2 Purpose	Deleted some of the text, particularly text describing previous versions of the plan, to remove duplication of text in Section 1.5. Changes required in response to having separate Coastal Waters CEMP for OPGGSER acceptance: • Delete text stating the document is written to meet OPGGSER content requirements. • Include text explaining the separate Coastal Waters CEMP has been developed to meet OPGGSER content requirements.	Accuracy and clarity of document	NA
1.3 Scope	Clarified the activities covered under the plan and supporting plans, e.g., the separate Coastal Waters CEMP. Delete text stating the document and DPD Project NT Waters Oil Pollution Emergency Plan (OPEP) is developed to meet requirements of OPGGSER. Add pipeline preservation phase to Table 1-1 for completeness Update Figure 1-2 to include for Coastal Waters CEMP on diagram and also the DPD Project Cultural Heritage Management Plan (CHMP). Update text regarding associated management plans for DPD Project, including inclusion of CHMP and Operations Environmental Management Plans. Section heading 1.4 'Plan Structure' removed – not required Delete text stating the document has been structured to meet OPGGSER requirements, no longer applicable. Deleted column in Table 1-2 that dealt with requirements under the OPGGSER.	Accuracy and clarity of document	The preservation phase is not new (the filling of the pipeline with Nitrogen was previously described) but it has been included in the table for greater clarity and for alignment with other regulatory documentation – no new or increased impact or risk.

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Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
1.4 Proponent	Remove text stating requirements of OPGGSER, not applicable to the Offshore CEMP. Updated pipeline licence details. Update proponent details, including contact details in Table 1-3 Update liaison person name.	Accuracy and clarity of document	NA
1.5 Document, review and availability	Minor updates for clarity. Remove text on revision requirements under OPGGSER as they are not applicable to the Offshore CEMP.	Accuracy and clarity of document	NA
2. Detailed activity description	Remove text stating requirements of OPGGSER as they are not applicable to the Offshore CEMP.	Accuracy and clarity of document	NA
2.1 Overview	Remove references to OPGGSER environment plan requirements as they are not applicable to the Offshore CEMP. Updated Table 2-1 to include additional details of key activities, e.g., testing and pre-commissioning phase, add 'preservation phase' for clarity (for consistency with the DPD Project Environment Plan (Commonwealth waters) (DPD EP), Coastal Waters CEMP and the Operations EMPs), add unplanned and non-routine IMR for clarity, add bunkering, add 'uncrewed survey vessel', add helicopters and ROVs to table for clarity. Minor correction to kilometre point (KP) reference (Table 2-2)	Accuracy and clarity of document. Consistency with other management plan documents.	No new or increased impact or risk. Preservation phase is not a new or increased impact or risk. The filling of the pipeline with Nitrogen was previously described. Unplanned and non-routine IMR is not a new or increased impact. Pipeline contingencies (pipeline repair) previously included. The use of ROVs, helicopters and survey vessels were all included in previous plan revision inclusive of controls to manage impacts and risks.
2.2 Project Area	Update to better describe the Project Area in terms of NT Internal Waters and NT Coastal Waters (which have different regulatory requirements under NT energy legislation).	Accuracy and clarity of document	NA
2.3 General detail of construction	For clarity added details of offshore surveying into to 'pre-lay' works sub-section. Added in more detail on use of grout bags to for consistency with the DPD EP and Coastal Waters CEMP. Remove text discussing mass flow excavation (MFE) tool impacts and moved it to the impact summary table (Table 6-7) Add further detail (additional clarity) on cable crossings, pipeline crossings and pipelay contingencies Added volume of contingency treated seawater discharge at Commonwealth boundary, e.g., KP23 – 43,332.5 m^3 as an example discharge. More detail on inspection, maintenance and repair activities and bunkering for consistency with other plans. Add remotely operated uncrewed survey vessels as a category of survey vessel. Update MARPOL discharge text – remove food waste as a discharge as not permitted in NT waters. Update expected Barossa first gas from Q2 to Q3 2025	Accuracy and clarity of document. Consistency with other management plan documents.	No new or increased impact or risk. The use of grout bags, MFE, cable crossings, pipeline crossings, pipelay contingencies (including pipeline repair), vessel bunkering and survey vessels was included in previous plan inclusive of controls to manage impacts and risks. Contingency treated seawater discharges anywhere along the pipeline in NT waters were included in previous plan revision, including management measures.
3. Legal and other obligations	Remove references to OPGGSER requirements. Offshore CEMP not submitted for OPGSGER acceptance.	Accuracy and clarity of document	NA

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Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
3.1 Legislative framework	Remove specific reference to Relevant Person consultation requirements being covered in Section 9.4 to 9.6 which are no longer included (since Coastal Waters CEMP accepted under the OPGGSER now includes this information).	Accuracy and clarity of document	NA
3.2 Key legislation	Update OPGGSER section to reflect that the Coastal Waters CEMP is the relevant document for acceptance under OPGGSER. Update currency of information of DPD Project approvals. Update text on NT Aboriginal Sacred Sites Act to reflect second Aboriginal Areas Protection Authority (AAPA) certificate now received by Santos for DPD Project.	Accuracy and clarity of document	The second AAPA certificate application was included for in previous revision. Additional certificate did not reveal impacts or risks not already accounted for in previous revision.
3.3 Other relevant legislation	Text updated in Table 3-1 (Commonwealth legislation) to provide more thorough description (as per DPD EP) Text updated in Table 3-2 (NT legislation) to provide more thorough description Text updated in Table 3-3 (International agreements/legislation) to add missing conventions/agreement (now same as DPD EP)	Accuracy and clarity of document	NA
4. Environmental Management Framework	Remove references to OPGGSER requirements. Offshore CEMP not submitted for OPGGSER acceptance.	Accuracy and clarity of document	NA
4.1 Santos Management System	Minor edits for consistency and accuracy	Accuracy and clarity of document	NA
4.3 DPD Project environmental management plans	Add text on the Coastal Waters CEMP, DPD EP and CHMP.	Accuracy and clarity of document	NA
4.4 Supporting management processes and procedures	Update section on Marine standards and compliance to present details of the Santos Marine Operations Manual and to align with DPD EP and Coastal Waters CEMP Added in a new section (Section 4.4.7) on the Cultural Heritage Management Plan and associated Unexpected Finds Protocols (UFPs) to align with DPD EP and Coastal Waters CEMP	Accuracy and clarity of document	NA
5. Existing environment	Remove references to OPGGSER requirements. Offshore CEMP not submitted for OPGGSER acceptance.	Accuracy and clarity of document	NA
5.1 Determining the EMBA	Minor edits for consistency and accuracy	NA	NA
5.2 EMBA values and sensitivities	Updates made for consistency with Coastal Waters CEMP and general readability including minor updates to information on protected and significant areas, threatened and migratory fauna and socio-economic features Replaced and added more detail on First Nations cultural features to align with information provided in the Coastal Waters CEMP and DPD EP. Minor correction to protected shipwrecks information.	Accuracy and clarity of document. Consistency with other management plan documents.	Increased detail on First Nations cultural features does not identify any new or increased impacts or risks.
5.3 Project Area values and sensitivities	Updated First Nations heritage to provide detail on second AAPA certificate. Information on non-first nations heritage was revised and expanded to provide greater detail and for consistency with other plans. General edits, e.g., to correct citations.	Accuracy and clarity of document. Consistency with other management plan documents.	The second AAPA certificate application was included for in previous revision. Additional certificate did not reveal new impacts or risks.

Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
	Update to EPBC protected species information, including in tables, to align with updated Protected Matters Search Tool (PMST) results		Increased detail on non-First Nations cultural features does not identify any new or increased impacts or risks. Updates PMST does not result in any new or increased impacts or risks not previously accounted for.
6. Impact and risk assessment	Remove references to OPGGSER requirements since Offshore CEMP not submitted for OPGGSER acceptance. Updated to refer to DME requirements. Minor updates to improve readability and consistency between management plans.	Accuracy and clarity of document. Consistency with other management plan documents.	NA
6.3 Impact/risk assessment summary	Minor changes for accuracy and to improve readability Table 6-7 updates General edits to improve accuracy and readability Remove references specifying which activities will occur in NT Coastal Waters and covered under the OPGGSER. Not required - the Offshore CEMP is not being submitted for OPGGSER acceptance. Added further detail on impacts from Mass Flow Excavation as well as Acid Sulfate Soils – both already included in activity and assessed Addition of MBES and SSS as noise sources into the table – already included as activity and assessed Revised sewage/greywater discharge volume downwards to align with Coastal Waters CEMP Remove text on putrescible waste discharge – putrescible waste will not be discharged in NT waters as per regulatory requirements. Added Ballast waters discharges to 'Routine vessel discharges' for completeness. This is also included under the 'Introduction of IMS heading' Add grout-line flushing for completeness - already included in the activity description as a discharge and assessed Add references to the *Prevention of the Sea (prevention of pollution from ships) Act 1983* (Cth) and the *Marine Pollution Act 1999* (NT), where applicable for the routine vessel discharge waste streams. Updated details for Contingency pipeline discharges based on latest modelling.	Accuracy and clarity of document. Consistency with other management plan documents.	No new or increased impact or risk. While new/additional discharge modelling of treated seawater at KP23, the boundary between NT and Commonwealth waters, has been undertaken, the contingency discharge of treated seawater had previously been described and assessed. The impact assessment of discharging treated seawater, specifically at KP23, was re-evaluated as part of the development of the Coastal Waters CEMP document and no new or increased impact or risk was identified.
6.4 Evaluation of ALARP and acceptability	Minor changes for accuracy and to improve readability	Accuracy and clarity of document.	NA
7. Environmental Management Strategies	Remove references to OPGGSER requirements. Offshore CEMP not submitted for OPGGSER acceptance.	Accuracy and clarity of document.	NA
7.2 Environmental performance objectives	Minor changes for accuracy and to improve readability	Accuracy and clarity of document.	NA
7.3 Performance criteria	Minor changes for accuracy and to improve readability	Accuracy and clarity of document.	NA

Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
7.6 Planned event impact management strategies	Some additional management actions have been included in the tables for planned events to align with the DPD EP and Coastal Waters CEMP, including in relation to cultural heritage and cultural values and permissible discharges under MARPOL. Additional information and detail has also been included in some of the 'Demonstration of ALARP and residual impact' sections for completeness and consistency with other management plans, e.g. 'Seabed and benthic habitat disturbance', 'Noise emissions' and 'Routine vessel discharges'.	Accuracy and clarity of document. Consistency with other management plan documents.	Additional controls have been included for completeness with other plans and continuous improvement and are not in response to new activities. Controls that were already being adopted have been explicitly stated.
7.9 Unplanned event risk management strategies	Some additional management actions have been included in the tables for unplanned events to align with the DPD EP and Coastal Waters CEMP, including in relation to cultural heritage and cultural values. Some additional management controls considered and rejected (with reasoning) have also been included for completeness and consistency with other management plans, e.g., 'Release of hydrocarbons'. Additional information and detail has also been included in the 'Release of hydrocarbons' 'Demonstration of ALARP and residual impact' section for completeness and consistency with other management plans.	Accuracy and clarity of document. Consistency with other management plan documents.	Additional controls have been included for completeness with other plans and continuous improvement and are not in response to new activities. Controls that were already being adopted have been explicitly stated.
8. Implementation strategy	Remove references to OPGGSER requirements. Offshore CEMP not submitted for OPGGSER acceptance.	NA	NA
8.1 Leadership, accountability and responsibility	Table 8-1 updated to present the current information and to align with the Coastal Waters CEMP.	Accuracy and clarity of document. Consistency with other management plan documents.	NA
8.2 Workforce training and competency	Induction section updated to include for cultural heritage awareness and processes for managing potential cultural heritage finds	Consistency with other management plan documents.	NA
8.3 Audits and inspections	Updated with the latest information to align with the Coastal Waters CEMP and providing greater detail on the type and frequency of assurance activities.	Accuracy and clarity of document. Consistency with other management plan documents.	NA
8.4 Environmental incident reporting	Minor updates for clarity and accuracy	Accuracy and clarity of document.	NA
8.5 Conformance	Minor updates to refer to the relevant Santos standard, and to improve clarity and accuracy	Accuracy and clarity of document.	NA
8.7 Emergency preparedness and response	Minor wording updates in text	Accuracy and clarity of document.	NA
8.8 Reporting and notifications	Minor wording updates in text to improve clarity and accuracy and updates to Table 8-3 to include notifications relating to/required by: • unexpected finds • revisions to action management plans (condition of the EPBC 2022/09372 approval) • end of the activity	Accuracy and clarity of document.	NA

Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
	• hydrocarbon spills. Added in a table of Marine user notification requests and recipients.		
8.9 Monitoring of discharges and emissions	Revisions to align with Coastal Waters CEMP. Removed the 'FCGT and planned pre-commissioning fluids' discharges (which are not part relevant in NT waters) and replaced it with the more relevant 'Contingency treated seawater discharge (wet buckle event)'. Also added in 'Ballast water' discharge and both of these activities have always been part of the impact assessment.	Accuracy and clarity of document. Consistency with other management plan documents.	No new or increased impact or risk. Discharge of ballast water and the contingency discharge of treated seawater had previously been described and assessed so the inclusion in this table does not introduce a new or increased impact or risk.
8.10 Management of change	Remove references to OPGGSER requirements for the Offshore CEMP. Clarified that OPPGSER revision and submission requirements only apply to the Coastal Waters CEMP and not the Offshore CEMP.	Accuracy and clarity of document.	NA
8.11 Other measures	Remove references to OPGGSER requirements and revert wording to that used by NT EPA. Offshore CEMP not submitted for OPGGSER acceptance.	Accuracy and clarity of document.	NA
9. Consultation	Remove reference to the OPGGSER requirements. Offshore CEMP not submitted for OPGGSER acceptance.	Accuracy and clarity of document.	NA
9.2 Consultation overview	Revised text on consultation undertaken, including that undertaken to meet the requirements of the OPGGSER and included in the NT Coastal Waters CEMP. Provides link to the Department of Mines and Energy (DME) web page where the NT Coastal Waters CEMP is publicly available. Removed specific reference to 'Relevant Persons' consultation given 'Relevant Persons' is a term specific under the OPGGSER which addressed in the NT Coastal Waters CEMP. Removed the following sections which were included in the previous revision purely for the purpose of detailing the Relevant Persons consultation methodology and responses as required under the OPGGSER: • Section 9.3 Relevant persons consultation background • Section 9.4 OPGGSER consultation requirements • Section 9.5 Government and industry guidance • Section 9.6 Applicable case law and guidance • Section 9.7 Relevant Persons consultation methodology • Section 9.8 Consultation report This information is now available through the publicly available Coastal Waters CEMP accepted by DME on 13 November 2024.	Accuracy and clarity of document. Consistency with other management plan documents.	NA
9.3 Ongoing consultation strategy (Previously 9.9 Post acceptance consultation)	Revised heading to 'Ongoing consultation strategy and presented a revised and updated strategy to be consistent with other management plans.	Accuracy and clarity of document. Consistency with other management plan documents.	The updated strategy does not reduce the commitment to consultation so no new or increased impact or risk.
10. References	Minor updates as required based on changes described in preceding rows.	Accuracy and clarity of document.	NA
Attachment 1. Santos EHS policy	Attachment updated with the most recent Santos Environment, Health and Safety Policy	Accuracy and clarity of document.	NA

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Document reference	Change made	Reason for change	Assessment of environmental risks and potential impacts associated with the change (EP2022/022-001 condition 9.1(4))
Attachment 2. DPD Values and Sensitivities	General review and update of the attachment to reflect latest information and greater consistency with information in the Coastal Waters CEMP and DPD EP, including around cultural heritage. An updated EPBC Act Protected Matters Search Tool (PMST) report for the Environment that May Be Affected (EMBA) (June 12) has been attached. Some updates made to ensure the secrecy provisions on sacred sites under the *Northern Territory Aboriginal Sacred Sites Act 1989* are not potentially contravened.	Accuracy and clarity of document. Consistency with other management plan documents.	The updates made do not identify any new or increased impacts and risks to environmental receptors not previously included for.
Attachment 3. Summary of management actions	Table updated to reflect additional management actions, performance standards and measurements criteria to align with the DPD EP and Coastal Waters CEMP, including in relation to cultural heritage and cultural values and permissible discharges under MARPOL. Table reordered so all Management Actions are sorted by code and not separated into those for planned events and unplanned events separately. Intent to make cross referencing against table easier. Minor wording correction made to the existing Performance Standard for DPD-MA07 to reflect correct vessel type. Minor wording correction made to existing Performance Standard and Measurement Criteria for DPD-MA17 to reflect correct evidence for demonstrating performance. Minor update to existing Management Action for DPD-MA63 to better reflect relevant legislation Minor update to existing Management Action and Performance Standard for DPD-MA75 to reflect the lower discharge concentration as committed to in the Coastal Waters CEMP and DPD EP.	Accuracy and clarity of document. Consistency with other management plan documents.	Additional management actions, performance standards and measurement criteria added for consistency with the Coastal Waters CEMP and DPD EP and for continuous improvement. Measures have not been added in response to a new activity or an increase in impact and risk.
Attachment 4. Summary of relevant persons consultation	Report removed given the Offshore CEMP is not being submitted for assessment under the OPGSGER. The Summary of Relevant Persons Consultation Report has been provided to DME together with the NT Coastal Waters CEMP (accepted by DME on 13 November 2024) as required to meet requirements of the OPGGSER. A link to publicly available NT Coastal Waters CEMP including the Summary of Relevant Persons Consultation Report provided in Section 9.2.	Accuracy and clarity of document. Consistency with other management plan documents.	NA
Attachment 5. Sensitive Information Report	Report removed given the Offshore CEMP is not being submitted for assessment under the OPGSGER. The Sensitive Information Report has been provided to DME together with the NT Coastal Waters CEMP (accepted by DME on 13 November 2024) as required to meet requirements of the OPGGSER.	Accuracy and clarity of document. Consistency with other management plan documents.	NA

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