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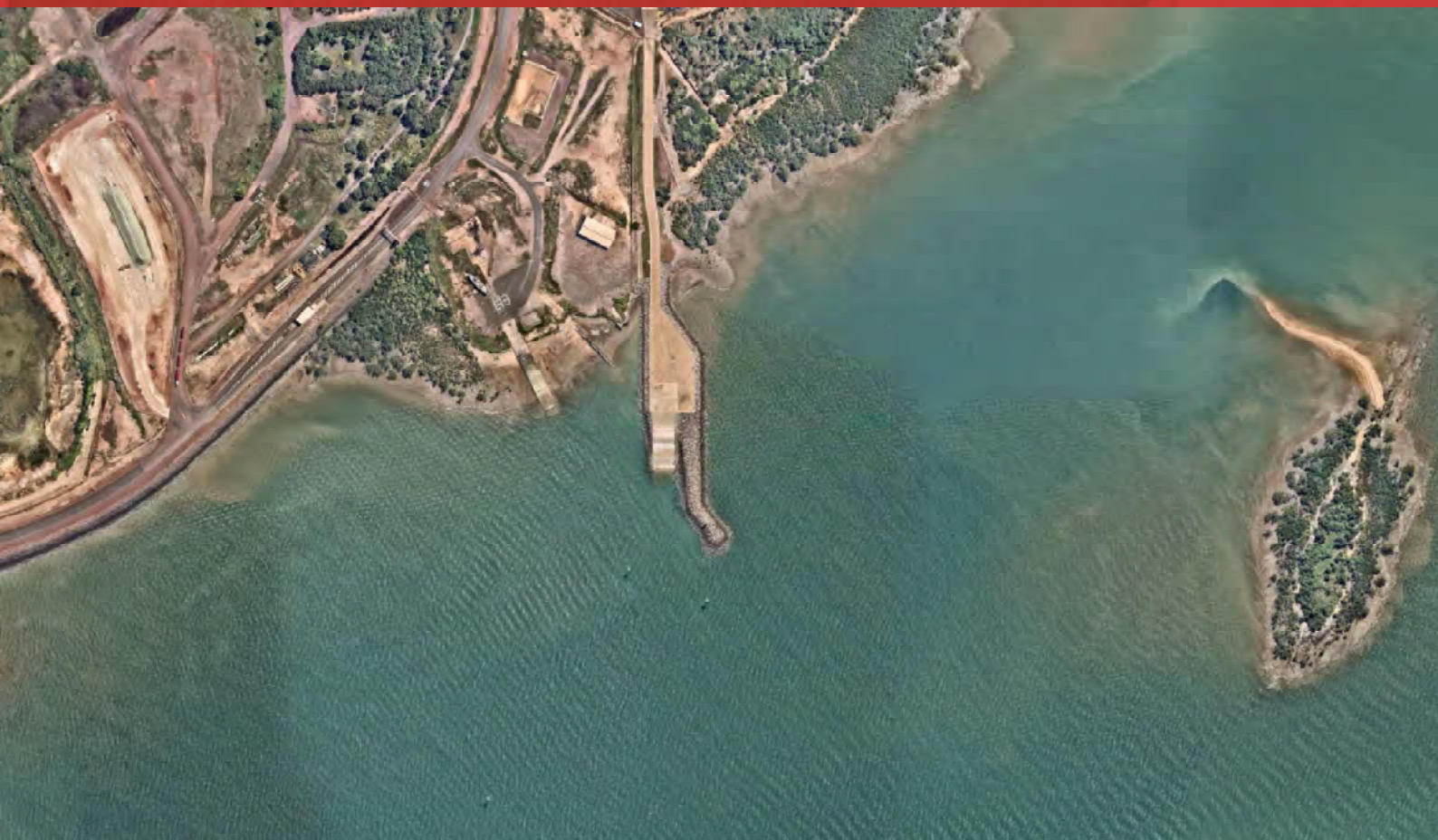
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Annual EPBC Act Controlled Action Compliance Report – Darwin Ship Lift Project (EPBC 2021/9068)

Reporting period: 03 October 2024 – 02 October 2025

Prepared for: Clough BMD Joint Venture





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ACRONYMS

AAPA	Aboriginal Areas Protection Authority
BHD	Backhoe Dredging
BOM	Bureau of Meteorology
BPESC	Best Practice Erosion and Sediment Control
CBJV	Clough BMD Joint Venture
CCTV	Closed-Circuit Television
CEMP	Construction Environment Management Plan
CPESC	Certified Professional in Erosion and Sediment Control
CSD	Cutter Suction Dredging
CUF	Common User Facility
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DDSPMP	Dredging and Dredge Spoil Placement Management Plan
DLI	Department of Logistics and Infrastructure
DPO	Darwin Port Area
EAW	East Arm Wharf
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMF	Environmental Management Frameworks
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
ESCP	Erosion and Sediment Control Plan
LAT	Lowest Astronomical Tide
MFO	Marine Fauna Observer
MHWS	Mean High-Water Springs
MMMP	Marine Megafauna Management Plan
MSB	Marine Supply Base
MUBRF	Multi-Use Barge Ramp Facility
NOI	Notice of Intent
NT	Northern Territory
NTG	Northern Territory Government
SoW	Scope of Works
SPMT	Self-propelled Modular Transporters
TABs	Temporary Access Bunds
TMOF	Temporary Materials Offloading Facility



EXECUTIVE SUMMARY

This Annual Compliance Report has been prepared by EcOz Environmental Consultants for Clough BMD Joint Venture (CBJV) on behalf of the Northern Territory of Australia (Department of Logistics and Infrastructure [DLI]) to comply with the Darwin Ship Lift Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action approval (**EPBC 2021/9068**).

The report outlines that CBJV maintained compliance with 19 of the 31 compliance designation outcomes for the above controlled action approval (**EPBC 2021/9068**). The remaining 12 conditions were determined to be not applicable to the controlled action during the period of reporting between 03 October 2024 and 02 October 2025.

Project activities commenced in October 2024 with the construction and installation of Temporary Materials Offloading Facility (TMOF) to support Backhoe Dredging (BHD) activities and continued through to October 2025 with the completion of the TMOF removal. There were no non-compliances with the controlled action approval as they relate to project activities.

This report fulfils compliance with **EPBC 2021/9068 Conditions 19-22** as they relate to annual compliance reporting (**Table 1-2**). A complete list of compliance designation with the controlled actions can be found in **Appendix I**.



1 INTRODUCTION

This annual compliance report has been prepared for the Darwin Ship Lift Project (herein 'the Project' or 'DSL') by EcOz for Clough BMD Joint Venture group (CBJV) on behalf of the Northern Territory (NT) of Australia (Department of Logistics and Infrastructure [DLI]) who is the approval holder of the Project *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action approval (**EPBC 2021/9068**).

The controlled action under the EPBC Act approval is to construct and operate a common user ship lift, repair and maintenance facility and adjoining marine facility approximately 700 m east of the existing East Arm Wharf and Marine Supply Base in Darwin Harbour, Northern Territory. Some of the conditions specific to the Project controlled action are taken from NT Environmental Protection Authority (EPA) Environmental Approval (**EP2023/028-001**) **Condition 1-1** and **Conditions 2-1 to 2-9** and pertain to avoiding and mitigating harm to protected matters by complying with disturbance limits (**Condition 1-1**), construction phase environmental objectives (**Conditions 2-1** and **Condition 2-2**), erosion and sediment control plan (**Condition 2-3**) and dredging management plan (**Conditions 2-4 to 2-9**). The NT EPA Environmental Approval action description includes:

- disturbance of no more than 11 ha of seabed within the approved extent;
- capital dredging (excluding maintenance dredging) shall not exceed 520,000 m³ and shall occur within the approved extent;
- disposal of dredged material within the East Arm Ponds or beneficial reuse of dredged material through placement in the revetment area; and
- land disturbance area (including, infrastructure, hardstand and revetments) must not exceed 22.2 ha.

1.1 Purpose

The report content is prepared to address the Project EPBC Act controlled action approval (**EPBC 2021/9068**) **Conditions 19 to 22** (annual compliance reporting) and prepared in accordance with the Department of Climate Change, Energy, the Environment and Water's (DCCEEW's) *Annual Compliance Report Guidelines: Reporting under the Environment Protection and Biodiversity Conservation Act 1999* (DCCEEW, 2023a). The compliance report has included an assessment of compliance with the relevant approval conditions, and summary of the evidence to support compliance.

The report content is also prepared in accordance with CBJV's principles and summarises the potential environmental impacts of the Project. It is intended to meet the annual reporting requirements and provide greater transparency to the community and stakeholders regarding the environmental objectives and progress of the Project.

1.2 Project description of approved action

The Darwin Ship Lift facility will feature the largest ship lift in Northern Australia and is designed to meet current and long-term vessel maintenance and servicing needs of the Department of Defence, Australian Border Force, general commercial and private maritime sector whilst supporting local jobs and economic growth in the Territory. Once operational, the facility will be a catalyst for the development of a marine maintenance and servicing industry, and the creation of many new jobs.



The facility is proposed to include:

- a ship lift and transfer system,
- a ship lift control room for ship lift, Self-propelled Modular Transporters (SPMT) vessel transfer system, SPMT shed, administration building and gatehouse,
- a vessel wash-down bay, blast and paint structure and hardstand,
- a dry berth hardstand for vessel repair and maintenance,
- trestles for vessel support (out of water), lifting and transfer,
- quay structures for six (6) berths, reclamation, and hardstand,
- marine structures, bunds, revetments, shore protection, and lead-in dolphins,
- berth fixtures, including fenders, bollards, mooring systems, ladders, and operational safety infrastructure (eye wash stations, buoyancy rings, spill kits),
- aids to navigation,
- dredged berth pockets, manoeuvring basins and adjustments to connect to existing shipping channel,
- services including electrical, communication, potable water, sewerage, waste management, fire water, lighting, access control system and closed-circuit television (CCTV),
- security fencing, gates, and boom-gates, and
- an access road, intersection upgrade and internal infrastructure.

The ship lift will have the capacity to lift vessels such as Cape Class Patrol Boat (Australian Border Force) and SEA 1180 Luerssen Arafura Class OPV (Navy), OSV / PSV MMA Plover, Brewster and Responder, and OSV/PSV Pacific Harrier, Hawk, Heron, Hornbill and Navy Frigate ANZAC Class.

The facility will be delineated into two discrete areas, one of which will be privately operated, and the other will be designated as a Common User Facility (CUF), which will enable vessel owners to choose and manage their own service and maintenance providers. This will also enable multiple providers to operate concurrently at the facility.

1.3 Project activities

Table 1-1 provides a high-level summary of Project activities from the commencement of site activities from 03 October 2024 to 02 October 2025.

Table 1-1. Project activities for the reporting period

Date/period when undertaken	Project Activities
3 October to 31 October 2024	• Commenced construction and installation of Temporary Materials Offloading Facility (TMOF) to support Backhoe Dredging (BHD) activities. • Delivery of sheet piles to site. • Continued daily in-situ sampling of East Arm Wharf (EAW) settling ponds, and weekly laboratory sampling in accordance with Dredging and Dredge Spoil Placement Management Plan (DDSPMP). • Issued the annual return of the Project EPBC Act Controlled Action Compliance Report (3 October 2023 to 2 October 2024).
November 2024	• Caisson backfill quarry material approved. • Completed piling works on TMOF. • Commenced reclamation bridging layer.
December 2024	• Site preparation for Holiday Shutdown Period.
January 2025	• Commenced Caisson template assembly.
February 2025	• Commenced Temporary Access Bund (TAB) 5 bridging layer. • Commenced eastern revetment bridging layer.



Date/period when undertaken	Project Activities
March 2025	Commenced W-Pontoon assembly.
April 2025	Commenced RA04 bridging layer.
May 2025	Commenced pitching date of Caisson 01 (C01).
June 2025	- Commenced onshore sheet piling. - Commenced Administration Building earthworks.
July 2025	- Completed Backhoe dredging. - Mobilisation and commencement of Administration Building. - Issued the annual return of Waste Discharge Licence (WDL254) monitoring report. - Commenced underwater acoustic noise monitoring for piling activities.
August 2025	- Commenced demobilisation of BHD. - Administration Building service groundworks. - Commenced relocation of BHD stockpiles in approved Dredge Placement/Disposal Area (DPO) locations of EAW. - All reclamation areas completed to +7.5 m Lowest Astronomical Tide (LAT).
September to 2 October 2025	- Completed TMOF removal. - Administration Building Bored Pier, Foundation slab and Blockwork works. - Commenced Gatehouse Building Service Groundworks and foundation slab works. - Commenced general fill for reclamation. - Commenced placement of BHD material in reclamation area. - Mobilisation of long reach excavator for rock armour installation. - Site visit by Certified Professional in Erosion and Sediment Control (CPESC) in preparation for drafting Wet Season Erosion and Sediment Control Plan (ESCP) for implementation by end of October.

1.4 EPBC Act controlled action conditions

Table 1-2 outlines the **EPBC Act (2021/9068)** controlled action conditions as they relate to annual compliance reporting.

Table 1-2. EPBC Act (2021/9068) controlled action approval conditions - annual compliance reporting

Condition	Condition Description	Sections Discussed
19	The approval holder must prepare a compliance report for each 12-month period following the date of this approval decision, or as otherwise agreed to in writing by the minister.	This report
20	Each compliance report must be consistent with the department's <i>Annual Compliance Report Guidelines</i> , Commonwealth of Australia 2014, or any subsequent official version.	This report has been prepared in compliance with the department's <i>Annual Compliance Report Guidelines</i> , Commonwealth of Australia 2023.
21	Each compliance report must include: a) Accurate and complete details of compliance and any non-compliance with the conditions and the plan, and any incidents. b) One or more shapefile showing all clearing of protected matters, and/or their habitat, undertaken within the 12-month period at	a) This report has outlined the details of compliance and any non-compliance with the conditions and the plan, and any incidents (refer Appendix I). b) Shapefiles provided as an attachment to this report. The shapefile captures that



Condition	Condition Description	Sections Discussed
	the end of which that compliance report is prepared. c) A schedule of all plans in existence in relation to these conditions and accurate and complete details of how each plan is being implemented.	disturbance of no more than 11 ha of seabed within the approved extent; and capital dredging did not exceed 520,000m³ and occurred within the approved extent. Note, there was no clearing of protected matters, and/or their habitat undertaken within the annual compliance reporting period. Cutter Suction Dredging (CSD) and BHD occurred during this reporting period which had the potential to disturb marine fauna habitat. Marine megafauna mitigation measures are outlined within the Marine Megafauna Management Plan (refer Appendix M). c) Schedule of Project plans and how each plan was implemented is provided in Section 2.1.1.
22	The approval holder must: a) Publish each compliance report on the conditions where relevant website within 60 business days following the end of the 12-month (or other) period for which that compliance report is required. b) Notify the department electronically, within 5 business days of the date of publication, that a compliance report has been published on the website. c) Provide a weblink for the compliance report in the notification to the department. d) Keep all published compliance reports required by these conditions on the website until the expiry date of this approval. e) Exclude or redact sensitive ecological data from compliance reports published on the website or otherwise provided to a member of the public. f) If sensitive ecological data is excluded or redacted from the published version of the compliance report, submit the full compliance report to the department within 5 business days of the redacted version being published on the website and notify the department in writing which exclusions and redactions have been made in the version published on the website.	Approval Holder has met all requirements of this condition.



1.5 Location and site layout

The Project is situated approximately 6.5 km south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour. The site is approximately 700 m east north-east of the EAW and the Marine Supply Base (MSB), and west of the Darwin Business Park. Road access is provided by Berrimah Road, linking the site to the Darwin Road network including the Stuart Highway and Tiger Brennan Drive.

The mix of land uses surrounding the Project include:

- *West:* the EAW and MSB support export and import of dry bulk materials and liquids associated with the mining and petroleum industries, containerised / break bulk (not containerised) and specialised heavy lift cargoes, general cargoes, and live cattle exports.
- *North:* industrial land including the Darwin Port stockpile area and dredge spoil ponds, the Northern Cement plant, the Darwin Vopak Terminal (petroleum import and distribution terminal), the CUF and the passenger terminal of the Adelaide - Darwin rail line.
- *East:* the recently constructed Multi-use Barge Ramp Facility (MUBRF), and Catalina Island.
- *South:* the southern end of the Project site encompasses the intertidal zone and the East Arm water confluence with Elizabeth River which forms part of Darwin Harbour.

The location of the Project area and the dredging activities is shown in **Figure 1-1** and **Figure 1-2**.



LOCALITY MAP
(NOT TO SCALE)

FRANCES BAY

EAST ARM
SETTLEMENT PONDS

DSL PROJECT

DARWIN HARBOUR
EAST ARM

SOUTH
SHELL
ISLAND

LEGEND

- SETTLEMENT PONDS BOUNDARY
- PROJECT EXTENT

COORDINATE SYSTEM: GDA 1994 MGA ZONE 52
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
FALSE EASTING: 500,000.0000
FALSE NORTHING: 10,000,000.0000
CENTRAL MERIDIAN: 129.0000
SCALE FACTOR: 0.9996
LATITUDE OF ORIGIN: 0.0000
UNITS: METER



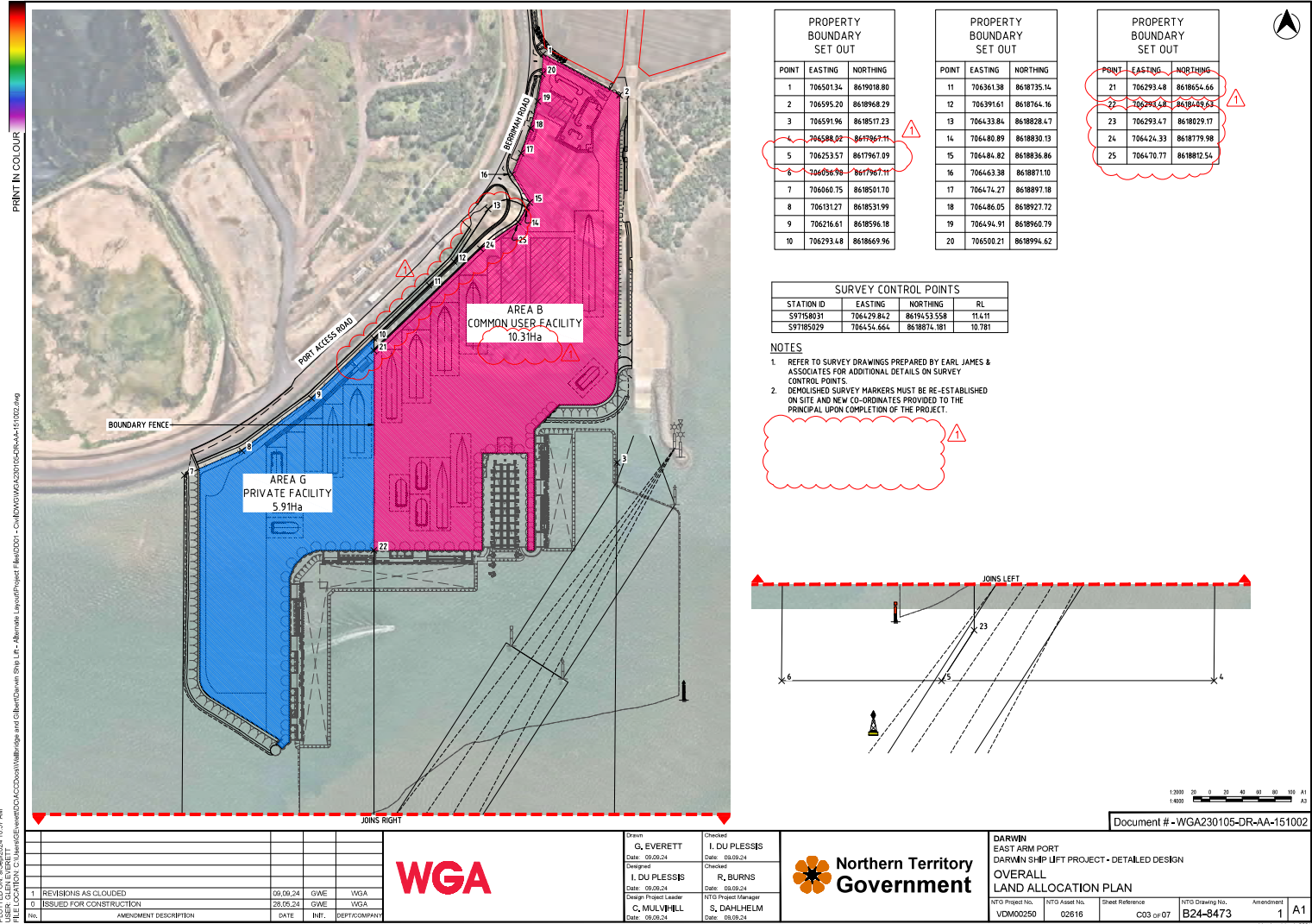
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METERS

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CHECKED	C. MACKENZIE	DATE	12/12/2022



PROJECT TITLE
DARWIN SHIP LIFT
DRAWING TITLE
FIGURE 1.1 - Darwin Ship Lift Project (EPBC 2021/9068) location



1	REVISIONS AS CLOUDED	09.09.24	GWE	WGA
2	ISSUED FOR CONSTRUCTION	20.09.24	GWE	WGA
AMENDMENT DESCRIPTION		DATE	INT.	DEPT/COMPANY

1.6 Environmental values

Environmental values that are present within and adjoining the Project controlled action area as defined within the Project EPBC Act controlled action approval (**EPBC 2021/9068**) and the approved extent as defined within the Project NT EPA Environmental Approval (**EP2023/028-001**) are summarised in **Table 1-3**.

Table 1-3. Environmental values within the Project controlled action area

Category	Specifications
Protected matters (EPBC Act)	• Flatback Turtle (<i>Natator depressus</i>) • Green Turtle (<i>Chelonia mydas</i>) • Hawksbi/1 Turtle (<i>Eretmochelys imbricata</i>) • Curlew Sandpiper (<i>Calidris ferruginea</i>) • Eastern Curlew (<i>Numenius madagascariensis</i>) • Great Knot (<i>Calidris tenuirostris</i>) • Greater Sand Plover (<i>Charadrius leschenaultii</i>) • Lesser Sand Plover (<i>Charadrius mongolus</i>) • Red Knot (<i>Calidris canutus</i>) • Spotted Bottlenose Dolphin (<i>Tursiops aduncus</i>) (<i>Arafura/Timor Sea populations</i>) • Australian Humpback Dolphin (<i>Sousa sahalensis</i>) • Australian Snubfin Dolphin (<i>Orcaella heinsohni</i>) • Black-tailed Godwit (<i>Limosa limosa</i>) • Grey-tailed Tattler (<i>Tringa brevipes</i>) • Sanderling (<i>Calidris alba</i>) • Sharp-tailed Sandpiper (<i>Calidris acuminata</i>) • Terek Sandpiper (<i>Xenus cinereus</i>) • Whimbrel (<i>Numenius phaeopus</i>)
Darwin Harbour Region Natural Waterways (Gazette: G27; 2010)	1. The protection of environment, cultural (aesthetic, recreational and cultural), and aquaculture to be beneficial uses that apply to the area of water known as Darwin Harbour being all saline waters south of the line drawn from Charles Point to Gunn Point and bounded by the upper limit of the high-water mark of tidal waterways, including all named and unnamed inlets and creeks. 2. The protection of environment, cultural (aesthetic, recreational and cultural), agriculture and rural stock and domestic to be the beneficial uses of water that apply to all natural waterways in the Darwin Harbour catchment, including all named and unnamed springs, creeks, rivers, lakes, lagoons, swamps, or marshes.
Darwin Harbour Region – High Water Mark (Gazette: G27; 2010)	1. The protection of environment, cultural (aesthetic, recreational and cultural) and aquaculture to be beneficial uses that apply to the area of water known as Darwin harbour being all saline waters south of the line drawn from Charles Point to Gunn Point and bounded by the upper limit of the high-water mark of tidal waterways, including all named and unnamed inlets and creeks.

2 ENVIRONMENTAL PLANNING AND RISK MANAGEMENT

Management of environmental issues for the Project has been based on the ISO14001 Environmental Management Systems standard and aligned to CBJV requirements for risk identification, assessment, and management. A range of risk assessment methods have been used for assessing the likelihood of an identified event occurring and what the consequences might be during the construction phase of the Project. This systematic approach has contributed to ensuring that facilities are constructed without unacceptable risk to the environment and are conducted in accordance with the HSSE Risk Management Procedure, 41213-HSE-PR-G-0072 and HSSE Management Manual, CORP-HSE-MN-G-0001.

2.1 Environmental management

A Project specific CEMP provides a framework for the management of all environmental aspects of the Project. The primary purpose of the CEMP is to describe the management systems and procedures, which will be adhered to in achieving Project environmental objectives and approval conditions. The CEMP is the overarching reference for environmental management throughout the construction phase and prescribes all applicable procedures, processes and practices to be undertaken by CBJV and their subcontractors. The CEMP outlines processes to manage environmental risks, minimise impacts on the surrounding environment and ensure compliance with regulatory requirements and other obligations throughout project delivery.

The Project CEMP, its sub-plans and procedures are applicable to all project works, staff, and subcontractors. Sub-plans have been developed for the relevant aspects that are considered high risk in relation to the Project Scope of Works (SoW). The implementation of the CEMP and associated sub-plans has ensured compliance with all applicable Project approval conditions that are in line with legislative and approval requirements.

2.1.1 List of supporting management plans

Where identified from regulatory approvals for the Project, by the Territory or the Project risk assessment, the following plans have been developed for the Project SoW:

- 41213-HSE-PL-G-1001 HSE Management Plan,
- 41213-HSE-PL-G-1005 Training Management Plan,
- 41213-HSE-PL-G-1007 Waste Management Plan,
- 41213-HSE-WI-G-022 Chemical and Hazardous Substance Work Instruction,
- 41213-HSE-PL-G-1011 Marine Megafauna Management Plan,
- 41213-HSE-PL-D-0001 Dredge and Dredge Spoil Placement Management Plan, and
- 41213-HSE-PL-G-1008 Erosion and Sediment Control Plan.

The following environmental management sub-plans have been developed:

- Unexpected Finds Management Sub-Plan,
- Erosion and Sediment Control, Stormwater Management and Earthworks Sub-Plan,
- Potential Acid Sulfate Soils Management Sub-Plan,
- Water Quality Management Sub-Plan,
- Terrestrial Flora and Fauna Management Sub-Plan,
- Pests, Weeds and Biosecurity Management Sub-Plan,
- Emissions Management Sub-Plan,
- Greenhouse Gas Management Sub-Plan, and
- Spill Management Sub-Plan.



Table 2-1 provides a summary of the implementation tasks undertaken for the key Project environmental management plans.

Table 2-1. Implementation of key environmental management plans

Project Management Plan	Implementation
CEMP and supporting subplans	• Project HSSE Induction • Site Inductions • Regular toolbox topics and training • Daily site checks • Weekly Environmental Inspections • Pre- and Post-rainfall Inspections • Environmental Reporting • Risk management processes and workshops • Environmental Audits
DDSPMP	• Completion of Daily and Weekly Reporting • Environmental Monitoring and Water Quality management Framework for Darwin Harbour and East Arm Wharf Dredge Ponds
Marine Megafauna Management Plan (MMMP)	• Marine megafauna logs completed daily during dredging activities • Regular inspections and audits of subcontractors

3 ENVIRONMENTAL MONITORING

The DDSPMP describes the commitments to the environmental monitoring program during the dredging activities. **Table 3-1** summarises the environmental monitoring program and the details that were recorded.

Refer to Appendices for environmental monitoring records for the annual compliance reporting period (03 October 2024 – 02 October 2025).

Table 3-1. Environmental monitoring program

Monitoring aspect	Details that were recorded	Reference
Weather observations	• Daily weather records • Tidal conditions • Rainfall event	Bureau of Meteorology (BoM)
On-shore water quality monitoring results and assessment: - As outlined within Section 7 of the DDSPMP (Appendix K) - As outlined within Appendix A and Appendix B of the Project Annual EPBC Act Controlled Action (EPBC 2021/9068) Compliance Report	• Plume monitoring • pH • Turbidity (NTU) • Benthic communities • Toxicants analysis • Exceedances	Appendix A Appendix B Appendix K
Darwin Harbour offshore water quality monitoring: • As outlined within Section 7, Figure 11 and Table 9 of the DDSPMP (Appendix K) • As outlined within Appendix A of the Project Annual EPBC Act Controlled Action (EPBC 2021/9068) Compliance Report	• Location and frequency • Turbidity (NTU)	Appendix C Appendix D Appendix K
East Arm Wharf Settling ponds water quality monitoring: • As outlined within Section 7 Figure 12 and Table 9 - East Arm Wharf Settling Pond Monitoring Locations of the DDSPMP (Appendix K) • As outlined in Appendix E, Appendix F and Appendix G of the Project Annual EPBC Act Controlled Action (EPBC 2021/9068) Compliance Report	• pH • Turbidity (NTU) • Toxicants	Appendix E Appendix F Appendix G Appendix K



Erosion and sediment control - As outlined within Section 9 of the ESCP (Appendix L)	• Checks on all drainage, erosion and sediment control measures • Occurrences of excessive sediment deposition (whether onsite or off-site) • Checks on all site discharge points (including dewatering activities as appropriate - none occurred during period), litter and waste receptors, and oil, fuel and chemical storage facilities • Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements	Appendix L
Marine megafauna - As outlined within Section 5 of the MMMP (Appendix M)	• Vessel Marine Fauna Observer (MFO) logs, including individual species observed, the frequency, location and timing of observations and photos (if available)	Appendix M

3.1 Performance criteria

Water quality monitoring criteria included in the DDSPMP have been based on the Australian and New Zealand Guidelines for Fresh and Marine Water (ANZECC Guidelines); the former NRETAS Water Quality Objectives for Darwin Harbour and the Darwin Harbour Region Report Cards 2010 (URS 2012).

4 LEGISLATIVE FRAMEWORK

All Project work was undertaken in accordance with the relevant statutory requirements. The following key legislation is recognised as relevant to the approval of the Project noting that the Contractor has implemented the relevant components of the legislation as applicable to the CEMP and the responsibilities under its Project SoW.

A summary of Commonwealth and Territory environmental legislation expected to be potentially relevant to the Project include:

Relevant Commonwealth Legislation

- *Aboriginal Land Rights (Northern Territory) Act 1976 (ALR Act)*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Australian Heritage Council Act 2003*
- *Australian Maritime Safety Authority Act 1990*
- *Biosecurity Act 2015*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- *Hazardous Waste (Regulation of Exports and Imports) Act 1989*
- *National Greenhouse Measurement Determination 2008 (Commonwealth) (DAWE, 2021)*
- *National Greenhouse and Energy Reporting Act 2007*
- *Native Title Act 1993*
- *Navigation Act 2012*
- *Occupational Health and Safety (Maritime Industry) Act 1993*
- *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*
- *Protection of the Sea (Powers of Intervention) Act 1981*
- *Underwater Cultural Heritage Act 2018*

Relevant Territory Legislation

- *Aboriginal Sacred Sites Act 1989*
- *Aboriginal Land Act 1978*
- *Building Act 1993*
- *Control of Roads Act 1953*
- *Crown Lands Act 1992*
- *Dangerous Goods Act 1998*
- *Environment Protection Act 2019*
- *Fire and Emergency Act 1996*
- *Fisheries Act 1988*
- *Heritage Act 2011*
- *Land Title Act 2000*
- *Marine Act 1981*
- *Marine Pollution Act 1999*
- *National Environment Protection Council (Northern Territory) Act 1994*
- *Planning Act 1999*
- *Ports Management Act 2015*
- *Port of Darwin Act 2015*
- *Public and Environmental Health Act 2011*
- *Soil Conservation and Land Utilisation Act 1969*
- *Territory Parks and Wildlife Conservation Act 1976*



- *Traffic Act 1987*
- *Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act 2010*
- *Waste Management and Pollution Control Act 1998 (WMPC Act)*
- *Water Act 1992*
- *Weeds Management Act 2001.*

Compliance with legislative requirements detailed in Project environmental approvals, including relevant management plans have been monitored regularly during the annual compliance reporting period and there have been no non-conformances within the reporting period. The environmental approvals and allowances are summarised in **Table 4-1**.

Table 4-1. Environmental allowances, approvals and permits

Environmental	Approval/Permit	Approved purpose and allowances
Development Permit	DP24/0037	To use and develop the land for the purpose of industry-general and excavation and fill (Darwin Ship Lift Facility) including reclamation and dredging of Darwin Harbour, revetment walls, wet berths, hardstand, and buildings in 2 stages, in accordance with the attached schedule of conditions and the endorsed plans.
Aboriginal Areas Protection Authority (AAPA) – Authority certification	RA2018/46 C2019/004	Subject Land A: All works associated with the development of the ship lift facility, including for all works associated with the construction, operation and ongoing repairs and maintenance of a marine industrial and ancillary services. Subject Land B: Access to the area for fauna and environmental monitoring and sampling, including transit by boat and occasional anchoring. Transit for ferrying of staff when weather requires it in shallow draft vessels. Note: no intended island access or anchoring in immediate vicinity of the island.
Fisheries Section 11 permit	2023-2024 / S11/549	CBJV during the period and times specified in Schedule 2, is permitted to conduct the following activities that may impact on fish or aquatic life or their habitats: • Cause shock, sound or other vibration within the area identified in Schedule 3 through activities for purposes associated with the dredging and piling activities for the Darwin Ship Lift project being constructed on behalf of the NTG. Approximately 240 days of piling activity are predicted during the construction phase, employing both drilling and hydraulic hammering as pile-driving methods.
NT Environmental Approval	EP2023/028-001	Construct and operate a common user ship lift, repair and maintenance facility and adjoining marine facility approximately 700 m east of the existing East Arm Wharf and Marine Supply Base in Darwin Harbour including: • Disturbance of no more than 11 ha of seabed within the approved extent;



Environmental	Approval/Permit	Approved purpose and allowances
		• Capital dredging (excluding maintenance dredging) shall not exceed 520,000 m³ and shall occur within approved extent; • Disposal of dredged material within the East Arm Ponds or beneficial reuse of dredged material through placement in the revetment area; and • Land disturbance area (including infrastructure hardstand and revetments) must not exceed 22.2 ha.
EPBC Act controlled action	EPBC2021/9068	To construct and operate a common user ship lift facility and an adjacent repair and maintenance facility, approximately 700 m east of the existing East Arm Wharf and Marine Supply Base in Darwin Harbour, Northern Territory.
Waste Discharge Licence	WDL254	The controlled discharge of wastewater from East Arm Pond E (North) to Pond E (South) into Darwin Harbour via the authorised discharge point and subject to the conditions of this Licence.

5 PROJECT APPROVAL CONDITIONS

5.1 Notification of approval

The Project EPBC Act controlled action decision was made under **Section 133(1)** of the EPBC Act noting that Section **134(1A)** of the EPBC Act applies to the Project approval.

5.2 Approved action

Person to whom the approval is granted (approval holder)	NORTHERN TERRITORY OF AUSTRALIA
ABN of approval holder	84 085 734 992
Action	To construct and operate a common user ship lift facility and an adjacent repair and maintenance facility, approximately 700 m east of the existing East Arm Wharf and Marine Supply Base in Darwin Harbour, Northern Territory (NT) [See EPBC Act referral 2021/9068].

5.3 Annual reporting

Approval holder must prepare annual compliance reports in accordance with the Project EPBC Act controlled action conditions and the *Annual Compliance Report Guidelines* (DCCEEW, 2023a). The Project annual compliance report is required to be prepared for each 12-month period following the Project controlled action approval (**EPBC 2021/9068**) date of the 03 October. The annual compliance report is published on the DLI's website within 60 business days following the end of the reporting period and notify the DCCEEW within five (5) business days of publication.

5.3.1 Compliance table

Section 3.6 of the *Annual Compliance Report Guidelines* (DCCEEW, 2023a) states that a compliance table (or similar) is required. The table must include condition numbering, full wording, designation of compliance and summary evidence.

Appendix I (Table 9-3) has been produced to satisfy the requirement for an EPBC Act controlled action approval conditions compliance table.

5.3.2 Assessment designations

The system used for describing the condition compliance findings (compliance designation) is set out in **Table 5-1**.

Table 5-1. Compliance designations

Finding	Description
Not Applicable	The requirement to comply with the specific condition or elements of a condition was not applicable for the reporting period (e.g. a condition that applies to an activity that has not yet commenced).
Compliant	The Northern Territory of Australia (DLI) (as the approval holder) is compliant with all the requirements of the condition, including the implementation of relevant management plans or other measures required by the condition.

Finding	Description
Non-compliant	The Northern Territory of Australia (DLI) (as the approval holder) is not compliant with the requirements of a condition or elements of a condition, including the implementation of relevant management plans or other measures required by the condition.

5.4 Addressing approval conditions

Section 3.5 of the *Annual Compliance Report Guidelines* (DCCEEW, 2023a) requires that all approval conditions, and management plans required under an approval condition, have been considered and addressed, that an evaluation of compliance is provided (compliance designation) and a summary of evidence to support the compliance designation.

All conditions of the Project EPBC Act controlled action approval (**EPBC 2021/9068**) have been assessed, in conjunction with the management plans relevant to this stage of the Project (refer **Appendix I**).

5.5 Addressing community concerns

CBJV documents the procedures for community contact, complaints handling and investigation. This process requires issues to be shared with the Project team, resulting in a consistent and unified response.

These procedures include:

- Complaints from any source (e.g. DLI, public, government) will be recorded using Incident Report Form 41213-HSE-FO-G-0035.
- The establishment and maintenance of a complaints (contact) register, including complaint 'closure' processes, from start of substantial construction until the date of completion.
- Reporting on the receipt and responses to complaints received in the monthly progress report.
- Recording of the closure process for each complaint received.
- Lodging enquiries and complaints via a telephone, or email.
- Lodging enquiries and complaints into a formal register for analysis, feedback and audit purposes.
- Directing issues requiring immediate action to the Project Manager who will be able to contact key personnel during or after work hours.
- The community will be advised of the issue/inquiry and complaints procedure and appropriate contact details upon request. This will be provided in writing to the complainant if requested.
- CBJV will monitor all issues/ enquiries and respond to complaints. These will be documented in the contact register and discussed at regular project meetings. Any contentious inquiries or complaints with potential to escalate as political, public or media issues will be referred immediately to the Northern Territory Government (NTG).

6 SUMMARY FINDINGS

6.1 Compliance – with EPBC Act controlled action approval conditions (EPBC 2021/9068)

A summary of the compliance designation outcome against the Project EPBC Act controlled action approval (EPBC 2021/9068) is provided in **Table 6-1**.

During the reporting period there were zero non-compliant EPBC Act controlled action conditions. Refer to **Appendix I (Table 9-3)** for the compliance table including the summary evidence supplied to support the compliance designation for the Project EPBC Act controlled action conditions.

Table 6-1. Summary of compliance designation outcome

Compliance designation term	Findings of compliance designation assessment	
Compliant	19	61%
Non-compliant	0	0%
Not Applicable	12	39%
Total	31	100%

6.2 Environmental risks

Section 3.9 of the *Annual Compliance Report Guidelines* (DCCEEW, 2023a) states that the compliance report must discuss any new environmental risks.

No new environmental risks were apparent during the Project annual compliance reporting period.

6.3 Notifiable incidents

6.3.1 ESCP

There were no notifiable incidents and/or potential non-compliances and/or actual non-compliances with the conditions or commitments made in the ESCPs (wet and dry seasons) to report.

6.3.2 DDSPMP

During dredging activities, there were five occasions when exceedances with the offshore water quality trigger level (> 140 NTU) was recorded 150m from the source. These five occasions were reported to the Territory and investigated by the Project Environmental Advisor in line with the methodology described in **Section 7.1.3** of the DDSPMP. In each instance the cause of the plume was found to be natural environmental factors and not the result of dredging activities. The Plume Attributability Assessment Reports can be found in **Appendix D**.

There were four recorded high turbidity events (above 140 NTU trigger) at the onshore monitoring locations across the monitoring period (refer Appendix A). These were isolated and non-notifiable incidents:

- 424 NTU (MUBRF on 15 Nov 2024)
- 522 NTU (MUBRF on 18 Nov 2024)
- 354 NTU (MUBRF on 17 Dec 2024)
- 160 NTU (TAB05 on 16 Jan 2025)



6.3.3 MMMP

Of the 366 entries into the MFO log records database, 64 did not have a MFO form, resulting in a compliance rate of 82%. If days where no works occurred are removed, the compliance rate is closer to 90%.

While this is technically a non-compliance in the MMMP, this does not necessarily result in a non-compliance with **EPBC 2021/9068 Condition 2** (and by extension NT Environmental Approval **EP2023/028-001 Conditions 2-1(1) and 2-1(3)**).

EP2023/028-001 Condition 2-1 requires the approval holder to carry out the construction phase of the action to achieve the following environmental objectives:

- (1) no **material environmental harm** to the environmental values and declared **beneficial uses** of Darwin Harbour beyond the **approved extent**, including but not limited to the quality and productivity of water, sediment and biota; and
- (2) dredging and land reclamation activities must not cause any **material environmental harm** to water quality, or the condition or distribution of **benthic communities** beyond the **approved extent**, as indicated by monitoring required by condition **2-4(3)**; and
- (3) risks of physical injury, mortality, behavioural changes and health impacts on marine megafauna are minimised.

Based on the very low number of instances where marine fauna were observed (3x occasions) and the fact that actions were immediately taken to cease works on all three occasions, the potential for material environmental harm or risk of physical injury, mortality, behavioural changes and health impacts to marine megafauna was very low throughout the dredging and piling activities. Corrective actions were taken when necessary by CBJV to minimise the risk even further and ensure no material environmental harm occurred to marine megafauna.

7 LIMITATIONS

7.1 Seasonal turbidity limit values

There are two sensitive receptor sites (Catalina Island and South Shell Island) which are located offshore from the Project dredging footprint. The areas surrounding these islands in East Arm were identified as potentially suitable habitat for hard corals, and filter feeders. Both types of benthic communities are sensitive to the physiological pressures of reduced benthic light availability and sedimentation associated with dredging activities or natural environmental conditions.

The mean turbidity values of 4.4 NTU (Dry season) and 8.3 NTU (Wet season) are considered the background levels, and these values were derived from the summary statistics for parameters monitored during water-quality program in Darwin Harbour (URS 2011) (refer **Table 7-1**).

The monitoring program outlines that an exceedance greater than the seasonal turbidity limit values for the Islands of 3.5 NTU + Mean of 4.4 (Total 7.9 NTU) (Dry season) and 21.2 NTU + Mean of 8.3 (Total 29.5 NTU) (Wet season) (refer **Table 7-1**).

Table 7-1. Summary water quality statistics for East Arm, Wet and Dry Season (URS, 2011)

Parameter	Dry Season			Wet season		
	Mean	Min	Max	Mean	Min	Max
Temperature (°C)	28.1	25.3	32.1	30.4	28.1	32.0
Conductivity (mS/cm)	48.7	40.2	52.9	46.2	36.7	49.8
Depth (m)	6.3	2.4	11.0	6.7	2.5	11.3
pH	8.0	7.7	8.5	8.0	7.6	8.2
DO (%)	93.5	73.4	121.1	88.5	67.3	106.4
Turbidity (NTU)	4.4	0.1	46.4	8.3	0.2	68.0
SSC (mg/L)*	10.8	7.1**	46.4	14.1	7.2**	64.7

* = Calculated from NTU using relationship in URS (2011): $SSC = 0.848 * NTU + 7.0477$.

** = These values are an artefact of applying a linear equation to the SSC/NTU relationship and the actual SSCs are likely to have been considerably lower.

7.2 Monitoring at sensitive receptor sites

Two turbidity buoys were installed to capture continuous turbidity levels during Project dredging and reclamation activities (**Table 7-2**). Where the turbidity within the water column exceeds the trigger value of 140 NTU, monitoring of turbidity was then carried out at the South Shell Island and Catalina Island monitoring locations. The maximum turbidity within the water column at the monitoring locations was compared against the allowable seasonal limit values (29.5 NTU in the Wet season or 7.9 NTU in the Dry season).

There were five recorded values above the trigger level of 140 NTU (refer **Appendix C (Table 9-2)**). Five plume attributability assessments were completed after exceedances were recorded at monitoring buoys 1 and 3 at Catalina Island. The exceedances were reported to DLI and were found not to be attributable to dredging activities.



Table 7-2. Location of turbidity buoys

Location	Latitude	Longitude	Notes
Turbidity Buoy 1	-12.491	130.902	(SW Dredge Extent) in 3-5m
Turbidity Buoy 2*	-12.494	130.896	(SE Dredge Extent) in 4m
Turbidity Buoy 3**	-12.491	130.902	(SW Dredge Extent) in 3-5m

**Maintenance log of turbidity buoys shows the turbidity buoy originally set up at South Shell Island was Turbidity Buoy 1, this was replaced by Turbidity Buoy 2 on 19 October 2024 and remained as Turbidity Buoy 2 for the remainder of the reporting period.*

***Maintenance log of turbidity buoys shows Turbidity Buoy 3 originally went online at Catalina Island on 10 September 2024 and was replaced with Turbidity Buoy 1 on 12 February 2025. The exceedances all related to the Turbidity Buoys set up at this monitoring location at Catalina Island.*

8 CONCLUSION

This report documents the outcomes for the 2024-2025 annual Project EPBC Act controlled action approval environmental compliance between the reporting period 03 October 2024 and 02 October 2025. The report has included an assessment of compliance with approval conditions, and summary evidence (refer **Appendix I, Table 9-3**).

CBJV were compliant with 19 of the 31 EPBC Act controlled action approval (**EPBC 2021/9068**) conditions, while 12 of the 31 were not applicable. Zero non-compliances were recorded for the EPBC Act controlled action conditions meaning that CBJV (and NT of Australia as the approval holder) are compliant with **EPBC 2021/9068** for the reported period.

There were no incidents or potential non-compliances with the conditions or commitments made in the ESCPs (wet and dry seasons) to report. There was a total of five notifiable incidents from offshore turbidity exceedances that were reported as per **Section 7.1.3** of the DDSPMP. Investigations into these incidents showed that these turbidity exceedances were not the result of project activities and were due to natural environmental factors. There was a compliance rate of 90% for the submission of MFO logs as per the commitment to submit daily observation logs in **Section 4** of the MMMP. While technically a non-compliance with the commitments of the MMMP, this did not result in a non-compliance with **EPBC 2021/9068 Condition 2** as CBJV were able to demonstrate that they took corrective action to minimise the risk for each recorded observation of marine fauna.

9 REFERENCES

AECOM 2022. *Darwin Shiplift Project Supplementary Environmental Impact Statement*. Prepared for the Department of Infrastructure, Planning and Logistics. July 2022.

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APPENDIX A WATER QUALITY MONITORING (IN-SITU) AND OBSERVATIONS UNDERTAKEN AT PROJECT TEMPORARY ACCESS BUNDS (TAB) AND REVETMENTS WITHIN PROJECT EXTENT



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (c)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	03-Oct-24	8:34	CH	7.98	55.6	33.4	76.8	4.49	27.24	N	0	Outgoing	5.8	-	-	Spring	Sunny, Clear	N	Construction activities on TAB01B
MUBRF	04-Oct-24	6:57	CH	8.02	54.5	32.7	86	4.65	28.33	N	0	Outgoing	7	-	-	Spring	Sunny, Clear	N	No dredging or construction activities during sample time
MUBRF	05-Oct-24	7:06	CF	8.04	54.3	32.6	86.5	3.27	28	N	0	High	7	1	7	Spring	Sunny, Clear	N	Construction of TAB03; dredging
MUBRF	06-Oct-24	6:39	CF	8.04	54.7	32.8	78.3	2.85	28.04	N	0	High, incoming	6.6	1	6.9	Spring	Sunny, Clear	N	No dredging or revetment works
MUBRF	07-Oct-24	9:42	CF	8.06	53.9	32.3	10.9	2.78	29.55	N	0	Outgoing	5.5	1.2	6.6	Spring	Sunny, Clear	N	No dredging; construction of TAB03
MUBRF	08-Oct-24	8:28	CF	8.06	54.1	32.5	73.5	3.01	28.75	N	0	High	6.2	1.5	6.2	Spring	Sunny, Clear	N	No dredging; construction of TAB03
MUBRF	09-Oct-24	14:00	CF	8.13	54	32.4	39	2.75	31.09	N	0	Outgoing	2.3	1.9	6	Spring	Sunny, Clear	N	No observations to note
MUBRF	10-Oct-24	9:06	CF	8.1	54	32.4	102	2.2	28.54	N	0	High	5.5	2.3	5.5	Spring	Sunny, Clear	N	No observations to note
MUBRF	11-Oct-24	9:59	CF	8.02	54.5	32.7	93.6	4.62	29.03	N	0	Outgoing	5	2.8	5.1	Neap	Sunny, Clear	N	No observations to note
MUBRF	12-Oct-24	13:20	CF	8.16	53.9	32.3	27.5	7.72	30.79	N	0	Outgoing	5	5.4	3	Neap	Sunny, Clear	N	No observations to note
MUBRF	14-Oct-24	14:22	CF	8.18	54.6	32.8	87.3	4.06	30.39	N	0	Incoming	5.1	3.1	5.4	Neap	Sunny, Clear	N	No observations to note
MUBRF	15-Oct-24	7:12	CF	8.06	54	32.4	94	4.59	28.48	N	0	Outgoing	6.4	4.7	2.4	Neap	Overcast	N	No observations to note
MUBRF	16-Oct-24	11:01	CF	8.06	55.1	33	134	6.44	29.11	N	0	Low	1.6	1.6	6.9	Spring	Overcast	N	No observations to note
MUBRF	17-Oct-24	7:31	CF	8.12	53.8	32.3	27	2.22	29.74	N	0	Outgoing	5.9	0.9	7.2	Spring	Overcast	N	No observations to note
MUBRF	18-Oct-24	10:16	CH	8.11	54.4	32.6	23.1	4.44	30.01	N	0	Outgoing	2.8	0.3	7.9	Spring	Sunny, Clear	N	Piling activities; revetment works on TAB01B and TAB04
MUBRF	19-Oct-24	7:19	CH	8.09	55.1	33.1	103	4.12	28.09	N	0	High, outgoing	7.3	0.1	8	Spring	Sunny, Clear, Calm	N	Piling activities
MUBRF	20-Oct-24	9:21	CH	8.16	42.1	32.4	42.1	2.83	29.56	N	0	High, outgoing	5.9	0.1	7.8	Spring	Overcast	N	No dredging or construction activities
MUBRF	21-Oct-24	13:14	CH	8.18	54	32.4	125	3.4	33.95	N	0	Low, outgoing	1	0.4	7.4	Spring	Partly cloudy, sunny	N	Construction on revetment directly opposite ramp; cleaning of ramp using pressure hose
MUBRF	22-Oct-24	13:29	CH	8.16	54.2	32.5	32.5	4.92	30.82	N	0	Low, outgoing	1.5	1	6.9	Spring	Partly cloudy, sunny	N	Construction on revetment directly opposite ramp
MUBRF	23-Oct-24	9:04	CH	8.11	54.1	32.5	101	4.6	28.76	N	0	High, outgoing	5.9	1.7	6.3	Spring	Partly cloudy, sunny	N	Piling activities on TAB01B
MUBRF	24-Oct-24	8:19	CH	8.1	54.8	32.9	107	4.24	28.31	N	0	High, incoming	5.2	2.5	5.8	Neap	Partly cloudy, sunny	N	No dredging; piling activities on TAB01B
MUBRF	25-Oct-24	10:43	CF	8.18	55	33	85.6	4.57	29.08	N	0	High	4.6	3.1	4.6	Neap	Partly cloudy, sunny	N	No dredging; RA05 fill
MUBRF	26-Oct-24	10:37	CF	8.24	54.2	32.5	9.1	4.48	30.54	N	4.6	Incoming	4	3.8	5.4	Neap	Sunny	N	Dredging; RA05 fill
MUBRF	28-Oct-24	16:15	CF	8.23	53.7	32.2	83.4	4.57	30.5	N	0	High	5.6	2.6	5.6	Spring	Sunny	N	Dredging, works to create basin A
MUBRF	29-Oct-24	15:50	CF	8.25	53.9	32.3	81.1	66.6	30.8	N	0	Incoming	5.9	2.3	6.1	Spring	Partly cloudy, sunny	N	Dredging, works to create basin A; some rain in morning.
MUBRF	30-Oct-24	15:13	CF	8.24	54.5	32.7	66.9	4.03	31.17	N	3.8	Incoming	5.4	2.6	6.4	Spring	Partly cloudy, Sunny	N	Dredging, works to create basin A; some rain in morning.
MUBRF	31-Oct-24	15:51	CF	8.2	54.8	32.9	85.4	4.14	28.47	N	25.6	Incoming	5.4	1.6	6.4	Spring	Cloudy	N	Dredging, works to create basin A; some rain in morning.
MUBRF	01-Nov-24	15:27	CF	8.24	53.9	32.4	16.4	3.71	30.76	N	1.8	Incoming	4.3	1.3	6.6	Spring	Partly cloudy, Sunny	N	Dredging, works to create basin A; some rain in morning.
MUBRF	02-Nov-24	15:11	CF	8.26	54.8	32.9	40.7	3.8	31.82	N	0	Incoming	3.2	1	6.7	Spring	Partly cloudy, sunny	N	Strong winds may have contributed to elevated NTU
MUBRF	03-Nov-24	6:49	CF	8.8	55.3	33.2	11.9	4.23	28.8	N	19.4	High, outgoing	6.7	0.9	6.6	Spring	Sunny, Clear	N	No observations to note
MUBRF	04-Nov-24	10:55	CF	8.25	54.4	32.7	11.3	3.52	31.44	N	0	Outgoing	2.5	0.9	6.7	Spring	Partly cloudy, Sunny	N	No observations to note
MUBRF	05-Nov-24	15:43	CF	8.23	54.7	32.8	117	5.32	29.6	N	0	Low, incoming	1.7	1.1	6.4	Spring	Clear	N	Sample captured plume emanating from dredge
MUBRF	07-Nov-24	7:51	CF	8.28	55.1	33	84.7	3.87	28.58	N	0	High, incoming	5.9	1.8	5.9	Spring	Clear, sunny	N	No construction or dredging works
MUBRF	08-Nov-24	10:03	CH	8.34	54.3	32.6	46.3	3.66	30.38	N	0	High, outgoing	5.2	2.3	6.1	Neap	Partly cloudy	N	Piling activities on TAB01B
MUBRF	09-Nov-24	8:05	CH	7.51	54.7	32.8	73.6	4.06	28.83	N	0	High, incoming	4.8	2.7	5.8	Neap	Clear, calm	N	Piling activities and construction of RA03
MUBRF	11-Nov-24	9:10	CH	7.2	54.5	32.3	75.6	5.6	29.9	N	0	Low, incoming	3.5	3.1	5.8	Neap	Clear, calm	N	Piling activities
MUBRF	12-Nov-24	11:10	CH	8.3	55.9	33.5	48.5	6.72	29.8	N	0	Low, incoming	3.3	2.7	5.6	Neap	Clear, calm	N	Piling activities



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	14-Nov-24	14:23	CH	-	54.1	32.5	47	3.6	32.39	N	0	High, incoming	5.1	1.3	7.1	Spring	Partly cloudy, Sunny	N	No dredging; piling activities on TAB016
MUBRF	15-Nov-24	12:08	CH	-	54.8	32.9	424	3.57	31.11	N	0	Low, outgoing	0.8	0.7	7.6	Spring	Partly cloudy, Sunny	N	No dredging activities; very turbid from low spring tides
MUBRF	17-Nov-24	8:45	CF	7.74	54.6	32.8	127	3.24	29.28	N	0	Low, outgoing	4.7	0.1	7.9	Spring	Partly cloudy, Sunny	N	No dredge, or construction activities
MUBRF	18-Nov-24	13:23	CF	-	53.2	31.9	522	3.6	31.42	N	0	Low	0.3	0.3	6.9	Spring	Sunny, Clear	N	Very turbid from low spring tides
MUBRF	21-Nov-24	15:41	CF	7.79	54.5	35.4	28.5	5.25	30.9	N	8	Low	1.9	1.8	5.9	Spring	Sunny, Clear	N	No observations to note
MUBRF	22-Nov-24	14:13	CF	7.98	54	35.1	7.5	6.27	32.9	N	32.8	Outgoing	3.1	2.5	5.3	Neap	Sunny, Clear	N	No observations to note
MUBRF	23-Nov-24	9:08	CF	8	54.9	35.7	4.6	5.92	30.3	N	6	Incoming	4.7	3.1	4.8	Neap	Cloudy	N	No observations to note
MUBRF	25-Nov-24	15:50	CF	7.79	54.5	35.5	4.52	5.34	31	N	0.6	Outgoing	4.8	3.7	4.9	Neap	Cloudy	N	No observations to note
MUBRF	26-Nov-24	15:33	CF	7.83	54.3	35.3	12.74	5.86	31.1	N	6.4	High	5.3	2.9	5.3	Neap	Partly Cloudy, Sunny	N	No observations to note
MUBRF	28-Nov-24	10:42	CH	7.73	54.1	35.1	28.13	5.24	30.7	N	23.4	Low, outgoing	2	2	6.3	Spring	Partly cloudy	N	Works at RA03; no piling activities
MUBRF	30-Nov-24	8:15	CH	7.06	53.3	34.6	56.6	6.34	30.4	N	25.2	Low, incoming	3.6	1.4	7	Spring	Partly cloudy, sunny	N	Sieve works at RA03; no piling activities
MUBRF	01-Dec-24	9:33	CH	7.91	53.1	34.5	4.88	5.34	30.4	N	0	Low, incoming	2.9	1.1	7.2	Spring	Partly cloudy, sunny	N	CSD operating near Western Revetment TAB05
MUBRF	03-Dec-24	12:06	CH	7.93	53.1	34.5	60.7	5.18	31.3	N	0	Low, incoming	1.3	1	7.3	Spring	Partly cloudy, sunny	N	No observations to note
MUBRF	04-Dec-24	9:13	CH	8.04	54	35.1	16.6	6.04	30.9	N	0.2	High, incoming	4.9	1.1	7.2	Spring	Partly cloudy, sunny	N	No dredging; sieving material in RA03
MUBRF	05-Dec-24	13:36	CH	8.06	53.71	34.9	21.8	6.12	32.5	N	6.6	Low, incoming	1.6	1.3	7	Spring	Partly cloudy, sunny	N	Sieving at RA03
MUBRF	06-Dec-24	11:28	CH	8.04	53.9	35	7.5	5.46	31.2	N	0	Low, incoming	3.5	1.6	6.8	Spring	Overcast	N	Sieving at RA03
MUBRF	07-Dec-24	9:07	CF	8	53.5	34.8	4.08	5.64	30.8	N	0.4	High	5.7	2	5.7	Neap	Overcast	N	No observations to note
MUBRF	09-Dec-24	9:11	CF	7.91	51.4	33	1.75	6.62	30.9	N	2.6	Incoming	4.5	3.2	5.2	Neap	Clear	N	No observations to note
MUBRF	11-Dec-24	8:07	CF	7.92	51.5	34	53.88	4.49	30.6	N	0	Low	2.4	2.4	5.7	Neap	Clear	N	
MUBRF	12-Dec-24	14:23	CF	8.08	51.7	34	1.49	6.64	32.6	N	0	Incoming	5.6	1.9	6.2	Neap	Overcast, windy	N	
MUBRF	13-Dec-24	15:27	CF	7.97	50.8	33	2.76	6.32	31.6	N	11	High	6	1.3	6.8	Spring	Overcast	N	No observations to note
MUBRF	14-Dec-24	10:00	CF	7.89	48.7	32	135	5.29	31.4	N	0	Outgoing	1.2	0.9	6.2	Spring	Overcast	N	Sampled within plume
MUBRF	16-Dec-24	15:35	CF	7.92	51.6	34	11.6	6.76	34	N	0	Incoming	3.5	0.6	7.6	Spring	Clear	N	No observations to note
MUBRF	17-Dec-24	14:01	CF	7.92	50.5	33	354	5.65	34.4	N	26	Outgoing	0.8	0.7	7.6	Spring	Clear	N	Sampled at low tide. Boat at MUBRF may have contributed to sediment disturbance
MUBRF	18-Dec-24	13:11	CF	7.89	50.2	33	24.6	5.44	32.7	N	25	Low	0.9	1.1	6.5	Spring	Clear	N	Visually turbidity due to low tide
MUBRF	19-Dec-24	8:58	CF	8.36	51.3	33	4.89	5.86	31	N	7.8	High	6.2	6.3	1.3	Spring	Clear	N	No observations to note
MUBRF	13-Jan-25	8:25	CH	7.92	49.16	32	2.17	5.01	31.6	N	0	Low, incoming	3.2	1.2	7.3	Spring	Clear	N	No dredging
MUBRF	14-Jan-25	16:09	CF	7.89	49.1	32.2	2.82	5.61	32.2	N	0	Outgoing	3.8	1	7.5	Spring	Clear	N	No dredging
MUBRF	15-Jan-25	16:31	CF	7.78	49	32	4.51	6.09	32.6	N	0	Incoming	3.3	1.1	7.6	Spring	Clear	N	No observations to note
MUBRF	16-Jan-25	14:23	CF	7.74	49.6	32	97	5.69	31.9	N	6.2	Low	1.1	1.1	7.6	Spring	Overcast	N	Sampled within plume from RA03
MUBRF	17-Jan-25	9:30	CF	7.92	49.7	32	8.73	5.38	31.2	N	38	Outgoing	5.8	1.3	6.5	Spring	Overcast	N	BHD operational
MUBRF	18-Jan-25	13:55	CF	7.71	48.3	31	24.5	5.29	31.4	N	0	Low	1.8	1.7	7.2	Spring	Overcast	N	Accessed from TMOF; no dredging
MUBRF	19-Jan-25	11:02	CF	7.74	49	32	6.3	5.5	31.1	N	0.2	Outgoing	5.4	2.2	6.2	Spring	Overcast	N	No observations to note
MUBRF	20-Jan-25	15:29	CF	7.83	49	32	19.08	7.25	33.2	N	4.4	Low	2.6	2.6	6	Neap	Clear	N	BHD operational
MUBRF	21-Jan-25	9:56	CF	7.87	49.3	32	2.67	5.62	31.4	N	0	High	5.6	3.1	5.7	Neap	Clear	N	BHD operational
MUBRF	22-Jan-25	13:15	CF	7.89	48.7	32	9.88	6.27	33.2	N	1.2	Outgoing	1.4	1.1	7.6	Spring	Overcast	N	BHD operational
MUBRF	23-Jan-25	9:35	CH	7.92	47.73	31	2.26	6.33	31	N	0	Low	3.8	2.8	5.4	Neap	Clear	N	BHD not operational; construction activities at TAB05
MUBRF	24-Jan-25	13:36	CH	7.81	47	31	1.91	5.84	31.8	N	0	High	5	2.9	5	Neap	Overcast	N	BHD operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (c)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	25-Jan-25	9:39	CH	7.97	47.5	31	4.21	5.84	30.8	N	0.2	Low, outgoing	2.9	2.8	5.5	Neap	Overcast	N	BHD operational
MUBRF	28-Jan-25	13:03	CH	7.95	48.3	31	8.65	6.63	33.9	N	0.4	Low	2.5	1.7	6.9	Spring	Overcast	N	BHD not operational; construction activities at TAB02
MUBRF	29-Jan-25	10:15	CH	7.7	48.5	32	9.95	4.33	32.2	N	46.2	Low, outgoing	2.3	1.3	7.3	Spring	Overcast	N	BHD not operational; construction activities at TAB02
MUBRF	31-Jan-25	11:24	CF	7.65	48	31	30.29	4.81	31.9	N	72	Outgoing	2.5	0.9	6.8	Spring	Overcast	N	BHD operational
MUBRF	01-Feb-25	13:03	CF	7.9	47.1	31	59.2	4.94	32.1	N	2.4	Outgoing	2.1	1.2	7.8	Spring	Partly cloudy	N	BHD operational
MUBRF	02-Feb-25	13:50	CF	7.8	48.3	31	34.4	5.82	32.5	N	0	Outgoing	1.6	1.2	7.7	Spring	Partly cloudy	N	BHD operational
MUBRF	04-Feb-25	11:58	CF	7.79	46.9	31	25.71	6.1	29.9	N	44.8	Outgoing	5.5	2.4	7.1	Spring	Overcast	N	BHD operational
MUBRF	05-Feb-25	9:48	CF	7.93	50.5	30	4.29	5.87	29.6	N	34	Incoming	6.1	3.1	6.3	Neap	Overcast	N	BHD operational
MUBRF	06-Feb-25	16:10	CF	8	42.1	27	2.87	7.05	30.8	N	0	Outgoing	4	2	5.9	Neap	Overcast	N	BHD operational
MUBRF	07-Feb-25	15:54	CF	8.02	46.9	31	2.54	6.61	30.8	N	0.2	Outgoing	5	2.3	5.5	Neap	Overcast	N	BHD operational
MUBRF	08-Feb-25	14:11	CF	8	46.3	30	3.77	5.68	30.1	N	11.6	High	5.3	2.5	5.6	Neap	Overcast	N	BHD operational
MUBRF	10-Feb-25	14:06	CF	7.94	45.7	30	7.82	5.95	30.2	N	0	Incoming	3.6	2	6.7	Neap	Overcast	N	BHD operational
MUBRF	12-Feb-25	15:35	CH	8.02	46.1	30	3.02	6.55	30.9	N	0	Low, outgoing	3.9	1.4	7.4	Spring	Overcast, calm	N	BHD operational
MUBRF	13-Feb-25	9:35	CF	7.75	44.6	29	14.71	6.26	30.2	N	100.8	Outgoing	3.9	1.2	7.6	Spring	Cloudy	N	BHD operational
MUBRF	14-Feb-25	12:57	CH	7.66	44.4	29	43.6	5.2	30.5	N	0.2	Low, outgoing	1.6	1.3	7.6	Spring	Overcast, calm	N	BHD operational
MUBRF	15-Feb-25	13:06	CH	7.5	-	-	17.06	8.52	25.9	N	5.4	Low, outgoing	1.7	1.4	7.6	Spring	Overcast	N	BHD operational
MUBRF	17-Feb-25	15:31	CH	8	44.8	29	7.9	7.2	32.4	N	6.6	Low, incoming	2.1	2.1	7.2	Spring	Partly cloudy	N	BHD operational
MUBRF	18-Feb-25	13:39	CH	8	44.9	29	8	6.2	31.1	N	1.6	Low, outgoing	3.4	2.5	6.9	Spring	Partly cloudy	N	BHD not operational
MUBRF	19-Feb-25	14:13	CH	8.1	45.8	30	14.8	7.01	31.9	N	1.6	Low, outgoing	3.3	3	6.5	Spring	Sunny, partly cloudy	N	BHD not operational
MUBRF	20-Feb-25	13:21	CH	8	45.9	30	3.5	6.8	31.7	N	0	Low, outgoing	4.7	2.2	6	Neap	Sunny, partly cloudy	N	BHD not operational; construction on TAB02
MUBRF	26-Feb-25	15:42	CF	7.93	44.3	29	4.69	6.87	33.3	N	0	Incoming	5.6	1.9	6.9	Neap	Clear	N	BHD operational
MUBRF	27-Feb-25	16:18	CF	8.07	47.5	31	2.79	6.44	32.7	N	19.8	Incoming	5.8	1.4	7.4	Spring	Partly Cloudy	N	BHD operational
MUBRF	28-Feb-25	16:14	CF	8.05	47.1	31	3.79	6.38	31.9	N	0.2	Incoming	4.9	1.1	7.8	Spring	Partly Cloudy	N	BHD operational
MUBRF	01-Mar-25	16:42	CF	8.02	47.4	31	4.38	6.19	32.3	N	7.8	Incoming	5.8	1.4	7.4	Spring	Partly Cloudy	N	BHD operational
MUBRF	06-Mar-25	14:31	CH	7.89	48.3	31	12.02	5.46	32.6	N	0	Outgoing	3.8	3.3	6.6	Spring	Clear	N	BHD operational
MUBRF	06-Mar-25	14:32	CH	7.94	48.3	31	42.1	6.1	32.9	N	0	Outgoing	3.8	3.3	6.6	Spring	Clear	N	BHD operational
MUBRF	08-Mar-25	12:18	CH	8.08	48.1	31	3	6.23	32.3	N	0	Outgoing	5.4	2.5	5.4	Neap	Clear	N	BHD operational
MUBRF	10-Mar-25	14:00	CH	8	47.2	31	1.2	6.5	32.7	N	16.4	High, incoming	4.9	2.8	6	Neap	Overcast	N	BHD operational
MUBRF	11-Mar-25	14:11	CH	8	47.4	31	3.02	6.6	33.1	N	2.2	High, incoming	4.5	2.4	6.5	Spring	Clear	N	BHD operational
MUBRF	12-Mar-25	13:21	CH	7.9	48.3	31	9.8	5.8	32.6	N	0	Low, incoming	2.7	2	6.9	Spring	Clear	N	BHD operational; construction of Eastern revetment
MUBRF	13-Mar-25	16:31	CH	8	48.8	32	6.8	6.15	32.8	N	9.2	High, incoming	5.7	1.8	7.2	Spring	Overcast	N	BHD operational
MUBRF	14-Mar-25	16:40	CH	7.9	48.6	32	2.8	6	32.5	N	51.2	High, incoming	5.4	1.6	7.4	Spring	Overcast	N	BHD operational
MUBRF	15-Mar-25	15:52	CH	8	47.9	31	13.5	6.3	32.2	N	35.2	Low, incoming	3.6	1.6	7.4	Spring	Overcast	N	BHD operational; unloading barge
MUBRF	16-Mar-25	10:48	CF	7.93	46.8	30	12.99	6	31.3	N	32.4	Outgoing	4.5	1.8	7.4	Spring	Clear	N	BHD operational
MUBRF	17-Mar-25	15:06	CF	7.84	47.2	31	9.57	5.88	33.7	N	31	Low, incoming	2.5	2	7.2	Spring	Clear	N	BHD operational
MUBRF	18-Mar-25	7:22	CF	7.94	47.3	31	5.54	5.77	30.8	N	15.8	High, incoming	6.6	1.4	7.1	Spring	Overcast	N	BHD operational
MUBRF	20-Mar-25	15:06	CF	7.91	45.4	30	5	6.07	31.3	N	0.4	Low	3	3	6.6	Neap	Overcast	N	BHD operational
MUBRF	21-Mar-25	15:58	CF	7.96	46	30	3.74	6.29	31.7	N	12.0	Low	3.6	2	6.3	Neap	Overcast	N	BHD operational
MUBRF	22-Mar-25	13:04	CF	7.97	43.6	28	3.92	5.86	30.8	N	0	High, outgoing	4.8	4	5.8	Neap	Overcast	N	BHD operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	25-Mar-25	10:53	CF	7.96	45.5	30	7.47	6.47	30.7	N	26.4	Low, incoming	3.7	3.2	5.7	Neap	Overcast	N	BHD operational; unloading barge
MUBRF	26-Mar-25	12:43	CF	7.8	43.6	28	7.3	6.6	29.8	N	0	Incoming	3.7	2.7	6.3	Neap	Overcast	N	BHD operational
MUBRF	27-Mar-25	14:42	CH	7.9	43.8	28	3.1	6.05	30.3	N	3.4	High, incoming	4.8	2.2	6.8	Spring	Overcast	N	BHD operational
MUBRF	31-Mar-25	15:05	CH	8	44.1	29	10.3	5.7	30.1	N	5.6	Low, incoming	2.4	1.5	8	Spring	Overcast, rain	N	No EC or TDS; BHD operational
MUBRF	03-Apr-25	13:05	CH	7.9	37.5	24	102.05	6.2	29.5	N	0	Low, outgoing	2.9	0.7	7.3	Spring	Partly cloudy, calm	N	BHD operational
MUBRF	04-Apr-25	13:48	CF	7.79	17.9	12	12.33	6.87	29.3	N	0	Outgoing	4.4	3.5	6.7	Neap	Partly cloudy, slight wind	N	BHD operational
MUBRF	07-Apr-25	15:12	CF	8.01	40.9	27	8.01	7.4	31.2	N	0	Outgoing	5.4	3.2	5.5	Neap	Clear	N	BHD operational
MUBRF	09-Apr-25	15:15	CF	8.11	43.4	28	4.64	7.11	30.1	N	9	Incoming	5.7	2.8	6.3	Neap	Overcast	N	BHD operational
MUBRF	10-Apr-25	15:52	CF	8.09	44.8	29	10.94	6.93	30.7	N	0	Incoming	6	2.5	6.6	Neap	Partly cloudy	N	BHD operational
MUBRF	11-Apr-25	15:42	CF	8.06	46.2	30	7.48	6.79	30.3	N	0	Incoming	5.5	2.3	6.8	Neap	Partly cloudy	N	BHD operational
MUBRF	14-Apr-25	10:17	CF	8.05	44.9	29	24.06	6.66	29.1	N	25.6	Outgoing	4.7	2.2	7.2	Spring	Partly cloudy	N	BHD operational
MUBRF	15-Apr-25	15:23	CF	7.98	46.2	30	8.45	6.65	32.5	N	5	Incoming	3.6	2.3	7.3	Spring	Partly cloudy	N	BHD operational
MUBRF	16-Apr-25	16:06	CF	8.04	6.71	29	6.82	6.71	30.8	N	6.6	Incoming	4	2.5	7.2	Spring	Partly Cloudy	N	BHD operational
MUBRF	17-Apr-25	15:10	CH	8.01	46.4	30	15.21	6.65	32	N	0	Low, incoming	3	2.8	6.5	Spring	Partly cloudy	N	BHD operational
MUBRF	18-Apr-25	15:18	CH	7.86	45.6	29	6.26	6.63	31.1	N	0	Low, incoming	3.2	3.1	6.8	Spring	Partly cloudy	N	BHD operational
MUBRF	19-Apr-25	14:32	CH	8	46.04	30	13.16	6.54	31.5	N	0	Low, outgoing	3.6	3.5	6.4	Neap	Overcast	N	BHD operational
MUBRF	20-Apr-25	8:32	CH	8	45	29	4.07	6.4	29.8	N	12.4	High, incoming	5.3	3.9	6	Neap	Partly cloudy	N	BHD operational; loading barge
MUBRF	21-Apr-25	16:00	CH	8.03	45.43	30	3.14	6.7	31.2	N	0	Low, outgoing	4.4	4.2	5.6	Neap	Partly cloudy	N	BHD operational
MUBRF	22-Apr-25	12:48	CH	8.03	45.1	29	4	6.83	30.4	N	0	High, incoming	5.1	3.1	5.7	Neap	Partly cloudy	N	BHD operational
MUBRF	24-Apr-25	13:30	CH	8.11	46.54	30	14.45	6.78	29	N	0	High, incoming	5.2	2.9	6.1	Spring	Partly cloudy	N	BHD operational; unloading barge
MUBRF	26-Apr-25	14:21	CH	8.04	47.9	31	7.4	6.99	30.9	N	0	High, incoming	4.6	2.2	6.9	Spring	Partly cloudy	N	BHD operational
MUBRF	28-Apr-25	13:25	CH	7.87	46.86	30	12.72	6.28	28.7	N	0	Low, incoming	2.5	2	7.7	Spring	Overcast	N	BHD operational New Calibrations on 28-04
MUBRF	29-Apr-25	9:46	CH	7.86	47.37	31	10.71	6.13	27.8	N	0	Low, outgoing	5	2.1	8	Spring	Overcast	N	BHD operational
MUBRF	30-Apr-25	15:42	CF	7.91	47.8	31	4.09	6.42	28.6	N	0	Incoming	3.6	2.3	7.9	Spring	Partly Cloudy	N	BHD non-operational
MUBRF	01-May-25	15:00	CF	7.88	47.7	31	18.42	6.36	27.6	N	0	Low, incoming	2.9	2.6	2.2	Spring	Clear	N	BHD operational; loading barge
MUBRF	02-May-25	14:10	CF	8.4	47.8	31	49.21	6.72	28.6	N	0	Low, outgoing	3.2	3	7.2	Neap	Clear	N	BHD operational; loading and unloading barge
MUBRF	03-May-25	13:30	CF	7.78	48.3	31	11.87	6.43	30	N	0	Low	3.4	3.4	6.7	Neap	Clear	N	BHD operational; loading and unloading barge
MUBRF	05-May-25	14:11	CF	7.86	48.7	32	8.65	6.71	29.9	N	9	High, outgoing	5.3	2.8	5.7	Neap	Overcast	N	BHD operational; loading and unloading barge
MUBRF	06-May-25	12:02	CF	7.88	47.7	31	5.63	6.61	29.1	N	0	High, incoming	5.3	3.2	5.6	Neap	Partly Cloudy	N	BHD operational; loading barge
MUBRF	07-May-25	14:08	CH	8.04	-	-	19.91	8.74	24.2	N	0	High, incoming	5.5	3	5.6	Neap	Partly Cloudy	N	BHD operational; unloading barge
MUBRF	08-May-25	14:37	CH	7.89	48.3	31	4.63	6.55	29	N	0	High, incoming	5.6	2.5	5.8	Neap	Clear, sunny	N	BHD operational; unloading barge
MUBRF	09-May-25	15:00	CH	7.91	48	31	4.48	6.48	29.2	N	0	High, incoming	5.6	3	6	Spring	Clear, sunny	N	BHD operational; unloading barge
MUBRF	10-May-25	12:07	CH	7.95	48.7	32	3.67	6.78	27.9	N	0	Low, incoming	3.1	2.9	6.2	Spring	Clear, sunny	N	BHD operational; unloading barge
MUBRF	11-May-25	15:40	CH	7.92	48.42	31	2.79	6.68	28.7	N	0	Low, incoming	4	2.7	6.9	Spring	Partly cloudy, sunny	N	BHD operational; loading barge
MUBRF	12-May-25	14:19	CH	7.97	48.79	32	4.59	6.67	28.1	N	0	Low, incoming	4	2.7	6.9	Spring	Partly cloudy, sunny	N	BHD operational; loading barge
MUBRF	13-May-25	15:47	CH	7.94	48.68	32	3.54	6.69	28.4	N	0	High, incoming	4.9	2.7	6.5	Spring	Partly cloudy, sunny	N	BHD operational; unloading barge
MUBRF	14-May-25	16:06	CH	7.95	48.7	32	3.27	6.72	28.6	N	0	High, incoming	4.6	2.7	7.1	Spring	Partly cloudy, sunny	N	BHD operational; loading barge
MUBRF	15-May-25	15:39	CH	7.97	48.79	32	6.12	6.75	28.6	N	0	Low, incoming	3.7	2.7	7.1	Spring	Partly cloudy, sunny	N	BHD operational; loading barge
MUBRF	16-May-25	16:34	CF	7.57	51.9	34	4.55	6.76	28.1	N	0	Low	4.3	2.9	6.9	Spring	Partly cloudy, sunny	N	*New Calibrations



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	17-May-25	14:37	CF	7.74	53.4	35	16.27	6.93	28.7	N	0	Low	3.1	3.1	6.7	Neap	Partly cloudy, sunny	N	BHD operational; loading barge and offloading barge
MUBRF	18-May-25	11:51	CF	7.78	52.7	34	2.69	6.76	25.7	N	0	Outgoing	5.4	3.3	6.5	Neap	Overcast	N	Unloading barge
MUBRF	19-May-25	15:04	CF	7.83	53.1	35	2.88	7.07	26.7	N	0	Low, outgoing	3.8	2.1	6.2	Neap	Overcast	N	Unloading barge
MUBRF	20-May-25	16:21	CF	7.79	53.2	35	5.72	6.85	29.4	N	0	Low, outgoing	3.9	3.7	6	Neap	Clear	N	BHD not operational- Barge movement to TMOF
MUBRF	21-May-25	8:39	CF	7.83	52	34	13.63	6.79	24.6	N	0	Incoming	4.1	2.8	5.8	Neap	Clear	N	BHD operational in front of TMOF
MUBRF	22-May-25	15:58	CF	7.76	-	-	26.9	8.11	29.6	N	0	High, outgoing	5	3	5.8	Neap	Clear	N	BHD operational
MUBRF	23-May-25	13:48	CF	7.76	53.6	35	1.85	6.79	28.3	N	0	High	6	3.1	5.9	Neap	Partly cloudy, sunny	N	BHD non-operational
MUBRF	26-May-25	9:45	CF	7.67	53.7	35	8.9	6.42	28.5	N	0	Low, outgoing	3.6	2.7	7.1	Spring	Clear	N	BHD non-operational
MUBRF	27-May-25	14:29	CF	7.6	52.3	34	22.8	6.58	27	N	3.4	High, incoming	4.4	2.6	7.5	Spring	Cloudy	N	BHD operational; offloading barge
MUBRF	28-May-25	13:11	CF	7.64	53.1	35	28.8	6.37	28	N	8.4	Low	2.6	2.6	7.7	Spring	Partly cloudy, sunny	N	BHD non-operational; unloading barge
MUBRF	29-May-25	14:22	CH	7.75	52.7	34	28.38	6.54	27.8	N	0	Low, incoming	3	2.6	7.6	Spring	Partly cloudy, sunny	N	BHD operational
MUBRF	30-May-25	16:06	CH	7.78	53.13	35	9.38	6.66	27	N	0	Low, incoming	3.7	2.7	7.4	Spring	Partly cloudy, sunny	N	BHD operational
MUBRF	31-May-25	10:54	CH	7.78	53.08	35	3.59	6.56	26.7	N	0	High, outgoing	6.5	2.9	7.1	Spring	Clear	N	BHD non-operational
MUBRF	01-Jun-25	14:22	CH	7.51	52.4	34	9.97	8.51	26.6	N	0	Low, outgoing	3.8	3.1	6.8	Spring	Partly cloudy, sunny	N	BHD non-operational *New Calibrations
MUBRF	02-Jun-25	15:15	CH	7.78	53.5	35	7.59	8.52	27.7	N	0	Low, outgoing	3.8	3.2	6.4	Spring	Clear	N	BHD non-operational
MUBRF	03-Jun-25	13:13	CH	7.73	53.4	35	3.19	8.44	27	N	0	High, outgoing	5.3	3.2	6	Neap	Clear	N	BHD operational
MUBRF	04-Jun-25	10:22	CH	7.7	53.38	35	5.3	8.11	26.3	N	0	High, incoming	5.2	3.1	5.7	Neap	Partly cloudy, sunny	N	BHD operational
MUBRF	05-Jun-25	14:29	CH	7.66	30.59	20	9.2	8.84	29	N	0	High, outgoing	5.4	3.4	5.5	Neap	Partly cloudy, sunny	N	BHD operational
MUBRF	06-Jun-25	12:00	CF	7.72	53.6	35	6.59	8.25	28.8	N	0	Incoming	4.8	3.6	5.4	Neap	Partly cloudy, sunny	N	Offloading
MUBRF	07-Jun-25	12:23	CF	7.69	53.5	35	8.84	8.38	27.3	N	0	Incoming	4.5	3.6	5.5	Neap	Clear	N	BHD operational
MUBRF	09-Jun-25	13:22	CF	7.68	53.6	35	5.4	8.42	27.1	N	0	Incoming	4.1	3.3	6.3	Neap	Clear	N	BHD operational
MUBRF	11-Jun-25	13:06	CF	7.72	54.3	35	10.34	8.86	28.2	N	0	Low	3	3	6.8	Neap	Clear	N	BHD operational
MUBRF	12-Jun-25	9:02	CF	7.73	53.3	35	9.56	8.37	24.3	N	0	High, outgoing	6.1	2.9	6.9	Spring	Clear	N	BHD operational
MUBRF	13-Jun-25	8:03	CF	7.77	53.2	35	9	8.29	23.6	N	0	High	6.9	2.8	6.9	Spring	Clear	N	BHD operational; offloading barge
MUBRF	14-Jun-25	8:44	CF	7.74	53.3	35	9.2	8.36	23.8	N	0	High	6.9	2.8	6.9	Spring	Clear	N	BHD operational; offloading barge
MUBRF	15-Jun-25	8:47	CF	7.69	54.2	35	18.78	8.42	24.5	N	0	High	6.8	2.8	6.8	Spring	Clear	N	BHD operational ; offloading - Sample taken within a plume
MUBRF	16-Jun-25	9:06	CF	7.71	53.3	35	8.61	8.34	23.6	N	0	High, incoming	6.9	2.9	6.9	Spring	Clear	N	BHD operational; offloading barge
MUBRF	17-Jun-25	8:53	CF	7.54	50.3	33	6.32	7	23.6	N	0	High, incoming	6.1	2.9	6.5	Spring	Clear	N	BHD operational
MUBRF	18-Jun-25	7:01	CF	7.98	53.4	35	7.88	6.79	23	N	0	Incoming	3.9	2.9	6.4	Spring	Clear	N	BHD operational; offloading barge
MUBRF	19-Jun-25	15:45	CH	8.01	53.45	35	29.29	7.27	26.1	N	0	Low, outgoing	3.6	2.7	6.1	Spring	Clear	N	BHD operational; offloading barge
MUBRF	20-Jun-25	15:46	CH	8.03	53.6	35	4.2	7.15	26	N	0	Low, outgoing	4.2	2.4	5.9	Neap	Clear	N	BHD operational; offloading barge
MUBRF	21-Jun-25	16:00	CH	8.02	53.6	35	4.03	6.97	26.3	N	0	High, outgoing	4.5	3.3	5.8	Neap	Clear	N	BHD operational; offloading barge
MUBRF	22-Jun-25	14:00	CH	8.01	53.75	35	2.98	6.86	25.8	N	0	High	5.7	3.4	5.7	Neap	Sunny, partly cloudy	N	BHD operational
MUBRF	23-Jun-25	8:16	CH	8	53.1	35	11.5	6.77	24.2	N	0	Low, outgoing	4	3.4	5.8	Neap	Calm, cloudy	N	Plume sampled >150m from source + readings from Turbidity Buoy 1
MUBRF	23-Jun-25	8:17	CH	7.98	53.81	35	7.69	6.68	24.5	N	0	Low, outgoing	4	3.4	5.8	Neap	Calm, cloudy	N	Plume sampled >150m from source + readings from Turbidity Buoy 1
MUBRF	23-Jun-25	10:53	CH	7.97	53.9	35	6.53	6.84	25.6	N	0	Low, incoming	3.5	3.4	5.8	Neap	Calm, cloudy	N	Plume sampled >150m from source + readings from Turbidity Buoy 1
MUBRF	23-Jun-25	10:54	CH	7.96	53.96	35	8.12	6.69	25.6	N	0	Low, incoming	3.5	3.4	5.8	Neap	Calm, cloudy	N	Plume sampled >150m from source + readings from Turbidity Buoy 1
MUBRF	24-Jun-25	14:02	CH	8	53.86	35	1.05	6.89	26.3	N	0	High, incoming	4.8	3.2	6.8	Spring	Sunny, partly cloudy	N	BHD not operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	25-Jun-25	15:26	CH	8	53.7	35	2.75	6.92	26.9	N	0	High, incoming	5.3	3	7.1	Spring	Sunny, partly cloudy	N	BHD operational; unloading barge
MUBRF	26-Jun-25	10:45	CH	7.96	54.33	35	6.2	6.9	25.4	N	0	Low, outgoing	10.3	2.8	7.3	Spring	Clear, sunny, strong winds	N	Plume sampled >150m from source
MUBRF	26-Jun-25	10:47	CH	7.94	54.2	35	5.36	6.73	25.1	N	0	Low, outgoing	10.3	2.8	7.3	Spring	Clear, sunny, strong winds	N	Plume sampled >150m from source
MUBRF	27-Jun-25	14:46	CF	7.92	54.9	35	17.72	6.92	26.5	N	0	Low, incoming	3	2.6	7.4	Spring	Clear, strong winds	N	BHD operational near TMOF
MUBRF	28-Jun-25	16:15	CH	7.89	53.2	35	11.42	9.12	24.6	N	0	Low, incoming	3.5	2.5	7.3	Spring	Clear, calm	N	BHD operational
MUBRF	29-Jun-25	7:07	CF	7.92	52.7	34	8.86	8.97	22.9	N	0	High, incoming	5.7	2.5	7.2	Spring	Clear, strong winds	N	BHD operational; offloading barge
MUBRF	30-Jun-25	16:34	CF	7.92	53.1	35	7.77	9.19	24.6	N	0	Low, outgoing	2.7	2.5	7.3	Spring	Clear, calm	N	BHD operational
MUBRF	01-Jul-25	11:22	CF	7.91	53.2	35	7.16	9.14	23.5	N	0	High, outgoing	6.4	2.5	6.6	Neap	Clear, light winds	N	BHD operational
MUBRF	02-Jul-25	7:33	CF	7.93	53	34	16.94	9.08	22.1	N	0	High, outgoing	6.1	2.5	6.3	Neap	Clear, light winds	N	BHD non-operational; works to remove pile
MUBRF	03-Jul-25	9:09	CF	7.85	53.8	35	2.57	8.86	23.8	N	0	High, incoming	5.1	3	5.9	Neap	Clear, light winds	N	BHD non-operational; works to remove pile, offloading from nightshift dredging
MUBRF	04-Jul-25	16:00	CF	7.93	53.4	35	1.63	9.33	25.3	N	0	Outgoing	3.7	2.7	5.5	Neap	Clear, calm	N	BHD operational
MUBRF	05-Jul-25	11:04	CF	7.82	54	35	15.53	8.82	25.5	N	0	High, outgoing	5	2.6	5.2	Neap	Clear, very calm	N	BHD operational; offloading barge
MUBRF	06-Jul-25	7:41	CF	7.88	53.22	35	11.95	8.39	22.9	N	0	Low, outgoing	4	3.9	5	Neap	Clear, very calm	N	BHD operational; offloading barge
MUBRF	07-Jul-25	8:22	CF	7.88	53.2	35	7.88	8.56	23.4	N	0	Outgoing	4.6	3.6	5.9	Neap	Clear, moderate winds	N	BHD operational
MUBRF	08-Jul-25	10:33	CF	7.89	53.8	35	3.09	8.8	24.8	N	0	Low, outgoing	3.7	3.6	5.9	Neap	Clear, moderate winds	N	BHD operational; offloading barge
MUBRF	09-Jul-25	16:15	CH	7.89	53.9	35	13.95	9.04	26.1	N	0	High, incoming	5.4	3.4	6.3	Neap	Clear, calm	N	Offloading barge
MUBRF	10-Jul-25	15:40	CH	7.87	54.18	35	0.3	9.06	27	N	0	High, incoming	5	3.1	6.5	Neap	Clear, calm	N	BHD operational; offloading barge
MUBRF	11-Jul-25	14:18	CH	7.71	53.97	35	3.16	9.32	25.1	N	0	Low, incoming	3.4	2.9	6.8	Spring	Partly cloudy	N	BHD operational
MUBRF	12-Jul-25	15:26	CH	7.88	53.9	35	38.16	8.97	25.5	N	0	Low, incoming	3.9	2.7	6.9	Spring	Clear, easterly moderate winds	N	BHD operational
MUBRF	13-Jul-25	14:07	CH	7.88	51.1	35	4.47	9.35	25.3	N	0	Low, incoming	2.5	2.5	7.1	Spring	Clear, easterly moderate winds	N	BHD operational
MUBRF	14-Jul-25	16:25	CH	7.88	54.54	35	22.51	9.03	26.4	N	0	Low, incoming	3.4	2.3	7.1	Spring	Clear, calm	N	BHD operational
MUBRF	15-Jul-25	16:20	CH	7.69	50.59	33	7.63	9.54	25.9	N	0	Low, incoming	2.6	2.2	7.1	Spring	Clear, calm	N	*New Calibrations
MUBRF	16-Jul-25	16:15	CH	7.78	50.75	33	19.56	9.35	26.1	N	0	Low, incoming	2.1	2.1	6.9	Spring	Clear, calm	N	BHD operational
MUBRF	17-Jul-25	15:00	CH	7.79	50.76	33	10.6	9.55	27.2	N	0	Low, outgoing	2.7	2	6.7	Spring	Partly cloudy, calm	N	Offloading barge
MUBRF	19-Jul-25	9:55	CH	7.82	50.58	33	5.48	9.14	25.2	N	0	High, incoming	5.6	2	6	Spring	Partly cloudy, low winds	N	BHD operational
MUBRF	21-Jul-25	14:38	CH	7.82	50.87	33	3.49	9.62	26.7	N	0	High, outgoing	5	1.8	5.2	Neap	Clear, calm	N	BHD operational
MUBRF	22-Jul-25	15:23	CF	7.81	50.69	33	7.81	9.6	26.3	N	0	High, outgoing	5.2	1.8	5.2	Neap	Clear, calm	N	BHD operational
MUBRF	23-Jul-25	14:53	CF	7.73	51.3	33	16.53	9.52	28.1	N	0	High, incoming	5	1.3	5.5	Neap	Clear, calm	N	BHD operational
MUBRF	24-Jul-25	9:42	CF	7.76	51	33	11.16	9.33	26.4	N	0	Outgoing	4.6	1	6.8	Spring	Clear, calm	N	BHD operational
MUBRF	25-Jul-25	16:35	OQV	7.8	50.68	33	18.24	9.41	26.6	N	0	High, incoming	5.5	2.6	6.2	Spring	Cloudy, calm	N	BHD operational
MUBRF	26-Jul-25	16:46	CF	7.84	51.1	33	8.89	9.31	27.6	N	0	Incoming	4.7	0.9	7.3	Spring	Clear, calm	N	No observations to note
MUBRF	27-Jul-25	16:36	OQV	7.62	50.71	33	7.9	9.09	26.9	N	0	Incoming	2.9	1.9	6.5	Spring	Clear, calm	N	Completion of dredge works
MUBRF	28-Jul-25	14:31	CF	7.55	49.16	32	9.3	9.18	26.8	N	0	Low	1.9	1.1	7.3	Spring	Clear, calm	N	No observations to note
MUBRF	29-Jul-25	16:35	CF	7.75	52.7	34	15.95	6.79	26.4	N	0	Low, incoming	2.3	1.4	7.1	Spring	Clear, calm	N	*New Calibrations
MUBRF	30-Jul-25	15:29	CH	7.75	53.12	35	27.2	6.64	26.4	N	0	Low, incoming	2	1.9	6.8	Spring	Partly cloudy, low winds	N	No observations to note
MUBRF	31-Jul-25	15:18	CH	7.62	53.57	35	16.84	6.58	27.4	N	0	Low, outgoing	2.3	2.1	6.5	Spring	Partly cloudy, low winds	N	No observations to note
MUBRF	01-Aug-25	15:25	CH	7.95	53.85	35	28.31	6.75	27.4	N	0	Low, outgoing	3	2.1	6.5	Spring	Clear, low winds	N	No observations to note
MUBRF	02-Aug-25	13:22	OQV	7.93	54.65	36	5.45	6.98	25.9	N	0	High, outgoing	4.5	2.5	5.6	Spring	Clear, calm	N	No observations to note



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
MUBRF	10-Aug-25	16:05	CF	7.83	54.196	35	4.01	6.99	26.6	N	0	Incoming	4.4	1.1	7.2	Spring	Clear, calm	N	No observations to note
MUBRF	12-Aug-25	11:52	CF	7.33	51.521	33	2.96	6.8	26.8	N	0	Outgoing	4	1	7.5	Spring	Clear, calm	N	*New Calibrations
MUBRF	13-Aug-25	16:40	CF	7.59	54.44	35	4.7	6.81	27.3	N	0	Low, incoming	2.1	1.2	7.4	Spring	Clear, calm	N	No observations to note
MUBRF	14-Aug-25	15:27	CF	7.65	54.126	35	19.8	6.92	26.3	N	0	Low, outgoing	1.2	1.2	7.2	Spring	Clear, calm	N	Sample taken at low tide within disturbed waters from outgoing low tide
MUBRF	15-Aug-25	15:50	OQV	7.59	54.812	36	12.44	6.71	27.4	N	0	Low	1.5	1.3	6.9	Spring	Clear, calm	N	No piling works
MUBRF	16-Aug-25	16:09	OQV	7.41	25.17	16	5.88	7.44	26.5	N	0	Low	1.8	1.6	6.4	Spring	Clear, calm	N	No piling or revetment works
MUBRF	17-Aug-25	16:01	OQV	7.45	55.27	35	11.81	6.81	25.9	N	0	Low	2.5	1.9	5.9	Spring	Clear, calm	N	No piling or revetment works
MUBRF	18-Aug-25	16:14	OQV	7.65	55.21	36	4.75	6.73	26.5	N	0	Low	3.1	2.3	5.4	Spring	Clear, calm	N	No piling or revetment works
MUBRF	19-Aug-25	15:50	CF	7.41	54.529	35	4.91	7.17	25.8	N	0	Outgoing	4	2.3	5.4	Neap	Clear, calm	N	No piling or revetment works
MUBRF	20-Aug-25	13:10	CH	7.46	54.33	35	0.57	6.92	25.7	N	0	High, incoming	4.5	3.8	5.8	Neap	Clear, calm	N	No observations to note
MUBRF	23-Aug-25	14:30	CH	7.39	54.03	35	3.11	6.71	27.2	N	0	Low, incoming	3.1	2.2	6.5	Spring	Clear, calm	N	No observations to note
MUBRF	26-Aug-25	15:28	CH	7.65	55.17	36	69.98	6.8	27.8	N	0	Low, incoming	1.9	1.4	7.3	Spring	Overcast, calm	N	Caisson backfill
MUBRF	29-Aug-25	15:33	CF	7.55	54.4	36	7.02	6.61	29.3	N	0	Low	1.7	1.7	6.5	Spring	Clear	N	No observations to note
MUBRF	30-Aug-25	15:20	CF	7.62	55.42	36	8.18	6.63	28.8	N	0	Low, outgoing	2.2	1.9	6.2	Neap	Clear	N	Piling works
MUBRF	31-Aug-25	15:41	CF	7.46	53.99	35	7.91	6.83	28.5	N	0	Low, outgoing	2.6	2.3	5.7	Neap	Clear	N	*New Calibrations
MUBRF	1-Sep-25	14:46	CF	7.36	52.83	34	4.4	6.81	27.4	N	0	Outgoing	3.4	2.7	5.1	Neap	Clear	N	Sheet pile threading
MUBRF	2-Sep-25	15:43	CF	7.63	54.27	35	5.39	7.08	28.7	N	0	Low, outgoing	3.4	3	5	Neap	Clear	N	Sheet pile threading
MUBRF	3-Sep-25	15:39	CF	7.6	54.323	35	1.74	7.12	29.8	N	0	Outgoing	4.1	2.9	5	Neap	Clear	N	No marine works
MUBRF	4-Sep-25	12:32	CF	7.48	53.59	35	3.2	6.95	28.6	N	0	Low, incoming	4	3.7	5.5	Neap	Clear	N	Piling on C13, no plume observed
MUBRF	5-Sep-25	15:49	CF	7.4	53.13	35	5.44	6.62	28	N	0	High, incoming	5.1	2	6	Neap	Clear	N	Cassion backfill, no plume observed
MUBRF	6-Sep-25	15:35	CF	7.58	54.05	35	2	6.81	28.5	N	0	High, incoming	5.1	1.5	6.5	Spring	Clear	N	Piling on C13, no plume observed
MUBRF	7-Sep-25	16:11	OQV	7.57	54.48	35	5.09	6.57	29	N	0	High, incoming	5.4	2.2	6.6	Spring	Overcast, windy	N	Piling on C13 occurring, no plume observed
MUBRF	8-Sep-25	12:08	CF	7.35	53.34	35	5.93	6.56	28.6	N	0	Low, outgoing	1.8	1.6	7.3	Spring	Clear, windy	N	No marine works
MUBRF	9-Sep-25	14:29	CF	7.36	53.58	34	25.32	6.49	28.4	N	0	Low, outgoing	1.5	1.1	7.6	Spring	Clear	N	Cassion backfill, no plume observed
MUBRF	10-Sep-25	16:05	CF	7.35	53.835	35	9.53	6.64	28.9	N	0	Low, incoming	2.6	0.7	2.5	Spring	Clear	N	No marine works
MUBRF	14-Sep-25	14:35	CH	7.58	54.06	35	8.76	6.7	29.5	N	0	Low, outgoing	2.2	1.5	6.3	Spring	Clear, calm	N	Cassion backfill, no plume observed
MUBRF	15-Sep-25	14:13	CH	7.66	54.22	35	4.92	6.72	28.4	N	0	Low, outgoing	3.4	2.2	5.6	Neap	Clear, calm	N	No marine works
MUBRF	19-Sep-25	14:23	CF	7.79	53.977	35	8.79	6.63	29.9	N	0	Incoming	4.5	2.7	5.8	Neap	Clear, calm	N	Piling on A05, no caisson backfill at the time of sampling
MUBRF	20-Sep-25	15:48	CF	7.84	54.446	35	5.94	6.54	30.7	N	0	High, incoming	5.2	2.2	6.7	Neap	Clear, calm	N	Cell template repositioned for C07
MUBRF	21-Sep-25	14:43	CF	7.89	53.849	35	2.13	6.65	30.4	N	0	Low, incoming	3.5	1.8	7	Spring	Overcast	N	Sheet cutting
MUBRF	22-Sep-25	14:35	CF	7.88	53.445	35	4.15	6.31	29.7	N	0	Low, incoming	2.3	1.4	7.2	Spring	Clear, partly cloudy	N	C13 backfill
MUBRF	23-Sep-25	15:37	CF	7.71	52.626	34	8.19	6.46	29.8	N	0	Incoming	2.8	1.2	7.2	Spring	Clear, slightly choppy	N	Setting up arc template - A12
MUBRF	24-Sep-25	14:36	CF	7.72	52.959	34	14.02	6.61	29.3	N	0	Low, incoming	1.4	1.1	7.2	Spring	Clear	N	Sampled at low tide, positioning cell template for C14
MUBRF	25-Sep-25	14:47	CF	7.87	53.598	35	22.72	6.78	30.5	N	0	Low, incoming	1.2	1.1	7	Spring	Clear	N	Sampled at low tide, piling operational
MUBRF	27-Sep-25	10:40	CF	7.71	52.208	34	3.37	6.28	27.6	N	0	Outgoing	5	1.4	6.5	Spring	Clear	N	Piling works
MUBRF	29-Sep-25	15:50	CF	7.72	52.44	34	3.78	6.52	29.6	N	0	Low	2.3	2.3	5.6	Neap	Clear	N	Sheet cutting
MUBRF	30-Sep-25	16:07	CF	7.77	52.394	34	6.42	6.69	29.9	N	0	Low, outgoing	2.9	2.8	5.1	Neap	Clear	N	Piling works
MUBRF	3-Oct-25	16:25	CH	7.74	53.15	35	0.38	6.64	30.6	N	0	High, outgoing	4.8	2.8	4.8	Neap	Partly cloudy	N	No marine activities
TAB02	28-Oct-24	16:25	CF	8.27	54.6	32.8	27.4	4.21	31.09	N	0	High	5.6	2.6	5.6	Spring	Sunny	N	Dredging, works to create basin A



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
TAB02	29-Oct-24	15:58	CF	8.27	54.6	32.8	17.3	4.05	31.43	N	0	Incoming	5.9	2.3	6.1	Spring	Partly cloudy, sunny	N	Dredging, works to create basin A
TAB02	30-Oct-24	15:23	CF	8.24	54.5	32.7	66.9	4.03	31.17	N	3.8	Incoming	5.4	2.6	6.4	Spring	Partly cloudy, Sunny	N	Dredging, works to create basin A, some rain in morning
TAB02	31-Oct-24	15:59	CF	8.25	55.3	33.2	19.7	4.52	28.96	N	25.6	Incoming	5.4	1.6	6.4	Spring	Cloudy	N	Dredging, works to create basin A, some rain in morning
TAB02	01-Nov-24	15:37	CF	8.25	53.7	32.2	17.2	2.71	30.97	N	1.8	Incoming	4.3	1.3	6.6	Spring	Partly cloudy, Sunny	N	Dredging, works to create basin A, some rain in morning
TAB02	02-Nov-24	14:56	CF	8.26	55.2	33.1	134	4.23	31.34	N	0	Incoming	3.2	1	6.7	Spring	Partly cloudy, sunny	N	Strong winds may have contributed to elevated NTU
TAB02	03-Nov-24	6:40	CF	8.2	54.7	32.8	80.7	3.86	28.26	N	19.4	High, outgoing	6.7	0.9	6.6	Spring	Sunny, Clear	N	No observations to note
TAB02	04-Nov-24	10:31	CF	8.26	54.4	32.7	8.2	4.37	30.41	N	0	Outgoing	2.5	0.9	6.7	Spring	Partly cloudy, Sunny	N	No observations to note
TAB02	14-Nov-24	14:36	CF	6.01	54	32.4	15.8	3.32	33.31	N	16.8	High, incoming	5.1	1.3	7.1	Spring	Partly cloudy, Sunny	N	No dredging; piling activities on TAB01B
TAB02	30-Nov-24	7:40	CH	6.8	52.9	34.3	6.8	5.07	30	N	25.2	Low, incoming	3.6	1.4	7	Spring	Partly cloudy, sunny	N	Sieve works at RA03; no piling activities
TAB02	12-Feb-25	15:48	CH	7.97	51.9	30	30.9	6.58	30.9	N	0	Low, outgoing	3.9	1.4	7.4	Spring	Overcast, calm	N	BHD in operation
TAB02	20-Feb-25	13:11	CH	7.9	45.7	30	95.1	6.5	32.3	N	0	Low, outgoing	4.7	2.2	6	Neap	Sunny, partly cloudy	N	BHD not operational; construction on TAB02
TAB02	21-Feb-25	16:01	CF	8.06	45.3	29	14.45	6.53	31.2	N	0	Low	4.1	4.1	5.5	Neap	Sunny, partly cloudy	N	BHD not operational; construction on TAB02
TAB02	24-Feb-25	15:51	CF	8.03	44.8	29	64.8	6.67	32	N	0	High, incoming	5.6	3	5.8	Neap	Overcast	N	BHD operational, sampled within a plume emanating from TAB02
TAB02	25-Feb-25	16:47	CF	8.02	43.6	28	27.93	6.59	30.7	N	24.2	High, incoming	6.2	2.5	6.4	Neap	Overcast	N	Sampled within plume emanating from TAB02
TAB02	26-Feb-25	15:54	CF	7.93	44	29	8.78	6.62	33.4	N	0	Incoming	5.6	1.9	6.9	Neap	Clear	N	BHD operational
TAB02	02-Mar-25	7:24	CF	7.97	47.2	31	3.61	5.44	31.2	N	0	High, incoming	7.3	1.1	7.6	Spring	Clear	N	BHD operational
TAB02	04-Mar-25	7:28	CF	7.95	48	31	19.18	5.78	31.3	N	0	High, incoming	6.2	0.8	7.6	Spring	Clear	N	BHD non-operational
TAB02	05-Mar-25	9:25	CF	7.97	47.8	31	30.18	5.92	31.5	N	0	High, incoming	7.1	1	7.2	Spring	Clear	N	BHD operational
TAB02	09-Mar-25	16:04	CH	8	47.6	31	3.6	6.15	32.2	N	0	Outgoing	5.5	2.9	5.5	Neap	Clear	N	BHD operational
TAB02	24-Mar-25	16:03	CF	7.94	45.8	30	10.73	6.19	30.3	N	0.6	High, outgoing	5.1	3.2	5.2	Neap	Overcast	N	BHD operational
TAB02	28-Mar-25	16:02	CH	8	44.9	29	11.8	6.5	30.1	N	21.8	High, incoming	6.1	1.7	7.3	Spring	Overcast, rain	N	BHD operational; unloading barge
TAB02	30-Mar-25	7:07	CH	8	45	29	6.9	5.6	30	N	4.6	High, outgoing	7.6	1.4	7.6	Spring	Overcast, rain	N	No observations to note
TAB03	05-Oct-24	6:52	CF	8.11	53.7	32.2	35.1	1.56	28.84	N	0	High, incoming	6.7	1	6.9	Spring		N	No dredging
TAB04	19-Oct-24	7:47	CH	8.15	54.3	32.6	28.6	3.64	29.73	N	0	High, outgoing	7.3	0.1	8	Spring	Sunny, Clear, Calm	N	Piling activities (Brady) TAB01B
TAB05	13-Jan-25	8:42	CH	7.95	50.16	33	12.9	5.28	31.9	N	0	Outgoing	3.2	1.2	7.3	Spring	Clear	N	No dredging
TAB05	14-Jan-25	15:46	CF	7.77	49.3	32	3.73	6.28	33.2	N	0	Incoming	3.8	1	7.5	Spring	Clear	N	No dredging
TAB05	16-Jan-25	10:11	CF	7.74	49.7	32	160	5.21	31.5	N	6.2	Outgoing	4.2	1.1	6.5	Spring	Overcast	N	Requested for bulldozer to create ramp for access to water. Bulldozer pushed rock to create ramp, and small plume of 1 meter in distance was created. Sample taken within a 1-meter plume from edge of TAB05
TAB05	17-Jan-25	9:11	CF	7.75	49	32	10.63	5.3	31.2	N	38	Outgoing	6	1.3	6.5	Spring	Overcast	N	BHD operational
TAB05	19-Jan-25	11:24	CF	7.88	49	32	18.56	5.2	31	N	0.2	Outgoing	5.1	2.1	6.2	Spring	Overcast	N	BHD operational
TAB05	20-Jan-25	9:16	CF	7.85	49.5	32	8.27	5.26	31	N	4.4	Low	2.6	2.6	6	Neap	Clear	N	BHD operational
TAB05	21-Jan-25	9:41	CF	7.87	49.5	32	14.58	5.48	31.3	N	0	High	5.6	3.1	5.7	Neap	Clear	N	BHD operational
TAB05	22-Jan-25	12:57	CF	7.72	48.3	31	33.47	6.01	32	N	1.2	Outgoing	1.4	1.1	7.6	Spring	Overcast	N	No observations to note
TAB05	25-Feb-25	16:33	CF	7.53	44.6	29	7.53	6.43	31.2	N	24.2	High, incoming	6.2	2.5	6.4	Neap	Overcast	N	BHD operational
TAB05	26-Feb-25	16:07	CF	7.92	43.9	29	14.02	6.44	34.7	N	0	Incoming	5.6	1.9	6.9	Neap	Clear	N	BHD operational
TAB05	28-Feb-25	16:36	CF	8	47.6	31	51.06	6.76	33.1	N	0.2	Incoming	4.9	1.1	7.8	Spring	Partly Cloudy	N	Sampled within plume from TAB05
TAB05	04-Mar-25	7:07	CF	7.98	47.7	31	11.36	6.01	30.5	N	0	High, incoming	6.2	0.8	7.6	Spring	Clear	N	BHD non-operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
TAB05	05-Mar-25	9:41	CF	7.92	48.4	31	10.43	5.83	32.9	N	0	High, incoming	7.1	1	7.2	Spring	Clear	N	Works on Western Revetment
TAB05	22-May-25	15:21	CF	7.74	53.3	35	7	6.77	27.9	N	0	High, outgoing	5	3	5.8	Neap	Clear	N	BHD operational
TAB06	03-Oct-24	8:34	CH	8.07	54.4	32.7	9.9	4.32	29.1	N	0	Outgoing	5.8	-	-	Spring	Clear, calm	N	Construction activities on TAB1B
TAB06	04-Oct-24	7:12	CH	8.06	54.5	32.7	10.8	4.15	29.04	N	0	Outgoing	7	-	-	Spring	Clear	N	No dredging or construction activities during sample time
TAB06	05-Oct-24	7:26	CF	8.08	54	32.4	36.1	2.83	28.65	N	0	High	7	1	7	Spring	Clear, light winds	N	No dredging
TAB06	06-Oct-24	7:01	CF	8.1	54.2	32.5	10	3.66	29.01	N	0	High, incoming	6.7	1	6.9	Spring	Clear	N	No dredging; no site works
TAB06	07-Oct-24	10:02	CF	8.1	53.7	32.2	9.2	4.16	31.13	N	0	Outgoing	5.2	1.2	6.7	Spring	Clear, light winds	N	No dredging, TAB03 construction
TAB06	10-Oct-24	9:19	CF	8.12	53.4	32	13.3	3.82	29.98	N	0	High	5.5	2.3	5.5	Spring	Clear, light winds	N	No observations to note
TAB06	11-Oct-24	10:24	CF	8.14	54.3	32.6	11.3	3.06	30.92	N	0	Outgoing	5	2.8	5.1	Neap	Sunny, Clear	N	No observations to note
TAB06	12-Oct-24	13:38	CF	8.17	54.1	32.5	14.7	3.46	32.09	N	0	Outgoing	5	5.4	3	Neap	Sunny, Clear	N	No observations to note
TAB06	14-Oct-24	14:34	CF	8.17	54.5	32.7	16.5	4.88	31.86	N	0	Incoming	5.1	3.1	5.4	Neap	Sunny, Clear	N	No observations to note
TAB06	15-Oct-24	7:27	CF	8.06	55.3	33.2	10.8	4.53	28.3	N	0	Outgoing	6.4	4.7	2.4	Neap	Overcast	N	No observations to note
TAB06	17-Oct-24	7:15	CF	8.1	54	32.4	108	4.55	28.46	N	0	Outgoing	5.9	0.9	7.2	Spring	Overcast	N	No observations to note
TAB06	18-Oct-24	10:02	CH	8.07	55.1	33.1	102	4.67	28.48	N	0	Outgoing	2.8	0.3	7.9	Spring	Clear, sunny	N	Piling activities; revetment activities on TAB01B and TAB04
TAB06	20-Oct-24	9:05	CH	8.09	54.6	32.8	99.6	3.75	28.68	N	0	High, outgoing	5.9	0.1	7.8	Spring	Overcast	N	No dredging or revetment activities
TAB06	23-Oct-24	9:22	CH	8.15	54.7	32.8	58.6	3.83	30.07	N	0	High, outgoing	5.9	1.7	6.3	Spring	Partly cloudy, sunny	N	Piling activities on TAB01B
TAB06	24-Oct-24	8:35	CH	8.13	55.2	33.1	27.9	4.1	29.62	N	0	High, incoming	5.2	2.5	5.8	Neap	Partly cloudy, sunny	N	No dredging; piling activities on TAB01B
TAB06	25-Oct-24	10:56	CF	8.2	55.9	33.5	13.6	4.64	30.1	N	0	High	4.6	3.1	4.6	Neap	Partly cloudy, sunny	N	No dredging; RA05 fill
TAB06	26-Oct-24	10:49	CF	8.19	52.7	31.6	10	3.75	31.99	N	4.6	Incoming	4	3.8	5.4	Neap	Sunny	N	Dredging; RA05 fill
TAB06	28-Oct-24	16:29	CF	8.27	54.7	32.8	23.8	2.92	31.31	N	0	High	5.6	2.6	5.6	Spring	Sunny	N	Dredging, works to create basin A
TAB06	29-Oct-24	16:04	CF	8.26	54.7	32.8	25.1	4.16	32.25	N	0	Incoming	5.9	2.3	6.1	Spring	Partly cloudy, sunny	N	Dredging, works to create basin A
TAB06	30-Oct-24	15:29	CF	8.26	53.8	32.3	75.6	3.89	31.84	N	3.8	Incoming	5.4	2.6	6.4	Spring	Overcast	N	Dredging, works to create basin A; some rain in morning
TAB06	31-Oct-24	16:04	CF	8.24	55.5	33.3	29.6	4.44	29.07	N	25.6	Incoming	5.4	1.6	6.4	Spring	Cloudy	N	Dredging, works to create basin A; some rain in morning
TAB06	01-Nov-24	15:49	CF	8.25	53.7	32.2	11.9	4	30.97	N	1.8	Incoming	4.3	1.3	6.6	Spring	Partly cloudy, Sunny	N	Dredging, works to create basin A; some rain in morning
TAB06	02-Nov-24	15:03	CF	8.27	54.9	32.9	50.8	4.3	30.55	N	0	Incoming	3.2	1	6.7	Spring	Partly cloudy, sunny	N	Strong winds may have contributed to elevated NTU
TAB06	04-Nov-24	10:41	CF	8.22	54.9	32.9	14.6	4.08	30.27	N	0	Outgoing	2.5	0.9	6.7	Spring	Partly cloudy, Sunny	N	No observations to note
TAB06	05-Nov-24	15:54	CF	8.32	55.2	33.1	83.1	4.4	31.13	N	0	Low, incoming	1.7	1.1	6.4	Spring	Clear	N	No observations to note
TAB06	07-Nov-24	8:04	CH	8.81	55.1	33	8.2	2.93	29.2	N	0	High, incoming	5.9	1.8	5.9	Spring	Clear, sunny	N	No dredging or revetment works
TAB06	09-Nov-24	8:16	CH	8.3	54.9	32.9	48.3	3.13	30.14	N	0	High, incoming	4.8	2.7	5.8	Neap	Clear, calm	N	Piling activities; construction of RA03
TAB06	14-Nov-24	14:47	CF	5.7	54.3	32.6	62.7	3.69	34.46	N	0	High, incoming	5.1	1.3	7.1	Spring	Partly cloudy, Sunny	N	No dredging; piling activities on TAB01B
TAB06	22-Nov-24	14:00	CF	7.93	54.5	35.4	9.45	5.75	31.7	N	32.8	Outgoing	3.3	2.5	5.3	Neap	Sunny, Clear	N	No observations to note
TAB06	23-Nov-24	8:53	CF	7.87	54.7	35.6	5.79	5.26	30.4	N	6	Incoming	4.7	3.1	4.8	Neap	Cloudy	N	No observations to note
TAB06	25-Nov-24	15:40	CF	7.7	54.5	35.5	4.77	6.23	31.5	N	0.6	Outgoing	4.8	3.7	4.9	Neap	Cloudy	N	No observations to note
TAB06	26-Nov-24	15:24	CF	7.87	54.5	35.4	4.45	6.17	30.9	N	6.4	High	5.3	2.9	5.3	Neap	Partly Cloudy, Sunny	N	No observations to note
TAB06	06-Dec-24	11:16	CH	7.9	53.6	34.8	19.3	4.7	31.3	N	0	Low, incoming	3.5	1.6	6.8	Spring	Overcast	N	Sieving at RA03
TAB06	07-Dec-24	9:17	CF	7.84	51.1	33	2.04	5.63	30.9	N	0.4	High	5.7	2	5.7	Neap	Overcast	N	No observations to note
TAB06	09-Dec-24	9:22	CF	7.94	51	33	0.87	5.34	30.3	N	2.6	Incoming	4.5	3.2	5.2	Neap	Clear	N	No observations to note
TAB06	12-Dec-24	14:31	CF	8.01	52.2	34	122	6.01	34.2	N	0	Incoming	5.6	1.9	6.2	Neap	Overcast	N	No observations to note
TAB06	16-Dec-24	15:47	CF	8	51.4	33	64.8	6.35	32.5	N	0	Incoming	3.5	0.6	7.6	Spring	Clear	N	No observations to note



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
TMOF	18-Jan-25	14:21	CF	7.8	48.3	31	4.03	5.32	30.8	N	0	Low	1.8	1.7	7.2	Spring	Overcast	N	Accessed from TMOF; no dredging
TMOF	19-Jan-25	11:16	CF	7.88	23.3	15	4.87	6.11	31.2	N	0.2	Outgoing	5.4	2.2	6.2	Spring	Overcast, calm	N	BHD operational
TMOF	21-Jan-25	9:33	CF	7.8	47.6	31	5.31	5.75	30.7	N	0	High	5.6	3.1	5.7	Neap	Clear	N	BHD operational
TMOF	23-Jan-25	9:18	CH	7.63	46.59	30	3.36	6.03	29.6	N	0	Low	3.8	2.8	5.4	Neap	Clear	N	BHD not operational; construction activities at TAB05
TMOF	24-Jan-25	13:59	CH	7.98	47.5	31	19.38	6.14	30.7	N	0	High	5	2.9	5	Neap	Overcast	N	BHD operational
TMOF	25-Jan-25	9:56	CH	7.94	47.3	31	27.6	5.87	29.9	N	0.2	Low, outgoing	2.9	2.8	5.5	Neap	Overcast	N	BHD operational
TMOF	28-Jan-25	13:30	CH	7.95	48.58	32	6.65	6.55	33.4	N	0.4	Low	2.5	1.7	6.9	Spring	Overcast	N	BHD not operational; construction activities at TAB02
TMOF	29-Jan-25	10:29	CH	7.9	48	31	9.47	5.96	31.4	N	46.2	Low, outgoing	2.3	1.3	7.3	Spring	Overcast	N	BHD not operational; construction activities at TAB02
TMOF	31-Jan-25	16:28	CF	8.03	48.7	32	16.76	5.95	32.1	N	72	Incoming	3.3	0.9	7.8	Spring	Overcast	N	BHD operational
TMOF	01-Feb-25	13:03	CF	7.9	47.1	31	59.2	4.94	32.1	N	2.4	Outgoing	2.1	1.2	7.8	Spring	Partly cloudy	N	BHD operational
TMOF	02-Feb-25	13:24	CF	7.96	48.6	32	50.16	5.77	32.3	N	0	Outgoing	1.6	1.2	7.7	Spring	Partly cloudy	N	BHD operational
TMOF	04-Feb-25	12:24	CF	7.96	48	31	20.87	5.97	29.8	N	44.8	Outgoing	5.5	2.4	7.1	Spring	Overcast	N	BHD operational
TMOF	06-Feb-25	16:24	CF	7.96	44	29	5.44	6.73	31.2	N	0	Outgoing	4	2	5.9	Neap	Overcast	N	BHD operational
TMOF	07-Feb-25	15:54	CF	8.02	46.9	31	2.54	6.61	30.8	N	0.2	Outgoing	5	2.3	5.5	Neap	Overcast	N	BHD operational
TMOF	08-Feb-25	14:25	CF	7.98	47.2	31	7.36	5.95	30.4	N	11.6	High	5.3	2.5	5.6	Neap	Overcast	N	BHD operational
TMOF	10-Feb-25	13:52	CF	8	45	29	9.13	6.58	30	N	0	Incoming	3.6	2	6.7	Neap	Overcast	N	BHD Operational
TMOF	11-Feb-25	6:52	CF	7.99	46	30	8.23	5.9	28.7	N	0	Outgoing	5.1	1.6	7.1	Neap	Partly cloudy	N	BHD Operational
TMOF	12-Feb-25	15:55	CH	7.97	46.9	31	25.5	6.45	30.6	N	0	Low, outgoing	3.9	1.4	7.4	Spring	Overcast, calm	N	No observations to note
TMOF	13-Feb-25	9:47	CF	7.75	44.6	29	14.71	6.26	30.2	N	100.8	Outgoing	3.9	1.2	7.6	Neap	Cloudy	N	BHD operational
TMOF	14-Feb-25	13:23	CH	7.92	45.3	30	20.7	6.28	31.1	N	0.2	Low, outgoing	1.6	1.3	7.6	Spring	Overcast, calm	N	BHD operational
TMOF	15-Feb-25	13:27	CH	7.9	46.1	30	27.7	5.92	31.7	N	5.4	Low, outgoing	1.7	1.4	7.6	Spring	Overcast	N	BHD operational
TMOF	17-Feb-25	15:06	CH	7.9	45.5	30	9.3	6.4	34.9	N	6.6	Low, incoming	2.1	2.1	7.2	Spring	Partly cloudy	N	BHD operational
TMOF	18-Feb-25	13:26	CH	8.06	46.2	30	4.9	6.2	31.4	N	1.6	Low, outgoing	3.4	2.5	6.9	Spring	Partly cloudy	N	BHD not operational
TMOF	19-Feb-25	14:29	CH	8	46.4	30	4.25	6.35	32	N	1.6	Low, outgoing	3.3	3	6.5	Spring	Sunny, partly cloudy	N	BHD not operational
TMOF	20-Feb-25	13:00	CH	8	46	30	2.24	6.08	30.8	N	0	Low, outgoing	4.7	2.2	6	Neap	Sunny, partly cloudy	N	BHD not operational; construction on TAB02
TMOF	21-Feb-25	16:09	CF	7.99	46.2	30	6.12	6.12	30.8	N	0	Low	4.1	4.1	5.5	Neap	Sunny, partly cloudy	N	BHD not operational; construction on TAB02
TMOF	24-Feb-25	16:00	CF	8	46	30	5.77	6.55	32.1	N	0	High, incoming	5.6	3	5.8	Neap	Overcast	N	BHD operational
TMOF	25-Feb-25	16:27	CF	8.19	44.9	29	11.98	6.7	30.4	N	24.2	High, incoming	6.2	2.5	6.4	Neap	Overcast	N	BHD operational
TMOF	26-Feb-25	16:01	CF	7.95	45.6	30	12.22	6.4	33.1	N	0	Incoming	5.6	1.9	6.9	Neap	Clear	N	BHD operational
TMOF	27-Feb-25	16:32	CF	8	47.5	31	7.08	5.98	31.7	N	19.8	Incoming	5.8	1.4	7.4	Spring	Partly Cloudy	N	BHD operational
TMOF	28-Feb-25	16:28	CF	8.05	47.1	31	3.79	6.38	31.9	N	0.2	Incoming	4.9	1.1	7.8	Spring	Partly Cloudy	N	BHD operational
TMOF	01-Mar-25	16:31	CF	8.09	46.8	30	63.7	6.22	31.7	N	7.8	Incoming	5.8	1.4	7.4	Spring	Partly Cloudy	N	Sampled within plume during offloading at TMOF
TMOF	02-Mar-25	6:55	CF	8.01	47.3	31	5.31	5.57	31.4	N	0	High, incoming	7.3	1.1	7.6	Spring	Clear	N	BHD operational
TMOF	03-Mar-25	15:43	CF	7.94	48.2	31	13.84	6.27	34.4	N	0	Low, incoming	2	1.4	7.9	Spring	Clear	N	BHD operational
TMOF	04-Mar-25	7:20	CF	7.96	47.9	31	19.62	6.09	31.3	N	0	High, incoming	6.2	0.8	7.6	Spring	Clear	N	BHD non operational
TMOF	05-Mar-25	9:32	CF	7.93	48.2	31	9.12	5.54	32.2	N	0	High, incoming	7.1	1	7.2	Spring	Clear	N	BHD operational
TMOF	08-Mar-25	12:34	CH	8	48.47	32	8	6.23	32.8	N	0	Outgoing	5.4	2.5	5.4	Neap	Clear	N	BHD operational
TMOF	09-Mar-25	15:57	CH	8	47.4	31	12.8	6.4	30.87	N	0	Outgoing	5.5	2.9	5.5	Neap	Clear	N	BHD operational
TMOF	10-Mar-25	14:16	CH	7.9	47.4	31	7.3	6.39	33.8	N	16.4	High, incoming	4.9	2.8	6	Neap	Overcast	N	BHD operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
TMOF	11-Mar-25	14:26	CH	7.9	48.1	31	5.1	6.35	33.2	N	2.2	High, incoming	4.5	2.4	6.5	Spring	Clear	N	BHD operational
TMOF	12-Mar-25	13:00	CH	8	-	-	13.8	8.6	27.5	N	0	Low, incoming	2.7	2	6.9	Spring	Clear	N	BHD operational; construction of Eastern revetment
TMOF	13-Mar-25	16:00	CH	8.02	47.8	31	27.3	6.5	32.1	N	9.2	High, incoming	5.3	1.8	7.2	Spring	Overcast	N	BHD operational
TMOF	16-Mar-25	10:30	CF	7.94	47.8	31	10.59	5.99	30	N	31.4	Outgoing	4.5	1.8	7.4	Spring	Clear	N	BHD operational
TMOF	17-Mar-25	14:30	CF	7.92	46.7	30	6.08	6.27	32.4	N	54	Low, incoming	2.5	2	7.2	Spring	Clear	N	BHD operational
TMOF	18-Mar-25	7:09	CF	8	47.5	31	10.82	5.61	31.1	N	15.8	High, incoming	6.6	1.4	7.1	Spring	Overcast	N	BHD operational
TMOF	20-Mar-25	14:53	CF	7.93	45.4	30	11.52	6.12	31.8	N	0.4	Low	3	3	6.6	Neap	Overcast	N	BHD operational
TMOF	21-Mar-25	15:36	CF	7.95	45.5	30	5.47	6.26	31.2	N	12.0	Low	3.6	2	6.3	Neap	Overcast	N	BHD operational
TMOF	22-Mar-25	13:21	CF	7.95	44.6	29	15.61	6.11	30.5	N	0	High, outgoing	4.8	4	5.8	Neap	Overcast	N	BHD operational
TMOF	25-Mar-25	10:42	CF	7.96	45.5	30	18.67	6.32	30.6	N	26.4	Low, incoming	3.7	3.2	5.7	Neap	Overcast	N	BHD operational; unloading barge
TMOF	26-Mar-25	12:57	CF	7.9	43.9	29	31.8	6.6	29.5	N	0	Incoming	3.7	2.7	6.3	Neap	Overcast	N	BHD operational
TMOF	27-Mar-25	14:31	CH	7.8	41.3	27	36.6	6.7	29.1	N	21.8	High, incoming	4.8	2.2	6.8	Spring	Overcast	N	BHD operational; unloading barge
TMOF	29-Mar-25	12:25	CH	7.8	43.4	28	31.1	5.8	29.3	N	9.8	Low, incoming	1.4	1.4	7.6	Spring	Overcast, rain	N	BHD operational
TMOF	31-Mar-25	15:22	CH	8.04	-	-	19.7	8.1	30.3	N	5.6	Low, incoming	2.4	1.5	8	Spring	Overcast, rain	N	BHD operational
TMOF	01-Apr-25	16:03	CH	7.7	43.4	28	48.3	6	29	N	15.6	Low, incoming	3.4	1.8	8	Spring	Overcast, rain	N	BHD operational
TMOF	02-Apr-25	15:42	CH	7.9	37.78	25	33.4	6.4	29.7	N	114	Low, incoming	2.8	2.3	7.8	Spring	Overcast, rain	N	BHD operational
TMOF	05-Apr-25	14:09	CF	7.68	40.3	26	68.78	5.87	29.9	N	0	Outgoing	4.9	4	6	Neap	Clear	N	BHD operational
TMOF	07-Apr-25	15:26	CF	8.02	41.8	27	11.18	7.15	31.6	N	0	Outgoing	5.4	3.2	5.5	Neap	Clear	N	BHD operational
TMOF	08-Apr-25	16:01	CF	8.05	44.2	29	8.3	7.15	30.6	N	15.6	High	5.9	3.1	5.9	Neap	Overcast	N	BHD operational
TMOF	10-Apr-25	16:05	CF	8.03	45.8	30	10.24	6.83	31.1	N	0	Incoming	6	2.5	6.6	Neap	Partly cloudy	N	BHD operational
TMOF	11-Apr-25	15:31	CF	8.09	46.2	30	18.72	7	30.3	N	0	Incoming	5.5	2.3	6.8	Neap	Partly cloudy	N	BHD operational
TMOF	12-Apr-25	14:35	CF	8.09	46	30	19.52	6.94	30.5	N	0	Incoming	3.8	2.2	6.9	Spring	Partly cloudy	N	BHD operational
TMOF	14-Apr-25	10:29	CF	8	46.2	30	4.53	6.2	30.2	N	25.6	Outgoing	4.7	2.2	7.2	Spring	Partly cloudy	N	BHD operational
TMOF	15-Apr-25	15:10	CF	7.99	45	29	10.52	6.35	31.3	N	5	Incoming	3.6	2.3	7.3	Spring	Partly cloudy	N	BHD operational
TMOF	16-Apr-25	16:23	CF	8.04	44.7	29	6.82	6.71	30.8	N	6.6	Incoming	4	2.5	7.2	Spring	Partly Cloudy	N	BHD operational
TMOF	19-Apr-25	14:15	CH	8.01	46.55	30	8.4	6.57	30.9	N	0	Low, outgoing	3.6	3.5	6.4	Neap	Overcast	N	BHD operational
TMOF	20-Apr-25	8:19	CH	8.03	44.4	29	6.17	6.23	28.6	N	12.4	High, incoming	5.3	3.9	6	Neap	Partly cloudy	N	BHD operational; loading barge
TMOF	22-Apr-25	12:37	CH	8.08	44.7	29	4.23	6.65	29.6	N	0	High, incoming	5.1	3.1	5.7	Neap	Partly cloudy	N	BHD operational
TMOF	26-Apr-25	14:06	CH	8.03	47.8	31	19.84	6.83	30.3	N	0	High, incoming	4.6	2.2	6.9	Spring	Partly cloudy	N	BHD operational
TMOF	28-Apr-25	13:42	CH	7.81	47.83	31	21.18	6.14	29.9	N	0	Low, incoming	2.5	2	7.7	Spring	Overcast	N	BHD operational
TMOF	29-Apr-25	10:18	CH	7.82	47.7	31	20	6.06	28.6	N	0	Low, outgoing	5	2.1	8	Spring	Overcast	N	BHD operational
TMOF	30-Apr-25	15:51	CF	7.83	47.8	31	4.92	6.24	28.6	N	0	Incoming	3.6	2.3	7.9	Spring	Partly Cloudy	N	BHD non-operational
TMOF	01-May-25	15:22	CF	7.79	48.4	31	8.97	6.35	30.3	N	0	Low, incoming	2.9	2.6	2.2	Spring	Clear	N	BHD operational; loading barge
TMOF	02-May-25	14:28	CF	7.81	48.5	32	10.25	6.45	29.1	N	0	Low, outgoing	3.2	3	7.2	Neap	Clear	N	BHD operational; loading and unloading barge
TMOF	03-May-25	13:49	CF	7.78	48.3	31	11.87	6.43	30	N	0	Low	3.4	3.4	6.7	Neap	Clear	N	BHD operational; loading and unloading barge
TMOF	05-May-25	13:51	CF	7.85	48.3	31	10.22	6.54	28.6	N	9	High, outgoing	5.3	2.8	5.7	Neap	Overcast	N	BHD operational; loading and unloading barge
TMOF	06-May-25	12:19	CF	7.77	48.3	31	39.97	6.41	30.5	N	0	High, incoming	5.3	3.2	5.6	Neap	Partly Cloudy	N	BHD operational; loading barge
TMOF	12-May-25	14:32	CH	7.92	48.8	32	3.93	6.73	29.1	N	0	Low, incoming	4	2.7	6.9	Spring	Partly cloudy, sunny	N	BHD operational; loading barge
TMOF	17-May-25	14:20	CF	7.73	52.6	34	1.58	6.57	27.8	N	0	Low	3.1	3.1	6.7	Neap	Partly cloudy, sunny	N	BHD operational; loading barge and offloading barge
TMOF	19-May-25	15:18	CF	7.72	53.2	35	22.93	6.68	26.9	N	0	Low, outgoing	3.8	2.1	6.2	Neap	Overcast	N	Unloading barge



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (c)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
TMOF	21-May-25	15:50	CF	7.74	53.3	35	7.49	6.7	27	N	0	Incoming	4.1	2.8	5.8	Neap	Clear	N	BHD operational in front of TMOF
TMOF	23-May-25	13:33	CF	7.79	53	35	4.65	6.79	27.3	N	0	High	6	3.1	5.9	Neap	Partly cloudy, sunny	N	BHD non-operational
TMOF	26-May-25	9:30	CF	7.72	53.7	35	1.01	6.28	27.8	N	0	Low, outgoing	3.6	2.7	7.1	Spring	Clear	N	BHD non-operational
TMOF	28-May-25	12:55	CF	7.48	53.2	35	14.48	6.31	28	N	8.4	Low	2.6	2.6	7.7	Spring	Partly cloudy, sunny	N	BHD non-operational; unloading barge
TMOF	31-May-25	11:20	CH	7.73	53.7	35	5.87	6.66	27.2	N	0	High, outgoing	6.5	2.9	7.1	Spring	Clear	N	BHD non-operational
TMOF	04-Jun-25	10:37	CH	7.63	53.77	35	3.47	7.84	27.4	N	0	High, incoming	5.2	3.1	5.7	Neap	Partly cloudy, sunny	N	BHD operational
TMOF	05-Jun-25	14:10	CH	7.67	53.87	35	2.19	8.13	28.3	N	0	High, outgoing	5.4	3.4	5.5	Neap	Partly cloudy, sunny	N	BHD operational
TMOF	07-Jun-25	12:41	CF	7.63	54.1	35	41.13	8.11	28.4	N	0	Incoming	4.5	3.6	5.5	Neap	Clear	N	BHD operational
TMOF	09-Jun-25	13:42	CF	7.64	54	35	10.98	8.16	27.8	N	0	Incoming	4.1	3.3	6.3	Neap	Clear	N	BHD operational
TMOF	10-Jun-25	11:59	CF	7.66	53.7	35	10.27	8.08	26	N	0	Low	3.1	3.1	6.6	Neap	Cloudy	N	BHD non-operational
TMOF	11-Jun-25	12:26	CF	7.64	54.3	35	5.33	8.3	26.9	N	0	Low	3	3	6.8	Neap	Clear	N	BHD operational
TMOF	12-Jun-25	9:20	CF	7.67	53.9	35	16.81	8.2	25.2	N	0	High, outgoing	6.1	2.9	6.9	Spring	Clear	N	BHD operational
TMOF	13-Jun-25	13:15	CF	7.68	53.9	35	25.52	8.33	25.6	N	0	Low	2.8	2.8	6.9	Spring	Clear	N	Offloading plume - Sampled, BHD operational
TMOF	14-Jun-25	9:01	CF	7.68	53.8	35	19.13	8.32	24.5	N	0	High	6.9	2.8	6.9	Spring	Clear	N	BHD operational; offloading barge
TMOF	15-Jun-25	9:50	CF	7.71	53.8	35	27.17	8.35	24	N	0	High	6.8	2.8	6.8	Spring	Clear	N	BHD operational ; offloading - Sample taken within a plume
TMOF	17-Jun-25	9:11	CF	7.91	54.1	35	0.84	7.25	24.4	N	0	High, incoming	6.1	2.9	6.5	Spring	Clear	N	BHD operational
TMOF	26-Jun-25	10:35	CH	7.96	54.1	35	12.01	6.73	25.4	N	0	Low, outgoing	10.3	2.8	7.3	Spring	Clear, sunny, strong winds	N	Plume sampled <150m from source
TMOF	27-Jun-25	14:32	CF	7.99	53.8	35	10.94	7.26	25.8	N	0	Low, incoming	3	2.6	7.4	Spring	Clear, strong winds	N	BHD operational near TMOF
TMOF	30-Jun-25	14:47	CF	7.84	53.9	35	30.27	9.09	25.3	N	0	Low, outgoing	2.7	2.5	7.3	Spring	Clear, calm	N	BHD operational
TMOF	01-Jul-25	11:33	CF	7.84	53.8	35	2.05	8.92	24.6	N	0	High, outgoing	6.3	2.5	6.6	Neap	Clear, light winds	N	BHD operational
TMOF	02-Jul-25	7:45	CF	7.89	53.6	35	6.22	8.9	22.1	N	0	High, outgoing	6.1	2.5	6.3	Neap	Clear, light winds	N	BHD non-operational; works to remove pile
TMOF	03-Jul-25	8:55	CF	7.85	53.7	35	15.6	9.07	23.5	N	0	High, incoming	5.1	3	5.9	Neap	Clear, light winds	N	BHD non-operational; works to remove pile, offloading from nightshift dredging
TMOF	04-Jul-25	11:25	CF	7.84	54.1	35	1.58	8.93	25.6	N	0	Outgoing	3.7	2.7	5.5	Neap	Clear, calm	N	BHD operational
TMOF	05-Jul-25	10:53	CF	7.85	53.9	35	6.7	8.9	24.6	N	0	High, outgoing	5	2.6	5.2	Neap	Clear, very calm	N	BHD operational; offloading barge
TMOF	07-Jul-25	9:05	CF	7.84	54.1	35	6.18	8.62	25	N	0	Low, outgoing	4.1	3.6	5.9	Neap	Clear, moderate winds	N	BHD operational
TMOF	23-Jul-25	14:27	CF	7.75	51.1	33	17.75	9.21	27.4	N	0	High, incoming	5	1.3	5.5	Neap	Clear, calm	N	BHD operational
TMOF	24-Jul-25	9:09	CF	7.8	50.5	33	9.1	9.08	25.6	N	0	Outgoing	4.6	1	6.8	Spring	Clear, calm	N	BHD operational
TMOF	27-Jul-25	16:25	OQV	7.62	50.71	33	7.9	9.09	26.9	N	0	Incoming	2.9	1.9	6.5	Spring	Clear, calm	N	Completion of dredge works
TMOF	29-Aug-25	15:55	CF	7.5	55.69	36	23.22	6.43	29.7	N	0	Low	1.7	1.7	6.5	Spring	Clear	N	No observations to note
TMOF	30-Aug-25	15:00	CF	7.58	55.15	36	24.42	6.2	28.3	N	0	Low, outgoing	2.2	1.9	6.2	Neap	Clear	N	Piling works
TMOF	1-Sep-25	15:28	CF	7.5	54.92	36	3.96	6.45	29.9	N	0	Outgoing	3.4	2.7	5.1	Neap	Clear	N	Sheet pile threading
TMOF	4-Sep-25	13:01	CF	7.5	54.81	36	4.66	6.69	29.8	N	0	Low, incoming	4	3.7	5.5	Neap	Clear	N	Piling on C13, no plume observed
TMOF	5-Sep-25	16:05	CF	7.53	54.7	36	2.72	6.9	29.9	N	0	High, incoming	5.1	2	6	Neap	Clear	N	Cassion backfill, no plume observed
TMOF	6-Sep-25	15:26	CF	7.47	53.1	35	5.5	6.66	27.4	N	0	High, incoming	5.1	1.5	6.5	Spring	Clear	N	Piling on C13, no plume observed
TMOF	7-Sep-25	15:54	OQV	7.42	53.78	35	2.34	6.54	28.2	N	0	High, incoming	5.1	2.2	6.6	Spring	Overcast, windy	N	Piling on C13 occurring, no plume observed
TMOF	8-Sep-25	12:24	CF	7.51	54.92	36	8.6	8.44	29.4	N	0	Low, outgoing	1.8	1.6	7.3	Spring	Clear, windy	N	No marine works
TMOF*	9-Sep-25	16:05	CF	7.52	55.21	36	4.85	6.63	30.6	N	0	Incoming	3.8	1.1	7.6	Spring	Clear	N	Cassion backfill, no plume observed
Western Revetment	26-Feb-25	16:13	CF	7.95	44.1	29	85.6	6.61	33	N	0	Incoming	5.6	1.9	6.9	Neap	Clear	N	Sampled within plume emanating from Western Revetment works
Western Revetment	27-Feb-25	16:42	CF	8.01	47.5	31	3.96	6.41	32.3	N	19.8	Incoming	5.8	1.4	7.4	Spring	Partly Cloudy	N	BHD operational



Location	Date	Time	Sampled by	pH	Electrical Conductivity (mS/cm)	TDS (g/L)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp (C)	Oil/Grease (Y/N)	Rainfall in last 24 hours (mm)	Tide	Tidal Height at time of sampling (m)	Low tide Height (m)	High Tide Height (m)	Type (Neap / Spring)	Weather	Debris (Y/N)	Comments (turbidity plume, work activities)
Western Revetment	02-Mar-25	7:06	CF	8	47.7	31	21.25	6.15	30.9	N	0	High, incoming	7.3	1.1	7.6	Spring	Clear	N	BHD operational
Western Revetment	06-Apr-25	9:54	CF	7.94	40.5	26	5.84	6.34	30	N	0	Incoming	4.5	2.7	5.5	Neap	Clear	N	BHD operational; sample taken from work boat
Western Revetment	08-Apr-25	16:15	CF	8.02	43.02	28	7.4	6.84	31	N	15.6	High	5.9	3.1	5.9	Neap	Overcast	N	BHD operational
Western Revetment	09-Apr-25	15:38	CF	7.96	44.4	29	12.03	6.69	30.4	N	9	Incoming	5.7	2.8	6.3	Neap	Overcast	N	BHD operational
Western Revetment	10-Apr-25	16:17	CF	8.03	46.3	30	7.35	6.83	31.4	N	0	Incoming	6	2.5	6.6	Neap	Partly cloudy	N	BHD operational
Western Revetment	11-Apr-25	15:24	CF	8.07	46.2	30	24.14	6.95	30.5	N	0	Incoming	5.5	2.3	6.8	Neap	Partly cloudy	N	BHD operational
Western Revetment	12-Apr-25	14:49	CF	8.05	47.1	31	12.75	6.92	32.1	N	0	Incoming	3.8	2.2	6.9	Spring	Partly cloudy	N	BHD operational
Western Revetment	14-Apr-25	10:40	CF	8	46.4	30	7.12	6.59	30.4	N	25.6	Outgoing	4.7	2.2	7.2	Spring	Partly cloudy	N	BHD operational
Western Revetment	26-May-25	9:08	CF	7.71	53.4	35	0.3	6.47	28.7	N	0	Low, outgoing	3.6	2.7	7.1	Spring	Clear	N	BHD non-operational
Western Revetment	07-Jun-25	15:35	CF	7.62	54.4	35	8.52	8.24	29	N	0	Incoming	4.5	3.6	5.5	Neap	Clear	N	BHD operational
Western Revetment	09-Jun-25	9:19	CF	7.66	53.5	35	7.19	8.19	26	N	0	Incoming	4.1	3.3	6.3	Neap	Clear	N	BHD operational
Western Revetment	11-Jun-25	12:39	CF	7.68	54.1	35	12.98	8.47	27.2	N	0	Low	3	3	6.8	Neap	Clear	N	BHD operational
Western Revetment	01-Jul-25	12:02	CF	7.84	54	35	2.33	8.96	26.2	N	0	High, outgoing	6	2.5	6.6	Neap	Clear, light winds	N	BHD operational
Western Revetment	03-Jul-25	8:42	CF	7.9	53.5	35	8.35	8.97	22.9	N	0	High, incoming	5.1	3	5.9	Neap	Clear, light winds	N	BHD non-operational, works to remove pile, offloading from nightshift dredging
Western Revetment	04-Jul-25	11:15	CF	7.88	53.8	35	2.64	8.98	26	N	0	Outgoing	3.7	2.7	5.5	Neap	Clear, calm	N	BHD operational

APPENDIX B WATER QUALITY MONITORING LOCATIONS ON THE TEMPORARY ACCESS BUNDS (TAB) AND REVETMENTS WITHIN PROJECT EXTENT



Figure 9-1. Water Quality Monitoring Locations within TAB and revetments within Project extent

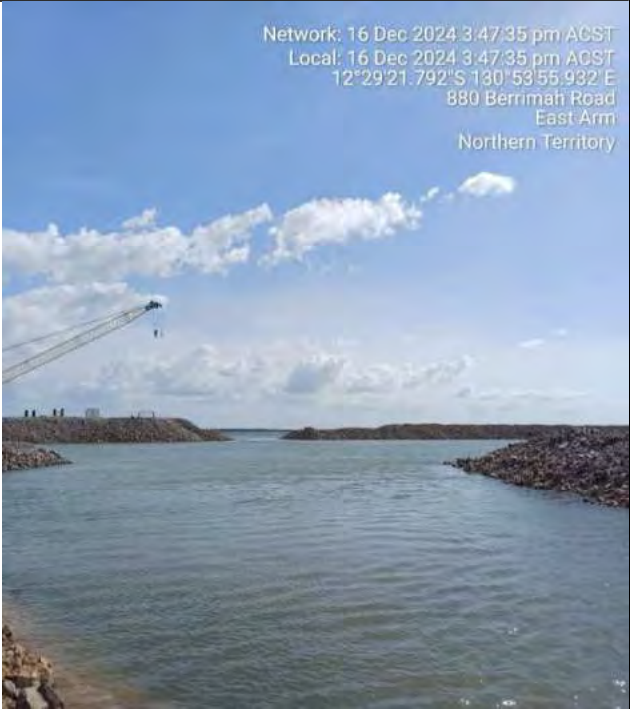


Table 9-1. Geotagged photos of monitoring locations along Temporary Access Bunds (TAB) and revetments within Project extent

TAB01B	TAB02
Network: 11 Oct 2024 10:13:23 am ACST Local: 11 Oct 2024 10:13:23 am ACST 12°29'26.862"S 130°53'56.316"E Unnamed Road East Arm Northern Territory	Sunday 30 March 2025 at 7:09 am S 12° 29' 27", E 130° 53' 57" NT,East Arm
TAB03	TAB04
Network: 5 Oct 2024 7:30:24 am ACST Local: 5 Oct 2024 7:30:23 am ACST 12°29'21.546"S 130°53'56.892"E Unnamed Road East Arm Northern Territory	Saturday 19 October 2024 at 7:46 AM S 12° 29' 28", E 130° 53' 47" NT,East Arm



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TAB05 Network time is not synchronized Local: 22 May 2025 at 3:19:04 pm ACST S 12° 29' 34.923", E 130° 53' 50.036" Northern Territory Rates Act 	TAB06 Network: 16 Dec 2024 3:47:35 pm ACST Local: 16 Dec 2024 3:47:35 pm ACST 12°29'21.792"S 130°53'55.932"E 880 Berrimah Road East Arm Northern Territory 
MUBRF Network:30 Sep 2025 at 4:06:08 pm ACST Local:30 Sep 2025 at 4:06:08 pm ACST S 12° 29' 15.167", E 130° 53' 59.454" 	Western Revetment Network time is not synchronized Local: 4 Jul 2025 at 11:13:39 am ACST S 12° 29' 33.701", E 130° 53' 51.169" Northern Territory Rates Act 



TMOF	
Network: 4 Jul 2025 at 11:24:29 am ACST Local: 4 Jul 2025 at 11:24:29 am ACST S 12° 29' 27.373", E 130° 53' 57.049" Northern Territory Rates Act 	



APPENDIX C TURBIDITY DATA RECORDED FROM TURBIDITY MONITORING BUOYS AND OFFSHORE VESSEL

Turbidity data (offshore monitoring buoys)

There were 5 recorded exceedances at the offshore turbidity monitoring buoys located at Catalina Island. The exceedances were reported to DLI. The maintenance log of the buoys shows that Buoy 3 went offline on 11 January 2025 and a supplier was engaged for diagnostic and technical repairs. The buoy was replaced with the new unit (Buoy 1) on Feb 12th at 8.30am. Therefore, the exceedances recorded at Buoy 1 and Buoy 3 are both from the same location (see **Table 9-2**).

The plume attributability reports found that the cause for all 5 plume incidences was determined to be natural environmental factors, rather than attributable to construction activities.

Table 9-2. Offshore turbidity monitoring buoy exceedances

Turbidity Monitoring Buoy 1 – Catalina Island				
Timestamp	Latitude	Longitude	Turbidity	Annotations
12/05/2025 13:15	-12.491	130.902	174.853	Exceedance was reported to DLI – Plume attributability assessment report.
12/05/2025 13:45	-12.491	130.902	162.255	Exceedance was reported to DLI – Plume attributability assessment report.
Turbidity Monitoring Buoy 3 – Catalina Island				
21/10/2024 11:45	-12.491	130.902	195.201	Exceedance was reported to DLI – Plume attributability assessment report.
24/10/2024 14:45	-12.491	130.902	244.046	Exceedance was reported to DLI – Plume attributability assessment report.
29/10/2024 10:30	-12.491	130.902	258.701	Exceedance was reported to DLI – Plume attributability assessment report.

Turbidity data (hand-held probe measurements from vessel)

Offshore turbidity results from sampling were generally low and stable, with most values below 15 NTU and typical background conditions ranging between 1–10 NTU (**Figure 9-2**). Occasional exceedances were

recorded during operational activities, with maximum values typically between 10–20 NTU and a few higher peaks up to 30–35 NTU. These increases were spatially and temporally limited and generally returned to background levels within short distances of the source. Results recorded outside the Project boundary and during dredging pauses were comparable to background, indicating that elevated turbidity was localised rather than widespread.

A small number of elevated spikes were recorded during Oct–Nov 2024; however, no turbidity measurements exceeded the trigger value of 140 NTU. Overall, the offshore turbidity monitoring indicates that water quality remains within the expected range for Darwin Harbour, with no attributable increases in turbidity from construction or dredging activities.

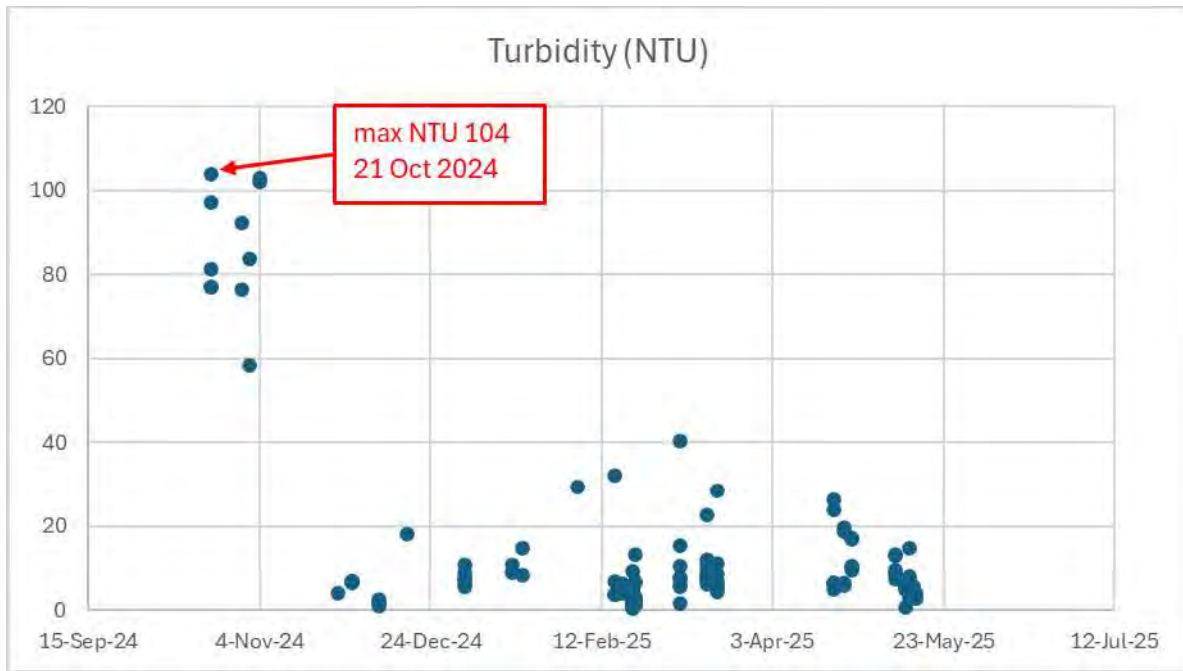


Figure 9-2. Turbidity levels measured 150m downstream from active dredge, pipeline or reclamation area



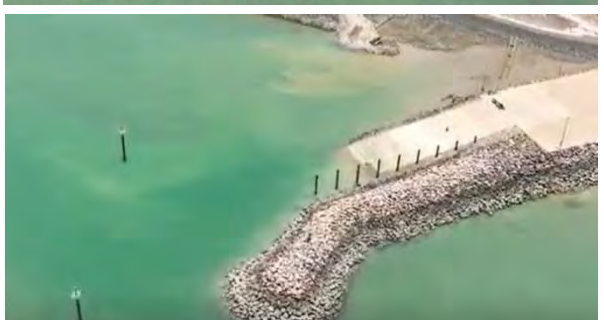
APPENDIX D PLUME ATTRIBUTABILITY ASSESSMENT REPORTS

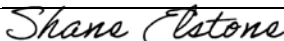
Plume Attributability Assessment Report Form



If a turbidity reading greater than 140NTU has been recorded at 150m from source, then complete the form below:

PLUME REPORT DETAILS			
Date of Plume	21/10/2024	Time of Plume Reported	12:00pm
Reported By	Name: Project Engineer	Event ID #	41213 - 013
Reported To	Name: Environmental Advisor		
Location of Event	East Arm, Darwin Harbour		
Description of Event	Description of the plume location, extent of the plume, turbidity readings recorded, what the site works & activities were going on at the time:		
On 21st of October, Project Engineer notified site Environmental Advisor that turbidity buoy 3 had recorded a high threshold reading of 195NTU at 11:45am. At 12:30pm, Onshore Superintendent deployed a drone to capture aerial imagery of the plume extent. Plume location CT / CP # Turbidity Bouy 3 – Catalina Island Latitude: 12°29'28"S Longitude: 130°54'09"E Site work activities 3x articulated haulers, 1x 30T and 1x 50T excavators were working on Reclamation Area 004 from 11:00am.		 	

PLUME ATTRIBUTABILITY ASSESSMENT (BY ENVIRONMENT ADVISOR)			
Date of Assessment	21/10/2024	Time of Assessment	2:00pm
Assessed By	Name: Caprice Hyde		
Description of Assessment	Description of potential plume attributes and discussion/determination of plume cause (Attach further information if required):		
<u>Preliminary assessment</u> At 11:45am, the tide was low and outgoing, at a height of 2.7m. The initial assessment of the aerial footage identified that the turbidity plume was emanating downstream of Catalina Island (refer above images). The shallow waters around Catalina Island contributed to the increased exposure and movement of sediment, causing elevated turbidity levels once it reached the buoy. The turbidity plume caused from site work activities was determined to remain within the project footprint and did not disperse east of the Multi-user Barge Ramp facility (MUBRF). <u>Assessment outcome</u> The assessment determined that site works was not the cause of the turbidity exceedance within the Harbour, and it was caused from natural environmental factors.		 	

PLUME ATTRIBUTABILITY SUMMARY (BY ENVIRONMENT ADVISOR)			
Plume Cause (Determined)	Natural environmental factors	Plume Caused by CBJV Activities	Yes / No / Unknown
PLUME ATTRIBUTABILITY SIGN-OFF (BY ENVIRONMENT ADVISOR)			
Name	Caprice Hyde	Date	23/10/2024
Signature		Time	am / pm
REPORT FINDINGS ACCEPTED SIGN-OFF (BY MARINE SUPERINTENDENT)			
Name	Shane Elstone	Date	23/10/2024
Signature		Time	am / pm

Plume

Attributability Assessment Report Form

clough

If a turbidity reading greater than 140NTU has been recorded at 150m from source, then complete the form below:

PLUME REPORT DETAILS					
Date of Plume	24/10/2024		Time of Plume Reported	14:45pm	Event ID # 41213 - 015
Reported By	Name:	Environmental Advisor			
Reported To	Name:				
Location of Event	East Arm, Darwin Harbour				
Description of Event	Description of the plume location, extent of the plume, turbidity readings recorded, what the site works & activities were going on at the time.				
On 24th of October, the environmental advisor received a notification from the turbidity buoy 3 which recorded a high threshold reading of 244 NTU at 14:45pm. At 15:15pm, the environmental advisor deployed a drone to capture arial imagery of the plume extent. <u>Plume location</u> Turbidity Bouy 3 – Catalina Island Latitude: 12°29'28"S Longitude: 130°54'09"E <u>Site work activities</u> Onshore: Place SRF1A in RA004 to +3.35m LAT, Place RF2A in RA001 to +7.5m LAT. Offshore: No dredging taken place on this day					
PLUME ATTRIBUTABILITY ASSESSMENT (BY ENVIRONMENT ADVISOR)					
Date of Assessment	25/10/2024		Time of Assessment	16:00pm	
Assessed By	Name:	Christian Freeman			
Description of Assessment	Description of potential plume attributes and discussion/determination of plume cause (Attach further information if required):				
<u>Preliminary assessment</u> At 14:45pm, the tide was low and outgoing, at a height of 2.9m. The assessment of the aerial footage identified that the turbidity plume was emanating down-stream of Catalina Island (refer above images). The shallow waters around Catalina Island contributed to the increased exposure and movement of sediment, causing elevated turbidity levels once it reached the buoy. Small plume observed coming from RA004 near MUBRF, though shows to be well within boundary. Water monitoring at MUBRF was conducted on this day, at 8:19am. Turbidity was recorded at 107 NTU. <u>Assessment outcome</u> The assessment determined that site works were not the cause of the turbidity exceedance within the Harbour, and it was caused by natural environmental factors. In addition, there was no dredging operations performed on this day to be a contributing factor to the exceedance.			 		
PLUME ATTRIBUTABILITY SUMMARY (BY ENVIRONMENT ADVISOR)					
Plume Cause (Determined)	Natural environmental factors		Plume Caused by CBJV Activities	Yes / No / Unknown	
PLUME ATTRIBUTABILITY SIGN-OFF (BY ENVIRONMENT ADVISOR)					
Name	Caprice Hyde			Date	25/10/2024
Signature				Time	am / pm
REPORT FINDINGS ACCEPTED SIGN-OFF (BY MARINE SUPERINTENDENT)					
Name	Brendan Pilmore			Date	25/10/2024
Signature				Time	am / pm

Plume Attributability Assessment Report Form

clough

If a turbidity reading greater than 140NTU has been recorded at 150m from source, then complete the form below.

PLUME REPORT DETAILS					
Date of Plume	29/10/2024		Time of Plume Reported	10:30am	Event ID # 41213 - 017
Reported By	Name:	Environmental Advisor			
Reported To	Name:				
Location of Event	East Arm, Darwin Harbour				
Description of Event	Description of the plume location, extent of the plume, turbidity readings recorded, what the site works & activities were going on at the time:				
On 29th of October, the environmental advisor received a notification from the turbidity buoy which recorded a high threshold reading of 258 NTU at 10:30am. At 11:00am, the environmental advisor deployed a drone to capture arial imagery of the plume extent. <u>Plume location</u> Turbidity Bouy 3 – Catalina Island Latitude: 12°29'28"S Longitude: 130°54'09"E <u>Turbidity buoy readings</u> 10:15am: 10.3 NTU 10:30am: 258 NTU 10:45am: 9.4 NTU <u>Site work activities</u> Onshore: Placement of SRF1A in RA006 for RL 5.5, and placement SRF1A in RA005 at RL 3.35 whilst tide low. Offshore: Dredge operations were taking place at the start of run line 12, on the far western side of dredge extent.					
PLUME ATTRIBUTABILITY ASSESSMENT (BY ENVIRONMENT ADVISOR)					
Date of Assessment	30/10/2024		Time of Assessment	09:00am	
Assessed By	Name:	Christian Freeman			
Description of Assessment	Description of potential plume attributes and discussion/determination of plume cause (Attach further information if required):				
<u>Preliminary assessment</u> At 10:30am, the tide was low and outgoing, at a height of 2.3m. The assessment of the aerial footage identified that the turbidity plume was emanating down-stream of Catalina Island (refer above image). The shallow waters around Catalina Island contributed to the increased exposure and movement of sediment, causing elevated turbidity levels once it reached the buoy. The turbidity readings were well below 140 NTU before/after the exceedance for the entire day. There were no works being performed on R004 during this period. Turbidity monitoring was completed at two onshore locations close to 4:00pm. MUBRF recorded a turbidity of 81.1 NTU and TAB02 recorded a turbidity of 17.3 NTU. <u>Assessment outcome</u> The assessment determined that Project activities were not the cause of the turbidity exceedance within the Harbour, and it was caused by natural environmental factors.			 		
PLUME ATTRIBUTABILITY SUMMARY (BY ENVIRONMENT ADVISOR)					
Plume Cause (Determined)	Natural environmental factors		Plume Caused by CBJV Activities	Yes / No / Unknown	
PLUME ATTRIBUTABILITY SIGN-OFF (BY ENVIRONMENT ADVISOR)					
Name	Caprice Hyde			Date	30/10/2024
Signature				Time	am / pm
REPORT FINDINGS ACCEPTED SIGN-OFF (BY MARINE SUPERINTENDENT)					
Name	Brendan Pilmore			Date	30/10/2024
Signature				Time	am / pm

Plume

Attributability Assessment Report Form

clough

BMD

If a turbidity reading greater than 140NTU has been recorded at 150m from source, then complete the form below.

PLUME REPORT DETAILS

Date of Plume

12/05/2025

Time of Plume Reported

13:45pm

Event ID #

41213 - 05

Reported By

Name:

Environmental Advisor

Reported To

Name:

Location of Event

East Arm, Darwin Harbour

Description of Event

Description of the plume location, extent of the plume, turbidity readings recorded, what the site works & activities were going on at the time:

On 12th of May, the site environmental advisor received a notification from the turbidity buoy 1 which recorded readings above 140 NTU limit.

At 2:00pm, the environmental advisor deployed a drone to capture aerial imagery of the plume extent.

Turbidity buoy readings (NTU)

Time	Catalina Island
12:00pm	134
12:30pm	104
1:15pm	174
1:45pm	162

At 10:30am, a plume was observed emanating 150m downstream from source (BHD dredger & offloading barge). Environmental advisor performed water quality sampling at three locations at plume extent which were below 6 NTU.

Site work activities

Onshore: Place RF2A in RA04 and offloading barge material.

Offshore: Loading barge.





PLUME ATTRIBUTABILITY ASSESSMENT (BY ENVIRONMENT ADVISOR)

Date of Assessment

12/05/2025

Time of Assessment

2:30pm

Assessed By

Name:

Caprice Hyde

Description of Assessment

Description of potential plume attributes and discussion/determination of plume cause (Attach further information if required):

Preliminary assessment

At 1:45pm, the tide was an incoming low, at a height of 3.2m.

The assessment of the imagery identified that the turbidity plume was emanating both upstream and downstream of Catalina Island. Movement of sediment was observed east of the Multi-user Barge Ramp facility (MUBRF).

Turbidity plumes caused by site work activities did not go beyond 150m from source at the time of exceedances.

Turbidity monitoring was completed at two onshore locations close to 2:30pm. MUBRF recorded a reading of 4.6 NTU and TMOF recorded a reading of 3.9 NTU.

Assessment outcome

The assessment determined that site works were not the cause of the turbidity exceedances within the Harbour, and it was caused by natural environmental factors.



PLUME ATTRIBUTABILITY SUMMARY (BY ENVIRONMENT ADVISOR)

Plume Cause (Determined)

Natural environmental factors

Plume Caused by CBJV Activities

Yes / No / Unknown

PLUME ATTRIBUTABILITY SIGN-OFF (BY ENVIRONMENT ADVISOR)

Name

Caprice Hyde

Signature



Date

12/05/2025

Time

am / pm

REPORT FINDINGS ACCEPTED SIGN-OFF (BY CONSTRUCTION MANAGER)

Name

Joseph Solomon

Signature



Date

12/05/2025

Time

am / pm

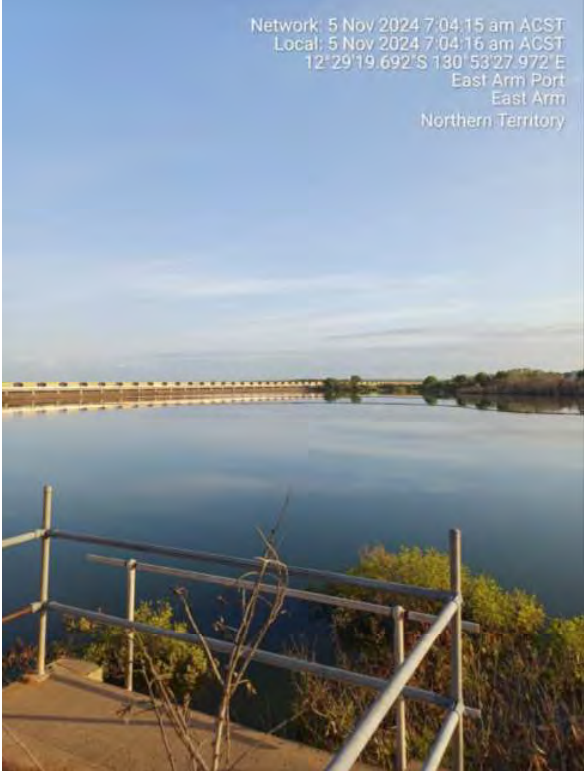
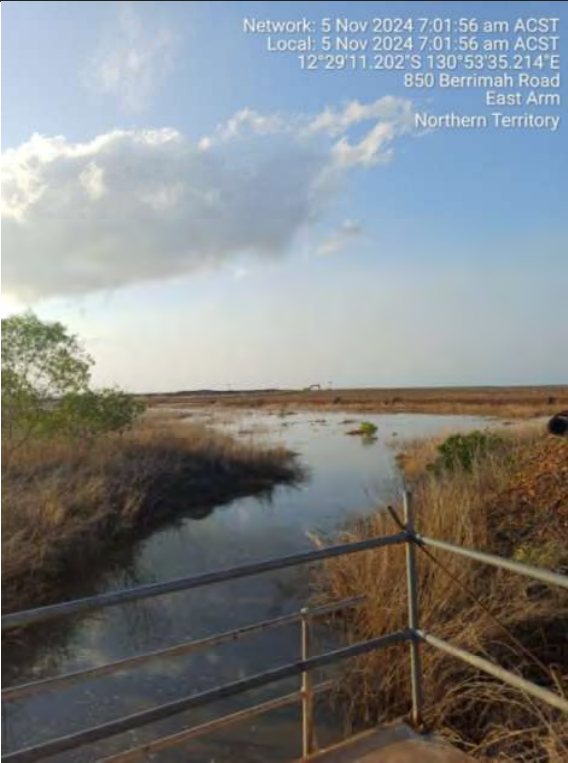


APPENDIX E WATER QUALITY MONITORING (IN-SITU) AND OBSERVATIONS UNDERTAKEN AT EAST ARM WHARF DREDGE PONDS DURING REPORTING PERIOD



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APPENDIX F WATER QUALITY MONITORING LOCATIONS AT EAST
ARM WHARF DREDGE PONDS

Pond E (South) - Monitoring Location 1  Network: 5 Nov 2024 7:25:23 am ACST Local: 5 Nov 2024 7:25:23 am ACST 12°29'22.638"S 130°53'19.218"E East Arm Port East Arm Northern Territory	Pond E (North) - Monitoring Location 2  Network: 5 Nov 2024 7:04:15 am ACST Local: 5 Nov 2024 7:04:16 am ACST 12°29'19.692"S 130°53'27.972"E East Arm Port East Arm Northern Territory
Pond K - Monitoring Location 3  Network: 5 Nov 2024 7:01:56 am ACST Local: 5 Nov 2024 7:01:56 am ACST 12°29'11.202"S 130°53'35.214"E 850 Berrimah Road East Arm Northern Territory	

APPENDIX G ONSHORE (IN-SITU) AND EAW SETTLING PONDS WATER QUALITY MONITORING RESULTS FOR PH AND TURBIDITY

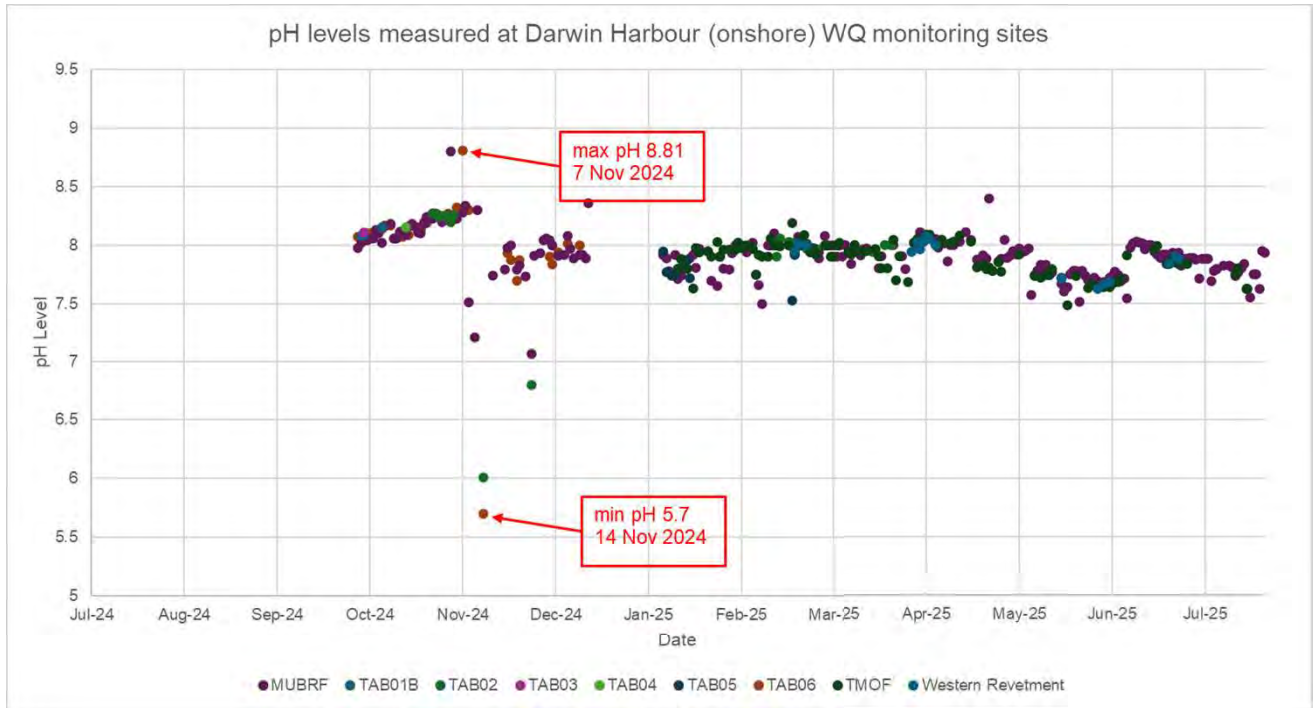


Figure 9-3 pH readings at onshore (in-situ) water quality monitoring sites

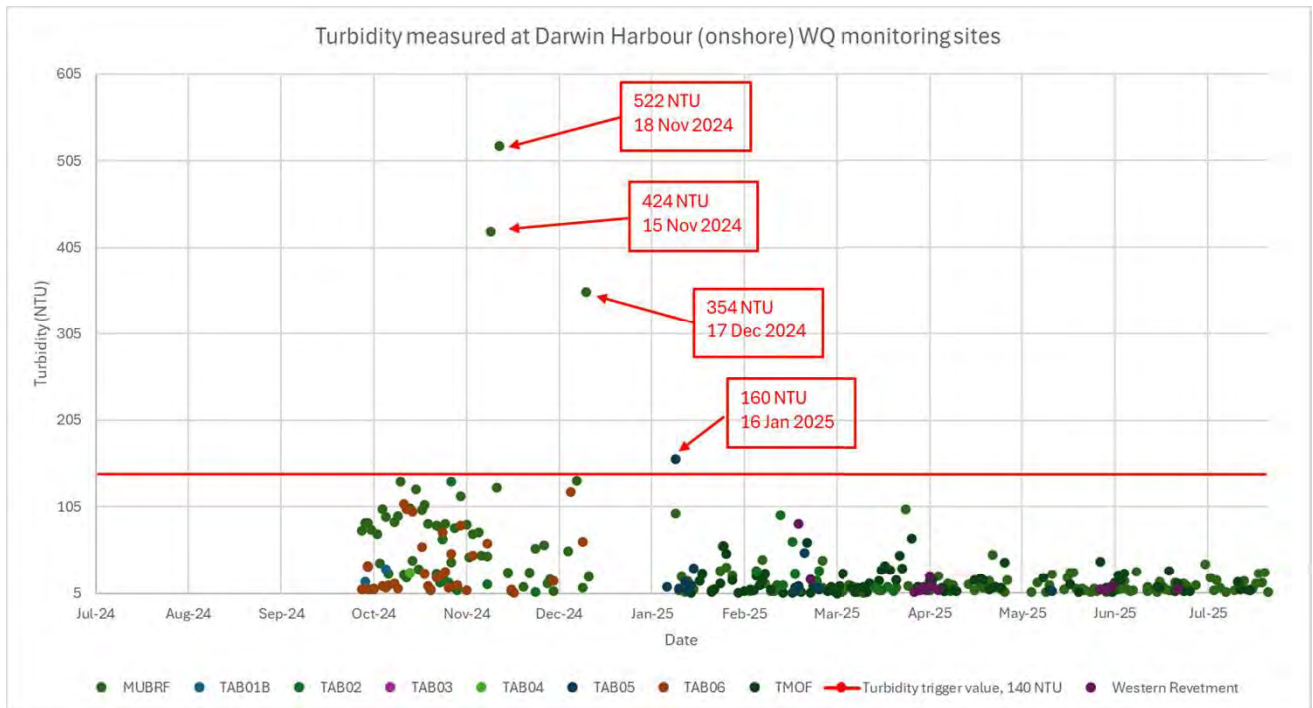


Figure 9-4. Turbidity readings at onshore (in-situ) water quality monitoring sites

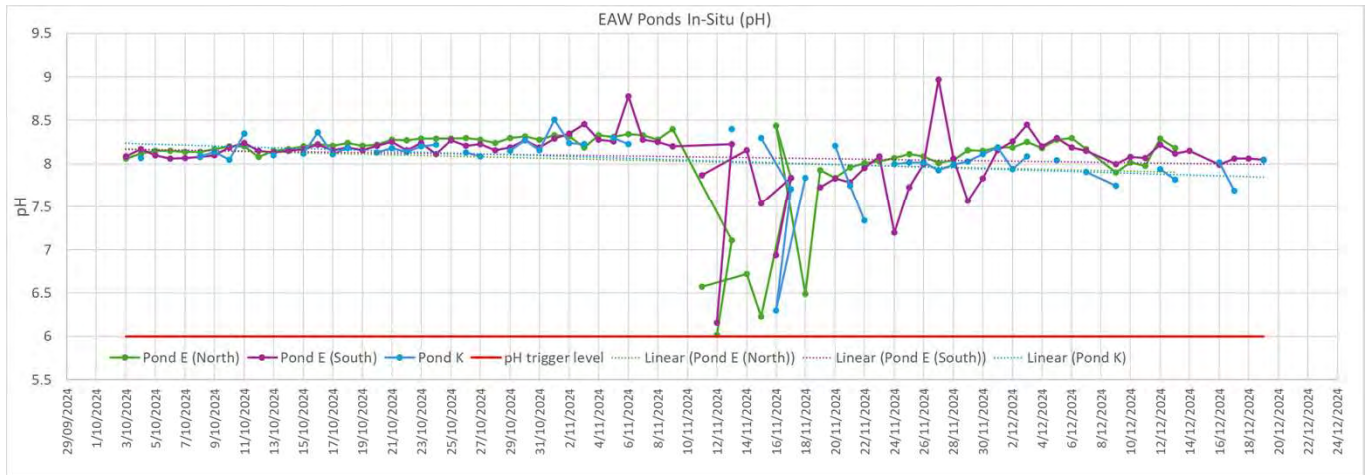


Figure 9-5. pH readings at EAW Settlement Ponds

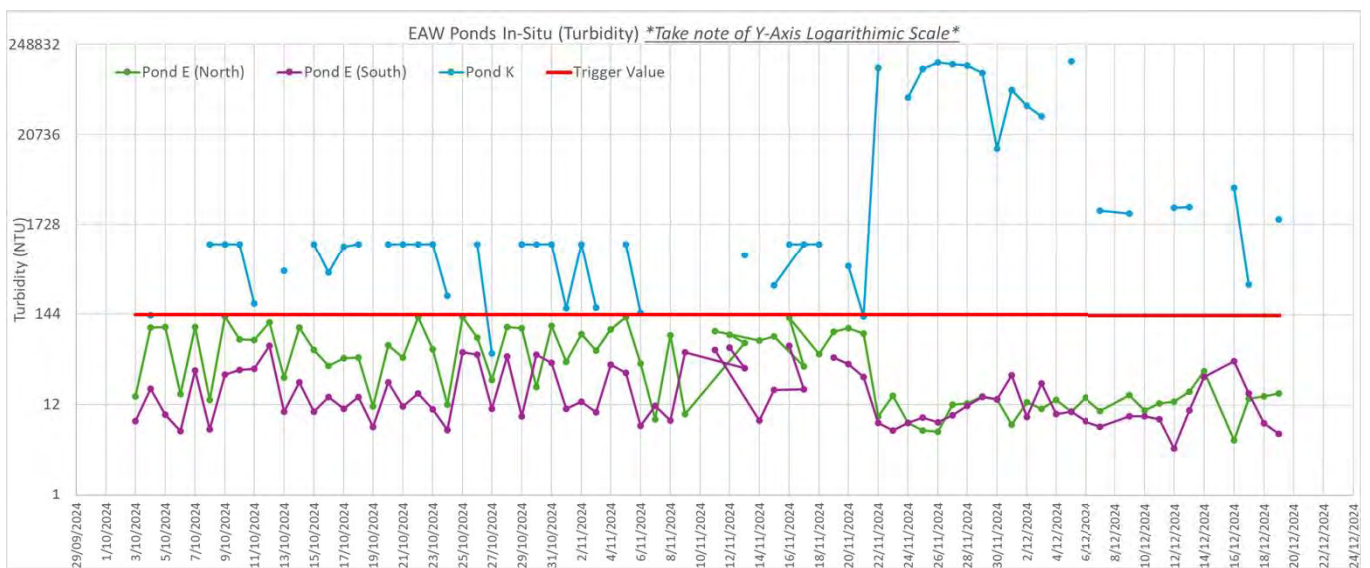


Figure 9-6. Turbidity readings at EAW Settlement Ponds



APPENDIX H MARINE MEGAFUNA OBSERVATION LOGS DURING SHEET PILING & DREDGING ACTIVITIES

CELLS	Caisson	Day	Month	Year	Driving Date	Marine Fauna Observed (Y/N)	MFO Log submitted (Y/N)	Link
TMOF	-	07-	Nov	2024	07-Nov2024	N	Y	LPI - Marine Megafauna - Piling Works 07.11.24.pdf
TMOF	-	16-	Nov	2024	16-Nov2024	N	Y	LPI - Marine Megafauna - Piling Works 16.11.24.pdf
TMOF	-	17-	Nov	2024	17-Nov2024	N	Y	LPI - Marine Megafauna - Piling works 17.11.24.pdf
Wet Berth A	C01	27-	May-	2025	27-May-2025		N	
Wet Berth A	C01	29-	May-	2025	29-May-2025	N	Y	MFO Form 29-05-25.pdf
Wet Berth A	C01	30-	May-	2025	30-May-2025	N	Y	MFO Form 30-05-25.pdf
Wet Berth A	C01	31-	May-	2025	31-May-2025	N	Y	MFO Form 31-05-25.pdf
Wet Berth A	C01	01-	Jun-	2025	01-Jun-2025	N	Y	MFO Form 01-06-25.pdf
-	-	12-	Jun-	2025	12-Jun-2025	N	Y	MFO Form 12-06-25.pdf
-	-	13-	Jun-	2025	13-Jun-2025	N	Y	MFO Form 13-06-25.pdf
-	-	14-	Jun-	2025	14-Jun-2025	N	Y	MFO Form 14-06-25.pdf
-	-	15-	Jun-	2025	15-Jun-2025	N	Y	MFO Form 15-06-25.pdf
Wet Berth A	A01	21-	Jun-	2025	21-Jun-2025	N	Y	MFO Form 21-06-25.pdf
Wet Berth A	A01	22-	Jun-	2025	22-Jun-2025	N	Y	MFO Form 22-06-25.pdf
Wet Berth A	C03	23-	Jun-	2025	23-Jun-2025	N	Y	MFO Form 23-06-25.pdf
Wet Berth A	A01	23-	Jun-	2025	23-Jun-2025	N	Y	
Wet Berth A	A01	24-	Jun-	2025	24-Jun-2025	N	Y	MFO Form 24-06-25.pdf
Wet Berth A	C03	25-	Jun-	2025	25-Jun-2025	N	Y	MFO Form 25-06-25.pdf
Wet Berth A	C03	27-	Jun-	2025	27-Jun-2025	N	Y	MFO Form 27-06-25.pdf
Wet Berth A	A02	01-	Jul-	2025	01-Jul-2025		N	
Wet Berth A	A02	02-	Jul-	2025	02-Jul-2025		N	
Wet Berth A	C04	05-	Jul-	2025	05-Jul-2025		N	
Wet Berth A	C04	06-	Jul-	2025	06-Jul-2025	N		06.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	C04	07-	Jul-	2025	07-Jul-2025	N	Y	07.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	C04	08-	Jul-	2025	08-Jul-2025	N	Y	08.07 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C12	16-	Jul-	2025	16-Jul-2025	N	Y	16.07 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C12	17-	Jul-	2025	17-Jul-2025		Y	17.07 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C12	18-	Jul-	2025	18-Jul-2025	N	Y	18.07 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C12	19-	Jul-	2025	19-Jul-2025	N	Y	19.07 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C12	20-	Jul-	2025	20-Jul-2025	N	Y	20.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	A03	21-	Jul-	2025	21-Jul-2025	N	Y	21.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	A03	22-	Jul-	2025	22-Jul-2025	N	Y	22.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	A03	23-	Jul-	2025	23-Jul-2025	N	Y	23.07 Marine Fauna Observation Log - Piling.pdf

Wet Berth A	A03	24-	Jul-	2025	24-Jul-2025	N	Y	24.07 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	C05	25-	Jul-	2025	25-Jul-2025		N	
Wet Berth A	C05	26-	Jul-	2025	26-Jul-2025	N	Y	26.07 Marine Fauna Observation Log.pdf
Wet Berth A	C05	27-	Jul-	2025	27-Jul-2025	N	Y	27.07 Marine Fauna Observation Log.pdf
Wet Berth A	C05	28-	Jul-	2025	28-Jul-2025	N	Y	28.07 Marine Fauna Observation Log.pdf
Wet Berth A	C05	29-	Jul-	2025	29-Jul-2025	N	Y	29.07 Marine Fauna Observation Log.pdf
Wet Berth A	C05	30-	Jul-	2025	30-Jul-2025		N	
Wet Berth A	C05	31-	Jul-	2025	31-Jul-2025	N	Y	31.07 Marine Fauna Observation Log-Piling.pdf
Ship Lift	C12	08-	Aug-	2025	08-Aug-2025		N	
Ship Lift	C12	09-	Aug-	2025	09-Aug-2025		N	
Ship Lift	C12	10-	Aug-	2025	10-Aug-2025		N	
Ship Lift	C12	11-	Aug-	2025	11-Aug-2025		N	
Wet Berth A	A04	31-	Aug-	2025	31-Aug-2025		N	
Wet Berth A	A11	02-	Sep-	2025	02-Sep-2025		N	
Wet Berth A	C06	04-	Sep-	2025	04-Sep-2025		N	
Ship Lift	C13	04-	Sep-	2025	04-Sep-2025		N	
Wet Berth A	C06	05-	Sep-	2025	05-Sep-2025		N	
Ship Lift	C13	05-	Sep-	2025	05-Sep-2025		N	
Ship Lift	C13	06-	Sep-	2025	06-Sep-2025		N	
Ship Lift	C13	07-	Sep-	2025	07-Sep-2025		N	
Ship Lift	C13	12-	Sep-	2025	12-Sep-2025	N	Y	12.09 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C13	13-	Sep-	2025	13-Sep-2025	N	Y	13.09 Marine Fauna Observation Log - Piling.pdf
Ship Lift	C13	17-	Sep-	2025	17-Sep-2025	N	Y	
Ship Lift	C13	18-	Sep-	2025	18-Sep-2025	N	Y	18.09 Marine Fauna Observation Log - Piling.pdf
Ship Lift	A12	18-	Sept	2025	18-Sept2025	N	Y	
Ship Lift	A12	19-	Sep-	2025	19-Sep-2025	N	Y	19.09 Marine Fauna Observation Log - Piling.pdf
Wet Berth A	A05	20-	Sep-	2025	20-Sep-2025		N	
Wet Berth A	A05	21-	Sep-	2025	21-Sep-2025		N	
Wet Berth A	C07	24-	Sep-	2025	24-Sep-2025		N	
Wet Berth A	C07	25-	Sep-	2025	25-Sep-2025		N	
Ship Lift	A12	25-	Sep-	2025	25-Sep-2025		N	
Wet Berth A	A06	26-	Sep-	2025	26-Sep-2025		N	
Ship Lift	A12	27-	Sep-	2025	27-Sep-2025		N	
Wet Berth A	A06	29-	Sep-	2025	29-Sep-2025		N	
Wet Berth A	A06	30-	Sep-	2025	30-Sep-2025		N	

Onshore/offshore	Vessel	Day	Month	Year	Marine Fauna Observed (Y/N)	MFO Log (Y/N)	Link	Comment
Offshore	Arnhem	03-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	04-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	05-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	06-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	07-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	08-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	09-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		10-	Oct-	2024		N		
Offshore		11-	Oct-	2024		N		
Offshore		12-	Oct-	2024		N		
Offshore		13-	Oct-	2024		N		
Offshore		14-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		15-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		16-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		17-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		18-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		19-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		20-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		21-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		22-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	23-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	24-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		25-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		26-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore		27-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	28-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	29-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	30-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	31-	Oct-	2024	N	Y	Priority Area 3 - Fauna Observation	
Offshore	Arnhem	01-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	02-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	03-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	04-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	05-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	06-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		07-	Nov-	2024		N	No dredging	
Offshore		08-	Nov-	2024		N	No dredging	
Offshore		09-	Nov-	2024		N	No dredging	
Offshore		10-	Nov-	2024		N	No dredging	
Offshore		11-	Nov-	2024		N	No dredging	
Offshore		12-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		13-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		14-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		15-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		16-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore	Arnhem	17-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		18-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		19-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		20-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		21-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		22-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		23-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		24-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		25-	Nov-	2024	N	Y	Priority Area 2 - Fauna Observation	
Offshore		26-	Nov-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		27-	Nov-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		28-	Nov-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		29-	Nov-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		30-	Nov-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		01-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		02-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		03-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		04-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		05-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		06-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		07-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	

Offshore		08-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		09-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		10-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		11-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		12-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		13-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		14-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		15-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		16-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		17-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		18-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		19-	Dec-	2024	N	Y	Priority Area 4 - Fauna Observation	
Offshore		20-	Dec-	2024		N	No dredging	
Offshore		21-	Dec-	2024		N	No dredging	
Offshore		22-	Dec-	2024		N	No dredging	
Offshore		23-	Dec-	2024		N	No dredging	
Offshore		24-	Dec-	2024		N	No dredging	
Offshore		25-	Dec-	2024		N	No dredging	
Offshore		26-	Dec-	2024		N	No dredging	
Offshore		27-	Dec-	2024		N	No dredging	
Offshore		28-	Dec-	2024		N	No dredging	
Offshore		29-	Dec-	2024		N	No dredging	
Offshore		30-	Dec-	2024		N	No dredging	
Offshore		31-	Dec-	2024		N	No dredging	
Offshore		01-	Jan-	2025		N	No dredging	
Offshore		02-	Jan-	2025		N	No dredging	
Offshore		03-	Jan-	2025		N	No dredging	
Offshore		04-	Jan-	2025		N	No dredging	
Offshore		05-	Jan-	2025		N	No dredging	
Offshore		06-	Jan-	2025		N	No dredging	
Offshore		07-	Jan-	2025		N	No dredging	
Offshore		08-	Jan-	2025		N	No dredging	
Offshore		09-	Jan-	2025		N	No dredging	
Offshore		10-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		11-	Jan-	2025		Y	Marine Fauna Logs - January	
Offshore		12-	Jan-	2025		N		
Offshore		13-	Jan-	2025		N		
Offshore		14-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		15-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		16-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		17-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		18-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		19-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		20-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		21-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		22-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		23-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		24-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		25-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		26-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		27-	Jan-	2025	N	Y	Marine Fauna Logs - January	Stop Dredging at 0700 and Start dredging at 1330 due to hydraulic issue
Offshore		28-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		29-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		30-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		31-	Jan-	2025	N	Y	Marine Fauna Logs - January	
Offshore		01-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		02-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		03-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		04-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		05-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		06-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		07-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		08-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		09-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		10-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		11-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		12-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		13-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		14-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		15-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		16-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		17-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		18-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		19-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		20-	Feb-	2025		N	Marine Fauna Logs - February	Dredging contractor stood down for >24hr period and did not submit an MFO form for 20/02.
Offshore		21-	Feb-	2025	N	Y	Marine Fauna Logs - February	
Offshore		22-	Feb-	2025	N	Y	Marine Fauna Logs - February	

[illegible]

Offshore		14-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		15-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		16-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		17-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		18-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		19-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		20-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		21-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		22-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		23-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		24-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		25-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		26-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		27-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		28-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		29-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		30-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		31-	May-	2025	N	Y	Marine Fauna Logs - May	
Offshore		01-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		02-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		03-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		04-	Jun-	2025	Y	Y	Marine Fauna Logs - June	1525 Dolphins x 2 spotted Cease operations
Offshore		05-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		06-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		07-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		08-	Jun-	2025	Y	Y	Marine Fauna Logs - June	1310 Cease Operations Marine fauna seen leaving operations area moving east. 1430 recommenced operations
Offshore		09-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		10-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		11-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		12-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		13-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		14-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		15-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		16-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		17-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		18-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		19-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		20-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		21-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		22-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		23-	Jun-	2025	N	Y	Marine Fauna Logs - June	Dredger was not-operational due to maintenance from 1140 - 1830
Offshore		24-	Jun-	2025		N	No dredging	Dredger was not-operational due to maintenance for 24hr period
Offshore		25-	Jun-	2025	N	Y	Marine Fauna Logs - June	Dredger was not-operational due to maintenance from 0600 – 1230
Offshore		26-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		27-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		28-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		29-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		30-	Jun-	2025	N	Y	Marine Fauna Logs - June	
Offshore		01-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		02-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		03-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		04-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		05-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		06-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		07-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		08-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		09-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		10-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		11-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		12-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		13-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		14-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		15-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		16-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		17-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		18-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		19-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		20-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		21-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		22-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		23-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		24-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		25-	Jul-	2025		N		

Offshore		26-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		27-	Jul-	2025	N	Y	Marine Fauna Logs - July	
Offshore		28-	Jul-	2025	N	Y	Marine Fauna Logs - July	



APPENDIX I EPBC APPROVAL CONDITIONS COMPLIANCE TABLE

Table 9-3. EPBC Approval conditions

Condition Number	Condition	Action Description	Designation	Evidence / Comments
Conditions specific to the Action – disturbance limits				
EPBC Condition 1	To avoid and mitigate harm to protected matters, the approval holder must: a) not take the Action outside the Action area; and b) comply with NT EPA Environmental Approval condition 1-1, to the extent it relates to protected matters.	NT EPA Environmental Approval condition 1-1 limitations include: Capital dredging (excluding maintenance dredging) shall not exceed 520,000m ³ and shall occur within the approved extent (Figure 1). Disturbance of no more than 11 ha of seabed within the approved extent.	Compliant	CBJV has submitted weekly dredge reports to the NTG which includes capital dredging totals for the Project (data or drawings) confirming areas of clearance were within approved extents. Shapefiles have been submitted to the DCCEE which shows the location of the Project works during the reporting period within the Project EPBC Act controlled action area.
Conditions specific to the Action – Construction phase environmental objectives				
EPBC Condition 2	To avoid and mitigate harm to protected matters as a result of taking the Action, the approval holder must comply with the NT EPA Environmental Approval conditions 2-1 and 2-2, to the extent that they relate to protected matters.	NT EPA Environmental Approval condition 2-1 include: The approval holder must carry out the construction phase of the action to achieve the following environmental objectives: (1) no material environmental harm to the environmental values and declared beneficial uses of Darwin Harbour beyond the approved extent, including but not limited to the quality and productivity of water, sediment, and biota; and (2) dredging and land reclamation activities must not cause any	Compliant	DLI is compliant with all the requirements of the condition, including the implementation of relevant management plans to ensure no material environmental harm to environmental values and declared beneficial uses occurred in Darwin Harbour. All controls were in place as outlined in the CEMP and DDSPMP, incorporating relevant Commonwealth and Territory legislative frameworks during the reporting period. The CEMP references management strategies within the following sub-plans • Appendix F – Potential acid sulfate soils management sub-plans:



Condition Number	Condition	Action Description	Designation	Evidence / Comments
		material environmental harm to water quality, or the condition or distribution of benthic communities beyond approved extent, as indicated by monitoring required by condition 2-4(3); and (3) Risks of physical injury, mortality, behavioural changes and health impacts on marine megafauna are minimised. NT EPA Environmental Approval condition 2-2 includes: To support the achievement of condition 2-1, the approval holder must implement the action in such a manner that: (1) The external revetment walls are designed and constructed to wholly contain all material placed within the reclaimed area and to prevent the release of sediment to tidal waters during construction; (2) The generation of sediment plumes during construction of the rock revetment, land reclamation, dredging and dredged material management, is minimised.		• Appendix G – Water quality management sub-plan. • Appendix H – Terrestrial flora and fauna management sub-plan. • Appendix I – Pests, weeds and biosecurity management sub-plan. • Appendix J – Emissions management sub-plan. • Appendix L - Spill management sub-plan. The DDSPMP outlines the Environmental Management Frameworks (EMFs) that have been developed for the risks associated with the dredging works, as identified through the environmental risk assessment process (AECOM 2022). These include: • Protected marine species – physical interaction and underwater noise. • Management measures, including water quality trigger levels, adaptive management measures and corrective actions are described in Section 6 of the DDSPMP. The environmental monitoring program that is implemented as part of the Plan is outlined in Section 7 of the DDSPMP. CBJV applied an environmental and heritage-based risk register to capture and manage environmental risks identified pre-construction and during the construction phase (Appendix M, CEMP). All environmental hazard analysis processes were based on ISO 31000:2009 Australian Standard Risk Management.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
				CBJV has submitted weekly dredge reports to capture daily monitoring logs (i.e., water quality, marine megafauna). CBJV's subcontractor provided evidence of attendance for Marine Fauna Observer training awareness. The register includes the names of six persons in the 2024-25 reporting period. Based on the very low number of instances where marine fauna were observed (3x occasions) and the fact that actions were immediately taken to cease works on all three occasions, the potential for material environmental harm or risk of physical injury, mortality, behavioural changes and health impacts to marine megafauna was very low throughout the dredging and piling activities. Corrective actions were taken when necessary by CBJV to minimise the risk even further and ensure no material environmental harm occurred to marine megafauna. Permanent revetments and temporary access bunds (TABs) were constructed with material which contained no particles less than 20mm and did not result in the release of sediment into tidal waters. Reclamation material was not placed until the full closure of specified areas behind completed revetments/TABs. The revetments and TABs were covered in geofabric to prevent migration of fines from the reclamation fill



Condition Number	Condition	Action Description	Designation	Evidence / Comments
				into tidal waters. Refer to WGA230105-DR-MA-155002 to WGA230105-DR-MA-155004 and WGA230105-DR-MA-352071 which show the application of geotextile along the revetments and TABs (refer Appendix J). Revetments and TABs were at all times higher than the reclamation fill material during construction at +8.1 m Lowest Astronomical Tide (LAT) and +7.9 m LAT, respectively to ensure sediment did not overtop the controls. These levels were greater than the Mean High-Water Springs (MHWS). Monitoring of tidal waters for sediment plumes was conducted regularly by site supervisors and engineers during the construction process (turbidity plume monitoring forms were supplied in the weekly dredge reports). Noting the controls above which fully contain the reclamation fill material and sediment generated during placement, sediment plumes from revetment or TAB construction may only arise during the placement of rock when it disturbs the seabed. Where plumes were observed, the placement of material was adjusted accordingly to reduce the severity of the plume if possible.
Conditions specific to the Action – Erosion and Sediment Control Plan				
EPBC Condition 3	To avoid and mitigate harm to protected matters as a result of taking the Action, the approval holder must comply with the NT EPA Environmental Approval	To minimise erosion and sedimentation from the Project activities that may impact water quality, soil quality and vegetation within the Project and surrounding properties.	Compliant	An Erosion and Sediment Control Plan (ESCP) was prepared by a Certified Professional in Erosion and Sediment Control (CPESC) in accordance with Best Practice Erosion and Sediment Control



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	condition 2-3, to the extent it relates to protected matters.			(BPESC) guidelines for Australia (International Erosion Control Association). Construction and revetment works were in accordance with the ESCP. The effectiveness of Erosion and Sediment Controls (ESCs) were captured in weekly environmental site inspections. ESCs were also inspected within 24 hours of expected rainfall (as per BOM forecast for area). Repairs or maintenance to ESCs were to be completed within 24 hours of directive, or immediately where rainfall was imminent.
Conditions specific to the Action – Dredging Management Plan <i>The purpose of the following conditions is to avoid and mitigate harm to protected matters as a result of taking the Action.</i>				
EPBC Condition 4	The approval holder must comply with the NT EPA Environmental Approval conditions 2-4 to 2-9 (inclusive), to the extent that they relate to protected matters.	EPBC 2021/9068 also requires compliance with the Dredging Management Plan required under conditions 4 to 7 inclusive.	Compliant	All mitigation measures were in place as per the DDSPMP, MMMP, and ESCP to ensure activities during construction of the rock revetment, land reclamation and dredged material management is minimised. • Silt curtains were installed in Pond E as part of the ESCP. • Environmental management measures and monitoring were carried out as per Section 6 and Section 7 of the DDSPMP, respectively. Any exceedances of trigger levels are recorded and reported to the NTG. • A dedicated MFO was on duty during daylight dredging and piling activities (refer to Appendix H for offshore and onshore MFO logs).
EPBC Condition 5	The approval holder must submit the Dredging Management Plan (DMP)		Compliant	The final DDSPMP together with a written review and endorsement from the independent qualified person was issued to



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	electronically to the department at least 20 business days prior to the commencement of dredging activities.			NT EPA and DCCEEW on 24 January 2024.
Administrative conditions - Changes to the Dredging Management Plan				
EPBC Condition 6	The approval holder must notify the department in writing within two business days of proposing to the NT EPA any changes to a version of the DMP. The notification must detail: a) what changes to the plan are requested. b) implications for protected matters if the proposed changes to the plan are made.		Compliant	The NTG has notified the department in writing within two business days of proposing to the NT EPA any changes to a version of the DDSPMP and MMMP. A tabulated summary of revision amendments is outlined in Table 1 of the DDSPMP (refer Appendix N) and in the revision history of the MMMP (refer Appendix M).
EPBC Condition 7	The approval holder must provide the department with the revised plan at least 10 business days prior to commencing dredging activities. The approval holder must include in writing what revisions have been made to the plan including changes relating to protected matters, which must include at a minimum the requirements of NT EPA Environmental Approval condition 2-8.		Compliant	The NTG has provided the department the revised DDSPMPs and MMMP at least 10 business days prior to commencing dredging activities.
Administrative conditions - Submission and publication of plans				
EPBC Condition 8	The approval holder must submit all plans required by conditions of this approval electronically to the department.	The approval holder (DLI) must submit all plans (DDSPMP, MMMP, and ESCP) required by conditions of this approval electronically to the DCCEEW.	Compliant	DDSPMP and MMMP were issued to NT EPA and DCCEEW on 24 January 2024. DCCEEW acknowledged receipt of the documents on 2 February 2024. ESCP was issued to DCCEEW on 24 January 2024.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
EPBC Condition 9	Unless otherwise agreed to in writing by the Minister, the approval holder must publish the plan on the website within 20 business days of the date the plan is submitted to the NT EPA.	Unless otherwise agreed to in writing by the Minister, the approval holder (DLI) must publish the plan (DDSPMP, MMMP and ESCP) on the website within 20 business days of the date the plan is submitted to the NT EPA.	Compliant	The plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) were published to the Infrastructure NT website on 2 February 2024. DCCEEW acknowledged this on 02 February 2024. The revised DDSPMP (rev 2) and MMMP (rev 2) are currently included on the Infrastructure NT website. Darwin Ship Lift Facility Infrastructure NT
EPBC Condition 10	If sensitive ecological data is excluded or redacted from the plan, the approval holder must submit the full plan to the department within 5 business days of its publication on the website and notify the department in writing what exclusions and redactions have been made in the version published on the website.		Not applicable	No sensitive ecological data has been excluded or redacted from the plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) submitted to the DCCEEW.
EPBC Condition 11	Keep the plan published on the website until the expiry date of this approval. This approval has effect until 3 October 2073.		Compliant	The plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) will remain published until the expiry date of approval. Darwin Ship Lift Facility Infrastructure NT
Administrative conditions - notification of date of commencement of the action				
EPBC Condition 12	The approval holder must notify the department electronically of the date of commencement of the Action, within 5 business days following commencement of the Action.	Commencement of the Action means the date on which the first instance of any activity associated with the Action (including clearing and construction) is undertaken.	Compliant	NTG notified DCCEEW on the 24 April 2024 at 11:54am by email (refer copy in Appendix N).
EPBC Condition 13	If the commencement of the Action does not occur within 5		Not applicable	Commencement of the action has occurred within 5 years from the date of the Project



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	years from the date of this approval, then the approval holder must not commence the Action without the prior written agreement of the Minister.			EPBC Act controlled action approval (EPBC2021/9068).
EPBC Condition 14	The approval holder must maintain accurate and complete compliance records.		Compliant	Accurate and complete records were maintained and managed in accordance with the Project Controls Operating Standard CORP-PC-OS-G-0003, and Project Quality Assurance and Control Operating Standard CORP-QM-OS-G-0002.
EPBC Condition 15	If the department makes a request in writing, the approval holder must provide electronic copies of compliance records to the department within the timeframe specified in the request. Note: Compliance records may be subject to audit by the department, or by an independent auditor in accordance with section 458 of the EPBC Act, and/or be used to verify compliance with the conditions. Summaries of the results of an audit may be published on the department's website or through the general media.	Upon request the relevant documents and records will be issued to the department.	Not applicable	To date no request has been made to the approval holder.
EPBC Condition 16	The approval holder must ensure that any monitoring data (including sensitive ecological data), surveys, maps, and other spatial and metadata required under the conditions of this		Compliant	CBJV's subcontractor has conducted works as per CEMP, MMMP and DDSPMP in accordance with the Project EPBC Act controlled action approval, Development Permit, Fisheries Permit, NT Environmental Permit, and WDL.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	approval are prepared in accordance with the Guidelines for biological survey and mapped data, Commonwealth of Australia 2018, or as otherwise specified by the Minister in writing.			CBJV has met the requirements with the following: • Weekly and monthly reports were issued to the NTG. • The subcontractor provided evidence of testing and third-party monitoring - CBJV uploaded to SharePoint and Glaass. • Accurate and complete records were maintained and managed in accordance with the Project Controls Operating Standard CORP-PC-OS-G-0003, and Project Quality Assurance and Control Operating Standard CORP-QM-OS-G-0002.
EPBC Condition 17	The approval holder must ensure that any monitoring data (including sensitive ecological data) surveys, maps, and other spatial and metadata required under the conditions of this approval are prepared in accordance with the Guide to providing maps and boundary data for EPBC Act projects, Commonwealth of Australia 2021, or as otherwise specified by the Minister in writing.		Compliant	CBJV has met the requirements with the following: • Weekly and monthly reports were issued to the NTG. • The subcontractor provided evidence of testing and third-party monitoring – CBJV upload to SharePoint and Glaass. • Accurate and complete records were maintained and managed in accordance with the Project Controls Operating Standard CORP-PC-OS-G-0003, and Project Quality Assurance and Control Operating Standard CORP-QM-OS-G-0002.
EPBC Condition 18	The approval holder must submit all monitoring data (including sensitive ecological data), surveys, maps, other spatial and metadata and all species occurrence record data (sightings and evidence of presence) electronically to the		Compliant	Monitoring data will be supplied electronically to the DCCEEW via a file transfer link.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	department within 12 months of the approval or in accordance with the requirements of the plans.			
Administrative conditions -annual compliance reporting				
EPBC Condition 19	The approval holder must prepare a compliance report for each 12-month period following the date of this approval decision, or as otherwise agreed to in writing by the Minister.		Compliant	This report addresses this condition requirement.
EPBC Condition 20	Each compliance report must be consistent with the department's Annual Compliance Report Guidelines, Commonwealth of Australia Guidelines, Commonwealth Australia 2014, or any subsequent official version.		Compliant	This report has been prepared in compliance with the department's <i>Annual Compliance Report Guidelines</i> , Commonwealth of Australia Guidelines, Commonwealth of 2023.
EPBC Condition 21	Each compliance report must include: a) Accurate and complete details of compliance and any non-compliance with the conditions and the plan, and any incidents. b) One or more shapefile the 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.		Compliant	This report has outlined the details of compliance and any non-compliance with the conditions and the plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)), and any incidents. Shapefiles provided as an attachment to this report. The shapefile captures that disturbance of no more than 11 ha of seabed within the approved extent; and capital dredging did not exceed 520,000m³ and occurred within the approved extent. Note, there was no clearing of protected matters, and/or their habitat undertaken within annual compliance reporting period.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	c) A schedule of all plans in existence in relation to these conditions and accurate and complete details of how each plan is being implemented.			CSD and BHD occurred during this reporting period which had the potential to disturb marine fauna habitat. Marine megafauna mitigation measures are outlined within the MMMP. Schedule of Project plans and how each plan was implemented is provided in Section 2.1.1.
EPBC Condition 22	The approval holder must: a) Publish each compliance report on the website within 60 business days following the end of the 12-month (or other) period for which that compliance report is required. b) Notify the department electronically, within 5 business days of the date of publication that a compliance report has been published on the website. c) Provide the weblink for the compliance report in the notification to the department. d) Keep all published compliance reports required by these conditions on the website until the expiry date of this approval. e) Exclude or redact sensitive ecological data from compliance reports published on the website or otherwise provided to a member of the public. f) If sensitive ecological data is excluded or redacted from the		Compliant	Approval holder has met all requirements of this condition.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	published version of the compliance report, submit the full compliance report to the department within 5 business days of the redacted version being published on the website and notify the department in writing which exclusions and redactions have been made in the version published on the website. Note: Compliance reports may be published on the department's website.			
Administrative conditions – reporting non-compliance				
EPBC Condition 23	The approval holder must notify the department electronically, within 2 business days of becoming aware of any incident and / or potential noncompliance and/or actual noncompliance with the conditions or commitments made in the plan.	Reporting of non-compliance with EPBC2021/9068 is required by conditions 23-25	Not applicable	There were no incidents and / or potential non-compliances and / or actual non-compliances with the conditions or commitments made in the plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) to report.
EPBC Condition 24	The approval holder must specify in the notification: a) Any condition or commitment made in the plan which has been or may have been breached. b) A short description of the incident and/or potential noncompliance and/or actual		Not applicable	There were no incidents and / or potential non-compliances and / or actual non-compliances with the conditions or commitments made in the plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) to report.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	noncompliance. c) The location (including coordinates), date and time of the incident and/or potential noncompliance and / or actual non-compliance. Note: If the exact information cannot be provided, the approval holder must provide the best information available.			
EPBC Condition 25	The approval holder must provide to the department in writing, within 12 business days of becoming aware of any incident and / or potential noncompliance and/or actual noncompliance, the details of that incident and/or potential non-compliance and/or actual noncompliance with the conditions or commitments made in a plan. The approval holder must specify: a) Any corrective action or investigation which the approval holder has already taken. b) The potential impacts of the incident and/or non-compliance. c) The method and timing of any corrective action that will be		Not applicable	There were no incidents and / or potential non-compliances and / or actual non-compliances with the conditions or commitments made in the plans (DDSPMP, MMMP, and ESCPs (wet season and dry season)) to report.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	undertaken by the approval holder.			
Administrative conditions - independent audit				
EPBC Condition 26	The approval holder must ensure that an independent audit of compliance with the conditions is conducted for every five-year period following the commencement of the Action until his approval expires, unless otherwise specified in writing by the Minister.		Not applicable	The CSD works were completed in January 2024. The BHD works achieved practical completion in August 2025.
EPBC Condition 27	For each independent audit, the approval holder must: a) Provide the name and qualifications of the nominated independent auditor, the draft audit criteria, and the proposed timeframe for submitting the audit report to the department prior to commencing the independent audit. b) Only commence the independent audit once the nominated independent auditor, audit criteria and timeframe for submitting the audit report have been approved in writing by the department.		Not applicable	Refer EPBC Condition 26 evidence/ comments response.



Condition Number	Condition	Action Description	Designation	Evidence / Comments
	c) Submit the audit report to the department for approval with the timeframe specified and approved in writing by the department. d) Publish each audit report on the website within 15 business days of the date of the department's approval of the audit report. e) Keep every audit report published on the website until this approval expires.			
EPBC Condition 28	Each audit report must report for five-year period preceding that audit report.		Not applicable	Refer EPBC Condition 26 evidence/ comments response.
EPBC Condition 29	Each audit report must be completed to the satisfaction of the Minister and be consistent with the department's Environment Protection and Biodiversity Conservation Act 1999 Independent Audit and Audit Report Guidelines, or any subsequent official version.		Not applicable	Refer EPBC Condition 26 evidence/ comments response.
Administrative conditions - Changes to the action				
EPBC Condition 30	The approval holder must notify the department in writing of any proposed change to the NT EPA Environmental Approval that may relate to protected matters:		Not applicable	No changes have occurred to the NT EPA Environmental Approval (EP2023/028-001) that relates to protected matters.



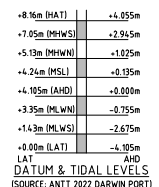
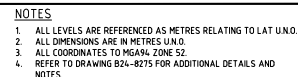
Condition Number	Condition	Action Description	Designation	Evidence / Comments
	a) Within two business days of becoming aware of any proposed change. b) Within five business days of becoming aware of any proposed change.			
EPBC Condition 31	The approval holder must notify the department in writing of any change to the NT EPA Environmental Approval conditions that may relate to protected matters within 10 business days of a change to conditions being finalised.		Not applicable	No changes have occurred to the NT EPA Environmental Approval (EP2023/028-001) that relates to protected matters.



APPENDIX J CONSTRUCTION DESIGN

Figure (A-C). Detailed designs of revetments and scour protection

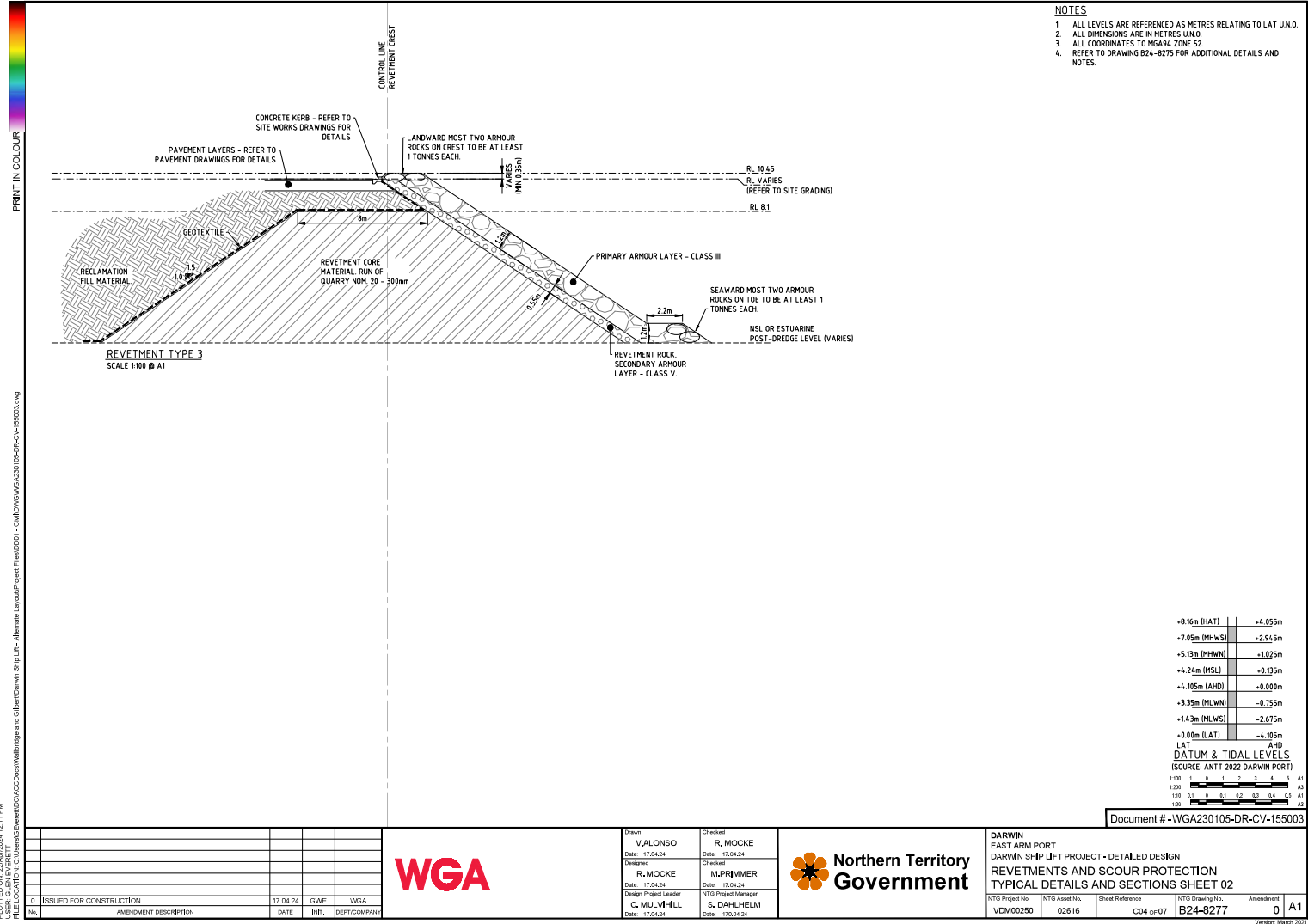
Figure (D). Detailed design of marine structures – caissons

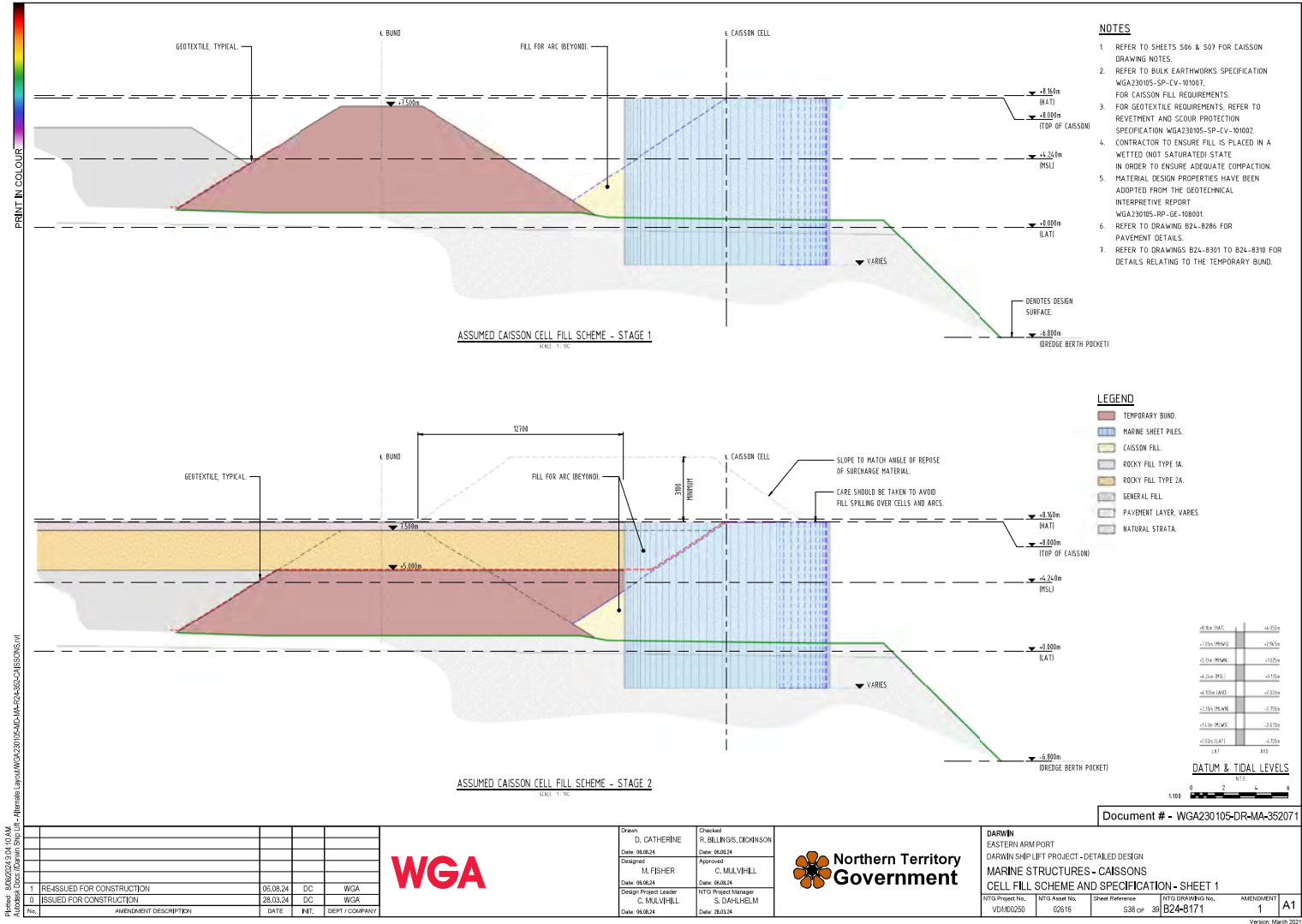
**WGA**

 Northern Territory
Government

DARWIN
EAST ARM PORT
DARWIN SHIP LIFT PROJECT - DETAILED DESIGN
REVTMENTS AND SCOUR PROTECTION
TYPICAL DETAILS AND SECTIONS SHEET 03

NTG Project No.	NTG Asset No.	Sheet Reference	NTG Drawing No.	Amendment	
VDM00250	02616	C05 OF 07	B24-8278	0	A1







APPENDIX K DREDGE AND DREDGE SPOIL PLACEMENT MANAGEMENT PLAN

INTERNAL

Darwin Ship Lift Project
Dredge and Dredge Spoil
Placement Management Plan
41213-HSE-PL-D-0001

REV	DATE	GENERAL DESCRIPTION	PREPARED	REVIEWED	APPROVED
0	24-Jan-2024	Issued for Use	M Pinkerton	J Weir	L Munro
1	11-Dec-2024	Seasonal Turbidity Limits Updated	C Hyde	J Weir	L Munro
2	17-Jan-2025	Updated Section 6.1.4 and Table 5	C Hyde	J Weir	L Munro

REV	SUBMITTED TO EPA APPROVAL HOLDER	SUBMITTED TO INDEPENDENT QUALIFIED PERSON	ENDORSED BY INDEPENDENT QUALIFIED PERSON	PROVIDED TO MINISTER	APPROVED FOR USE
2	17-Jan-2025	6-Feb-25	17-Feb-25	17-Feb-25	

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1 Introduction

1.1 Purpose

The Dredge and Dredge Spoil Placement Management Plan (DDSPMP) provides a framework for the management of potential impacts to the environment from the dredging and dredged material placement activities associated with the Darwin Ship Lift Project.

This DDSPMP also satisfies condition 2-1 and 2-4 of *Environment Protection Act 2019* Environmental Approval EPA2023/028-001 (EP Approval), and condition 4 of *EPBC Act 1999* Approval EPBC2021/9068 (EPBC Approval).

The DDSPMP has been developed in accordance with the following documents:

- Darwin Ship Lift Project Construction Environmental Management Plan (CEMP) (41213-HSE-PL-G-1002)
- Darwin Ship Lift Project Marine Megafauna Management Plan (MMMP) (41213-HSE-REP-D-1002)
- Darwin Ship Lift Project Draft Environmental Impact Statement (AECOM, 2021)
- Darwin Ship Lift Project Supplementary Environmental Impact Statement (AECOM, 2022a)

1.2 Summary of Revision Amendment(s)

The DDSPMP (Rev 0) has been amended in accordance with the Darwin Ship Lift Environmental Approval (EP2023/028-001) condition 2-7 (Table 1).

Table 1 Tabulated summary of revision amendment(s)

	Revision 1	Revision 2
Amendment(s)	The seasonal turbidity limit values (wet and dry season) for the benthic communities at Catalina Island and South Shell Island sites were updated to include the mean background values (4.4 NTU (dry season) and 8.3 NTU (wet season)).	Section 4.1, 6.1.4 and Table 5 were amended to remove the use of silt curtains as a primary control to minimise the generation of turbid plumes during land reclamation activities. Where turbidity exceeds the trigger level 150m down current of any sources of turbid plumes, installation of silt curtains along seaward edge of reclamation area will remain as a corrective action.
Reason(s) for changes	The tolerance limits for Dry and Wet season outlined in the draft DDSPMP were translated incorrectly from the draft to the final DDSPMP. It was recommended by the IQP that the DDSPMP (Rev 0) should be amended so that seasonal turbidity limit values include 21.2 NTU plus background (8.3 NTU Wet season) and 3.5 NTU plus background (4.4 NTU Dry season).	The release of sediment from the reclamation area and runoff from the area will be managed to minimise the entry of sediments into the marine environment by the following management measures: • Installation of geofabric on the internal side of the revetment walls. • Placement of the marine monitoring turbidity buoys. • Regular drone surveillance to monitor plume.

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		Water quality monitoring.
Assessment of environmental risks and potential impacts associated with the amendment(s)	There are no new environmental risks and potential impacts identified from the changes. Marine environmental quality is managed in accordance with Environmental Approval (EP2023/028-001) conditions 2-1 and 2-4.	Project construction activities will be carried out to achieve the environmental objectives in accordance with Environmental Approval (EP2023/028-001) conditions 2-1 and 2-2. The implemented management measures including the use of additional controls are considered best environmental practices to minimise the potential environmental impacts from the release of sediment.

1.3 Project Overview

The Northern Territory Government (NTG) is delivering the Darwin Ship Lift Project (the Project) which comprises construction and operation of a Ship Lift facility and an adjacent maintenance facility at East Arm. The early stages of the Project have been managed by the Department of the Chief Minister and Cabinet (DCMC), which is responsible for economic development and supporting business growth and sustainability in the NT. The Project is being managed through the construction and operational phases by the Department of Infrastructure, Planning and Logistics (DIPL).

The Project will enable maintenance and servicing of a broad range of industries, including the Australian Defence Force (ADF) and Australian Border Force (ABF) vessels, as well as commercial and private vessels, including those servicing the oil, gas, pearling, fishing and other marine industries. It will be northern Australia's largest common user Ship Lift and will provide marine infrastructure that will deliver key services to northern Australia, acting as an enabler for the continued economic growth of Darwin as the logistics and marine services hub of the Northern Territory (NT) and northern Australia.

The Clough Projects Australia Pty Ltd (Clough) and BMD Constructions Pty Ltd (BMD) have established an unincorporated and fully integrated joint venture (Clough BMD Joint Venture / CBJV) for the execution of the Darwin Ship Lift Project to the Northern Territory of Australia (also referred to as the 'Territory') under a Collaborative Construction Contract. Throughout this plan the Northern Territory Government (NTG) is hereby referred to as the Territory or Client.

1.4 Project Description

The Project site is situated approximately 6.5 km south-east of the Darwin Central Business District (CBD), on the East Arm Peninsula within Darwin Harbour, east of East Arm Wharf (EAW) and on the seaward side of Berrimah Road (**Figure 1**).

The facility is proposed to include:

- A Ship Lift and transfer system, Lloyds Register Certified for Compliance with Code for Lifting Appliances in a Marine Environment, July 2020.
- A Ship Lift control room for Ship Lift, SPMT vessel transfer system, SPMT shed, administration building and gatehouse.
- A vessel wash-down bay, blast and paint structure and hardstand.
- A dry berth hardstand for vessel repair and maintenance.

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- Trestles for vessel support (out of water), lifting and transfer.
- Quay structures for 6 berths.
- Reclamation and hardstand.
- Marine structures, bunds, revetments, shore protection, and lead-in dolphins.
- Berth fixtures, including fenders, bollards, mooring systems, ladders, and operational safety infrastructure (eye wash stations, buoyancy rings and spill kits).
- Dredged berth pockets, manoeuvring basins, and adjustments to connect to existing shipping channel.
- Services including electrical, communication, potable water, sewerage, waste management, fire water, lighting, access control system and CCTV.
- Security fencing, gates, boom gates.
- An access road, intersection upgrade and internal infrastructure.

The Ship Lift will have the capacity to lift vessels such as Cape Class Patrol Boat (Australian Border Force) and SEA 1180 Luerksen Arufura Class OPV (Navy), OSV/PSV MMA Plover, Brewster and Responder, and OSV/PSV Pacific Harrier, Hawk, Herron, Hornbill and Navy Frigate ANZAC Class.

The facility will be delineated into two discrete areas, one of which will be privately operated, and the other will be designated as a Common User Facility, which will enable vessel owners to choose and manage their own service and maintenance providers. This will also enable multiple providers to operate concurrently at the facility.

Darwin Ship Lift Project – Dredge and Dredge Spoil Placement Management Plan



Figure 1 Darwin Ship Lift Project Location

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Figure 2 shows the location of the Darwin Ship Lift facility, and the location of the settlement ponds used during dredging. Development of the Project will require dredging of a manoeuvring basin, berth areas and Ship Lift zone to provide safe navigable water depths for the proposed vessel sizes and access to the deeper waters within East Arm.



Figure 2 Darwin Ship Lift Project Location and Settlement Ponds

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The areas to be dredged will comprise:

- Ship Lift at declared dredge depth -7.5 m lowest astronomical tide (LAT) (Declared dredge level – 7.2mLAT)
- wet berths at -6.8 m LAT (Declared dredge level – 6.5mLAT)
- manoeuvring basin areas at -3.3 m LAT (Declared dredge level – 3.0mLAT)

There are two components to the dredging program:

Capital dredging (excluding maintenance dredging) shall not exceed 520,000m³ and shall occur within the approved extent, of which:

- 173,430m³ is Estuarine sediments (unconsolidated material) which are intended on being dredged with a Cutter Suction Dredge (CSD) and the balance of:
- 343,675m³ comprises material beneath the estuarine sediments including residual soil, weathered rock, bedrock (Laterite, Siltstone, Sandstone, Shale, Conglomerate) and bedrock (quartzite) (consolidated materials) which is intended to be dredged using a large Backhoe Dredger (BHD) for incorporation into the reclamation.

The above dredging figures are based on detail design drawings WGA230105-DR-CV-104110, WGA230105-DR-CV-104111, Amendment A. The dredging quantities are subject to change based on design layout, however, shall not exceed the approved quantity of 520,000m³ outlined in EP2023/028-001.

The approved extent as constrained by the EP Act Approval EP2023/028-001 is provided in **Figure 3**. The action area is represented by the brown shaded zone and Ponds K and E spoil disposal areas. The cation area includes the area between the brown shaded area and Pond K for the purposes of the pipeline used for the transport of dredged material.

Details of the proposed dredging and dredged material placement methodologies are presented in Section 4.

Darwin Ship Lift Project – Dredge and Dredge Spoil Placement Management Plan



Figure 3 Location for the proposed Action

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1.5 DDSPMP Objectives and Targets

The Objectives relevant for this DDSPMP are:

Project construction activities must be carried out to achieve the environmental objectives included in Environmental Approval (EP2023/028-001), including the following:

- Protect the quality and productivity of water, sediment and biota so that environmental values are maintained within Darwin Harbour beyond the approved extent of the project.
- No material environmental harm to the environmental values and declared beneficial uses of Darwin Harbour beyond the approved extent, including but not limited to the quality or productivity of water, sediment and biota [2-1(1) of the EP approval].
- Minimise risks of physical injury, mortality, behavioural changes and health impacts on marine megafauna [2-1(3) of the EP approval].
- Dredging and land reclamation must not cause any adverse impact on water quality, or the condition or distribution of benthic communities or marine megafauna outside of the footprint and immediate surrounds, as indicated by monitoring required by condition 2-4(3) [of the EP Approval].
- To implement measures for avoidance and minimisation of impacts on marine megafauna, as indicated by condition 2-4(7) [of the EP Approval]

1.6 Abbreviations

Abbreviation	Definition
AAPA	Aboriginal Areas Protection Authority
ABF	Australian Border Force
ADF	Australian Defence Force
AIMS	Australian Institute of Marine Science.
ANC	Acid neutralising capacity
ANZG	Australian and New Zealand Governments
BHD	Backhoe Dredger
CBD	Central Business District
CBJV	Clough Projects Australia Pty Ltd and BMD Constructions Pty Ltd Joint Venture
CD	Chart Datum
CEMP	Construction Environmental Management Plan
CSD	Cutter Suction Dredge
DCA	NT Development Consent Authority
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DCMC	Department of the Chief Minister and Cabinet
DDSPMP	Dredge and Dredge Spoil Placement Management Plan
DEPWS	Department of Environment, Parks and Water Security
DGV	Default guideline values
DIPL	Department of Infrastructure, Planning and Logistics
EAW	East Arm Wharf
EIS	Environmental Impact Statement
EMF	Environmental Management Framework
EPBC	Environment Protection and Biodiversity Conservation Act
MMP	Marine Megafauna Management Plan
MSB	Marine Supply Base
MUBRF	Multi-User Barge Ramp Facility

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NATA	National Association of Testing Authorities
NT	Northern Territory
NTEPA	Northern Territory Environmental Protection Authority
NTG	Northern Territory Government
PASS	Potential Acid Sulfate Soils
RAAF	Royal Australian Air Force
SSC(s)	Suspended Sediment Concentration(s)
TSS	Total Suspended Solids
UXO	Unexploded Ordnance
WDL	Waste Discharge Licence
WQMF	Water Quality Management Framework

2 Legislative Requirements

The legislation, policies, standards and guidelines of specific relevance to dredging activities are described below:

International

- *Guidelines for the Development of Garbage Management Plans for compliance with Regulation 9(2), Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)*
- *International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)*
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments*
- *The Convention on the Conservation of Migratory Species of Wild Animals*
- *International Convention for the Prevention of Pollution from Ships as modified by the Protocol of 1978 relating thereto and Annex V (Prevention of Pollution by Garbage from Ships) (IMO 1973)*

Commonwealth

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Biosecurity Act 2015 and Biosecurity Regulations 2016*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Hazardous Waste (Regulation of Exports and Imports) Act 1989*
- *Hazardous Waste (Regulation of Exports and Imports) Amendment Act 1996*
- *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*
- *Biosecurity Amendment (Ballast Water and Other Measures) Act 2017, Biosecurity (Ballast Water and Sediments) Determination 2017 and the Biosecurity (Ballast Water Same Risk Area) Instrument 2017.*
- *Intergovernmental Agreement on a National System for the Prevention and Management of Marine Pest Incursions (Commonwealth of Australia, 2005)*
- *National Water Quality Management Strategy (Commonwealth of Australia, 1992)*
- *National Assessment Guidelines for Dredging (NAGD, Commonwealth of Australia, 2009)*
- *National Acid Sulfate Soils Guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson et al, 2018)*

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- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments (ANZG, 2018)*

Northern Territory

- *Northern Territory Aboriginal Sacred Sites Act 1989 and Regulations*
- *Crown Lands Act 1992*
- *Dangerous Goods Act 1998 and Amendment Act 2003 (Act No. 20, 2003)*
- *Port of Darwin Act 2015*
- *Environmental Protection (National Pollutant Inventory) Objective 2004*
- *Heritage Act 2011*
- *Water Act 1992*
- *Marine Pollution Act 1999 and Marine Pollution Regulations 2010*
- *Waste Management and Pollution Control Act 1998*
- *Environment Protection Act 2019*
- *Fisheries Act 1988*
- *Marine Act 1981 and Marine (Pilotage) Regulations 2001*
- *Ports Management Act 2015*
- *Territory Parks and Wildlife Conservation Act 1976*
- *A Strategy for the Conservation of Marine Biodiversity in the Northern Territory of Australia, Parks and Wildlife Commission of the NT (PWCNT, 2000)*
- *A Review of Environmental Monitoring of the Darwin Harbour Region and Recommendations for Integrated Monitoring (NTG, 2005)*
- *Declaration of beneficial uses and water quality objectives for Darwin Harbour region (NTG, 2010)*
- *Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA, 2013)*
- *Recommendations for sampling and analysis of Darwin Harbour sediment (Munksgaard, 2013)*
- *Darwin Harbour Water Quality Protection Plan (DLRM, 2014)*
- *Interim Turbidity Water Quality Objectives for Dry season Neap Tide Conditions in Darwin Harbour (Cassilles Southgate & Fortune, 2018)*
- *NT EPA Environmental Factors and Objectives (NT EPA, 2018)*
- *Sediment Quality Sampling Design for Darwin Harbour (Brinkman & Logan, 2019)*
- *Development of Pressure Indicators for Darwin Harbour (Radke et al, 2019)*
- *2020-2025 Darwin Harbour Strategy (Darwin Harbour Advisory Committee, 2020)*

2.1 Project Approvals

Table 2 Summary of approvals provides a summary of the approvals for the Project.

Table 2 Summary of approvals

Approval	Legislation	Administrating Authority	Responsibility for Obtaining Approval	Approval Reference and Date
Development Approval	<i>Planning Act 1999</i>	NT Development Consent Authority (DCA)	Territory	DP24/0037 (22/02/2024)
EPBC Act Controlled Action	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Department of Climate Change, Energy, the Environment and Water [DCCEEW]	Territory	2021-9068 (dated 03/10/2023)
Environmental Protection Approval	<i>Environmental Protection Act 2019</i>	NT Environmental Protection Authority (NTEPA) EPA	Territory	EP2023/028-001 Granted 30/08/2023
Waste Discharge Licence (WDL)	<i>Water Act 1992</i>	NT Environmental Protection Authority (NTEPA) EPA	CBJV (on behalf of Territory)	WDL254 (29/04/2024)

3 Existing Environment and Relevant Studies

3.1 Background

This section of the Plan provides a brief overview of those components of the existing environment that are pertinent to the consideration of impacts from dredging and spoil placement during dredging associated with the Project. This information provides the context for determining the monitoring programs and management strategies detailed in Section 7.

The Darwin Harbour region extends from Gunn Point in the east, to Charles Point in the west, covering an area of over 3200 km² comprising 65% terrestrial and 35% marine habitats (at high tide) (Fortune 2016). The Darwin Harbour region includes the catchments of the rivers and streams that flow into the harbour, including the Howard River, Elizabeth River and Blackmore River, as well as the large estuarine/marine water body that is Darwin Harbour. Within the harbour, shores are characterised by extensive intertidal mud flats and mangroves.

3.2 Existing physical environment

3.2.1 Meteorological conditions

Darwin Harbour lies in the monsoonal (wet–dry) tropics of northern Australia and experiences two distinct seasons; a hot Wet season from November to March (when winds are predominantly westerly) and a warm Dry season from May to September (when winds vary from south-easterly through to northerly). The months of April and October are transitional.

Maximum temperatures are defined as hot all year round, but November is the hottest month with a range of 25°C minimum to 33°C maximum, while the lowest average daily temperatures (19°C minimum to 31°C maximum) are normally experienced in July (Bureau of Meteorology [BoM] 2022). The mean annual rainfall for Darwin is 1724 mm, with rain falling on an average of 94 days, mainly from November to March (BoM 2022a).

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Cyclone activity occurs intermittently in the Darwin region, mainly between November and April, with cyclones typically causing the most damage within 50km from the coast. Aside from the impacts of strong winds, storm surges can be of concern to vessels and coastal developments surrounding Darwin Harbour. Storm surges result from strong onshore winds and reduced atmospheric pressure and can cause flooding and damage through raised tidal levels and increased wave heights. The height of a storm surge is influenced by many factors, including the intensity and speed of winds within the associated cyclone, the angle at which the cyclone crosses the coast, the speed and direction of tidal flows and the bathymetry of the affected area (NT Emergency Service 2011).

In October 2022, BoM published the cyclone outlook for the tropical cyclone season. In summary, BoM predicts that it is likely there will be an above-average number of tropical cyclones for the 2022–23 Australian tropical cyclone season (BoM, 2022b).

The established La Niña in the tropical Pacific Ocean and warmer-than-average sea surface temperatures to the north of Australia, have influenced this year's tropical cyclone outlook (BoM, 2022b).

In La Niña years, the first cyclone to make landfall on the Australian coast typically occurs earlier than normal. Like tropical cyclones, the number of tropical lows that form during La Niña years is typically greater than the number which form during non-La Niña years. From the 2005–06 season onwards, the typical number of tropical lows has been 7 for all years, and 10 for La Niña years (BoM, 2022b).

3.2.2 Coastal geomorphology and bathymetry

Darwin Harbour is a large ria system, or drowned river valley, formed by post-glacial marine flooding of a dissected plateau. The harbour was formed by rising sea levels about 6000–8000 years ago. Since the formation of the harbour, surface erosion from the adjoining terrestrial environment has carried substantial quantities of sediment into the harbour. This sediment now forms much of the intertidal flats that overlie bedrock around the harbour margins.

The harbour extends for more than 30 km along a north-west to south-east axis. The main channel of the harbour is around 15-25 m chart datum (CD) deep, with a maximum depth of some 36 m. The channel favours the eastern side of the harbour and continues into East Arm, at water depths of more than 10m CD. The bathymetry in this area has been modified by dredging for the development of EAW and the INPEX LNG processing facilities located at Bladin Point.

3.2.3 Marine sediments

3.2.3.1 Darwin Harbour seafloor

Approximately 80% of the Darwin Harbour region's seafloor is estimated to be covered with soft surfaces consisting of mud and fine sand. Soft surfaces containing varying amounts of gravel and sand are found in the main channels around reefs, on beaches and on spits and shoals near the mouth of the harbour (Fortune 2006).

The typical geological profile of the Darwin Harbour seafloor comprises Quaternary age intertidal marine alluvium comprising mud, silt, sand and coral remnants, underlain by the Proterozoic metasediments of the Burrell Creek Formation, consisting of meta-siltstone, meta-sandstone and phyllite. The rocks strike close to north-south and are steeply dipping either to the east or west. Quartz veins are widespread within the Burrell Creek Formation.

Sediments in the river catchments are predominantly fine-grained, mainly clay and silt. Creeks and rivers may transport coarser material (e.g. sand) into the estuary during the Wet season, though much is trapped by coastal vegetation, both riparian and mangrove (McKinnon et al. 2006). The fine sediment delivered to the upper arms of the harbour settles out of suspension and is then eroded and re-deposited mainly by tidal currents, especially at spring tides (Munksgaard 2013).

Hydrodynamic modelling of the fate of suspended sediment plumes has shown that substantial sediment fluxes are directed up-estuary where fine sediments are trapped; the sediment fraction exported to the ocean is relatively small (Williams, Wolanski & Spagnol 2006).

3.2.3.2 Contaminants of potential concern

DLRM (2014) estimated that 30% of the land within the Darwin Harbour catchment was developed. About 13% of the developed area was subject to urban and other intensive land-uses in and around the cities of Darwin and Palmerston, including residential living, manufacturing, industry, roads, airport infrastructure and defence facilities. Skinner et al (2009) note that runoff from urban areas contain a disproportionately high pollutant load relative to that from non-urban areas. The remainder of the developed area comprised rural land-uses, including horticulture and agriculture. Non-polluting uses (e.g. remnant native vegetation, surface water supply, conservation areas) were considered by the Darwin Harbour Advisory Committee (2003) to occupy the remaining 70% of the Darwin Harbour catchment.

The Elizabeth River has the second largest catchment of the rivers entering Darwin Harbour (the largest is the Blackmore River that enters Middle Arm [Padovan 2001]). Skinner et al (2009) estimated that 58% of the Elizabeth River catchment area comprised native vegetation with minimal disturbance, rural land use (such as irrigated crops and rural living) accounted for approximately 39% of the catchment area and only 2% was considered to support urban or industrial land uses. Undeveloped land (predominantly mangrove communities) fringes the river over a distance of some 25 km between the rural land use areas and East Arm; this has the potential to act as a buffer to reduce the amounts of pollutants reaching East Arm from sources in the upper catchment.

Some 3km upstream of the Project location is Hudson Creek, which has a history of livestock export and light industrial uses and which receives inputs from the Darwin Correctional Centre's Sewage Treatment Plant (KBR 2020). It also includes rural and urban land; Skinner et al (2009) calculated that 50% of the catchment supported urban or industrial land uses.

Approximately 6 km upstream of the Project location, the Palmerston Wastewater Treatment Plant discharges treated effluent into Myrmidon Creek; this enters the Elizabeth River estuary at the head of East Arm. The mass loadings of the nutrients in the release from the Plant in 2005-06 were 40 tonnes of ammonia, 69 tonnes of Kjeldahl nitrogen and 18 tonnes of phosphorus (Power and Water Corporation 2006); it appears that no more recent data are publicly available. Skinner et al (2009) note that treated sewage effluent is the dominant anthropogenic point source of nutrients to Darwin Harbour. However, based upon the data of Butler et al (2013), Munksgaard et al (2018) considered that the water body in Darwin Harbour is generally nitrogen limited. Burford et al (2008) determined that the main input of nitrogen to the harbour was from the open ocean, while inputs from rivers and wastewater treatment plants entering the harbour were relatively minor.

Industrial, urban and rural land uses all represent sources of potential pollutants that may accumulate in the Project dredging area. The mean annual pollutant loads contributed to the harbour from the Elizabeth River, Hudson Creek and Myrmidon Creek catchments were estimated by Padovan (2001) based upon the 1995-96 and 1996-97 Wet seasons, and by Skinner et al (2009) for the 2006-07 Wet season. A fourth catchment, Palmerston South, also discharges into the Elizabeth River, though the pollutant loads predicted by Padovan (2001) and Skinner et al (2009) were markedly lower than those from the Elizabeth River and Hudson Creek catchments.

3.2.3.3 Distribution of contaminants

Environmental factors that may potentially affect the distribution of contaminants within Darwin Harbour, and hence could influence the concentrations of contaminants in the sediments of the dredging footprint, include:

- Strong tidal currents that readily mobilise seafloor sediments on flood and ebb tides, especially during spring tide periods.

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- Eddies in water flows that enhance the settlement of sediments from the water column in certain areas (such as at the eastern end of EAW).
- Wind-driven water circulation that can redistribute large amounts of seafloor sediments, particularly during tropical storms and cyclones.

Each of these factors would primarily influence the distribution of fine sediment fractions, to which many metals are typically bound at higher densities (Batley 1995, Munksgaard & Parry 2002, Welch et al 2008).

Munksgaard et al (2018) noted that sediments provide time-integrated measures of net accumulation of contaminants at a location; these are independent of the seasonal and tidal variations in contaminant concentrations within the overlying water column.

3.2.3.4 Potential acid sulfate soils (PASS)

In the Darwin region, PASS has been identified in association with mangrove sediments (e.g. Hill & Edmeades 2008).

The materials to be dredged as part of the Project were sampled by AECOM (2020) and an assessment of the potential risk associated with acid sulfate soils was undertaken. All sediments sampled were identified as having the potential to be acid generating (to varying degrees) if left in an oxygenated environment post-dredging. The outcome of that assessment is summarised below:

- No existing acidity (indicated by titratable actual acidity) was reported in any of the samples.
- However, all samples reported potential acidity (chromium reducible sulfur %) ranging between 0.04%S and 0.23%S, indicating presence of PASS (i.e. un-oxidised sulfides) which could generate acidity upon oxidation.
- Hence, the sum of existing and potential acidity in all samples exceeded the action criterion (as per Simpson et al [2018]) of 0.03%S.
- All samples reported some acid neutralising capacity (ANC) ranging between 1.57 %S and 18.5%S. ANC is noted potentially due to the abundance of naturally occurring calcium carbonate such as shell fragments and coral skeletons as observed in the field. The ANC ranged between 19 and 231 times greater than the sum of existing and potential acidity concentrations; well within the adopted criterion of ANC being greater than 15 times the total acidity of samples (as per Simpson et al [2018]).

Based on the PASS with an ANC in excess of 15 times the total acidity, acid sulfate soils will be monitored throughout the dredge works, however active management is not expected to be required during the works. Monitoring requirements are outlined in Section 7.

3.2.4 Hydrodynamics and sediment transport

The tidal range in Darwin Harbour is between 0 m (i.e. LAT) and approximately 8.2 m above LAT (Table 3). The mean spring tide range is approximately 5.6m and the approximate mean neap tide range is 1.8m. Tides within Darwin Harbour are predominantly semidiurnal, with a slight inequality between the successive tides during a single day.

Rigby et al. (2014) indicate that the wave climate in the region is dominated by locally generated waves, with little incident swell entering the harbour from the west, except under monsoonal cyclone or tropical low events. Between November and March, north-westerly winds blow over the uninterrupted fetch of the Timor Sea, increasing incident wave energy in Beagle Gulf and at the entrance to Darwin Harbour. Due to the alignment and narrow nature of the harbour entrance and the presence of the Tiwi Islands to the north, the interior of the harbour is sheltered from long period swell, and any swell that does enter the harbour is quickly dissipated by the generally shallow bathymetry and indented nature of the harbour shoreline.

The daily harbour inflow and outflow is approximately 216 million m³ on a spring tide and 71 million m³ on a neap tide. These flows represent 69% and 29% of water flows in Darwin Harbour respectively (Williams et al 2006). Tidal flows are strongest in the narrowest sections of the harbour, including sections of the East Arm channel.

Modelling by Brinkman and Logan (2019) indicates that flood tidal current velocities within the harbour are generally higher than ebb tide velocities. Elevated tidal energy, particularly during spring tides, results in the regular resuspension of fine sediments from the seabed, leading to naturally high turbidity levels within the harbour. The suspended sediments are then carried into areas within the harbour where they are deposited but are not resuspended on ebb tides (Williams et al 2006, Brinkman & Logan 2019).

It is noted that Baird (2019) found ebb tidal flows (measured between May and July 2019) at a site within the body of East Arm tended to be stronger than flood tidal flows, with peak current speeds of 0.6-0.7 m/s during spring tides and 0.2-0.25 m/s during neap tides. This suggests that the relative ebb/flood tidal flows within the main East Arm channel are contrary to those within the harbour in general. As the Project location is outside of the channel, the relative flows at the site are likely to be aligned with those within the harbour in general.

Table 3 Darwin Harbour tidal planes

Tidal Plane	Description	LAT (m)
HAT	Highest Astronomical Tide	8.2
MHWS	Mean High Water Springs	7.0
MHWN	Mean High Water Neaps	5.1
MSL	Mean Sea Level	4.24
AHD	Australian Height Datum	4.105
MLWN	Mean Low Water Neaps	3.3
MLWS	Mean Low Water Springs	1.4
LAT	Lowest Astronomical Tide	0.0

Brinkman and Logan (2019) consider that, during the Wet season, there is a significant contribution of fine sediments to the harbour from terrestrial sources draining into the harbour via the reaches of West, Middle and East Arms. McKinnon et al. (2006) calculated that the annual total suspended sediment load transported to the harbour had increased by a factor of 1.3 compared to the pre-urbanisation load.

Nawaz (2010) estimated that in the order of 80% of terrestrial sediment transported into the harbour was from channel erosion rather than from sheet erosion; the latter being a more likely source of contaminant inputs than the former.

Previous investigations within the harbour have demonstrated that complex circulation occurs near headlands and embayment's that includes jets, eddies, separation points and stagnation zones. This may result in trapping of fine sediments at headlands and in embayment's; modelling by Brinkman and Logan (2019) predicts that the nearshore portion of the Project footprint lies within an area of net sediment deposition, while net erosion is predicted in the portion further from shore.

3.2.5 Geochemical assessment of material to be dredged

In August 2020, AECOM undertook a geochemical assessment of the sediments within the dredging footprint. A summary of the potential contaminant inputs to the dredging area is provided above.

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Following the completion of the geochemical assessment sediment sampling campaign, the area to be dredged was modified as part of the ongoing engineering design phase of the Project.

The full geochemical assessment report (AECOM 2020) is included as Appendix H of the Draft EIS for the Project. Key findings from the assessment were:

- Within the dredging footprint for the Ship Lift, berth and manoeuvring basin no contaminants of potential anthropogenic origin were detected at levels above the criteria levels within the NAGD. That is, all contaminants of potential anthropogenic origin in these areas were present at concentrations at which, under the NAGD, toxic effects on organisms are not expected. Hence there was no evidence of inputs of contaminants to the sediments arising from the operation of EAW.
- All samples collected within the dredging footprint returned TBT concentrations below the laboratory limit of detection and therefore the NAGD Low Screening level.
- Arsenic concentrations typically exceeded NAGD criteria levels. Previous studies (e.g. Padovan 2003, Fortune 2006, URS 2009) have attributed elevated arsenic concentrations in Darwin Harbour sediments to local geological influence (e.g. weathering of bedrock in the catchment). Some of these studies (e.g. URS 2009) have demonstrated that, in the natural marine environment, the arsenic has low bioavailability. That is, the arsenic is bound to the sediment in such a way that it will not readily enter the food chain.
- The distribution of potentially acid producing sediments within the material to be dredged cannot be accurately mapped. Hence it must be assumed that potentially acid-producing sediments could be dredged at any time during the campaign. It should be noted that only the surface layer of the deposited sediments will be exposed to air and hence potentially acid producing. As sediments are progressively buried as the dredging campaign progresses, they will again become anoxic and their potential to generate acid will decrease accordingly.

The tailwater discharged from the settling pond system will be monitored to ensure compliance with pH criteria levels, and also to monitor metals concentrations in the tailwater as decreased pH levels could stimulate the release of metals into the overlying water column; this monitoring is detailed in Section 7 of this Plan. During monitoring, there will be a particular focus on arsenic; whilst it is considered to have low bioavailability in the natural seawater of Darwin Harbour, in the presence of reduced pH the concentrations of arsenic in the tailwater may gradually trend upwards over the course of dredging. As described in Section 6.2.4 of this Plan, management measures will be implemented in the event that tailwater pH levels become unacceptably low, or metals concentrations become unacceptably high.

With respect to the reclamation area within the Project site, the porewater will not be retained within the dredged material for a sufficient period of time for release of toxicants (from the sediment into the porewater) to occur; rather, the porewater will percolate into the harbour waters and be rapidly diluted under the influence of the prevailing currents.

In conclusion, the investigation has shown that the sediments are suitable, from a geochemical standpoint, to be disposed into both the settling ponds at EAW and within the reclamation area within the Project site.

3.2.6 Marine water quality – Darwin Harbour

Water quality in Darwin Harbour is typically described as generally high, although naturally turbid most of the time. Water quality parameters vary greatly with the tide phase (spring versus neap; flood versus ebb), location (inner versus outer harbour), and with the season (Wet season versus Dry season).

Duggan (2006) conducted research on the water quality of Darwin Harbour from 2002 to 2004. Seasonal aspects, rather than spatial or tidal aspects, were found to be the most important

determinant of water quality within the harbour in general, with rainfall considered to have the greatest impact on water quality (increasing nutrients, suspended solids and chlorophyll a).

Tidal movement can play an important role in re-suspending material from the harbour floor into the water column and water quality in the dredging areas is predominantly impacted by suspended sediments resulting from fast moving currents.

Water quality is typically higher in outer harbour waters than within the inner harbour, though turbidity at the harbour mouth can be elevated in shallow areas due to re-suspension of sediments from intertidal flats, especially during spring tides.

A typical Darwin Wet season extends from November to April and is characterised by warm air temperatures, convective storms and monsoonal weather which brings heavy rain and strong north- westerly winds and, in some years, cyclonic weather (Fortune 2016). These Wet season conditions affect harbour water quality due to high surface runoff from the land (URS 2011).

There is no evidence of widespread water or sediment pollution in the Harbour (Fortune 2016, DENR 2020), although there some localised pollution has been identified in the past (e.g. Padovan 2003, Water Monitoring Branch 2005, Drewry et al 2011). Anthropogenic influences on Harbour water quality include the EAW port operations, historic industrial activities at Darwin Waterfront, Sadgroves Creek and wastewater outfalls (URS 2004); however, there has been no evidence of widespread or persistent hydrocarbon or pesticide pollution in the harbour (Darwin Harbour Advisory Committee 2007).

The harbour may be subject to occasional pollution events such as hydrocarbon spills, from potential sources such as:

- seasonal stormwater inflow from Darwin and Palmerston stormwater drainage networks
- creeks with industrial developments in their catchments (e.g. Hudson Creek, Sadgroves Creek)
- bulk hydrocarbon storage (e.g. at East Arm Peninsula, Darwin LNG plant and Channel Island Power Station)
- inventories in recreational vessels and commercial ships
- refuelling locations (e.g. HMAS Coonawarra, Cullen Bay, Fishermans Wharf).

Darwin Harbour water quality has been monitored against a series of Water Quality Objectives (WQOs) and reported by DENR (now DEPWS) in annual report cards since 2009. The annual report cards provide a score based on the following parameters:

- dissolved oxygen (DO)
- Total Suspended Solids (TSS) (by way of a TSS – turbidity relationship)
- chlorophyll a (as an indicator of algae)
- nutrients (nitrogen and phosphorus)
- temperature, pH and salinity are also measured but not included in the determination of the report card score.

In 2020, water quality in East Arm was monitored at 23 sites through this process. The East Arm region has consistently met water quality objectives over the period since the program began in 2009.

3.2.7 Water quality baseline data

Between 2008 and 2011, a number of water quality investigations were undertaken by URS on behalf of INPEX to characterise the existing conditions in East Arm (URS 2009, 2011). Table 4 presents summary statistics for Dry and Wet season water quality, as recorded at a site off the southern tip of South Shell Island (URS 2011).

These data were collected every 15 minutes over a year-long program. Data were grouped and averaged based on tidal cycle and seasonal variation, allowing seasonal means, medians and percentiles to be calculated. This gives a robust body of data to compare background levels of turbidity with potential increases associated with various natural and artificial turbidity-generating events in the harbour.

Water quality data from South Shell Island are considered applicable to the dredging and reclamation works as this site has the nearest sensitive receptors (hard coral communities) to them, although modelling does not predict that the communities are at risk of detectable impacts from the works.

Table 4 Summary water quality statistics for East Arm Wet and Dry season (URS 2011)

	Dry season			Wet season		
	Mean	Min	Max	Mean	Min	Max
Temperature (°C)	28.1	25.3	32.1	30.4	28.1	32.0
Conductivity (mS/cm)	48.7	40.2	52.9	46.2	36.7	49.8
Depth (m)	6.3	2.4	11.0	6.7	2.5	11.3
pH	8.0	7.7	8.5	8.0	7.6	8.2
DO (%)	93.5	73.4	121.1	88.5	67.3	106.4
Turbidity (NTU)	4.4	0.1	46.4	8.3	0.2	68.0
SSC (mg/L)*	10.8	7.1	46.4	14.1	7.2	64.7

* Calculated from NTU using relationship in URS (2011): $SSC = 0.848 * NTU + 7.0477$ Source: URS (2011)

3.3 Environmental receptors

3.3.1 Marine communities

Darwin Harbour has a complex assemblage of marine ecological communities, including rocky shore biota, hard corals, filter feeders (primarily soft corals and sponges), macroalgae, seagrasses, soft sediment biota, mangroves and fish communities. Smit, Penny and Griffiths (2012), in their summary of previous benthic habitat mapping of Darwin Harbour, suggest that the benthic habitats present in the inner and outer harbour differ significantly and are typically characterised as follows:

- Outer harbour:
 - extensive seagrass communities occur in shallow waters
 - corals and algae dominate on hard substrates in shallow waters.
 - deeper waters are characterised by filter feeder communities (e.g. sponges, soft corals).
- Inner harbour:
 - hard substrates in shallow and deeper waters consist of mixed communities or are dominated by sponge communities

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- no seagrass communities are present (though it is noted that, subsequent to the Smit, Penny and Griffiths [2012] report, there have been unpublished records of seagrasses around Wickham Point, and opposite the Channel Island boat ramp in Middle Arm).

Predictive modelling of the benthic habitats within, and in the vicinity of, the Project area was encompassed within the modelling of major habitat classes within Darwin and Bynoe Harbours that was undertaken by the AIMS in 2019 (Galaiduk et al 2019). This extensive program considered bathymetric, physical seabed and biological data collected during Project-specific and historical field sampling campaigns to produce spatial predictive habitat models (Galaiduk et al 2019).

Subsequent habitat modelling undertaken by the Australian Institute of Marine Science (2021) built on the 2019 habitat modelling by incorporating additional field observation data and new and higher resolution datasets. The resultant benthic habitat predictions were presented at a 1m x 1m resolution and showed habitat suitability for six biological communities in Darwin Harbour: Filter Feeders / Octocorals, Hard Corals, Macro Algae, Seagrasses, Sponges and Bare Ground and Bare Ground (**Figure 4**).

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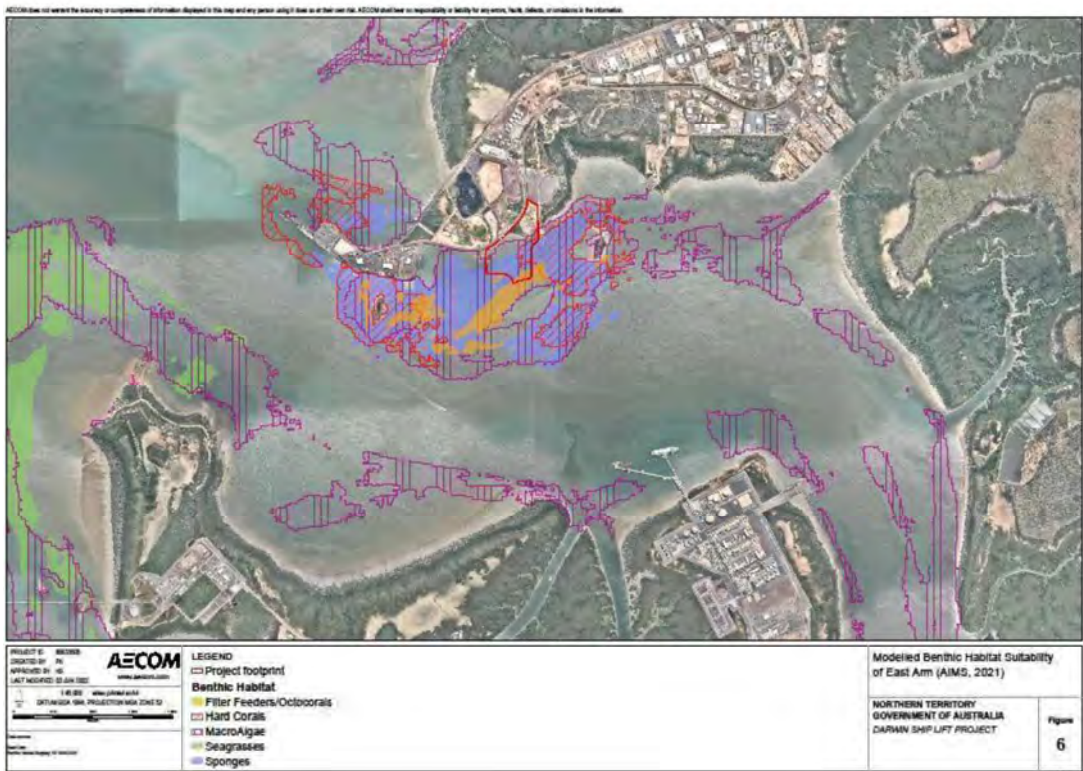


Figure 4 Modelled benthic habitats of the Project region (AECOM, 2022b)

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The map presented by AECOM (2022) shows predicted habitat suitability for each habitat type, with the following interpretations provided by AIMS (2021):

- Bare ground having the most extensive coverage across the southern Darwin Harbour region.
- Filter feeder/octocoral habitats were predicted to occur in deeper waters of the outer harbour, with some small patches of suitable habitat also predicted south of the EAW for both habitat types.
- Small patches of habitat suitable for filter feeders/octocorals were predicted south-west of Channel Island.
- Hard coral habitats were far more restricted within Darwin Harbour but predicted in shallower regions of the outer- and mid- Harbour, as well as an area to the south of EAW.
- The areas surrounding South Shell Island and Catalina Island in East Arm were identified as potentially suitable habitats for hard corals.
- Macro Algae habitats were typically predicted in shallower habitats, with the thresholded model predicting extensive patches throughout the mid harbour and within East Arm.
- Suitable habitats for seagrasses were not predicted within East Arm; however, they were predicted in patches throughout the mid-Harbour, with the largest patch predicted within Fannie Bay, and smaller patches predicted to line the top of the Middle Arm channel.
- Overall, areas adjacent to Fannie Bay and the mouth of the East Arm were identified as areas with potentially substantial benthic habitat coverage.

Within the northern East Arm region in the vicinity of the Project, mapping by AIMS (2021) shows:

- Suitable hard coral habitat is predicted to occur surrounding South Shell Island and shallow waters west of Catalina Island and encroaching into the Project footprint.
- Suitable filter feeder habitat within the offshore extremity of the Project footprint, extending offshore into the main channel of East Arm. Further areas are identified as suitable filter feeder habitat to the east and west of South Shell Island.
- No suitable habitat was identified for seagrass in the vicinity of the Project area.
- Large areas of suitable habitat for macroalgae and sponges were identified across wide areas of the northern East Arm region, including within the Project footprint.

For the Project EIS and Supplementary EIS it was necessary for benthic habitat surveys to be undertaken to assess the accuracy of the model predictions in areas of direct and potential indirect disturbance from the construction and operation of the Project. The first of these surveys was undertaken by AIMS in November 2020 (Case et al 2021), with the objective of refining the model in these areas, although the modelling undertaken by AIMS (2021) was deemed to provide a better representation of modelled habitats in East Arm. A review of all of the video records from the AIMS November 2020 survey transects within the area of direct disturbance from the Project was conducted, supplementing the five-points-per-frame analysis of selected frames from the video records undertaken by AIMS. This review confirmed AIMS' conclusion that the seabed in this area was predominantly bare substrate, with only scattered filter feeders and no visible hard corals or seagrasses.

The second survey was conducted by SLR Australia in May 2022 and focussed on collecting data in the vicinity of South Shell Island and Catalina island, the closest sponge and hard coral communities to the Project location. Observations during this survey showed filter feeders, occasional hard corals and macroalgae communities present to the west of Catalina Island with the seabed typically bare sediment to the east. Benthic communities in the vicinity of South Shell Island were observed as being dominated by hard corals in shallower reef areas with filter feeder habitats dominating further from shore on the western side of the island. To the

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east of South Shell Island, a mix of filter feeder and macroalgae communities were dominant with areas of bare sand. Cover of all communities was typically moderate to sparse with smaller patches of dense benthic cover observed. Habitat observations generally align well with the modelled benthic habitat distribution developed by AIMS (2021) (AECOM, 2022c).

3.3.1.1 Hard coral communities

Hard coral communities occur in Darwin Harbour where the substrate is rocky in the lower intertidal and shallow subtidal zones and where hydrodynamic conditions permit. A total of 123 species of corals have been recorded in Darwin Harbour (Wolstenholme, Dinesen & Alderslade 1997). Hard coral communities are typically dominated by colonies with massive (e.g. Faviidae, *Porites* spp.), foliose (e.g. *Turbinaria* spp.) or encrusting (e.g. Faviidae) growth forms (INPEX 2010). Habitat modelling undertaken by AIMS (2021) (Figure 6) predicted potential hard coral habitat in East Arm to occur at a small number of locations, with previous surveys also identifying hard coral communities in the vicinity of South Shell Island and Catalina Island. Hard corals are dominant within some of the benthic communities around South Shell Island, mainly on the western side of the island. A reduction in hard coral cover was recorded at one South Shell Island monitoring site during the INPEX capital dredging campaign conducted between 2012 and 2014; this was concluded to be as a result of a combination of elevated turbidity and increased sedimentation (Cardno 2014a).

Reductions in hard coral cover at South Shell Island monitoring sites were also detected during the MSB capital dredging campaign that was undertaken within the same period as the much larger INPEX campaign (Macmahon 2013, Department of Infrastructure [DoI] 2014). Sediment plume modelling for the dredging works covered in this Plan (Section 5.0) predicts that the South Shell Island coral community is sufficiently distant from the works to not be at risk of detectable impact.

Other well-known hard coral communities in Darwin Harbour include the following:

- Off the north-east shore of Wickham Point.
- Weed Reef, Plater Rock and Kurumba Shoal, on the western side of the harbour, and Dudley Point at the northern end of Fannie Bay.
- Channel Island coral community in Middle Arm, on the intertidal platform between Channel Island and the mainland. This is listed on the Register of the National Estate and is a declared Heritage Place under the NT Heritage Act 2011.

All of these communities are sufficiently remote from the dredging, reclamation and tailwater discharge locations that there is no credible risk of impact to them.

3.3.1.2 Filter feeder communities

Filter feeder communities are those that primarily comprise sponges, gorgonians (sea fans and sea whips) and other soft corals. They primarily occur on intertidal or subtidal hard substrates and may co- occur with hard corals, giving rise to “mixed species” communities. However, they also occur at depths shallower than, and deeper than, those at which hard corals thrive and can be the dominant component of the benthic community in some areas.

Habitat modelling undertaken by AIMS (2021) identified areas of potential filter feeder habitat in the vicinity of the Project footprint and across much of the northern side of East Arm (Figure 6) Sponge habitat was modelled separately by AIMS (2021), though it is noted that sponges are also filter feeders and are typically mapped together with them.

It is recognised that filter feeder communities around South Shell Island may contain species that could be of importance to bio-prospecting. However, it is also recognised that large areas of filter feeder communities are present both within East Arm and across the broader harbour (Geo Oceans 2011, 2012a,b; Siwabessy et al 2015, Galaiduk et al 2019).

Benthic habitat monitoring during the MSB capital dredging campaign (undertaken in 2012 and 2013) found no statistically significant changes in filter feeder communities across the three surveys (Macmahon 2013, DoI 2014). This is somewhat unsurprising as these communities

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are generally less sensitive than corals to the physiological pressures of reduced benthic light availability and sedimentation associated with dredging activities or natural environmental conditions. Filter feeder communities were not monitored as part of the INPEX dredging campaign that was conducted within the same period as the MSB dredging (INPEX 2013).

3.3.2 Protected marine species

3.3.2.1 Cetaceans

Three species of coastal dolphin are the most commonly recorded cetaceans in Darwin Harbour: the Australian humpback (*Sousa sahulensis*; formerly known as the Indo-Pacific humpback), Indo-Pacific bottlenose (*Tursiops aduncus*) and Australian snubfin (*Orcaella heinsohni*) dolphins (Palmer 2008). INPEX (2011) details knowledge of the taxonomy, distribution, microhabitats, residency and site fidelity of the three species of coastal dolphins, while Brooks and Pollock (2014), Brooks et al (2017) and Griffiths et al (2020) present data from the extensive surveys undertaken for the INPEX Ichthys LNG project. In addition, the conservation status of coastal dolphins in the NT has been assessed by Palmer et al (2017).

Other species of dolphin that may be present in Darwin Harbour include common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), spotted dolphin (*Stenella attenuata*) and bottlenose dolphin (*Tursiops truncatus*). Pods of false killer whales (*Pseudorca crassidens*) are considered by Palmer et al (2009) to be regular visitors to the harbour. It is notable that all cetaceans are protected under the EPBC Act.

Griffiths et al (2020) summarise the outcomes of studies of the abundance, movements and habitat use of coastal dolphins (Australian humpback, Indo-Pacific bottlenose and Australian snubfin) in the Darwin region (Darwin Harbour, Bynoe Harbour and Shoal Bay). On the basis of data from surveys undertaken between 2011 and 2019, and model outputs based upon capture-recapture data from these surveys, Griffiths et al (2020) concluded the following:

- All three species typically occurred at low densities, exhibited substantial emigration and had fluctuating population size.
- Humpback dolphins were the most commonly observed of the three species and there was demonstrable movement of this species between the three monitoring areas. Over the course of the monitoring program, there was a significant decrease in estimated abundance in Darwin Harbour a non-significant increase in Bynoe Harbour and a non-significant decrease at Shoal Bay.
- The snubfin dolphin population was small, and was considered to have the greatest variability in population size and the greatest degree of temporary emigration (i.e. temporarily leaving the study area). Modelling indicated a significant negative trend in estimated abundance over the course of the monitoring program.
- The bottlenose dolphin population was the smallest, with an apparently high degree of temporary emigration and a significant overall decrease in estimated abundance.
- The reasons for the significant declines were considered to be unclear, but were thought to potentially be related to population dynamics, environmental or anthropogenic factors.
- The estimated population density of each species appeared to be similar to average densities in NT coastal waters.
- The estimated population densities of humpback and snubfin dolphins appeared to be within the ranges of densities recorded in Western Australia and Queensland, while the estimated densities of bottlenose dolphins in the Darwin Harbour region and the NT appeared to be lower than in similar northern Australian locations.
- The estimated temporary emigration rates were considered to be similar to those in coastal dolphin populations elsewhere in Australia and overseas.

- Apparent survival rates were considered to be similar to, or lower than, those reported elsewhere for the same species, though the difficulty in accurately assessing survival rates was recognised. It was considered that emigration probably had a greater influence on population growth than deaths.

It is noted that there are no known areas of critical feeding or breeding habitat for dolphins within the zone of potential effects from the development and operation of the Project. The Indo-Pacific humpback and the Australian snubfin dolphin appear to be opportunistic generalist feeders, eating a wide variety of fish both on the seabed and within the water column (Parra 2006). No calving areas have been identified in Australian waters for either species and little is known of their reproductive biology or population structure (Ross 2006, Parra et al 2006).

The EPBC protected matters database also lists the following as “species or species habitat [that] may occur within area”, though the species are not known to occur within Darwin Harbour:

- Blue whale (*Balaenoptera musculus*).
- Bryde's whale (*Balaenoptera edeni*).
- Humpback whale (*Megaptera novaeangliae*).
- Killer whale (*Orcinus orca*).

3.3.2.2 Dugongs

Dugongs (*Dugong dugon*) are known to occur in Darwin Harbour waters, although in relatively low numbers. Dugongs have been recorded in higher densities at Gunn Point and the Vernon Islands, some 30–50 km to the north-east of the mouth of the harbour. Dugongs have also been observed in relatively high numbers at Bare Sand Island and Dundee Beach in Fog Bay, 60 km south-west of Darwin Harbour, and are known to travel long distances (Whiting 2008).

Cardno (2014b) compared the results of baseline surveys with four surveys undertaken throughout the dredging phases of the *Turtle and Dugong Monitoring Program* associated with the INPEX Ichthys project. This study revealed that dugongs were observed in varying numbers between surveys; however, no trends (including seasonal variations) were evident. There was a higher number of dugong observed in shallower waters (6 – 10m), generally in foraging areas where seagrass was present.

Variation in dugong observed between surveys within sites was concluded to most likely be a result of short term movement of dugongs to visit optimum foraging areas of seagrass.

During baseline surveys (June to October 2012) most sightings in Darwin Harbour were around Weed Reef, West Arm and near Bladin Point, as well as in the shallow regions of Shoal Bay. During later baseline surveys, most dugong sightings were around outer Darwin Harbour, with aggregations around mapped seagrass near Casuarina Beach (Cardno, 2014b).

During the first of the Dredging Phase surveys (May 2013), dugongs were predominantly sighted in outer Darwin Harbour, with only one dugong sighted near Weed Reef and another in the shallow areas in West Arm. During the Dredging Phase surveys in July/August and October 2013, no dugongs were sighted in the inner Darwin Harbour, while during the end of dredging survey (May 2014) three dugongs were sighted near Weed Reef (Cardno, 2014b).

During the two surveys undertaken in October 2013, sightings were concentrated around Casuarina Beach and were associated with areas of seagrass (*Halodule* sp.). Lower numbers were observed in this area in Wet season surveys and it was considered that the reduced seagrass coverage in this season was likely to have been a contributing factor (Cardno 2014b).

In general, it is considered that dugongs could occur anywhere in the harbour that could support seagrasses or macroalgae. Within Darwin Harbour, dugongs have been observed at Channel Island in Middle Arm, where they were thought to be feeding on macroalgae (Whiting 2002). However, there are anecdotal records of seagrass occurrence in the vicinity of the Channel Island boat ramp and this may have been a contributory factor to their presence.

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While some macroalgal communities may be present in the vicinity of the Project area, substantially greater areas of potential foraging habitat for dugong exist elsewhere in the harbour (INPEX 2011).

3.3.2.3 Turtles

Six species of marine turtles are known to occur in NT waters. Of these, four (green [*Chelonia mydas*], hawksbill [*Eretmochelys imbricata*], olive Ridley [*Lepidochelys olivacea*] and flatback [*Natator depressus*]) are considered to occur in the Darwin region, though olive Riddleys are thought to occur only occasionally within the harbour (Cardno 2014b). Loggerhead turtles (*Caretta caretta*) are suspected to be infrequent users of the harbour and the leatherback turtle (*Dermochelys coriacea*) is considered to be an oceanic species which is unlikely to occur in Darwin Harbour (Whiting 2003).

The shoreline throughout Darwin Harbour, and particularly in East Arm, consists largely of mangrove forests and mudflats and does not provide suitable nesting habitat for any species of turtle (INPEX 2010). The nearest nesting beach (used by the flatback turtle) is located in the Casuarina Coastal Reserve near Lee Point on the north-eastern shore of the harbour. Turtles visiting the harbour are more likely to be foraging for food. Flatback and hawksbill turtles forage on the filter feeder communities which are extensive in the harbour. The hawksbill turtle also forages on seagrass and macroalgal communities in addition to filter feeders. Green turtles forage amongst seagrass and macroalgal communities (INPEX 2011).

Cardno (2014b) implemented the *Turtle and Dugong Monitoring Program* for the INPEX Ichthys project; this included aerial and land survey techniques to monitor the abundance and distribution of turtles around Darwin Harbour. They concluded that:

- Statistical analysis of population and density estimates formed in this study did not indicate that the distribution or abundance of these animals had changed since the baseline phase.
- During survey D4 (during dredging) 813 turtles were sighted, which was higher than the average number of turtles sighted per survey during the baseline phase (634 turtles), but approximately 17% lower than the number of turtles recorded during baseline survey B3 (984 turtles), undertaken at the same time of year (October 2012).
- Statistical analyses of turtle population densities did not detect any significant difference between the impact and control treatments in either phase, or between baseline and dredging phases, for either treatment. In contrast, estimates of turtle density based on raw observations were significantly higher at the control blocks compared with the impact block during the baseline phase, but not during the dredging phase. The observed temporal and spatial variation in turtle distribution and abundance was considered possibly to be a result of short-term movements in and out of specific areas, possibly due to avoidance behaviour and/or the pursuit of more optimal foraging areas.
- Turtle sightings were most frequently recorded within relatively shallow water habitat, most commonly in waters less than 5 m in depth; however, a small number were sighted in the deep water channels near the Vernon Island (outside of Darwin Harbour) in waters greater than 30m depth.
- Where benthic habitat type had been identified and mapped, turtles were primarily sighted in association with gravel, sand and reef. Only 3% of turtle sightings were associated with mud habitat, the predominant habitat within, and around, the Project area.

3.3.2.4 Sawfish

The EPBC protected matters database indicates that dwarf sawfish (*Pristis clavata*), green sawfish (*Pristis zijsron*), freshwater sawfish (*Pristis microdon*) and narrow sawfish (*Anoxypristis cuspidata*) may potentially inhabit Darwin Harbour, or that their habitats may be present in the harbour. While these species are widely distributed throughout Australian tropical waters, within the Atlas of Living Australia (ALA 2021), in Darwin Harbour the following are recorded:

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- One record of a dwarf sawfish caught in a gill net in the creek leading to the Gardens Golf Course. This species inhabits shallow (2-3 m) coastal waters and estuarine habitats (Department of the Environment, Water, Heritage and the Arts [DEWHA] 2009) and is not known to move into freshwater areas (Thorburn et al 2007). Estuarine habitats in north-western Australia are used as nursery areas, with immature juveniles remaining in those areas up until three years of age (Thorburn et al 2007). Adults have been found to seasonally migrate back into inshore waters (Peverell 2007).
- One record of a green sawfish caught on a line and released off Lee Point, in the outer harbour. This record was made by a 'citizen scientist' and the identification verification status on the ALA database is deemed to be 'uncertain'. However, elsewhere in northern Australia most records of the species have been from marine and estuarine areas (Thorburn et al 2003, Peverell et al 2004) and they have been noted to move into estuarine or more fresh waters to breed during the Wet season and subsequently move into marine waters after the Wet season (Peverell 2005).
- There are no records of freshwater sawfish within harbour waters. Elsewhere in northern Australia, it has been reported that their first three to four years of life are spent in freshwater (Larson et al 2006, Thorburn et al 2007) before moving into marine waters. They are thought to breed either in freshwater (Peverell 2005) or in marine waters (Thorburn et al 2007).
- There are no records of narrow sawfish within harbour waters.

Although there is a limited number of records of the four sawfish species within harbour waters, studies elsewhere in northern Australia indicate that there is the potential for them to occur in the vicinity of the Project area during parts of their lifecycles; this may only be transitory as they move between freshwater and marine habitats before and after the Wet season.

3.3.3 Migratory bird species

Migratory bird species recorded around the East Arm area have been predominantly within the mangroves, the saline wetlands and beside the water in the settling ponds. Although historical counts suggest that migratory shorebird numbers within Darwin Harbour are modest (Chatto [2003] survey Block 4), EAW does seasonally support nationally significant numbers of some migratory shorebirds.

Since November 2009, shorebird monitoring has been undertaken at EAW and the settling ponds through the program developed in accordance with EPBC Approval 2010/5304 for the EAW Expansion project.

Field assessments identified that the Project area is not a known or potential roost site for threatened or migratory shorebirds (Lilleyman, Lawes & Garnett 2013). These studies noted that during high tides small numbers of birds were observed to be roosting on saline flats and in mangrove areas along other areas of the East Arm Peninsula; however, no large aggregations (>30 birds) of roosting birds were detected anywhere other than the EAW settling ponds, with very few birds observed foraging or roosting on the foreshore areas within the Project area.

The criteria for determining the importance of habitat for migratory shorebirds in Australia (EPBC Act policy statement 3.21) rates a site as nationally important habitat if:

- the site is identified as internationally important under Ramsar: or
- the site supports:
 - at least 0.1% of the fly away population of a single migratory shorebird species; or
 - at least 2000 migratory birds; or
 - at least 15 shorebird species.

The EAW area meets the criteria for supporting nationally important migratory shorebird habitat in that:

- Five migratory shorebird species (lesser sand plover, greater sand plover, far eastern curlew, terek sandpiper and sharp-tailed sandpiper) have been recorded within the EAW area at numbers greater than 0.1% of the fly away population by Chatto (2003).
- Six migratory shorebird species (whimbrel, far eastern curlew, common greenshank, sharp-tailed sandpiper, lesser sand plover and greater sand plover) have been recorded within Pond D at numbers greater than 0.1% of the fly away population by Lilleyman, Lawes and Garnett (2013).
- At least 2000 migratory birds have been recorded
- Twenty-two migratory shorebird species have been recorded within the study area (EMS 2011).

Nationally significant numbers of some migratory birds listed under the EPBC Act roost on Pond D at EAW. Recent survey data indicates that the total abundance of roosting shorebirds has increased at EAW since 2010 (Lilleyman et al 2020). Previous survey work in Darwin Harbour has shown that the EAW roost site is the only available roost site for shorebirds when the tide is greater than 7.6 m as available roosting space at all other survey sites is greatly reduced (Lilleyman et al. 2018). Further preliminary tagging studies have indicated that separate shorebird sub-populations roost at EAW to those tagged at other known natural roosting sites within Darwin Harbour (Lilleyman et al 2020).

Surveys have not identified any use of the intertidal area within the Project area as being utilised by EPBC listed bird species for roosting.

Based on a literature review and three field observation periods in 2022 (during which two common sandpipers [*Actitis hypoleucos*] were the only migratory shorebirds observed within the Project area), AECOM (2022) noted that, while migratory shorebirds may occasionally forage within the Project area, this appears to be uncommon and is unlikely to contribute to EAW's status as important habitat, which is derived from the populations utilising habitat at the EAW ponds. The Project area provides feeding habitat only during spring low tides, during which time such habitat would be plentiful throughout the Darwin Harbour shoreline.

3.3.4 Other EPBC listed species

The EPBC protected matters database indicates that the following threatened “species or species habitat may occur within [the] area”, though there are no records (in the Atlas of Living Australia) of these species occurring within Darwin Harbour:

- Great white shark (*Carcharodon carcharias*)
- Northern river shark (*Glyphis garricki*)
- Whale shark (*Rhincodon typus*).

The database also indicates that the following migratory marine “species or species habitat may occur within [the] area”:

- Estuarine crocodile (*Crocodylus porosus*) – this is known to occur within Darwin Harbour but is likely to typically avoid areas of high vessel activity, such as the dredging location. Because only limited nesting sites for the estuarine crocodile are available inside Darwin Harbour, the area is not considered critical habitat for crocodile survival in the NT (Whiting, 2003).
- Coastal manta ray (*Manta alfredi*) and oceanic manta ray (*Manta birostris*) – manta rays are known (from anecdotal accounts) to occur in the harbour, though there are no records (in the Atlas of Living Australia) from which to determine which particular species have been present.

3.4 Historical site use

The Project site appears to have been vegetated by natural scrub and mangrove until 1927, when the Commonwealth of Australia acquired East Arm properties for the purpose of establishing a quarantine station, with associated facilities located to the north of the Project site (KBR 2020).

The Project site and its surrounds were used during World War II for a range of activities, with a flying boat base and the lugger maintenance section located within the area. The flying boat base comprised a number of components, including a large tarmac hardstand, hangar, workshop and stores with associated maritime infrastructure. The latter included a large concrete ramp enabling Catalinas to be taken in and out of the water (the RAAF Catalina Ramp) and a concrete slipway with iron rails to serve the Marine Section vessels. Some of this infrastructure falls outside of the Project site, such as the timber jetty located to the east of the flying boat base site (Cosmos 2015).

The flying boat base also included a range of offshore marine infrastructure, including permanent Catalina and vessel moorings comprised of at least 22 seaplane moorings, nine marine craft buoys, five lugger buoys, three warping and steadying buoys, three marker buoys, and one submarine buoy (Cosmos 2015).

Maintenance and repair activities, including refuelling, were largely conducted on the hardstand area at the base; however, some maintenance works such as engine tuning, minor repairs and supply activities were carried out on the Catalinas whilst they were on their moorings, under tow or taxiing (Cosmos 2015).

In the 1980s, the former RAAF Catalina Ramp was opened to the public by the NTG for use as a recreational boat ramp. The boat ramp became one of the most popular ramps in Darwin Harbour due to its length, which enabled small craft to easily access the harbour waters during most tidal phases. However, in 2005 the boat ramp was no longer required to support recreational boating as a new recreational boat ramp was constructed at East Arm, north of Catalina Island (KBR 2020).

At present, the site is currently used for a marine services business. It has a car park, site office and hardstand areas which are used to conduct marine services activities (including marine equipment and material hardstand/laydown), a works depot and marine workshop.

During the FEED stage of the Project a geophysical survey was undertaken for the identification of potential unexploded ordnance (UXO) (G-Tek 2017). Prior to dredging commencing, a geotechnical investigation will be conducted, which will also include a diver survey to investigate and remove any potential targets identified in that survey.

3.5 Cultural heritage

3.5.1 Indigenous cultural heritage

Advice sought from the NT Heritage Branch in April 2018 confirmed that there are no existing registered Aboriginal archaeological sites within the proposed Project area. The AAPA certificate issued for the Project (RA2018/46, dated 18 January, 2019) indicates that there are no sacred sites within the Stage 1 dredging footprint, while two registered sacred sites are within 1km of the Project area:

- 5073-66 - Yirra (also known as Catalina Island), including the sand bar that extends in a north-westerly direction from the northern tip of the island; approximately 650 m to the east.
- 5073-90 – described on the AAPA certificate as ‘a rock in the harbour at East Arm’; this is known locally as Old Man Rock; approximately 900 m to the south-east.

3.5.2 European heritage

A number of cultural heritage surveys and archaeological assessments have been completed for the East Arm area as part of the EAW expansion and MUBRF projects. These assessments included field investigations and review of both cultural and indigenous heritage within portions of the proposed Project footprint, including:

- East Arm Multi-User Barge Ramp Facility, Recovered Cultural Objects, Maritime Archaeological Analysis Report (Cosmos 2015).
- Multi-User Barge Ramp Facility – Archaeological Report (Aurecon 2015).
- Archaeological Survey of the EAW Expansion and Surrounding Area, Darwin NT (Earth Sea Heritage Surveys 2011).

While a search of the NT Heritage Register indicated that no nominated or declared heritage places are located within the immediate Project area, the East Arm Flying Boat Base (described in 3.4) included a range of offshore marine infrastructure, including permanent Catalina and vessel moorings comprised of at least twenty-two seaplane moorings, nine marine craft buoys, five lugger buoys, three warping and steadying buoys, three marker buoys, and one submarine buoy (Cosmos, 2015); some remnants of this infrastructure may be within the dredging footprint.

An archaeological assessment was undertaken for the adjacent MUBRF in 2014/2015 (Cosmos 2015). This investigation noted that the seabed within and surrounding the footprint of the MUBRF had served as a 'rubbish dump' from the early to middle years of the 20th century, and up to the present day. The majority of artefacts recovered during the survey represented discards into the harbour associated with various land-based and water-based activities, primarily relating to World War II use of the area. Similar material may be present within the Project dredging footprint.

A search of the Australian National Shipwreck Database noted that there are no registered shipwrecks within the dredging footprint. The search identified, within the general East Arm area, four registered shipwrecks including two Vietnamese refugee boats (ID3429 and ID3430), a two-part barge (ID3428) and HMAS Kelat. None of these registered shipwrecks have been placed on a heritage register.

The database search also identified a number of aircraft wreck sites within the general East Arm area. The Catalina 2 (RAAF Catalina A24-69) site was located within the database search area, but approximately 500 m to the south of the dredging footprint. It is charted as rising to 4 m below LAT. The Catalina 3 (RAAF Catalina A24-206) site is located to the south of Catalina Island, over 1 km from the Project site. Neither of the Catalinas are a registered heritage site.

3.6 Sediment Transport Modelling and Impact Assessment

3.6.1 Synthesis of assessment approach

Sediment transport modelling was undertaken by AIMS to assess the potential impact of dredging for the Project on local water quality, and potential sedimentation impacts in the local area (Simão & Tonin 2020; Appendix I to the Project Draft EIS).

It is noted that the modelling was conducted on a preliminary Project layout, using indicative estimates of dredging volumes; these differ in some respects to the layout and volumes presented in the Project EIS. However, the modelling is considered to be sufficiently representative of the extents and magnitudes of potential changes in water quality that could occur in the vicinity of the dredging works to be of value for informing the environmental management framework presented in Section 6 of this Plan.

The following assessment of potential environmental impacts from the dredging works at the Project site was informed by:

- three-dimensional hydrodynamic models that incorporated water levels, wind, currents and waves
- sediment transport models that determined suspended sediment dispersion and sediment accumulation
- GIS analyses to quantify and depict potential impacts on habitats on the basis of tolerance limits.

Details of the hydrodynamic and sediment transport models applied are presented in Simão and Tonin (2020) and are not repeated here. The outcomes of this modelling are discussed in Sections 3.9.1

Modelling of elevated SSC associated with tailwater discharge from the settling ponds at EAW has not been repeated for this Project. Modelling of tailwater discharge from the same location (Pond E [South]), meeting the same water quality criteria, was completed for the MUBRF dredging program and has therefore been applied to assess potential impacts associated with tailwater discharge for the Project dredging program.

3.7 Tolerance limits for biological communities

3.7.1 Suspended sediment concentrations

Tolerance limits applied to the assessment of potential impacts from the MSB and MUBRF dredging campaigns are adopted for this Project. These tolerance limits were derived from turbidity data collected by URS (2011) in a long-term water quality study conducted in Darwin Harbour. The URS data were collected every 15 minutes at two sites in East Arm (South Shell Island and North-east Wickham Point) over a year-long program. Data were grouped and averaged based on tidal cycle and seasonal variation, allowing seasonal means, medians, and percentiles to be calculated. This gave a robust body of data to compare background levels of turbidity with potential increases associated with various natural and artificial turbidity-generating events in the harbour.

This dataset is considered to be relevant in the context of the current Project as the South Shell Island monitoring location is in the vicinity of the benthic communities of value that are closest to the Project site and it provides the longest continuous water quality dataset for this region. Further, as reported in the Project EIS a study was undertaken to review TSS concentrations in the region using remote sensing methods (EnSTaR 2021). It is noted that turbid plume dispersion modelling, and dredging monitoring and management measures, utilise measures of SSC. However, satellite imagery interpretation provides data in terms of TSS as the contribution of suspended sediments to the total amount of suspended solids in the water column cannot be determined in isolation from other (non-sediment) suspended solids.

This assessment applied the semi-analytic sediment model from Dorji et al (2016) to estimate TSS concentrations in surface waters, based on reflectance from MODIS satellite imagery. Using this methodology, TSS concentrations in East Arm were derived for the period February 1, 2010 – January 31, 2011; the period that data were collected by URS (2011), and then again for the period January 1, 2016 – October 30, 2020. While TSS derived through remote sensing methods and in situ turbidity measurements are not directly comparable, EnSTaR (2021) showed that, generally, based on the satellite-derived TSS results, TSS in Darwin Harbour during the period that the URS (2011) turbidity dataset was collected (median TSS = 4.72 mg/L, 95th percentile = 14.89 mg/L), was lower than that estimated for the period between 2016 – 2020 (median TSS = 5.4 mg/L, 95th percentile = 20.6 mg/L). Hence, it is evident that the tolerance limits derived for the INPEX dredging campaign, and adopted for the Project, are conservatively low relative to those that would be calculated from contemporary (2016-2020) data.

As there may be a need to dredge during either or both of the Dry and Wet seasons, tolerance limits for these seasons will be adopted from the appropriate (Dry or Wet season) subset of

the one-year baseline dataset of water quality (URS 2011), on the presumption that biological communities in East Arm are adapted to local conditions but will be stressed if exposed to conditions that regularly exceed the 95th percentile of normally prevailing background concentrations (calculated from URS 2011).

3.7.2 Tolerance Limits

As the sediment transport model calculates excess (above background) SSC caused by the dredging the median of the background concentrations was subtracted from the 95th percentile of the background concentrations to provide a comparable tolerance limit. This yielded a tolerance limit for Dry season dredging of 10 mg/L (3.5 NTU) and a Wet season tolerance limit of 25 mg/L (21.2 NTU) + background mean turbidity levels (4.4 NTU (Dry season) and 8.3 NTU (Wet season), Table 4 Summary water quality statistics for East Arm Wet and Dry season (URS 2011)).

3.7.3 Sedimentation

Tolerance limits for sediment deposition on mangroves were derived by INPEX (2010, 2011) from a review of the outcomes of habitat-specific dose-response experiments and field observations reported in the scientific literature. These tolerance limits were adopted for the MSB and MUBRF dredging programs and will also be applied to the Project dredging program. The tolerance limits are based on the literature suggesting that 50 mm accretion may lead to reduced health or mortality; above 100 mm accretion, mortality of trees was considered “likely”.

For corals and filter feeder communities, INPEX (2011) contended that a meaningful sedimentation threshold could not be derived from the literature due to factors such as wide variations in tolerances between species, and between morphologies within species. Notwithstanding this, a sedimentation tolerance limit of 15 mm was included in the approved Dredging and Spoil Disposal Management Plans for both the Ichthys capital dredging campaign (INPEX 2013) and for the Ichthys maintenance dredging campaigns (INPEX 2018). It is noted by INPEX (2018) that “*the tolerance limit values were extensively discussed with and endorsed by the Ichthys Project Dredging Expert Panel*”.

3.8 Zones of impact and influence

For the assessment of potential dredging-related impacts upon benthic communities, definitions of Zones of Impact and Influence consistent with the WA EPA (2016) *Technical Guidance for the Environmental Impact Assessment of Dredging Proposals* were adopted:

- **Zone of High Impact:** this zone constitutes the direct footprint of the dredged area and a 20 m wide annulus around the footprint to account for smothering from coarse sediments liberated from the cutter head during dredging. Impacts in these areas are predicted to be severe and often irreversible.
- **Zone of Moderate Impact:** within this zone, damage to benthic habitats and mortality of benthic biota may occur, primarily as a result of the indirect impacts from increased turbidity and sedimentation that may occur at times over areas within the zone. Impacts within this zone are predicted to occur, but the disturbed areas may recover (after completion of the dredging operations). It is expected that there will be no long-term (beyond a period of five years) modification of the benthic habitats in this zone. The outer edge of the Zone of Moderate Impact is delineated by the 90th percentile contour plot for SSC, as defined by dredge plume modelling. This delineates the areas where, for 90% of the time, the predicted SSC is below the calculated tolerance for benthic communities (dredging-related SSC of 10 mg/L for East Arm communities during the Dry season, 25 mg/L during the Wet season, refer Section 3.7.1). The 10% of time during which the SSC threshold is predicted to be met or exceeded is likely to represent periods of mid-flow tidal states (particularly during spring tides) and any one exceedance event is not likely to exceed two hours.

- Zone of Influence:** this zone includes the areas in which, at some time during the dredging works, benthic communities may experience (detectable) changes in sediment-related environmental quality outside the natural ranges that are normally expected. However, the intensity, duration and frequency of these changes is such that any damage to benthic habitats is likely to be reversible, and no mortality of benthic biota is expected to occur. The outer boundary of this zone is delineated by the 95th percentile contour plot for SSC, as defined by dredge plume modelling. This reflects the area where, for 95% of the time, excess SSC from the dredging will be below the calculated tolerance for benthic communities (10 mg/L in the Dry season, 25 mg/L in the Wet season, refer Section 3.7.1).

3.9 Modelling results

Model outputs are presented as:

- 90th percentile plot of modelled SSC (mg/L) (**Figure 5**)
- 95th percentile plot of modelled SSC (mg/L) (**Figure 6**)
- Sediment deposition (mm) following the completion of dredging and the 30-day post dredge period (**Figure 7**).

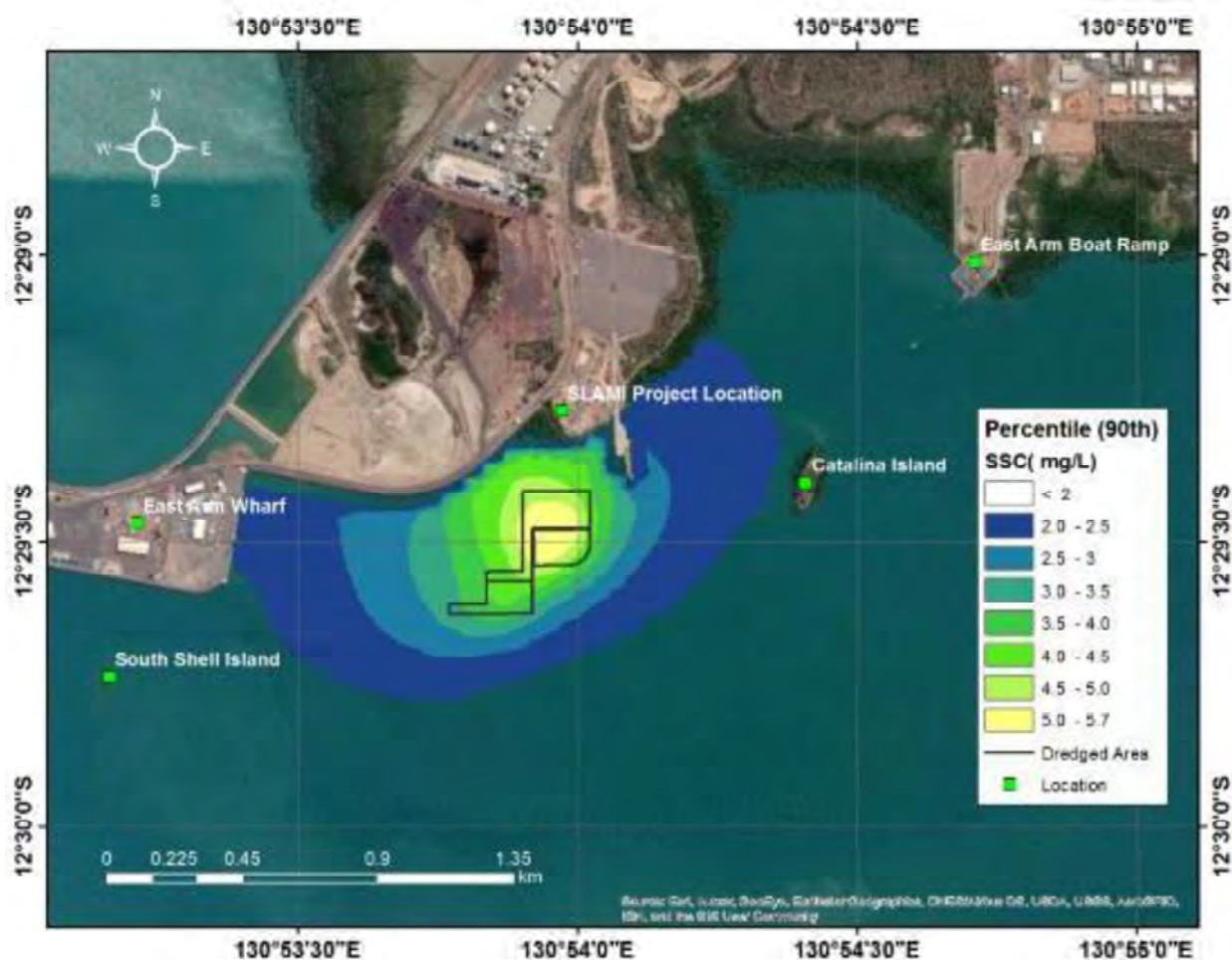


Figure 5 90th Percentile modelled SSC (above background level) (mg/L)

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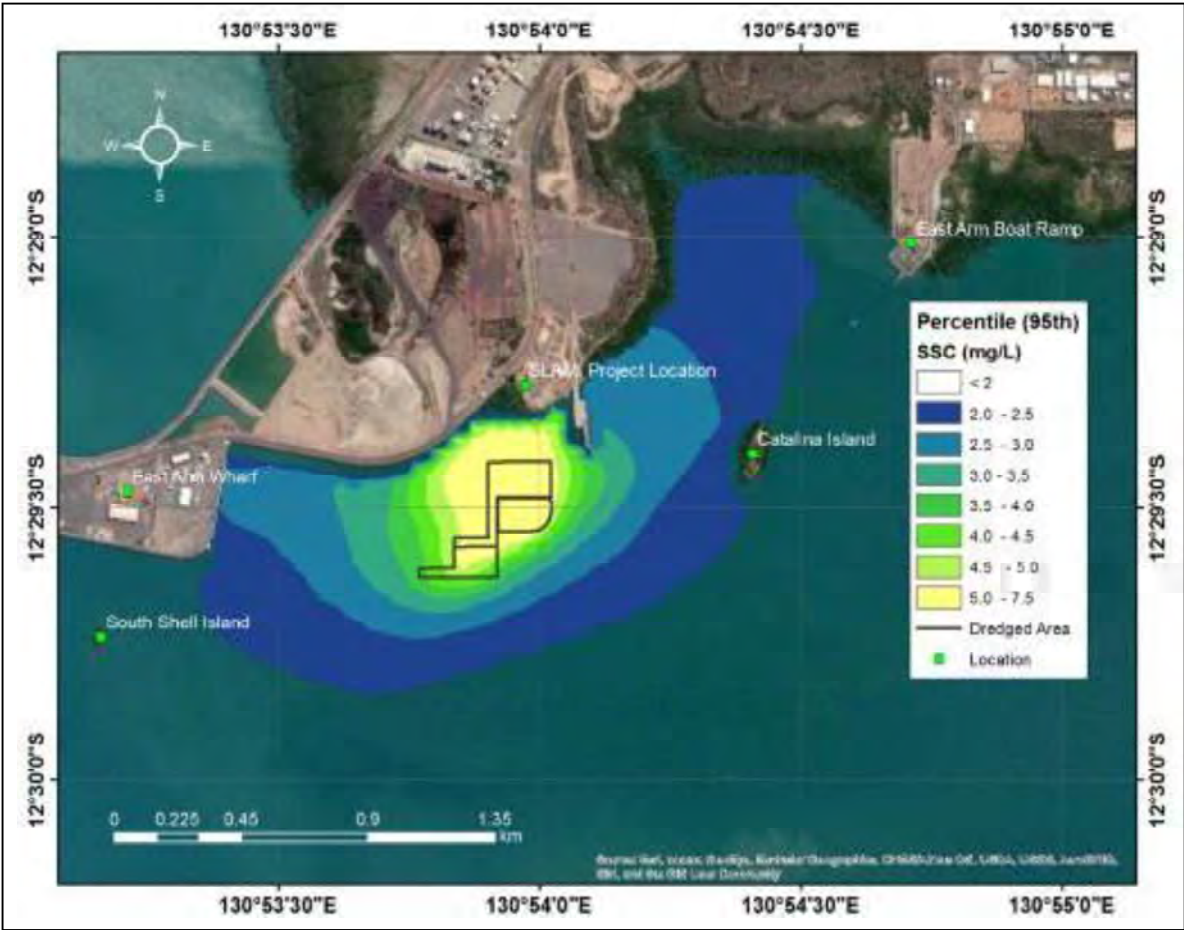


Figure 6 95th Percentile modelled SCC (above background level) (mg/L)

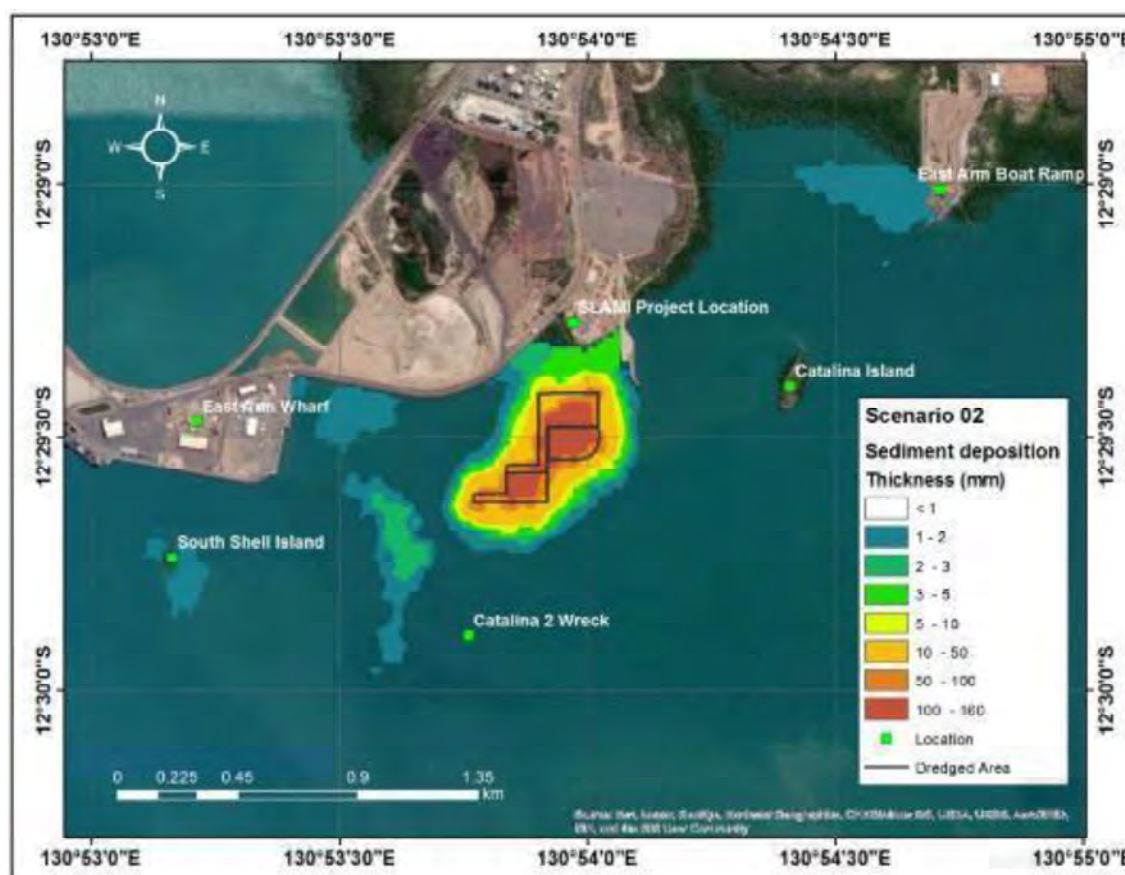


Figure 7 Sediment deposition at the completion of dredging and the 30-day post dredge period (in mm)

3.9.1 Suspended sediments

3.9.1.1 Dredging

Sediment modelling predicts a 90th percentile SSC of up to only 5.7 mg/L (**Figure 5**), which is less than the Dry season and Wet season tolerance limits of 10 mg/L and 25 mg/L respectively. Hence, the Zone of Moderate Impact falls completely within the Zone of High Impact. Similarly, a 95th percentile SSC of 7.5 mg/L is predicted at the cutter head (**Figure 6**) meaning that the Zone of Influence also falls entirely within the Zone of High Impact (i.e. within 20 m of the proposed dredging footprint boundary). As a result, suspended sediments mobilised from the dredge are not predicted to extend beyond the dredging area at concentrations that could result in detectable changes to environmental quality.

3.9.1.2 Tailwater discharge

Boundaries of the Zones of Moderate Impact and Influence at the tailwater discharge point at the permeable section of the railway bund wall (based upon a tailwater SSC criterion of 100mg/L; refer Section 6.2.2) were also defined by the 90th and 95th percentile plots produced by the modelling as follows:

- The outer edge of the Zone of Moderate Impact is delineated by the 90th percentile contour plot for SSC. On **Figure 8**, the outer edge of the Zone of Moderate Impact for the Dry season is shown as the purple contour, extending a maximum of approximately 100m from the railway bund wall. For the Wet season, there are no areas seawards of the railway bund wall where an SSC of 25 mg/L is exceeded more than 90% of the time; hence the Zone of Moderate Impact does not extend seaward of the railway bund wall.

- The outer boundary of the Zone of Influence is delineated by the 95th percentile contour plot for SSC. On **Figure 8**, the outer edge of the Zone of Influence for the Dry season is shown as the red contour, extending a maximum of approximately 120m from the railway bund wall. For the Wet season, there are no areas seawards of the railway bund wall where an SSC of 25 mg/L is exceeded more than 95% of the time; hence the Zone of Influence does not extend seaward of the railway bund wall.

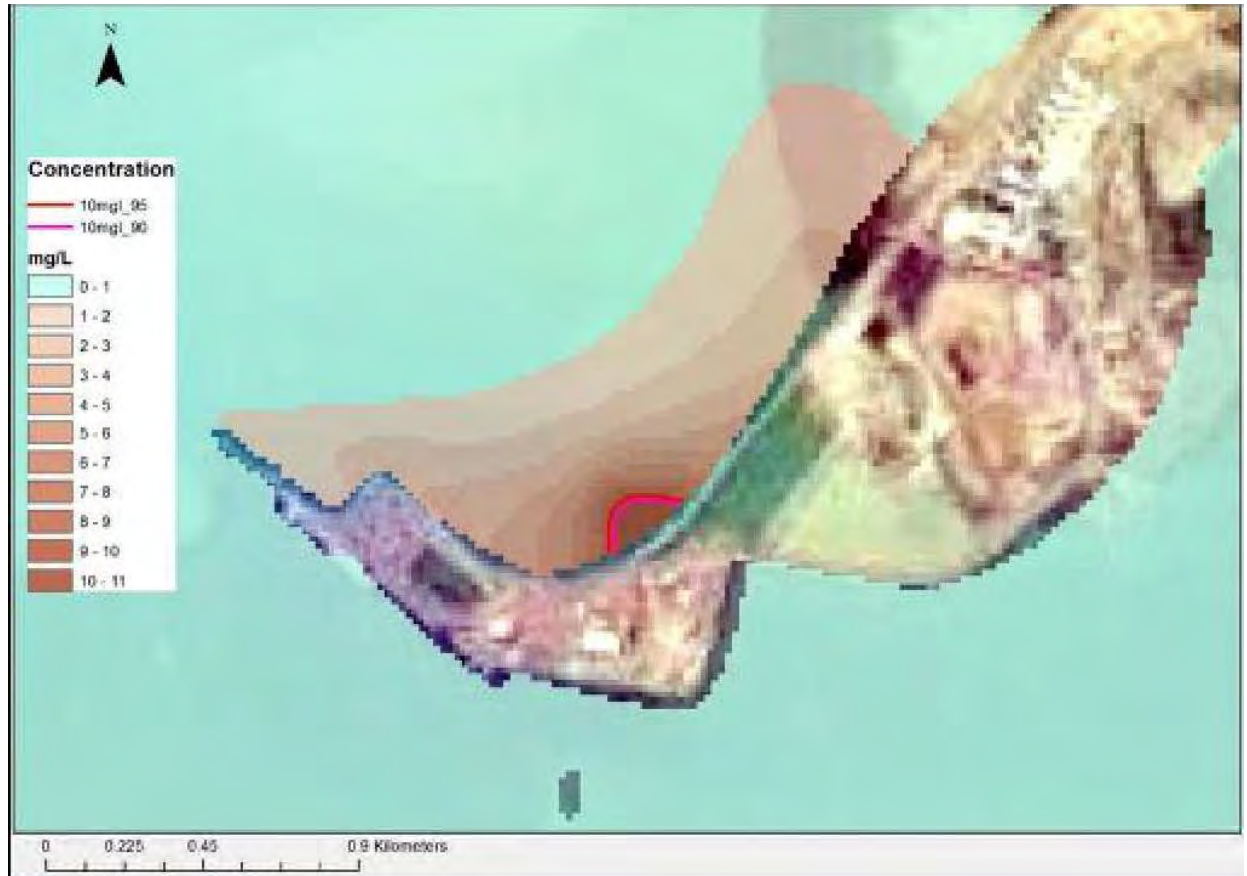


Figure 8 Predicted Dry season zones of Impact and Influence (SSC) at the tailwater discharge location

Suspended sediments may potentially impact a small area of benthic habitat up to 120 m from the Pond E (South) discharge point. While the habitat within this small area has not been mapped in detail, observations from low tide aerial imagery indicate that it is an intertidal mud/sandflat which would support benthic invertebrates living on and in the surface sediments. The suspended sediments could impact upon these organisms through clogging of feeding or respiratory structures, though any impacted areas would be expected to be recolonised by similar fauna once tailwater discharge has ceased. It should also be noted that no exceedance of suspended sediment limits set during the MSB or MUBRF dredging were observed at the outflow point from the pond system.

3.9.2 Sedimentation

3.9.2.1 Dredging

Sedimentation after 30 days of completion of dredging was modelled to identify any potential areas for concern for the exceedance of the sedimentation tolerance limits in mangrove areas. **Figure 7** shows that sediment deposition above 50mm is predicted to remain within the dredging footprint and does not extend beyond the Zone of High Impact defined for SSC (i.e. within 20 m of the dredging footprint). As such, no mangrove stands are predicted to be exposed to sediment accumulation beyond the tolerance levels proposed for mangroves (50 mm and 100 mm for reduced mangrove health, and likely mangrove mortality respectively). Hence sediment accumulation is not expected to impact on mangrove communities in areas

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such as upper reaches of East Arm, Blessers Creek and Charles Darwin National Park. It would be reasonably expected that Wet season wave activity under normal conditions would have a greater impact in these areas than sedimentation associated with the dredging and tailwater discharge (D Williams, AIMS, pers. comm. 2015).

A pocket of sediment deposition of between 1-2 mm (well below the 15 mm tolerance limit in the approved INPEX [2013, 2018] dredging management plans) is predicted to occur near South Shell Island (**Figure 7**). However, the modelling does not account for:

- The ability of hard corals to actively remove sediment from their surfaces (e.g. through the production of mucus) or for the influence of colony morphology in aiding sediment removal (e.g. Jones et al 2019).
- The active removal of sediments from the water column by filter feeders (e.g. Strehlow et al 2017, Abdul Wahab et al 2018) which may reduce the amount of sediment settling upon their surfaces, reducing the potential for impacts from smothering.

The wreck of Catalina 2 is located offshore from the proposed dredging footprint. It can be seen that sediment transport and sedimentation modelling does not predict sedimentation to occur in this area (**Figure 7**). Similarly, there is no net sedimentation predicted at either of the registered sacred sites (Catalina Island and Old Man Rock) that are present within 1 km of the dredging footprint.

3.9.2.2 Tailwater discharge

Previous modelling of sediment accumulation associated with the discharge of tailwater with SSC up to 100 mg/L (modelled for the MUBRF dredging) indicated sedimentation up to 2.88 mm may occur in close proximity to the outfall, well below the tolerance limits proposed for mangroves.

If the rate of sediment deposition adjacent to the settling pond discharge point is sufficiently high, then some of the benthic fauna may be smothered. However, any impacted areas would be expected to be recolonised by similar fauna once tailwater discharge has ceased.

It is concluded that potential sedimentation effects need not be given further detailed consideration in this Plan and that monitoring and management of suspended sediment levels within the pond system will provide an appropriate level of mitigation against the risk of impacts upon the receiving environment.

4 Dredging Program and Methodology

4.1 Dredging and Dredge Spoil Placement

Dredging will be carried out using a CSD to remove the unconsolidated material to the existing East Arm Wharf settling ponds, then a BHD to remove the consolidated material for land reclamation.

The location of the works within a tidal zone, sediment characteristics, limited available draught for vessels, and the method of placement of the dredged material were the determining factors for the selection of the preferred dredging methodology. Dredging shall not exceed more than 11ha of seabed disturbance within the approved extent, as per condition 1-1 condition of EP approval (EP2023/028-001). The land disturbance area (including infrastructure, hardstand and revetments) must not exceed 22.2 ha.

The current seabed surface levels within the proposed dredging footprint range from +1.0 m LAT to -3.0 m LAT. The typical geotechnical profile of the unconsolidated surface materials to be dredged consists of sand and gravel surface sediments (with gravel potentially comprising shell fragments) with silt and clay content generally increasing with depth. During sediment sampling undertaken at the site sample recovery of between 0.2 and 1.5 m was achieved before encountering consolidated material (AECOM, 2020). These unconsolidated sediments are underlaid by a thin layer of 'stiffer' consolidated residual soils, typically silty sand / sandy

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silt, which are overlaying shallow rock material. Side casting of excavated material may occur within the project extent (e.g., during early works for access to the Ship Lift pocket or dredging of Ship Lift).

Dredging of unconsolidated material will be undertaken using a small CSD. Dredged material will be transported via a temporary pipeline to the settling ponds at EAW. The final pipeline route would be determined by the Dredging Contractor in conjunction with CBJV and the Harbour Master.

The EAW ponds have previously been used for the disposal of capital dredging material from the initial development of EAW and from two developments undertaken as part of the EAW expansion project (Marine Supply Base [MSB] and Multi-User Barge Ramp Facility [MUBRF]), as well as from the Darwin City Waterfront Redevelopment. The existing EAW pond external pond revetment walls have been designed and constructed to wholly contain all material placed within the reclaimed area and to prevent the release of sediment to tidal waters during Project construction. This is in accordance with Environmental Approval (EP2023/028-001) condition 2-2(1),

It is expected that tailwater flow rates into the pond system would be approximately 500 L/s at a water to sediment ratio of 9:1. A sediment loss rate of 5% at the CSD cutter head could be expected and a dry bulk density of 857 kg/m³ is considered to be likely; these are in line with those characteristics assumed for the MUBRF dredging campaign (URS, 2015).

The material placement scenario is shown in **Figure 9**:

- The dredged material will initially be pumped into the ponds at a location in Pond K, in which the larger particles (sands and silts) will settle out. If necessary, internal bunds may be constructed within Pond K to enhance the settlement process, or tailwater held within Pond K for a longer settling period.
- The supernatant tailwater will then flow into Pond E (North), in which retention will be managed such that there is sufficient time for finer particles to settle out, using the weir box into Pond E south to control the level in Pond E north. Silt curtains may be installed in Pond E (North) to assist in this process.
- Pond E (South) will provide a final settlement stage before the tailwater, under tidal influence, enters Frances Bay (Darwin Harbour) via a permeable section of the bund wall.

The primary method of control over tailwater quality discharged from the pond system would be through the use of silt curtains, internal diversion walls (bunds), control of the dredging regime and through the management of weir boxes. The flow direction and flow rate of tailwater into the ponds would be controlled so that sufficient residence time is achieved to result in suspended sediment concentrations (SSCs) within allowable limits at the point of entry of the tailwater to Pond E (South).

The reclamation area would be bunded as required and then progressively filled with consolidated material until the extent of the proposed reclamation is reached. Consolidated material would be removed by a BHD, placed into hopper barges and transferred into the reclamation area within the Project footprint. Sediment control measures listed in Table 6 will be implemented to minimise the release of sediments into the receiving environment from the reclamation area. Additional control measures such as silt curtains may be used to further minimise the release of sediments.



Figure 9 Indicative settling pond configuration

4.2 Pond levels (water only)

The maximum water height in Pond K will be 6.0 m AHD or a minimum of 0.5 m freeboard (whichever is higher).

Pond E (North) will operate with a water level of between 3.5 and 5.0 AHD and be controlled by a reclamation box with an adjustable weir.

The water level in Pond E (South) will be controlled to ensure at least 0.5 m freeboard at all times. During the dredging works, tailwater will pass through the permeable section of the railway bund (at the south-west corner of Pond E) at a rate which matches or exceeds the dredge output; hence the water level in the pond will not vary significantly and is mainly influenced by tidal variation. As a backup there will be a pump discharge outlet located in the south-east corner of Pond E (South) where a pump system capable of pumping 600 L/s, if required, will return the tailwater to Pond K or Pond E (North).

Each pond will operate with a minimum 0.5 m freeboard. While it is not anticipated to be required given the relatively low flow rates into the ponds, pumps may be used to supplement gravity flows to ensure transfer flows equivalent to the dredge output are maintained between ponds.

During dredging the daily water levels of each pond will be recorded and provided in the weekly reports. Where transfer pipes are fitted, the flow between ponds can be stopped by blocking the pipework between these ponds with steel plates and/or inserting rubber expanding plugs, with both options available on site.

Where a reclamation box is fitted the flow can be stopped by adding drop boards and raising the height of the weir. In both instances flow can be stopped within an hour as a corrective action if required.

4.3 Stormwater flow paths

Stormwater from the pond network and adjacent Darwin Port land ultimately flows into Pond E (South) for return to the harbour via the permeable section of the railway bund wall (refer **Figure 9**). During dredging operations, particularly where dredging is undertaken over the Wet season, consideration will be given to possible storm events and ensuring a flow path is always available for stormwater to find its way through the ponds.

Stormwater from the Pond K road bund and a catchment area near the gatehouse, estimated to be 20,000 m², is diverted into a stormwater channel in place along the boundary between Pond K and the former Pond C area, into Pond D, instead of flowing into Pond K (refer **Figure 10**). Stormwater from the highpoint on the road to the south of Pond K flows along a stormwater channel and through a culvert into Pond E (North).

The runoff from Darwin Port land to the north of the ponds passes through both Pond D and into Pond E (North). Importantly, stormwater does not flow into Pond K, allowing greater control over water exiting from this disposal pond.

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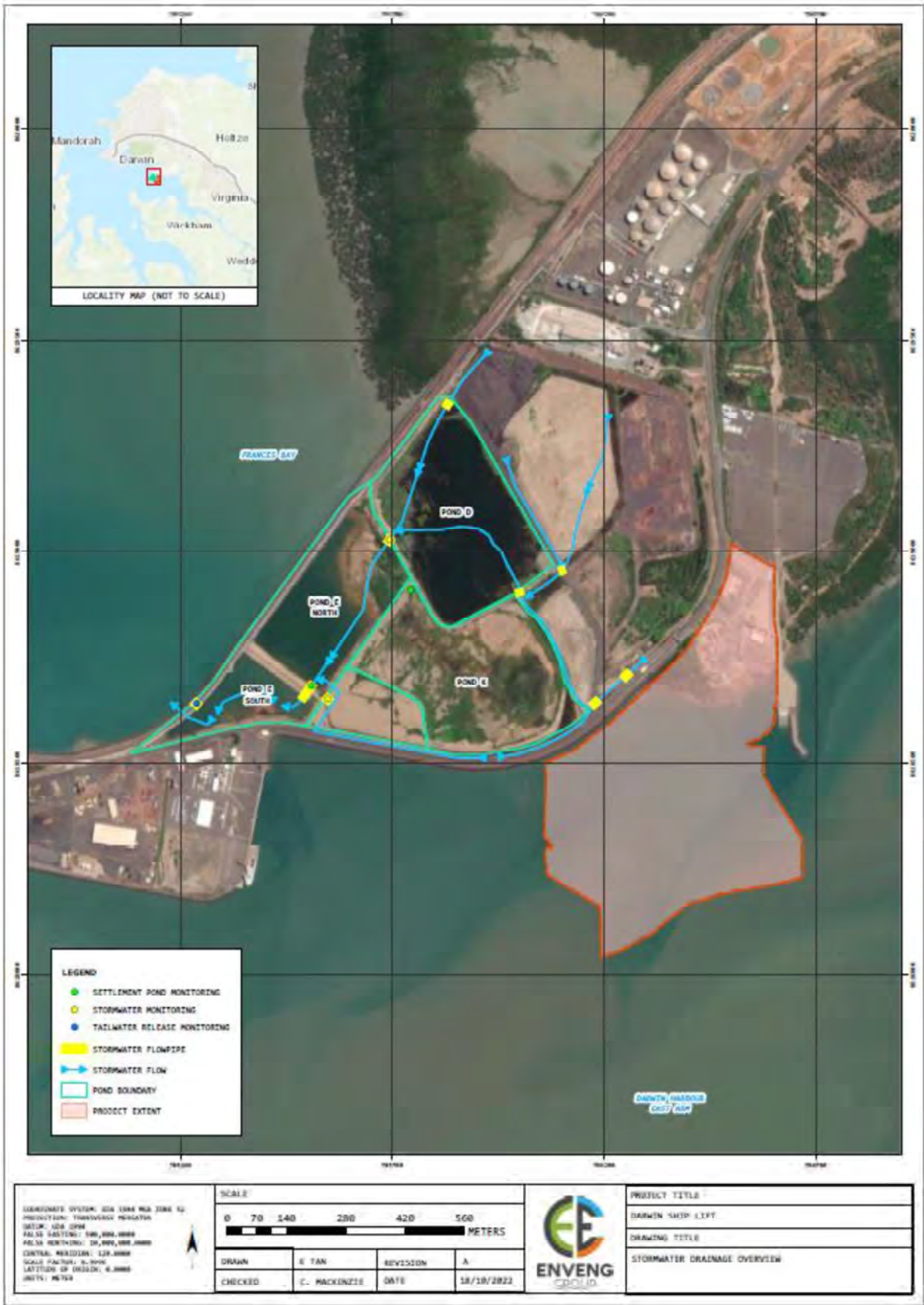


Figure 10 Stormwater flow paths through the EAW pond system

5 Environmental Factors and Objectives

Environmental factors are those features of the environment that may be impacted by an aspect or activity of a proposal. The NT EPA has identified 14 environmental factors, categorised under five themes: Land, Water, Sea, Air and People and Communities (NT EPA 2018).

Each environmental factor has an associated environmental objective against which the Project can be assessed, and which guides the development of impact mitigation and management measures set out within this Plan.

Table 5 lists the environmental factors that have been identified in the Project EIS Terms of Reference (NT EPA 2019) as those that may potentially be impacted by the Project activities set out in this Plan (i.e. the dredging and reclamation activities), the EPA objective for each and the potential impact pathway associated with the Project.

The Environmental Performance Objectives, management targets and measures for each environmental factor are defined in the Environmental Management Frameworks in Section 6.

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Table 5 Environmental factors, objectives and potential impact pathways

Theme	Environmental Factor	Objective	Potential Impact Pathway
Sea	Marine flora and fauna	Protect marine flora and fauna so that biological diversity and ecological integrity are maintained.	Direct impact to or loss of marine habitats within or in close proximity to the dredge footprint due to dredging.
			Indirect impacts to marine ecosystems due to increased turbidity and subsequently reduced benthic light availability as a result of dredging and tailwater discharge.
			Underwater noise and vibration associated with dredging and other Project-related vessel movements.
			Smothering of benthic flora, fauna and infauna as a result of sedimentation during and following dredging.
			Interaction between vessels and marine fauna including entrainment in dredge and collisions with Project-related vessels.
			Introduced invasive marine pest (IMP) species may compete with, or prey on, local marine fauna.
			Potential impacts to coral spawning due to increased turbidity associated with dredging during or around the time of coral spawning events
			Introduction of IMP species from Project- related vessels may impact benthic communities through competition for food and resources.
	Marine environmental quality	Protect the quality and productivity of water, sediment, and biota so that environmental values are maintained.	Impacts to water quality resulting from suspended sediment loads created by dredging potentially impacting marine ecosystem values.
			Potential hydrocarbon release associated with vessel operations, equipment operation (hydraulic fluids), bunkering or vessel collision.

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			Changes to the physico-chemical properties of the water column resulting from dredging and tailwater discharge.
			Introduction of IMP species may impact local environment by altering population dynamics of local species through competition and predation.
People and communities	Social, economic and cultural surroundings	Protect the rich social, economic, cultural and heritage values of the NT.	Suspended sediments generated by dredging activities settling upon cultural heritage sites.
			Physical impacts upon cultural heritage sites by Project vessels.

6 Environmental Management

This section describes the Environmental Management Frameworks (EMFs) that have been developed for the risks associated with the dredging works, as identified through the environmental risk assessment process (AECOM, 2022b). The EMFs are instrumental to effectively manage and mitigate environmental risks to sensitive receptors identified in Section 3.3, and to achieving the objectives set by the NT EPA for each of the Environmental Factors identified in Section 5 of this Plan.

EMFs have been developed for the following receptors:

- water quality – Darwin Harbour
- water quality – EAW settling ponds
- protected marine species – physical interaction
- protected marine species – underwater noise.

Each EMF states the relevant Project commitments made and objectives to be met, and contains specific, measurable targets to achieve the objective for each of the applicable Environmental Factors. It also summarises the management actions required to meet these targets, the relevant KPIs and the monitoring activities to be employed to measure success in meeting the requirements and to identify the need for corrective actions.

It should be noted that:

- catallmanagement actions are routine tasks that will be undertaken to meet the objectives of each EMF
- corrective actions are those tasks that are possible to be undertaken if monitoring indicates that trigger levels have been exceeded.

Where trigger levels are proposed, it should be noted that these are triggers for further investigation and are set well below levels at which significant adverse ecological effects could be anticipated. Monitoring is described in greater detail in Section 7. Each EMF also indicates the relevant reporting requirements (detailed further in Section 8) and the responsibilities of Project personnel.

6.1 Water quality – Darwin Harbour

6.1.1 Potential impacts

6.1.1.1 Suspended sediments

Plumes of suspended sediments ('turbid plumes') may impact upon marine organisms through clogging of feeding or respiratory structures or through a reduction in light penetration through the water column.

Turbid plumes containing elevated levels of suspended sediments will be generated:

- At the cutter head of the CSD.
- From any improperly sealed joints within the pipeline leading from the dredge to the EAW settling ponds.
- As the BHD bucket interacts with the seabed and lifts the dredged material through the water column.
- At the seaward face of the reclamation area, as a result of the return of entrained water from the dredged material.

As discussed in Section 3.9, sediment modelling predicts the Zone of Moderate Impact falls completely within the Zone of High Impact, i.e. within 20m of the dredging footprint boundary. Tidal currents will rapidly disperse the suspended sediments, and SSC's will rapidly return to background levels upon the completion of dredging. As a result, suspended sediments mobilised from the dredge are not predicted to extend beyond the dredging area at concentrations that could result in detectable changes to environmental quality. As such, and consistent with the *Darwin Port Long Term Dredging Management Plan* (AECOM 2018), monitoring of benthic communities is not considered necessary.

The risk assessment (AECOM, 2022b) has assessed the risk of increased SSC in the water column from dredging activities as Small magnitude, and Moderate sensitivity, equating to a Minor overall risk.

AECOM (2022) assessed the risk of reduction on incident light levels to benthic biota, potentially leading to reduced growth or to mortality; and clogging of fauna feeding or respiratory structures, potentially leading to reduced growth or to mortality, as Small magnitude, and Moderate sensitivity, equating to a Minor overall risk. Benthic biota within the area over which reduced light levels may occur are well represented within the harbour. No benthic communities of conservation significance are known to occur in the vicinity of the dredging and reclamation activities. In the past, a degree of research importance has been ascribed to the filter feeder communities around South Shell Island. However, it is predicted from modelling that elevations in SSC will not reach the predicted tolerance limits (Section 3.7) over these communities.

Given that dredging-related SSC is not predicted to approach these receptors, a precautionary monitoring program (detailed in Section 7.1) will be implemented to determine whether SSCs in the vicinity of the operating dredge are sufficiently low as to pose a negligible risk of exceedance of tolerance limits at the nearest sensitive receptor sites. In addition, monitoring of benthic communities will occur at selected locations around South Shell Island (refer Section 7.2).

6.1.1.2 Toxicants

The potential for toxicants to be released from the porewater within the unconsolidated seabed materials to be dredged is recognised. However, on the basis of the results from the sediment geochemical assessment undertaken by AECOM (2020) it is considered that there is negligible risk of these being released at sufficient concentrations to significantly impact upon the beneficial uses, water quality objectives or identified environmental values of Darwin Harbour.

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The following aspects of the dredge operation will further mitigate the potential for changes in toxicant concentrations to occur in the water column beyond the dredging footprint:

- CSDs utilise powerful suction to transport the dredged material to the disposal location. This entrains the majority of porewater (within the dredged material) into the dredge, then into the pipeline to the disposal location.
- While there is typically some release of fine sediment particles from CSD cutter heads (conservatively estimated as 5% of the volume of dredged material), these are only carried away from the cutter head if currents are sufficiently strong. These currents will have the effect of rapidly diluting any porewater (and any toxicants therein) that may become entrained in the flow away from the cutter head.
- It is anticipated that the loss at the cutter head will be considerably lower than 5% when dredging unconsolidated materials as the CSD would primarily operate in 'suction-only' mode. The release of sediments from a cutter head typically occurs when it is activated in order to fracture consolidated material, within which there is limited porewater.
- During BHD operations, much of the sediment porewater will be retained within the dredged material as it is raised through the water column. While this will be released as the material is deposited into the reclamation area, it is reiterated that the toxicant concentrations within the sediments to be dredged have been determined (by AECOM 2020) to be sufficiently low as to not pose a risk of significant impacts upon the receiving environment.

It is considered that the monitoring of turbidity levels, as an indication of the veracity of the plume dispersion modelling, is an appropriate strategy to also mitigate the risk of impacts from nutrients and toxicants.

6.1.2 Trigger levels

A turbidity **trigger level** of 100 mg/L (140 NTU) has been set at a distance of 150 m down current from the operating dredge, the pipeline, or the seaward edge of the reclamation area; this is based on the need to retain SSCs at sensitive receptor sites (e.g. South Shell Island) below the tolerance limits for those communities (10 mg/L for Dry season and 25 mg/L for Wet season).

Given the distance between the proposed dredging location and the nearest significant sensitive receptor site at South Shell Island, this trigger level is considered suitable to provide an early warning that SSCs are elevated above those predicted and that management measures may be required to reduce the risk of the relevant SSC tolerance limit being exceeded at South Shell Island.

Seasonal turbidity **limit values** of 29.5 NTU (Wet season) and 7.9 NTU (Dry season) (AECOM 2018) have been set at the benthic communities at South Shell Island monitoring site and Catalina Island monitoring site.

6.1.3 Response to trigger exceedance

Where a **trigger level** (140 NTU) at a distance of 150m from the operating dredge, from its associated pipeline, or from the seaward edge of the reclamation area is exceeded, a drone will be employed to capture aerial imagery of the plume.

Additional turbidity monitoring will then be carried out at the South Shell Island and Catalina monitoring sites, to determine if the limit value has been exceeded.

If a **trigger value** and/or seasonal turbidity **limit value** is exceeded, then this will be reported to the Territory within 24 hours and corrective actions (see Table 6) will be implemented in a manner aimed at determining which of them have the greatest potential to reduce the

dispersion of plumes from the dredging and reclamation activities towards South Shell Island and / or Catalina Island.

Concurrently, an attributability assessment will be initiated and submitted to the Territory to determine whether or not the exceedance was likely to have been caused by dredging or reclamation activities. This assessment will be completed within three business days of the exceedance occurring and will include consideration of information such as:

- Changes in TSS levels within East Arm that are due to natural factors such as storm activity, or to other anthropogenic sources.
- Observations of turbid plumes emanating from other sources within East Arm.
- Wind, wave, current direction and tidal data.

If it is deemed that the exceedance is potentially due to the dredging or reclamation activities, then those corrective actions (Table 6) that are most effective in adequately reducing turbidity emanating from these sources will continue to be implemented until such time as the turbidity levels fall to below the **trigger level** and/or **limit value**.

Where the turbidity **trigger value** (140 NTU) at a distance of 150m from the operating dredger, associated pipeline or the seaward edge of the reclamation area is exceeded, this will be reported by the Contractor to the Territory within 24 hours. Also within 24 hours, additional monitoring and corrective actions (see Table 6) will be implemented in a manner aimed at determining which of them have the greatest potential to reduce the dispersion of plumes from the dredging and reclamation activities towards South Shell Island and Catalina Island.

If attributability report determines CBJV dredging is the cause of the exceedance tolerance at benthic communities, the following actions should be undertaken:

Monitor the turbidity at nominated monitoring sites (South Shell Island and/ or Catalina Island), a minimum of once per day for a period of 7 days. Where the seasonal turbidity **limit values** of 29.5 NTU (wet season) and 7.9 NTU (dry season) at the benthic communities at South Shell Island or Catalina Island monitoring sites is exceeded for a period of greater than 7 days, the immediate response is to cease dredging, implement corrective actions (see Table 6) and report in accordance with the trigger level exceedance.

6.1.4 Management measures

The following inherent characteristics of the dredging operation are anticipated to minimise the generation of turbid plumes:

- Dredging and reclamation activities are situated close to shore, at locations which are afforded some protection from the effects of tidal currents.
- During CSD operations, the feed of sediments into the suction pipe is maximised by its location directly behind the cutter head. This minimises the release of sediment into the water column surrounding the dredge. When dredging unconsolidated materials the cutter will be disengaged for much of the time, while dredge pumps will operate at the maximum speed possible.
- During BHD operations, the bucket will be raised through the water column at a speed that minimises the loss of material from the bucket. The dredged material will be placed into barges from which there will be no overflow of entrained water or porewater. Geofabric will be placed on the internal side of the revetment walls which prevents sediment being released from the reclamation area and any runoff from the area will be managed to minimise the entry of sediments into the marine environment. Additional controls such as but not limited to will be the placement of turbidity buoys, regular drone surveillance and water testing.

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Monitoring of the turbid plume from the dredge will allow for detection of exceedances of the trigger value. Where the turbidity exceeds the **trigger value** 140 NTU 150m down current of any sources of turbid plumes from the dredging, dredge pipeline and reclamation activities, the following management measures will be implemented (Table 6).

- Cutter head and pump speeds adjusted to minimise dispersion of fine sediments from the cutter head.
- Immediate action to repair pipeline to ensure integrity maintained to reduce the potential for spoil leakage from joints between sections.
- Speed of BHD bucket movement through water column adjusted to minimise loss of sediments into the water column.
- Installation of Geofabric on the internal side of the revetment walls.

An exceedance of the **trigger value** will cause additional turbidity monitoring at the South Shell Island monitoring site or the Catalina Island Monitoring Site.

Where turbidity exceeds the seasonal **limit value** (29.5 NTU Wet season and 7.9 NTU Dry season) at the South Shell or Catalina Island monitoring site, the following management measures will be implemented (Table 6 Water Quality Management Framework – Darwin Harbour

- Cease dredging activities.
- Depending on the tidal cycle, relocation of the dredge can be scheduled to coincide with those times when the tide will not move sediments towards benthic habitats.
- Implement corrective actions as for exceedance of trigger level.

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Table 6 Water Quality Management Framework – Darwin Harbour

Element	Maintenance of water quality in East Arm
Commitments	EP Approval conditions 2-1 and 2-2.
Objective	To minimise the potential for impacts upon the hard coral and filter feeder communities at South Shell and Catalina Islands from turbid plumes emanating from dredging and reclamation activities.
Target	1. No instances of exceedance of turbidity trigger levels at a distance of 150m down- current of the operating dredge or its associated pipeline or the seaward face of the reclamation. 2. No instances of exceedance of turbidity limit value at the South Shell Island or Catalina Island monitoring site
Key Performance Indicators	Number of instances of exceedance of trigger level at the sampling locations 150m down current from the sources that require corrective actions to be implemented to return water quality in East Arm to an acceptable level. Number of instances of exceedance of seasonal limit value at the South Shell Island or Catalina Island monitoring site(s) that require corrective actions to be implemented to return water quality to an acceptable level.
Management	CSD: • Cutter head and pump speeds managed to minimise dispersion of fine sediments from the cutter head. • Pipeline integrity maintained to reduce the potential for spoil leakage from joints between sections. BHD: • Speed of bucket movement through water column managed to minimise loss of sediments into the water column. • No overflow from barges. • Installation of Geofabric on the internal side of the revetment walls. • Turbidity Buoys placed 150m down- current of the operating dredge. • Drone Surveillance. • Water Testing. • Management of runoff from reclamation area.
Monitoring (Sections 6.1.2 and 6.1.3)	• Reactive water quality monitoring 150m down current of the operating dredge, the pipeline and the reclamation area, if a plume is emanating from it.

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	- Where there is an exceedance of the trigger value at a distance of 150m from the dredge, pipeline or reclamation area, a drone will be employed to capture aerial imagery of the plume and additional turbidity monitoring will be carried out at the South Shell Island and / or Catalina Island monitoring sites - Baseline and post-dredging assessments of proportions of live hard corals and filter feeders within benthic communities at South Shell Island and Catalina Island monitoring sites.
Reporting (Section 12)	- Reporting of reactive monitoring data by Project Environmental Advisor to the Territory within 24 hours of an exceedance of trigger level or limit value. - Monitoring report to the NT EPA at the conclusion of dredging. - A report on attributability assessment and corrective actions implemented to address the cause of the exceedance will be submitted by Project Environmental Advisor to the Territory within three business days of the notification.
Corrective Actions	- Where turbidity exceeds the trigger level 150m down current of any sources of turbid plumes: - Cutter head and pump speeds adjusted to minimise dispersion of fine sediments from the cutter head. - Immediate action to repair pipeline to ensure integrity maintained to reduce the potential for spoil leakage from joints between sections. - Speed of BHD bucket movement through water column adjusted to minimise loss of sediments into the water column. - Installation of silt curtains along seaward edge of reclamation area. - Where turbidity exceeds the seasonal limit value at the South Shell Island and/or Catalina monitoring site: - Cease dredging activities. - Depending on the tidal cycle, relocation of the dredge can be scheduled to coincide with those times when the tide will not move sediments towards benthic habitats. - Implement corrective actions as for exceedance of trigger level.
Term	For the duration of dredging and reclamation works.

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Responsibility	• Project Environmental Advisor to ensure that works are undertaken in compliance with the approved WQMF. • Project HSSE Manager to ensure monitoring program and water quality management measures are implemented.
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6.2 Water quality – East Arm Wharf settling ponds**6.2.1 Potential impacts**

The tailwater discharge from the settling ponds will contribute suspended sediments to the receiving environment in the vicinity of the permeable railway bund wall at East Arm Port, though on occasions (e.g. during spring tides) the concentrations of suspended sediments in the tailwater may be less than those in the receiving environment.

AECOM (2022), assessed the risk to receiving waters of increased SCC from tailwater release as Negligible magnitude and Low sensitivity, equating to a Minor overall risk.

Monitoring during the MSB and MUBRF dredging provides a relevant comparison with which to compare likely suspended sediment dispersion and sedimentation resulting from the use of the pond system. No exceedances of SSC trigger levels occurred in the natural environment at the outflow point of the pond system, indicating that the ponds are capable, with effective management, of maintaining tailwater outflow to the environment within the set limits for dredge programs utilising similar dredging equipment. Based on this experience, it is expected that the use of the ponds as described in this Plan will result in outflow to the receiving environment at acceptable SSCs, with negligible risk of unacceptable degrees of sedimentation.

There will be two primary sources of potential impact upon the receiving environment in Frances Bay from tailwater discharge from the EAW settling ponds:

- Elevated concentrations of suspended sediments; these are addressed in Section 6.1.1.1.
- Increased acidity (i.e. reduced pH) and/or elevated toxicant concentrations due to the oxidation of potential acid sulfate soils. These could result in acute or chronic adverse impacts upon biota in the vicinity of the permeable section of the railway bund wall.

6.2.1.1 Acid sulfate soils

Potential impacts upon the water quality within the settling ponds (reduced pH) may occur as a result of generation of acid if dredged sediments that contain ASS are exposed to air within the ponds for extended periods. Synergistic impacts may arise if these sediments are subsequently re-wet (e.g. by water from the dredging process, or from rainfall); the water would be acidified and would potentially leach metals (including arsenic) from the dredged sediments, or from the existing sediments within the ponds.

If acidic tailwater is released from the Pond E (South) into Francis Bay, then impacts around the discharge location could include:

- injury to, or mortality of, protected marine species, fish, crustaceans, mangroves, etc.
- reduction of bicarbonates in the receiving water, potentially resulting in deformities in shellfish development.
- release of contaminants from sediment in the receiving environment.
- corrosion of metals and weakening of concrete structures, potentially impacting on infrastructure and/or engineering works.

Some indicators for the presence of acid leachate arising from oxidation of PASS are:

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- green-blue water, sometimes cloudy but sometimes extremely clear due to the presence of metals that have leached from the soils (aluminium)
- rust coloured stains on soils, and rust coloured slime on water (due to iron oxidising bacteria)
- yellow patches on soils as they dry out (“jarosite”).

As discussed in Section 3.2.3.4, all samples reported ANC ranging between 1.57 %S and 18.5%S. The ANC ranged between 19 and 231 times greater than the sum of existing and potential acidity concentrations; well within the adopted criterion of ANC being greater than 15 times the total acidity of samples.

6.2.2 Water quality criteria for tailwater release

The key water quality guidelines that are relevant to the management of the dredging and dredged material placement activities are the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG) 2018 and the Darwin Harbour Region Water Quality Objectives (WQOs) (Fortune 2010, Cassilles Southgate & Fortune 2018). The Darwin Harbour Region Report Cards (e.g. DEPWS 2021) are also relevant as they contain data from ongoing NTG water quality monitoring in Darwin Harbour.

The National Water Quality Management Strategy recommends that “the guidelines for each indicator should be based on locally derived data to reflect local (ambient) conditions. Where derivation of guidelines based on local monitoring is not possible, it is recommended that the national ANZECC Guidelines are used instead (for tropical Australia)”. Therefore, the most applicable guidelines for this Project are Darwin Harbour Region WQOs, and in the absence of guidelines for certain parameters, reference will be made to the national ANZG (2018) Guidelines.

The most stringent water quality criterion for Darwin Harbour was considered by NRETAS (2010) to be the environmental beneficial use category. This was because the intent of the environmental beneficial use was to maintain the health of aquatic ecosystems, and a water body that meets an environmental beneficial use will in almost all circumstances also meet the requirements for all other beneficial uses.

NRETAS (2010) adopted the ANZECC Guidelines approach for physico-chemical indicators for ‘slightly to moderately disturbed’ systems. The ANZECC (now ANZG) Guidelines have defined acceptable effect sizes for each level of protection for different indicator types.

NRETAS (2010) states that the Darwin Harbour Region WQOs can be used as a tool for monitoring water quality and supporting decision making on the management of activities affecting coastal marine waters in the Darwin Harbour catchment. They apply to ambient waters (i.e. the receiving waters) and should not be regarded as individual discharge criteria. The values include protection of aquatic ecosystems and recreational activities associated with the use of marine waters such as swimming, boating and fishing. Where the values are not being met, planning and management of these areas should move towards achieving the objectives over time.

The Darwin Harbour Region WQOs and the ANZG (2018) Guidelines can be used to provide guidance to those undertaking water quality monitoring programs by providing key water quality indicators that can be monitored over time. Measured water quality can be compared with the criteria to determine whether management goals are being achieved or where management action is required.

The ANZG (2018) Guidelines and Darwin Harbour Region WQOs apply to the receiving environment, rather than to the tailwater. However, if the tailwater meets the following criteria before discharge from the settling ponds then it will be considered suitable for continued release:

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- The pH of the water samples collected during monitoring at the weir box between Pond E (North) and Pond E (South) (see Section 7.2.2) is greater than 6.0. This will meet the criterion for an Upper Estuary setting, as presented in the Darwin Harbour Region Water Quality Objectives.
- For toxicants (including arsenic) the Darwin Harbour Region WQOs defer to the ANZG (2018) default guideline values (DGVs). Hence concentrations of toxicants will be compared against the ANZG (2018) DGVs for slightly to moderately disturbed ecosystems (i.e. for 95% species protection). For some toxicants (including arsenic) ANZG (2018) has no DGV for marine waters as there are considered to be insufficient data to derive reliable trigger levels. In these instances, the criteria levels for fresh water will be adopted. The list of metallic toxicants to be tested (Table 7) is based on the potential presence and toxicity of these metals in Darwin Harbour.
- The target SSC for the tailwater will be 100 mg/L (140 NTU). As SSC cannot be monitored directly in the environment, turbidity (in NTU) is used as a surrogate measure. A mathematical relationship between NTU and SSC was derived from water samples collected within the pond system and analysed for both SSC and turbidity as part of the MSB capital dredging monitoring program (DoI 2014). This relationship (100 mg/L = 140 NTU) will be applied during interpretation of water quality monitoring undertaken during the dredging campaign.

Table 7 Toxicant trigger levels for tailwater released to Darwin Harbour

Toxicant	Trigger Level
Arsenic (AsIII)	24 µg/l (freshwater)
Arsenic (AsV)	13 µg/l (freshwater)
Cadmium	5.5 µg/l
Chromium (CrIII)	27.4 µg/l
Chromium (CrVI)	4.4 µg/l
Copper	1.3 µg/l
Lead	4.4 µg/l
Mercury (inorganic)	0.4 µg/l
Nickel	70 µg/l
Selenium (total)	5 µg/l (freshwater)
Zinc	15 µg/l

6.2.3 Response to trigger exceedance

Prior to the release of tailwater from Pond E (South), if the laboratory analytical results indicate that the mean concentrations of any (dissolved) toxicants exceed ANZG DGVs, or if the pH is below 6.0, then further investigations and contingency measures (e.g. dilution of tailwater with seawater, refer Table 8) will be instigated and tailwater will be retained within Pond K and Pond E (North).

It is acknowledged that a period of time will elapse between the collection of water samples and receipt of the laboratory analytical results. Hence, if monitoring shows an increasing trend in any toxicant concentrations in Pond E (North) that may indicate a potential for trigger level

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exceedance, then tailwater will not be released into Pond E (South) until such time that the analytical results are received and it can be confirmed that no trigger levels are exceeded.

During tailwater discharge, if the mean turbidity level at the weir box between Pond E (North) and Pond E (South) exceeds the trigger level (140 NTU), then (subject to the need to keep the weir open under high stormwater flow conditions) the weir box will be closed until turbidity levels have fallen to below 140 NTU.

6.2.4 Management measures

The tailwater will be managed within the settling ponds such that the quality of the water discharging through the railway bund wall is within the guideline criteria discussed in Section 6.2.2. If trigger levels are exceeded within any of the ponds, then this will be reported to the Territory within 24 hours of the exceedance occurring. Should the exceedance occur at either of the two critical monitoring locations – where tailwater enters Pond E (North) or in Pond E (North) at the weir into Pond E (South), the Project Environmental Advisor will notify the Territory.

Exceedances occurring in Pond E (North) at the weir into Pond E (South) will trigger management actions requiring the cessation of flow from Pond E (North) into Pond E (South). Monitoring results approaching or exceeding the trigger levels at the point where water flows into Pond E (North) from Pond K will be used as an early indication that pre-emptive management actions should be considered to prevent an exceedance in Pond E (North) prior to the weir into Pond E (South). Where an exceedance requires the closing of the weir into Pond E (South), Pond E (South) will remain isolated from the tailwater management system until corrective actions (see Table 8) can be implemented to preserve the quality of the receiving waters. It will remain isolated until such time that it can be demonstrated that the pond can be reinstated into the tailwater management system without causing the water quality in Pond E (South) to exceed trigger levels.

The frequency of monitoring within the ponds (refer Section 7.2) limits the risk of trigger level exceedances within Pond E (South) arising from tailwater effects. Trends identified within the preceding ponds will enable corrective actions to be implemented before exceedances occur within Pond E (South). In this manner Pond E (South) is effectively considered to be the 'receiving environment', with the railway bund wall providing an additional buffer against impacts upon the environment of Frances Bay and Darwin Harbour.

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Table 8 Water Quality Management Framework – EAW settling ponds

Element	Maintenance of water quality within the EAW settling ponds
Commitments	Conditions on the WDL for the Project
Objective	- Protection of receiving waters from impacts arising from the physico-chemical properties of discharged tailwater. - No increase in acidity within pond waters to the extent that the tailwater is unacceptable for discharge due to low pH or elevated toxicant concentrations.
Target	- No increase in tailwater acidity within Pond E (North) to the extent that it is unacceptable for discharge into Pond E (South) and receiving waters due to low pH (<6.0). - No exceedances of ANZG DGVs for toxicants (refer Table 7 Toxicant trigger levels for tailwater released to Darwin Harbour) in tailwater within Pond E (North) prior to the commencement of transfer into Pond E (South). - All tailwater discharging from Pond E (North) into Pond E (South) has: - SSC less than 100 mg/L (measured as turbidity [140 NTU]), and - pH greater than 6.0 - No occasions when tailwater discharging from Pond E (South): - Contains floating oil or grease or petroleum hydrocarbon sheen or scum, or litter or other objectionable matter. - Causes or generates odours which would adversely affect the use of surrounding waters - Causes algal blooms - Causes visible change in the behaviour of fish or other aquatic organisms - Causes mortality of fish or other aquatic organisms - Causes adverse impacts on plants
Key Performance Indicators	- Number of instances when pH or bioavailable toxicant concentrations are outside of acceptable guidelines (pH <6.0; bioavailable toxicant concentrations >ANZG DGVs) in Pond E (North), prior to discharge into Pond E (South). - Number of instances when SSC at the weir box between Pond E (North) and Pond E (South) is >100 mg/L (measured as turbidity). - Number of instances when target criteria 4 (a)-(d) are not met.
Management	- The dredged sediments are pumped via pipeline into Pond K, and tailwater residence time is managed to allow for settlement of suspended sediments within the ponds. - Internal pond system maintained with a minimum freeboard to ensure sufficient water to facilitate settlement of suspended sediments and to minimise mobilising existing sediments.

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	• Ensure discharge of dredge spoil into EAW ponds is managed taking into account storm events and an increase in stormwater within the system. • Pond K maintained below 6.0m AHD with a minimum freeboard of 0.5 m to ensure sufficient water to facilitate settlement of suspended sediments and to minimise mobilising existing sediments.
Monitoring (Sections 7.2)	• Water quality monitoring within ponds – pH, toxicants, NTU as detailed in Section 7.2 • Visual monitoring of target criteria 4 (a)-(d) outside the permeable section of railway bund (during the water quality monitoring events).
Reporting (Section 12)	• Weekly reporting of water quality monitoring data to the Territory. • Monitoring report to the NT EPA at the conclusion of dredging • Should a trigger level exceedance occur in Pond E (North) at the weir into Pond E (South), this will be reported by the Project Environmental Advisor to the Territory within 24 hours of the exceedance occurring and a report on corrective actions implemented to address the cause of the exceedance provided within five business days of the notification.
Corrective Actions	• If pH falls below 6.0, toxicant concentrations exceed ANZG DGVs, or SSC exceeds 100 mg/L in Pond E (North) at the weir into Pond E (South), then tailwater flows out of Pond E (North) will be blocked at the weir within one hour of detection. • If pH is <6.0, tailwater will be recirculated until the pH at each point of tailwater transfer between ponds is >6.0. • If toxicant concentrations exceed ANZG DGVs, the water may be diluted using water with lower toxicant concentrations (either from within the pond system or from within the dredging footprint) until toxicant concentrations are returned to below ANZG DGV levels. • If SSC exceeds 100 mg/L, then tailwater will be retained within Pond E (North) until the SSC (measured as turbidity, 140 NTU) is reduced to below 100 mg/L due to settlement of sediments out of suspension. If deemed necessary, silt curtains may be installed within Pond E (North) to increase the flow path of tailwater through the pond; this will increase the settlement of suspended sediments from the tailwater.
Term	• For the duration of tailwater flow from Pond E (North) into Pond E (South).
Responsibility	• Project Environmental Advisor to ensure that works are undertaken in compliance with the approved WQMF.

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	• Project HSSE Manager to ensure monitoring program and water quality management measures are implemented.
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6.3 Protected Marine Species

Management of the impacts on protected marine species that may occur within the Project area (dolphins, turtles and dugongs) is provided in the Marine Megafauna Management Plan (41213-HSE-REP-D-1002).

6.4 Seabed Disturbance

Ensure the Project complies with the Environmental Approval (EP2023/028-001) condition 1-1 limitation that the disturbance of no more than 11 ha of seabed within the approved extent.

6.4.1 Management measures

Prior to dredging activities commencing marker buoys will be located at the dredge extent as a visual barrier to act as both a barrier for both the public and also as a visual barrier of the project extent. Regular surveys will be completed to assess dredge extents by the dredging contractor including dredge hydrographic surveys confirming dredge volumes and locations CBJV to compile report to be issued to Territory as discussed in Section 12.1.4.

6.5 Land Disturbance

The Environmental Approval (EP2023/028-001) action description that states: 'land disturbance area (including, infrastructure, hardstand and revetments) must not exceed 22.2 ha.'. Management measures to be employed on the project are outlined in Section 6.5.1.

6.5.1 Management measures

The project approved extent will be surveyed and the disturbance area is to be clearly demarcated prior to the commencement of works, in accordance with land clearing requirements and development permit. Temporary fencing is proposed to be used to delineate the project clearing boundary and extent. The project induction will outline the project boundaries and outline that disturbance outside the project is prohibited.

GPS will be used in machinery where available.

Project Environmental advisor to be present onsite to complete regular inspections of project boundaries. Clearing and Ground Disturbance to be managed in line with Project Construction Environmental Management Plan 41213-HSE-PL-G-1002.

7 Environmental Monitoring

The environmental monitoring program to be implemented as a part of this DDSPMP comprises the following:

- Monitoring of water quality surrounding the dredge and pipelines transporting spoil to the EAW settling pond system and reclamation (Section 7.1).
- Monitoring of water quality within the EAW settling ponds (Section 7.2).

Key aspects of each of the monitoring programs are summarised in Section 7.5.

During dredging and reclamation activities all monitoring data (including sensitive ecological data), surveys, maps, and other spatial and metadata required under the conditions the controlled action approval (EPBC2021-9068) are prepared in accordance with:

- the *Guidelines for biological survey and mapped data*, Commonwealth of Australia 2018, as required by controlled action approval [EPBC2021-9068, condition 16].

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- *Guide to providing maps and boundary data for EPBC Act projects*, Commonwealth of Australia 2021, [EPBC2021-9068, condition 17].

Further guidance regarding monitoring data and compliance records refer to EPBC Controlled action approval (EPBC2021-9068).

7.1 Darwin Harbour water quality - dredge, pipeline and reclamation

7.1.1 Objectives

The objectives of monitoring water quality in the vicinity of the dredge, pipeline and reclamation are to:

- Determine if the maximum turbidity levels within observable plumes exceed the allowable SSC **trigger value** of 100 mg/L (measured as 140 NTU) at a distance of 150m from these sources, and the allowable SCC **limit values** (Wet season 29.5 NTU; Dry season 7.9 NTU) at the South Shell Island monitoring site.
- Provide a trigger for corrective actions to be implemented to reduce the dispersion of plumes from the dredging and reclamation activities towards South Shell Island and/or Catalina Island.
- Comply with the EP Approval.

7.1.2 South Shell and Catalina Island Monitoring Locations

The below monitoring sites have been selected to ensure compliance with Condition 2-1 of EP Approval (EP2023/028-001), to ensure that no dredging or reclamation activities cause any material environmental harm to water quality, or the condition or distribution of benthic communities beyond the approved extent.

The South Shell Island monitoring site is a putative impact site due to proximity to the dredging location, the model outcomes and the known presence of benthic communities that may be adversely affected by increased turbidity levels from dredging at the DSL. The monitoring site is located within filter-feeder communities known to occur in this location and is shown in

Figure 11.

It is considered that the South Shell Island and Catalina Island benthic communities are sufficiently distant from the predicted Zones of Impact and Influence from the dredging and reclamation activities. Suitable hard coral habitat is predicted to occur surrounding the shallow waters west of Catalina Island and therefore, due to proximity to the project has been included as an additional monitoring site shown in

Figure 11.

All access to Catalina Island and associated environmental monitoring must be undertaken in line with Aboriginal Areas Protection Authority (AAPA) Certificate (C2019/004) issued under the *Aboriginal Sacred Sites Act 1989* including all permit conditions.

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Figure 11 South Shell and Catalina Island Monitoring Locations

7.1.3 Methodology

A visual survey of the areas surrounding the sources of turbid plumes (dredge, pipeline and reclamation) will be undertaken continuously during daylight hours from the commencement and during Project dredging and reclamation activities to determine the extents of the plumes. Should the visual survey determine that a plume may be extending beyond 150m from its source, a small vessel or dredge tender will be used to inspect the distance from the source to the edge of the plume using a GPS. The GPS will be used to locate and record a point 150m from the source; at this point a turbidity measurement will be taken, using a handheld water quality probe to measure a profile through the entire water column. The maximum turbidity within the water column will be compared against the allowable **trigger value**.

Where the turbidity within the water column exceeds the trigger value of 140 NTU at a point 150m from the source, monitoring of turbidity will then be carried out at the South Shell Island and Catalina monitoring locations. The maximum turbidity within the water column at the South Shell Island and Catalina monitoring locations will be compared against the allowable limit value (29.5 NTU in the Wet season or 7.9 NTU in the Dry season).

Sampling will be carried out by the Project Environmental Advisor in accordance with the methods described in AS/NZS 5667.1:1998 *Water quality – Sampling. Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*.

The calibrated turbidity meter should be kept in gentle motion through the water column while a reading is being taken and allow several minutes for the reading to stabilise. Measurements using probes must be made at least 1m below the water surface and deeper in clear waters to ensure that there is no influence from ambient light.

To assist with any attributability assessments that may be required during dredging (refer Section 6.1.3), where there is an exceedance of the trigger value at a distance of 150m from the dredge, pipeline or reclamation area, a drone will be employed to capture aerial imagery of the plume. This will assist in determining whether the turbidity level at 150m from the dredge and pipeline, or in the case of a plume extending to South Shell Island or Catalina Island, can be attributed to the dredging activity, or whether it is a result of broader regional influences (e.g. due to a period of high rainfall or elevated wave action, or to other turbidity-generating activities within the harbour). It is noted that the broadscale indications of turbidity presented in the drone imagery would provide a more reliable measure of potential impacts to benthic communities than turbidity measures made by submersed turbidity probes at discrete locations (at which turbidity levels may be either higher or lower than in the surrounding area and may therefore be un-representative of the risk of potential impacts to the benthic communities in the broader area).

During monitoring, quality assurance and quality control (QA/QC) methods will be implemented including ensuring equipment used is calibrated and water quality Monitoring is undertaken in accordance with AS/NZS 5667.1:1998 *Water quality – Sampling*. During collection of laboratory samples, field blanks and duplicates are examples of QA/QC measures that should be undertaken in line with project water quality monitoring programs.

7.1.4 Data Analysis

NTU levels measured in the field as required will be assessed against the **trigger value** and **limit values**.

A rolling average of measured turbidity over a seven-day period would be used to assess compliance with trigger levels.

If additional water quality monitoring is required, the results of the turbidity monitoring will be provided to the Territory one week after completion of monitoring, or when monitoring data is available.

7.1.5 Outcomes

Based on the SSC determined at 150m from the dredge or reclamation, management procedures will be initiated to reduce the maximum SSC to below the **trigger value** at distances greater than 150m from the source and below the limit value at the South Shell Island monitoring location and below the limit value at the Catalina Island monitoring location.

Management procedures may include ceasing dredging activities, modification of dredging and reclamation activities during certain tidal phases or other steps deemed appropriate by the Project Environmental Advisor. These management measures shall remain in place until the maximum SSC fall below the **trigger value** and **limit value**.

The data outputs from the monitoring will enable ongoing assessments to be made of the need to implement management measures within the dredging and reclamation operations, in order to reduce the potential for them to contribute to turbidity levels at sensitive receptor sites further afield (e.g. South Shell Island and/or Catalina Island).

7.2 East Arm Wharf settling ponds – water quality

7.2.1 Objectives

The objectives of monitoring water quality within the EAW settling ponds will be to:

- Detect trends in tailwater pH that may indicate the generation of acid from dredged PASS material pumped into the ponds.
- Detect trends in toxicant concentrations within the ponds that may indicate the mobilisation of toxicants from the dredged sediments, or from material placed in the ponds during past dredging programs (EAW development, Darwin City Waterfront Redevelopment, etc.).
- Confirm the physio-chemical properties (pH, toxicants and SSC) of the tailwater are suitable for discharge from the ponds to the harbour waters.
- Comply with the Waste Discharge Licence.

7.2.2 Monitoring locations

The water quality monitoring locations are shown in **Figure 12**, and Table 10 Summary of environmental monitoring programs. The pH, turbidity and toxicant concentrations of the tailwater will be monitored at any pond discharge point where tailwater is flowing and within Pond E (South) prior to discharge through the permeable bund wall.

In the event that stormwater enters Ponds E (North) from Pond D and/or Pond K road bund, then pH and toxicants will be monitored weekly at the point of stormwater entry to Pond E (North). This will inform the assessment of potential causes of any changes in pH and toxicant concentrations that may become evident in Ponds E (North) or (South) (i.e. it will determine if contaminants are present in the stormwater).

Table 9 East Arm Wharf Settling Pond Monitoring Locations

Monitoring Site Number	Monitoring Location Description	Latitude	Longitude
1	Tailwater release – Pond E (South)	130.888507	-12.489
2	Settlement pond – Pond E (North)	130.891	-12.488591
3	Settlement pond – Pond K	130.8931499	-12.48652585
4	Stormwater – Pond D	130.8926716	-12.48547552
5	Stormwater – Pond K road bund	130.8913588	-12.48887974

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Figure 12 East Arm Wharf Settling Pond Monitoring Locations

7.2.3 Methodology

Over the course of discharge of tailwater from the pond system:

- Tailwater pH will be monitored in the field by extracting water samples daily from each monitoring location and testing the water with a hand-held pH meter.
- Turbidity will be monitored in the field daily at each monitoring location using a hand-held probe.
- One water sample per week will be collected from each of the monitoring locations and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of toxicant concentrations. A rapid turnaround time for analysis will be specified, to minimise the time that elapses before any required corrective actions are able to be implemented.

Where stormwater is discharging into Pond E (North) from Pond E, and/or discharging sampling will be carried out by the Project Environmental Advisor in accordance with the methods described in AS/NZS 5667.1:1998 *Water quality – Sampling. Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*.

Two samples are required, as the analysis includes filtered metals, and total (and speciation, if required) arsenic and chromium. Dissolved metals are determined by analysing those metals in a filtered sample that passes through a 0.45 µm membrane filter. Containers are to be pre-prepared plastic with caps that have a Teflon liner. Containers will not be pre-rinsed and will contain 2 mL acid. Samples will be refrigerated at 1-4°C or frozen.

Based on potential toxicity and presence within Darwin Harbour sediments, the metallic toxicants to be monitored through collection of water samples are presented in Table 7.

During monitoring, quality assurance and quality control (QA/QC) methods will be implemented including ensuring equipment used is calibrated and water quality Monitoring is undertaken in accordance with AS/NZS 5667.1:1998 *Water quality – Sampling*. During collection of laboratory samples, field blanks and duplicates are examples of QA/QC measures that should be undertaken.

7.2.4 Data analysis

Data for tailwater pH, turbidity and toxicants will be plotted and assessed for trends after each data collection period. Any trends towards allowable limits will be used as an early warning mechanism, and dredging operations and tailwater or stormwater management procedures will be assessed to ascertain whether corrective actions (such as those presented in Table 8) may need to be implemented to avoid exceedance of water quality limits.

The toxicant trigger levels are set at the 95% species protection level as per ANZG (2018). Where marine water quality triggers are not available due to insufficient data, freshwater trigger levels applicable to slightly–moderately disturbed systems are adopted. Speciated toxicants (arsenic and chromium) will be analysed for total concentrations, and if any total exceeds the trigger level of one of the species, then the samples will be reanalysed for the individual species.

The pH of the water samples collected during monitoring at the weir box between Pond E (North) and Pond E (South) is to be greater than 6.0. This will meet the criterion for an Upper Estuary setting, as presented in the Darwin Harbour Region Water Quality Objectives.

7.2.5 Outcomes

The data outputs from the monitoring enable ongoing assessments to be made of the need to implement further tailwater (or stormwater) management measures to maintain water quality parameters within the pond system below trigger levels and to render the water suitable for disposal from Pond E (South) through the permeable bund wall.

7.3 South Shell Island and Catalina Island benthic communities

As discussed in **Section 3.9**, sediment modelling predicts the Zone of Moderate Impact falls completely within the Zone of High Impact, i.e. within 20m of the dredging footprint boundary. Tidal currents will rapidly disperse the suspended sediments, and SSC's will rapidly return to background levels upon the completion of dredging. As a result, suspended sediments mobilised from the dredge are not predicted to extend beyond the dredging area at concentrations that could result in detectable changes to environmental quality. As such, and consistent with the *Darwin Port Long Term Dredging Management Plan* (AECOM 2018), monitoring of benthic communities is not considered necessary.

However, the NT EPA considers it necessary for the Territory to design an appropriate monitoring program that can reliably measure the response of these habitats to disturbance from dredging and landfill. The benthic monitoring program is not included in this DDSPMP.

7.3.1 Contingency Monitoring Program

While the CBJV does not anticipate any sedimentation impacts from dredging to occur outside the zone of Moderate/High Impact, a monitoring plan for aquatic water quality has been developed (outlined in **Section 6** and Table 6).

A benthic habitat monitoring strategy has not been developed, however, CBJV has prepared the following plan as a contingency. This monitoring plan shall be used to enable the measurement of the response of benthic community habitats to disturbance attributed to the CBJV dredging campaign, after the conclusion of the attributability review outlined in **Section 6.1.3**.

After consultation with Territory, the following or similar shall be incorporated into a revised version of the DDSPMP and the CEMP, as necessary:

7.3.2 Contingency Monitoring Program Draft Methodology

If exceedance of 7.9 NTU (**limit value**) for Dry Season or 29.5 NTU (**limit value**) for Wet Season for greater than 7 consecutive days is recorded (**Section 6.1.3**):

- Conduct benthic monitoring to assess the impact upon the hard coral and filter communities at South Shell and Catalina Islands from turbid plumes emanating from dredging and reclamation activities.
- Benthic monitoring shall be carried out in accordance with the methodology outlined in Case et al. (2021). A Slow Towed Video (Slowvid) shall be used to record underwater video and stills imagery of the benthos.
- It is considered that it is only feasible to detect (with sufficient statistical confidence) a change of 10% in biota cover at the monitoring locations (Darwin Ship Lift Project: Draft Dredging and Dredge Spoil Placement Management Plan, AECOM, 2022).
- Analysis of 50 still images per transect will be required, with five points analysed per image.
- The results of the Geo Oceans study (Geo Oceans (2012). NT Department of Lands and Planning – East Arm Wharf Expansion Project. Baseline Marine Habitat Monitoring Survey. Report to URS Australia Pty Ltd, Document code DLPEAWMON.401) will be taken into account when assessing the biota cover.
- In addition to measurements of benthic cover of hard corals and filter feeders, the proportion of biota showing evidence of stress (e.g. bleaching or excessive mucus production) will also be recorded and comparisons made between the South Shell Island and/or Catalina Island sites.
- Fortnightly monitoring of the benthic communities at the South Shell Island and/or Catalina Island will be carried out. Monitoring will continue over four fortnightly periods following the positive attributability assessment. It is recognised that elevated turbidity levels at the South Shell Island and/or Catalina Island sites are unlikely to result in immediate changes to benthic community health, but that indications of reduced health may become evident over time (AECOM, 2022).

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- If the monitoring does not indicate any trend in decreasing health of the benthic communities at the monitoring sites (as indicated by increasing stress or mortality of hard corals or filter feeders), and there have been no further positive attributability assessments over the monitoring period, then monitoring will be suspended.
- Post-dredging assessments of proportions of live hard corals and filter feeders within benthic communities at South Shell and Catalina Island monitoring sites shall be carried out, using the same methodology as provided by Case et al. (2021).

7.4 Protected Marine Species

Monitoring of protected marine species that may occur within the Project area is provided in the Marine Megafauna Management Plan (41213-HSE-REP-D-1002). Whilst this management plan was prepared for the management of megafauna (dolphins, turtles and dugongs), the same principles apply to the management of other protected marine species, including sawfish.

7.5 Summary of monitoring programs

Key aspects of each of the monitoring programs are summarised in Table 10.

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Table 10 Summary of environmental monitoring programs

Locations	Parameter	Methods	Frequency	Triggers	EMF
TURBID PLUME (dredge, pipeline and reclamation)					
Daily visual survey of areas surrounding the sources of turbid plumes (dredge, pipeline and reclamation).	Turbidity	Visual	Continuously visual monitoring during daylight hours	Any visual turbid plume	Water Quality Management – Darwin Harbour
TURBID PLUME UP TO AND GREATER THAN 150 m FROM DREDGE, PIPELINE OR RECLAMATION AREA					
Section 7.1 Throughout the water column where the turbid plume extends beyond 150m from the source. Monitoring locations: within the plume at a point 150m from source.	Turbidity	Visual Hand-held probe	As required by visual monitoring.	Maximum SSC >100 mg/L (measured as turbidity, 140 NTU) 150 m from source (trigger level).	Water Quality Management – Darwin Harbour
Section 7.1 Aerial imagery from dredge to South Shell Island and Catalina Island	Drone imagery	Drone	As required by exceedance of trigger level SSC >100 mg/L (measured as turbidity, 140 NTU) where the turbid plume extends beyond 150m from the source.	Visual confirmation of plume extending from dredge to South Shell Island and/or Catalina Island.	Water Quality Management – Darwin Harbour
Section 7.1 Throughout the water column where the turbid plume extends to South Shell Island and/or Catalina Island. Monitoring location: South Shell Island Monitoring Site. Catalina Island Monitoring Site	Turbidity	Visual Hand-held probe	As required by exceedance of trigger level SSC >100 mg/L (measured as turbidity, 140 NTU) where the turbid plume extends beyond 150 m from the source.	Maximum seasonal limit value (Wet season, 29.5 NTU) or (Dry season, 7.9 NTU) at South Shell Island) and Catalina Island.	Water Quality Management – Darwin Harbour

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EAST ARM WHARF SETTLING PONDS					
Section 7.2 Pond E (South) at the railway bund – Monitoring Site 1 Pond E (North) at the weir prior to flow into Pond E (South) – Monitoring Site 2 Pond K at the weir prior to flow into Pond E (North) - Monitoring Site 3	pH	Hand-held probe	Daily while tailwater is flowing, from commencement of dredging until cessation of tailwater discharge	pH <6.0	Water Quality Management – EAW Settling Ponds
	Turbidity	Hand-held probe		Toxicant concentrations > ANZG DGVs for toxicants (refer Table 7 Toxicant trigger levels for tailwater released to Darwin Harbour).	
	Toxicants	Laboratory	Weekly from the commencement of dredging until cessation of tailwater discharge	SSC >100 mg/L (measured as turbidity, 140 NTU)	
Section 7.2 <i>Stormwater Monitoring</i> Pond E (North) where stormwater enters from Pond D - Monitoring Site 4 Pond E (North) where stormwater enters from Pond K road bund – Monitoring Site 5	pH	Hand-held probe	Weekly when stormwater enters Pond E (North) from Pond D.	pH <6.0	Water Quality Management – EAW Settling Ponds
	Turbidity	Hand-held probe		SSC >100 mg/L (measured as turbidity, 140 NTU)	
	Toxicants	Laboratory		Toxicant concentrations > ANZG DGVs for toxicants (refer Table 7 Toxicant trigger levels for tailwater released to Darwin Harbour).	

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8 Performance Management

Performance management includes activities to ensure that goals are consistently being achieved in an effective and efficient manner. A key component of the environmental management process is the development and implementation of specific measures to ensure that the environmental risks arising from the dredging and dredged material placement activities are minimised. The success of these objectives is measured with key performance indicators (KPIs) defined for environmental management (see Section 6).

8.1 Performance criteria

The DDSPMP is the key reference document which identifies actions and commitments to be followed by the CBJV and Dredging Contractor and any subcontractor personnel throughout dredging operations. The broad performance criteria of the DDSPMP are as follows:

- Compliance with the DDSPMP by all Project personnel and activities.
- Adherence to discharge water quality parameters as identified in the water quality monitoring program outlined in Section 7 of this Plan.
- No net long-term adverse impacts on biota.
- No injuries to protected marine species.
- No complaints received in relation to dredging-related noise or vibration and no impacts on protected species from these sources.
- Response to all registered complaints and completion of Complaint Record and / or Incident Report; appropriate corrective actions taken within three working days.

Where performance criteria are not met, this will form a trigger for review of the DDSPMP, in addition to initiating corrective actions specific to the scenario.

8.2 Environmental management KPIs

In the environmental management frameworks detailed in Section 6 of this plan, specific objectives and targets, and KPIs related to these, are set for each significant environmental aspect.

General objectives and targets are:

- all personnel working on site have undergone an environmental induction
- CBJV and Dredging Contractor 100% compliance with the DDSPMP
- no activity in breach of the provisions of any environmental legislation and Project environmental approval conditions
- 100% investigation and reporting of any environmental incident at the site
- 100% compliance required for management measures relating to dredging and dredge spoil management.

9 Environmental Incidents, Non-conformances and Complaints

9.1 Environmental incidents

Environmental incidents will be investigated and reported on in accordance with the CBJV's Incident Investigation Operating Standard (CORP-GOV-OS-G-0001). Any environmental incidents will be immediately reported to the environmental representative or project manager, who will report the incident to the client / Territory as per project requirements.

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In the event of serious or material environmental harm CBJV will notify the relevant regulatory authorities as per legislative requirements as outlined in the Incident Investigation Operating Standard. Where necessary, CBJV will also notify the respective property owners or occupiers within 24 hours of the incident occurring.

An incident will be reported if any of the following scenarios occur or have the potential to occur:

- serious environmental harm
- material environmental harm
- prosecution by a Regulatory Authority
- environmental approval condition breach
- environmental monitoring parameter breach.

Incidents will be reported both verbally and in writing. Details of any environmental incident will be investigated and entered into the CBJV's Incident and Accident Database/Register. Additionally, this information will be forwarded to the Client. Verbal notification will be provided immediately (where practicable), and written notification will be forwarded as per project requirements.

Complaints will be investigated by the Project Environmental Advisor and action taken to enable satisfactory closeout. Any incidents that have caused environmental harm, or that have the potential to cause environmental harm, will also be reported to the Project Environmental Advisor and to the NT EPA Pollution Hotline (1800-064-567) or, for marine fauna incidents, Marine Wildwatch line (1800-453-941) within 24 hours.

9.2 Environmental Non-Conformances

Non-conformances relating to product or services shall be managed in accordance with Contractor Non-conformance and Reporting Work Instruction 41213-QM-WI-G-0003. All non-conformances shall be reported to the Territory.

Further to this all non-conformances will be reported and investigated internally and to Client via the requirements of the 41213-HSE-WI-G-0063- HSSE Incident Notification, Investigation and Reporting Work Instruction.

9.3 Complaints

In the event of a complaint received as a result of dredging activities, they will be entered and tracked using the CBJV's incident management system. Details to be recorded include:

- date, time and method of complaints
- description of complaint
- complainant details
- cause, action and proposed action, including allocation of a person to action the complaint and an action date
- follow-up and close-out.

Corrective action in response to valid complaints is to occur within 48 hours following receipt of the complaint. Records will be made available to the Territory and authorities upon request, taking into account any privacy issues of the complainant as appropriate.

10 Inspections and Audits

10.1 Inspections / monitoring

Daily visual monitoring will be conducted by site supervisors. Any corrective actions resulting from inspections will be entered onto a 'Non-conformance and Corrective Action Register' and the progress tracked for completion.

10.2 Internal audits

An internal audit of this DDSPMP will be undertaken prior to commencement of dredging to assess the likely effectiveness of the Plan in the field and to identify any opportunities for improvement. A second internal audit will be undertaken three months after the commencement of dredging to assess the effectiveness of the implementation of the Plan, and of the monitoring and reporting procedures being applied. The intent of this audit is to identify any opportunities for improvement to ensure monitoring, reporting and record keeping are sufficient to support required reporting.

10.3 External audits

External audits can be conducted by CBJV or third parties, such as other government departments. The NTG may conduct an audit at any time when they believe there is an issue in relation to environmental compliance. The Project Environmental Advisor will assist with any external audit.

Results from any external audits will be reviewed by the Project HSSE Manager, with any necessary corrective actions assigned to Project personnel to ensure appropriate and timely closeout. Any corrective actions will be entered into a Project corrective action register and the progress tracked for completion.

10.4 Project Corrective Action Register

Any environmental non-conformance (e.g. incidents, audit-related non-conformance, complaints, government notices, etc.) will be recorded in project corrective actions register or similar to be developed by CBJV. The corrective actions register will detail the non-conformance, the corrective action required, the responsible person(s), the timeframes by which the action is to be completed, and the actual completion date. Each non-conformance will be reviewed and it will be established if there are any actions available to reduce the severity or likelihood of re-occurrence.

11 Communication

A program for formal internal correspondence will be implemented during project delivery. Regular project management and coordination meetings will be held to monitor progress, discuss issues and plan upcoming construction activities. Environmental management will be a mandatory agenda item at such meetings.

11.1 Meetings

Meetings where environmental issues are identified and discussed will include:

- Daily prestart meetings – a forum where all construction personnel have the opportunity to raise concerns, where specific environmental works can be discussed and delegated, and where general environmental issues can be relayed to the workforce. Items are to be recorded on the Prestart Talk and Site Attendance Record form.
- Weekly / fortnightly toolbox meetings – current project environmental issues are to be discussed on a regular basis. Additionally, specific toolbox meetings may be held following an environmental incident to ensure the team is aware of issues and

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preventative measures are communicated. Items are to be recorded on the Toolbox Talk Record form.

- Weekly project management meeting – attended by key construction and management personnel, client and other relevant participants.

Minutes of all formal meetings will be recorded and distributed to relevant personnel.

11.2 Site Induction

Communication of the DDSPMP requirements will commence with the compulsory site induction. The site induction will ensure all project personnel, subcontractors, consultants and visitors become familiar with the environmental management obligations and requirements of the project. The environmental component of the induction has been developed for the project, targeting the relevant environmental aspects of the site.

The project site induction will outline the following:

- General environmental duty / duty to notify
- Legislation and permit / approval / licence / compliance obligations applicable to the project
- Site incident reporting requirements
- Sensitive or protected environmental areas on and surrounding site
- Significant project environmental risks and mitigation measures

12 Reporting

12.1 Routine reporting

12.1.1 Beginning of dredging

The CBJV will notify the Territory and the NT EPA at least seven days prior to the planned start of dredging. This notification will include confirmation that all of the necessary measures are in place to comply with this DDSPMP.

The Territory will provide details of the dredging works to the Regional Harbourmaster so that a Notice to Mariners can be issued. The Notice to Mariners will be the mechanism through which stakeholders, and other members of the general public, will receive notification of the intention to commence dredging.

12.1.2 Daily reporting

Brief daily reports will be provided by the CBJV to the Territory and will include:

- a summary of the dredging completed in the last 24 hours and status of dredging operations
- information relating to any exceedances detected through monitoring
- proposed schedule for dealing with exceedances reported and next steps to be followed
- dredge daily logs showing work area and availability.

12.1.3 Weekly monitoring report

Each week during the dredging, reclamation and tailwater discharge activities, a weekly summary report of monitoring data will be submitted by the CBJV to the Territory. The report will include:

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- tailwater pH and turbidity (NTU) data within the EAW settling ponds, from the commencement of dredging and dredged material placement until the cessation of tailwater discharge into Pond E (South)
- toxicants data for tailwater, once available from the laboratory
- comments on any apparent trends in the tailwater data, both over time and between ponds
- summary of daily data reports
- discussion of any trigger level exceedances
- corrective actions taken to address exceedances
- South Shell Island and/or Catalina Island and Channel Island benthic community data (including analysis of trends), if any surveys triggered within the previous fortnight
- details of any injuries to, or mortalities of, turtles, dugongs, dolphins or migratory birds as a result of dredging or reclamation activities, or settling pond water management
- a summary of environmentally significant equipment failures or events and an outline of corrective actions taken, or proposed, to reduce environmental harm arising therefrom.
- Analysis and interpretation of monitoring data to demonstrate whether compliance with the requirements of Environmental Approval (EP2023/028-001) condition 2 has been achieved

12.1.4 Dredge operation records and reporting

The Dredging Contractor will advise the CBJV of areas dredged, the volumes of material removed and dredge availability daily. These records will be provided to the Territory weekly, and the findings from hydrographic surveys confirming dredge volumes and locations will be included in the CBJV's report to the Territory fortnightly and on completion of the dredging). Copies of daily environmental inspection checklists and other relevant environmental records will be provided by the Dredging Contractor to the CBJV for circulation as appropriate. All records will be provided in a format that allows auditing by relevant environmental regulators if required.

12.1.5 End of dredge phase reporting

Within one month of the conclusion of dredging, the CBJV will submit a monitoring report to the Territory, who will in turn provide this report to the NT EPA and DCCEE. The report will include the outcomes of all monitoring activities, exceedances, management actions and any relevant trend analysis and interpretation of analytical data collected in accordance with environmental conditions.

The end of dredge phase reporting will also include a comparison of the predicted impacts of the action, including dredging and dredged material management activities as identified in baseline surveys, and the actual impacts of the action as verified by environmental monitoring data collected during dredging and dredged material placement activities, as required by Environmental Approval (EP2023/028-001) condition 7-4(2).

12.1.6 Compliance reporting

The Territory, as the holder of the NT EPA approvals, will report to the NT EPA in accordance with the pertinent approval. The CBJV will report to the NT EPA in accordance with Environmental Approval (EP2023/028-001) conditions. The CBJV will provide information to the Territory as required to facilitate this reporting requirement, including:

- summaries of all monitoring program outcomes
- summaries of any monitoring exceedances

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- details of corrective actions (method and timing) implemented to dredging, reclamation and tailwater management in response to monitoring exceedances, as required by EPBC Act controlled action approval (EPBC2021-9068) condition 25 (c).
- analysis and interpretation of monitoring data to demonstrate whether compliance with the requirements of Environmental Approval (EP2023/028-001) condition 2 has been achieved.
- the potential impacts of the incident and/or non-compliance as required under the Darwin Ship Lift EPBC Act controlled action approval (EPBC2021-9068) condition 25 (b).
- CBJV compliance reporting to be consistent with DCCEE's Annual Compliance Report Guidelines, Commonwealth of Australia 2014, or any subsequent official version, as required by Darwin Ship Lift EPBC Act controlled action approval (EPBC2021-9068) condition 20.
- one or more shapefile showing all clearing of protected matters (as defined under the Darwin Ship Lift EPBC Act controlled action approval (EPBC2021-9068)), and/or their habitat, undertaken within the Project dredging period from the commencement to 3 October 2024, and Project dredging period from 4 October 2024 to the completion of dredging. This is a requirement of the Darwin Ship Lift EPBC Act controlled action approval (EPBC2021-9068) condition 21(b).

During dredging, the Territory will notify DCCEE within 12 business days of becoming aware of any incident and/or potential non-compliance and/or actual noncompliance, the details of that incident and/or potential non-compliance and/or actual noncompliance with the conditions or commitments made in the Construction EMP (CEMP), DDSPMP, MMMP and Erosion and Sediment Control Plan.

During dredging, the CBJV will notify the Territory and the NT EPA of any non-compliance with the WDL, as required by that licence.

12.2 Exceedance notification and reporting

The following notifications of exceedances will be made by the CBJV to the Territory within 24 hours of the exceedances occurring:

- Within the EAW settling ponds in Pond E (North) at the weir into Pond E (South), or in Pond E (South), exceedance of pH, toxicant or SSC (measured as NTU) trigger levels.
- At the location 150m down current of the dredge, pipeline or reclamation area, where management measures are implemented.
- At the South Shell Island and Catalina Island monitoring locations, exceedance of SCC (measured as NTU) limit values.

Exceedances will also be reported to the NT EPA in accordance with conditions of the WDL, and as required under the *Waste Management and Pollution Control Act 1998* and the *Water Act 1992*.

For each exceedance at Pond E (North) at the weir into Pond E (South), or in Pond E (South), the CBJV will provide the NT EPA (via the Territory) with a report on the corrective actions implemented to address the cause of the exceedance. This report will be submitted in accordance with the required timeframe stipulated in the WDL.

CBJV are to notify the Territory of the outcomes of investigative corrective action, adaptive management, stop work or recommencement actions within 24 hours of completing the three-day attributability review period.

12.3 Environmental incident notification and reporting

Environmental incidents (spills, etc.) will be recorded and reported in environmental monitoring reports to the Territory. If the incident is a notifiable incident under the *Waste Management and Pollution Control Act 1998*, then the NT EPA will be notified by the Territory within 24 hours.

All incidents will be investigated and recorded on a CBJV 'Incident Report Form' (41213-HSE-FO-G-0035) in accordance with the CBJV's Incident Investigation Operating Standard (CORP-GOV-OS-G-0001). Preventative and corrective actions will be established, and these will be recorded on the CBJV 'Non-conformance and Corrective Action Register', and the progress tracked for completion.

12.4 Complaints reporting

In the event of a complaint received as a result of dredging activities, they will be entered and tracked using the CBJV's incident management system. Details to be recorded include:

- date, time and method of complaints
- description of complaint
- complainant details
- cause, action and proposed action, including allocation of a person to action the complaint and an action date
- follow-up and close-out.

Corrective action in response to valid complaints is to occur within 48 hours following receipt of the complaint. Records will be made available to the Territory and authorities upon request, taking into account any privacy issues of the complainant as appropriate.

12.5 Reporting and notification summary

Reporting and notifications will be sent to the following Northern Territory Government (NTG) stakeholders, as per the requirements detailed within this section of the DDSPMP.

The Department of Infrastructure Planning and Logistics (DIPL): <https://dipl.nt.gov.au/>

NT EPA: <https://ntepa.nt.gov.au/make-a-report>

The reporting and notification requirements for the Project are summarised in Table 11.

Darwin Ship Lift Project – Dredge and Dredge Spoil Placement Management Plan**Table 11 Reporting and notifications summary**

Reporting Type	Time	Reporting to	Content/Comments
Routine reporting			
Commencement of dredging notification.	Seven days before intended commencement of dredging	Territory NT EPA Regional Harbourmaster	Notification of intent to commence dredging works and confirmation that all required measures are in place to comply with the requirements of this DDSPMP. This notification will include any other reporting requirements of the WDL.
Daily reports	Daily	Territory	Daily work completed, monitoring undertaken and any exceedances detected. If an exceedance is detected the report will include a summary of proposed corrective actions and timeframes for implementation.
Weekly monitoring reports	Weekly	Territory	Water quality data from tailwater monitoring within the EAW settling ponds and at 150 m down current from the dredge, pipeline and reclamation area, and South Shell Island and Catalina Island monitoring locations (if required due to exceedance of trigger levels or limit values). Benthic community monitoring data (if triggered due to exceedance of limit value at South Shell Island and/or Catalina Island monitoring locations). Summary of dredge operation records for the week.
End of dredging report	Within one month of conclusion of dredging.	Territory NT EPA	Monitoring report as per WDL conditions.
Exceedance reporting			
Water quality exceedance – initial notification	24 hours (from occurrence)	Territory	Location and value of exceedance.
Water quality exceedance – attributability review	24 hours (from end of three-day attributability review period)	Territory	Details of determination and logic used to support the conclusions.
Water quality exceedance – corrective actions	Five business days (from notification)	Territory NT EPA	As per WDL conditions.
Other reporting			

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Incident Investigation and Corrective action	Within 24 hours of completing the three-day attributability review period	Territory	Outcomes of investigative corrective action, adaptive management, stop work or recommencement actions
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APPENDIX L EROSION AND SEDIMENT CONTROL – DARWIN SHIP LIFT



EROSION AND SEDIMENT CONTROL PLAN

DARWIN SHIP LIFT



CLIENT: Clough BMD JV

DOCUMENT NUMBER: 22-0063/R3016

VERSION: E

DATE: 04/06/25



22-0063/R3016 – DARWIN SHIP LIFT ESCP

1 SCOPE

Topo were engaged by Clough BMD JV to develop a CPESC certified Erosion and Sediment Control Plan (ESCP) for works associated with construction of the Darwin Ship Lift Project.

1.1. GUIDELINES

This ESCP has been prepared in accordance with the following documents:

- + Environmental Assessment Act 1982
- + Waste Management and Pollution Control Act 1998
- + Soil Conservation and Land Utilisation Act 1969
- + Best Practice Erosion and Sediment Control (IECA, 2008) and Appendix B (IECA, 2018)
- + DIPL Standard Specification for Environmental Management (Version 2)

1.2. CERTIFICATION

I Tom Bailey certify that this Erosion and Sediment Control Plan (ref: R3016) has been prepared to satisfy the following requirements:

- + The intent and minimum standards nominated within the IECA (2008) Best Practice Erosion and Sediment Control Guideline and relevant supporting Appendices (IECA, 2015).
- + NT Government Environmental Approval EP2023/028-001 Condition 2-3
- + Environmental Approval EP2023/028-001
- + Australian Government EPBC Approval ref 2021/9068
- + Environmental Approval EP2023/028-001

If implemented correctly, it will assist Clough BMD JV in meeting environmental obligations defined in the *Waste Management and Pollution Control Act 1998* (NT) and approvals identified above.

The ESC plan has been designed to minimise the impact for downstream/adjacent water quality and marine impacts.

CPESC 6374



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1.3. REVISION

It is anticipated that this ESCP will be reviewed biannually to capture changes arising from seasonal variability and the progression of project works. It is suggested that the ESCP be updated in or around October of each year for the onset of the wet season, and again around March-April for the upcoming dry season.

VERSION	DATE	AUTHOR	REVIEWER	APPROVED
A	27/09/23	T. Bailey		T. Bailey
B	30/10/23	T. Bailey		T. Bailey
C	9/02/24	T. Bailey		T. Bailey
D	20/11/24	T. Bailey		T. Bailey
E	04/06/25	T. Bailey		T. Bailey





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2 PROJECT DESCRIPTION

2.1. LOCATION

The project is situated approximately 6.5 Kilometres (km) south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour. The site is approximately 700 m east north-east of the East Arm Wharf (EAW) and the Marine Supply Base (MSB), and west of the Darwin Business Park. Road access is provided by Berrimah Road, linking the site to the Darwin road network including the Stuart Highway and Tiger Brennan Drive. The project location is represented visually in Figure 1.



Figure 1 – Site Location (Source: AECOM)

Environment, Engineering, Education



2.2. PROJECT WORKS

Project works involve road and service upgrades and reclamation for the common user ship lift facility. The facility will include: a ship lift 26m wide, 103m long and 6m deep with lifting capability of 5,000 tonnes, four wet berths (wharves) and 20ha of hardstand for ship repair and maintenance works. Associated works include:

- + Roadworks for upgrade of Berrimah Road
- + Dredging (Cutter Suction and Backhoe+Barge)
- + Piling (Marine and Land Based)
- + Land Based Bulk Earthworks
- + Imported Fill Reclamation
- + Rock armouring
- + Stormwater drainage and utilities installation
- + Large scale pavements and hardstand areas
- + Building works
- + Electrical works
- + Lines, signs and road furniture
- + Security infrastructure

Works are expected to commence in 2023, with completion scheduled for 2025.

2.3. CLIMATE

The historic monthly rainfall for the region is presented below in Figure 2. The Darwin area experiences a tropical climate with distinctly wet summers and dry winters. The highest periods of rainfall are recorded in summer months, with the maximum mean monthly rainfall recorded in January (432 mm). Relatively low rainfall is recorded in the months of May to September, with the lowest mean rainfall month being July (1 mm).

Tropical cyclones have a high occurrence of forming in Darwin's surrounding oceans during the wet season (November to April), and have the potential to result in strong to gale force winds, large wave heights and heavy rainfall along much of the coast of the NT.



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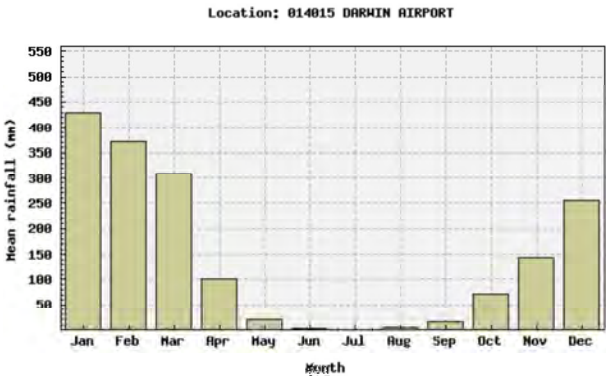


Figure 2 – Historic rainfall (Source: BoM)

2.4. TOPOGRAPHY AND DRAINAGE

Land elevation throughout the project is generally between 0.0m and 7.0m AHD with elevation greatest in the northern and north-eastern sections of the project area. The area is generally well-drained with moderately sloping terrain up to approximately 5 degrees grading to the southern sections of the project area (KBR 2018). Localised flooding has however been reported in the vicinity of the lower sheds. The project area located above HAT is approximately 4.2ha, with a further 15ha of rocky mud-flats in intertidal areas, and an isolated stand of remnant mangrove habitat. Marine areas consist of sandy substrate.

Existing drainage consists of roadside swales with culverts along Berrimah Road and a major channel running along the northern boundary of the landside site where a very large hardstand is located. An access road crosses from that hardstand area to the existing MUBRF to the east of the project, with significant associated drainage currently in place. Informal drainage is present within the landside area, draining east to the new MUBRF stormwater.

Topography and drainage across the project is presented in detail in Appendix A.



2.5. SOILS

Geology at the site is comprised of quaternary coastal alluvial sediments such as mud, silt and clays which overlay unconsolidated Cainozoic unconsolidated solids and laterites. Bedrock at the site is understood to be the Burrell Creek Formation which is Orosirian in age (Geological Map Series Sheet 5073). Through interviews conducted with persons knowledgeable with the site and its history, it is understood that much of the site is reclaimed land.

As reported in the project EIS by AECOM, the general hinterland landforms around Darwin Harbour comprise of dissected upland terrain, low strike-ridges and hills (approximately 15-40m high mostly along the southern coastline, formed on shales, siltstones and sandstones of the Proterozoic Burrell Creek Formation [BCF]) and intervening alluvial flats (Wood et al. 1985, Pietsch 1987, Burns 1997). Sediments of Cainozoic age cover most of the region and consist of Tertiary and Quaternary soils and laterite exposures. Quaternary sands, silty clay, laterites or ferruginous clayey sand are associated with drainage lines and low lying country (Pietsch 1987). East Arm comprises areas of high ground with tropical woodland vegetation surrounded by intertidal mangroves which are partially or completely inundated by water at high tide. Some minor hills and ridges occur over the higher elevations of woodland areas (Douglas Partner 2015). Land elevation ranges from 0-30 m (URS, 2011).

Around the peninsula coastline, the mangroves merge into extensive tidal mudflats formed from marine alluvium and mud, clay and silt (Brocklehurst and Edmeades 1996). Sandy shelly chenier ridges and small areas of salt flats also occur (Pietsch 1987).

The Project area has two primary land systems as defined by the Land System Mapping from NTG:

- + Krans: This land system consists of plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products.
- + Littoral 1: This land system consists of tidal mudflats and coastal floodplains with channels and estuaries, subject to tidal inundation. Soils are usually poorly drained clays and muds.

Based on the 1:100,000 scale geological map of Darwin (NTG 1983), the Project area is underlain by metasediments belonging to the BCF. Quaternary age cover, comprising alluvium, unconsolidated sands, colluvium, and marine and estuarine sediments cover the BCF rocks.



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The current seabed surface levels within the proposed dredging footprint range from +1.0 m LAT to -3.0 m LAT. The typical geotechnical profile of the unconsolidated surface materials to be dredged consists of sand and gravel surface sediments (with gravel potentially comprising shell fragments) with silt and clay content generally increasing with depth.

During sediment sampling undertaken at the site sample recovery of between 0.2 and 1.5 m was achieved before encountering consolidated material (AECOM 2020). These unconsolidated sediments are underlain by a thin layer of ‘stiffer’ consolidated residual soils, typically silty sand / sandy silt, which are overlaying shallow rock material.

ASS commonly occur in Quaternary aged sediments of marginal marine or estuarine origin and are mainly confined to coastal lowlands. A review of the ASS Risk Mapping database (ASRIS 2017) classifies the area around the site as having a high probability of occurrence. Potential acid sulfate soils (PASS) is likely to occur within the intertidal flats associated with mangroves, the area between the mangrove line boundary and the proposed dredge area above the mean low tide, and subtidal zones that are permanently inundated estuarine or marine areas.

3 EROSION RISK ASSESSMENT

3.1. SOIL LOSS

A preliminary erosion risk assessment has been conducted using the Revised Universal Soil Loss Equation (RUSLE). The calculated soil loss is then used to determine the level of sediment control required, as well as stabilisation and staging requirements. Note, stage and area specific assessments will be undertaken throughout the course of the project.

$$A = K \times R \times LS \times P \times C$$
 Equation 1 (IECA 2008)

- Where:
- A is the predicted soil loss per hectare per year
 - K is the soil erodibility factor
 - R is the rainfall erosivity factor
 - LS is the slope length/gradient factor
 - P is the erosion control practice factor
 - C is the ground cover and management factor



3.1.1. K-FACTOR – SOILS

The soil erodibility factor (K factor) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Soil texture is the principle component affecting the K factor, but soil structure, organic matter and profile permeability also contribute.

Based on the description discussed in section 2.5 and based on Table E5 Best Practice Erosion and Sediment Control (IECA, 2008) a K-factor of 0.030 was adopted for this risk assessment.

3.1.2. R-FACTOR – RAINFALL

The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. It is the product of two components (1) total energy and (2) intensity for each rainfall event. R factors are published for a range of locations throughout Queensland, including Cairns, which is considered reflective of the Project. Reference to Table E1 of IECA (2008) indicates an annual R factor value of 4,245.

Monthly R-factors have been assessed to investigate impacts to seasonal variability using the closest known breakdown (Darwin).

Table 1 – Monthly Rainfall Erosivity

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1300	935	663	246	25.5	4.2	0	0	17.0	106	276	671

3.1.3. LS - SLOPE-LENGTH

Slope length and slope gradient have substantial effects on soil erosion by water. The two effects are represented by the slope length factor (L) and the slope steepness factor (S). In application of RUSLE the two are evaluated together as a numerical representation of the length-slope combination (LS factor).

Slopes across most of the existing land portion of the site rarely exceed 3% over no more than 50m. Slopes across reclaimed land work areas are even milder, rarely exceeding 1%. Slope lengths are greater however, but we've assumed a maximum fall of 80m before drainage must be installed. Corresponding LS factors therefore range from 0.19 to 0.52.

3.1.4. COVER (C) AND PRACTICE (P) FACTORS

Within RUSLE, the C and P factors are used to describe management of the site with respect to reducing soil loss. The C factor measures the combined effect of all the

interrelated cover and management variables adopted over the site. It also represents non-structural methods for controlling erosion (i.e. covering exposed areas with various erosion control products to minimise raindrop impact or stabilisation by temporary or permanent vegetation). Soil loss estimates have adopted a default C value of 1.0, representing an exposed surface with no ground cover.

The P factor measures the combined effect of all support practices and management variables. P factor is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. It also represents structural methods for controlling erosion. An industry accepted default value of 1.3 (compacted and smooth) has been adopted as per Table E11 of IECA (2008) for all construction areas.

3.1.5. ESTIMATED SOIL LOSS

Estimated soil loss ranges from 30t/ha/yr for runoff from the reclaimed laydown areas to 90t/ha/yr for runoff from land based work areas.

Preliminary annual soil loss estimates are presented in Table 2. Note, stage and area specific assessments will be undertaken throughout the course of the project.

Table 2 – Annual Soil Loss Estimate (t/ha/year)

Area Description	Area (ha)	R	K	Slope Length (m)	Slope (%)	LS	P	C	A (t/ha/yr)
Existing Lands	4.11	4245	0.03	50	3.0	0.52	1.3	1.00	86
Reclaimed Pads	13.2	4245	0.03	80	1.0	0.19	1.3	1.00	31

It should also be noted that the soil loss estimate is not considered representative of actual annual soil loss at the site and should be used rather as indicator of potential erosion risk. If at any time circumstances affecting the above factors should change, a reassessment should be conducted immediately. Obviously, RUSLE assessments are not appropriate for marine works such as dredging.

3.2. MONTHLY EROSION RISK

Seasonal risk ratings are presented in Table 3, based on the Monthly Rainfall Erosivity and Table G.2 of IECA 2008. Where possible, high risk land disturbance activity (such as stripping) should be scheduled for months of Very Low (VL) erosion risk.

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Table 3 – Monthly Erosion Risk

LOCATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site	H	H	H	M	VL	VL	VL	VL	VL	M	M	H

H = High, M = Moderate, L = Low, VL = Very Low erosion risk.

4 SEDIMENT CONTROL

The sediment control standard is typically determined using Table 4.5.1 (IECA, 2008) which defines the sediment control standard based on catchment area and soil loss rate. The revised Table 4.5.1 (IECA, 2008) provided in Appendix B (IECA, 2018) as Table B1 is provide below as Table 4. The revised table includes an additional area limit trigger of 1 hectare to increase the sediment control standard for large sites with an estimated soil loss exceeding 75 t/ha/yr.

Table 4 – Sediment Control Standard (Table B1 Appendix B IECA 2018)

AREA LIMIT (m²)	SOIL LOSS RATE LIMIT (T/HA/YR)		
	TYPE 1	TYPE 2	TYPE 3
1000	N/A	N/A	All cases
2500	N/A	> 75	75
> 2500	> 150	150	75
> 10000	>75	N/A	75

Based on Table 3 (IECA, 2018) the work area on existing land triggers Type 1 sediment control, whilst the large, flat laydown areas on reclaimed land require only Type 3 sediment control.

Specific soil loss assessments undertaken for the 2025 dry season also indicate Type 3 sediment control as appropriate for all catchments until October when a review of this plan should be undertaken.



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5 EROSION CONTROL

The minimum erosion control requirements for various risk ratings in accordance with IECA (2008) guidelines are presented in Table 5.

Table 5 – Minimum erosion control requirements according to IECA (2008) - adapted from Table 4.4.7

EROSION RISK RATING	SOIL LOSS RATE (T/HA/YEAR)	ADVANCE LAND CLEARING ALLOWED (WKS WORK)	MAX DAYS TO STABILISATION (DAYS - % COVER)	STAGED CONSTRUCTION AND STABILISATION OF EARTH BATTERS >6H:1V	STOCKPILES STABILISED
Very Low	0 to 150	8	30 (60%)		
Low	150 to 225	8	30 (70%)		
Moderate	225 to 500	6	20 (70%)	✓	
High	500 to 1500	4	10 (75%)	✓	✓
Extreme	> 1500	2	5 (80%)	✓	✓

In addition to these requirements, erosion controls shall include:

- + Establishing stabilised entry/exit points where works intersect roadways or access tracks
- + Utilising existing tracks wherever possible
- + Establish exclusion zones to prevent over-disturbance, and restrict stripping to approved areas only
- + Stabilise diversion bunds and temporary drainage features with nominated measures
- + Stage topsoil stripping to coincide with areas of active earthworks only
- + Minimise occurrence and duration of stockpiling
- + Carry out dust suppression and monitor air quality during high winds, noting that some works may be discontinued if excessive dust is observed
- + Roughen earthworks areas, including batters
- + Progressively stabilise steep batters if practical, using temporary erosion control (binders and blankets) or by expediting final treatment



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- + Retain existing ground cover in drainage lines as long as possible, restricting disturbance to immediately before active works
- + Expedite construction works in drainage lines, monitoring weather forecasts and maximising production during dry weather
- + Implement temporary erosion control (erosion control mat) prior to rainfall if permanent treatments are not complete

Given the stark wet-dry season rainfall variability all efforts should be afforded to achieving ground cover using permanent treatments in the maximum area possible prior to the wet season.

6 DRAINAGE CONTROL

Drainage control considers three main principles; diverting external flow before it enters site, directing site runoff to an appropriate sediment control, and ensuring runoff is conveyed in a non-erosive manner.

Flow diversion for flat sites is typically achieved using topsoil bunding or excavated catch drains. Given that 'topsoil' is being stripped on site this may be windrowed to form diversion bunds. The flowpath of these bunds is to be stabilised with soil binder or geotextile prior to rainfall. Internally, runoff will be allowed to sheetflow to proposed sediment controls, or be diverted to the sediment basin using diversion bunds.

Temporary drainage has been designed in accordance with Table 6.

Table 6 – Drainage Design Standards

Reference	Drainage Feature	Anticipated Design Life (Months)			
		<3	3 - 12	12 - 24	>24
Best Practice Erosion and Sediment Control (IECA, 2008)	Temporary Drainage Structures	2yr ARI		5yr ARI	10yr ARI
	Emergency Spillways	10yr ARI	20yr ARI	50yr ARI	
	Temporary Culverts	1yr ARI			



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7 DREDGING AND RECLAMATION

The Dredging and Dredge Spoil Placement Management Plan prepared by AECOM as part of the project Environmental Impact Assessment process provided two options for the management of dredging and reclamation.

Option 1: using a CSD to remove the unconsolidated material to settling ponds, then a BHD to remove the consolidated stiff clays and rock for land reclamation.

Option 2: using a BHD to mix all dredged material and utilise for land reclamation required for construction of the Project.

Further information on these options may be found in the DDSPMP (refer Section 2.0).

Following publication of the Draft EIS, as part of the ongoing refinement of the Project construction methodologies, it was determined that:

- + Prior to any reclamation activity occurring, a rock revetment will be constructed at the seaward extent of the reclamation area.
- + The rock material to be used within the revetment will be screened to remove the majority of fine materials prior to its placement into the marine environment.
- + Geofabric will be placed in a manner to effectively mitigate the extent to which any fines can penetrate through the revetment.
- + Dredged material will subsequently be placed on the landward side of the revetment.
- + Silt curtains will be deployed wherever there may be the potential for fines from within the placed dredged material to migrate into the surrounding marine waters.
- + Runoff from the reclamation area will be managed (e.g. through the deployment of silt fences and silt curtains) to ensure that it does not result in elevations in turbidity seaward of the revetment.

Two potential construction strategies were proposed to develop the reclaim area:

1. The rock revetment will be developed to fully enclose the reclaim area prior to the placement of dredge spoil within the bund wall.
2. The rock revetment will be constructed such that it mostly encapsulate the reclaim area, with an opening along the western side to allow barges to enter the reclaim area to deposit the dredged material. The opening will have silt curtains across its width to minimise suspended sediment entering the harbour.

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A turbidity trigger level of 100 mg/L (140 NTU) has been set at a distance of 150 m down-current from the operating dredge, the pipeline, or the seaward edge of the reclamation area. Detailed response requirements associated with exceeding this trigger are included in the DDSPMP, including reporting and following management measures:

1. Dredging and reclamation activities are situated close to shore, at locations which are afforded some protection from the effects of tidal currents.
2. During CSD operations, the feed of sediments into the suction pipe is maximised by its location directly behind the cutter head. This minimises the release of sediment into the water column surrounding the dredge. When dredging unconsolidated materials the cutter will be disengaged for much of the time, while dredge pumps will operate at the maximum speed possible.
3. During BHD operations, the bucket will be raised through the water column at a speed that minimises the loss of material from the bucket. The dredged material will be placed into barges from which there will be no overflow of entrained water or porewater. Silt curtains will be deployed along the seaward edge of the reclamation area and runoff from the area will be managed to minimise the entry of sediments into the marine environment.

Consideration of trends in the water quality data collected during the monitoring program will be used to adaptively manage the dredging operations to minimise the potential for water quality trigger levels to be exceeded. The monitoring will provide advanced warning of any impending trigger level exceedance, allowing precautionary corrective actions to be implemented before the trigger level is exceeded. For example, observations during monitoring will indicate the times within the tidal cycle when the migration of dredge-generated plumes towards South Shell Island is highest; maintenance or relocation of the dredge can then be scheduled to coincide with those times.

The controls proposed herein are recognised as demonstrating Best Practice Erosion and Sediment Control. The IECA guidelines do however provide limited guidance for marine works such as dredging and reclamation. This aspect of the work is guided by the project EIS which provided the above options, understood to represent general environmental duty. As described in the EIS, sediment transport modelling was undertaken to predict the potential extent and concentration of turbid plumes generated by dredging activity. The modelling suggested that zones of impact and influence were restricted to the project footprint for most of the time and unlikely to extent to the nearest sensitive hard coral and filter feeder communities at South Shell Island.





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8 ROLES AND RESPONSIBILITIES

Table 7 outlines the responsibilities of project personnel in respect to ESC.

Table 7 - Roles and responsibilities

ROLE	RESPONSIBILITY
Project Manager	+ Overall responsibility for environmental compliance (including ESC implementation)
Construction Superintendent/Manager	+ Notify the Environmental Manager immediately of any non-compliance with ESCP; + Provide resources to ensure installation, maintenance and operation of ESC devices on ground.
Site Supervisor/Foremen	+ Ensure ESC measures are installed prior to commencing any disturbance activities; + Conduct site inspections as required to ensure ESC measures are operational and in good order; + Monitor daily rainfall; + Notify Environmental Advisor when runoff generating rainfall occurs in the previous 24 hours; + Treat, test and dispose of captured runoff as per operation procedures;
Environmental Manager/Advisor	+ Conduct site inspections and audits as required; + Prepare audit reports based in inspections; + Provide advice, as required regarding ESC site improvement. + Conduct in-situ monitoring as required; + Collect and submit samples to laboratory as required; + Collate results and prepare reports as required; + Maintain current records of rainfall, water quality, treatment practices, discharge activities.
All Personnel	+ Report any damage to ESC devices and any potential or actual environmental harm in line with Duty to Notify under the requirements of the <i>Waste Management and Pollution Control Act 1998 (NT)</i>

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9 SITE INSPECTION AND MONITORING

Site inspections and monitoring is to be undertaken in accordance with Sections 6.17 and 7.4 of the Best Practice Erosion and Sediment Control Document (IECA, 2008) as detailed below. When a site inspection detects a notable failure in the adopted ESC measures, the source of this failure must be reported, investigated and appropriate amendments made to the site and the ESCP.

ESCPs should be considered live documents that in some instances will require review and updating as site conditions change, or if the adopted measures fail to achieve the required treatment standard.

Best practice site management requires all ESC measures to be inspected at the following frequencies and include the following checks as a minimum:

Daily site inspections (during rainfall)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + All site discharge points (including dewatering activities as appropriate)

Weekly site inspections (even if work is not occurring on-site)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
- + Litter and waste receptors
- + Oil, fuel and chemical storage facilities

Prior to anticipated runoff producing rainfall (within 24 hours of expected rainfall)

- + All drainage, erosion and sediment control measures
- + All temporary flow diversion and drainage works

Following runoff producing rainfall (within 18 hours of rainfall event)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

The findings of ESC site inspections and monitoring will be documented as per the CEMP reporting requirements for compliance and non-compliance reporting.





22-0063/R3016 – DARWIN SHIP LIFT ESCP

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APPENDIX A

EROSION AND SEDIMENT CONTROL DRAWINGS

Environment. Engineering. Education.





EROSION AND SEDIMENT CONTROL DRAWINGS

DARWIN SHIP LIFT

2025 DRY SEASON



ADMINISTRATOR - NT GOV

DRAWING LIST:
D00 - COVER SHEET
D01 - CATCHMENT PLAN
D02 - MONTHLY SOIL LOSS CALCULATIONS
D03 - CONTROLS
D04 - CONTROLS
D05 - CALCULATIONS AND STANDARD DETAIL
D06 - CALCULATIONS AND STANDARD DETAIL

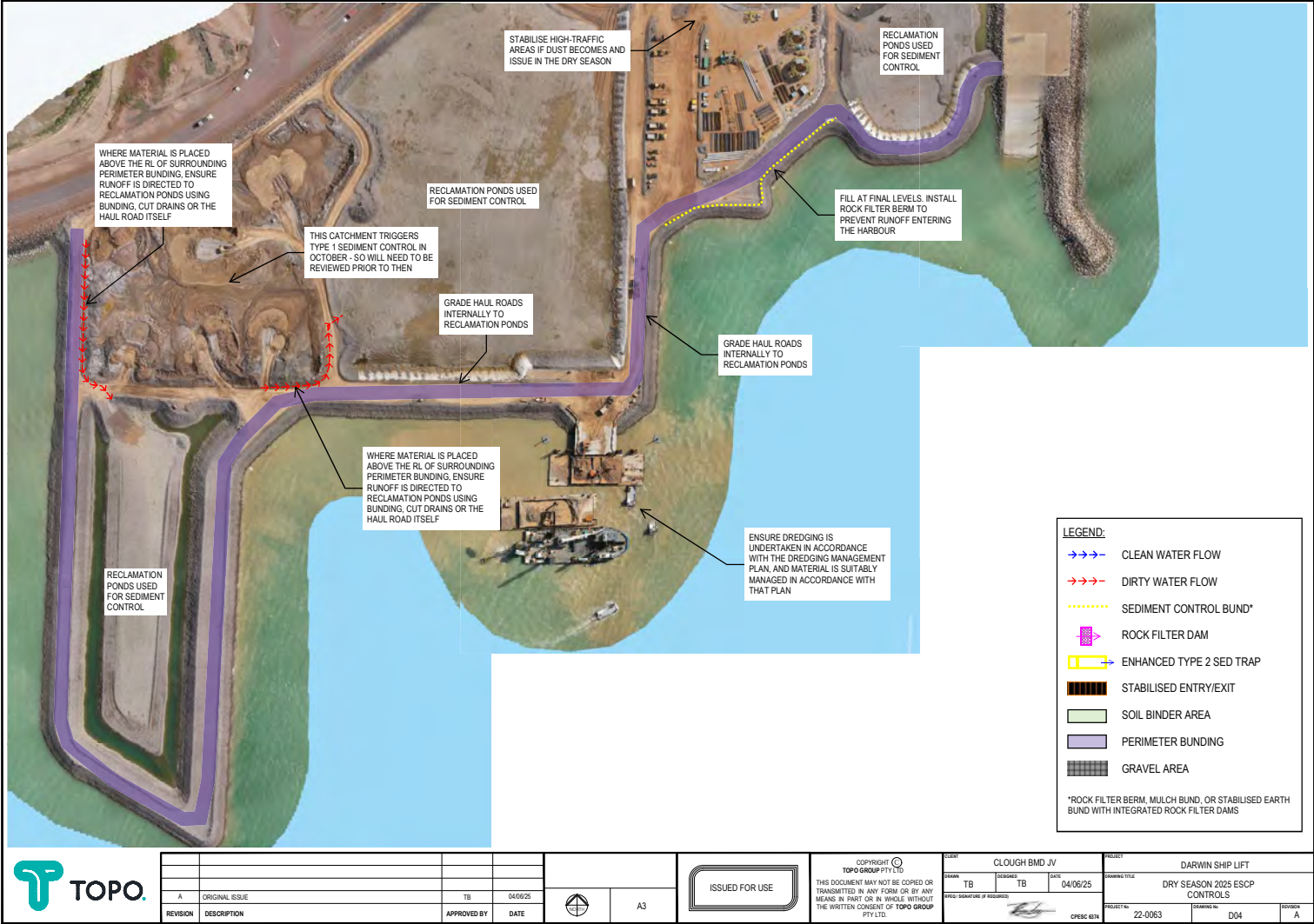
REFER TO REPORT (REFERENCE: R3016) FOR ADDITIONAL DETAILS RELATING TO GUIDELINES USED, PROJECT AND SITE DESCRIPTION, CLIMATE, TOPOGRAPHY, SOILS, EROSION RISK ASSESSMENT, EROSION, SEDIMENT AND DRAINAGE CONTROL SPECIFICATIONS, SEDIMENT BASIN OPERATION, ROLES AND RESPONSIBILITIES AND SITE INSPECTION AND MONITORING

PROPOSED TEMPORARY DESIGN PROVIDED FOR CONSTRUCTION PHASE EROSION, SEDIMENT & DRAINAGE CONTROL ONLY. THE CLIENT IS RESPONSIBLE FOR ENSURING THE INSTALLATION OF ANY CONTROLS PROPOSED HEREIN CAN BE INSTALLED & OPERATED SAFELY FOR PEDESTRIANS, VEHICLES, WORKERS/ CONTRACTORS/ ADMINISTRATORS & MEMBERS OF THE PUBLIC.



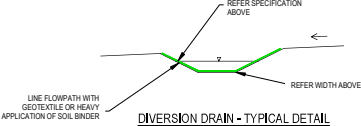
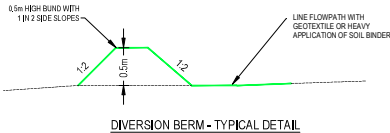
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REVISION	DESCRIPTION	APPROVED BY		DATE											

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		PROJECT NO 22-0063		DRAWING NO D00		REVISION A	



DIVERSION BUND / DRAIN SIZING

DRAIN ID	CATCH AREA (HA)	ARI	C _{ARI}	TIME OF CONC (MINS)	I _{ARI}	FLOW - Q (m³/s)	LONG. SLOPE (m/m)	BASE WIDTH	SIDE SLOPE 1 (1 in x)	SIDE SLOPE 2 (1 in x)	LINING	MANNING ROUGH COEFF	MAX PERM VEL (m/s)	DESIGN VEL (m/s)	DEPTH OF FLOW (m)	DEPTH WITH F/BOARD (m)	DRAIN TOP WIDTH (m)	OK / NOT OK
Diversion Bund	2	5	0.665	10	161	0.59	0.01	-	1	50	Vital HR - L/m²	0.02	1.5	0.92	0.16	0.31	-	OK
Diversion Drain	2	5	0.665	10	161	0.59	0.01	1	1	1	Vital HR - 2L/m²	0.02	2.5	1.69	0.28	0.43	1.85	OK
HR Table Drain	1	2	0.665	10	142	0.26	0.03	0.5	1	1	Vital HR - 2L/m²	0.02	2.5	2.12	0.18	0.33	1.16	OK



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REVISION	DESCRIPTION	APPROVED BY	DATE



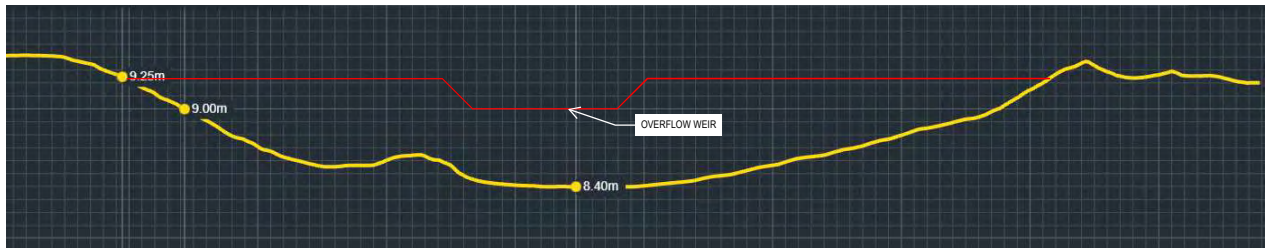
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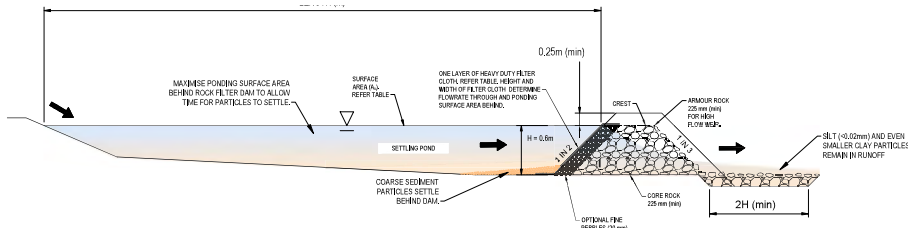
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CLIENT CLOUGH BMD JV		
DRAWN TB	DESIGNED TB	DATE 04/06/25
DESIGNER SIGNATURE (IF REQUIRED)		

PROJECT DARWIN SHIP LIFT		
DRAWING TITLE DRY SEASON 2025 ESCP CALCULATIONS AND STANDARD DETAILS		
PROJECT NO. 22-0063	DRAWING NO. D05	REVISION A

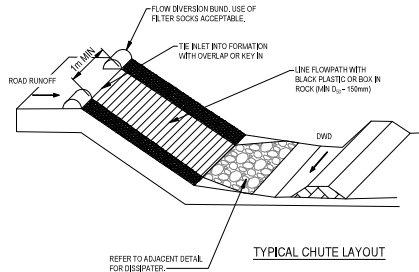


ROCK FILTER DAM (CROSS SECTION)



ROCK FILTER DAM (LONG SECTION)

EXAMPLE



TYPICAL CHUTE LAYOUT



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DRAWN TB		DESIGNED TB		DATE 04/06/25		DRAWING TITLE DRY SEASON 2025 ESCP CALCULATIONS AND STANDARD DETAILS		PROJECT NO 22-0063	
DESIGNED TB		DATE 04/06/25		DRAWING TITLE DRY SEASON 2025 ESCP CALCULATIONS AND STANDARD DETAILS		PROJECT NO 22-0063		DRAWING NO D06	
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DESIGNED TB		DATE 04/06/25		DRAWING TITLE DRY SEASON 2025 ESCP CALCULATIONS AND STANDARD DETAILS		PROJECT NO 22-0063		DRAWING NO D06	

Supplier Document Cover Sheet



Project	41213 – Darwin Ship Lift Project	Total # Pages: (incl Doc Cover Sheet)	20
Clough BMD JV Doc No	41213-D-70046-PL-D-00003	Clough Revision	1
Document Title	Erosion and Sediment Control Plan - Wet Season		
DDSR Code			
Equipment Tag No			
Supplier Doc No		Supplier Revision	D
NTG Doc No		Client Revision	

Supplier shall ensure that documents have been fully checked and approved prior to submittal.	Prepared by	Tom Bailey	Checked by	Curtis Triffet	Approved by	Matthew Boynes
	Signature	TB	Signature	CT	Signature	MB
	Date	20/11/2024	Date	05/12/2024	Date	05/12/2024

Clough Review Codes:	Supplier Details:	Contractor Details:
1. Approved 2. Approved – Submit Certified Final 3. Approved as Noted – Revise and Submit Final 4. Not Approved – Revise and Resubmit for Review 5. Information Only		DARWIN SHIP LIFT PROJECT 6/250 St Georges Tce Perth WA 6000 Phone: +61 8 9281 9281
Approval does not relieve supplier from full compliance with contractual obligations		
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			NTG Review Code
1	05/12/2024	Re-issued for Use	
0	04/11/2024	Issued for Use	
Rev	Date	Description	
Revisions to Clough BMD JV Document No			

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EROSION AND SEDIMENT CONTROL PLAN

DARWIN SHIP LIFT



CLIENT: Clough BMD JV

DOCUMENT NUMBER: 22-0063/R3016

VERSION: D

DATE: 20/11/24



22-0063/R3016 – DARWIN SHIP LIFT ESCP

1 SCOPE

Topo were engaged by Clough BMD JV to develop a CPESC certified Erosion and Sediment Control Plan (ESCP) for works associated with construction of the Darwin Ship Lift Project.

1.1. GUIDELINES

This ESCP has been prepared in accordance with the following documents:

- + Environmental Assessment Act 1982
- + Waste Management and Pollution Control Act 1998
- + Soil Conservation and Land Utilisation Act 1969
- + Best Practice Erosion and Sediment Control (IECA, 2008) and Appendix B (IECA, 2018)
- + DIPL Standard Specification for Environmental Management (Version 2)

1.2. CERTIFICATION

I Tom Bailey certify that this Erosion and Sediment Control Plan (ref: R3016) has been prepared to satisfy the following requirements:

- + The intent and minimum standards nominated within the IECA (2008) Best Practice Erosion and Sediment Control Guideline and relevant supporting Appendices (IECA, 2015).
- + NT Government Environmental Approval EP2023/028-001 Condition 2-3
- + Environmental Approval EP2023/028-001
- + Australian Government EPBC Approval ref 2021/9068
- + Environmental Approval EP2023/028-001

If implemented correctly, it will assist Clough BMD JV in meeting environmental obligations defined in the *Waste Management and Pollution Control Act 1998* (NT) and approvals identified above.

The ESC plan has been designed to minimise the impact for downstream/adjacent water quality and marine impacts.

CPESC 6374



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1.3. REVISION

It is anticipated that this ESCP will be reviewed biannually to capture changes arising from seasonal variability and the progression of project works. It is suggested that the ESCP be updated in or around October of each year for the onset of the wet season, and again around March-April for the upcoming dry season.

VERSION	DATE	AUTHOR	REVIEWER	APPROVED
A	27/09/23	T. Bailey		T. Bailey
B	30/10/23	T. Bailey		T. Bailey
C	9/02/24	T. Bailey		T. Bailey
D	20/11/24	T. Bailey		T. Bailey





22-0063/R3016 – DARWIN SHIP LIFT ESCP

2 PROJECT DESCRIPTION

2.1. LOCATION

The project is situated approximately 6.5 Kilometres (km) south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour. The site is approximately 700 m east north-east of the East Arm Wharf (EAW) and the Marine Supply Base (MSB), and west of the Darwin Business Park. Road access is provided by Berrimah Road, linking the site to the Darwin road network including the Stuart Highway and Tiger Brennan Drive. The project location is represented visually in Figure 1.



Figure 1 – Site Location (Source: AECOM)

Environment, Engineering, Education



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2.2. PROJECT WORKS

Project works involve road and service upgrades and reclamation for the common user ship lift facility. The facility will include: a ship lift 26m wide, 103m long and 6m deep with lifting capability of 5,000 tonnes, four wet berths (wharves) and 20ha of hardstand for ship repair and maintenance works. Associated works include:

- + Roadworks for upgrade of Berrimah Road
- + Dredging (Cutter Suction and Backhoe+Barge)
- + Piling (Marine and Land Based)
- + Land Based Bulk Earthworks
- + Imported Fill Reclamation
- + Rock armouring
- + Stormwater drainage and utilities installation
- + Large scale pavements and hardstand areas
- + Building works
- + Electrical works
- + Lines, signs and road furniture
- + Security infrastructure

Works are expected to commence in 2023, with completion scheduled for 2025.

2.3. CLIMATE

The historic monthly rainfall for the region is presented below in Figure 2. The Darwin area experiences a tropical climate with distinctly wet summers and dry winters. The highest periods of rainfall are recorded in summer months, with the maximum mean monthly rainfall recorded in January (432 mm). Relatively low rainfall is recorded in the months of May to September, with the lowest mean rainfall month being July (1 mm).

Tropical cyclones have a high occurrence of forming in Darwin's surrounding oceans during the wet season (November to April), and have the potential to result in strong to gale force winds, large wave heights and heavy rainfall along much of the coast of the NT.



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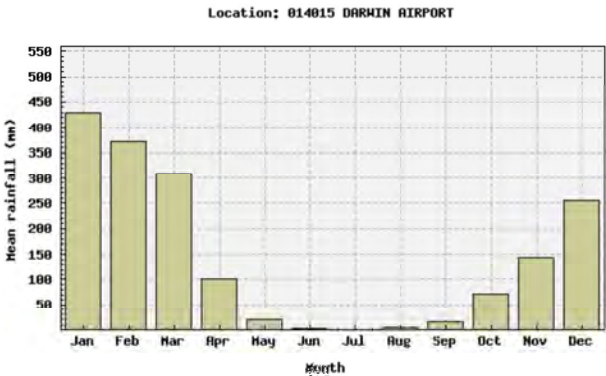


Figure 2 – Historic rainfall (Source: BoM)

2.4. TOPOGRAPHY AND DRAINAGE

Land elevation throughout the project is generally between 0.0m and 7.0m AHD with elevation greatest in the northern and north-eastern sections of the project area. The area is generally well-drained with moderately sloping terrain up to approximately 5 degrees grading to the southern sections of the project area (KBR 2018). Localised flooding has however been reported in the vicinity of the lower sheds. The project area located above HAT is approximately 4.2ha, with a further 15ha of rocky mud-flats in intertidal areas, and an isolated stand of remnant mangrove habitat. Marine areas consist of sandy substrate.

Existing drainage consists of roadside swales with culverts along Berrimah Road and a major channel running along the northern boundary of the landside site where a very large hardstand is located. An access road crosses from that hardstand area to the existing MUBRF to the east of the project, with significant associated drainage currently in place. Informal drainage is present within the landside area, draining east to the new MUBRF stormwater.

Topography and drainage across the project is presented in detail in Appendix A.



2.5. SOILS

Geology at the site is comprised of quaternary coastal alluvial sediments such as mud, silt and clays which overlay unconsolidated Cainozoic unconsolidated solids and laterites. Bedrock at the site is understood to be the Burrell Creek Formation which is Orosirian in age (Geological Map Series Sheet 5073). Through interviews conducted with persons knowledgeable with the site and its history, it is understood that much of the site is reclaimed land.

As reported in the project EIS by AECOM, the general hinterland landforms around Darwin Harbour comprise of dissected upland terrain, low strike-ridges and hills (approximately 15-40m high mostly along the southern coastline, formed on shales, siltstones and sandstones of the Proterozoic Burrell Creek Formation [BCF]) and intervening alluvial flats (Wood et al. 1985, Pietsch 1987, Burns 1997). Sediments of Cainozoic age cover most of the region and consist of Tertiary and Quaternary soils and laterite exposures. Quaternary sands, silty clay, laterites or ferruginous clayey sand are associated with drainage lines and low lying country (Pietsch 1987). East Arm comprises areas of high ground with tropical woodland vegetation surrounded by intertidal mangroves which are partially or completely inundated by water at high tide. Some minor hills and ridges occur over the higher elevations of woodland areas (Douglas Partner 2015). Land elevation ranges from 0-30 m (URS, 2011).

Around the peninsula coastline, the mangroves merge into extensive tidal mudflats formed from marine alluvium and mud, clay and silt (Brocklehurst and Edmeades 1996). Sandy shelly chenier ridges and small areas of salt flats also occur (Pietsch 1987).

The Project area has two primary land systems as defined by the Land System Mapping from NTG:

- + Kras: This land system consists of plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products.
- + Littoral 1: This land system consists of tidal mudflats and coastal floodplains with channels and estuaries, subject to tidal inundation. Soils are usually poorly drained clays and muds.

Based on the 1:100,000 scale geological map of Darwin (NTG 1983), the Project area is underlain by metasediments belonging to the BCF. Quaternary age cover, comprising alluvium, unconsolidated sands, colluvium, and marine and estuarine sediments cover the BCF rocks.



22-0063/R3016 – DARWIN SHIP LIFT ESCP

The current seabed surface levels within the proposed dredging footprint range from +1.0 m LAT to -3.0 m LAT. The typical geotechnical profile of the unconsolidated surface materials to be dredged consists of sand and gravel surface sediments (with gravel potentially comprising shell fragments) with silt and clay content generally increasing with depth.

During sediment sampling undertaken at the site sample recovery of between 0.2 and 1.5 m was achieved before encountering consolidated material (AECOM 2020). These unconsolidated sediments are underlain by a thin layer of 'stiffer' consolidated residual soils, typically silty sand / sandy silt, which are overlying shallow rock material.

ASS commonly occur in Quaternary aged sediments of marginal marine or estuarine origin and are mainly confined to coastal lowlands. A review of the ASS Risk Mapping database (ASRIS 2017) classifies the area around the site as having a high probability of occurrence. Potential acid sulfate soils (PASS) is likely to occur within the intertidal flats associated with mangroves, the area between the mangrove line boundary and the proposed dredge area above the mean low tide, and subtidal zones that are permanently inundated estuarine or marine areas.

3 EROSION RISK ASSESSMENT

3.1. SOIL LOSS

A preliminary erosion risk assessment has been conducted using the Revised Universal Soil Loss Equation (RUSLE). The calculated soil loss is then used to determine the level of sediment control required, as well as stabilisation and staging requirements. Note, stage and area specific assessments will be undertaken throughout the course of the project.

A = K x R x LS x P x C

Equation 1 (IECA 2008)

- Where:
- A is the predicted soil loss per hectare per year
 - K is the soil erodibility factor
 - R is the rainfall erosivity factor
 - LS is the slope length/gradient factor
 - P is the erosion control practice factor
 - C is the ground cover and management factor



3.1.1. K-FACTOR – SOILS

The soil erodibility factor (K factor) is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. Soil texture is the principle component affecting the K factor, but soil structure, organic matter and profile permeability also contribute.

Based on the description discussed in section 2.5 and based on Table E5 Best Practice Erosion and Sediment Control (IECA, 2008) a K-factor of 0.030 was adopted for this risk assessment.

3.1.2. R-FACTOR – RAINFALL

The rainfall erosivity factor (R factor), is a measure of the ability of rainfall to cause erosion. It is the product of two components (1) total energy and (2) intensity for each rainfall event. R factors are published for a range of locations throughout Queensland, including Cairns, which is considered reflective of the Project. Reference to Table E1 of IECA (2008) indicates an annual R factor value of 4,245.

Monthly R-factors have been assessed to investigate impacts to seasonal variability using the closest known breakdown (Darwin).

Table 1 – Monthly Rainfall Erosivity

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1300	935	663	246	25.5	4.2	0	0	17.0	106	276	671

3.1.3. LS - SLOPE-LENGTH

Slope length and slope gradient have substantial effects on soil erosion by water. The two effects are represented by the slope length factor (L) and the slope steepness factor (S). In application of RUSLE the two are evaluated together as a numerical representation of the length-slope combination (LS factor).

Slopes across most of the existing land portion of the site rarely exceed 3% over no more than 50m. Slopes across reclaimed land work areas are even milder, rarely exceeding 1%. Slope lengths are greater however, but we've assumed a maximum fall of 80m before drainage must be installed. Corresponding LS factors therefore range from 0.19 to 0.52.

3.1.4. COVER (C) AND PRACTICE (P) FACTORS

Within RUSLE, the C and P factors are used to describe management of the site with respect to reducing soil loss. The C factor measures the combined effect of all the



interrelated cover and management variables adopted over the site. It also represents non-structural methods for controlling erosion (i.e. covering exposed areas with various erosion control products to minimise raindrop impact or stabilisation by temporary or permanent vegetation). Soil loss estimates have adopted a default C value of 1.0, representing an exposed surface with no ground cover.

The P factor measures the combined effect of all support practices and management variables. P factor is reduced by practices that reduce both the velocity of runoff and the tendency of runoff to flow directly downhill. It also represents structural methods for controlling erosion. An industry accepted default value of 1.3 (compacted and smooth) has been adopted as per Table E11 of IECA (2008) for all construction areas.

3.1.5. ESTIMATED SOIL LOSS

Estimated soil loss ranges from 30t/ha/yr for runoff from the reclaimed laydown areas to 90t/ha/yr for runoff from land based work areas.

Preliminary annual soil loss estimates are presented in Table 2. Note, stage and area specific assessments will be undertaken throughout the course of the project.

Table 2 – Annual Soil Loss Estimate (t/ha/year)

Area Description	Area (ha)	R	K	Slope Length (m)	Slope (%)	LS	P	C	A (t/ha/yr)
Existing Lands	4.11	4245	0.03	50	3.0	0.52	1.3	1.00	86
Reclaimed Pads	13.2	4245	0.03	80	1.0	0.19	1.3	1.00	31

It should also be noted that the soil loss estimate is not considered representative of actual annual soil loss at the site and should be used rather as indicator of potential erosion risk. If at any time circumstances affecting the above factors should change, a reassessment should be conducted immediately. Obviously, RUSLE assessments are not appropriate for marine works such as dredging.

3.2. MONTHLY EROSION RISK

Seasonal risk ratings are presented in Table 3, based on the Monthly Rainfall Erosivity and Table G.2 of IECA 2008. Where possible, high risk land disturbance activity (such as stripping) should be scheduled for months of Very Low (VL) erosion risk.

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Table 3 – Monthly Erosion Risk

LOCATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site	H	H	H	M	VL	VL	VL	VL	VL	M	M	H

H = High, M = Moderate, L = Low, VL = Very Low erosion risk.

4 SEDIMENT CONTROL

The sediment control standard is typically determined using Table 4.5.1 (IECA, 2008) which defines the sediment control standard based on catchment area and soil loss rate. The revised Table 4.5.1 (IECA, 2008) provided in Appendix B (IECA, 2018) as Table B1 is provide below as Table 4. The revised table includes an additional area limit trigger of 1 hectare to increase the sediment control standard for large sites with an estimated soil loss exceeding 75 t/ha/yr.

Table 4 – Sediment Control Standard (Table B1 Appendix B IECA 2018)

AREA LIMIT (m²)	SOIL LOSS RATE LIMIT (T/HA/YR)		
	TYPE 1	TYPE 2	TYPE 3
1000	N/A	N/A	All cases
2500	N/A	> 75	75
> 2500	> 150	150	75
> 10000	>75	N/A	75

Based on Table 3 (IECA, 2018) the work area on existing land triggers Type 1 sediment control, whilst the large, flat laydown areas on reclaimed land require only Type 3 sediment control.

Specific soil loss assessments undertaken for the 2024-2025 wet season also indicate Type 1 sediment control is required for the majority of site catchments for the period November to March.

Appendix B (IECA, 2018) provides a hierarchy of Type 1 sediment control based on performance outcome and site conditions. Given that project works are dominated by the formation of very large reclamation areas, used to place dredge material it may also be considered reasonable to use these reclamation areas for sediment control, in the form of large Type D sediment basins.



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Table 5 – Sediment Basin Type Summary (IECA, 2018)

Basin type	Soil and/or catchment conditions ^[1]
Type A	The duration of the soil disturbance, within a given drainage catchment, exceeds 12 months. ^[2, 3, 4]
Type B	The duration of the soil disturbance, within a given drainage catchment, does not exceed 12 months. ^[2, 3, 4]
Type C	Less than 33% of soil finer than 0.02 mm (i.e. d ₃₃ > 0.02 mm) and no more than 10% of soil dispersive. ^[5, 6]
Type D	An alternative to a Type A or B basin when it can be demonstrated that automatic chemical flocculation is not reasonable nor practicable. ^[3]

Notes:

- [1] If more than one soil type exists on the site, then the most stringent criterion applies (i.e. Type A supersedes Type B/D, which itself supersedes Type C).
- [2] The duration of soil disturbance shall include only those periods when there is likely to be less than 70% effective ground cover (i.e. C-Factor of 0.05 or higher, refer to Appendix E (IECA, 2008)).
- [3] Because the footprints of Type A, B and D basins are similar, the issue of reasonableness and practicability comes down to whether or not effective automated dosing can be implemented. Situations where this is not practical are likely to occur only when the physical layout results in multiple inflow locations, and alternative configurations are not achievable.

With a combined catchment area of 13.6ha (surface area reporting to basin during 2024-2025 wet season), the project will require at least 6,500m³ of ponding for a Type D sediment basin based on the following formula and a R factor of 46.2mm (85th percentile 5-day rainfall depth) and a runoff coefficient of 0.9.

$$V_s = 10 \cdot R_{(Y\%, 5\text{-day})} \cdot C_v \cdot A$$

where: V_s = volume of the settling zone [m³]
 $R_{(Y\%, 5\text{-day})}$ = Y%, 5-day rainfall depth [mm]
 C_v = volumetric runoff coefficient (refer to Table B31)
 A = effective catchment surface area connected to the basin [ha]

With a surface area of 30,000m² and depth of 5m, once enclosed and available for sediment control the primary reclamation area on site will far exceed this minimum basin volume. Although treatment and dewatering is unlikely to be necessary given the volume and porous nature of reclamation area revegetment it is important that the ponds achieve a commensurate water quality outcome as traditional sediment basins.



5 EROSION CONTROL

The minimum erosion control requirements for various risk ratings in accordance with IECA (2008) guidelines are presented in Table 5.

Table 6 – Minimum erosion control requirements according to IECA (2008) - adapted from Table 4.4.7

EROSION RISK RATING	SOIL LOSS RATE (T/HA/YEAR)	ADVANCE LAND CLEARING ALLOWED (WKS WORK)	MAX DAYS TO STABILISATION (DAYS - % COVER)	STAGED CONSTRUCTION AND STABILISATION OF EARTH BATTERS >6H:1V	STOCKPILES STABILISED
Very Low	0 to 150	8	30 (60%)		
Low	150 to 225	8	30 (70%)		
Moderate	225 to 500	6	20 (70%)	✓	
High	500 to 1500	4	10 (75%)	✓	✓
Extreme	> 1500	2	5 (80%)	✓	✓

In addition to these requirements, erosion controls shall include:

- + Establishing stabilised entry/exit points where works intersect roadways or access tracks
- + Utilising existing tracks wherever possible
- + Establish exclusion zones to prevent over-disturbance, and restrict stripping to approved areas only
- + Stabilise diversion bunds and temporary drainage features with nominated measures
- + Stage topsoil stripping to coincide with areas of active earthworks only
- + Minimise occurrence and duration of stockpiling
- + Carry out dust suppression and monitor air quality during high winds, noting that some works may be discontinued if excessive dust is observed
- + Roughen earthworks areas, including batters
- + Progressively stabilise steep batters if practical, using temporary erosion control (binders and blankets) or by expediting final treatment



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- + Retain existing ground cover in drainage lines as long as possible, restricting disturbance to immediately before active works
- + Expedite construction works in drainage lines, monitoring weather forecasts and maximising production during dry weather
- + Implement temporary erosion control (erosion control mat) prior to rainfall if permanent treatments are not complete

Given the stark wet-dry season rainfall variability all efforts should be afforded to achieving ground cover using permanent treatments in the maximum area possible prior to the wet season.

6 DRAINAGE CONTROL

Drainage control considers three main principles; diverting external flow before it enters site, directing site runoff to an appropriate sediment control, and ensuring runoff is conveyed in a non-erosive manner.

Flow diversion for flat sites is typically achieved using topsoil bunding or excavated catch drains. Given that ‘topsoil’ is being stripped on site this may be windrowed to form diversion bunds. The flowpath of these bunds is to be stabilised with soil binder or geotextile prior to rainfall. Internally, runoff will be allowed to sheetflow to proposed sediment controls, or be diverted to the sediment basin using diversion bunds.

Temporary drainage has been designed in accordance with Table 6.

Table 7 – Drainage Design Standards

Reference	Drainage Feature	Anticipated Design Life (Months)			
		<3	3 - 12	12 - 24	>24
Best Practice Erosion and Sediment Control (IECA, 2008)	Temporary Drainage Structures	2yr ARI		5yr ARI	10yr ARI
	Emergency Spillways	10yr ARI	20yr ARI	50yr ARI	
	Temporary Culverts	1yr ARI			



7 DREDGING AND RECLAMATION

The Dredging and Dredge Spoil Placement Management Plan prepared by AECOM as part of the project Environmental Impact Assessment process provided two options for the management of dredging and reclamation.

Option 1: using a CSD to remove the unconsolidated material to settling ponds, then a BHD to remove the consolidated stiff clays and rock for land reclamation.

Option 2: using a BHD to mix all dredged material and utilise for land reclamation required for construction of the Project.

Further information on these options may be found in the DDSMP (refer Section 2.0).

Following publication of the Draft EIS, as part of the ongoing refinement of the Project construction methodologies, it was determined that:

- + Prior to any reclamation activity occurring, a rock revetment will be constructed at the seaward extent of the reclamation area.
- + The rock material to be used within the revetment will be screened to remove the majority of fine materials prior to its placement into the marine environment.
- + Geofabric will be placed in a manner to effectively mitigate the extent to which any fines can penetrate through the revetment.
- + Dredged material will subsequently be placed on the landward side of the revetment.
- + Silt curtains will be deployed wherever there may be the potential for fines from within the placed dredged material to migrate into the surrounding marine waters.
- + Runoff from the reclamation area will be managed (e.g. through the deployment of silt fences and silt curtains) to ensure that it does not result in elevations in turbidity seaward of the revetment.

Two potential construction strategies were proposed to develop the reclaim area:

1. The rock revetment will be developed to fully enclose the reclaim area prior to the placement of dredge spoil within the bund wall.
2. The rock revetment will be constructed such that it mostly encapsulate the reclaim area, with an opening along the western side to allow barges to enter the reclaim area to deposit the dredged material. The opening will have silt curtains across its width to minimise suspended sediment entering the harbour.



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A turbidity trigger level of 100 mg/L (140 NTU) has been set at a distance of 150 m down-current from the operating dredge, the pipeline, or the seaward edge of the reclamation area. Detailed response requirements associated with exceeding this trigger are included in the DDSPMP, including reporting and following management measures:

1. Dredging and reclamation activities are situated close to shore, at locations which are afforded some protection from the effects of tidal currents.
2. During CSD operations, the feed of sediments into the suction pipe is maximised by its location directly behind the cutter head. This minimises the release of sediment into the water column surrounding the dredge. When dredging unconsolidated materials the cutter will be disengaged for much of the time, while dredge pumps will operate at the maximum speed possible.
3. During BHD operations, the bucket will be raised through the water column at a speed that minimises the loss of material from the bucket. The dredged material will be placed into barges from which there will be no overflow of entrained water or porewater. Silt curtains will be deployed along the seaward edge of the reclamation area and runoff from the area will be managed to minimise the entry of sediments into the marine environment.

Consideration of trends in the water quality data collected during the monitoring program will be used to adaptively manage the dredging operations to minimise the potential for water quality trigger levels to be exceeded. The monitoring will provide advanced warning of any impending trigger level exceedance, allowing precautionary corrective actions to be implemented before the trigger level is exceeded. For example, observations during monitoring will indicate the times within the tidal cycle when the migration of dredge-generated plumes towards South Shell Island is highest; maintenance or relocation of the dredge can then be scheduled to coincide with those times.

The controls proposed herein are recognised as demonstrating Best Practice Erosion and Sediment Control. The IECA guidelines do however provide limited guidance for marine works such as dredging and reclamation. This aspect of the work is guided by the project EIS which provided the above options, understood to represent general environmental duty. As described in the EIS, sediment transport modelling was undertaken to predict the potential extent and concentration of turbid plumes generated by dredging activity. The modelling suggested that zones of impact and influence were restricted to the project footprint for most of the time and unlikely to extent to the nearest sensitive hard coral and filter feeder communities at South Shell Island.



8 ROLES AND RESPONSIBILITIES

Table 8 outlines the responsibilities of project personnel in respect to ESC.

Table 8 - Roles and responsibilities

ROLE	RESPONSIBILITY
Project Manager	+ Overall responsibility for environmental compliance (including ESC implementation)
Construction Superintendent/Manager	+ Notify the Environmental Manager immediately of any non-compliance with ESCP; + Provide resources to ensure installation, maintenance and operation of ESC devices on ground.
Site Supervisor/Foremen	+ Ensure ESC measures are installed prior to commencing any disturbance activities; + Conduct site inspections as required to ensure ESC measures are operational and in good order; + Monitor daily rainfall; + Notify Environmental Advisor when runoff generating rainfall occurs in the previous 24 hours; + Treat, test and dispose of captured runoff as per operation procedures;
Environmental Manager/Advisor	+ Conduct site inspections and audits as required; + Prepare audit reports based in inspections; + Provide advice, as required regarding ESC site improvement. + Conduct in-situ monitoring as required; + Collect and submit samples to laboratory as required; + Collate results and prepare reports as required; + Maintain current records of rainfall, water quality, treatment practices, discharge activities.
All Personnel	+ Report any damage to ESC devices and any potential or actual environmental harm in line with Duty to Notify under the requirements of the <i>Waste Management and Pollution Control Act 1998 (NT)</i>



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TOPO.

9 SITE INSPECTION AND MONITORING

Site inspections and monitoring is to be undertaken in accordance with Sections 6.17 and 7.4 of the Best Practice Erosion and Sediment Control Document (IECA, 2008) as detailed below. When a site inspection detects a notable failure in the adopted ESC measures, the source of this failure must be reported, investigated and appropriate amendments made to the site and the ESCP.

ESCPs should be considered live documents that in some instances will require review and updating as site conditions change, or if the adopted measures fail to achieve the required treatment standard.

Best practice site management requires all ESC measures to be inspected at the following frequencies and include the following checks as a minimum:

Daily site inspections (during rainfall)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + All site discharge points (including dewatering activities as appropriate)

Weekly site inspections (even if work is not occurring on-site)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements
- + Litter and waste receptors
- + Oil, fuel and chemical storage facilities

Prior to anticipated runoff producing rainfall (within 24 hours of expected rainfall)

- + All drainage, erosion and sediment control measures
- + All temporary flow diversion and drainage works

Following runoff producing rainfall (within 18 hours of rainfall event)

- + All drainage, erosion and sediment control measures
- + Occurrences of excessive sediment deposition (whether on-site or off-site)
- + Occurrences of construction materials, litter or sediment placed, deposited, washed or blown from the site, including deposition by vehicular movements

The findings of ESC site inspections and monitoring will be documented as per the CEMP reporting requirements for compliance and non-compliance reporting.





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APPENDIX A

EROSION AND SEDIMENT CONTROL DRAWINGS

Environment. Engineering. Education.





EROSION AND SEDIMENT CONTROL DRAWINGS

DARWIN SHIP LIFT

WET SEASON

NOV 2024 - MARCH 2025



ADMINISTRATOR - NT GOV

DRAWING LIST:
D00 - COVER SHEET
D01 - CATCHMENT PLAN
D02 - MONTHLY SOIL LOSS CALCULATIONS
D03 - CONTROLS
D04 - CONTROLS
D05 - CALCULATIONS AND STANDARD DETAIL
D06 - CALCULATIONS AND STANDARD DETAIL
D07 - CALCULATIONS AND STANDARD DETAIL

REFER TO REPORT (REFERENCE: R3016) FOR ADDITIONAL DETAILS RELATING TO GUIDELINES USED, PROJECT AND SITE DESCRIPTION, CLIMATE, TOPOGRAPHY, SOILS, EROSION RISK ASSESSMENT, EROSION, SEDIMENT AND DRAINAGE CONTROL SPECIFICATIONS, SEDIMENT BASIN OPERATION, ROLES AND RESPONSIBILITIES AND SITE INSPECTION AND MONITORING

PROPOSED TEMPORARY DESIGN PROVIDED FOR CONSTRUCTION PHASE EROSION, SEDIMENT & DRAINAGE CONTROL ONLY. THE CLIENT IS RESPONSIBLE FOR ENSURING THE INSTALLATION OF ANY CONTROLS PROPOSED HEREIN CAN BE INSTALLED & OPERATED SAFELY FOR PEDESTRIANS, VEHICLES, WORKERS/ CONTRACTORS/ ADMINISTRATORS & MEMBERS OF THE PUBLIC.



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CATCHMENT RISK ASSESSMENT - MONTHLY SOIL LOSS

CATCHMENT ID

AREA (HA)

R

K

SLOPE LENGTH (m)

SLOPE (%)

LS

P

C

Jan (t/ha/month)

Feb (t/ha/month)

Mar (t/ha/month)

Apr (t/ha/month)

May (t/ha/month)

Jun (t/ha/month)

Jul (t/ha/month)

Aug (t/ha/month)

Sep (t/ha/month)

Oct (t/ha/month)

Nov (t/ha/month)

Dec (t/ha/month)

A (t/ha/yr)

A (t/yr)

CONTROL

1

0.25

4245

0.030

25

2.0

0.28

1.3

1.00

14.20

10.21

7.24

2.69

0.28

0.05

0.00

0.00

0.19

1.16

3.01

7.33

46

12

TYPE 3

2

1.24

4245

0.030

80

2.0

0.41

1.3

1.00

20.79

14.95

10.60

3.93

0.41

0.07

0.00

0.00

0.27

1.69

4.41

10.73

68

84

TYPE 3

3

2.09

4245

0.030

80

3.0

0.65

1.3

1.00

32.96

23.70

16.81

6.24

0.65

0.11

0.00

0.00

0.43

2.69

7.00

17.01

108

225

TYPE 1

4

3.29

4245

0.030

80

3.0

0.65

1.3

1.00

32.96

23.70

16.81

6.24

0.65

0.11

0.00

0.00

0.43

2.69

7.00

17.01

108

354

TYPE 1

TYPE 2

TYPE 2

TYPE 2

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 2

TYPE 1

TYPE 1

TYPE 1

TYPE 3

TYPE 3

TYPE 3

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TYPE 1

TYPE 1

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TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 3

TYPE 1

Table B1 – Sediment control standard (default) based on soil loss rate

Catchment Area (m²)^[1]

Soil loss (t/ha/yr)^[2]

Soil loss (t/ha/month)^[2]

Type 1

Type 2

Type 3

Type 1

Type 2

Type 3

250

N/A

N/A

[4]

N/A

N/A

[4]

1000

N/A

N/A

All cases

N/A

N/A

All cases

2500

N/A

> 75

75

N/A

> 6.25

6.25

>2500

> 150

150

75

> 12.5

12.5

6.25

> 10,000

> 75

N/A

75

> 6.25

N/A

6.25

Notes:

[1] Area is defined by the catchment area draining to a given site discharge. Sub-dividing a given drainage catchment shall not reduce its 'effective area' if runoff from these sub-areas ultimately discharges from the site at the same general location. The 'area' does not include any 'clean' water catchment that bypasses the sediment trap. The catchment area shall be defined by the 'worst case' scenario, i.e. the largest effective area that exists at any instance during the soil disturbance.

[2] Soil loss defines the maximum allowable soil loss rate (based on RUSLE analysis) from a given catchment area. A slope length of 80 m should be adopted within the RUSLE analysis unless permanent drainage or landscape features reduce this length.

[3] RUSLE analysis on a monthly basis shall only apply in circumstances where the timing of the soil disturbance incident be regulated by enforceable development approval conditions. When conducting monthly RUSLE calculations, use the worst-case monthly R-Factor during the nominated period of disturbance.

[4] Refer to the relevant regulatory authority for assessment procedures. The default standard is a Type 3 sediment trap.

[5] Exceptions to the use of Sediment Basins shall apply in circumstances where it can be demonstrated that the construction and/or operation of a Sediment Basin is not practical, such as in many forms of linear construction where the available work space or Right of Way does not provide sufficient land area. In these instances, the focus must be erosion control using techniques to achieve an equivalent outcome. The intent shall always be to take all reasonable and practicable measures to prevent or minimise potential environmental harm.

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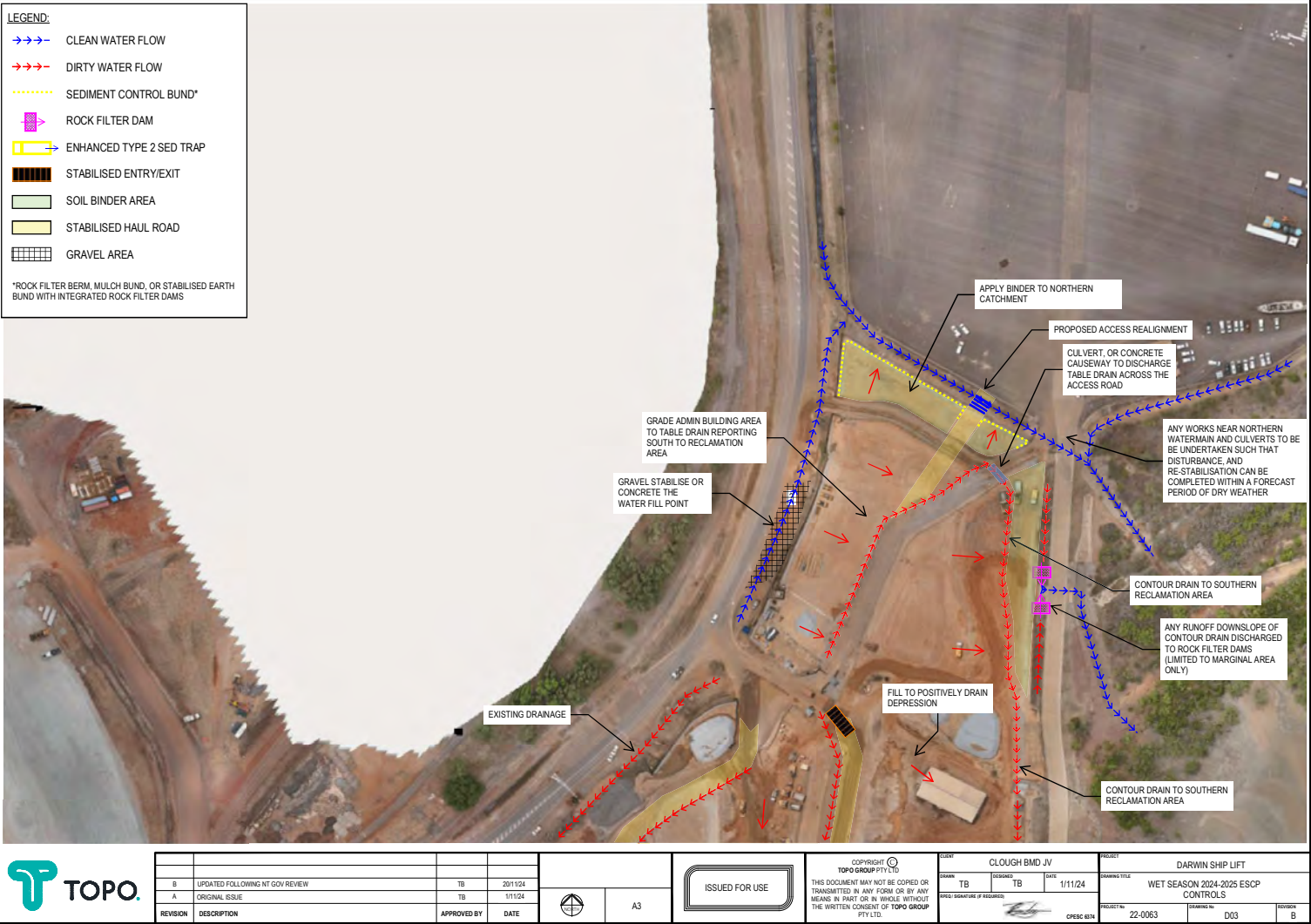
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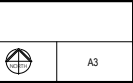
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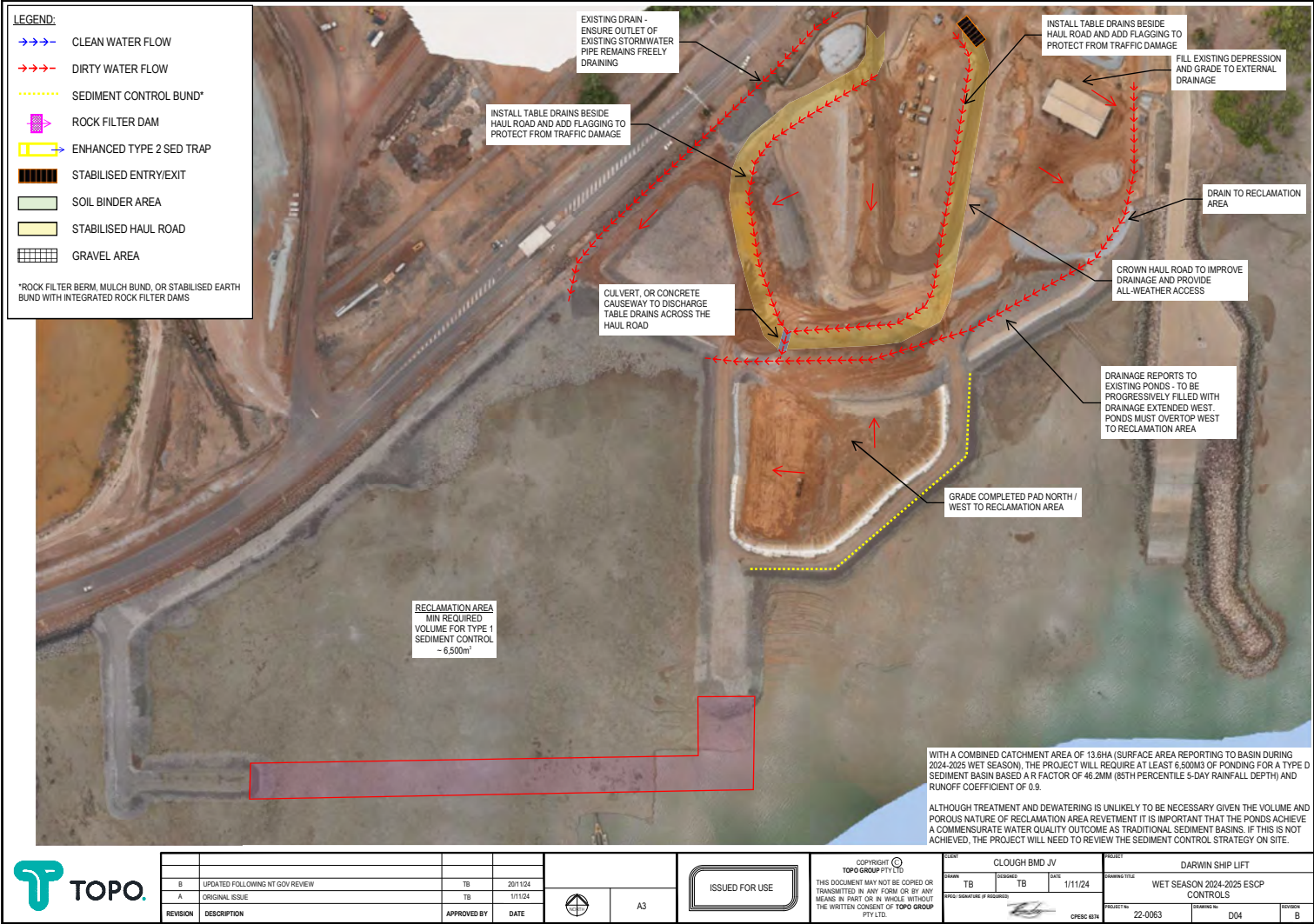


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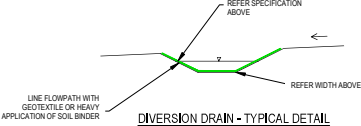
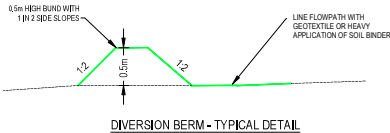
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DIVERSION BUND / DRAIN SIZING

DRAIN ID	CATCH AREA (HA)	ARI	C _{ARI}	TIME OF CONC (MINS)	I _{ARI}	FLOW - Q (m³/s)	LONG. SLOPE (m/m)	BASE WIDTH	SIDE SLOPE 1 (1 in x)	SIDE SLOPE 2 (1 in x)	LINING	MANNING ROUGH COEFF	MAX PERM VEL (m/s)	DESIGN VEL (m/s)	DEPTH OF FLOW (m)	DEPTH WITH F/BOARD (m)	DRAIN TOP WIDTH (m)	OK / NOT OK
Diversion Bund	2	5	0.665	10	161	0.59	0.01	-	1	50	Vital HR - L/m²	0.02	1.5	0.92	0.16	0.31	-	OK
Diversion Drain	2	5	0.665	10	161	0.59	0.01	1	1	1	Vital HR - 2L/m²	0.02	2.5	1.69	0.28	0.43	1.85	OK
HR Table Drain	1	2	0.665	10	142	0.26	0.03	0.5	1	1	Vital HR - 2L/m²	0.02	2.5	2.12	0.18	0.33	1.16	OK



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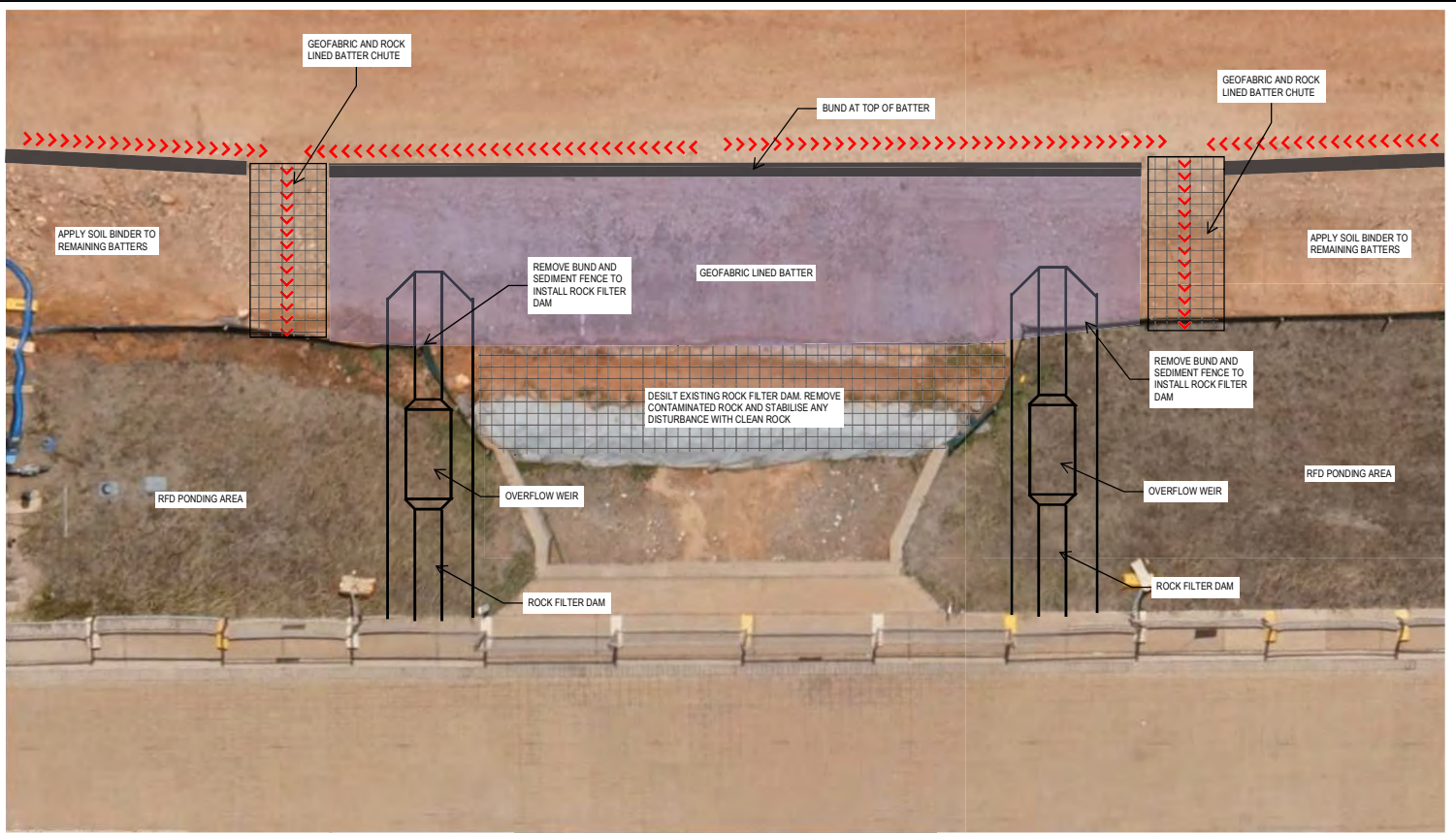
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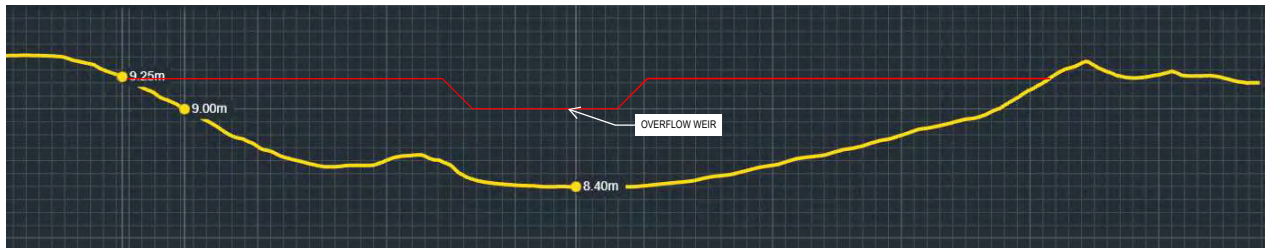
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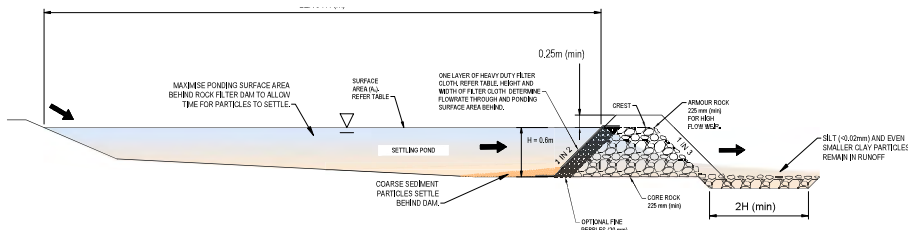
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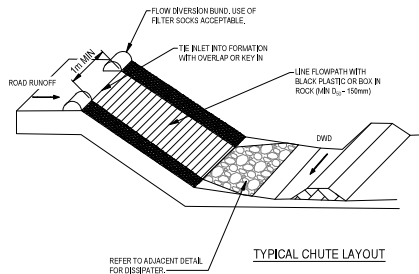


ROCK FILTER DAM (CROSS SECTION)



ROCK FILTER DAM (LONG SECTION)

EXAMPLE



TYPICAL CHUTE LAYOUT



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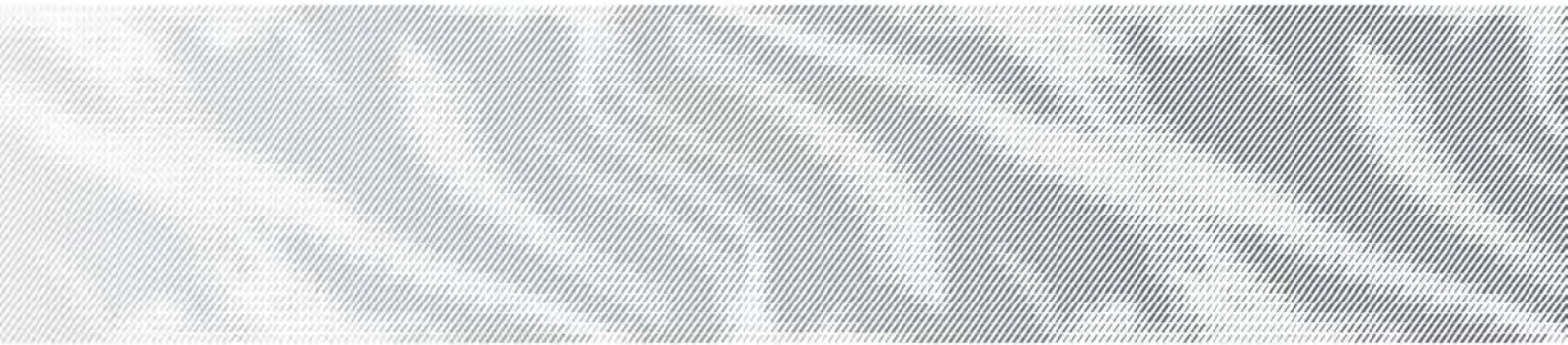
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APPENDIX M MARINE MEGAFUNA MANAGEMENT PLAN

INTERNAL



Darwin Ship Lift Project
Marine Megafauna Management Plan
41213-HSE-REP-D-1002

REV	DATE	GENERAL DESCRIPTION	PREPARED	REVIEWED	APPROVED
0	19-Jan-2024	Issued for Use	M Pinkerton	J Weir	L Munro
1	11-Dec-2024	Re-issued for Use	C Hyde	J Weir	L Munro
2	31-May-2025	Re-issued for Use	C Hyde	J Weir	C Thornton
			Signed by:  DocuSigned by: Caprice Hyde	DocuSigned by:  DocuSigned by: John Weir	DocuSigned by:  DocuSigned by: Chris Thornton

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1 Introduction

1.1 Purpose

The Marine Megafauna Management Plan (MMMP) provides a framework for the management of potential impacts to marine megafauna associated with the Darwin Ship Lift Project. The MMMP supplements the DDSPMP, which satisfies condition 2-4 of Environmental Approval EP2023/028-001.

The MMMP has been developed in accordance with the following documents:

- *Environmental Protection Act 2019* (EP Act) Environmental Approval EPA2023/028-001
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) controlled action approval EPBC2021-9068
- Darwin Shiplift Project Dredging and Dredge Spoil Placement Management Plan (DDSPMP) (41213-HSE-PL-D-0001)
- Darwin Shiplift Project Construction Environmental Management Plan (CEMP) (41213-HSE-PL-G-1002)
- Darwin Shiplift Project Draft Environmental Impact Statement (AECOM, 2021)
- Darwin Shiplift Project Supplementary Environmental Impact Statement (AECOM, 2022)

1.2 Project Overview

The Northern Territory Government (NTG) is delivering the Project which comprises construction and operation of a ship lift facility and an adjacent maintenance facility at East Arm. The early design and procurement of the Project has been managed by a dedicated NTG Ship Lift Project Team within the Department of the Chief Minister and Cabinet (DCMC). Final procurement and construction will be managed by the Department of Infrastructure, Planning and Logistics (DIPL).

The Project will enable maintenance and servicing of a broad range of industries, including the Australian Defence Force (ADF) and Australian Border Force (ABF) vessels, as well as commercial and private vessels, including those servicing the oil, gas, pearling, fishing and other marine industries. It will be northern Australia's largest common user ship lift and will provide marine infrastructure that will deliver key services to northern Australia, acting as an enabler for the continued economic growth of Darwin as the logistics and marine services hub of the NT and northern Australia.

The Project is situated approximately 6.5 km south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour. The site is approximately 700 m east north-east of the East Arm Wharf (EAW) and the Marine Supply Base (MSB), and west of the Darwin Business Park. Road access is provided by Berrimah Road, linking the site to the Darwin road network including the Stuart Highway and Tiger Brennan Drive.

The location of the Project is shown in Figure 1. The approved extent as constrained by the EP Act Approval EPA2023/028-001 is provided in Figure 3.

Darwin Ship Lift Project – Marine Megafauna Management Plan

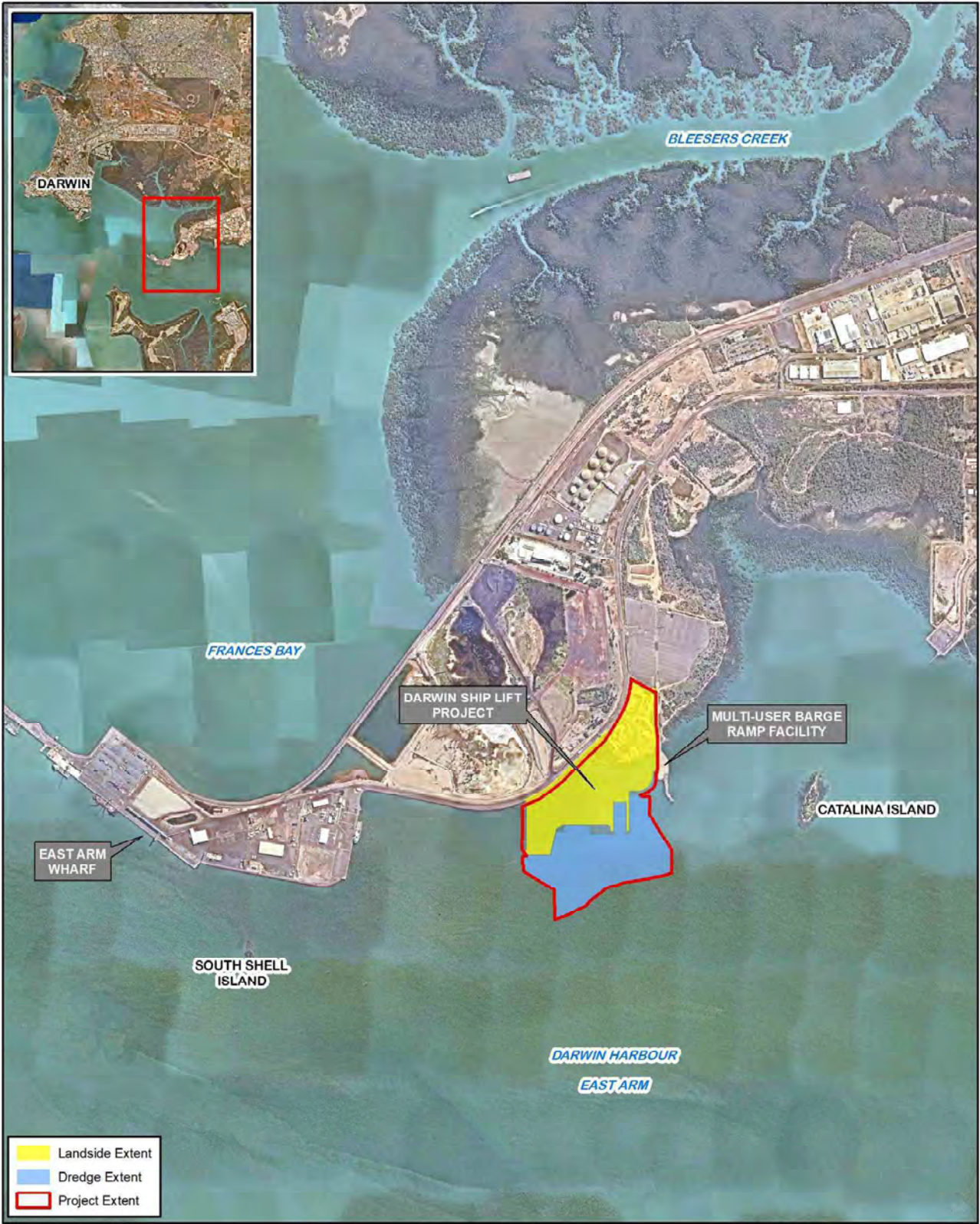


Figure 1 - Project Location

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1.3 Project Footprint

The footprint of the Project when constructed will cover 29.7 ha and incorporate both land and water components. Within the project footprint, the following construction activities are anticipated:

- site preparation
- dredging
- transport of fill and materials
- land reclamation and revetments
- service installation, pavement sealing and paving
- piling
- infrastructure/component fabrication and installation
- corrosion protection

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Figure 2 – Darwin Shiplift Project Layout including Dredging Footprint, and Settlement Ponds

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1.4 Description of Works

To enable the construction of the Darwin Ship Lift Project it is estimated that approximately 9.2 ha of dredging will be required. The dredging consists of:

- ship lift minimum dredge level -7.5m lowest astronomical tide (LAT) (Declared dredge level -7.2mLAT).
- wet berths minimum dredge level -6.8mLAT (Declared dredge level -6.5mLAT)
- approach channel and manoeuvring basin areas at -3.3mLAT (Declared dredge level -3.0mLAT).

There are two components to the program for dredging the footprint of the wet berth and maneuvering basin areas:

- removal of approximately 173,430 cubic metres (m³) of unconsolidated marine material
- removal of approximately 343,675 m³ of consolidated materials.

1.4.1 Component 1 - Unconsolidated Material

The dredging campaign will be undertaken by using a small cutter suction dredge (CSD), similar to that used for the neighbouring MUBRF dredge campaign, to remove the unconsolidated material to settling ponds, then a backhoe dredge (BHD) to remove the consolidated stiff clays and rock for land reclamation.

The CSD, supported by work boats, will pump the unconsolidated material (via floating, submerged and/or overland pipelines) to the existing EAW settlement ponds. The final pipeline route will be determined by the Dredging Contractor in conjunction with the Contractor and Harbour Master.

The dredged material will be deposited into dredge Pond K, in which the larger particles (sands and silts) will settle out. The supernatant tailwater will then flow into Pond E (north), in which finer particles will settle out. Pond E (south) will provide a final settlement stage before discharge of the tailwater to Darwin Harbour via a permeable section of the bund wall. Testing of the water will take place prior to discharge to ensure all environmental targets are met.

The EAW settlement ponds have been utilised in this manner in the past for dredged material placement for the MSB and MUBRF dredging campaigns.

1.4.2 Component 2 - Consolidated Material

The reclamation area would be bunded and then progressively filled with consolidated material until the extent of the proposed reclamation is reached. Consolidated material would be removed by a BHD, placed into hopper barges and transferred into the reclamation area within the Project footprint. Sediment control measures such as silt curtains would be used to further minimise the release of sediments into the receiving environment from the reclamation area.

All dredging works will be undertaken in accordance with the approved DDSPMP and the Waste Discharge Licence.

Dredging is expected to be undertaken during both day and night-time hours, seven days per week. The dredging would not be continuous, and there would be periodic down time of the dredge (e.g. due to relocation of the dredge, shift changes, maintenance and weather interruptions). Other activities associated with the dredging (e.g. pipeline relocations, anchor relocations, movement of attendant work boats and barges) will also need to occur intermittently during both day and night time hours.

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Dredging is expected to commence in August 2024 and conclude in October 2025.

1.5 Objectives and Targets

The Objectives relevant for this MMMP are:

Project construction activities must be carried out to achieve the environmental objectives included in Environmental Approval (EP2023/028-001), including the following:

- Protect the quality and productivity of water, sediment, and biota so that environmental values are maintained within Darwin Harbour
- Protect marine habitats to maintain environmental values including biodiversity, ecological integrity, and ecological functioning within Darwin Harbour
- No material environmental harm to the environmental values and declared beneficial uses of Darwin Harbour beyond the approved extent, including but not limited to the quality or productivity of water, sediment and biota
- Dredging and land reclamation must not cause any adverse impact on water quality, or the condition or distribution of benthic communities or marine megafauna outside of the footprint and immediate surrounds, as indicated by monitoring required by condition 2-4(3) [of the EP Approval]
- Minimise the risk of physical injury, mortality, behavioural changes and health impacts on marine megafauna
- To implement measures for avoidance and minimisation of impacts on marine megafauna, as indicated by condition 2-4(7) [of the EP Approval]

1.6 Legislative Requirements

The legislation, policies, standards, and guidelines of specific relevance to marine fauna are described below:

Commonwealth

- *Biosecurity Act 2015*
- *Environment Protection and Biodiversity Conservation Act 1999*
- National system for the prevention and management of marine pest incursions
- Anti-fouling and in-water cleaning guidelines.

Northern Territory

- *Environment Protection Act 2019*
- *Fisheries Act 1988*
- *Marine Act 1981*
- *Ports Management Act 2015*
- *Territory Parks and Wildlife Conservation Act 1976*
- Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory, Version 2.0.

2 Existing Marine Environment

Darwin Harbour is one of the least-disturbed working harbours in Australia and the Asia-Pacific region. The region's catchment extends from Charles Point in the west and Gunn Point in the east and covers approximately 3,230 km². The area includes the tributaries and estuarine areas of Cox Peninsula, West Arm, Middle Arm, East Arm, Blackmore River, and Howard River.

Several major river systems drain to the estuary (Blackmore, Elizabeth, and Howard) unlike other Australian cities which receive most of their catchment inflows from one large riverine system (DHAC 2020). Freshwater inflow into the Harbour occurs from January to April, when estuarine conditions prevail in all areas (Hanley 1988). Darwin Harbour supports a range of ecosystems including mudflats, mangroves, coral reefs, and seagrass. It is also home to varied animal life such as dolphins, dugong, sea turtles, shorebirds, sponges, and a large variety of fish (DLRM 2014).

The main channel of the Harbour is around 15-25 m deep, with a maximum depth of 36 m. The channel favours the eastern side of the Harbour, with broader shallower areas occurring on the west side. Intertidal flats and shoals are generally more extensive on the western side than on the eastern side. The natural channel continued into East Arm, towards Bladin Point, at water depths of more than 10 m below LAT. Over recent years, the bathymetry in this area has been modified by dredging and reclamation for the development and expansion of EAW and the construction of the INPEX LNG onshore processing plant on Bladin Point.

The Project location features shallow bathymetry (approximately 0 to 10 m below LAT), bounded by dredged channels for the adjacent marine facilities and offshore by the main East Arm channel.

Marine coastal processes, water and sediment quality, and marine ecological communities are described fully in AECOM (2021, 2022).

2.1 Marine Fauna

2.1.1 Protected Marine Species

Certain species within Darwin Harbour are protected under the following legislation and conventions:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), which provides a legal framework to protect and manage nationally and internationally threatened plants and animals. The EPBC Act also considers potential impacts upon species listed under international treaties and conventions.
- The *Territory Parks and Wildlife Conservation Act 1976* (TPWC Act). Under section 29 of the TPWC Act, the responsible Minister administers the NT Threatened Species List and assesses and classifies the conservation status of all wildlife species occurring in the NT. In this endeavor the Minister is supported by the relevant NT Government department, which is currently the Department of Environment, Parks and Water Security (DEPWS). Sightings of threatened species, as well as those considered to be 'significant', are recorded in the Natural Resource Maps NT database (Biodiversity (nt.gov.au)). In turn, these sightings are recorded in the Atlas of Living Australia (ALA 2021).
- The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, which includes marine animals that are considered to be under threat of extinction.
- The Bonn Convention on migratory species.
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

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The threatened species that the EPBC Protected Matters Search Tool (PMST) database indicates may be found in the vicinity of East Arm, including the Project location, are listed in Table 1. However, it is noted that the database applies very broad distributions of species and their habitats and some of the listed species are not known to occur within Darwin Harbour. Hence, in relation to the species listed in Table 1:

- Humpback whales migrate to northern Australia from June to August but are not known to venture as far north-east as Darwin Harbour.
- Whale sharks are not known to occur within Darwin Harbour.

Table 1 Threatened species listed in the EPBC protected matters database as potentially occurring in the vicinity of the Project area

Scientific Name	Common Name
Cetaceans: Whales	
<i>Megaptera novaeangliae</i>	Humpback whale
Turtles	
<i>Caretta caretta</i>	Loggerhead turtle
<i>Chelonia mydas</i>	Green turtle
<i>Dermochelys coriacea</i>	Leatherback turtle
<i>Eretmochelys imbricata</i>	Hawsbill turtle
<i>Lepidochelys olivacea</i>	Olive ridley turtle
<i>Natator depressus</i>	Flatback turtle
Cartilaginous Fish	
<i>Pristis clavata</i>	Dwarf sawfish
<i>Pristis microdon</i>	Freshwater sawfish
<i>Pristis zijsron</i>	Green sawfish
<i>Rhincodon typus</i>	Whale shark

In addition to the species in **Table 1**, several other species known to be, or are potentially present in Darwin Harbour are listed as migratory species under the EPBC Act (**Table 2**). Dugongs and the dolphin species are discussed in sub-sections below. Bryde's and Humpback whales are not known to occur within Darwin Harbour, while Killer whales are regarded by Palmer et al (2017) to be occasional visitors to NT waters, though not specifically to Darwin Harbour.

Table 2 EPBC listed migratory species known to occur, or potentially occurring, in Darwin Harbour

Scientific Name	Common Name
<i>Dugong dugon</i>	Dugong
<i>Balaenoptera edeni</i>	Bryde's whale
<i>Megaptera novaeangliae</i>	Humpback whale
<i>Orcinus orca</i>	Killer whale
<i>Orcaella heinsohni</i>	Australian snubfin dolphin
<i>Sousa sahalensis</i>	Australian humpback dolphin
<i>Tursiops aduncus</i>	Spotted bottlenose dolphin
<i>Crocodylus porosus</i>	Estuarine Crocodile

2.1.2 Cetaceans

Three species of coastal dolphin are the most commonly recorded cetaceans in Darwin Harbour: the Australian humpback (*Sousa sahalensis*; formerly known as the Indo-Pacific humpback), Indo-Pacific bottlenose (*Tursiops aduncus*) and Australian snubfin (*Orcaella heinsohni*) dolphins (Palmer 2008). INPEX (2011) details knowledge of the taxonomy, distribution, microhabitats, residency, and site fidelity of the three species of coastal dolphins, while Brooks and Pollock (2014), Brooks et al (2017) and Griffiths et al (2020) present data from the extensive surveys undertaken for the INPEX Ichthys LNG project. In addition, the conservation status of coastal dolphins in the NT has been assessed by Palmer et al (2017).

Other species of dolphin that may be present in Darwin Harbour include Common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), Spotted dolphin (*Stenella attenuata*) and Bottlenose dolphin (*Tursiops truncatus*). Pods of False killer whales (*Pseudorca crassidens*) are considered by Palmer et al (2009) to be regular visitors to the harbour. It is notable that all cetaceans are protected under the EPBC Act.

Griffiths et al (2020) summarise the outcomes of studies of the abundance, movements, and habitat use of coastal dolphins (Australian humpback, Indo-Pacific bottlenose, and Australian snubfin) in the Darwin region (Darwin Harbour, Bynoe Harbour and Shoal Bay). On the basis of data from surveys undertaken between 2011 and 2019, and model outputs based upon capture-recapture data from these surveys, Griffiths et al (2020) concluded the following:

- All three species typically occurred at low densities, exhibited substantial emigration, and had fluctuating population size.
- Humpback dolphins were the most commonly observed of the three species and there was demonstrable movement of this species between the three monitoring areas. Over the course of the monitoring program, there was a significant decrease in estimated abundance in Darwin Harbour a non-significant increase in Bynoe Harbour and a non-significant decrease at Shoal Bay.
- The Snubfin dolphin population was small and was considered to have the greatest variability in population size and the greatest degree of temporary emigration (i.e. temporarily leaving the study area). Modelling indicated a significant negative trend in estimated abundance over the course of the monitoring program.

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- The Bottlenose dolphin population was the smallest, with an apparently high degree of temporary emigration and a significant overall decrease in estimated abundance.
- The reasons for the significant declines were considered to be unclear but were thought to potentially be related to population dynamics, environmental or anthropogenic factors.
- The estimated population density of each species appeared to be similar to average densities in NT coastal waters.
- The estimated population densities of Humpback and Snubfin dolphins appeared to be within the ranges of densities recorded in Western Australia and Queensland, while the estimated densities of Bottlenose dolphins in the Darwin Harbour region and the NT appeared to be lower than in similar northern Australian locations.
- The estimated temporary emigration rates were considered to be similar to those in coastal dolphin populations elsewhere in Australia and overseas.
- Apparent survival rates were considered to be similar to, or lower than, those reported elsewhere for the same species, though the difficulty in accurately assessing survival rates was recognised. It was considered that emigration probably had a greater influence on population growth than deaths.

It is noted that there are no known areas of critical feeding or breeding habitat for dolphins within the zone of potential effects from the development and operation of the Project. The Indo-Pacific humpback and the Australian snubfin dolphin appear to be opportunistic generalist feeders, eating a wide variety of fish both on the seabed and within the water column (Parra 2006). No calving areas have been identified in Australian waters for either species and little is known of their reproductive biology or population structure (Ross 2006, Parra et al 2006).

2.1.3 Dugongs

Dugongs are known to occur in Darwin Harbour waters, although in relatively low numbers. Dugongs have been recorded in higher densities at Gunn Point and the Vernon Islands, some 30–50 km to the north-east of the mouth of the harbour. Dugongs have also been observed in relatively high numbers at Bare Sand Island and Dundee Beach in Fog Bay, 60 km south-west of Darwin Harbour, and are known to travel long distances (Whiting 2008).

Cardno (2014b) compared the results of baseline surveys with four surveys undertaken throughout the dredging phases of the Turtle and Dugong Monitoring Program associated with the INPEX Ichthys project. This study revealed that dugongs were observed in varying numbers between surveys; however, no trends (including seasonal variations) were evident. There was a higher number of dugongs observed in shallower waters (6 – 10 m), generally in foraging areas where seagrass was present. Variation in dugong observed between surveys within sites was concluded to most likely be a result of short-term movement of dugongs to visit optimum foraging areas of seagrass.

During baseline surveys (June to October 2012) most sightings in Darwin Harbour were around Weed Reef, West Arm and near Bladin Point, as well as in the shallow regions of Shoal Bay. During later baseline surveys, most dugong sightings were around outer Darwin Harbour, with aggregations around mapped seagrass near Casuarina Beach (Cardno, 2014b).

During the first of the Dredging Phase surveys (May 2013), dugongs were predominantly sighted in outer Darwin Harbour, with only one dugong sighted near Weed Reef and another in the shallow areas in West Arm. During the Dredging Phase surveys in July/August and October 2013, no dugongs were sighted in the inner Darwin Harbour, while during the end of dredging survey (May 2014) three dugongs were sighted near Weed Reef (Cardno, 2014b).

During the two surveys undertaken in October 2013, sightings were concentrated around Casuarina Beach and were associated with areas of seagrass (*Halodule* sp.). Lower numbers were observed in this area in wet season surveys, and it was considered that the reduced seagrass coverage in this season was likely to have been a contributing factor (Cardno 2014b).

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In general, it is considered that dugongs could occur anywhere in the harbour that could support seagrasses or macroalgae. Within Darwin Harbour, dugongs have been observed at Channel Island in Middle Arm, where they were thought to be feeding on macroalgae (Whiting 2002). However, there are anecdotal records of seagrass occurrence in the vicinity of the Channel Island boat ramp, and this may have been a contributory factor to their presence. While some macroalgal communities may be present in the vicinity of the Project area, substantially greater areas of potential foraging habitat for dugong exist elsewhere in the harbour (INPEX 2011).

2.1.4 Turtles

Six species of marine turtles are known to occur in NT waters. Of these, four (the Green, Hawksbill, Olive ridley and Flatback turtles) are considered to occur in the Darwin Harbour region (Whiting 2003). Loggerhead turtles are suspected to be infrequent users of the harbour and the Leatherback turtle is considered to be an oceanic species which is unlikely to occur in Darwin Harbour (Whiting 2003).

The shoreline throughout Darwin Harbour, and particularly in East Arm, consists largely of mangrove forests and mudflats and does not provide suitable nesting habitat for any species of turtle (INPEX 2010). The nearest nesting beach (used by the Flatback turtle) is located in the Casuarina Coastal Reserve near Lee Point on the north-eastern shore of the harbour. Turtles visiting the harbour are more likely to be foraging for food. Flatback and Hawksbill turtles forage on the filter feeder communities which are extensive in the harbour. The Hawksbill turtle also forages on seagrass and macroalgal communities in addition to filter feeders. Green turtles forage amongst seagrass and macroalgal communities (INPEX 2011).

Cardno (2014b) implemented the Turtle and Dugong Monitoring Program for the INPEX Ichthys project; this included aerial and land survey techniques to monitor the abundance and distribution of turtles around Darwin Harbour. They concluded that:

- Statistical analysis of population and density estimates formed in this study did not indicate that the distribution or abundance of these animals had changed since the baseline phase.
- During survey D4 (during dredging) 813 turtles were sighted, which was higher than the average number of turtles sighted per survey during the baseline phase (634 turtles), but approximately 17% lower than the number of turtles recorded during baseline survey B3 (984 turtles), undertaken at the same time of year (October 2012).
- Statistical analyses of turtle population densities did not detect any significant difference between the impact and control treatments in either phase, or between baseline and dredging phases, for either treatment. In contrast, estimates of turtle density based on raw observations were significantly higher at the control blocks compared with the impact block during the baseline phase, but not during the dredging phase. The observed temporal and spatial variation in turtle distribution and abundance was considered possibly to be a result of short-term movements in and out of specific areas, possibly due to avoidance behaviour and/or the pursuit of more optimal foraging areas.
- Turtle sightings were most frequently recorded within relatively shallow water habitat, most commonly in waters less than 5 m in depth; however, a small number were sighted in the deep-water channels near the Vernon Island (outside of Darwin Harbour) in waters greater than 30 m depth.
- Where benthic habitat type had been identified and mapped, turtles were primarily sighted in association with gravel, sand, and reef. Only 3% of turtle sightings were associated with mud habitat, the predominant habitat within, and around, the Project area.

A search of Fauna Atlas NT recorded sightings of both the Green turtle (*Chelonia mydas*) and the Flatback turtle (*Natator depressus*) in the Project area, neither of which are listed under NT legislation.

2.1.5 Estuarine Crocodiles

Whilst Estuarine (saltwater) Crocodiles (*Crocodylus porosus*) have the potential to occasionally occur in the Project area as they move between suitable foraging areas, the project will have no impact to Estuarine crocodiles as:

- they typically avoid areas of high vessel activity such as the dredging and spoil disposal locations.
- the project area does not contain any important habitat for the Estuarine Crocodile. There are only limited nesting sites for the estuarine crocodile available inside Darwin Harbour (Whiting 2003).

In addition, the EPBC notice (EPBC2021/9068) outlines that the only impacts that could occur to individual crocodiles because of the proposed action are temporary sub-tidal impacts and removal of basking habitat related to the project activities (including dredging and pile driving), however, there is no evidence that crocodiles use the project area for basking and other activities. This may be due to the dynamic environment of the existing site.

Therefore, the Project does not consider management actions specific to the protection of the Estuarine Crocodiles are required, and management actions adopted for other megafauna species (outlined in Section 2) are deemed sufficient for this species.

3 Risk Identification and Assessment

3.1 Potential Impacts and Risks

This sub-section provides an overview of pathways for potential impacts upon marine megafauna – dolphins, Dugongs, and turtles - attendant to construction of the Project. It broadly outlines the reasoning that leads to a conclusion that the Project does not represent a source of impacts with the potential to significantly impact upon the marine biological diversity or ecological integrity of East Arm, or of the broader Darwin Harbour. This is contingent upon the effective implementation of the management and mitigation measures described in Section 8.3.

3.1.1 Fauna interactions with vessels

The main risk of physical interaction with marine megafauna species will be in relation to the movement of dredge support vessels (e.g., Tug and Spoil barge, crew transfer vessel, tender vessel). The risk of direct impact to protected marine species from the operating dredge is considered to be very low. As the dredge will be stationary during most of the works, with the most mobile part of the equipment (the CSD cutter head or BHD bucket) generating noise and vibration which is likely to discourage any species that may be present from approaching sufficiently close to the dredge for them to be exposed to the risk of impact or entrainment. It is noted that exclusion devices to reduce the risk of entrainment of marine megafauna into dredges are only able to be applied to mobile dredges (e.g. Trailer Suction Hopper Dredges [TSHDs]) and not to stationary dredges such as the (potential) CSD and BHD to be used for the Project.

When moving between or within the dredging footprint, the dredge will transit at low speeds (<5 Kn) and only over small distances (tens of metres).

It should be noted that physical interactions between dredging vessels and marine species are a higher risk when mobile dredges such as TSHDs are used, or when dredged material is disposed offshore. Neither of these scenarios is applicable to the dredging for the Project.

Nevertheless, there will be monitoring, and management measures implemented to reduce the risk of physical interaction with protected marine species, as described in the Marine Megafauna Management Framework – vessel interaction, in Section 8.3.1. These measures will apply to the operation of the dredge and also to any other vessels engaged in the works

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(e.g. crew transfer vessels).

3.1.2 Underwater Noise and Vibration

Underwater noise and vibration will be generated by dredging and piling activities; however, pile-driving presents the greater risk to marine fauna with respect to the effects of underwater noise. An extensive assessment and modelling of the risks and impacts of construction noise with respect to marine megafauna can be found in AECOM (2021) *Appendix G: Underwater Noise Technical Report* (Talis 2021).

Approximately 240 days of piling activity are predicted during the construction phase, employing both drilling and hydraulic hammering as pile-driving methods. Pile dressing is not required and therefore associated noise impacts are not considered.

The majority of the estimated 80 piles are located above mean low water, meaning that some noise- impact risk is mitigated due to characteristics of local tidal regimes. Shallow water sound attenuation is significant due to the reflective properties of the narrow seabed-sea surface interface; as a result, acoustic energy decays faster with distance from the noise source than in deeper water. This effect is particularly exacerbated for low frequencies in shallow water; this further reduces the distance from source that deleterious effects of piling and dredging noise may be encountered.

The impacts of construction noise on marine fauna are separated into two categories:

- The onset of (sub-lethal) injury, defined as permanent threshold shift (PTS), indicative of tissue injury within hearing organs. PTS is considered a reliable, conservative indicator of the onset of permanent, albeit slight, irreversible physical injury.
- Temporary threshold shift (TTS), indicative of reduced hearing sensitivity. This results primarily from fatigue, rather than injury, of hearing organs and is reversible. TTS therefore serves as a cautious indicator of the possible onset of reversible physiological effects.

As well as noise thresholds being classified as PTS and TTS, they are further split into:

- Impulsive sounds, which are typically less than a second in duration with a high peak pressure and rapid onset and decay. Pile-driving and blasting are examples of impulsive sound sources underwater (Gordon et al 2004, cited in Hastie et al 2019).
- Non-impulsive noise sources, which include a range of frequency band widths and can be brief, intermittent, or continuous in duration and do not demonstrate high peak sound pressure waves. Dredging, drilling and vessel noise are typically non-impulsive noise sources.

Both impulsive and non-impulsive noise can cause behavioural changes in marine megafauna, particularly over long exposure times. Behavioural changes may include changes in feeding and breeding behaviour, as well as differences in more complex ecological interactions. It is noted that there are no known areas of critical breeding or feeding habitat for protected marine species within the zone of potential effects from the development and operation of the Project. Estimates for distances from source for predicted effects of underwater noise are estimated for TTS, PTS and behavioural changes in *Appendix G: Underwater Noise Technical Report* (Talis 2021).

Key predictions from Talis (2021) are:

- Dredging:
 - Dugongs are predicted to potentially reach TTS onset at 90m from the dredge cutter, and only at high tide, with behavioural disturbances occurring at 50m distances from source.
 - Dolphins are predicted to potentially reach TTS onset earlier, at a distance of 170m at high tide, with behavioural disturbances at 50m.
 - No TTS thresholds are predicted to be exceeded at low tide, and at no point are PTS

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levels predicted to be exceeded for either dugongs or dolphins.

- TTS onset for turtles is predicted to potentially be reached earliest, at distances of 240m at high tide and 100m at low tide. They are the only species predicted to potentially reach dredge-induced PTS onset, at 110m and 30m for high and low tides, respectively.
- Piling:
 - Dugongs are predicted to potentially reach TTS onset at 120m during low tide and 100m at high tide. Behavioural disturbances are predicted at 2200m and 1050m at low and high tides, respectively.
 - Dolphins are predicted to potentially reach TTS onset earlier than dugongs, at 360m and 300m for low and high tide, respectively. Unlike dugongs they are predicted to reach PTS onset at 40m and 30m for low and high tide, respectively. Predicted behavioural disturbance distances are the same as for dugongs.
 - Turtles are predicted to potentially reach TTS onset at 175m and 450m for low and high tides, respectively, whereas PTS onset is predicted to potentially occur at 100m and 150m for low and high tides, respectively. Behavioural disturbance onset is predicted to potentially occur only at high tide, at approximately 70m distant from the piling source.

From the simulation results, it is evident that the standard mitigation measure of assessing for the presence of dugongs, dolphins and turtles within Observation and Shut-down Zones prior to the commencement of (and during) dredging and piling activities is to be implementable for the Project works. That is, a dedicated marine fauna observer (MFO) will be able monitor out to the maximum distance at which TTS is predicted to occur (450m at low tide for turtles).

It is predicted that noise levels that could lead to behavioural disturbance will not extend across the width of East Arm. Hence, it is predicted that dredging and piling will not have the potential to disrupt the passage of dugongs, dolphins or turtles between Elizabeth River and Darwin Harbour.

It is considered that the mitigation and management measures to be incorporated into the environmental management plans described in Sections 8.3.2 and 8.3.3, will be appropriate to reduce the risk of significant impacts upon marine fauna to as low as reasonably possible.

3.1.3 Contaminant inputs during construction

AECOM (2021) considered the risk of contaminant inputs into the marine environment during construction, and found the following:

- Contaminants in terrestrial soils - With the application of standard management and mitigation measures specified in the Construction Environmental Management Plan (CEMP) (41213-HSE-PL-G-1002), the potential for impacts upon marine flora and fauna, and their habitats, from contaminants (if present) in any soil that may enter the marine environment during terrestrial construction works is sufficiently low.
- Acid sulfate soils - The reclamation of the Project area will progress seaward from the existing shoreline any mud waving that may occur would only expose ASS (if present) to air over those parts of the tidal cycle that they are not inundated by tidal waters. It is not considered a credible risk that the exposure times would be of sufficient duration for soil acidity levels to be raised to the extent that toxicants could be mobilised to a degree that they could pose a risk to marine flora and fauna in the vicinity of the Project area.
- Contaminants in marine sediments - When compared against established guideline criteria the concentrations of potential toxicants within the material to be dredged are below those which are considered to potentially pose a risk of significant impact to marine environmental quality. It follows, then, that they are also considered to be sufficiently low as to not pose a risk of significant impact to marine flora and fauna.
- Unplanned releases – Project specific environmental management plans are provided in

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Appendix L – Spill Management Sub-Plan of the CEMP. Management and control measures are described to address each of the key environmental factors for uncontrolled releases of hydrocarbons or other hazardous substances/chemicals. It is considered that, with the effective implementation of management and control measures, the risk of impacts to marine flora and fauna from these toxicant sources will be as low as reasonably practicable (ALARP).

3.1.4 Lighting

Artificial light can disrupt critical behaviours in wildlife, stalling the recovery of threatened species and interfering with a migratory species' ability to undertake long distance migrations integral to its life cycle.

Light pollution was identified as a high-risk threat in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) because artificial light can disrupt critical behaviours such as adult nesting and hatchling orientation, sea finding and dispersal, and can reduce the reproductive viability of turtle stocks. Light is likely to affect the turtles if it can be seen from the nesting beach, nearshore or adjacent waters.

The effect of artificial lights on turtles is most pronounced at nesting beaches and in the nearshore waters, which might include interesting areas, through which hatchlings travel to reach the ocean.

The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023) discusses the impacts of artificial light on wildlife including marine turtles, seabirds, and migratory shorebirds. In regard to marine turtles, impacts are observed the greatest on nesting adults and hatchling orientation.

3.2 Statement of Residual Risk

Assessments of the risks of potential impacts on marine flora and fauna are summarised in Table 7. Risks were assessed both prior to mitigation and following the implementation of the mitigation measures within the Marine Megafauna Management Frameworks detailed above, to provide an assessment of residual risk.

The residual risk assessment indicates that there is a Medium risk of impacts to marine fauna from vessel strike. Given the Major consequence that would arise if vessel strike upon a protected marine species was to occur, it is not possible to reduce the residual risk rank to lower than Medium. This highlights the need to effectively implement surveillance protocols and controls on vessel speeds within the vicinity of the Project area. It is noted that surveillance protocols are routinely implemented by vessels traversing the harbour, to mitigate the risk of collision with floating objects that may result in damage to the vessels; these will also be effective in reducing the risk of vessel strike of protected species to as low as reasonably possible.

The residual risk to marine fauna attendant to all other impact sources is considered, with the implementation of the mitigation measures within the Marine Megafauna Management Frameworks provided above, to be Low.

With regards to significant marine species and habitats, due to limitations in survey techniques (i.e. observations have only been made on discrete occasions, and only during daylight hours), there is inherent uncertainty around whether significant marine species will be present within the vicinity of Project construction and operation activities and, therefore, if they will be potentially vulnerable to disturbance or direct impact. However, the management and mitigation measures included within the plans listed in the Marine Megafauna Management Frameworks provided above have been developed on the assumption that these species may be present in the vicinity of the Project at some time of the day or night, and during some seasons.

Darwin Ship Lift Project – Marine Megafauna Management Plan**Table 3 Pre and post-mitigation risk assessment for marine fauna**

Aspect	Pre-mitigation risk rating	Mitigation measures	Post-mitigation risk rating
Dredging and reclamation – liberation of sediments into water column (turbid plumes)	Medium	Preparation and implementation of Dredging and Dredge Spoil Placement Management Plan (DDSPMP) (41213-HSE-PL-D-0001), including monitoring and reactive management protocols.	Low
Dredging and reclamation – underwater noise and vibration	Medium	Implementation of the Construction Environmental Management Plan (CEMP), and DDSPMP, including monitoring and reactive management protocols. Implementation of mitigation measures provided in the Marine Megafauna Management Framework – Underwater noise, dredging.	Low
Piling - underwater noise and vibration	Medium	Implementation of the CEMP, and DDSPMP, including monitoring and reactive management protocols. Implementation of mitigation measures provided in the Marine Megafauna Management Framework – Underwater noise, piling.	Low
Discharges of contaminants from terrestrial activities	Medium	Implementation of the CEMP (Erosion and Sediment Control Plan and Spill Prevention and Response Procedure). Compliance with AS1940-2004 (Storage and handling of flammable and combustible liquids).	Low
Potential to generate acidic and metal drainage	Medium	Implementation of the CEMP (Potential Acid Sulfate Soils Management Plan). Adoption of construction methodologies that reduce potential for mud waving to as low as reasonably possible.	Low
Vessel discharges – hydrocarbon or chemical spills	Medium	Implementation of the CEMP (Spill Prevention and Response Procedure). Compliance with AS1940-2004 (Storage and handling of flammable and combustible liquids).	Low
Marine traffic impacts – vessel strike	High	Implementation of the Marine Megafauna Management Framework – Physical interaction. Implementation of standard navigational procedures and navigation aids.	Medium
Lighting impacts on marine fauna	Low	Implementation of the Marine Megafauna Management Framework – Lighting, dredging.	Low

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4 Mitigation and Management

To support the achievement of the environmental objectives and outcomes, piling and dredging must be implemented in such a manner that:

1. isolates from Darwin Harbour all material (dredged and imported fill) used for reclamation by constructing an appropriately engineered rock revetment to fully enclose the reclaim area prior to placement of fill material, and
2. prevents the generation of turbid plumes during construction of the rock revetment, and
3. protects any locations where runoff or suspended sediments may enter harbour waters from the reclamation area and dredge spoil ponds with geofabric and/or silt curtains, and
4. avoids the overflow of entrained water and sediment from dredge spoil barges.

To manage the potential for impacts to marine megafauna during construction, mitigation measures have been proposed below.

The management of spills and contamination are provided in the *Spill Prevention and Response Procedure* (prepared in accordance with the Darwin Port Oil Spill Contingency Plan and the Northern Territory Oil Spill Contingency Plan) the *Potential Acid Sulfate Soils Management Plan*, and the *Erosion and Sediment Control Plan*, provided in the CEMP.

4.1 Physical Interaction

Table 4 Marine Megafauna Management Framework – Physical Interaction

Element	Vessel interaction with marine megafauna
Objectives	Minimise the risk of injury to, or mortality of, marine megafauna species. Develop and maintain awareness of the need to conserve marine megafauna species.
Targets	1. No incidents of vessel interaction with protected marine species. 2. All dredging personnel to complete an HSE induction, including marine megafauna species awareness and management requirements. 3. All vessel masters competent in marine megafauna species interaction procedures.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing the Project Induction.
Management	• Training of Vessel Masters in interaction procedures • During movements of Project vessels, if marine megafauna species are sighted within 50m of a vessel, then avoidance actions will be taken by the vessel (e.g. change of direction or slowing to less than 6 knots) until the individuals are no longer within this distance. • Vessels will adhere to Darwin Port speed restrictions.

Darwin Ship Lift Project – Marine Megafauna Management Plan

	- Vessels will not approach, circle, or wait in front of marine megafauna species for the purposes of casual viewing. - Support vessels will not approach, circle, or wait in front of wildlife for the purposes of casual viewing.
Monitoring	Watch will be maintained for stranded, injured, or dead marine megafauna fauna; if observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment, or post-mortem of the fauna.
Reporting	- Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in Appendix 1). - Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. - Monitoring report to the Territory at the conclusion of dredging in accordance with the DDSPMP. - Any vessel interaction incidents and marine megafauna species injury or mortality will be reported to the Project HSSE Manager within 24 hours of the incident occurring. The Contractor will notify DEPWS and DCCEEW.
Corrective Actions	- In the event that an incident or near miss occurs between vessels and protected marine species, the incident will be investigated and discussed to further improve awareness to reduce risk of collision. - For mobile vessels associated with the Project, a 5 Kn vessel speed limit will be applied in areas where frequent sightings (an average of >1 per day in any one week) are made of protected marine species.
Term	For the duration of dredging activities
Responsibility	Vessel Operators to ensure Vessel Masters implement marine megafauna species interaction procedures in compliance with this Marine Megafauna Management Framework – vessel interaction. Project Manager for Vessel Operators to liaise with Contractor, DIPL and DEPWS on response to stranded, injured or dead protected marine species and potential recovery, treatment or post-mortem.

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4.2 Underwater Noise - Dredging

Table 5 Marine Megafauna Management Framework – Underwater Noise, Dredging

Element	Impact of underwater noise on marine megafauna species from dredging activities.
Objectives	Minimise the risk of disturbance to marine megafauna species from underwater noise during dredging activities. Establish and maintain awareness of the importance of protecting marine megafauna species during dredging activities.
Targets	1. No avoidable disturbance to marine megafauna species as a result of noise generated during dredging activities. 2. All dredging personnel to complete an HSE induction. 3. At all times that dredge is operational, crew members must be suitably trained in marine megafauna species awareness to act as a dedicated MFO.
Key Performance Indicators	• Number of audits and incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing an HSE site induction. • Availability of MFO crew members on operating dredge.
Management	• MFO to undertake assessments of the Observation, Start-up Exclusion and Dredging Response Zones as follows. • On each occasion that the dredge has been non-operational for a period exceeding 30 minutes, a visual assessment will be undertaken of the 750m radius Observation Zone by the MFO for a period of 20 minutes. Dredging will not recommence until no marine megafauna species have been sighted within the 500m radius Start-up Exclusion Zone for a period of 10 minutes. • The assessment of the Observation Zone will be made from an elevated position on the dredge, where a clear line of sight is achievable to the edge of the zone. • The MFO will not be engaged in any other activities during the 20-minute assessment period. • Every 30 minutes whilst the dredge is operating, the MFO will dedicate a period of five minutes for scanning (from an elevated position) for marine megafauna species within the Observation Zone. • Once dredging operations have commenced, if marine megafauna species enter within 50 m of the dredge, or a dolphin with calf enter within 150 m of the dredge (i.e. the Dredging Response Zones), then dredging will be temporarily suspended. Dredging will not recommence until no marine megafauna species have been sighted within the 500m radius Start-up Exclusion Zone for a period of 30 minutes. • Dredging that commences prior to sunset, or prior to a period of low visibility (defined as where continuous visual observations to a

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	distance of 1000m from the dredge are not possible), will continue unless, within the preceding 12 hours, there have been three or more suspensions of dredging due to marine megafauna species encroaching within the Dredging Response Zone. - The generation of underwater noise by all vessels will be reduced by ensuring that: - All equipment is maintained in good operating condition (balancing, greasing, etc.) and has proper noise control systems in place. - All noise minimisation measures such as mufflers, special enclosures and sound-insulation mounts are fitted and working. - Revolving equipment such as propellers and drive shafts are balanced to reduce vibration. - Equipment such as thrusters and auxiliary plants are switched off when not in use (i.e. not running in standby mode). - During periods of low visibility (where observations cannot extend to the extent of the exclusion zone e.g heavy rain or fog or periods of high winds), piling will continue: - unless, within the preceding 12 hours, there have been three or more suspensions of works due to marine megafauna species encroaching within the dredge exclusion zone. - If operations were not previously underway during the preceding 24 hours, providing no fauna of interest has been sighted in the exclusion zone. - During low visibility, where conditions allow, visual observations of the 500-metre exclusion zone from the dredge shall be maintained continuously to identify if there are any marine megafauna present. - During night or poor visibility, undertake last suitable light searches of the area where possible to determine if marine megafauna are present.
Monitoring	- Marine megafauna species observations (as per Management section above). - Watch will be maintained for the presence of stranded, injured, or dead marine megafauna species. If observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment or post-mortem of the animal(s).

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Reporting	• Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in Appendix 1). • Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Monitoring report to the Territory at the conclusion of dredging in accordance with the DDSPMP. • Any suspected noise-related incidents will be reported by Dredging Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	• In the event that noise-related impact is suspected, the incident will be investigated to confirm a noise-related impact has occurred and identify the most appropriate action(s) to reduce the impact. This may include one or more of the following: - Implementation of further noise reduction measures. - Restriction on vessel movements/activities. - Increase in the radius of the Observation Zone to 900 m.
Term	For the duration of dredging activities
Responsibility	Dredging Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – underwater noise, dredging. Dredging Contractor to implement noise management aboard all vessels.

4.3 Underwater Noise - Piling

Table 6 Marine Megafauna Management Framework – Underwater Noise, Piling

Element	Impact of underwater noise on marine megafauna species from piling activities.
Objectives	Minimise the risk of disturbance to marine megafauna species from underwater noise from piling activities. Establish and maintain awareness of the importance of protecting marine megafauna species.
Targets	1. No avoidable disturbance to marine megafauna species as a result of noise generated during piling activities. 2. All piling personnel to complete an HSE induction. 3. At all times that piling is carried out, at least one person is a dedicated MFO.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine megafauna species. • Number of personnel completing an HSE site induction. • Availability of MFO personnel during piling activities.
Management	Marine Piling Management: • Marine piling exclusion zones will be established and implemented so as to ensure that marine megafauna are not exposed to sound exposure levels (SEL) of greater than or equal to 183 dB re 1µ Pa².s for longer than 5 continuous minutes. The marine piling exclusion zones shall consider the range of marine piling source energy and the marine piling exclusion zones must not be less than 500 metres from the pile hammer. • Visual observations for marine megafauna must be undertaken to the extent of the marine piling exclusion zones by a dedicated MFO, for at least 30 minutes before the commencement of marine piling activities. • During piling activities, visual observations covering the extent of the marine piling exclusion zones shall be maintained continuously to identify if there are any marine megafauna present. • If marine megafauna are sighted within the marine piling exclusion zones, action to cease all marine piling within 2 minutes or as soon as is safely possible. • Marine piling activities must not recommence until marine megafauna are observed to move outside the marine piling exclusion zones or 30 minutes have passed since the last sighting. • Marine piling activities must commence with soft-start procedures, by gradually increasing the piling impact energy for a period of no less than 15-minutes from the commencement of piling to alert marine megafauna to the presence of piling activities, enabling the marine

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	megafauna to move away on their own accord. The soft-start procedures may only commence if no marine megafauna have been sighted within the marine piling exclusion zone during the pre-start up visual observations. • Piling undertaken during daylight hours only. Onshore Piling Management: • Establish a 500-metre exclusion zone for marine megafauna. • Visual observations for marine megafauna shall be undertaken to the 500-metre exclusion zone by a dedicated MFO for at least 30 minutes before the commencement of piling activities. • During piling activities, visual observations of the 500-metre exclusion zone from the pile hammer shall be maintained continuously to identify if there are any marine megafauna present. • If marine megafauna are sighted within the 500-metre exclusion zone, action to cease all piling within 2 minutes or as soon as is safely possible. • Piling activities must not recommence until megafauna are observed to move outside the 500-metre exclusion zone or 30 minutes have passed since the last sighting. • Piling activities must commence with soft-start procedures, by gradually increasing the piling impact energy for a period of no less than 15-minutes from the commencement of piling to alert marine megafauna to the presence of piling activities, enabling the marine megafauna to move away on their own accord. The soft-start procedures may only commence if no marine megafauna have been sighted within the 500-metre exclusion zone during the pre-start up visual observations. • Piling undertaken during daylight hours only. • During periods of low visibility (where observations cannot extend to the extent of the exclusion zone e.g heavy rain or fog or periods of high winds), piling will continue: • unless, within the preceding 12 hours, there have been three or more suspensions of works due to marine megafauna species encroaching within the marine piling exclusion zone. • If operations were not previously underway during the preceding 24 hours, providing no fauna of interest has been sighted in the exclusion zone. • During low visibility, where conditions allow, visual observations of the 500-metre exclusion zone from the pile hammer shall be maintained continuously to identify if there are any marine megafauna present.
Monitoring	• Marine megafauna species observations (as per Management section above). • Watch will be maintained for the presence of stranded, injured, or dead marine megafauna species. If observed, the NT Government Marine Wildwatch line (1800-453-941) will be contacted for retrieval, treatment, or post-mortem of the animal(s).

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Reporting	• Daily submission of marine fauna observations sheets by Piling Contractor to the Project HSSE Manager (example shown in Appendix 1). • Weekly summary reporting by Piling Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Any suspected noise-related incidents will be reported by Piling Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	Marine Piling Management: • If marine megafauna are sighted within the marine piling exclusion zones, action to cease all marine piling within 2 minutes or as soon as is safely possible. • Marine piling activities must not recommence until marine megafauna are observed to move outside the marine piling exclusion zones or 30 minutes have passed since the last sighting. Onshore Piling Management: • If marine megafauna are sighted within the 500-metre exclusion zone, action to cease all piling within 2 minutes or as soon as is safely possible. • Piling activities must not recommence until marine megafauna are observed to move outside the 500-metre exclusion zone or 30 minutes have passed since the last sighting.
Term	• For the duration of piling activities
Responsibility	• Piling Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – underwater noise, piling.

4.4 Lighting - Dredging

Table 7 Marine Megafauna Management Framework – Lighting, dredging

Element	Lighting impacts on marine turtle species during dredging activities.
Objectives	Minimise the risk of disturbance to marine turtle species from lighting during dredging. Establish and maintain awareness of the importance of protecting marine turtle species.
Targets	1. Reduction of light spill into marine environment from dredge vessels to as low as practically possible. 2. All dredging personnel to complete an HSE induction. 3. At all times that dredge is operational, at least one crew member is a dedicated MFO.
Key Performance Indicators	• Number of incident reports. • Number of reported sightings of live, injured, or dead marine turtle species. • Number of personnel completing an HSE site induction. • Availability of MFO personnel during dredging activities.
Management	• Reduction of light spill into marine environment from dredge vessels to as low as practically possible. • Avoid direct light shining into the water. • Avoid lights containing short wavelength violet/blue light. • Avoid white LEDs. • Avoid high intensity light of any colour. • Use only the minimum number and intensity of lights needed to provide safe and secure illumination required to meet the lighting objectives, including health and safety requirements. Avoiding light fixtures surplus to needs will decrease overall light emissions. • Where compliant with health and safety requirements, white lights should be avoided, and amber/orange lights used instead. If white lights are required, filters to block green, blue, violet, and ultra-violet wavelengths should be applied. • Lights that are not required to be continuously lit to be motion activated, put on a timer, or wired to allow manual ON/OFF operation. • Use flashing/intermittent lights instead of fixed beam, for example, small red flashing lights can be used to identify an entrance or delineate a pathway. • All non-essential lighting to be automatically switched off. • Lighting design for above-water infrastructure to be in accordance with national guidelines.

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Monitoring	• Conduct regular inspections and audits of the dredge vessel and undertake monitoring of specific environmental aspects and impacts. • Conduct monitoring to assess whether the management actions are effective against the environmental objectives.
Reporting	• Daily submission of marine fauna observations sheets by Dredging Contractor to the Project HSSE Manager (example shown in Appendix 1). • Weekly summary reporting by Dredging Contractor to the Project HSSE Manager of number of sightings, incidents, and corrective actions. • Any suspected noise-related incidents will be reported by Dredging Contractor to the Project HSSE Manager within 24 hours of the incident occurring.
Corrective Actions	• In the event that light-related impact is suspected, the incident will be investigated to confirm a light-related impact has occurred and identify the most appropriate action(s) to reduce the impact. This may include one or more of the following: - Implementation of further light reduction measures. - Restriction on vessel movements/activities. - Increase in the radius of the Observation Zone to 900 m.
Term	For the duration of dredging activities
Responsibility	Dredge Contractor to ensure works are conducted in compliance with this Marine Megafauna Management Framework – lighting, dredging.

5 Monitoring

At all times that the dredge is operational, the crew will include at least one member that is assigned the duty of Marine Fauna Observer (MFO). As described in Section 8.3 the MFO will be responsible for undertaking visual assessments for marine megafauna of the 750 m radius Observation Zone around the dredge. The assessment of the Observation Zone will be made from an elevated position on the dredge, where a clear line of sight is achievable to the edge of the zone. The MFO will not be engaged in any other activities during the dedicated assessment periods.

Procedures for the protection of marine megafauna potentially vulnerable to dredging noise will be as follow:

- Prior to the commencement of any dredging, an Observation Zone extending 750 m in all seaward directions from the dredge will be established.
- From 20 minutes prior to the commencement of any dredging, an MFO will monitor the Observation Zone to check for the presence of any marine megafauna species.
- If any individual of a marine megafauna species is observed within a 500 m radius Start-up Exclusion Zone, then noise-intensive dredging activities will not commence until the animal is observed to have left this zone, or until 30 minutes have elapsed since the last sighting.

During dredging, at 30-minute intervals the designated MFO will check the Observation Zone for a period of five minutes. Once dredging activities have commenced, if any marine megafauna species approach within 50 m of the dredge, or a dolphin with calf enters within 150 m of the dredge (i.e. the Dredging Response Zones), the sightings will be recorded (including details of the time and results of observation) and the management measures described in Section 8.3 will be implemented.

The Dredging Contractor will provide awareness training to selected crew members to inform them about the marine megafauna species which may occur within Darwin Harbour; to provide a description of the record form to be used for recording marine species sightings; and to explain how to apply appropriate avoidance and mitigation measures to minimise the potential for impacts or collisions with marine megafauna. The purpose of the training will be to raise awareness; to encourage recording and reporting of marine species sightings; and to emphasise the requirement to report stranded, injured, or dead marine megafauna species regardless of what caused the injuries or deaths.

All sightings of marine megafauna species will be recorded by the MFO on marine fauna observation forms similar to that presented Appendix 1; these will be available on all Project vessels. These records will be provided to the Project HSSE Manager and logged into the Project's marine megafauna sighting register.

The Dredging Contractor will be responsible for reporting sightings of any EPBC-listed marine fauna to the Project HSSE Manager, who will in turn report these sightings to the relevant authorities within 24 hours. This includes where there is injury or mortality to a listed threatened or migratory species that may be attributable to the dredging activity. The report will include details of the individual species observed, the frequency, location and timing of observations, and photos (if available). The objective of these reports will be to identify potential interaction areas which will be incorporated by the Dredging Contractor into pre-starts, toolboxes, marine fauna awareness training, or other general awareness sessions.

6 MMMP Review

Consistent with the requirements of the EP Approval, this MMMP has been reviewed by an independent qualified person to ensure it is consistent with the achievement of the environmental objectives specified in the approval.

The MMMP, its operation and implementation will be periodically reviewed during project delivery. Formal review of the MMMP will be implemented at least once every 6 months.

Other triggers for review may include:

- Corrective or Preventative Actions are raised through the reporting process requiring amendments to the MMMP;
- Changes to relative legislative, regulatory or compliance obligations;
- Significant changes to any constituent of project construction;
- Request by the Client or any regulatory authority;
- Significant changes to the environment;
- Changes to Best Practice Environmental Management; or
- Identification of new environmental risks.

The Environmental Representative (or Project Manager nominee) will be responsible for review and amendment of the MMMP. If updated at any stage of the project, a revised copy will be submitted to all relevant stakeholders.

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Appendix 1 Marine Fauna Observer Record Sheet

Name:	Date:
Employer:	Day or Night Shift:

Time	Reported Observations & Actions							
	Species ¹	No.	Calves (Y/N)	Distance (m)	Mitigation Response ²	Beaufort state	Comment	Initial

- 1- Record the species as accurately as you can. If unsure, use the general terms "dolphin", "turtle", "sawfish", etc.
- 2- If no mitigation response is required, you should still record this. Take photos if possible



APPENDIX N EMAIL NOTIFICATION FROM NTG TO DCCEEW FOR COMMENCEMENT OF ACTION (CONDITION 12)



FW: EPBC ref 2021/9068 - Darwin Ship Lift - notice of works commencing

From Suzanne Dunkerton <Suzanne.Dunkerton@nt.gov.au>
Date Tue 2024-05-07 10:56 AM
To Morgan Pinkerton <morgan.pinkerton@cloughbmdjv.com.au>

FYI&R

Suzie Dunkerton
Project Director, Darwin Harbour Infrastructure Projects
Infrastructure NT
Department of Infrastructure, Planning and Logistics
m... 0417 127 944

From: Suzanne Dunkerton
Sent: Wednesday, 24 April 2024 11:54 AM
To: 'EPBC Monitoring' <epbcmonitoring@dcceew.gov.au>
Cc: Sam Jongue <Sam.Jongue@nt.gov.au>; Donald Chan <Donald.Chan@nt.gov.au>; Jerome Cook <Jerome.Cook@nt.gov.au>; 'environmentalregulation@nt.gov.au' <environmentalregulation@nt.gov.au>
Subject: EPBC ref 2021/9068 - Darwin Ship Lift - notice of works commencing

Hi EPBC Monitoring,

In regards to EPBC approval 2021/9068, this is a formal notice that works regarding the action have commenced on 18/04/2024.

Please let me know if you require any further information.

Regards,
Suzie Dunkerton
Project Director
Darwin Harbour Infrastructure Projects
Infrastructure NT
Department of Infrastructure, Planning and Logistics

Unit 1/35 Export Drive, East Arm, NT 0822
GPO Box 2520, Darwin, NT 0801

m ... 0417 127 944
e ... Suzanne.Dunkerton@nt.gov.au

Please note that I am out of the office on Mondays

VISIT OUR WEBSITE
infrastructure.nt.gov.au



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10 DECLARATION OF ACCURACY

Declaration of accuracy - Contractor (Clough BMD Joint Venture (CBJV))

In making this declaration, I am aware that sections 490 and 491 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular. I am authorised to bind the Joint Venture parties to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed Christopher Thornton

Full name (please print) Christopher Thornton

Position (please print) _____

Organisation (please print including ABN/ACN if applicable) _____

Date 28/11/2025 / _____

Declaration of accuracy - EPA Approved Independent Person

In making this declaration, I am aware that sections 490 and 491 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular in so far as it has been recorded, compiled and presented to me by the Contractor – Clough BMD Joint Venture (CBJV). I further declare that the report, prior to submission to the Authorities, has been reviewed and endorsed by me (a representative of Aurecon Australasia) and I have relied upon the action of these CBJV parties in making this declaration.

Signed Stephen Cole

Full name (please print) Stephen Cole

Position (please print) _____

Organisation (please print including ABN/ACN if applicable) _____

Date 27/11/2025 / _____

Declaration of accuracy - Approval Holder

In making this declaration, I am aware that sections 490 and 491 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular. I am authorised to bind the Joint Venture parties to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed Gemma Lake

Full name (please print) Gemma Lake

Position (please print) ACTING CHIEF EXECUTIVE OFFICER

Organisation (please print including ABN/ACN if applicable) DEPARTMENT OF LOGISTICS AND INFRASTRUCTURE

Date 10/12/25



EcOz Environmental Consultants

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