DREDGING MONITORING AND MANAGEMENT PLAN

Nathan River Resources

Bing Bong Loading Facility Dredging Program

TABLE OF CONTENTS

Figures

Tables

Appendices

1 INTRODUCTION

The NRP (previously referred to as the Roper Bar Iron Ore Project (RBIOP)) is wholly operated by NRR Services Pty Ltd (NRR) since acquiring the NRP in 2019 from the previous operators, Western Desert Resources (WDR). The NRP is located approximately 530 kilometres (km) southeast of Darwin within the Gulf of Carpentaria and is comprised of three main operation domains: the mine, the haul road and the Bing Bong Loading Facility (BBLF). The mine is located within mining leases (ML) 28962, 28267, 28266, 28963 and 28264. The haul road, privately owned and operated by NRR, stretches for 171 km, connecting the mine and the BBLF allowing the haulage of material to the BBLF. The BBLF is situated within ML 29628, located on the south-western coast of Gulf of Carpentaria approximately 50 km north of Borroloola. Glencore's McArthur River Mine (MRM) operates a larger loading facility at the BBLF and is the overarching controller of the Port. The regional location of the NRP is presented in **Figure 1-1**.

The previous operator, WDR commenced mine construction and operations in 2013 following the approval of the Roper Bar Iron Ore Project (RBIOP) Environmental Impact Statement (EIS) under the previous *Environmental Assessment Act.* Upon acquiring the RBIOP, NRR submitted a Mining Management Plan (MMP) in accordance with the *Mining Management Act 2001* (MM Act), receiving approval in the form of mining authorisation 1062 to commence operations in 2020.

NRR currently operates the NRP under the approved Variation of Authorisation 1062-01 granted in October 2023 which authorises the recommencement of mining, haulage and shipping operations across the three domains of the NRP.

NRR proposes to undertake a maintenance dredging program within the BBLF transhipment zone to facilitate future shipping operations at the BBLF during 2024.

1.1 Objectives

The objectives of this Dredging Monitoring and Management Plan (DMMP) are to:

- Protect the terrestrial and marine environment surrounding the BBLF from any potential impacts associated with maintenance dredging activities;
- Demonstrate consideration of potential impacts to the terrestrial and marine environment values of the BBLF and surrounds associated with the proposed dredging activities;
- Provide practical and achievable monitoring programs to ensure early detection of potential impacts, providing effective management and mitigation measures and inform future dredge management plans;
- Communicate environmental protection requirements to all personnel involved in undertaking the proposed dredging activities; and
- Provide regulatory authorities with a basis to confirm compliance with environmental policies and monitoring conditions.

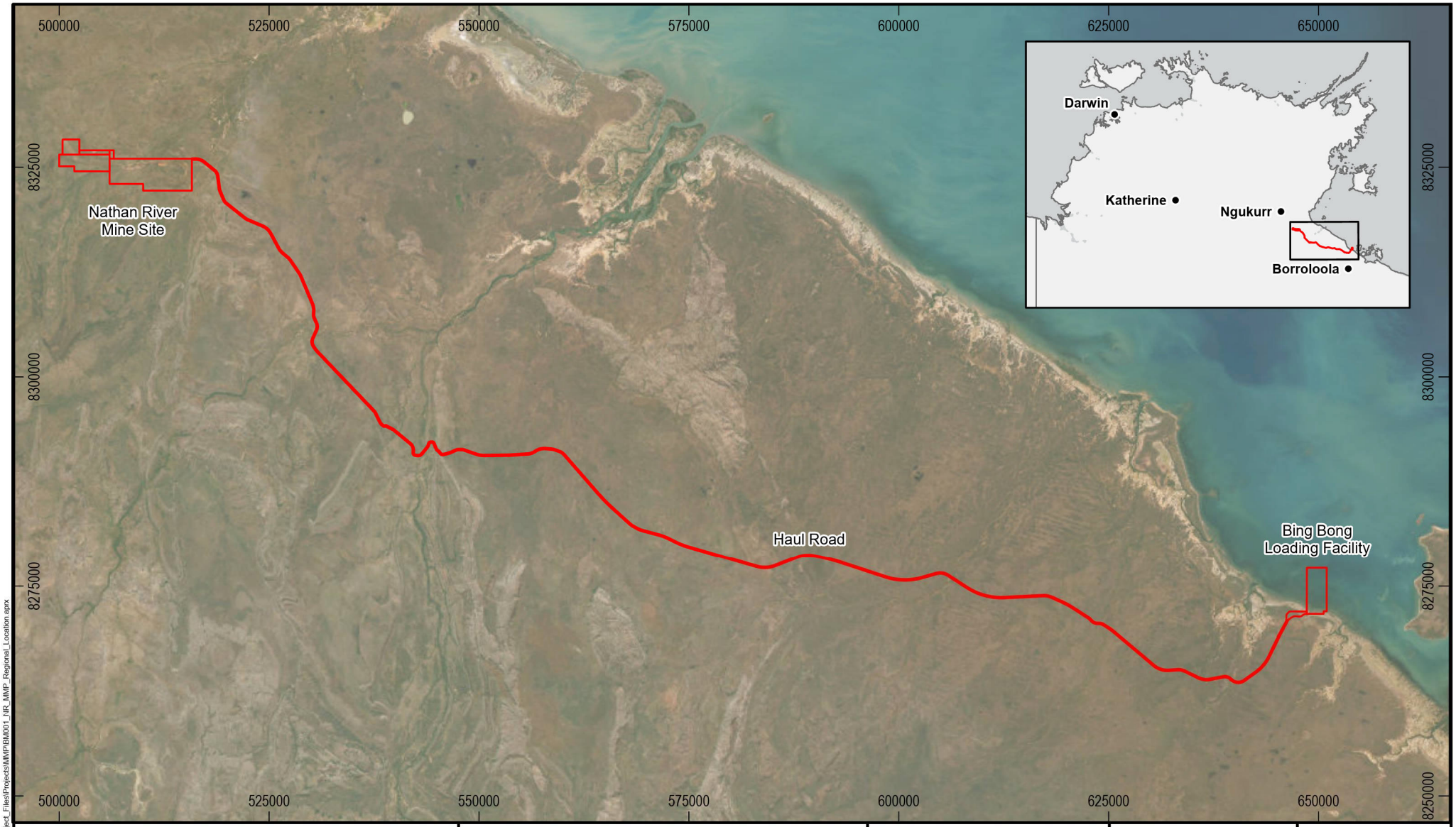
1.2 Purpose

The purpose of this DMMP is to provide a framework for planning and managing maintenance dredging so that potential impacts to the environment are minimised. All other impacts associated with routine operations at the BBLF are addressed in the NRP MMP (NRR 2024).

The DMMP is a requirement of NRR's mining authorisation (1062-01) issued under the MM Act and will be submitted to the Department of Industry, Tourism and Trade (DITT) for approval prior to the commencement of dredging activities. Authorisation conditions relating to dredging activities are outlined in **Table 1-1** below.

Table 1-1 Variation of Authorisation 1062-01 Dredging Conditions

Condition	Description
34	Dredging operations cannot commence until monitoring baselines are determined and trigger limits are set.
	a. Monitoring baselines and trigger limits must be provided to the Department for approval in the form of a *Monitoring and Management Plan* prior to works commencing.
35	Monitoring against trigger limits must be undertaken daily, at suitable tide times, in the first week of dredging operations.
36	In the event of exceedance of trigger limits, dredging works must immediately cease and management methodology be reassessed prior to recommencement of works.
37	Exceedance of trigger limits must be reported to the Department.
38	Should monitoring demonstrate the management systems are effective, monitoring in subsequent weeks can occur at weekly intervals, at suitable tide times.



Legend

Tenement Boundaries

Source: Geoscience Australia 2006, Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2018-2020, METServe 2023, Earthstar Geographics.

Nathan River Project

Regional Location

0 5 10 20

Kilometers

Scale: 1:640,000 (A4)

14/06/2023

Datum: GDA2020
Projection: MGA53

FIGURE 1-1

METSERVE
Mining & Energy Technical Services Pty Ltd

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2 LEGISLATIVE AND POLICY REQUIREMENTS

The Commonwealth and Northern Territory legislative requirements applicable to the proposed dredging activities at BBLF are summarised in the sections below.

2.1 Commonwealth Legislation and Policies

The maintenance dredging program proposed for the BBLF does not require referral to the Commonwealth under the *Environment Protection and Biodiversity Conservation Act* 2000 (EPBC Act) as the 'prior authorisation' provisions of section 43 of the EPBC Act apply. NRR does not consider the action to trigger a matter of national environmental significance.

2.2 Northern Territory Legislation

The key pieces of NT legislation applicable to the proposed maintenance dredging activities at BBLF are listed below in **Table 2-1**.

Table 2-1 NT legislation relevant to dredging program

Legislation	Relevance to activities
NT Mining Management Act	'Authorisation' for operation of the NRP is subject to annual revision and approval of an MMP. Activities not addressed in the MMP, including maintenance dredging, require separate approval from DITT. An MMP amendment will be submitted to DITT seeking approval for the proposed maintenance dredging activities, whereby this DMMP is a key component of the MMP amendment.
NT Water Act	Under section 74 of the Water Act, a Waste Discharge License (WDL) is required to authorise the discharge of decant water from the spoil containment pond to the receiving environment. NRR has recently submitted an application for a WDL for the proposed dredging activity.
Aboriginal Sacred Sites Act	Establishes protection for Aboriginal sacred sites. No registered or recorded sacred sites are known to occur within NRR BBLF lease.
NT Heritage Conservation Act	Archaeological heritage sites must not be disturbed or destroyed without a permit. There are no registered heritage sites located within the maintenance dredge footprint. No previously undisturbed areas will be affected by the proposed activities.

2.3 NRR Environmental Compliance Requirements

As a condition of NRR's mining authorisation 1062-01 issued by DITT under the MM Act, there are two main annual plans/reports which are required to demonstrate compliance with environmental regulations/conditions of approval and commitment to continual improvement. These include:

- the Mining Management Plan (MMP) revision (if any); and
- the Environmental Mining Report (EMR).

The NRP operates under a broader Environmental Management System (EMS) (NRR 2024) that has been developed to provide a methodology for the environmental management of the NRP in accordance with its environmental policy, legal responsibilities, relevant guidelines and site-specific requirements.

The EMS has been created to identify environmental risks, establish performance measures and develop performance indicators for all aspects of the NRP. This also includes the design and implementation of monitoring and management programs. The EMS establishes the review, reporting and communication processes for the NRP, as they apply to both internal and to external stakeholders as well as administering authorities. This includes the reporting of incidents, registering of complaints and communicating of environmental management responsibilities to NRP employees, contractors and visitors. The NRP's General Managers are responsible for the implementation of all on site work programs under this policy and the EMS.

The overarching objectives of the NRP EMS include compliance with:

- All regulatory approval conditions including applicable DITT Authorisation and Commonwealth EPBC approval; and
- NRR's Environmental Policy (NRR 2024), which includes the intent of preventing negative impact on the environment and the community.

2.4 Agreements with McArthur River Mine (MRM)

NRR's shipping operations at the BBLF takes into consideration the other operator and overall controller of the port, Glencore's McArthur River Mining (MRM). Since the recommencement of shipping activities, NRR has developed a strong relationship with MRM, and operates under their direction should MRM be shipping at the same time as NRR. This strong relationship between the two port operators allows for safe and efficient shipping operations to occur at the BBLF. To continue to ensure safe shipping operations for both operators at the BBLF, maintenance dredging of the BBLF transhipment zone is required. The proposed maintenance dredging program will service both NRR and MRM shipping operations at the BBLF.

2.5 Guidelines and strategies

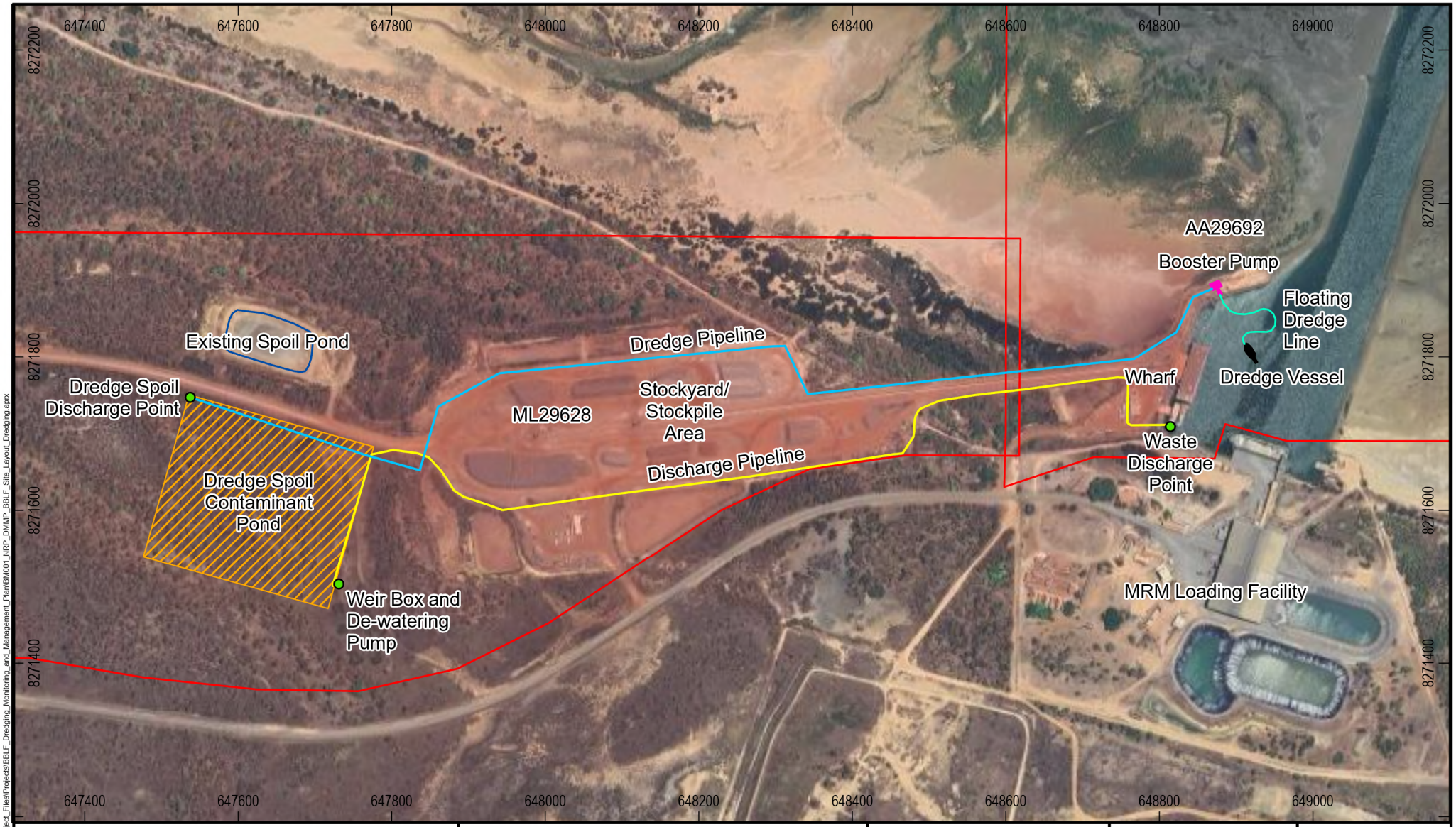
The following guidelines have been referenced in this DMMP:

- ANZECC 2000 Guidelines for Aquatic Ecosystems (marine);
- ANZECC 2000 Interim Sediment Quality Guidelines;
- Handbook for Sediment Quality Assessment (Simpson and Batley 2016);
- Queensland Acid Sulfate Soil Technical Manual (Dear et al. 2014):
- Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013);
- Marine Dredging Guidelines (NT EPA 2023); and
- National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra 2009 (Australian Government 2009).

3 DESCRIPTION OF DREDGING ACTIVITIES

NRR proposes a short-term, maintenance dredging program at the BBLF which will remove built-up marine sediment from the transhipment channel and swing basin, further facilitating access to these areas of the BBLF. The last dredging program undertaken at the BBLF was completed by NRR in 2020, which saw the removal of 8,000 m^3 of material dredged from the transhipment zone. The proposed dredge program is larger and will aim to remove an estimated 90,000 m^3 of material over a four-month period. Dredged material is proposed to be stored in an appropriately constructed dredge spoil pond with decanted seawater proposed to be discharged back to the swing basin under a waste discharge licence (WDL). Construction of the dredge spoil pond is expected to commence in Q3 2024 (subject to approvals), with dredging to commence in November/December 2024 and continue throughout the 2024-2025 wet season. The proposed dredging program will ensure future transhipment activities can continue at the BBLF and is considered critical to both NRR and MRM's BBLF operations.

The site layout for the proposed dredging program at the BBLF is presented in **Figure 3-1**.



Legend

- Tenement Boundaries
- Infrastructure
- Pump and Discharge Point
- Discharge Pipeline
- Dredge Pipeline
- Floating Dredge Line
- Existing Spoil Pond
- Dredge Spoil Contaminant Pond
- 18 Inch Diesel Booster Pump
- Dredge Vessel

Source: Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2024, METServe 2024. Imagery - © OpenStreetMap and contributors

Nathan River Project

BBLF Site Layout - Dredging

**Infrastructure locations are approximate only. Not to scale.*

0 50 100 200

Meters

Scale: 1:7,000 (A4)

25/06/2024

Datum: GDA2020
Projection: MGA53

FIGURE 3-1

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3.1 Dredge Program

No dredging has occurred at the BBLF since the small-scale dredge program in 2020. Since the most recent large-scale dredge program completed in 2012, a significant amount of sediment has accumulated within the swing basin and transhipment channel. Majority of this deposited material can be indirectly attributed to the ongoing movements of the vessel *Aburri,* manoeuvring in the swing basin as part of ongoing MRM operations and natural sediment infill processes typical of shallow coastal waters.

The proposed dredging program aims to remove approximately 90,000 m^3 of material from the swing basin and transhipment channel over a period of four months. This material will be removed using a cutter suction dredger (CSD), a common dredging method which cuts marine sediment into fragments with a rotating cutter head (**Figure 3-2**). While operating, the CSD will remain stationary and anchored to the seabed via a spud at the rear of the vessel. Despite the vessel remaining stationary, the ladder which houses the cutter head, extends into the water to the seabed and is secured by two anchors and winches. These anchors and winches on either side of the ladder allow for the ladder and cutter head to swing sideways without moving the CSD vessel, facilitating the cutting and removal of marine sediment.

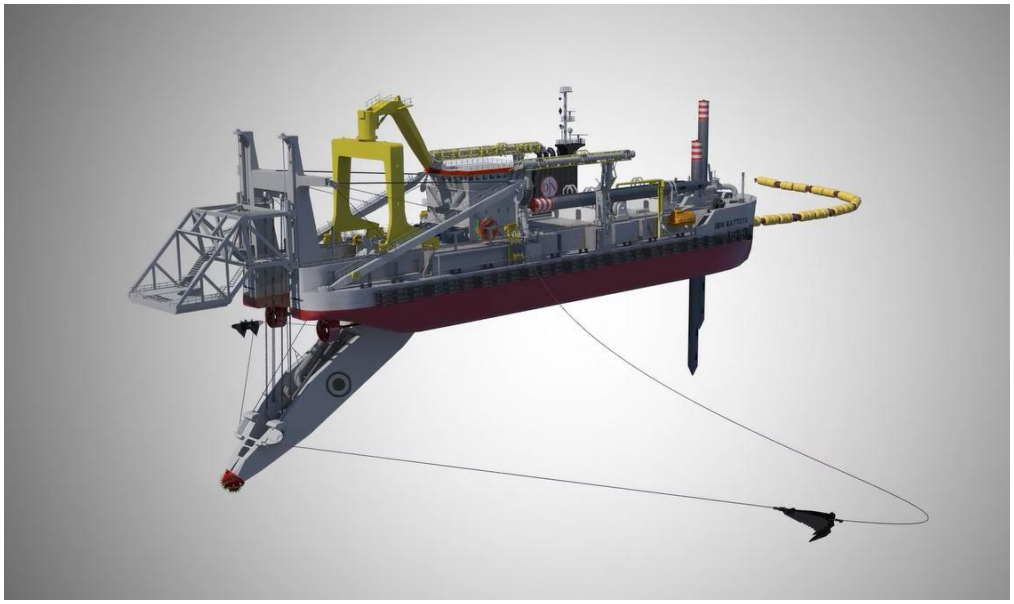


Figure 3-2 Example of a Cutter Suction Dredger (CSD)

Marine sediment and seawater are removed by the dredge's cutter head, sucked up by dredge pumps and transported along a floating pipeline, discharging dredged slurry into the spoil pond located near the BBLF stockyard. Dredge slurry material will be transported and contained within a poly-welded HDPE pipeline to ensure pipeline integrity and reduce the risk of uncontrolled spills from the dredge pipeline. Given the distances between the dredge pontoon and the spoil pond, diesel booster pumps will be positioned on the wharf to assist in transporting the dredge slurry from the CSD to the spoil pond.

Once dredge slurry is discharged into the spoil pond on the north-western corner, sediment and fines are expected to settle to the bottom of the pond as slurry migrates towards the south-eastern corner of the pond. Numerous baffles and the graded design of the spoil pond will facilitate the settlement of sediment from solution, resulting in relatively clean seawater in the decant area of the spoil pond. Decanted seawater will then be discharged back into the swing basin via a dedicated discharge HDPE pipeline subject to meeting the water quality guidelines stipulated under the WDL. Once the dredge program has been completed, decommissioning of dredge infrastructure will be undertaken. Environmental monitoring will be conducted prior, during and after completion of the dredge program to ensure management and mitigation measures are effective in limiting impact to the receiving environment.

The proposed dredge spoil pond will service future subsequent maintenance dredging programs, hence the closure and rehabilitation of the pond is not proposed in this MMP period. Closure and rehabilitation of the proposed spoil pond will be addressed at which point the pond holds no further capacity for dredge spoil storage.

3.1.1 Swing basin

The swing basin within the BBLF incorporates two berthing pockets which allow for the movement of marine vessels in and out of the two berths operated by MRM and NRR. The BBLF swing basin has a design depth of 3.23 m below the lowest astronomical tide (LAT), which facilitates vessel movements regardless of tide. A recent hydrographic survey of the swing basin completed in November 2023 indicates sections of the swing basin to be much shallower than the design depth of 3.23 m below LAT. The reduced depth of the swing basin has caused the current NRR and MRM shipping operations to be dictated by tidal movements given the lack of clearance for vessels to manoeuvre in and out of the basin on low tide. The current depth of the swing basin has and will continue to significantly restrict the shipping operations of both NRR and MRM at the BBLF until the proposed dredging program is complete.

3.1.2 Transhipment Channel

The transhipment channel refers to 3.5 km stretch from the first set of channel beacons to the most seaward beacons. This channel is 40 m wide and similar to the swing basin, has accumulated a significant amount of marine sediment since previous dredge programs where sections of the channel are shallower than the design depth of 3.23 m below LAT.

3.2 Dredge material composition

The expected chemical composition of dredge material to be encountered during the dredge program has been assessed with reference to marine sediment monitoring data available sourced from MRM monitoring programs and Potential Acid Sulphate Soils (PASS) sampling undertaken at the BBLF during the construction of NRR's BBLF (Cardno, 2013) and records from previous dredge programs at the BBLF.

Bioavailable metals

Marine sediments are monitored annually by MRM at a total of 10 monitoring sites located in the vicinity of the BBLF (**Table 3-1**). MRM have provided the results of the annual marine sediment sampling program from 2020 to 2023 to NRR (raw data provided in **Appendix D**). This data has been analysed for the presence of contaminants in the material that will be dredged.

Table 3-1 MRM Marine sediment sampling locations

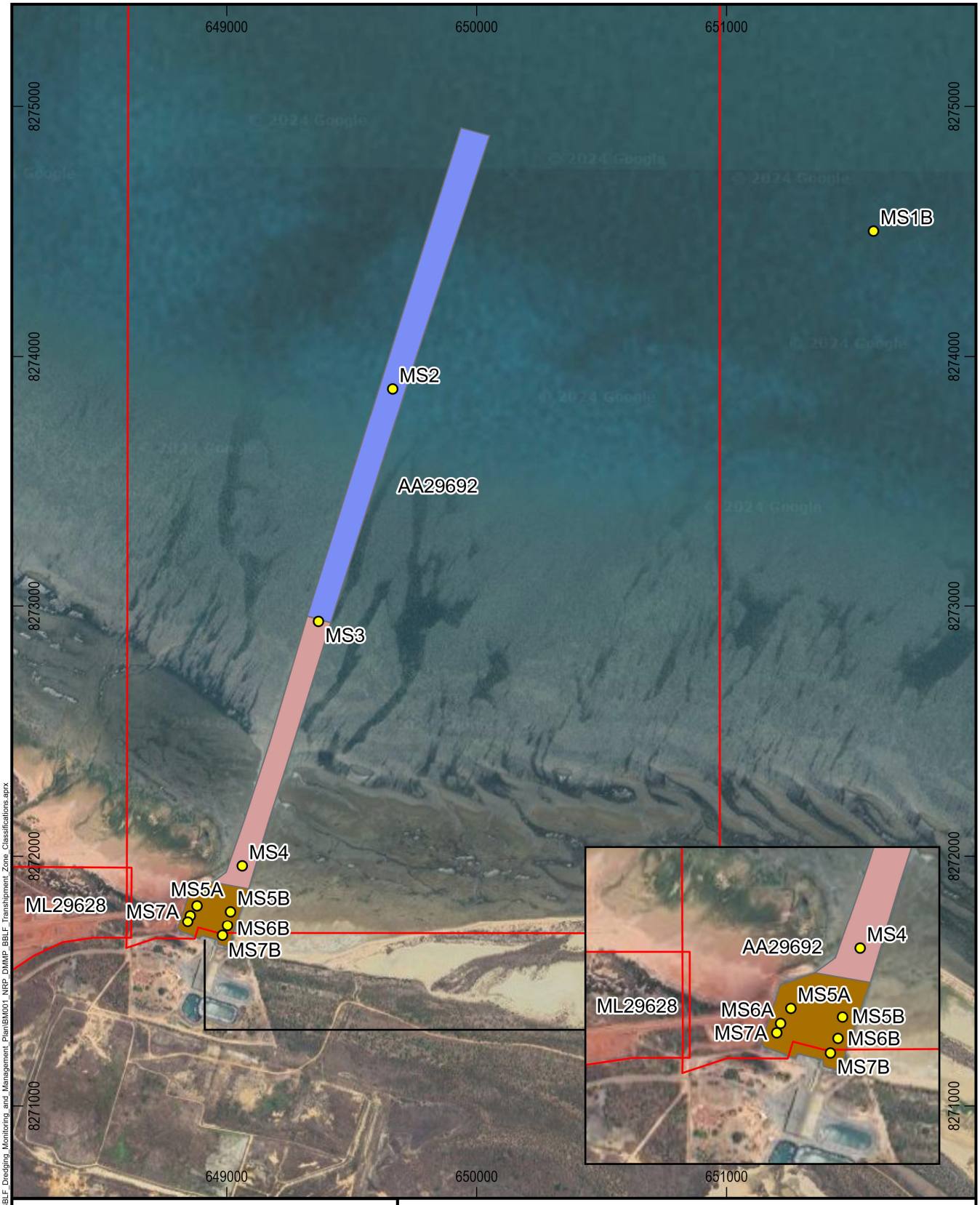
Site	Impact / control	Location description	Easting	Northing
MS1B	Control	Located furthest from dredging activities, NE of BBLF	651587	8274500
MS2	Impact	Channel: Between MS3 and MS1B	649663	8273869
MS3	Impact	Channel	649366	8272937
MS4	Impact	Channel: Within mouth of swing basin.	649061	8271960
MS5A	Impact	Swing basin NW	648880	8271800
MS5B	Impact	Swing basin NE	649014	8271776
MS6A	Impact	Swing basin W	648853	8271760
MS6B	Impact	Swing basin E	649002	8271719
MS7A	Impact	Swing basin SW	648843	8271735
MS7B	Impact	Swing basin SE	648982	8271680

Dilute acid extract of metals analysis for bioavailable fraction <63 µm was undertaken on the following parameters: Al, Mn, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Sb, Hg and Pb. Historic marine sediment data has been used to understand the dredge material composition expected during the maintenance program and inform any handling/storage measures to reduce the potential risk to the surrounding environment.

The sample number 10 is considered appropriate to sufficiently characterise the material for the volume to be dredged. It is estimated that approximately 90,000 m^3 of sediment will be dredged. For maintenance dredging, a volume between 50,000 m^3 and 500,000 m^3 is considered a medium-sized project by the National Assessment Guidelines for Dredging (NAGD) (Australian Government, 2009). As recommended in the NAGD (Australian Government 2009), the BBLF transhipment zone has been classified into three areas based upon historic marine sediment quality data provided by MRM. Areas have been categorised as the following and are presented in **Figure 3-3**:

- Probably contaminated – Swing basin;
- Suspect – Inner transhipment channel; and
- Probably clean – Outer transhipment channel.

As outlined in the NADG (Australian Government 2009), should a robust monitoring dataset exist for the dredge site, the minimum number of sample locations recommended may be halved. Given this, a minimum of nine sample sites are recommended, which has been halved from 17, for a dredge program expecting to remove between 83,000 to 92,000 m^3 of potentially contaminated material. The annual marine sediment monitoring program which currently exists at the BBLF conducted by MRM monitors 10 sites across the transhipment zone and is considered to be sufficiently robust for informing this dredging program.



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Legend

- Marine Sediment Monitoring Sites (MRM BBLF)
- Tenement Boundaries

Transhipment Zone

- Probably Contaminated - Swing Basin
- Suspect - Inner Transhipment Channel
- Probably Clean - Outer Transhipment Channel

Source: Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2024, METServe 2024. Imagery - © OpenStreetMap and contributors

Nathan River Project

BBLF Transhipment Zone Classifications

0 200 400 800

Meters

Scale: 1:22,000 (A4)

15/04/2024

Datum: GDA2020
Projection: MGA53

FIGURE 3-3

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For each of the 10 marine sediment sampling sites from 2020 to 2023, the minimum, maximum and mean metal concentrations have been calculated and compared against the screening levels provided within the NADG (**Table 3-2**).

The results summarised in **Table 3-3** to **Table 3-12** indicate that the sediments within the swing basin (represented by sample sites MS5A, MS5B, MS6A, MS7A, and MS7B) are typically elevated in zinc and lead and exceed the NADG Screening Level - High (NADG SL-High). The elevated concentrations of lead and zinc recorded within swing basin marine sediments are considered to be attributed to dust deposition and spillage of ore into the swing basin during MRM loading operations.

Table 3-2 NAGD Screening Levels

Contaminant - metals / metalloids	NAGD SL (mg/kg dry weight)	NAGD SL-High (mg/kg dry weight)
Arsenic	20	70
Cadmium	1.5	10
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Silver	1.0	3.7
Zinc	200	410

Table 3-3 Marine sediment results of MS1B (control)

MS1B	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	1,800	230	7,300	4.1	2.3	5.3	7.7	1.8	0.02	0.05	0.2	0.01	9.8
Max	2,600	300	9,100	4.8	2.7	7.6	8.9	4.7	0.02	0.05	0.2	0.01	12
Mean	2,200	267.5	8,075	4.5	2.5	6.15	8.25	3.43	0.02	0.05	0.2	0.01	10.95

ND: No data

Table 3-4 Marine sediment results of channel (MS2)

MS2	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Unit	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,500	330	11,000	5.1	2.7	8.5	23	2.6	0.03	0.06	0.2	0.01	18
Max	2,800	490	13,000	5.8	3.1	11	40	5.7	0.04	0.1	0.2	0.01	30
Mean	2,600	390	11,500	5.3	2.83	9.55	28.5	4.43	0.04	0.07	0.2	0.01	22

ND: No data

Table 3-5 Marine sediment results of channel (MS3)

MS3	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Unit	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,100	230	6,700	4	2.2	7.8	19	2.2	0.02	0.08	0.2	0.01	17
Max	3,200	340	14,000	5.3	3.2	14	52	4.5	0.04	0.17	0.2	0.01	34
Mean	2,575	282.5	10,450	4.65	2.7	10.78	34.5	3.38	0.03	0.12	0.2	0.01	25.75

ND: No data

Table 3-6 Marine sediment results of channel (MS4)

MS4	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,500	280	8,700	4	2.2	17	88	2	0.04	0.25	0.2	0.01	55
Max	3,200	330	13,000	5.2	3.1	28	250	4.6	0.05	0.71	0.2	0.01	190
Mean	2,725	302.5	10,225	4.83	2.75	21	149.5	3.8	0.05	0.43	0.2	0.01	104

ND: No data

Table 3-7 Marine sediment results of swing basin (MS5A)

MS5A	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,300	300	8,800	4	2.4	30	240	4.3	0.06	0.74	0.2	0.01	200
Max	3,300	350	12,000	4.6	3.4	41	430	6	0.08	1.2	0.2	0.01	350
Mean	2,725	325	10,700	4.3	2.85	35.75	330	5.2	0.07	0.97	0.2	0.01	257.5

ND: No data

Table 3-8 Marine sediment results of swing basin (MS5B)

MS5B	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,600	300	9,000	3.2	2.4	30	190	3.1	0.05	0.65	0.2	0.01	140
Max	3,200	360	16,000	4.4	2.8	35	350	5.5	0.07	0.97	0.2	0.01	270
Mean	2,775	332.5	12,000	4.03	2.63	32.25	265	4.5	0.058	0.83	0.2	0.01	200

ND: No data

Table 3-9 Marine sediment results of swing basin (MS6A)

MS6A	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,500	290	8,600	3.8	2.4	13	72	4.1	0.04	0.17	0.2	0.01	50
Max	3,000	350	13,000	6.2	3.3	37	330	5.4	0.06	0.99	0.2	0.01	270
Mean	2,650	320	10,350	5.05	2.88	28.5	258	4.83	0.06	0.71	0.2	0.01	180

ND: No data

Table 3-10 Marine sediment results of swing basin (MS6B)

MS6B	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,200	240	7,400	3.9	2.4	16	95	2.6	0.03	0.23	0.2	0.01	61
Max	2,600	420	14,000	6.1	2.8	37	300	5.9	0.07	0.97	0.2	0.01	220
Mean	2,375	345	10,525	4.55	2.55	29.5	226.25	4.38	0.06	0.69	0.2	0.01	167.8

ND: No data

Table 3-11 Marine sediment results of swing basin (MS7A)

MS7A	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,500	290	7,800	3.9	2.3	22	200	3.2	0.04	0.52	0.2	0.01	150
Max	2,600	360	17,000	5.9	2.9	47	470	6.4	0.07	1.4	0.2	0.01	320
Mean	2,550	330	13,700	4.48	2.68	34.25	302.5	4.78	0.058	0.92	0.2	0.01	230

ND: No data

Table 3-12 Marine sediment results of swing basin (MS7B)

MS7B	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Hg	Pb
Units	**mg/kg (dry weight)**												
NAGD SL-High	**ND**	**ND**	**ND**	**ND**	**52**	**270**	**410**	**70**	**4**	**10**	**25**	**1**	**220**
NAGD-SL	**ND**	**ND**	**ND**	**ND**	**21**	**65**	**200**	**20**	**1**	**1.5**	**2**	**0.15**	**50**
Min	2,000	270	7,200	3.7	2.3	21	120	3.2	0.04	0.28	0.2	0.01	95
Max	2,600	340	15,000	5.2	2.7	33	330	9	0.06	1	0.2	0.01	400
Mean	2,275	297.5	12,050	4.28	2.55	26.75	242.5	5.18	0.05	0.74	0.2	0.01	231.3

ND: No data

Potential Acid Sulphate Soils (PASS)

Potential Acid Sulphate Soils (PASS) investigations completed by Western Desert Resources during the construction of the BBLF in 2012 included the collection and analysis of borehole soil samples from eight locations at the BBLF immediately adjacent to the swing basin (Cardno 2013). Analytical results did not indicate the presence of PASS material within landside areas of the BBLF. Along with this, no PASS material has been encountered during previous capital and maintenance dredging campaigns at the BBLF. PASS material is considered unlikely to occur within the accumulated marine sediments to be targeted by this dredging program, as the accumulated sediments have been deposited under aerobic conditions and are likely oxidised already. This dredging program is not expected to remove marine sediments deeper than the original design depth.

As a precaution, dredge spoil material will be sampled during the first week of dredging operations to assess the presence of PASS and the potential impact to the quality of discharge water. Details of the PASS testing program proposed are provided in **Section 6.2.5**. The monitoring will be undertaken in accordance with the Queensland Acid Sulfate Soil Technical Manual (Dear et al. 2014).

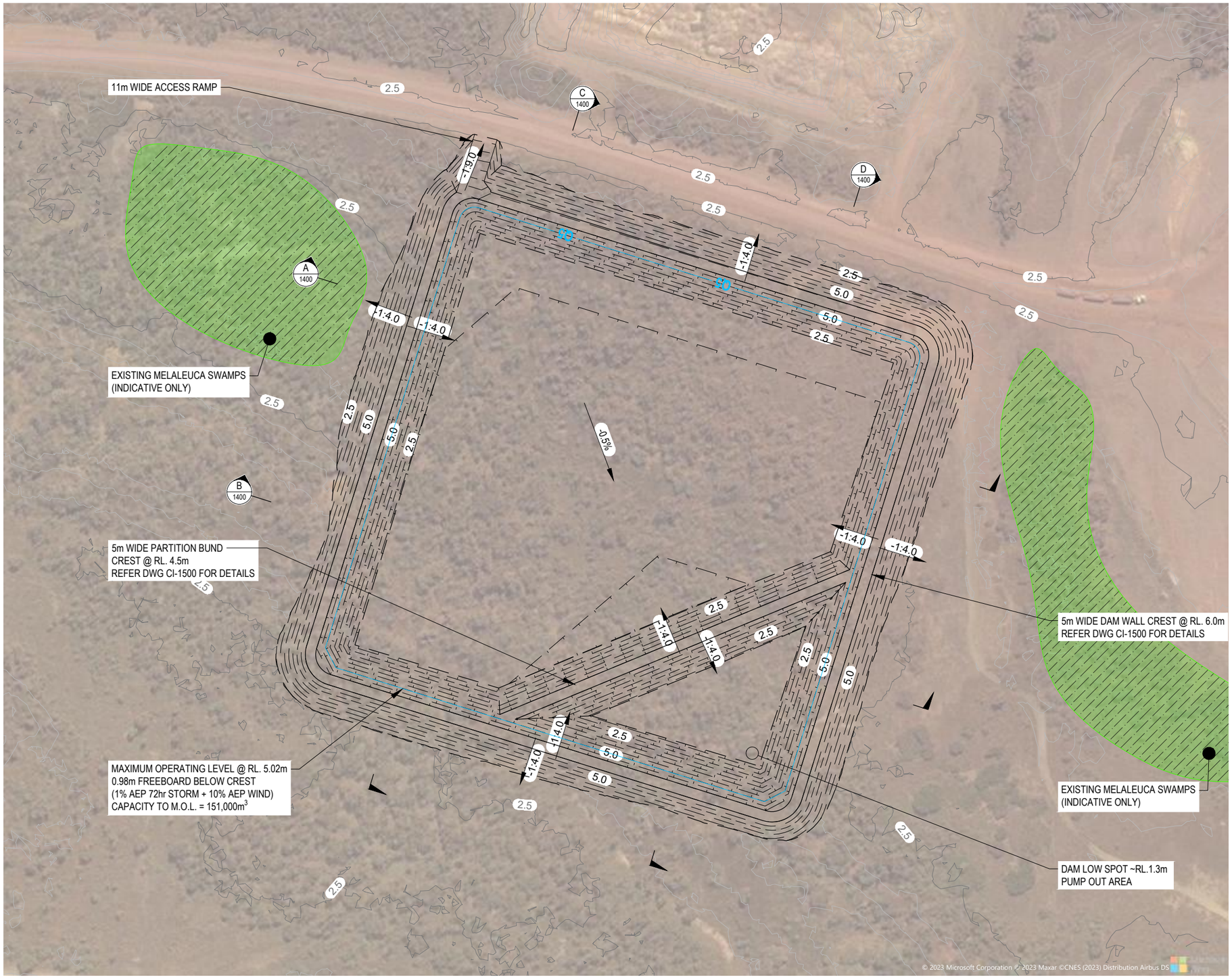
3.3 Dredge spoil disposal

NRR requires to construct an appropriate dredge spoil containment pond to handle and store the dredged material removed from the transhipment zone. There is an existing dredge spoil pond located on NRR's BBLF ML which was used to stored material from the 2020 dredge program. This existing spoil pond is small and has insufficient capacity to store the volume of material proposed for this dredge program. Hence, NRR is proposing to construct a new spoil pond within the BBLF ML to service the proposed dredge program and future maintenance dredging programs.

NRR engaged specialist engineers SLR and BLW Marine to develop a spoil pond design and location plan which is presented in **Figure 3-4**. **Table 3-13** summaries the design details of the proposed spoil pond (SLR 2024).

Table 3-13 Spoil Pond Design Details

Design Parameter	Description
Footprint Area	75,900 m^2
Capacity	180,000 m^3
Deposition Slurry	< 20% solids
Dredge discharge flow rate	≤ 2,000 m^3 / hour
Grading	Grade at minimum of 0.5% from northwest corner (dredge spoil discharge point) to southeast corner.
Embankment Wall Height	Varies from 1.9 m to 4.1 m above natural ground level.
Separation Bund Height	3 m
Design Criteria	1 in 20-year AEP, 72 hr storm
Catchment Area	6 ha
Full Storage Volume (FSL)	205 ML
Maximum Operating Volume (MOL)	180 ML



N
W E
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NOTE:

REFER DWG 623.030222-CI-1001 FOR
CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.

LEGEND

- 2.5 — EXISTING GROUND CONTOURS (0.5m INTERVALS)
- EXISTING MELALEUCA SWAMPS
- 5.0 — DESIGN CONTOURS (0.5m INTERVALS)
- TOP OF BANK / DAM CREST
- BATTER TOE
- Q5 — MAXIMUM OPERATING LEVEL (MOL)

GENERAL ARRANGEMENT PLAN

SCALE 1:2000

REVISIONS				
	0	11/01/24	FINAL DESIGN ISSUE	DOT
	A	03/10/23	PRELIMINARY DESIGN ISSUE	DOT
		DATE	DESCRIPTION	APPROVED

0.0 20 40 60 80
METRES

SCALE 1:2000

DRAWN:	JM	DATE:	11/01/24
DESIGN:	JM	DATE:	11/01/24
DWG. CHECK:	AK	DATE:	11/01/24
DES. CHECK:	AK	DATE:	11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE:	11/01/24
RPEQ :			
RPEQ :			

SLR
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QUEENSLAND 4810
AUSTRALIA
T: 61 7 4722 8000
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www.slrconsulting.com

CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: GENERAL ARRANGEMENT PLAN

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:2000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1100

REVISION: 0

PLOT DATE 11-Jan-2024 12:38:42 PM

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The proposed spoil pond is separated into two basins; the main basin and the decant basin. The main basin will settle out and store the dredged marine sediment, whereas the decant basin will store seawater which will be separated from the dredged sediment. The main basin of the spoil pond will be designed with a 0.5% gradient sloping from the northwest to the southeast corner, assisting with the settlement of suspended sediments and fines from dredged seawater. The separation bund between the two basins will be constructed from a semi-permeable material (different to the compacted embankment walls and basin foundation), allowing water to diffuse through this bund into the decant basin. Water stored in the decant basin will be periodically discharged back to the swing basin should water quality of discharge water meet WDL trigger values.

NRR expects to deposit dredge material into the northwestern corner of the spoil pond at a maximum flow rate of 2,000 m^3/hr. This flow rate is anticipated to vary throughout the dredge program due to changes in settlement times, pond capacity and rainfall. Discharge of seawater from the decant basin of the pond back to the BBLF swing basin will occur on a periodic basis and will not exceed a discharge flow rate of 300 L/second. Approximately 450 ML of water is anticipated to be decanted and discharged back to the swing basin over the entirety of the dredge program. To detect any potential impacts to receiving waters associated with the discharge of decant water, a monitoring program has been developed and is further discussed in **Section 7.1**.

The spoil pond foundations and embankment walls will be sourced from locally available material should it be deemed appropriate for construction. Material proposed for foundation and embankment walls construction will be tested prior to construction and post-construction (in-situ), specifically for compaction. A series of compaction methods and tests will be implemented during the construction of the pond to ensure seepage from the pond is limited (see Section 6 of **Appendix A** for further details). Construction of the dredge spoil pond will be supervised by qualified and experienced civil and geotechnical engineers. In accordance with Variation of Authorisation 1062-01 conditions 39 to 45, the proposed dredge spoil pond will be reviewed and subsequently endorsed by an Independent Certifying Engineer (ICE), whereby an 'as-construction' report will be developed and submitted to DITT for approval prior to commission.

3.4 Scheduling

The construction of the proposed spoil containment pond is scheduled to commence in June/July 2024 subject to approvals. Construction of the spoil pond is expected to be completed within five weeks of commencement, with dredging activities to commence two weeks after the completion of the spoil pond and installation of the required dredging infrastructure. Maintenance dredging of the transhipment zone is expected to take approximately eight weeks not accounting for any delays.

The dredging vessel will operate 24 hours per day, seven days per week. Given the low tidal variation in the region, dredging will not be scheduled to coincide with any specific tidal movement. Given the dredge program will be completed at the start of the wet season, delays to the dredging operation are expected due to monsoonal or cyclonic weather conditions.

4 EXISTING ENVIRONMENTAL VALUES

The proposed maintenance dredging program will target a previously dredged area and is not expected to directly impact any intact environmental values. Therefore, this section focuses on describing the marine and coastal environmental conditions and environmental values surrounding the BBLF which may be potentially impacted by the proposed dredging activities.

4.1 Coastal morphology and bathymetry

The southwestern region of the Gulf of Carpentaria where the BBLF is located, is typified by relatively shallow depths with a coastline dominated by alluvial plains, tidal channels and river systems predominately comprising of clays and muds. The BBLF is relatively sheltered from prevailing winds and waves by West Island (part of the Sir Edward Pellew Group of Islands), which is located approximately 5 km offshore from the coast. The other islands in this group are located further to the east.

The coastline is characterised by low topographic relief, formed by deposition of quaternary marine deposits resulting in tidal inlets, beach flats and low beach ridges. The BBLF is located adjacent to a narrow beach berm, with low frontal and hind dune formation and extensive tidal mud flats, in a typical chenier formation. At higher elevations within the coastal zone, low, partially stabilised sand dunes are present, intersected in several locations by tidal channels (EcOz 2012).

4.2 Tidal range and currents

Tidal range in this region is approximately 0.50 m to 3 m. Tide timing is complex, varying from mixed semi-diurnal (i.e. two high tides of unequal height per day) to semi diurnal (i.e. two equal high tides per day) to diurnal (only one high tide per day). The combination of tidal currents and wave action are the primary cause of the mobilisation of bed sediments and sediment transport and mixing in the shallow coastal waters (EcOz 2012).

The McArthur River is the nearest large river to the BBLF that has the potential to influence water quality offshore from the BBLF. Large quantities of freshwater, sediments and nutrients flow into the Gulf during the wet season. These are largely trapped within the coastal boundary as there is limited exchange between the near-coastal waters and deeper waters within the central Gulf basin (DEWHA 2007a).

The interaction between prevailing dry season south-east trade winds from May to October, and moister north-westerlies during the wet season, combined with tidal flows, result in a slow clockwise movement of water around the coastal margins of the Gulf of Carpentaria (DEWHA 2007b). The surface current flows are shown in **Figure 4-1** below (BoM 2024).

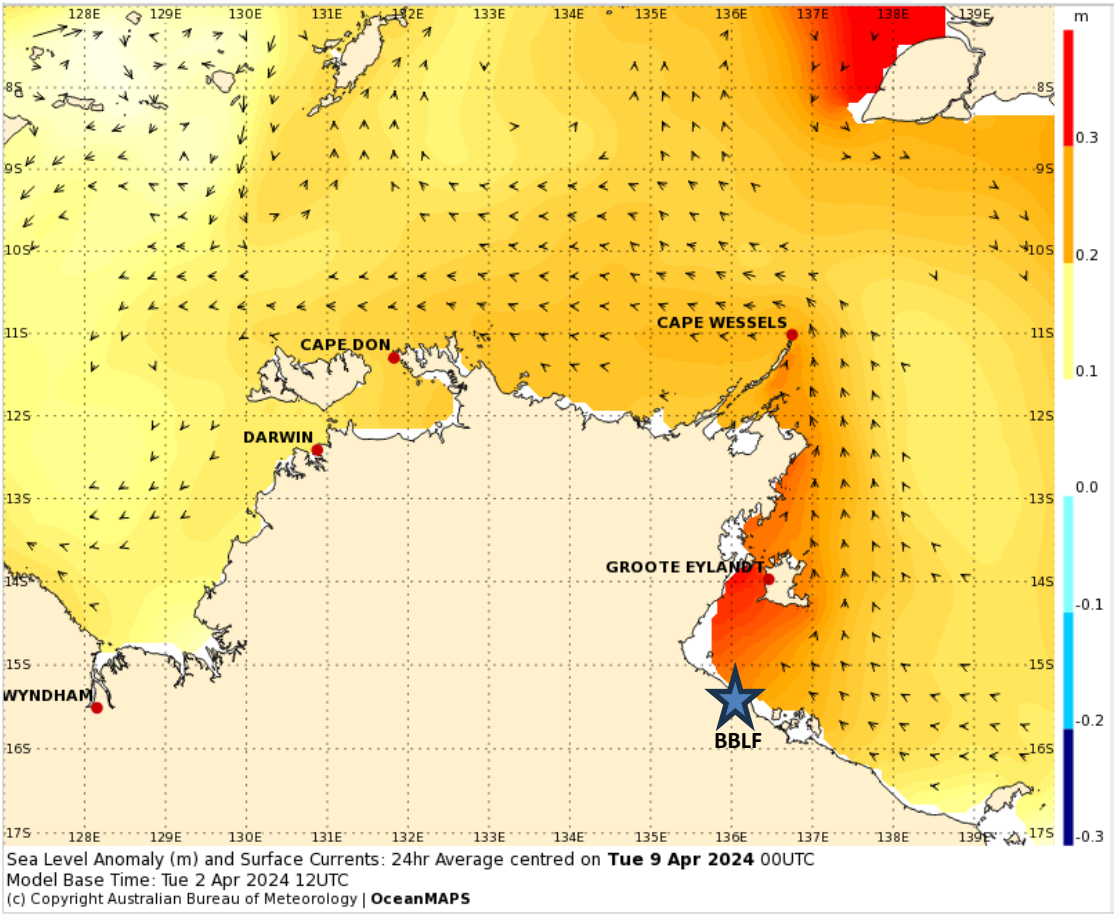


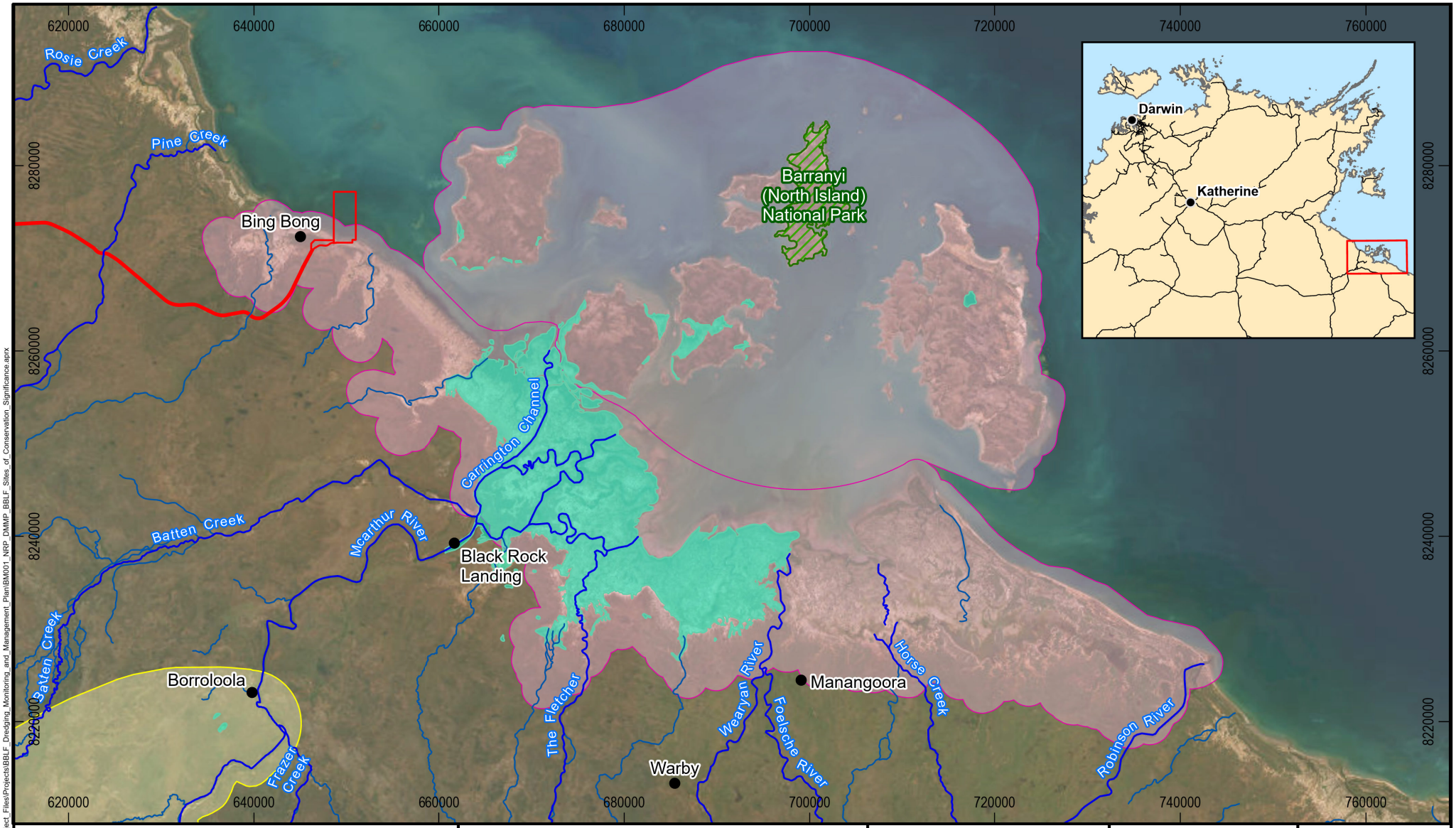
Figure 4-1 **Northern Territory, BBLF sea level and currents (BoM 2024)**

4.3 Sites of Conservation Significance

The McArthur River Coastal Flood Plain and the Sir Edward Pellew Island Group are declared NT Site of Conservation Significance (SOCS) (#34 and #33 respectively), located within the immediate vicinity of the BBLF. These sites in proximity to the BBLF are shown in **Figure 4-2**.

The McArthur River Coastal Flood Plain encompasses a vast area of open saline flats that are amongst the most extensive around the coast of the Northern Territory. The coastal flats are dissected by a series of tidal channels that form a large delta system around the mouth of the McArthur River. The mud flats support low chenopod shrublands, are dry for much of the year, and extend beyond extensive mangrove systems for up to five kilometres in places. The McArthur River coastal floodplain has outstanding conservation values and attracts very large aggregations of migratory shorebirds, including internationally significant numbers of many species (Pavey et al. 2009a).

The Sir Edward Pellew Group of Islands is located at the Mouth of the McArthur River, comprised of five Islands. The Pellew Islands have outstanding conservation values, including internationally significant sites for nesting marine turtles and colonial seabirds. Marine turtles frequent the waters around the islands, and some of the islands support high density nesting of Green and Flatback Turtles. Large numbers of seabirds aggregate to nest on islets and small islands, including more than 1% of the world population of Crested and Roseate Tern. The islands support an unusual mix of mammal species, five of which are listed as threatened (Brush-tailed Rabbit-rat, Northern Brush-tailed Phascogale, Northern Quoll, Carpentarian Antechinus), including the only Northern Territory location of the Canefield Rat. The Pellew group also provides important habitat for other rare or uncommon species and serves as an important refuge area for species threatened on the mainland (Pavey et al. 2009b).



Legend

- Town
- Major Drainage
- Minor Drainage
- National Park
- International Site of Conservation Significance
- National Site of Conservation Significance
- Important Wetlands
- Mineral Title

Source: Northern Territory Government (Department of Infrastructure Planning and Environment 2005; Department of Environment, Parks and Water Security 2021-2022; Department of Industry, Tourism and Trade 2022), Nathan River Resources 2024, METServe 2024, Earthstar Geographics.

Nathan River Project

Sites of Conservation Significance within the Proximity to the BBLF

0 5 10 20

Kilometers

Scale: 1:580,000 (A4)

15/04/2024

Datum: GDA2020
Projection: MGA53

FIGURE 4-2

METSERVE
Mining & Energy Technical Services Pty Ltd

Path: S:\Projects\BM001 Nathan River\ArcGIS\Project_Files\Projects\BBLF_Dredging_Monitoring_and_Management_Plan\BM001_NRP_DMMP_BBLF_Sites_of_Conservation_Significance.aprx

4.4 Marine habitats

The predominant marine communities outside of the BBLF transhipment zone are seagrass and other subtidal soft sediment communities. These are described in further detail below.

Seagrass communities

Seagrass communities are monitored by MRM on an annual basis in the vicinity of the BBLF between Pine Reef and West Island. Impacts to the benthic seagrass habitats can impact on fauna which heavily rely on these habitats such as dugong and fish species. Additionally, seagrass habitats in the region are known to be significant for Tiger Prawns, a commercially important species which the NT. At least two EPBC listed species are known to inhabit waters adjacent to the BBLF which feed directly on seagrass; Dugong (*Dugong dugon*) and the Green Turtle (*Chelonia mydas*) (EcOz 2012).

Results of annual seagrass surveys conducted during 2016 and 2017, suggest that the BBLF does not have a measurable impact on nearby seagrass communities. Overall, changes observed within the BBLF transhipment zone are consistent with the other areas (control sites located between 7-14 km to the east and north-west of BBLF), with the continued succession of seagrass species away from the pioneer species *Halophila ovalis* and *Halodule uninervis*, towards colonising species *S. isoetifolium* and *C. serrulata*. An increase in seagrass coverage and decrease in macroalgae coverage was observed across most sectors in 2017 when compared to 2016. Overall, survey results from 2017 indicate that operations at the BBLF are not having a measurable impact on seagrass communities (ERIAS 2018).

Intertidal communities

The soft sediment substrates present in the intertidal and subtidal zones fringing the BBLF are expected to provide habitat for a moderately diverse assemblage of invertebrates, including polychaete worms, bivalves, crustaceans and echinoderms. One study of benthic invertebrates in the sediments adjacent to the BBLF found 452 species (DEWHA 2008 cited in EcOz 2012).

4.5 Marine fauna

Marine fauna of conservation significance that occur in the Pellew Bioregion include threatened species of marine turtles and sawfish that are listed under the EPBC Act and / or *Territory Parks and Wildlife Conservation Act* (TPWC Act). Species known or likely to occur in proximity to the BBLF are summarised below.

Marine turtles

Four species of marine turtle have been recorded nesting in the bioregion where the BBLF is located (referred to as the Pellew Bioregion) (Chatto 2008). These species include the:

- Olive Ridley (*Lepidochelys olivacea*) - Endangered (EPBC Act) and Vulnerable (TPWC Act);
- Green (*Chelonia mydas*) - Vulnerable (EPBC Act) and Near Threatened (TPWC Act);
- Hawksbill (*Eretmochelys imbricata*) - Vulnerable (EPBC Act) and Vulnerable (TPWC Act); and
- Flatback (*Natator depressus*) - Vulnerable (EPBC Act) and Data Deficient (TPWC Act).

The Pellew bioregion is considered important for turtle nesting; however, the coastline near the BBLF is not suitable turtle nesting habitat given it is mostly inter-tidal mudflat abutting mangroves. There are some narrow sections of shallow sandy beach over 10 km to the north of the BBLF where a small amount of Flatback Turtle (*Natator depressus*) nesting has been recorded. This is considered to be the closest nesting site to the BBLF, > 10 km away from the BBLF.

Crocodiles

Estuarine crocodiles (*Crocodylus porosus*) are known to inhabit the regions surrounding the BBLF including estuarine waterways and offshore marine waters. As nesting occurs in rivers, there are no nesting habitats in the proximity to the BBLF.

Sawfish

There are three threatened species of sawfish listed as vulnerable under the EPBC Act and TPWC Act that have been recorded in the Gulf of Carpentaria. The Green Sawfish (*Pristis zijsron*) is likely to occur in the coastal waters surrounding the BBLF, with catch records indicating that the species inhabits all regions of the Gulf in low numbers and with a highly variable frequency of occurrence (Peverell 2005). The other two threatened sawfish species, Freshwater or Largetooth Sawfish (*Pristis pristis*) and Dwarf Sawfish (*Pristis clavata*) are less likely to occur in numbers due to the absence of suitable habitat and past records (EcOz 2012).

In addition to the threatened sawfish species, there are many inshore and offshore records of Narrow Sawfish (*Anoxypristis cuspidata*) with the Gulf region. During the study of the eastern Gulf of Carpentaria undertaken by Peverell (2005), this species was the most abundant both inshore and offshore, and in both the benthic and mid-layer depths. There are many records for the western Gulf near Groote Eylandt, and the species is commonly caught by prawn fishing boats (Laird 2017).

Dugong

The Dugong is a large marine mammal that forages on seagrasses and is listed as *migratory* under the EPBC Act and *near threatened* under the TPWC Act. The distribution of the species is closely correlated with the occurrence of seagrass beds (Groom et al. 2017). Seagrass beds occur immediately adjacent to the BBLF and more broadly across the region and are surveyed on an annual basis by MRM. Dugong surveys in and around the Sir Edward Pellew Islands, including the surrounding coastlines of the BBLF, have recorded the highest densities and population estimates for the NT (Groom et al. 2017). The species is likely to forage in the areas around the BBLF.

Dolphins

There are three dolphin species that are likely to occur in the waters surrounding the BBLF. These species include:

- Irrawaddy or Australian Snubfin Dolphin (*Orcaella brevirostris*) - Migratory (EPBC Act);
- Australian Humpback Dolphin (*Sousa chinensis*) - Migratory (EPBC Act); and
- Bottlenose Dolphin species (*Tursiops aduncus* and *Tursiops truncatus*) - Least Concern (TPWC Act).

5 BASELINE ENVIRONMENTAL MONITORING

The Gulf of Carpentaria has naturally high turbidity as a result of major inputs of fine sediments from river systems during the wet season. Coastal creeks are located 4 km east and 7 km west of the BBLF and the McArthur River mouth is located 30 km to the east. The deposition of sediment forms sand bars and mudflats which are a source of high turbidity throughout the year as sediments are re-suspended by wind/wave action and tidal movements. A study of light attenuation in the Northern Marine Region of Australia (Schroeder et al. 2009) found that near-shore regions show up to 50 % higher turbidity values during the wet season compared to the dry seasons, while the off-shore regions show up to 50 % higher turbidity values during the dry seasons compared to the wet season (EcOz 2012).

Marine waters surrounding the BBLF can be characterised with reference to seawater monitoring data collected as part of MRM's routine marine monitoring programs. An overview of existing marine water quality as relevant to the assessment, management and monitoring of dredging activities is presented below from monitoring data supplied by MRM.

The beneficial uses that are applicable to the coastal waters of, and surrounding, the BBLF are aquatic (marine) ecosystem protection, recreational water quality and aesthetics. Given the previous dredging programs which have occurred at the BBLF and the industrial activities in which it facilitates, the default water quality guideline values (DGVs) considered to be relevant are ANZECC / ARMCANZ (2000) 95% species protection in marine water for slightly to moderately disturbed ecosystems.

5.1 Marine water quality

Marine water quality of the BBLF and surrounds are routinely monitored by MRM via the use diffuse gradients in thin films (DGT). DGTs are a sampling technique which can provide *in situ* measurement of labile metal-species concentrations in aquatic systems (INAP 2002, and Simpson & Batley 2016). In a DGT device, dissolved analyte species diffuse through a thin hydrogel layer and become trapped in a gel, typically impregnated with a chelex resin that selectively accumulates the metals of interest (Simpson & Batley 2016). MRM's DGT monitoring program currently includes six monitoring locations which are monitored on a quarterly basis.

NRR intends to utilise existing DGT monitoring data collected during periods of no dredge activity (between 2022 and 2024) as baseline data. Details on the DGT monitoring locations are outlined in **Table 7-3** and locations presented in **Figure 7-2** in **Section 7.3**.

Physico-chemistry

Physico-chemical parameters are collected at each DGT monitoring site upon deployment during MRM's routine DGT monitoring program using a multi-parameter water quality probe. Field parameters collected between August 2022 and March 2023 are provided in **Table 5-2** and have been compared to the applicable ANZECC default trigger values for tropical marine waters (ANZECC, 2000). Data provided in **Table 5-2** are considered to be reflective of baseline conditions given no dredging activities occurred over this monitoring period.

Table 5-2 Field water quality data collected by MRM at DGT sites (2022-2023)

Monitoring Site	Date	Temp	Field pH	Field EC	DO	ORP
Unit		°C	pH Units	µS/cm	% saturation	mV
95% DGV		ND	8.0 – 8.4	ND	< 90%	ND
DGT1	August 2022	24.6	7.78	61,065	106.3	212
	November 2022	30.5	7.59	57,498	93.4	224
	March 2023	29.9	7.05	37,306	91.4	276
DGT2	August 2022	24.2	7.90	60,792	104.1	206
	November 2022	30.5	7.87	57,705	94.6	202
	March 2023	30.2	7.54	37,537	93.1	191
DGT3	August 2022	26.3	7.62	62,230	91.3	229
	November 2022	30.6	7.57	58,443	80.7	258
	March 2023	29.2	6.50	28,620	77.4	246
DGT4	August 2022	26.6	7.70	62,444	99.7	215
	November 2022	32.5	7.91	60,358	98.3	213
	March 2023	29.6	6.53	29,925	91.1	278
DGT5	August 2022	24.7	7.84	60,415	104.1	205
	November 2022	30.6	7.96	57,569	91.0	119
	March 2023	29.7	7.74	47,194	96.8	159
DGT6	August 2022	23.7	7.88	60,545	103.6	174
	November 2022	31.0	8.23	58,754	98.4	174
	March 2023	30.0	7.53	46,275	94.5	223

Metals

DGT laboratory analysis includes DGT-labile Zn, Pb, Cd, Co, Cu, Ni, Mn and Fe. Results which are considered to be reflective of baseline conditions at the BBLF (no dredging activity) are summarised in **Table 5-3** and compared to the ANZECC (2000) 95% species protection DGV limit in marine waters for slightly to moderately disturbed ecosystems.

Results showed that all analytes (Mn, Fe, Co, Ni, Cu, Zn, Cd, Pb) were within the relevant ANZECC (2000) 95% DGV for marine waters. Each monitoring result presented in **Table 5-3** is an average across three replicates collected during the specific monitoring period.

To account for the bio-accumulating nature of Cd, Ni and Zn, ANZECC (2000) recommends that the 99% species protection level DGV is used for slightly to moderately disturbed systems, to protect key species from chronic toxicity. DGT monitoring data during this period for Cd, Ni and Zn remained within the ANZECC (2000) 99% species protection DGV for marine waters.

Table 5-3 summarises DGT monitoring data from August 2022 to March 2023 with comparison to 95% species protection DGV (refer to **Appendix D** for all DGT data).

Table 5-3 Results summary of DGT monitoring

Monitoring Site	Date	Mn	Fe	Co	Ni	Cu	Zn	Cd	Pb
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
LoR		0.01	0.03	0.01	0.02	0.01	0.2	0.005	0.005
95% DGV		ND	ND	1.0	7*	1.3	3.3*	0.7*	4.4
DGT1	August 2022	4.00	3.92	0.03	1.14	0.12	0.13	0.01	0.01
	November 2022	1.84	2.53	0.02	<0.20	0.07	<0.40	0.01	0.02
	March 2023	3.11	13.36	0.03	0.16	0.11	0.45	0.01	0.01
DGT2	August 2022	4.20	3.46	0.03	1.59	0.11	0.21	0.01	0.01
	November 2022	2.12	5.09	0.02	<0.20	0.07	<0.40	0.01	0.01
	March 2023	1.49	8.79	0.02	0.14	0.09	0.33	0.01	0.01
DGT3	August 2022	6.64	2.77	0.06	<0.50	0.43	3.07	0.02	0.20
	November 2022	5.37	2.55	0.04	<0.20	0.15	1.40	0.02	0.12
	March 2023	7.46	2.57	0.05	0.14	0.11	2.38	0.02	0.06
DGT4	August 2022	5.38	7.00	0.05	0.66	0.16	1.03	0.01	0.09
	November 2022	4.14	1.51	0.04	<0.20	0.07	0.44	0.01	0.06
	March 2023	4.13	4.93	0.04	0.13	0.09	0.77	0.01	0.02
DGT5	August 2022	2.66	3.94	0.02	<0.50	0.13	0.17	0.01	0.01
	November 2022	1.19	4.50	0.02	<0.20	0.11	0.51	0.01	0.01
	March 2023	1.74	16.32	0.02	0.13	0.10	<0.20	0.01	0.02
DGT6	August 2022	2.06	3.81	0.02	<0.50	0.11	0.14	0.01	0.01
	November 2022	1.67	4.58	0.02	<0.20	0.08	<0.40	0.01	0.00
	March 2023	2.25	12.20	0.02	0.12	0.08	0.28	0.01	0.01

Notes: * 99% DGV species protection used for slightly to moderately disturbed systems to account for bioaccumulation.

5.2 Sediment quality

Existing sediment quality has been discussed in **Section 3.3** above.

6 POTENTIAL IMPACTS AND MITIGATION MEASURES FOR PROPOSED ACTIVITIES

There are several potential direct and indirect impacts that are typically associated with typical marine dredging activities. Direct impacts from dredging are most likely to occur at the location where the dredge interacts with the seafloor and/or the area where spoil is stored (NT EPA 2013). Indirect impacts are associated with the effects of suspended sediments generated by dredging, in a plume that affects a larger area around the site of activity, creating a raised level of sediment accretion and/or turbidity exceeding the natural tolerances of benthic habitats over time. Indirect impacts from dredging can affect ecological processes resulting in impacts ranging in severity from 'irreversible' to 'readily-reversible' (NT EPA 2013).

Potential impacts to environmental values associated with the proposed dredging activities have been assessed with reference to the following documents and information:

- NRR Mining Management Plan Amendment – BBLF Dredging (NRR 2024);
- NRR Mining Management Plan (NRR 2019);
- RBIOP EIS (EcOZ 2012); and
- MRM Independent Monitor Annual Reports.

6.1 Conceptual site model

A source-pathway-receptor (SPR) conceptual site model (CSM) have been developed for the proposed maintenance dredging program (**Table 6-1**). This CSM has been developed to identify potential direct and indirect impacts associated with the dredging program and is further discussed in **Section 6.2**.

Table 6-1 Maintenance dredging conceptual site model

Activity	Source	Pathway	Receptors
Dredging operations	- Turbidity / suspended sediments. - Metals and metalloids present in dredged sediments. - Hydrocarbons released from maintenance, refuelling and spills.	- Mobilisation in dredge plume. - Transported by tides and currents.	- Marine water quality - Benthic habitats (seagrasses) - Coastal habitats (mudflats and mangroves) - Marine fauna
Spoil placement and storage	- Saline leachate - Metalliferous and/or acidic leachates	- Seepage of contaminated water into soils. - Seepage or overflow of contaminated water to surface water or groundwater. - Failure of containment resulting in sediments released to land and water.	- Terrestrial vegetation - Marine water quality - Groundwater quality
Discharge of dredge spoil decant	- Turbidity / suspended sediments. - Metalliferous and/or acidic leachates.	- Mobilisation and release in decant water discharged to swing basin.	- Marine water quality/biota - Benthic habitats (seagrasses) - Coastal habitats (mudflats and mangroves)

6.2 Risk Assessment

6.2.1 Risk assessment method and outcomes

Following on from the conceptual site model, a high-level risk assessment was completed for the maintenance dredging program proposed for the BBLF. This risk assessment aimed to identify the potential environmental impacts associated with the dredging program, the corresponding initial risk of said impact, proposed management and mitigative controls, and the residual risk which is deemed to remain once mitigative controls have been implemented. The full risk assessment for the maintenance dredging program proposed for the BBLF is included in **Appendix E** (Table 6).

The consequence (or severity) of each potential impact was assessed using the following criteria:

- Scale (extent);
- Intensity (including consideration of the receiving environment sensitivity to impact); and
- Duration and frequency.

Categories used to rate the consequence of each impact are provided in **Appendix E** (Table 1). Impact identification and analysis was informed by the project details provided in the MMP and the various baseline and monitoring studies undertaken at the BBLF since it was developed by MRM.

The principles of qualitative risk management described in *AS/NZS 31000:2009 Risk Management – Principles and Guidelines* were used to assess inherent risk (without mitigation) and residual risk (with mitigation). Risk is a combination of the impact severity (consequence) and likelihood of the impact occurring. The likelihood and consequence categories adopted in the environmental risk assessment are provided in **Appendix E** (Table 2 and Table 3).

Measures to avoid, mitigate and manage impacts were identified, focussing on impacts with an inherent risk level of medium or above. Impacts with a low level of inherent risk were considered for further mitigation where routine controls would further contribute to risk minimisation. Measures were applied with the goal of reducing all risks to 'as low as reasonably practicable' (ALARP). ALARP is considered to be the point at which the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

The likelihood and consequence ratings were combined to derive an overall risk rating using the matrix and risk level in **Appendix E** (Table 4 and Table 5 respectively).

6.3 Potential Impacts

The main impacts identified in the risk assessment provided in **Appendix E** along with specific mitigative measures proposed are discussed further below.

6.3.1 Coastal geomorphology and processes

It is not expected that the proposed dredging program will cause changes to currents and/or sediment deposition in addition to those already experienced in the previously dredged transhipment zone. The proposed maintenance dredging program aims to return the swing basin and transhipment channel to the original design depth of 3.23 m below LAT established during the capital dredging program and subsequent maintenance dredging activities. The previous capital dredging program was designed to allow good tidal flushing throughout the BBLF transhipment zone whilst limiting the impact to the surrounding environment (e.g. mudflats / coastal environment). Given the relatively small scale of this dredge program, the amount of deposited material which is proposed to be removed is unlikely to impact surrounding coastal geomorphology or hydrologic processes.

6.3.2 Benthic habitat removal

The area to be targeted by the proposed maintenance dredging program is confined to the previously dredged transhipment zone. Monitoring undertaken by MRM indicates that there is a lack of significant habitat for motile marine species, or seagrasses within the swing basin and the transhipment channel (ERIAS 2018). The NT EPA Marine Dredging Guidelines (NT EPA 2023) recognises that benthic biota may colonise previously dredged areas between maintenance events and may be removed in future maintenance dredging. However, further impacts on these directly-affected biota are not considered to be a key consideration in the assessment of maintenance dredging proposals. This is due to those direct impacts being largely unavoidable and recolonising biota being well-adapted to surviving within dynamic benthic habitats. The risk of benthic habitat removal associated with the proposed dredging activities is considered low given the lack of such habitat within the already disturbed transhipment zone.

6.3.3 Marine water quality

Marine water quality will be temporarily impacted by increased turbidity and potentially elevated dissolved metal concentrations. Dissolved metals may potentially mobilise into the water column during dredging given the high likelihood of metals within the upper marine sediments of the transhipment zone as a result of dust and ore spillages during ship loading. There is also potential for spillages of hydrocarbons during refuelling of the dredge vessel, and in a worst-case scenario equipment failure, grounding or collision.

Turbidity and heavy metals

In addition to the NT EPA's guidance on benthic biota being well-adapted to surviving dynamic benthic habitats, studies of the local assemblages of benthic invertebrates and seagrasses within the BBLF and surrounds have recorded naturally high resilience to turbid waters. This is primarily due to the high prevalence of seasonal monsoons and high cyclone activity within the Gulf of Carpentaria (ERIAS 2018). It has also been noted that seagrass communities in the closest proximity to the BBLF are demonstrating normal health and natural succession (ERIAS 2016 and 2018). Further to this, surveys conducted by MRM has concluded that there are no significant turbidity impacts associated with previous dredge maintenance programs or ongoing shipping operations at the BBLF (ERIAS 2018). Monitoring data available from previous BBLF dredge programs indicate that water quality impacts are expected to be localised. During the 2020 maintenance dredging program, turbidity did not exceed the 20 NTU trigger limit outside of a 50 m zone around the dredge vessel, and dissolved metal concentrations exceeding the ANZECC (2000) 95% level of species protection guidelines were not recorded outside of the swing basin (EcOz 2021).

The NT EPA Guidelines identifies two main sources of turbidity typically associated with dredging activities. These include:

- Physical interaction of dredging equipment with the seabed; and
- Spills of sediment-laden water from dredge barges.

Physical interaction of dredging equipment with the seabed causes sediment to mobilise into the surrounding water column at the dredge site. When all dredged material is not captured by the dredging equipment (e.g. fugitive loss from a CSD cutter head), a proportion is liberated into the surrounding water column as suspended sediment. Turbulence from propellers and movement of vessel hulls can also disturb and lift sediments into the water column where under-keel clearance is limited. Certain dredging methods require the storage and transport of dredged material from the dredged site via dedicated barges. This increases the risk and frequency of dredged material spills into the marine environment.

The proposed dredging activities are expected to increase turbidity in waters within the immediate vicinity of the dredge site for short periods of time during operations. To limit the magnitude and migration of turbidity plumes from the immediate dredge site, NRR has implemented control measures in the design of the dredge program to assist with this. One such design feature which aims to mitigate the magnitude of turbidity plumes is the selected dredge method of a CSD. CSD's are a commonly used method when dredging in sensitive environments given its less intensive interaction with the seabed.

This results in a significant reduction of turbidity plumes at the dredge site in comparison to other methods like backhoe dredge methods. In addition to this, the CSD method enables the dredge vessel to remain stationary (whilst the dredge head swings sideways) when dredging, avoiding the need to move around and potentially mobilise more sediment into the water column.

Another common source of turbidity associated with dredging activities, spills from dredge barges, is not considered to be relevant to NRR's proposed dredge program. As outlined in **Section 3.1**, from the cutter head of the dredge to the spoil pond discharge point, dredge material will be entirely contained within a welded HDPE pipeline in order to prevent any spills of dredge material back into the receiving waters. No dredge material will be stored on the dredge vessel, removing the risk of spilling dredged material into the marine environment.

NRR also intends to complete the proposed dredge program over the monsoonal wet season. During this time of year, turbidity within shallow, coastal waters such as the BBLF are naturally elevated due to high rainfall and contributions from surface water run-off. By scheduling the dredge program during periods of naturally high turbidity, additional turbidity associated with dredging is less likely to impact the marine environment, namely benthic communities. This sentiment is shared by the NT EPA who outline in the Marine Dredging Guidelines that Darwin Harbour dredging programs are typically scheduled over the wet season during periods of naturally elevated turbidity to lessen the potential impacts on the marine environment (NT EPA 2023).

Along with the dredge program design aiming to mitigate the potential impacts of turbidity generation, NRR has proposed an extensive water quality monitoring program to be conducted prior, during and at completion of the dredge program. This monitoring program will facilitate the pro-active detection of any adverse impacts to water quality associated with dredging activities. During dredging operations, turbidity will be frequently monitored at several locations surrounding the dredge site, whereby if trigger values are exceeded, dredging operations will be postponed until measures are implemented to reduce the turbidity plume. Further information on the proposed monitoring program is detailed in the **Section 7**.

The relatively small scale and short timeframe of the proposed maintenance dredging program will result in a localised and short-term impact to water quality. Given that there has not been an impact on seagrass or other benthic communities from activities at the BBLF to date, the maintenance dredging program poses a low risk of any significant impacts from elevated turbidity or metals in the wider marine environment.

Hydrocarbon spills

The likelihood of a major spill occurring is low given that relatively small amounts of fuel which are stored on the dredge vessel and/or handled during vessel refuelling. Release of large amounts of oil or fuel to the BBLF transhipment zone could result in a significant deterioration in marine water quality should emergency spill procedures not be implemented. However, due to the relatively small tidal range and weak currents at the BBLF, impacts on benthic ecology and marine assemblages could be minimised through the immediate implementation of emergency spill response procedures currently in-place at the BBLF. Minor releases of fuel or oil into the marine environment are unlikely to cause any long-term impact subject to the timely implementation of spill response.

6.3.4 Marine fauna

The BBLF transhipment zone is a disturbed ecosystem that does not provide significant areas of habitat for marine fauna. There are some areas of seagrass in close proximity to the BBLF, a habitat that is an important food source for a range of threatened and migratory marine species. There are also coastal mudflat and mangrove habitats, which are also recognised as important habitats. A range of marine fauna are known to utilise the marine waters surrounding the BBLF, but there is no known important feeding, breeding or nesting areas in close proximity that are likely to be impacted by the dredging.

Water quality

Increased turbidity and dissolved metal concentrations associated with dredging is expected to be localised, short-term in nature and is unlikely to cause long-term impacts to any marine fauna at the individual or population level. Many inshore cetacean species are known to be able to continue normal behaviour in turbid waters due to their habitat generally being located in shallow, turbid, inshore locations such as river mouths, estuaries and mangroves.

Species such as sea snakes, crocodiles and some syngnathids also inhabit areas that are naturally turbid and therefore are expected to also tolerate temporary increases in turbidity levels (Inpex 2011). Species such as Dugongs and Green Turtles may alter their behaviour to avoid turbidity plumes by moving to adjacent, unaffected habitats (Inpex 2011).

Physical injury

The likelihood of fauna injury is limited by the small extent of the dredging footprint and the effect of noise and turbid plumes, which generally discourage the presence of most species in close proximity to the active dredge vessel. CSD's are considered to have a lower risk profile than other common dredge methods (e.g. trailing suction hopper dredges), with limited mortalities reported associated with this operation of CSD dredges (Dickerson et al. 2004). Given the large size and slow speeds (approximately 2-3 knots) associated with dredge vessel, the risk of collision with marine megafauna is considered to be low.

Noise impacts

Noise from dredging operations can cause disruption to behaviours and possible short to medium term displacement. In the case of sudden start-ups of machinery, potential mortality or injury for noise sensitive species particularly fish and cetaceans. As the proposed dredging activities are targeting a heavily disturbed and operational port facility whereby noise impacts are already present, most marine fauna are likely to be habituated to a degree of noise. Dredging activities are not proposed within an area of critical habitat for dugongs, cetaceans, turtles or other species, nor is it expected to prevent migration of populations, or disrupt feeding on seasonally restricted seagrass species. Given the extensive areas of suitable habitat available outside the target dredging areas within the transhipment zone, displacement of animals from the BBLF for the short-period of dredging is considered to be the worst-case scenario.

Artificial lighting

Impacts from the dredging operation on turtle nesting behaviour are expected to be minimal owing to the distance to the closest known nesting beach, estimated to be a minimum of 10 km away, and absence of mating areas in the immediate vicinity of the dredge footprint.

Invasive marine species

There is a potential for exotic marine species to be introduced to waters in and around the BBLF through ballast water or on the dredging vessel hull. Introduction of marine pest species can potentially impact upon marine invertebrate assemblages through competition and predation, as well as cause problems with marine infrastructure through fouling. Discharge of ballast water within an unauthorised area is considered unlikely; however, NRR and the dredging contractor are required to comply with Australian Quarantine and Inspection Service (AQIS) procedures and NT monitoring procedures.

6.3.5 Coastal vegetation/habitats

Storage of dredged marine sediment in a land-based containment facility has the potential to produce saline, acidic (if PASS is present) or metalliferous drainage from drying spoil material. The potential for poor-quality leachate to enter the receiving environment from the spoil pond will be minimised by returning decant water to the swing basin via a WDL. Draining and decanting excess seawater from the spoil material for discharge back to the sea aims to minimise evaporative water loss from the spoil pond whereby excessive salts are not retained in the spoil sediment (NT EPA 2013). Along with this, the decant of seawater from spoil material will reduce the overall salinity captured within the dried sediments and moisture of the stored material, reducing the overall risk of seepage from the pond to the receiving environment.

The risk of impacts to vegetation surrounding the spoil pond from potentially increased salinity is considered low, as the littoral vegetation assemblages present are salt tolerant by nature (EcOz 2012). The existing dredge spoil storage pond has existed for approximately 11 years, since the construction of the BBLF, without record of significant vegetation dieback, indicating that the containment bunds and floor are operating as designed. Further to this, current monitoring of similar vegetation for impacts from the storage of dredge spoil and potential salinity at the nearby MRM operation, has concluded that the vegetation of the area is generally tolerant of high saline conditions (ERIAS 2016 and 2018).

The likelihood of the dredged material being PASS is considered low based on the fact that no PASS material was encountered during the capital dredging program and subsequent maintenance programs since. An assessment of PASS was undertaken as part of geotechnical investigations prior to construction of the BBLF and did not identify any materials that required management (Cardno 2013). As a precaution, the dredged material will be tested during the initial stages of the dredging program for PASS. Should dredge spoil material has PASS characteristics, material will be managed in accordance with the Queensland Acid Sulfate Soil Technical Manual (Dear et al. 2014). Any PASS material will be treated if required.

6.3.6 Groundwater

Impacts to groundwater from poor quality leachate from the proposed spoil pond are considered to be low. Historic water quality from groundwater monitoring bores at the BBLF indicate highly saline groundwater conditions. Monitoring bore, BBMB01, approximately 250 m away from the proposed spoil pond site recorded an electrical conductivity of 103,000 µS/cm in July 2023, significantly higher than the EC of seawater (~50,000 µS/cm). Given the highly saline nature of groundwater at the BBLF, there are limited beneficial uses for groundwater at the BBLF. Impacts on surrounding groundwater quality associated with spoil pond seepage are not expected to occur. Routine groundwater monitoring of level and quality will continue on a bi-annual basis allowing the detection of any significant changes in water quality.

6.3.7 Waste pollution

Rubbish and waste materials could potentially enter the marine environment as a result of poor housekeeping. Rubbish could potentially be blown off into surrounding waters during strong winds. This could potentially result in localised habitat degradation, and potential marine fauna mortality through entanglement and ingestion. The potential impacts of waste on the marine environment will be minimised through the implementation of waste management controls on the dredge and removal of wastes for disposal at the appropriate onshore facilities.

7 MONITORING PROGRAM

NRR propose to undertake water quality monitoring, dredge spoil discharge monitoring and visual drone monitoring throughout the maintenance dredging operations to ensure the early detection of potentially unacceptable impacts to the receiving environment. The monitoring programs detailed in **Section 7** will be conducted prior to, during and post dredging activities. **Table 7-4** below provides a summary of all monitoring proposed to be undertaken as part of the DMMP.

Monitoring of cumulative impacts to the broader marine environment associated with the operation of the BBLF (by both NRR and MRM) will continue to be monitored by MRM through the already implemented, routine monitoring programs. NRR will provide monitoring results to MRM to inform analysis of future monitoring data.

7.1 Discharge monitoring

In accordance with the NT Water Act, an application for a WDL must be accompanied by a proposed monitoring program designed to assess any potential impacts associated with the proposed waste discharge for approval by the NT Controller of Water. The monitoring program must include a compliance monitoring location whereby water quality trigger values are assigned against. Water quality trigger values are implemented as a compliance tool to assess potential environmental impact, and if exceeded, prompts investigation and action by the operator. Compliance trigger values are typically based upon published default guidelines should limited site-specific data exist to develop locally derived trigger values.

NRR have proposed a monitoring program which aims to fulfill the requirements of the Water Act for a WDL application and ensures that potential impacts to marine water quality associated with the discharge of decant water can be detected in a timely manner. The proposed monitoring program includes three monitoring locations: the decant basin within the dredge spoil containment pond (BBDSCP), the decant water discharge point (BBDP01), and the receiving waters / mixing zone within the BBLF swing basin (BBMZ01). Monitoring location details are summarised in **Table 7-1**, along with locations illustrated in **Figure 7-1**. **Table 7-2** summarises the parameters and monitoring frequencies for the proposed discharge monitoring program. Several analytes listed in **Table 7-2** do not have a trigger value assigned and are used for data interpretation purposes only.

Table 7-2 also includes water quality trigger values which have been assigned to BBMZ01 given it is the proposed compliance monitoring point. The assigned trigger values are based upon the default values published by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). Trigger values for pH, dissolved oxygen and turbidity are based upon ANZECC's default trigger values for inshore marine environments for tropical Australia (ANZECC 2000). The proposed trigger values for metal and metalloids are based upon the ANZG's 95% species protection in marine waters for slightly to moderately disturbed ecosystems.

Table 7-1 Dredge spoil decant surface water monitoring locations

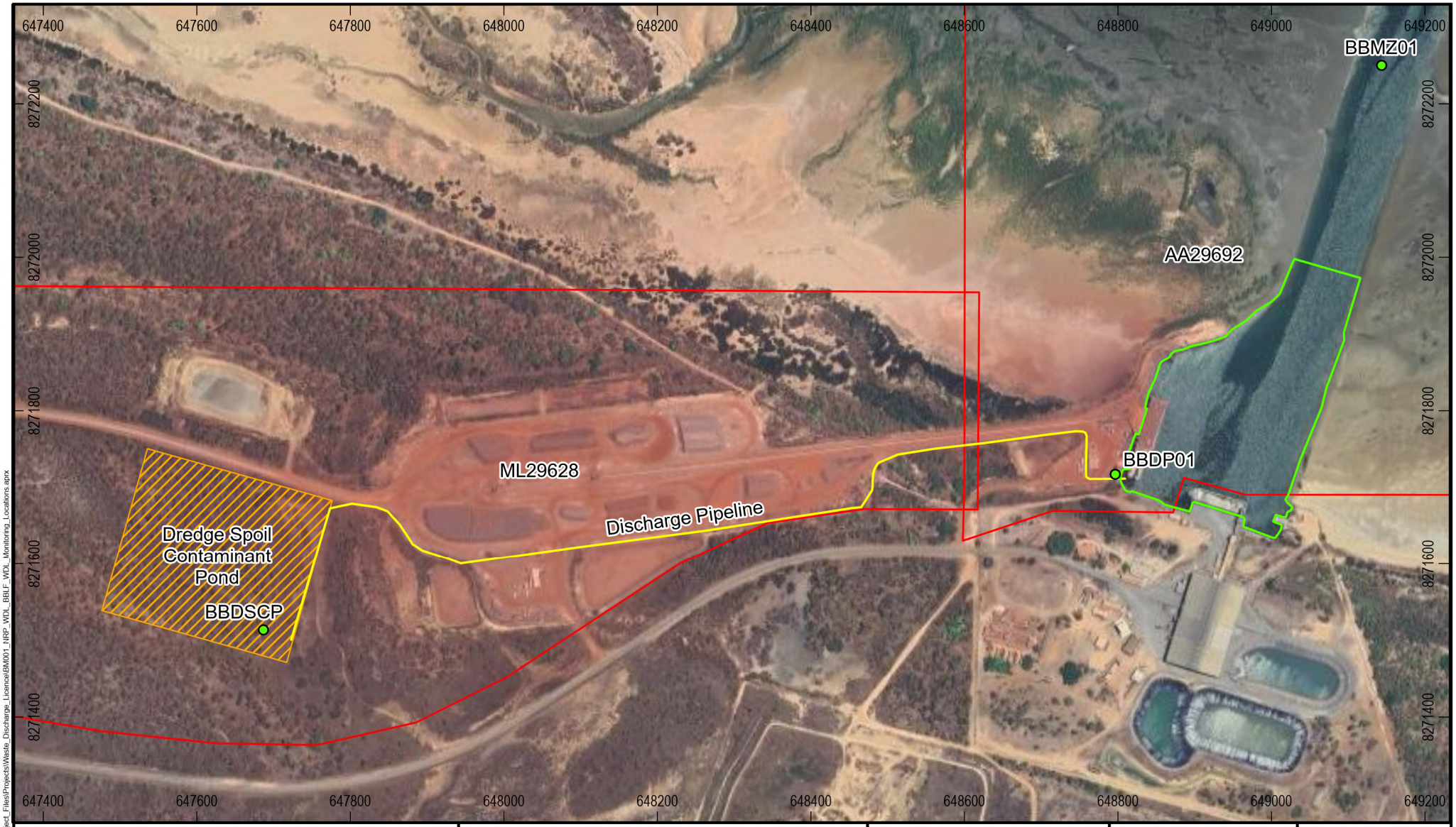
Monitoring Location	Description	Coordinates	
		Latitude	Longitude
BBDSCP	Decant basin located within the dredge spoil containment pond.	-15.6300	136.3777
BBDP01	Discharge point located south of the NRR BBLF wharf.	-15.6281	136.3881
BBMZ01	Located within the mixing zone of the swing basin (compliance point).	-15.6233	136.3913

Table 7-2 Proposed Discharge Monitoring Program

		Monitoring Locations			Trigger Values
Parameters	**Units**	**BBDSCP**	**BBDP01**	**BBMZ01**	**BBMZ01**
Field Measurements					
Flow	kL/day	-	C	-	-
Water Level	mb MOL	D	-	-	-
pH	pH units	D	D	B, W, A	8 – 8.4 [1]
Electrical Conductivity (EC)	µS/cm	D	D	B, W, A	-
Dissolved Oxygen (DO)	% saturation	D	D	B, W, A	<90 [1]
Temperature	°C	D	D	B, W, A	-
Turbidity	NTU	D	D	B, W, A	-
Metals/Metalloids					
Aluminium (Al)	µg/L Unfiltered & Filtered (0.45 µm)	W	W	B, W, A	-
Cadmium (Cd)		W	W	B, W, A	5.5 [2]
Cobalt (Co)		W	W	B, W, A	1 [2]
Copper (Cu)		W	W	B, W, A	1.3 [2]
Iron (Fe)		W	W	B, W, A	-
Lead (Pb)		W	W	B, W, A	4.4 [2]
Manganese (Mn)		W	W	B, W, A	80 [3]
Nickel (Ni)		W	W	B, W, A	70 [2]
Zinc (Zn)		W	W	B, W, A	8 [4]
Other					
Total Suspended Solids (TSS)	mg/L Unfiltered	W	W	B, W, A	-
Major cations (Ca, Na, K)	mg/L Unfiltered	W	W	B, W, A	-
Major anions (HCO3, CO3, Cl, SO4)	mg/L Unfiltered	W	W	B, W, A	-

A – the day immediately following cessation of discharge.
B – Immediately before dredging commences.
C – Continuous using flow meter.
D – Daily during first week of discharge, then weekly thereafter.
W – Weekly during discharge.
mb – Meters below.
MOL – Maximum operating level

[1] Default trigger value for tropical Australia, Marine inshore (ANZECC 2000).
[2] Trigger values based on 95% species protection for marine protection (ANZG 2018)
[3] Unknown level of species protection (%) (ANZG 2018)
[4] Trigger values based on 95% species protection for marine protection (ANZG 2021)



Legend

- WDL Monitoring Locations
- Discharge Pipeline
- Tenement Boundaries
- Dredge Spoil Contaminant Pond
- Proposed Mixing Zone

Source: Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2024, METServe 2024. Imagery - © OpenStreetMap and contributors

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WDL Monitoring Locations

**Infrastructure locations are approximate only. Not to scale.*

0 50 100 200

Meters

Scale: 1:7,000 (A4)

25/06/2024

Datum: GDA2020
Projection: MGA53

FIGURE 7-1

METSERVE
Mining & Energy Technical Services Pty Ltd

Path: S:\Projects\BM001 Nathan River\ArcGIS\Project_Files\Projects\Waste_Discharge_Licence\BM001_NRP_WDL_BBLF_WDL_Monitoring_Locations.aprx

7.2 Dredge Plume Turbidity Monitoring

As outlined in **Section 6.2.3**, turbidity levels are expected to be elevated within a localised zone surrounding the dredge site during operations. NRR has proposed the following turbidity monitoring with the intent to provide early indication of water quality impacts and to gather plume monitoring data for future maintenance dredging activities.

Turbidity monitoring using a calibrated multi-parameter water quality probe will be conducted at several locations downgradient and in the direction of the dredges' associated turbidity plume or flow of current where a turbidity plume is not visible. Turbidity monitoring will occur at a depth of 0.5 m and at several distance intervals away from the dredge vessel; 50 m, 100 m, 150 m and 200 m. Prior to plume monitoring commencing, an aerial survey using a drone will be done over the dredge to confirm the direction and magnitude of the turbidity plume (if exists).

During dredging operations, dredge turbidity plume monitoring will occur daily and will reduce to weekly if trigger values are not exceeded within the first week of dredging operations commencing. Monitoring will be undertaken regardless of tidal movement at the time. Results from a similar monitoring program conducted during the 2020 maintenance dredge operation highlighted that revolving water quality monitoring programs around tidal movements at the BBLF did not meaningfully impact results.

Environmental observations will be documented each day including wind speed and direction, rainfall, tidal movements, and dredging activity.

7.3 Marine Water Quality via DGT technique

NRR proposes to monitor marine water quality within the BBLF transhipment zone and surrounding receiving marine waters during dredging operations using DGTs. NRR will utilise water quality data collected through the existing DGT monitoring program implemented by MRM at the BBLF. The monitoring program to be implemented during dredging activities will utilise the same sampling procedure and monitoring locations to MRM's existing DGT monitoring program, ensuring a standardised and consistent monitoring approach which allows for the comparison of historic data and identification of potential impacts during dredging activities (independent of MRM monitoring). DGT monitoring location details are provided in **Table 7-3** and presented in **Figure 7-2**.

NRR proposes to deploy DGTs on two occasions: within the first week of dredging activities commencing and one month post dredging completion. Should monitoring data collected from the first DGT monitoring event show no impacts associated with the proposed dredging activity, the second DGT monitoring event (post-completion) is not considered necessary. This is a recommendation from monitoring conducted in 2020, whereby the post completion monitoring event did not add any value to the dredge monitoring program even though no exceedances were recorded in the first monitoring event.

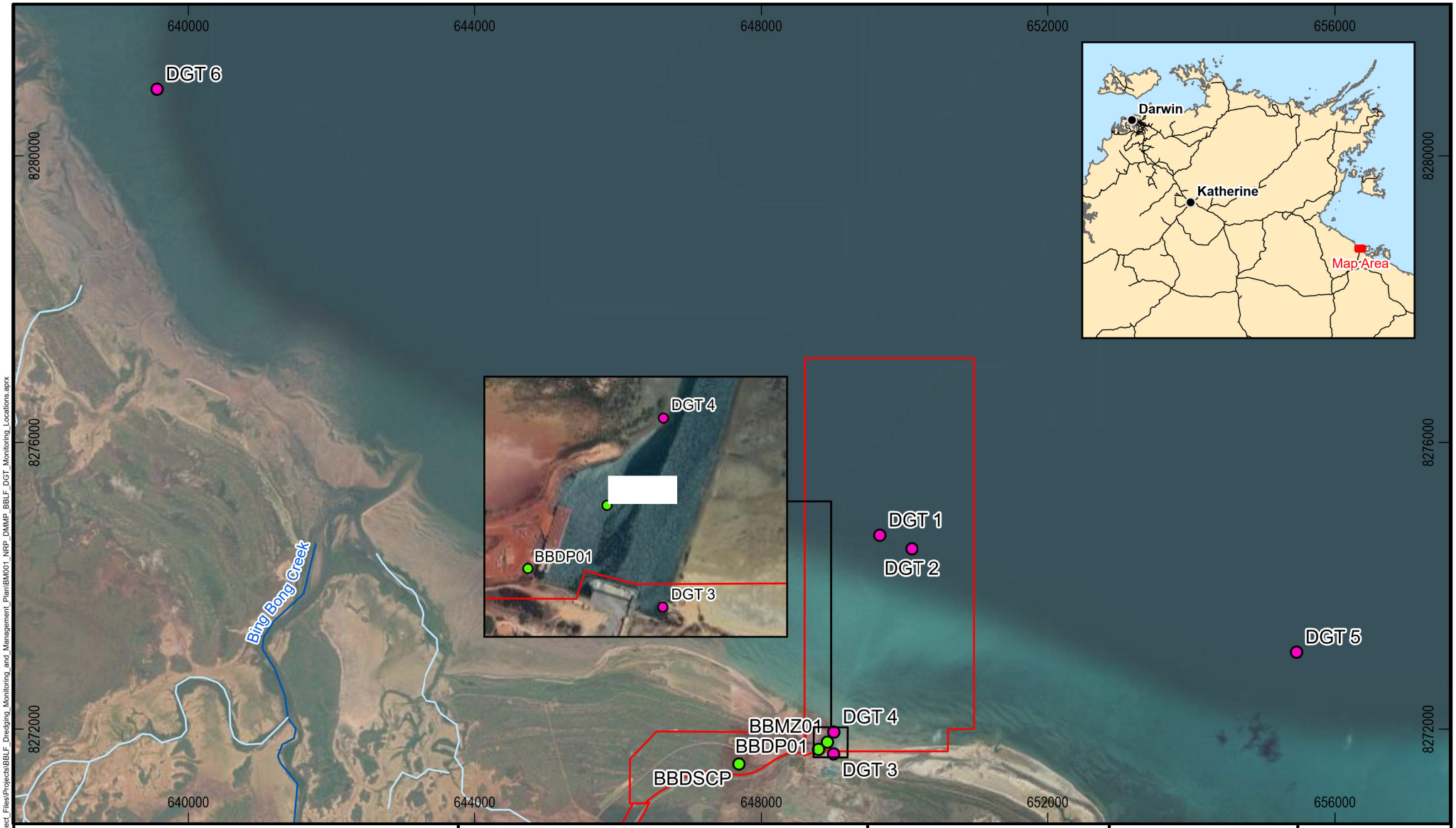
Monitoring data collected from the existing MRM DGT program between 2020 and 2023 (**Section 5**) will provide sufficient baseline data during which time no dredging activities have been undertaken to allow for comparison. Physico-chemical parameters will be recorded using calibrated multi-parameter water quality probes at each monitoring location when the DGTs are deployed. These parameters will include:

- pH;
- Electrical Conductivity (EC) (µS/cm);
- Temperature (°C);
- Dissolved Oxygen (% saturation);
- Oxygen Reduction Potential (ORP) (mV); and
- Turbidity (NTU).

Laboratory analysis will include DGT-labile Mn, Fe, Co, Ni, Zn, Cd and Pb. DGTs will be left in-situ over a six-day monitoring period +/- one day, whereby three DGT replicates are undertaken at each DGT monitoring location per monitoring event. Numerous environmental observations during the monitoring period are recorded should it be needed during data interpretation. These include: wind speed and direction, rainfall, tidal range, dredging activities.

Table 7-3 MRM DGT Monitoring locations

Monitoring Location	Description	Impact	Easting (GDA94 Z53)	Northing (GDA94 Z53)
DGT 1	Located approximately 2.8 down gradient of swing basin mouth (DGT4), at moorings 150m either side of the navigational channel markers and north-west of DGT2.	Impact – within channel	649650	8274704
DGT 2	Located approximately 2.8 km down gradient of swing basin mouth (DGT4), at moorings, 150m either side of the navigational channel markers and east of DGT1.	Impact – within channel	650099	8274515
DGT 3	Swing basin, south-west corner mooring	Impact – within swing basin	649006	8271652
DGT 4	Swing basin, mooring near the narrowing of the entrance channel	Impact – within swing basin	649009	8271957
DGT 5	East of BBLF	Reference (up current of BBFL swing basin impacts).	655464	8273072
DGT 6	NW of BBLF	Impact - down gradient	639562	8280928



Legend

- DGT Monitoring Locations
- Discharge Monitoring Locations
- Minor Drainage
- Streams
- Mineral Title

Source: Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2024, METServe 2024. Imagery - Earthstar Geographics, © OpenStreetMap and contributors.

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DGT Monitoring Locations

0 0.5 1 2

Kilometers

Scale: 1:75,000 (A4)

15/04/2024

Datum: GDA2020
Projection: MGA53

FIGURE 7-2

METSERVE
Mining & Energy Technical Services Pty Ltd

Path: S:\Projects\BM001 Nathan River\ArcGIS\Project_Files\Projects\BBLF_Dredging_Monitoring_and_Management_Plan\BM001_NRP_DMMP_BBLF_DGT_Monitoring_Locations.aprx

7.4 Dredge Plume Drone Monitoring

NRR proposes to implement routine drone monitoring of the dredge site during operations. Such monitoring was implemented throughout the 2020 dredge program and proved to be helpful in identifying the magnitude of the dredge plume and its direction, particularly useful for turbidity plume monitoring (**Section 7.2**). Drone monitoring is proposed to occur on a weekly basis during dredging activities. The aerial drone survey will focus over the dredging operations within the swing basin, transhipment channel and channel outlet into the Gulf. An example of images captured from the 2020 dredge program monitoring are presented in **Figure 7-3**, showing a localised plume close to the dredge vessel.

Figure 7-3 Dredge plume monitoring from 2020

7.5 Visual Inspections

Visual inspections of critical dredge infrastructure will be conducted on a daily basis to ensure infrastructure is in good condition, working correctly and is not causing environmental harm. Infrastructure subject to daily inspections include:

- Dredge vessel to ensure good housekeeping on board, including spill kits;
- Pipeline infrastructure to ensure no leaks or spills have occurred;
- Swing basin, channel and adjacent shore line for evidence of hydrocarbon sheen or waste/rubbish;
- Dredge spoil containment cell to ensure:
    - Spoil containment pond wall integrity is maintained (no geotechnical failures of bunding or seepage);
    - Maximum operating level (MOL) is maintained;
    - Suitable deposition of spoil and settlement of decant water prior to discharge of decant water; and
    - Outer bund walls and vegetation surrounding the containment cell to detect seepage or spills.

Photographs will be provided, and observations presented within the operational dredging monitoring daily inspections report.

Table 7-4 Summary of proposed dredge monitoring programs

Monitoring Program	Objective	Number of sites	Location	Frequency	Parameters
Discharge Water Quality Monitoring	Compliance with WDL conditions	Three	As per **Table 7-1** and **Figure 7-1**.	As per **Table 7-2**.	Physico-chemistry: • pH; • Temperature (°C); • EC (µS/cm); • DO (%); and • Turbidity (NTU). Laboratory analysis: • Al, Cd, Co, Cu, Fe, Pb, Mn, Ni, and Zn.
Dredge Plume Turbidity Monitoring	Extent and magnitude of plume generated by dredging activity.	Four	At 50, 100, 150 and 200 m distance increments from the dredge vessel in the direction of plume/current at a 0.5 m depth.	Prior to commencement of operations: Daily for one week at two locations (one within the swing basin and another in the transhipment channel). Daily during dredging operations reducing to weekly for the duration of the program should no exceedances be recorded.	Turbidity (NTU)
Marine Water Quality Monitoring via DGTs	Monitoring of marine water quality during dredging activities.	Six	As per **Figure 7-2** and **Table 5-1**.	Two monitoring events: 1st : after the first week of dredging activities, insitu for 406 days. 2nd: Within one month of dredge program completion should the 1st	Physico-chemistry: • pH; • EC (µS/cm); • Temperature (°C); • DO (%); • ORP (mV); and • Turbidity (NTU).

Monitoring Program	Objective	Number of sites	Location	Frequency	Parameters
				event outline exceedances of default trigger values.	Laboratory analysis (DGT-labile): • Mn, Fe, Co, Ni, Zn, Cd, Pb and Pb Isotope ratios.
Dredge Spoil	To further characterise dredge spoil material for PASS prior to discharge of decant water.	Four	Randomised locations within the dredge spoil contaminant pond.	One monitoring events within the first week of dredge deposition and prior to commencing discharge of decant water.	Potential Acid Sulfate Soils (PASS): • Chromium suite test
Drone Inspections	Dredge plume extent and magnitude.	One	BBLF transhipment zone and surrounding waters to the BBLF.	Weekly during dredging operation.	Aerial Photographs.
Visual Site Inspections	Early detection of potential environmental incidents or impacts.	Three	Inspections of the following infrastructure: • Dredge spoil contaminant pond; • Pipelines; and • Dredge vessel / dredging area.	Daily during dredging operations.	Photographs and observations.

8 ADAPTIVE MANAGEMENT

8.1 Adaptive Management Framework

NRR intends to adopt an adaptive management framework to minimise risks to the environment associated with the dredging activities. The framework aims to identify:

- Environmental objectives and routine management measures that will be implemented to achieve these objectives;
- Performance indicators that will be used to monitor environmental performance;
- Monitoring programs that will provide early warning of potentially unacceptable impacts;
- Trigger values for further investigation and management; and
- Corrective actions/adaptive management options that will be undertaken if monitoring indicates trigger values have been exceeded.

The NRR response process for trigger value exceedances is shown below in **Figure 8-1**. **Table 8-1** outlines the proposed framework pertaining to monitoring to be conducted for the dredging program.

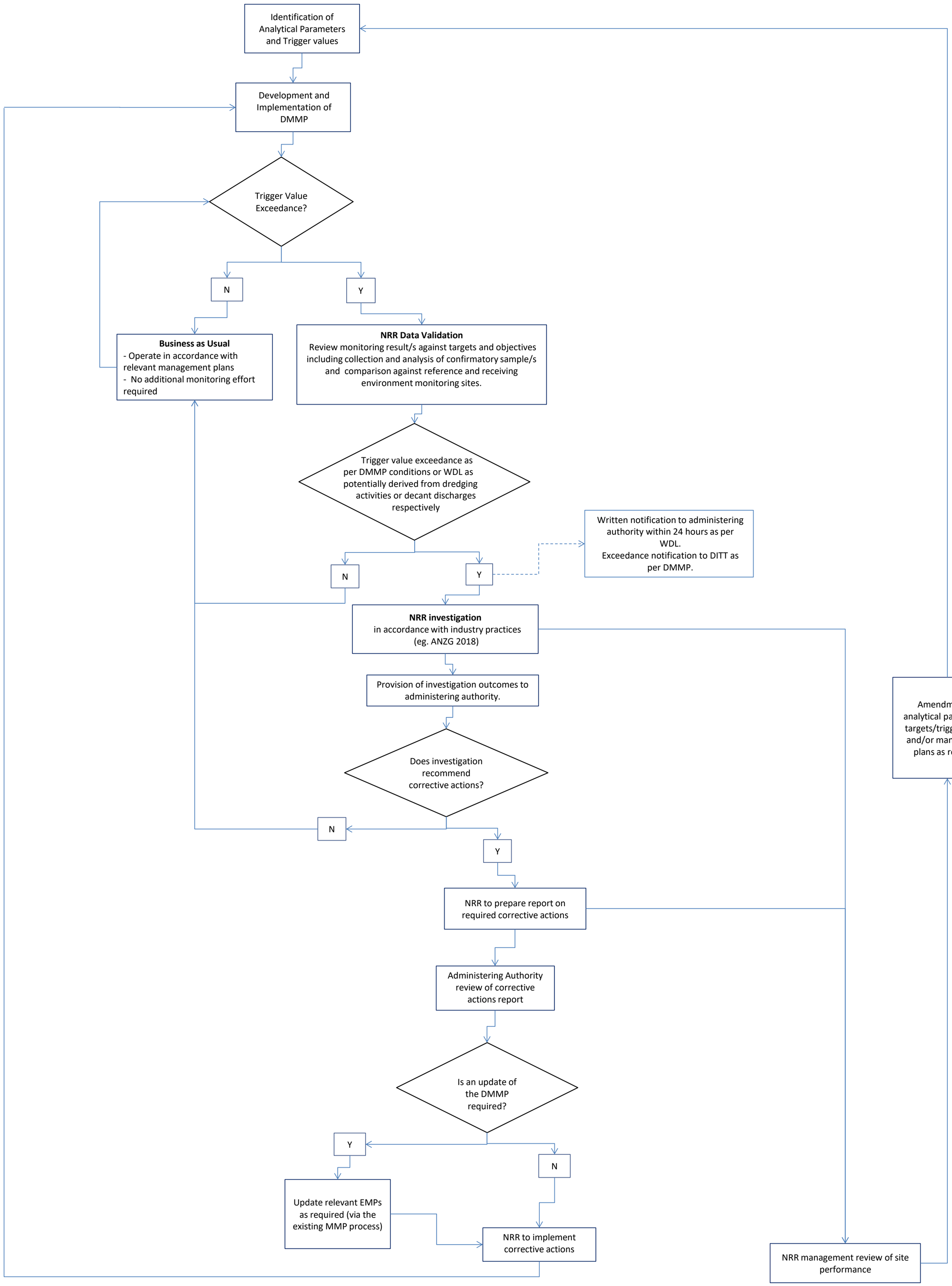

Figure 8-1 NRR Response Process for Trigger Value Exceedances

Table 8-1 BBLF Dredging Program Environmental Aspects and Impacts Register

Activity/Aspect/ Environmental Objective	Target	Routine management measures	Monitoring	Trigger and compliance point	Management Response, Monitoring, and Reporting
Activity/Aspect: Dredging plume **Objective**: To protect the marine ecosystem from adverse impacts to water quality associated with dredging	• Water quality impacts localised to within the swing basin and channel. • Water quality returns to normal operating concentrations when dredging ceases.	• Dredging process managed to minimise loss and dispersion of sediments. • Spoil disposal onshore within designated containment cells • Certified poly welding of spoil disposal pipeline to reduce split/leaking pipelines.	• Dredge plume turbidity monitoring • Marine water quality monitoring – bioavailable metals and physico-chemical parameters • Visual monitoring of plume extent by drone	• Turbidity >20 NTU based on ANZG 2018 guidelines, at 200m from dredge (based on localised impact within the swing basin). • Turbidity concentrations trending upwards over time. • Exceedance of 95% species protection guideline values for marine ecosystem (ANZG 2018) at impact DGT monitoring sites outside of swing basin. • Dredge plume visible outside the BBLF swing basin and channel.	• Use monitoring data from all sources and locations to confirm cause-effect relationship between water quality impact and dredging activities. • Reduce dredging rate to minimise sediment discharges if required. • Adjust dredging timing in consideration of tidal direction of plumes. • Increase frequency of turbidity monitoring to daily and sample at 50m intervals until the point at which turbidity is <20 NTU • Undertake follow-up DGT monitoring • Suspend dredging to allow investigation of alternative management strategies if turbidity trigger exceeded on three consecutive occasions or follow-up DGT monitoring shows ongoing exceedance of guidelines values.
Activity/Aspect: Dredging vessel interaction with marine fauna **Objectives**: To minimise the risk of physical injury to marine fauna due to vessel interaction. To minimise disturbance of marine species due to noise interaction	Nil incidents of injury to marine fauna No avoidable disturbance of marine species from underwater noise	• Compliance with all requirements of the NRP Marine Management and Monitoring Plan • Mandatory speed restriction of four knots inside the channel and swing basin • Mandatory go-slow zone of six knots outside channel and swing basin • All equipment is maintained in good operating condition. • All noise minimisation measures such as mufflers, special enclosures and sound-insulation mounts are fitted and working. Minimise the noise generation of equipment (thrusters and auxiliary plant) by switching them off when not used (i.e. avoid running on standby mode).	• Visual observation for the presence of dolphins, dugongs turtles prior to dredge start-up each day and during dredging activities.	• Marine fauna observed within 50m exclusion zone from dredge • Near misses or vessel strike of marine fauna	• Record sighting and notify vessel master. • Suspend operations temporarily until animal has moved outside of the exclusion zone • In the event of an injury or mortality, report to NT Parks and Wildlife and act on advice received.
Activity/Aspect: Decant water discharges **Objectives**: To protect the marine ecosystem from adverse impacts to water quality associated with discharge of decant water	• Water quality parameters at compliance point (BBMZ01) comply with WDL criteria. • Turbidity of decant water proposed for discharge must comply with trigger values applied to BBDSCP.	• Test dredged material to confirm absence of PASS within the first week of dredging • Discharge management in accordance with the WDL. • Containment cell managed to design volumes and MOL to prevent wall failure and/or overflows.	• Discharge monitoring • Visual inspection of spoil containment and surrounding areas	**Internal trigger** • Presence of PASS • Any exceedance of licenced water quality parameters due to high source levels. **WDL compliance triggers** • An exceedance of a trigger value on three consecutive sampling occasions for compliance monitoring location, BBMZ01. • An exceedance of the trigger value on a single occasion by three times or more for compliance monitoring location, BBMZ01. • An exceedance of the turbidity trigger value applied to authorised discharge point, BBDP01.	• Conduct an attributability investigation to determine the likely cause for the elevated measures. • Treat and manage PASS to prevent discharge water acidity exceeding licenced parameters. • Reduce discharge flow rates from settlement pond. • Adjust timing of discharges to avoid ebb tides. • Temporarily suspend discharges to allow sufficient settlement time. • Reduce dredging rates to ensure maximum operational capacity of settlement pond is not exceeded. • Suspend dredging until sufficient capacity available in settlement pond. • Investigate additional source controls such as geotextile fabric / silt curtains within the settlement pond. • If the event is determined to be a non-compliance with the WDL the administering agency will be notified as soon as practicable and within 24 hours of first becoming aware of the non-compliance.

Activity/Aspect/ Environmental Objective	Target	Routine management measures	Monitoring	Trigger and compliance point	Management Response, Monitoring, and Reporting
				• Where discharge from all discharge events at the authorised discharge point: -contains any floating debris, oil, grease, petroleum hydrocarbon sheen, scum, litter or other objectionable matter - causes or generates odours which would adversely affect the use of surrounding waters - cause algal blooms in the receiving water - cause visible change in the behaviour of fish or other aquatic organisms in the receiving water - cause mortality of fish or other aquatic organisms - cause adverse impacts on plants - cause erosion at and immediately downstream of the authorised discharge point.	• Cease discharge if turbidity measured at BBDP01 exceeds corresponding turbidity trigger value.
Activity/Aspect: Overflows or seepage from spoil containment area **Objective**: To protect coastal vegetation and habitats from adverse impacts associated with overflows or seepage from spoil containment area	• No overflow, seepage or release of water or sediments to the surrounding land	• Spoil containment pond managed to design volumes and MOL to prevent wall failure and/or overflows.	• Visual monitoring of spoil containment and surrounding vegetation • Routine surface water and groundwater monitoring at BBLF in accordance with NRP Water Monitoring and Management Plan (WMMP).	• MOL is exceeded, seepage occurring and/or wall integrity compromised (i.e. erosion, slumping). • Split / leaking pipelines • Exceedance of site specific trigger values set for surface water and groundwater protection at BBLF	• Temporarily suspend dredging and discharge operations. • Implement spill response procedure to capture, contain any potentially contaminated material and divert discharges towards the swing basin. • Fix split/leaking pipes. • Undertake engineering assessment of spoil containment area and rectify. • Implement ongoing water quality and vegetation monitoring program around containment cell to detect changes (improvements or adverse impacts) over time.
Activity/Aspect: Hydrocarbon spills **Objective**: To protect the marine ecosystem from adverse impacts to water quality associated with hydrocarbon spills	• All hydrocarbons and hazardous materials are stores, handled and transported in accordance with best practice management and relevant Australian Standards • Spills are contained within the BBLF swing basin	• Dredging vessel procedures used for refuelling. • Shipboard Oil Pollution Emergency Plan implemented.	• Visual observations of hoses and sea surface during refuelling to identify spills or leaks	• Spill	• Implemented in the event that inspections identify a failure to meet performance targets. • An incident investigation will be undertaken and appropriate corrective actions documented. • Corrective actions will be appropriate to the size, nature and scale of the incident identified.
Activity/Aspect: Waste Management **Objective**: To protect the marine fauna from adverse impacts from inappropriate waste management	• No waste or rubbish entering the marine environment	• Appropriate collection and disposal of all vessel waste onshore in accordance with regulatory requirements (and by licensed waste contractor) and vessel operating procedures. • All materials and equipment on board vessels and plant are to be appropriately covered and/or stored to prevent waste overboard. • Dredge contractor to receive induction and training in relation to waste management procedures.	• The Waste Management Plan will detail the checks and controls to be in place at the BBLF. It will also describe the triggers for corrective actions, should the Waste Management Plan not be adhered to. • Visual inspections	• Presence of waste in the immediate area of the dredging operations that is directly attributable to the dredging operations.	• Corrective actions to be taken in the event of non-compliance with the Waste Management Plan • Review of procedures • Dredging contractor to immediately rectify source of waste and prevent further waste entering the marine environment and initiate clean up.

Activity/Aspect/ Environmental Objective	Target	Routine management measures	Monitoring	Trigger and compliance point	Management Response, Monitoring, and Reporting
		• NRR Waste Management Plan implemented as required.			

9 COMPLIANCE MONITORING AND REPORTING

9.1 Project roles and responsibilities

Roles and responsibilities relating to the implementation of the DMMP are as follows:

HSET Superintendent

The NRR HSET Superintendent is responsible for the implementation of all on site work programs under the environmental policy and the EMS. The Superintendent will also oversee all occupational health and safety aspects of the operations.

Dredge contractor

The dredge contractor will:

- Adhere to the conditions of this DMMP;
- Provide appropriately qualified and training staff to conduct the dredging activities;
- Ensure dredge and pipelines are maintained and operated in accordance with manufacturer specifications and best practice at all times;
- Comply with all relevant Commonwealth and NT legislation;
- Ensure appropriate spill response equipment is fully stocked and available on the vessel;
- Report all incidents to the HSET Superintendent in accordance with the requirements of this DMMP; and
- Maintain records of compliance with the DMMP.

General Manager - BBLF

A dedicated General Manager for BBLF operations is based on the site, reporting directly to the NRR CEO.

The BBLF General Manager is responsible for the implementation of the BBLF DMMP. To maximise the effective implementation of the DMMP, the BBLF General Manager will be responsible for:

- Providing resources and equipment to meet objectives;
- Initiating reviews of the DMMP when required;
- Reporting non-compliances;
- Reporting environmental incidents;
- Implementing monitoring plans;
- Maintaining site records; and
- Daily/monthly reporting.

The BBLF General Manager will also be responsible for identifying training needs so that all BBLF personnel receive an appropriate level of training to understand and implement the requirements of the DMMP. To achieve this, they will use a combination of training and communication tools including:

- Site induction: this will provide staff with an understanding of the environmental values of the site, the MMMP framework and a general overview of the objectives of the MMMP. The induction will provide staff with an understanding of their general environmental duty, incident reporting requirements and required standards of environmental performance.
- Toolbox talks: the toolbox talks will communicate specific aspects of the MMMP relevant to the activities being undertaken that day. They will inform the operational methodology and provide staff with appropriate management strategies to manage potential environmental impacts.
- Reference hard copies of the DMMP available in the BBLF main office.

BBLF Personnel

All staff have a general environmental duty as outlined in section 12 of the *Waste Management and Pollution Control Act 1998* (WMPC Act). This means that all staff are responsible for the actions they take that affect the environment.

Staff will be responsible for:

- Carrying out environmental management activities as directed by the BBLF General Manager;
- Routine vessel servicing and inspections;
- Observing and informing the BBLF General Manager regarding general environmental performance of the DMMP;
- Notifying the BBLF General Manager of any environmental incidents;
- Notifying the BBLF General Manager of any trigger value exceedances;
- Notifying the BBLF General Manager of any sightings of marine megafauna;
- Notifying the BBLF General Manager of any non-conformances; and
- Participating in induction processes and daily toolbox talks to build a suitable understanding of site environmental values.

9.2 Inductions, training and communications

Environmental training will be facilitated through site inductions and toolbox talks. The site induction will be provided to all staff and include the following:

- Identification of site environmental values;
- An understanding of the requirements of this DMMP;
- Roles and responsibilities of site personnel;
- Environmental emergency response procedures;
- Site environmental controls;
- Environmental incident identification and response; and
- The potential consequences (for both NRR and individuals) of not meeting environmental obligations/responsibilities.

The NRR Safety Department will log site visitors and maintain database of site inductions completed. Records of all training and induction will be maintained and be available for inspection.

9.3 Compliance monitoring, record keeping and reporting

Compliance monitoring and reviews

Weekly compliance reviews will be undertaken by NRR in accordance with the DMMP requirements during the dredging operations. The reviews incorporate analysis of monitoring data and inspections to assess compliance of the Dredge Contractor. Monitoring data will be analysed to determine whether any of the triggers identified in **Sections 7** have been exceeded.

If at any time it becomes apparent that control measures are inadequate and/or non-compliance with the DMMP is occurring then corrective actions will be implemented as specified in **Section 8**. If the DMMP is considered to be inadequate then the relevant part/s of the plan will be revised to ensure potential impacts are properly addressed. Any major change to the DMMP will be subject to DITT approval.

Record keeping

The following records will be maintained by the Dredge Contractor:

- Induction and training register;
- Daily inspection records for dredging activities;
- Evidence of compliance with marine pest management requirements;
- Marine fauna sightings log book; and
- Incident reports and corrective active records.

NRR will appoint an appropriate and qualified environmental contractor will undertake monitoring activities outlined in **Section 7**.

Reporting

Internal reporting requirements include daily reporting of dredging activities, decant discharges, monitoring and results, and identification of any non-conformances with the monitoring programs.

External reporting is required as a condition of the WDL and annual EMR. Exceedance of the trigger values will be reported to DITT as soon as reasonably practicable. NRR will ensure any reporting requirements conditioned by the WDL will be adhered to.

9.4 Emergency contacts and incident response

Non-conformance incidents will be documented in accordance with NRR's Incident Reporting Procedure.

All environmental incidents will be reported to DITT as soon as practicable in accordance with section 29 of the MM Act and the DITT Reporting Guidelines.

All environmental incidents which trigger the environmental harm thresholds, associated with dredging activities, will be reported to the NTEPA under section 14 of the WMPC Act. Notification must be received by the NT EPA within as soon as practicable (in any case within 24 hours of becoming aware of the incident).

Incident investigation and reporting will be promptly undertaken to identify and evaluate the immediate and contributory causes and enable timely and effective corrective actions to be implemented.

Any incident / disturbance to cultural heritage sites will be reported to the AAPA and /or NT Heritage Branch as soon as practicable in accordance with section 14 of the *NT Aboriginal Sacred Sites Act and NT Heritage Act.*

Emergency contacts are provided in **Table 9-1.** The NRP's Emergency Response Plan, provided in **Appendix C**, which covers operations at the BBLF is currently implemented and will continue to be for the duration of the proposed dredging activities.

Table 9-1 Emergency Contact Information

Name	Description	Contact Details
NRR		
Simon Peat	Chief Executive Officer	Simon.peat@nathan-river.com 0418 124 024
Krysten Roberts	General Manager - BBLF	Krysten.roberts@nathan-river.com 0419 004 936
McArthur River Mining		
Adam Hatfield	Business Strategy Manager	Adam.hatfield@glencore.com.au 0428 859 783
MRM Processing Operations	-	(08) 8975 8179
Emergency Response Team	-	0407 937 130
Other		
Northern Territory Environmental Protection Authority (NT EPA)	Waste, Pollution and Control Team. Pollution Hotline	pollution@nt.gov.au 08 8924 4218 1800 064 567
Northern Territory Department of Environment, Parks and Water Security (DEPWS)	Environmental Regulation	Environmentalregulation@nt.gov.au
NT Work Safe	Accident notifications, general enquiries and complaints	ntworksafe@nt.gov.au 1800 019 115
Northern Land Council (NLC)	Legal Branch	08 8920 5157
NT Parks and Wildlife Service (NPWS) – Limmen National Park	Katherine Region	08 8973 8888
NT Police Service	Emergency Non-emergency	000 131 444

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APPENDIX A – BING BONG DREDGE POND DETAILED DESIGN REPORT (SLR 2024)

Bing Bong Dredge Pond - Detailed Design Report

Detailed Engineering Design

NRR Equipment Pty Ltd

47 Callatina Road
Hawthorn, Victoria, 3122

Prepared by:

SLR Consulting Australia

12 Cannan Street, South Townsville QLD 4810,
Australia

SLR Project No.: 623.030222.00001

15 January 2024

Revision: 1.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	15 January 2024	Alfred Krebs / Jack Daly	Danielle O'Toole	Danielle O'Toole

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with NRR Equipment Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Table of Contents

Tables in Text

Figures in Text

Appendices

1.0 Introduction

SLR Consulting Australia (SLR) was engaged by Nathan River Resources (NRR) for the provision of engineering design services for the new dredge pond at Bing Bong Loadout Facility (BBLF).

Results of an initial assessment by SLR indicated that due to the required capacity, raising the existing dredge pond would result in a dam footprint that would breach the northern extent of the NRR lease boundary. SLR has therefore undertaken a detailed design of a new dredge pond facility to enable dredge spoil to be deposited. The concept design was reviewed by NRR representatives on the 1st December 2023 and SLR were advised to proceed with the design at a detailed level.

This Report should be read in conjunction with the engineering drawings, as listed in **Table 1** and attached in **Appendix A** and cognisant of the exclusions and assumptions listed in **Section 3.2** and throughout this Report.

Table 1 Drawing List

Drawing Number	Drawing Name
623.030222-CI-1000	DRAWING SCHEDULE AND LOCALITY
623.030222-CI-1001	GENERAL NOTES
623.030222-CI-1100	GENERAL ARRANGEMENT PLAN
623.030222-CI-1200	SETOUT PLAN
623.030222-CI-1300	EARTHWORKS PLAN
623.030222-CI-1400	CROSS SECTIONS
623.030222-CI-1500	TYPICAL DETAILS

2.0 Background Information

2.1 Objectives

Based on discussions with NRR, the requirements of the dam are as follows:

- Capacity of the order of 180,000 m^3.
- Locally sourced material is to be used to form any new embankments.

Information in italics in the following **Sections 2.2** to **2.5** has been taken from the Nathan River Resources Mining Management Plan for the BBLF (Authorisation – 0965.01), dated October 2020.

2.2 Topography

The BBLF is located on the Gulf coast within the Yiyintyi Range – Bing Bong "G6" geomorphic province as described by Aldrick and Wilson (1990, 1992), which consists of very low relief, almost flat coastal terraces; level to very gently undulating plains; broad or narrow fluvial corridors, swamps and low-lying areas; broad depositional floodplains; tidal mud flats with channels and estuaries; coastal sand sheets, dunes and cheniers. The geology of the area is characterised by scattered rugged areas of Proterozoic sandstones and Tertiary sediments (i.e., the IBRA "Gulf Coastal" bioregion).

2.3 Surface water

The BBLF is within the Rosie Creek Catchment (5,000 km^2), on the dunes and beach ridges adjacent to tidal mud flats along the coastline of the Gulf. The main drainage lines, Mule Creek to the east and Bing Bong Creek to the north, are not within the Loadout Facility area. The majority of BBLF drainage enters the marshland system.

There are no major fresh surface waterbodies in the immediate vicinity of the BBLF, with the closest major systems being Bing Bong Creek ~10 km to the west and Mule Creek to the east approximately ~10 km away.

2.4 Groundwater

The area surrounding the BBLF is affected by saline groundwater, which extends inland for a distance of 10 km or more in this area (Zarr 2009). A registered bore (RN25711) located approximately 4.5 km to the south of the BBLF has a standing water level of 8 m below ground level and yield of 3 L/s (Zarr 2009).

There are no formally nominated groundwater management areas, in or near the BBLF, nor are there any known existing users.

Recent groundwater readings adjacent to the dredge spoil dam range from RL 0.33m to RL 1.76m. The base of the dredge spoil dam is between RL 1.0m to RL 2.5m.

2.5 Dredge Spoil Characteristics

An assessment of the risk of acid sulfate soil was undertaken as part of geotechnical investigations prior to construction of the BBLF, and it was concluded that there is a negligible risk of formation of acid sulfate soils associated with the material that is excavated at the BBLF site (WDR 2013).

Nonetheless sediment testing will be undertaken to identify potential acid sulfate soils (PASS), and material will be handled in accordance with the Northern Territory Land Suitability Guidelines (Department of Lands, Planning and the Environment 2013), and the relevant recommendations outlined in 'Acid Sulfate Soils of the Darwin Region' (Land and Water Division Department of Natural Resources, Environment the Arts and Sport 2008).

3.0 Basis of Design

3.1 Reference Information

In preparing this Detailed Design Report SLR has relied on information provided by NRR as follows:

- Aerial survey of the site (dated 8th March 2023).
- Previous geotechnical information developed by SLR (SLR 2021).
- Monitoring bore reports.
- Groundwater monitoring data.
- Publicly available vegetation mapping.

3.2 Detailed Design Assumptions

In order to undertake the detailed design of the proposed dredge pond, SLR has relied on a number of engineering assumptions including the following:

- Groundwater levels are no higher than 1.0m below ground level.
- No rock is present within 1.0m below ground level.
- The materials on site are suitable for re-use in construction of the proposed pond embankments.
- The proposed pond footprint does not intercept significant flora and fauna that is not identified on publicly available maps.
- The proposed inlet pipes will be placed in the north-western corner of the new dredge pond.
- No detailed wave allowance calculation was conducted.

This Detailed Design Report relies on a number of engineering assumptions relating to geotechnical and geohydrological site conditions. It is recommended that in order to reduce the number of potential risks associated with these assumptions that further technical studies be carried out prior to construction.

3.3 Considerations for Dam Siting

The proposed pond site is proximate to Melaleuca swamps directly west and east of the site. Site personnel noted that swamp areas act as low points and can be covered by up to 0.5m of water throughout the year therefore hindering constructability and ability to excavate.

SLR propose the dam footprint will be situated on the higher ground between the two swamp areas as presented in **Drawing No. 623.030222-CI-1100** attached in **Appendix A**.

3.4 Detailed Design Parameters

Key dam design parameters relating to the proposed design is presented in **Table 2** with the design drawings attached in **Appendix A**.

Table 2 Key Detailed Design Parameters

Parameter	Value
General	
Footprint Area	75,900m^2
Total Capacity	205,000m^3
Maximum Operating Level	RL 5.02m
Deposition slurry	<10% solids
Access Ramp	11m wide (1V:9H) located on NW corner
Basin	
Cut volume	47,525m^3
Fill volume	57,125m^3
Grading	Grade at minimum of 0.5% from northwest corner (dredge spoil deposition point) to southeast corner.

Parameter	Value
External Embankments	
Height	Varies from 1.9m to 4.1m
Crest Elevation	RL 6.0m
Crest Width	5m
Crest Length	~960m
Side Slopes	1V:4H
Separation Bund	
Height	3.0m
Crest Elevation	RL 4.5m
Crest Width	5m
Crest Length	~180m
Side Slopes	1V:4H

4.0 Consequence Category Assessment (CCA)

The Northern Territory does not have specific criteria for dam design, hence the CCA has been undertaken using Australian National Committee on Large Dams *Guidelines on the Consequence Categories for Dams* (ANCOLD 2012).

The consequence category has been assessed based on an 'initial level' assessment, against the criteria outlined in **Table 3** which is extracted from Table 3 of (ANCOLD 2012) which is based on Total Population at Risk (PAR).

Table 3 Consequence Categories Based on PAR

Population at Risk	Extent of Damage and Loss			
	Minor	Medium	Major	Catastrophe
<1	Very Low	Low	Significant	High C
>1 to <10	Significant (Note 2)	Significant (Note 2)	High C	High B
>10 to <100	High C	High C	High B	High A
>100 to <1,000	(Note 1)	High B	High A	Extreme
>1,000		(Note 1)	Extreme	Extreme

1. With a PAR in excess of 100, it is unlikely damage will be minor. Similarly, with a PAR in excess of 1,000 it is unlikely damage will be classified as medium.
2. Change to 'High C' where there is the potential of one or more lives being lost.

The following sections assess the PAR and extent of damage or loss to allow the CCA to be established. All tables contained in the following sections are extracted from (ANCOLD 2012).

4.1 Flood Inundation and PAR

Due to the lack of available elevation data of the area, a dam break modelling assessment has not been undertaken. However, given the relatively flat terrain, the flood water would be

expected to flow predominantly north toward the Gulf and may spread out across the port facility. Due to the remote location of the site, the approximate capacity of 205ML and low embankment height (max. 4.1m) is unlikely to have significant impact on any nearby infrastructure or personnel except for the adjacent road servicing the port facility (Bing Bong Road).

It is noted that this high-level assessment only provides an indication of the potential inundation path and it is recommended to be reviewed following completion of construction of the facility and a survey of the site.

4.2 Extent of Damage and Loss

The extent of the damage and loss has been assessed against **Table 4** to **Table 7**.

Table 4 Total Infrastructure Costs

Type	Minor	Medium	Major	Catastrophic
See Below	<$10M	$10M to $100M	$100M to $1B	>$1B

Explanatory Notes for Infrastructure Costs

Type	Description
Residential	*Total number of houses affected, some destroyed, and others damaged.*
Commercial	*Including businesses and agriculture. e.g., retail, manufacturing, resources.* *Loss of stock and/or produce as a direct result of the flood wave.*
Community infrastructure	*Such as roads, railways, power, communications, gas, water supply, sewerage, irrigation, drainage, schools, hospitals, community facilities and public buildings.*
Dam replacement or repair cost	*Repairs to the embankment or wall and appurtenant works which will return the dam to its previous level of service.*

Considering that the cost of dam replacement or repair is significantly less than $10M the extent of damage and loss is assessed as **Minor**.

Table 5 Impact on Dam Owner's Business

Impact	Minor	Medium	Major	Catastrophic
Importance to the business	Restrictions needed during dry periods	Restrictions needed during peak days and peak hours	Essential to maintain supply	Dissolution of business/entity
Effect on services provided by the owner	Minor difficulties in replacing services	Reduced services are possible with reasonable restrictions	Severe restrictions would be applied for at least one year	Services cannot be replaced or cannot get services from another source
Effect on continuing credibility	Some reaction but short lived	Severe widespread reaction	Extreme discontent	Total loss of confidence and credibility
Community reaction and	Some reaction but short lived	Severe widespread reaction	Extreme discontent	Total loss of confidence and credibility

Impact	Minor	Medium	Major	Catastrophic
political implications				
Impact on financial viability	Able to absorb in one financial year	Significant impact in the long term	Severe to crippling in the long term	Bankruptcy
Value of water in the storage	Can be absorbed in one financial year	Loss of invoice for at least 1 year	Loss of income for more than 1 year	Bankruptcy

Explanatory Notes for Dam Owner's Business

Type	*Description*
Importance to the business	*Loss of storage is likely to affect the service provided to some degree.* *It may be appropriate to increase the severity level because of the importance of the reservoir. However, a less vital water resource may lead to a reduction of the severity of the cost of replacement or cover.*
Effect on the services provided by the owner	*Water supply, power or recreational facility is no longer available or disrupted to a proportion of the community supplied by the agency.*
Effect on continuing credibility	*Standing or reputation of the organisation in the community.*
Community reaction and political implications	*There may be community objective to replacement of the dam. Also, the relationship between the dam owner and local, state and federal legislation.*
Impact on financial viability	*Economic and legal liability; ability to meet the costs of repairs and damage; ability to meet claims from others.*
Value of water in the storage	*Loss of income from the loss of stored water.*

The impact across all fields for the Dam Owner Business is assessed as **Minor**, except for Importance to Business and Effect on Services which are **Medium**.

Table 6 Health and Social Impacts

Type	Minor	Medium	Major	Catastrophic
Human health	<100 people affected	100 to 1000 people affected	>1000 people Heated for greater than one month	>10,000 people affected for a year or more
Loss of services to the community	<100 people affected	100 to 1000 people affected	>1000 people affected for greater than one month	>10,000 people affected for a year or more
Cost of emergency management	<1000 person days	1000 to 10,000 person days	>10,000 person days	>100,000 person days
Dislocation of people	<100 person months	100 to 1000 person months	>1000 person months	>10,000 person months

Type	Minor	Medium	Major	Catastrophic
Dislocation of businesses	<20 business months	20 to 200 business months	>200 business months and some business failures	Numerous business failures
Employment affected	<100 jobs lost	100 to 1000 jobs lost	>1000 jobs lost	>10,000 jobs lost
Loss of heritage	Local facility	Regional facility	National facility	International facility
Loss of recreational facility	Local facility	Regional facility	National facility	International facility

Explanatory Notes for Health and Social Impacts

Type	Description
Human health	*Human health could be affected by:* • *contamination of drinking water* • *failure or lack of water supplies, sewage treatment works, power.* *Contamination of services such as food, health, recreation areas and facilities caused by the uncontrolled release of sewage, industrial or toxic waste as a result of a daybreak.*
Loss of services to the community	*Loss of gas/power/communications and transport. Distribution of medical supplies, food, especially perishable food items.*
Cost of emergency management	*Police, Emergency Services and volunteers will incur a cost both directly and indirectly.*
Dislocation of people	*People whose homes are destroyed or damaged will need to be re-housed or billeted for various times.*
Dislocation of businesses	*Businesses will be prevented from trading in the short term and may be affected in the long term.*
Employment affected	*Loss of employment.*
Loss of heritage	*Historic sites, both pre- and post-European settlement.*
Loss of recreational facility	Many communities rely, to various degrees, on bodies of water for boating, fishing and other recreational aspects, including visual relief. Other recreational facilities may be located downstream of the reservoir, e.g., golf course, sports grounds.

The impact across all fields for Health and Social Impacts is assessed as **Minor**.

Table 7 Environmental Impacts

Type	Minor	Medium	Major	Catastrophic
Area of impact	<1km	<5km	<20km	>20km
Duration of impact	<1 year	<5 years	<20 years	>20 years
Stock and fauna	Discharge from Dam break would	Discharge from Dam break would	Discharge from dam break would	Discharge from dam break would

Type	Minor	Medium	Major	Catastrophic
	not contaminate water supplies used by stock and fauna.	contaminate water supplies used by stock and fauna. Health impacts not expected.	contaminate water supplies used by stock and fauna with contaminant uptake.	contaminate water supplies used by stock and fauna with contaminant uptake and measurable health impacts expected.
Ecosystems	Discharge from dam break is not expected to impact ecosystems. Remediation possible.	Discharge from dam break would have short term impacts on ecosystems with natural recovery expected after one wet season. Remediation possible.	Discharge from dam break would have significant impacts on ecosystems with normal recovery expected after several wet seasons. Remediation possible over many years.	Discharge from dam break would have significant permanent impacts on ecosystems. Remediation involves altered ecosystems.
Rare and endangered species	Species exist but minimal damage expected. Recovery within one year.	Species exist with losses expected to be recovered over a number of years.	Rare and endangered species will be severely impacted Recovery will take many years.	Endangered species will be lost from the area. Permanent loss of species will occur.

Explanatory Notes for Environmental Impacts

Type	Description
Areas of impact	*Land damaged by dam failure exclusive of land prone to natural flooding. For tailings dams, the damage will relate to the toxicity of the material in relation to both area of impact and the depth of penetration of the toxic materials.*
Duration of impact	*Habitats may take a long time to recover (e.g., substantial erosion, deposition of Hood borne materials). The duration of the impact will also relate to the toxicity of discharged material (e.g., saline, tailings, sewerage, cold water, deoxygenated water).*
Stock and fauna	*Stock and fauna may ingest contaminated water/fodder. Stock may need to be removed from the area or destroyed. Contaminants may cause damage in relation to reproduction cycle. The impact on stock and fauna may not be immediately identified unless testing of food source is carried out.*
Ecosystem	*Includes organisms and non-living components which interact to form a stable system. Consideration should be given to their environment, habitat, breeding grounds and food chain.*
Rare and endangered species	*Information can be gained from state and federal government agencies in relation to areas known to contain rare and endangered Hora and fauna.*

Mapping of the surrounding environment to establish sensitive areas has been undertaken using NT Government, Department of Environment, Parks and Water Security – Natural Resources Maps (NR MAPS) – the output is provided in **Appendix B** and indicates that within the proposed footprint of the dam there is:

- No significant flora.
- No wetlands.
- No sites of botanical significance.

Based on the mapping the following environmental impact assessment has been made:

- Area of impact: <1 km – **Minor**
- Duration of impact: <1 year – **Minor**.
- Stock and fauna: Discharge from dam break would not contaminate water supplies used by stock and fauna – **Minor**.
- Ecosystems: Discharge from dam break would have short term impacts on ecosystems with natural recovery expected after one wet season. Remediation possible – **Medium**.
- Rare and endangered species: Species exist but minimal damage expected. Recovery within one year – **Minor**.

4.3 Consequence Category Assessment based on PAR

Due to the proximity of the Bing Bong access road and port facility to the proposed new sediment pond the **PAR** is assessed to be **>1 but <10.** The highest rated extent of damage or loss, based on environmental and service impacts is **Medium**. The consequence category assessment is therefore **Significant** as summarised in **Table 8**.

Table 8 Consequence Category Assessment

Population at Risk	Extent of Damage and Loss			
	Minor	Medium	Major	Catastrophic
<1	Very Low	Low	Significant	High C
>1 to <10	Significant (Note 2)	**Significant (Note 2)**	High C	High B
>10 to <100	High C	High C	High B	High A
>100 to <1,000	(Note 1)	High B	High A	Extreme
>1,000		(Note 1)	Extreme	Extreme

1. With a PAR in excess of 100, it is unlikely damage will be minor. Similarly, with a PAR in excess of 1,000 it is unlikely damage will be classified as medium.
2. Change to 'High C' where there is the potential of one or more lives being lost.

4.4 Consequence Category Assessment based on Incremental PLL

Potential Loss of Life (PLL) was estimated using the Flood Severity Based Method where fatality rates are based on flood severity, the amount of warning and a measure of whether people understand the severity of the flooding. The PLL assessment is provided in **Appendix C**. In summary the following categories were selected:

- Flood severity was assumed to be **Low** which is indicative of a flood where "no buildings are washed off their foundations". This was selected due to a lack of dwellings and infrastructure downstream of the structure and the isolation of the site.

- The **None** warning time category was selected due to the flood water reaching the adjacent roads in less than 15 minutes.
- **PAR** was previously estimated as >1 but <10 and for conservative PLL estimations, a **PAR of 9** was used in the calculations.

With the above criteria, an estimated fatality rate of 0.1 was assessed along with a suggested **PLL of 0.09**. The consequence category assessment is therefore **LOW** as summarised in **Table 9**.

Table 9 Consequence Category Assessment

Population at Risk	Extent of Damage and Loss			
	Minor	Medium	Major	Catastrophic
<0.1	Very Low	**Low**	Significant	High C
≥0.1 to <1	Significant	Significant	High C	High B
≥1 to <5	High C	High C	High B	High A
≥5 to <50	(Note 1)	High A (where PLL is 5 and above but less than 10, can be reduced to High B)	High A	Extreme
≥50		(Note 1)	Extreme	Extreme

1. With incremental PLL equal to or greater than one (1), it is unlikely damage will be minor. Similarly with an incremental PLL in excess of 50 it is unlikely damage will be classified as medium.

4.5 Recommended Consequence Category

Based on the information available at the time of preparation of the current assessment, the recommended consequence category for the dredge pond shall be taken as **Significant** due to the CCA based on PAR.

5.0 Storm Storage Allowance

5.1 Catchments

The dredge pond has been designed as an above ground Turkey's Nest structure for the disposal of dredge spoil material produced at the loading facility. As this structure will have no contributing external catchment, the catchment area is limited to the surface area of the storage, which is approximately 6ha.

5.2 Freeboard

Following the *Guidelines on Tailings Dams; Planning, Design, Construction, Operation and Closure* (ANCOLD 2019), a contingency storage allowance has been factored in to mitigate the risk of spillage to an acceptable level. The calculation of the recommended freeboard involves determining the wave run-up height based on the specified design event for a **Significant** consequence facility as presented in **Table 10**. Due to the temporary nature of the dredge pond no dry freeboard allowance has been included.

Table 10 Summary of Freeboard Calculations

Facility	NRR Dredge Pond
Design criteria	1 in 10-year AEP, wind event
Fetch (km)	0.32
Significant Wave Height	0.27
Wave Run-up Height (m)	0.32
Freeboard (m)	**0.32**

5.3 Maximum Operating Level (MOL)

A risk-based approach has been undertaken in accordance with the *Guidelines on Tailings Dams; Planning, Design, Construction, Operation and Closure* (ANCOLD 2019) in order to develop an appropriate MOL. The MOL has been adopted to minimise the risk of an uncontrolled release over the crest and as a trigger to maintain pond level.

To determine the MOL, the following scenario was assessed:

- Depth below the spillway crest required to contain the full volume of catchment rainfall from a 1 in 100-year AEP 72-hour storm event[1] plus the contingency freeboard.

The rainfall depth for a 100-year 72 hour storm event at Bing Bong was determined to be 606mm. No catchment losses were allowed for in the calculation. The total volume of rainfall over the catchment was then calculated.

The MOL calculation results for the pond are summarised in **Table 11**.

Table 11 Summary of MOL Results

Facility	NRR Dredge Pond
ESS Design criteria	1 in 100-year AEP, 72-hour storm
Rainfall depth (mm)	606
Catchment area (ha)	6
Full supply volume (ML)	205
1 in 100-year AEP, 72-hour storm volume (ML)	36
1 in 100-year AEP, 72-hour storm depth below contingency freeboard (m)	0.66
Total Freeboard (m)	0.98
MOL (RL m)	**5.02**
MOL Volume (ML)	151

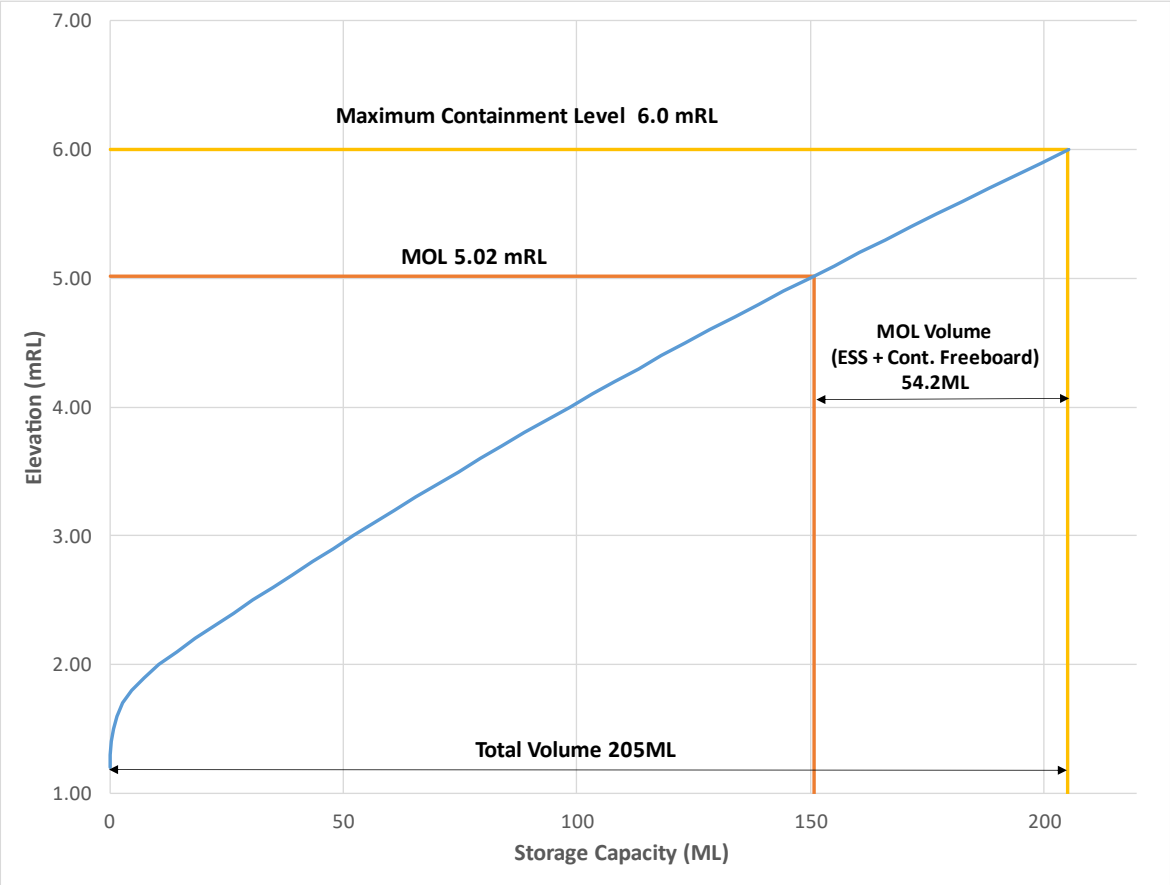
An MOL marker is to be located adjacent to the pump at the NRR dredge pond, the water level in the pond must be maintained below the level indicated on the marker.

[1] Equivalent to the Extreme Storm Storage (ESS) as per the Guidelines on Tailings Dams; Planning, Design, Construction, Operation and Closure 2019, ANCOLD.

5.4 Storage / Elevation Data

The storage volume elevation characteristics for the proposed dredge pond arrangement and the MOL are presented in **Figure 1**.

Figure 1 Dredge Pond Stage Storage Curve



6.0 Construction Quality Control

6.1 Basin Floor

A cut to fill approach is recommended to form the basin floor.

The aim of the basin design is to have a moderately smooth, consistently graded floor over which deposited dredge spoil can flow, depositing sediment as it goes. The Detailed design takes into account slurry being pumped from the northwest corner toward the separation embankment in the southeast corner where clean water is to be pumped out of the pond.

6.2 Embankment Foundation

Whilst no minimum bearing pressure (i.e., foundation strength) is required for the basin itself, the foundation area supporting the proposed new embankment will need to be of sufficient strength to support the overlying construction of the embankment.

Proof roll using (preferably) a 10 to 12 tonne static smooth drum roller to be undertaken and to be assessed by suitably qualified site personnel. If required, compact using the 10 to 12 tonne mass to achieve the target Density Ratio, at a moisture content of +/- 2% of Optimum

Moisture Content. After completion of foundation compaction, place the embankment fill material to the required thicknesses. Compact the materials in layers not exceeding the prescribed compacted thickness to the required minimum density ratios at a moisture content of -2% to +2% of optimum.

6.3 Trial Pad/s

Given the temporary nature of the dam, the testing requirement during construction has been proposed to be reduced to facilitate a relatively rapid construction program. As such, trial pad/s shall be constructed to determine the optimal layer thickness and number of passes and suitable moisture conditioning to achieve the required compactive effort.

Ideally, the trial pad/s shall be constructed within the proposed embankment foundation area.

Trial pads should aim for estimating the following:

- Optimal layer placement depth.
- Moisture conditioning required.
- Number of passes with a smooth drum roller (preferably 10 to 12 tonne) with no vibration.

During the construction of the trial pad, proof roll observation, Nuclear Densometer (ND) testing, and Dynamic Cone Penetrometer (DCP) testing shall be undertaken at each compacted layer to establish the optimal parameters above, to be taken forward for construction.

A target minimum compactive effort to 98% maximum dry density of standard compaction has been nominated for each compacted layer.

6.4 Containment and Separation Embankments

As nominated above, the construction of both the containment and decant embankments shall require a minimum compactive effort to 98% maximum dry density of standard compaction. Proof roll observation, ND testing, and DCP testing shall be undertaken at the start and on completion of embankment construction. Proof roll observation and DCP testing shall be carried out for the rest of the construction program.

As a guide the following construction methodology and compactive effort is assumed per embankment lift:

- Suitable material to be placed in loose layer thickness not exceeding 300mm.
- Blend between drier and over-moist materials, if required. Moisture added if required.
- Allow 6 to 8 passes of a smooth drum roller with no vibration (preferably 10 to 12 tonne).
- DCP testing at 50m intervals to be undertaken, to compare strength against the trial pad outcomes.

6.4.1 Containment Embankment Materials

The excavated material may be suitable for use as fill provided that there is not a significant organic content and that it is able to conform to the specified testing requirements as determined by the trial pads.

7.0 Limitations

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8.0 Bibliography

ANCOLD. 2012. “Australian National Committee on Large Dams - Guidelines on the Consequence Category for Dams.”

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Appendix A Design Drawings and Technical Specifications

Bing Bong Dredge Pond - Detailed Design Report

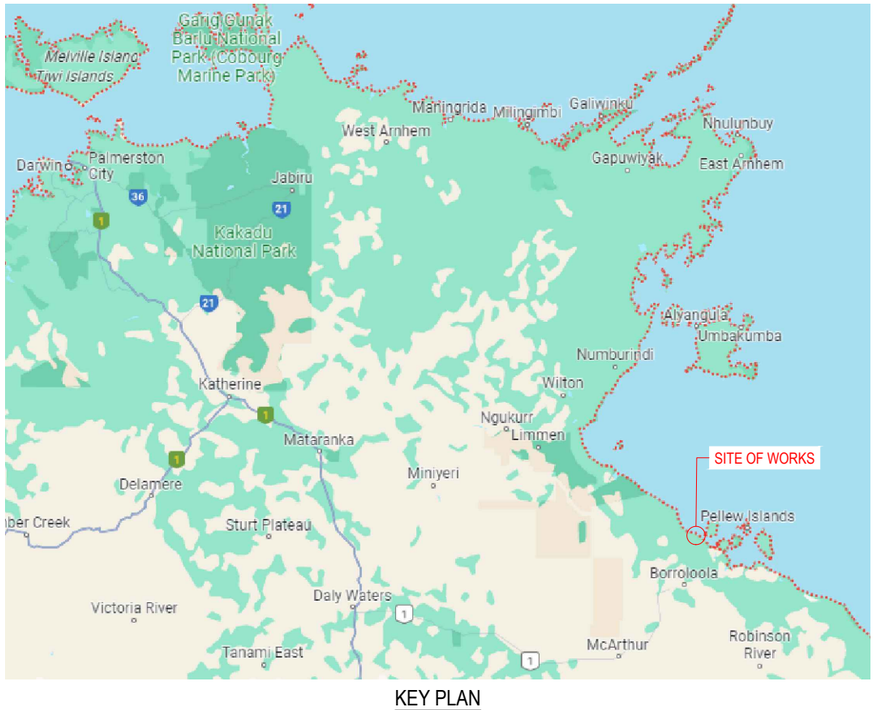
Detailed Engineering Design

NRR Equipment Pty Ltd

SLR Project No.: 623.030222.00001

15 January 2024

NATHAN RIVER RESOURCES (NRR)
BING BONG FACILITY DREDGE POND
ENGINEERING DESIGN



KEY PLAN
SCALE N.T.S.

LOCALITY PLAN
SCALE 1:100000

PROJECT DRAWING SCHEDULE	
SHEET NUMBER	SHEET TITLE
623.030222-CI-1000	DRAWING SCHEDULE AND LOCALITY PLAN
623.030222-CI-1001	GENERAL NOTES
623.030222-CI-1100	GENERAL ARRANGEMENT PLAN
623.030222-CI-1200	SETOUT PLAN
623.030222-CI-1300	EARTHWORKS PLAN
623.030222-CI-1400	CROSS SECTIONS
623.030222-CI-1500	TYPICAL DETAILS

REVISIONS				
0	11/01/24	FINAL DESIGN ISSUE		DOT
A	03/10/23	PRELIMINARY DESIGN ISSUE		DOT
	DATE	DESCRIPTION		APPROVED

0.0 1000 2000 3000 4000
METRES

SCALE 1:100000

DRAWN:	JM	DATE: 11/01/24
DESIGN:	JM	DATE: 11/01/24
DWG. CHECK:	AK	DATE: 11/01/24
DES. CHECK:	AK	DATE: 11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE: 11/01/24
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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: DRAWING SCHEDULE AND LOCALITY

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:100000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1000

REVISION: 0

PLOT DATE 11-Jan-2024 12:38:25 PM

H:\Projects-SLR\623-TSV\623.030222.00001NRR Bing Bong Dredge Pond Desi\06 SLR Data\01 CAD\GIS\CAD\Drawings\623.030222-CI-1000.dwg

GENERAL

G1 ALL DIMENSIONS ARE IN METRES AND ALL LEVELS ARE IN METRES RELATIVE TO AUSTRALIAN HEIGHT DATUM (AHD) UNLESS NOTED OTHERWISE. CO-ORDINATE SYSTEM IS GDA94 ZONE 53.

G2 ALL DIMENSIONS AND SETTING OUT SHALL BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING WORK. DO NOT OBTAIN DIMENSIONS BY SCALING FROM THE DRAWINGS.

G3 ANY DETAILS OF EXISTING SERVICES SHOWN ON THE DRAWINGS ARE NOT TO BE TAKEN AS INDICATING ALL EXISTING SERVICES OR LOCATIONS. IT IS THE CONTRACTORS RESPONSIBILITY TO ADEQUATELY INFORM THEMSELVES AS TO THE LOCATION OF ANY AND ALL SERVICES. THE CONTRACTOR SHALL EXERCISE DUE CARE WHEN UNDERTAKING ANY EXCAVATION. WHERE AN EXISTING SERVICE IS DAMAGED BY THE CONTRACTOR FOR ANY REASON WHATSOEVER, THE CONTRACTOR SHALL BEAR ALL COSTS AND ANY DELAYS FOR REPAIRING AND/OR DISCONNECTING THE SERVICES AS WELL AS ANY ASSOCIATED COSTS (E.G. DAMAGES, CLEAN UP, ETC.).

G4 SOURCE DATA FOR DESIGN PROVIDED BY NRR.

ENVIRONMENTAL

EN1 TEMPORARY EROSION AND SEDIMENT CONTROL (ESC) MEASURES SHALL BE PROVIDED IN ACCORDANCE WITH THE RELEVANT NRR MANAGEMENT PLAN AND PROCEDURE.

EN2 THE CONTRACTOR SHALL ENSURE THAT ALL ESC MEASURES ARE COMPLIANT WITH THE ABOVE STANDARDS.

EN3 THE CONTRACTOR AND ANY SUB-CONTRACTORS SHALL BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION OF DOWNSLOPE LANDS AND WATERWAYS IN THE ABOVE STANDARDS.

EARTHWORKS

E1 STRIP THE WORK AREA OF ALL GRASS, VEGETATIVE MATTER, FIBROUS ROOTS AND LOOSE MATERIAL AND HANDLE IN ACCORDANCE WITH NRR RELEVANT MANAGEMENT PLAN AND PROCEDURE.

E2 ESTABLISH EARTHWORK EXCESS STOCKPILES IN HEIGHTS NOT GREATER THAN 2 METRES.

E3 CREATE SEPARATE STOCKPILES FOR DIFFERENT SOIL TYPES. DO NOT MIX SUB-SOIL WITH TOPSOIL. PROVIDE ADEQUATE WATERING, DRAINAGE AND EROSION CONTROL.

E4 DO NOT ALLOW TRAFFIC ON STOCKPILES.

E5 ALL EXCAVATION SURFACES SHALL BE STRIPPED AS SPECIFIED AND LEVELLED TO TOLERANCES OF +0mm / -50mm OF THE DESIGN LEVELS.

E6 ALL FINAL SURFACES SHALL BE CONSTRUCTED AS SPECIFIED, AND LEVELLED TO TOLERANCES OF +25mm / -0mm OF THE DESIGN LEVELS.

E7 PERMANENT CUT EXCAVATION BATTERS FOR EARTHWORKS SHOULD BE GRADED NO STEEPER THAN 4(H):1(V).

E8 THE EXCAVATED PROFILE AND ALL AREAS WHICH WILL RECEIVE FILL SHALL BE PROOF ROLLED PRIOR TO PLACEMENT OF FILL. USE STATIC SMOOTH WHEELED ROLLERS OR SIMILAR WITH A MASS OF NOT LESS THAN 10 TONNES OR A LOAD INTENSITY UNDER EITHER FRONT OR REAR AXIS OF NOT LESS THAN 5 TONNES. PROOF ROLL IMMEDIATELY FOLLOWING COMPLETION OF COMPACTION.

E9 ALL EARTHWORKS FILL OPERATION SHALL BE UNDERTAKEN UNDER LEVEL 1 SUPERVISION BY COMPETENT EXPERIENCED PERSONNEL.

DAM EMBANKMENT

EM1 GENERAL FILL SHALL BE PLACED IN NEAR HORIZONTAL LAYERS NOT EXCEEDING 300mm THICK, COMPACT TO 98% MAXIMUM DRY DENSITY AT -2 TO +2% OMC.

EM2 COMPACTED SURFACES SHALL BE SCARIFIED AND WETTED AT THE START OF EACH DAY AND AFTER ANY CONSTRUCTION HIATUS AND PRIOR TO THE PLACEMENT OF ADDITIONAL LAYERS.

DRAINAGE AND DEWATERING

D1 PROVIDE ADEQUATE STANDBY DEWATERING EQUIPMENT IN CRITICAL AREAS WHERE FAILURE OF THE SYSTEM COULD LEAD TO DANGER TO LIFE OR DAMAGE TO PARTIALLY COMPLETED STRUCTURES

D2 DISPOSE OF THE WATER FROM THE WORK IN A SUITABLE MANNER IN ACCORDANCE WITH ENVIRONMENTAL REQUIREMENTS AND WITHOUT DAMAGING THE WORKS OR ADJACENT PROPERTY. NO WATER SHALL BE DRAINED INTO WORK BUILT OR UNDER CONSTRUCTION WITHOUT THE PRIOR CONSENT OF THE SUPERINTENDENT

D3 CONTRACTOR IS RESPONSIBLE FOR ENSURING SITE IS LEFT IN A CONDITION THAT ALLOWS ADEQUATE DRAINAGE OF SURFACE WATER WHENEVER UNATTENDED.

DISPOSAL OF SURPLUS AND UNSUITABLE MATERIALS

DM1. DISPOSE OF ALL SURPLUS AND UNSUITABLE MATERIALS IN ACCORDANCE WITH NRR SPECIFICATIONS.

DM2. UNSUITABLE MATERIAL INCLUDES:

- ALL EXCAVATED MATERIAL WHICH DOES NOT SATISFY THE REQUIREMENTS FOR USE IN CONSTRUCTION OF THE WORKS (MATERIALS WHICH VISIBLY HEAVE WHEN TRAFFICKED BY EARTHWORKS PLANT, OR SUBGRADES WITH ASSESSED CBR OF LESS THAN 2%)
- ALL DISUSED MATERIALS RESULTING FROM CLEARING (SUCH AS TREES, STUMPS, BRUSH, FENCING AND STRUCTURAL DEBRIS); AND
- ALL RUBBISH.

DESIGN ASSUMPTIONS

A1. GROUNDWATER LEVELS ARE NO HIGHER THAN 1.0m BELOW GROUND.

A2. NO ROCK IS PRESENT WITHIN 1.0m BELOW GROUND.

A3. THE MATERIALS ON SITE ARE SUITABLE FOR RE-USE IN CONSTRUCTION OF THE PROPOSED POND EMBANKMENTS.

A4. THE PROPOSED INLET PIPES WILL BE PLACED IN THE NORTH WESTERN CORNER OF THE NEW DREDGE POND.

A5. NO DETAILED WAVE ALLOWANCE CALCULATION WAS UNDERTAKEN.

A6. THE MELALEUCA SWAMPS SHOWN ON THE DRAWING LAYOUTS ARE INDICATIVE ONLY. LOCATION OF SWAMPS TO BE VERIFIED PRIOR TO, AND PROTECTED DURING, CONSTRUCTION WORKS.

PLOT DATE 11-Jan-2024 12:38:30 PM

REVISIONS

	DATE	DESCRIPTION	APPROVED
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A	03/10/23	PRELIMINARY DESIGN ISSUE	DOT

DRAWN: JM	DATE: 11/01/24	
DESIGN: JM	DATE: 11/01/24	
DWG. CHECK: AK	DATE: 11/01/24	
DES. CHECK: AK	DATE: 11/01/24	
RESPONSIBLE PRINCIPAL SIGNATURE: DANIELLE O'TOOLE RPEQ : RPEQ :	DATE: 11/01/24	

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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: GENERAL NOTES

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: N/A

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1001

REVISION: 0

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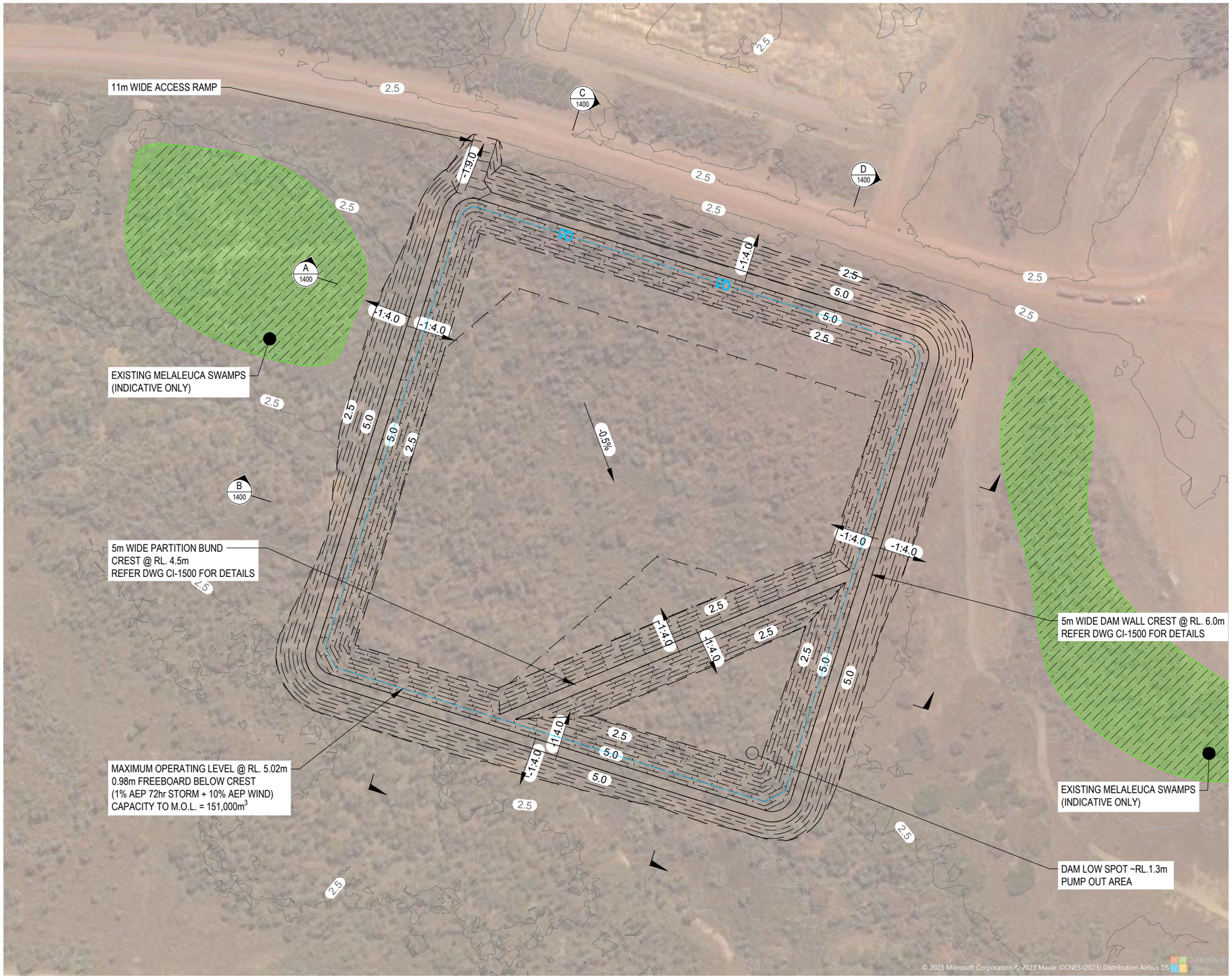

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NOTE:

REFER DWG 623.030222-CI-1001 FOR
CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.

LEGEND

- 2.5 — EXISTING GROUND CONTOURS (0.5m INTERVALS)
- EXISTING MELALEUCA SWAMPS
- 5.0 — DESIGN CONTOURS (0.5m INTERVALS)
- TOP OF BANK / DAM CREST
- BATTER TOE
- Q5 — MAXIMUM OPERATING LEVEL (MOL)

GENERAL ARRANGEMENT PLAN

SCALE 1:2000

REVISIONS				
	0	11/01/24	FINAL DESIGN ISSUE	DOT
	A	03/10/23	PRELIMINARY DESIGN ISSUE	DOT
		DATE	DESCRIPTION	APPROVED

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METRES

SCALE 1:2000

DRAWN:	JM	DATE:	11/01/24
DESIGN:	JM	DATE:	11/01/24
DWG. CHECK:	AK	DATE:	11/01/24
DES. CHECK:	AK	DATE:	11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE:	11/01/24
RPEQ :			
RPEQ :			

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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: GENERAL ARRANGEMENT PLAN

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:2000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1100

REVISION: 0

PLOT DATE 11-Jan-2024 12:38:42 PM

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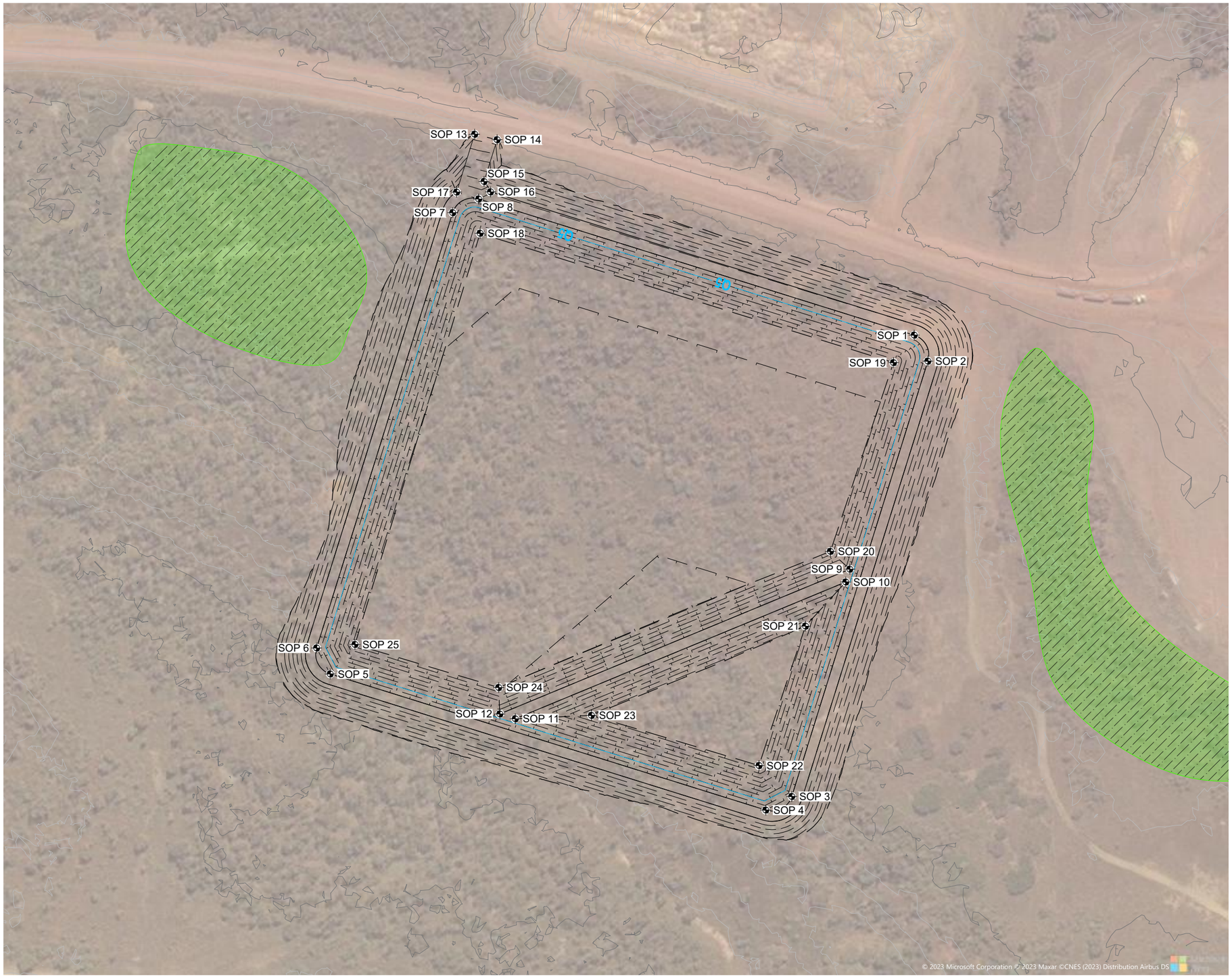

SETOUT PLAN

SCALE 1:2000

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W E
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NOTE:
REFER DWG 623.030222-CI-1001 FOR CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.

SETOUT POINT TABLE			
SOP REF	EASTING	NORTHING	ELEVATION
SOP 1	647,729.63	8,271,672.85	6.00
SOP 2	647,736.21	8,271,660.31	6.00
SOP 3	647,670.57	8,271,450.29	6.00
SOP 4	647,658.04	8,271,443.73	6.00
SOP 5	647,447.94	8,271,509.40	6.00
SOP 6	647,441.38	8,271,521.92	6.00
SOP 7	647,507.02	8,271,731.95	6.00
SOP 8	647,519.55	8,271,738.51	6.00
SOP 9	647,698.56	8,271,559.96	4.50
SOP 10	647,696.62	8,271,553.75	4.50
SOP 11	647,537.21	8,271,487.78	4.50
SOP 12	647,529.76	8,271,490.11	4.50
SOP 13	647,517.61	8,271,769.77	2.70
SOP 14	647,528.42	8,271,767.10	2.75
SOP 15	647,522.14	8,271,746.95	5.04
SOP 16	647,525.26	8,271,741.96	5.91
SOP 17	647,508.89	8,271,741.85	6.00
SOP 18	647,520.22	8,271,722.00	2.11
SOP 19	647,719.64	8,271,659.61	2.10
SOP 20	647,689.21	8,271,568.52	1.63
SOP 21	647,677.17	8,271,532.47	1.44
SOP 22	647,654.78	8,271,465.20	1.12
SOP 23	647,573.94	8,271,489.42	1.37
SOP 24	647,529.19	8,271,502.83	1.51
SOP 25	647,459.84	8,271,523.61	1.72

LEGEND

- 2.5 — EXISTING GROUND CONTOURS (0.5m INTERVALS)
- EXISTING MELALEUCA SWAMPS
- 5.0 — DESIGN CONTOURS (0.5m INTERVALS)
- TOP OF BANK / DAM CREST
- BATTER TOE
- Q5 — MAXIMUM OPERATING LEVEL (M.O.L.)

PLOT DATE 11-Jan-2024 12:38:56 PM

REVISIONS				
	0	11/01/24	FINAL DESIGN ISSUE	DOT
	A	03/10/23	PRELIMINARY DESIGN ISSUE	DOT
		DATE	DESCRIPTION	APPROVED

0.0 20 40 60 80
METRES

SCALE 1:2000

DRAWN:	JM	DATE: 11/01/24
DESIGN:	JM	DATE: 11/01/24
DWG. CHECK:	AK	DATE: 11/01/24
DES. CHECK:	AK	DATE: 11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE: 11/01/24
RPEQ :		
RPEQ :		

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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: SETOUT PLAN

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:2000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1200

REVISION: 0

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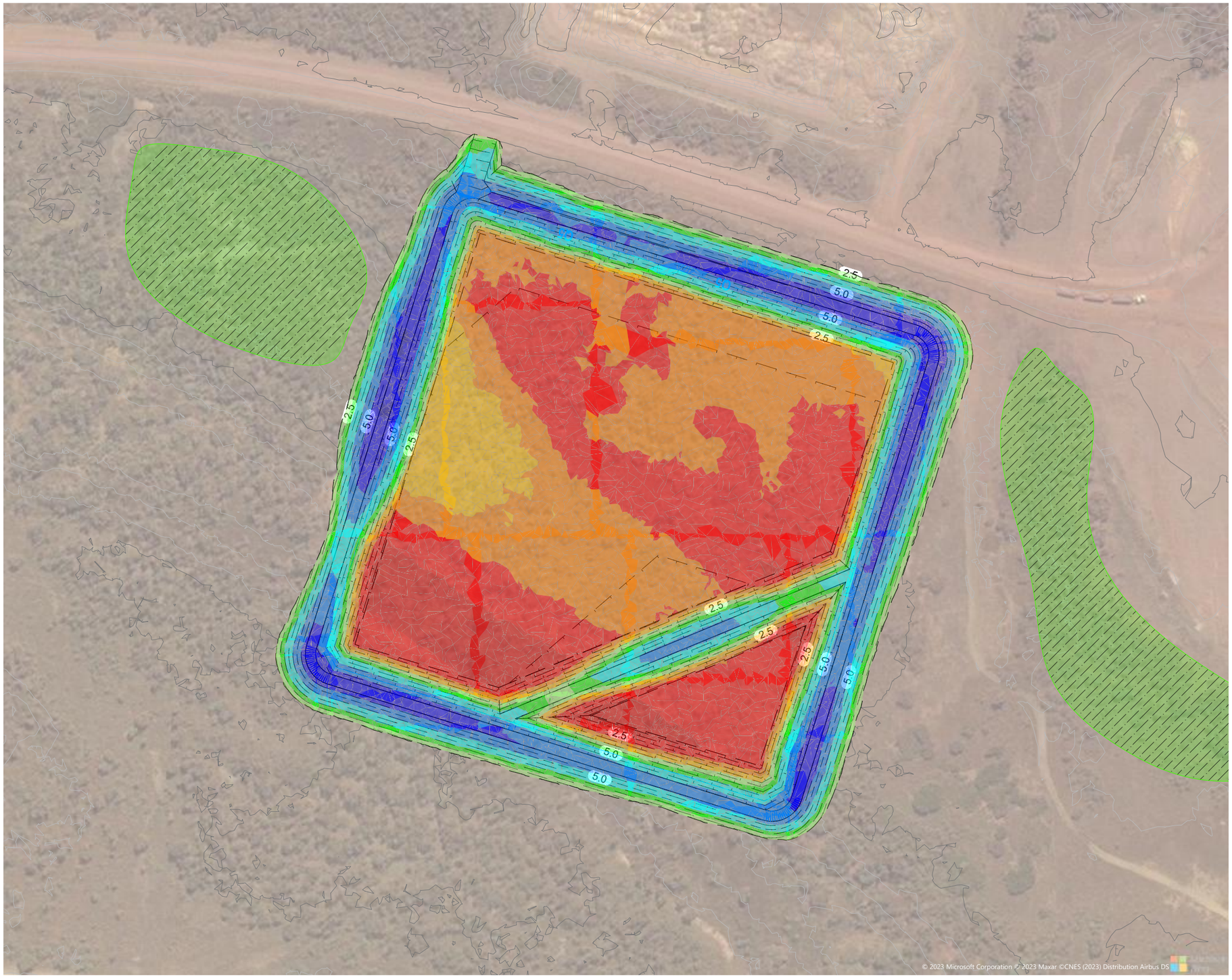

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NOTE:
REFER DWG 623.030222-CI-1001 FOR CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.

LEGEND

- 2.5 — EXISTING GROUND CONTOURS (0.5m INTERVALS)
- EXISTING MELALEUCA SWAMPS
- 5.0 — DESIGN CONTOURS (0.5m INTERVALS)
- TOP OF BANK / DAM CREST
- BATTER TOE
- Q5 — MAXIMUM OPERATING LEVEL (M.O.L.)

EARTHWORKS DEPTHS				
NO.	MIN. EL.	MAX. EL.	AREA	COLOUR
1	-2.89m	-2.00m	4967.62m²	
2	-2.00m	-1.00m	18393.70m²	
3	-1.00m	-0.50m	16112.85m²	
4	-0.50m	0.00m	4317.51m²	
5	0.00m	0.50m	4412.59m²	
6	0.50m	1.00m	4501.52m²	
7	1.00m	2.00m	9250.58m²	
8	2.00m	3.00m	8572.24m²	
9	3.00m	4.00m	5307.29m²	
10	4.00m	4.13m	66.80m²	

EARTHWORKS VOLUMES	
2D FOOTPRINT AREA	75,900m²
CUT VOLUME	47,525m²
FILL VOLUME	57,125m²

EARTHWORKS PLAN
SCALE 1:2000

PLOT DATE 11-Jan-2024 12:39:12 PM

REVISIONS				
0	11/01/24	FINAL DESIGN ISSUE		DOT
A	03/10/23	PRELIMINARY DESIGN ISSUE		DOT
	DATE	DESCRIPTION		APPROVED

0.0 20 40 60 80
METRES
SCALE 1:2000

DRAWN:	JM	DATE: 11/01/24
DESIGN:	JM	DATE: 11/01/24
DWG. CHECK:	AK	DATE: 11/01/24
DES. CHECK:	AK	DATE: 11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE: 11/01/24
RPEQ :		
RPEQ :		

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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: EARTHWORKS PLAN

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:2000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1300

REVISION: 0

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NOTE:
REFER DWG 623.030222-CI-1001 FOR CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.

SECTION A
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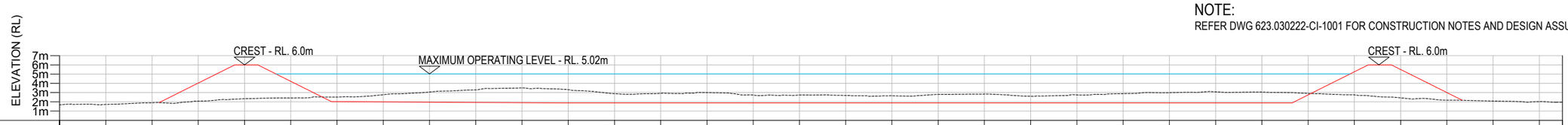
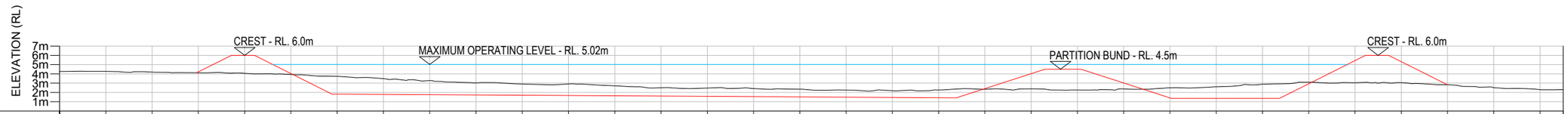


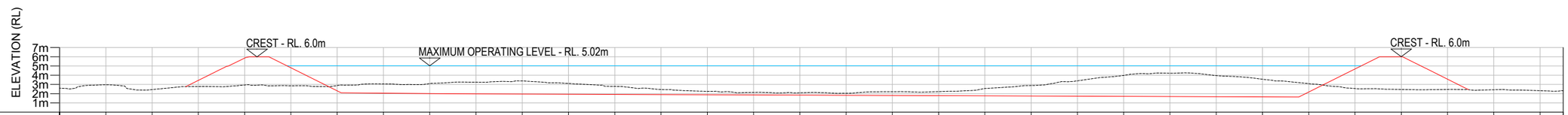
CHAINAGE (m)	DESIGN SURFACE (RLm)	ORIGINAL GROUND (RLm)	DEPTH (m)
10.00		1.72	
20.00		1.90	
30.00	4.03	2.08	1.95
40.00	6.00	2.34	3.66
50.00	4.22	2.42	1.80
60.00	2.02	2.52	-0.49
70.00	1.99	2.77	-0.77
80.00	1.96	3.06	-1.10
90.00	1.93	3.29	-1.36
100.00	1.90	3.51	-1.60
110.00	1.88	3.31	-1.43
120.00	1.88	2.88	-1.00
130.00	1.88	2.92	-1.04
140.00	1.88	2.99	-1.11
150.00	1.88	2.73	-0.85
160.00	1.88	2.73	-0.85
170.00	1.88	2.69	-0.81
180.00	1.88	2.65	-0.77
190.00	1.88	2.80	-0.92
200.00	1.88	2.84	-0.96
210.00	1.88	2.60	-0.71
220.00	1.88	2.75	-0.87
230.00	1.88	2.88	-1.00
240.00	1.88	2.98	-1.10
250.00	1.88	3.08	-1.20
260.00	1.88	3.05	-1.17
270.00	2.75	2.91	-0.16
280.00	5.25	2.76	2.49
290.00	5.50	2.43	3.07
300.00	3.00	2.18	0.82
310.00		2.09	
320.00		2.02	
325.00		1.96	

SECTION B
SCALE - V 1:500
H 1:1000



CHAINAGE (m)	DESIGN SURFACE (RLm)	ORIGINAL GROUND (RLm)	DEPTH (m)
10.00		4.27	
20.00		4.19	
30.00	4.22	4.12	0.09
40.00	6.00	4.06	1.94
50.00	4.03	3.94	0.10
60.00	1.82	3.73	-1.92
70.00	1.79	3.48	-1.70
80.00	1.76	3.27	-1.52
90.00	1.73	3.03	-1.30
100.00	1.70	2.91	-1.21
110.00	1.67	2.91	-1.25
120.00	1.64	2.71	-1.07
130.00	1.61	2.50	-0.89
140.00	1.58	2.47	-0.89
150.00	1.55	2.41	-0.86
160.00	1.52	2.35	-0.83
170.00	1.49	2.25	-0.76
180.00	1.46	2.18	-0.72
190.00	1.43	2.26	-0.84
200.00	2.41	2.33	0.08
210.00	4.02	2.38	1.64
220.00	4.50	2.26	2.24
230.00	3.01	2.38	0.64
240.00	1.41	2.49	-1.09
250.00	1.35	2.61	-1.26
260.00	1.35	2.88	-1.54
270.00	2.93	3.11	-0.17
280.00	5.43	3.05	2.39
290.00	5.32	3.05	2.27
300.00		2.82	
310.00		2.51	
320.00		2.30	
325.00		2.30	

SECTION C
SCALE - V 1:500
H 1:1000



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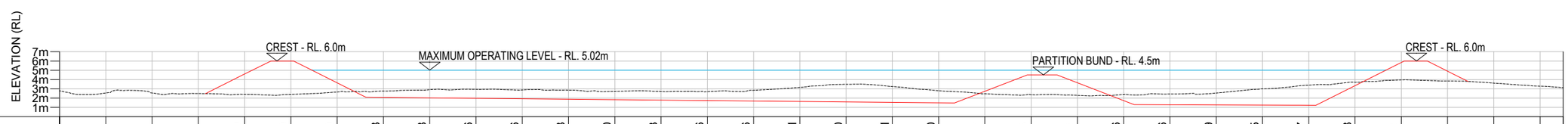
20.00		2.44	
30.00	3.44	2.77	0.67
40.00	5.86	2.94	2.92
50.00	4.81	2.86	1.95
60.00	2.31	2.88	-0.57
70.00	2.05	3.05	-1.00
80.00	2.00	3.09	-1.09
90.00	1.97	3.24	-1.27
100.00	1.95	3.38	-1.43
110.00	1.93	3.10	-1.17
120.00	1.92	2.79	-0.87
130.00	1.90	2.45	-0.56
140.00	1.88	2.25	-0.37
150.00	1.86	2.13	-0.27
160.00	1.84	2.09	-0.25
170.00	1.82	2.04	-0.22
180.00	1.80	2.21	-0.41
190.00	1.79	2.22	-0.44
200.00	1.77	2.56	-0.79
210.00	1.75	2.88	-1.14
220.00	1.73	3.39	-1.66
230.00	1.71	3.97	-2.26
240.00	1.69	4.21	-2.52
250.00	1.67	3.96	-2.29
260.00	1.65	3.56	-1.91
270.00	2.18	3.08	-0.90
280.00	4.68	2.56	2.12
290.00	6.00	2.45	3.55
300.00	3.57	2.46	1.11
310.00		2.42	
320.00		2.32	
325.00		2.31	

SECTION D
SCALE - V 1:500
H 1:1000



CHAINAGE (m)	DESIGN SURFACE (RLm)	ORIGINAL GROUND (RLm)	DEPTH (m)
10.00		2.55	
20.00		2.56	
30.00		2.49	
40.00	4.60	2.42	2.19
50.00	6.00	2.40	3.60
60.00	3.65	2.65	0.99
70.00	2.08	2.76	-0.68
80.00	2.03	2.91	-0.88
90.00	1.98	2.95	-0.96
100.00	1.93	2.89	-0.96
110.00	1.88	2.86	-0.98
120.00	1.84	2.73	-0.90
130.00	1.79	2.72	-0.93
140.00	1.74	2.70	-0.96
150.00	1.69	2.84	-1.16
160.00	1.64	3.15	-1.51
170.00	1.59	3.49	-1.90
180.00	1.54	3.25	-1.71
190.00	1.49	2.79	-1.30
200.00	2.74	2.47	0.27
210.00	4.50	2.37	2.13
220.00	3.66	2.30	1.36
230.00	1.74	2.40	-0.66
240.00	1.28	2.44	-1.16
250.00	1.27	2.56	-1.29
260.00	1.25	3.00	-1.75
270.00	1.23	3.40	-2.17
280.00	3.34	3.72	-0.38
290.00	5.84	3.96	1.88
300.00	4.91	3.84	1.07
310.00		3.62	
320.00		3.29	
325.00		3.12	

REVISIONS				
0	11/01/24	FINAL DESIGN ISSUE		DOT
A	03/10/23	PRELIMINARY DESIGN ISSUE		DOT
	DATE	DESCRIPTION		APPROVED

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SCALE 1:500 METRES

0.0 10 20 30 40
SCALE 1:1000 METRES

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DESIGN:	JM	DATE:	11/01/24
DWG. CHECK:	AK	DATE:	11/01/24
DES. CHECK:	AK	DATE:	11/01/24
RESPONSIBLE PRINCIPAL SIGNATURE:	DANIELLE O'TOOLE	DATE:	11/01/24
RPEQ :			
RPEQ :			

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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: CROSS SECTIONS

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:500 & 1:1000

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1400

REVISION: 0

PLOT DATE 11-Jan-2024 12:39:25 PM

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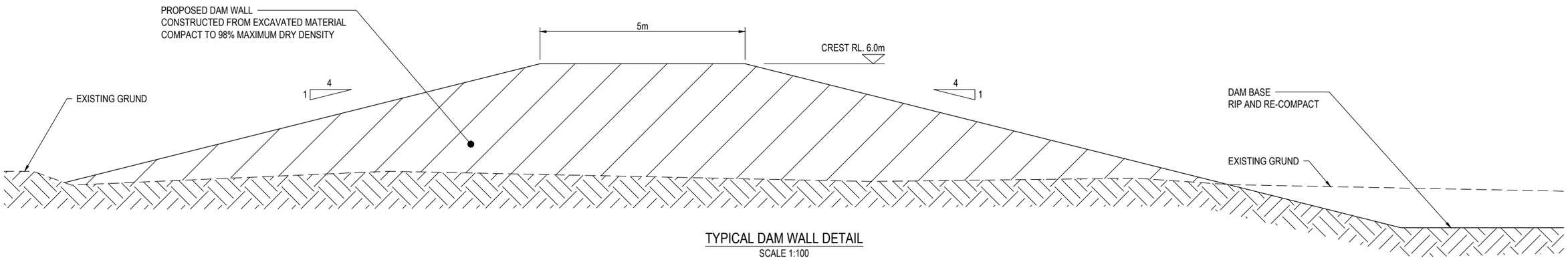
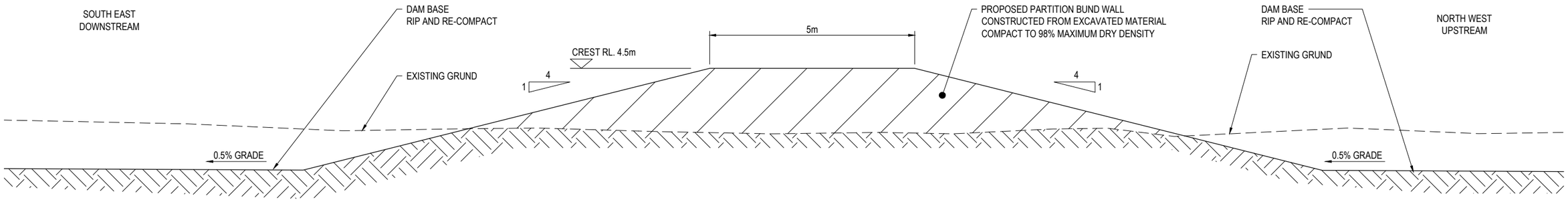
NOTE:
REFER DWG 623.030222-CI-1001 FOR
CONSTRUCTION NOTES AND DESIGN ASSUMPTIONS.



TYPICAL DAM WALL DETAIL
SCALE 1:100



TYPICAL PARTITION BUND DETAIL
SCALE 1:100

PLOT DATE 11-Jan-2024 12:39:31 PM

REVISIONS

0	11/01/24	FINAL DESIGN ISSUE	DOT
A	03/10/23	PRELIMINARY DESIGN ISSUE	DOT
	DATE	DESCRIPTION	APPROVED

0.0 1.0 2 3 4
METRES

SCALE 1:100

DRAWN: JM	DATE: 11/01/24	
DESIGN: JM	DATE: 11/01/24	
DWG. CHECK: AK	DATE: 11/01/24	
DES. CHECK: AK	DATE: 11/01/24	
RESPONSIBLE PRINCIPAL SIGNATURE: DANIELLE O'TOOLE	DATE: 11/01/24	
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CLIENT: NRR

PROJECT: BING BONG FACILITY DREDGE POND
PRELIMINARY ENGINEERING DESIGN

DRAWING TITLE: TYPICAL DETAILS

SIZE: A3

STATUS: FOR EXTERNAL ISSUE
NOT TO BE USED
FOR CONSTRUCTION PURPOSES

SCALE: 1:100

DATUM: GDA94 - Z53

DRAWING NUMBER: 623.030222-CI-1500

REVISION: 0

H:\Projects-SLR\623-TSV\623.030222.00001NRR Bing Bong Dredge Pond Desi\06 SLR Data\01 CADGIS\CAD\Drawings\623.030222-CI-1500.dwg

Appendix B Environmental Mapping

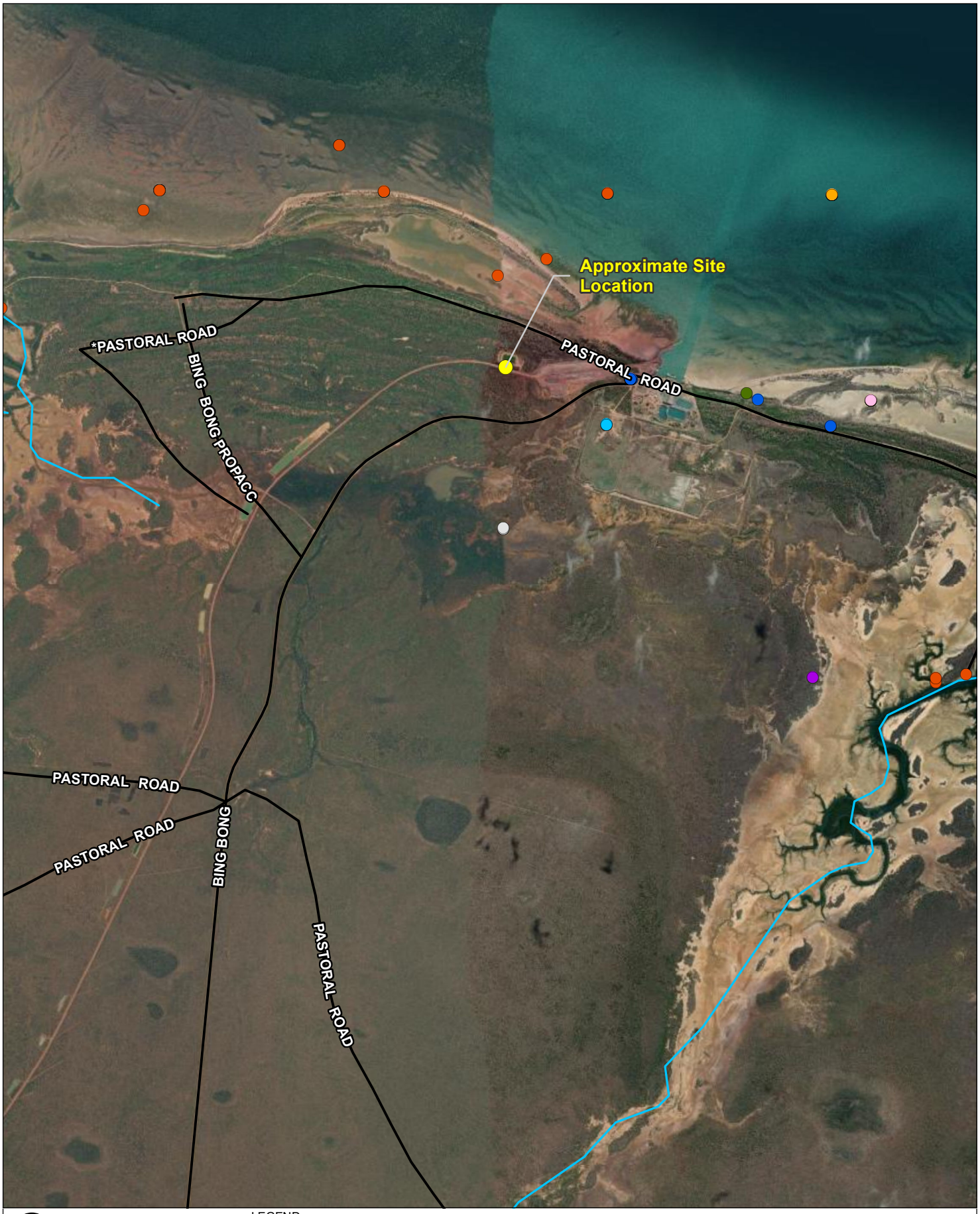
Bing Bong Dredge Pond - Detailed Design Report

Detailed Engineering Design

NRR Equipment Pty Ltd

SLR Project No.: 623.030222.00001

15 January 2024



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Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

SLR

LEGEND

- Road
- Watercourse - streams

Fauna Atlas - Threatened Species Observation

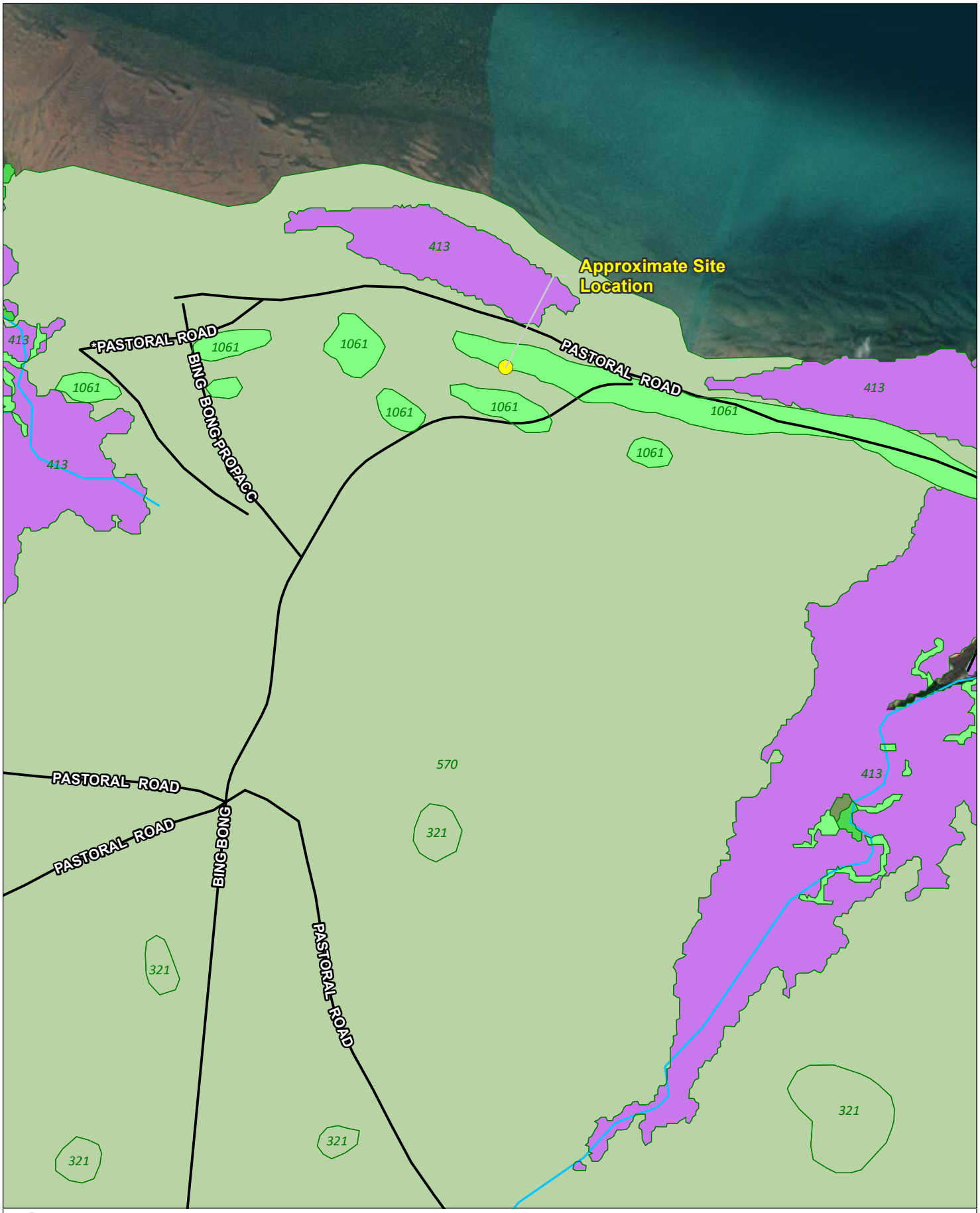
- Australian Painted-snipe
- Curlew Sandpiper
- Far Eastern Curlew
- Great Knot
- Greater Sand Plover
- Green Turtle
- Lesser Sand Plover
- Loggerhead Turtle
- Red Knot
- Yellow-spotted Monitor

NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

THREATENED FAUNA

FIGURE B1

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desi\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_ThreatenedFauna.mxd



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Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

LEGEND

- Road
- Watercourse - streams

NVIS Vegetation - Dominant Structural Formation

- Closed forest
- Mid closed forest
- Open forest
- Woodland
- Sparse samphire shrubland
- NVIS Vegetation - Dominant Veg ID

NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

VEGETATION TYPES

FIGURE B2

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desl\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_VegetationTypes.mxd

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Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

LEGEND

- Watercourse - streams
- Mangrove

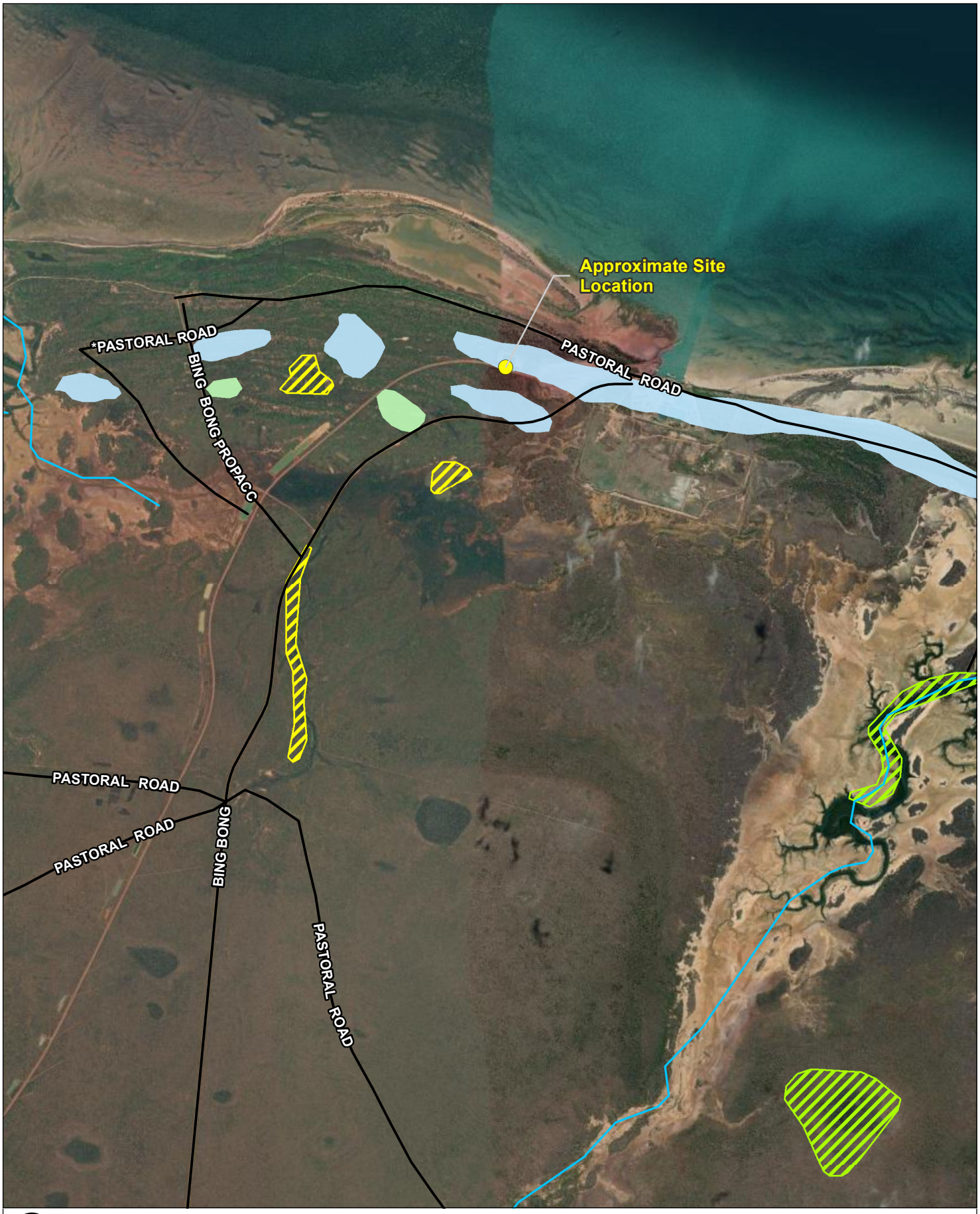
NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

WETLANDS

SLR

FIGURE B3

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desl\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_Wetlands.mxd



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Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

SLR

LEGEND

- Road
- Watercourse - streams

Terrestrial GDE

- Moderate Potential GDE
- Low Potential GDE

Aquatic GDE

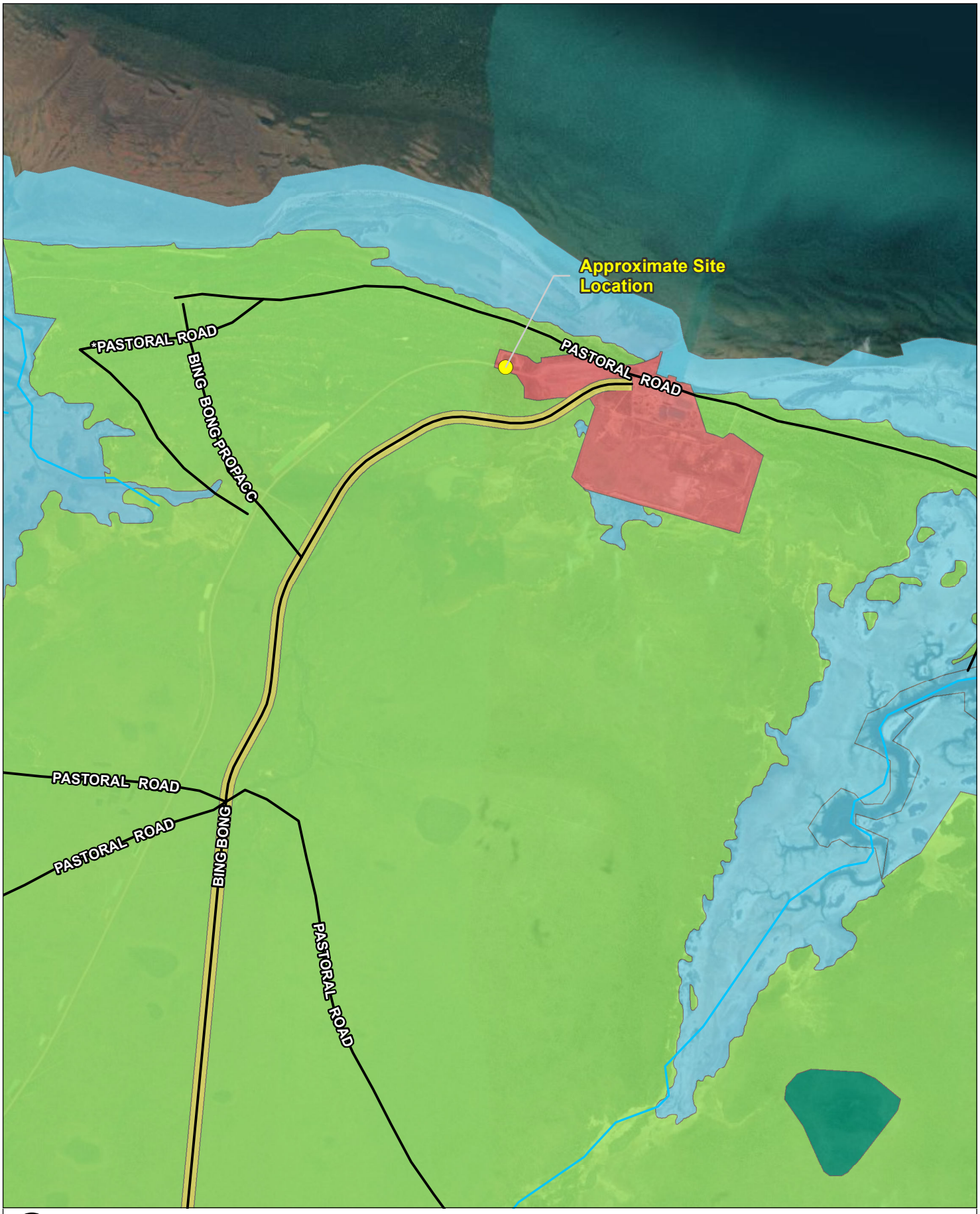
- Moderate potential GDE - from national assessment
- Low potential GDE - from national assessment

NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

GROUNDWATER DEPENDENT ECOSYSTEMS

FIGURE B4

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desi\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_Groundwater\DependentEcosystems.mxd



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Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

LEGEND

- Road
- Watercourse - streams

Land Use

- Estuary/coastal waters - conservation
- Grazing native vegetation
- Marsh/wetland - production
- Ports and water transport
- Roads

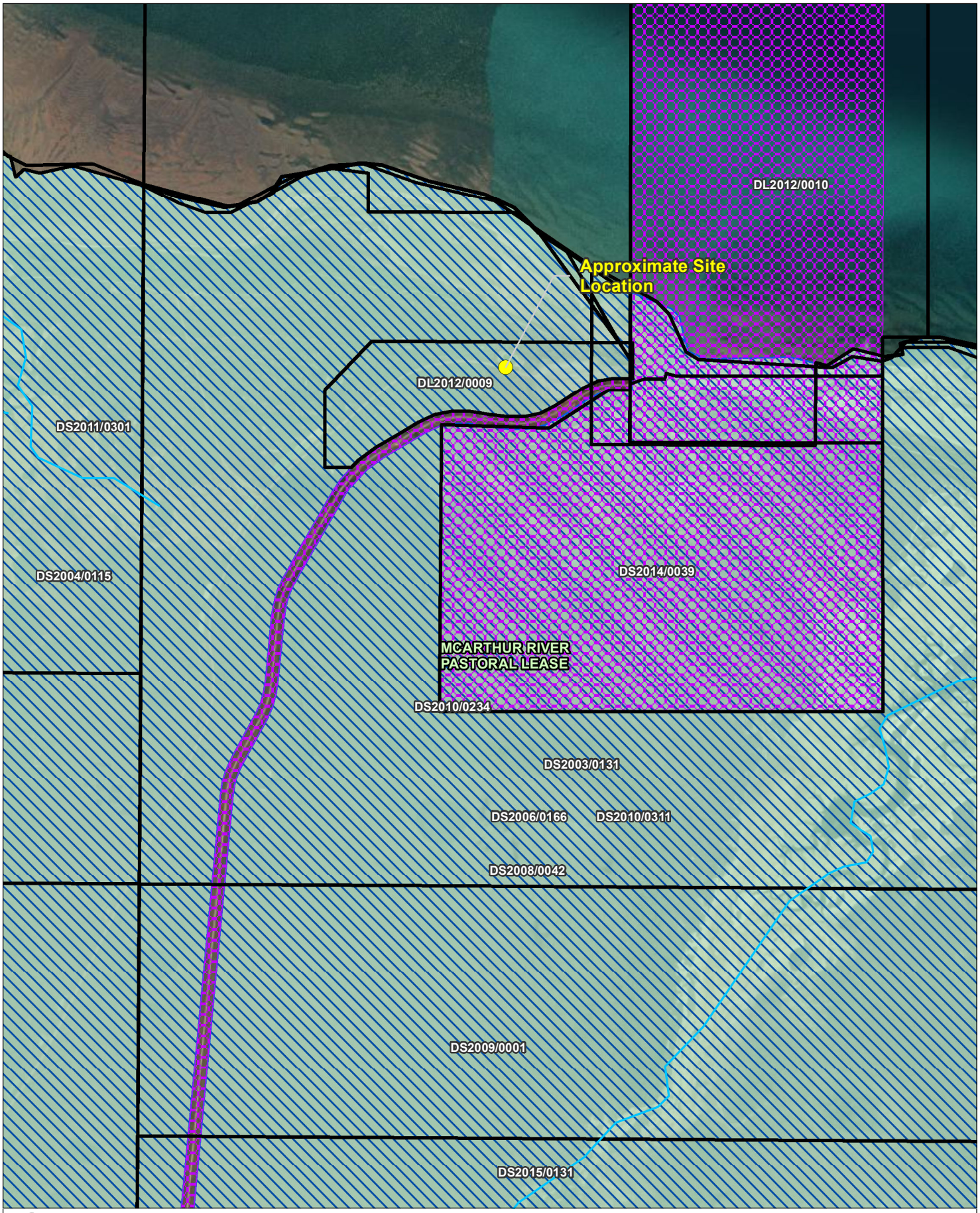
NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

LAND USE ZONES

SLR

FIGURE B5

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desi\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_LandUseZones.mxd



0 250 500 Meters

Coordinate System:	GDA 1994 MGA Zone 53
Scale:	1:40,000 at A4
Project Number:	623.030222
Date:	19-Dec-2023
Drawn by:	LC

LEGEND

- Watercourse - streams
- Future act Notices, Objections and Determination Applications
- Schedule of Native Title Determinations
- Registered Native Title Bodies Corporate
- Native Title Determination Outcomes

NATHAN RIVER RESOURCES
BING BONG FACILITY DREDGE POND

NATIVE TITLES

SLR

FIGURE B6

\\au.slr.local\Corporate\Projects-SLR\623-TSV\623.030222.00001\NRR Bing Bong Dredge Pond Desl\06 SLR Data\01 CAD\GIS\GIS\SLR623030222_NRRBingBongDredgePond_NativeTitles.mxd

Appendix C PLL Calculation

Bing Bong Dredge Pond - Detailed Design Report

Detailed Engineering Design

NRR Equipment Pty Ltd

SLR Project No.: 623.030222.00001

15 January 2024

SUMMARY OF PROCEDURE

The procedure for estimating loss of life due to dam failure relies heavily on data obtained from U.S. dam failures. The procedure is composed of 7 steps:

1) Determine dam failure scenarios to evaluate.
2) Determine time categories for which loss of life estimates are needed.
3) Determine when dam failure warnings would be initiated.
4) Determine area flooded for each dam failure scenario.
5) Estimate the number of people at risk for each dam failure scenario and time category.
6) Apply empirically-based equations or methods for estimating the number of fatalities.
7) Evaluate uncertainty.

STEP 1: Determine Dam Failure Scenarios to Evaluate

Failure modes to evaluate

Sunny Day dam failure

STEP 2: Determine Time Categories For Which Loss of Life Estimates Are Needed

Number of people at risk Influenced by seasonality or day of week factors

24/7 Operation: >1 person during day, none at night.

Summer rainfall: >1 person during day and none at night

STEP 3: Determine When Dam Failure Warnings Would be Initiated

Timely dam failure warnings more likely when dam failure occurred during daylight in the presence of a dam tender or others and where drainage area above the dam was large or the reservoir had space for flood storage

Timely dam failure warnings less likely when failure occurred at night or outside the presence of a dam tender or casual observers, and where drainage area was small or the reservoir had little or no space for flood storage

Availability of emergency action plans, upstream or dam-site instrumentation, or the requirement for on-site monitoring during threatening events influences when a dam failure warning would be initiated

Table 2
Guidance for Estimating When Dam Failure Warnings Would be Initiated (Earthfill Dam)

Dam Type	Cause of Failure	Special Considerations	Time of Failure	When Would Dam Failure Warning be Initiated?	
				Many Observers at Dam	No Observers at Dam
Earthfill	Overtopping	Drainage area at dam less than 100 mi^2 (260 km^2)	Day	0.25 hrs. before dam failure	0.25 hrs. after fw reaches populated area
		Drainage area at dam less than 100 mi^2 (260 km^2)	Night	0.25 hrs. after dam failure	1.0 hrs. after fw reaches populated area
		Drainage area at dam more than 100 mi^2 (260 km^2)	Day	2 hrs. before dam failure	1 hr. before dam failure
		Drainage area at dam more than 100 mi^2 (260 km^2)	Night	1 to 2 hr. before dam failure	0 to 1 hr. before dam failure
	Piping (full reservoir, normal weather)		Day	1 hr. before dam failure	0.25 hrs. after fw reaches populated area
			Night	0.5 hr. after dam failure	1.0 hr. after fw reaches populated area
	Seismic	Immediate Failure	Day	0.25 hr. after dam failure	0.25 hr. after fw reaches populated area
			Night	0.50 hr. after dam failure	1.0 hrs. after fw reaches populated area
		Delayed Failure	Day	2 hrs. before dam failure	0.5 hrs. before fw reaches populated area
			Night	2 hrs. before dam failure	0.5 hrs. before fw reaches populated area

Notes: "Many Observers at Dam" means that a dam tender lives on high ground and within site of the dam or the dam is visible from the homes of many people or the dam crest serves as a heavily used roadway. These dams are typically in urban areas. "No Observers at Dam" means that there is no dam tender at the dam, the dam is out of site of nearly all homes and there is no roadway on the dam crest. These dams are usually in remote areas. The abbreviation "fw" stands for floodwater.

No night work. No observers. No warning

STEP 4: Determine Area Flooded for Each Dam Failure Scenario

Refer to inundation maps

Judgements will have to be made whether maps reflect the flooding from the various failure scenarios for which loss of life estimates are needed

Maximum area of inundation estimated to be ~1.5km as flooding likely to enter gulf

STEP 5: Estimate the Number of People at Risk for Each Failure Scenario and Time Category (PAR)

Determine the number of people at risk for each failure scenario and time category

PAR = number of people occupying the dam failure floodplain prior to issuance of warning

Number of people at risk varies throughout the day

Can use: census data, field trips, aerial photographs, telephone interviews, topographic maps, remote sensing and GIS

PAR estimated at >1 but <10. Use 9 for calculation

STEP 6: Apply Empirically-Based Equations or Method for Estimating the Number of Fatalities

LOSS OF LIFE ESTIMATING EQUATIONS

Option 1 - Brown and Graham, 1988. Assessing Threat to Life from Dam Failure

Option 2 - DeKay and McClelland, 1993. Predicting Loss of Life in Cases of Dam Failures and Flash Floods

Equations did not include some types of events and warning, larger structures, earthquakes, or events that caused severe flooding

THEREFORE USE:

FLOOD SEVERITY BASED METHOD FOR ESTIMATING LIFE LOSS

Recommended fatality rates based on flood severity, amount of warning and a measure of whether people understand the severity of the flooding.

	Flood severity categories	
1	Low	Occurs when no buildings are washed off
2	Medium	Occurs when homes are destroyed but trees or mangled homes remain for people to seek refuge in or on
3	High	Occurs when the flood sweeps the area clean and nothing remains. Use for locations flooded by the near instantaneous failure of concrete dam, OR an earthfill dam that turns into "jello" and goes out in seconds rather than minutes or

In determining whether flooding is low severity or medium severity:
Use low severity if most structures will be exposed to depths of less than 10 feet (3m) and medium severity if most of the structures will be exposed to depths of 10 feet (3 m) or more. (Note that low severity flooding can be quite deadly to people attempting to drive vehicles).

OR calculate DV (d^2/s or depth x velocity) = Representative of general level of destructiveness

$$DV = \frac{Q_{df} - Q_{2.33}}{W_{df}}$$

And:

Q_{df} is the discharge at a particular site caused by dam failure.

$Q_{2.33}$ is the mean annual discharge at the same site. This discharge can be easily estimated and it is an indicator of the safe channel capacity. As discharges increase above this value, there is a greater chance that it will cause overbank flooding.

W_{df} is the maximum width of flooding caused by dam failure at the same site.

Low flood severity should be assumed when DV is less than 50 ft^2/s (4.6 m^2/s). Medium flood severity should be assumed, in general, when DV is more than this value.

	Warning time categories	
1	None	No warning issued by media/official sources in area prior to flood water arrival; only sight / sound of approaching
2	Some	Officials/media begin warning in area 15 - 60 minutes before flood water arrival. Some people will learn of flooding indirectly when contacted by friends, neighbors or relatives.
3	Adequate	Officials/media begin warning in area more than 60 minutes before flood water arrives. Some people will learn of the flooding indirectly when contacted by friends, neighbors or relatives.

	Flood severity understanding	
1	Vague	Warning issuers have not yet seen an actual dam failure or do not comprehend the true magnitude of the flooding
2	Precise	Warning issuers have an excellent understanding of the flooding due to observations of the flooding made by themselves or others.
		Assumed staff are well trained and monitoring system functions optimally.

Table 6
Fatality Rates Derived from Case Studies
(Use Table 7 for selecting fatality rates)

Flood Severity	Warning Time (minutes)	Flood Severity Understanding	Fatality Rate (Fraction of people at risk that died)	
			Average	Range
HIGH	no warning	not applicable	0.76	0.3 to 1.00
	15 to 60	vague	No case fit this category.	
		precise	No case fit this category.	
	more than 60	vague	No case fit this category.	
		precise	No case fit this category.	
MEDIUM	no warning	not applicable	0.14	0.02 to 0.43
	15 to 60	vague	0.014	only one case
		precise	0.01	only one case
	more than 60	vague	0.05	only one case
		precise	0.035	0.0 to 0.080
LOW	no warning	not applicable	0.007	0.0 to 0.025
	15 to 60	vague	0.0095	0.007 to 0.012
		precise	0.0	only one case
	more than 60	vague	No case fit this category	
		precise	0.0003	0.0 to .002

Table 7
Recommended Fatality Rates for Estimating Loss of Life Resulting from Dam Failure

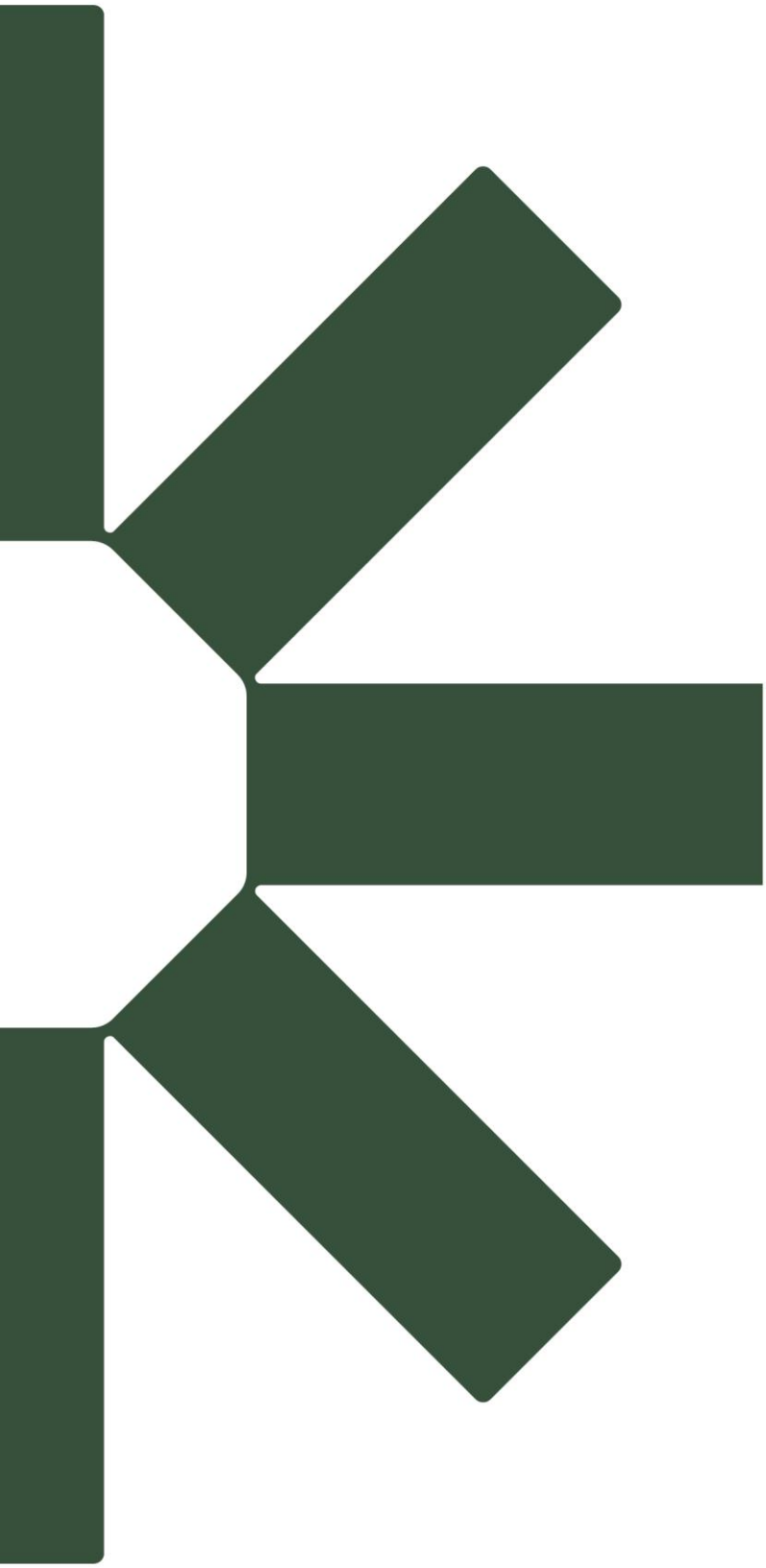
Flood Severity	Warning Time (minutes)	Flood Severity Understanding	Fatality Rate (Fraction of people at risk expected to die)	
			Suggested	Suggested Range
HIGH	no warning	not applicable	0.75	0.30 to 1.00
	15 to 60	vague	Use the values shown above and apply to the number of people who remain in the dam failure floodplain after warnings are issued. No guidance is provided on how many people will remain in the floodplain.	
		precise		
	more than 60	vague		
		precise		
MEDIUM	no warning	not applicable	0.15	0.03 to 0.35
	15 to 60	vague	0.04	0.01 to 0.08
		precise	0.02	0.005 to 0.04
	more than 60	vague	0.03	0.005 to 0.06
		precise	0.01	0.002 to 0.02
LOW	no warning	not applicable	0.01	0.0 to 0.02
	15 to 60	vague	0.007	0.0 to 0.015
		precise	0.002	0.0 to 0.004
	more than 60	vague	0.0003	0.0 to 0.0006
		precise	0.0002	0.0 to 0.0004

STEP 7: Evaluate Uncertainty

Types of uncertainty and evaluation suggestions:

1 Cause of dam failure
Develop separate loss of life estimates for each failure cause of interest
2 Time of day, time of week and time of year that failure occurs
Develop separate loss of life estimates for various possible combinations
2 When warnings would be initiated -
Vary assumption
3 Inability to precisely determine fatality rate
Use range of fatalities in Table 7
When flooding falls between two categories (e.g. medium or low severity) loss of life estimates can be developed using fatality rate and range of rates from all categories touched by the event and
Events in Table 5 can be evaluated to see if there are any that closely match the situation at the DREA

Fatality Rate	0.01
Population at Risk (PAR)	9
Potential loss of life (PLL)	0.0900



Making Sustainability Happen

APPENDIX B – NRP MARINE MANAGEMENT PLAN

MARINE MANAGEMENT PLAN

Nathan River Project

Bing Bong Loading Facility

TABLE OF CONTENTS

Figures

Tables

1 INTRODUCTION

1.1 Background

NRR Services Pty Ltd (NRR) operates an iron ore mine in the Roper Region of the Northern Territory known as the Nathan River Project (NRP). The NRP is located approximately 530 kilometres (km) southeast of Darwin within the Gulf of Carpentaria and is comprised of three main operation domains: the mine, the haul road and the Bing Bong Loading Facility (BBLF). The mine is located within mining leases (ML) 28962, 28267, 28266, 28963 and 28264. The haul road, privately owned and operated by NRR, stretches for 171 km, connecting the mine and the BBLF allowing the haulage of material to the BBLF. The BBLF is situated within ML 29628, located on the south-western coast of Gulf of Carpentaria approximately 50 km north of Borroloola. Glencore's McArthur River Mine (MRM) operates a larger loading facility at the BBLF and is the overarching controller of the Port. The regional location of the NRP is presented in **Figure 1-1**.

The previous operator, WDR commenced mine construction and operations in 2013 following the approval of the Roper Bar Iron Ore Project (RBIOP) Environmental Impact Statement (EIS) under the previous *Environmental Assessment Act*. Upon acquiring the RBIOM, NRR submitted a Mining Management Plan (MMP) in accordance with the *Mining Management Act 2001,* receiving approval in the form of mining authorisation 1062 to commence operations in 2020.

NRR currently operates the NRP under the approved Variation of Authorisation 1062-01 granted in October 2023 which authorises the recommencement of mining, haulage and shipping operations across the three domains of the NRP

1.2 Objectives

The objectives of this Marine Management Plan (MaMP) are to:

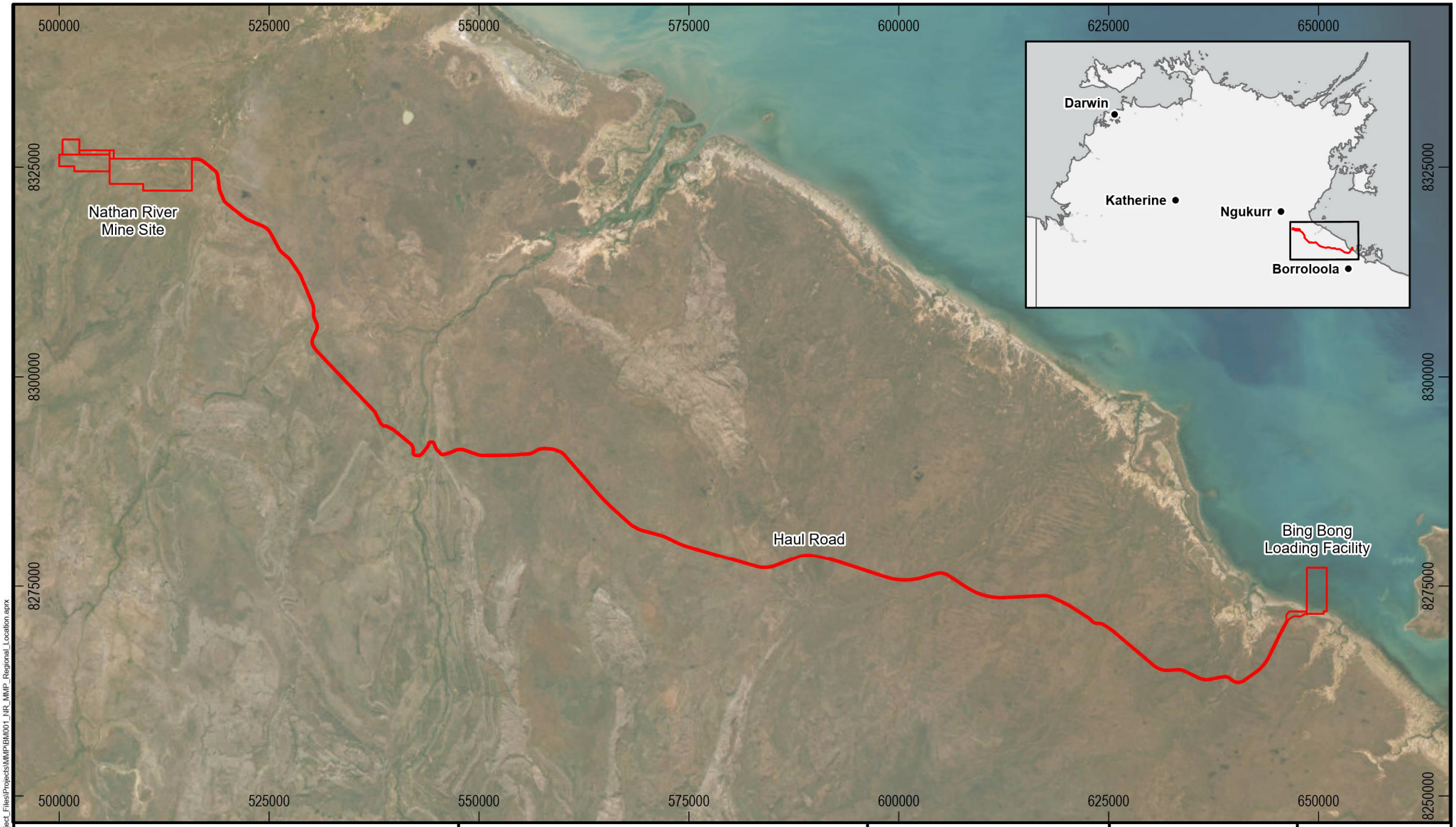
- Protect the terrestrial and marine environment from operations at the BBLF;
- Demonstrate consideration of potential impacts to the terrestrial and marine environment values of the BBLF and surrounds associated with shipping and barge activity;
- Provide practical and achievable monitoring programs to ensure early detection of potential impacts, providing effective management and mitigation measures and inform future plans;
- Communicate environmental protection requirements to all personnel involved in undertaking the proposed activities; and
- Provide regulatory authorities with a basis to confirm compliance with environmental policies and monitoring conditions.

1.3 Location and surrounding land use

The mine area is situated within NT Portion 819 which is the former St Vidgeon Pastoral Lease. Adjacent to the mine is the Limmen National Park. The Haul Road crosses four land tenures including the Limmen National Park, Lorella Springs Station, Wurrunburru Association and McArthur River Station. **Table 1-1** details the surrounding land uses.

Table 1-1 NRP Surrounding land use

Name	Tenure Type
Lorella Springs Station NT Portion 1333	Pastoral Lease
NT Portion 2432	Crown Lease in Perpetuity
McArthur River Station NT Portion 4319	Perpetual Pastoral Lease
Wurrunburra Association Incorporated	Crown Lease Perpetual
Limmen National Park	Reserve



Legend

Tenement Boundaries

Source: Geoscience Australia 2006, Northern Territory Government (Department of Industry, Tourism and Trade) 2022, Nathan River Resources 2018-2020, METServe 2023, Earthstar Geographics.

Nathan River Project

Regional Location

0 5 10 20

Kilometers

Scale: 1:640,000 (A4)

14/06/2023

Datum: GDA2020
Projection: MGA53

FIGURE 1-1

METSERVE
Mining & Energy Technical Services Pty Ltd

Path: S:\Projects\BM001 Nathan River\ArcGIS\Project_Files\Projects\MMP\BM001_NR_MMP_Regional_Location.aprx

1.4 Scope and overview

This MaMP has been developed in response to Recommendation 10 of NT EPA's Assessment Report 70, and is designed to manage potential risks to marine megafauna (including the dugong, sea turtle and dolphin) during ore transport activities associated with the operation of the BBLF. In developing this MaMP, NRR has also taken into consideration the relevant Commonwealth EPBC Approval conditions relating to the operation of the BBLF including marine vessel speed restrictions and regulatory reporting requirements in the event of any injury to, or mortality of, marine fauna.

This MaMP provides information about the ecology of the dugong, sea turtles and dolphins, identifies the potential impacts that may occur in the context of the operation of the BBLF and proposes management and monitoring strategies to mitigate the potential impacts identified. This MaMP has been developed as a supporting document to the 2024-2028 Mining Management Plan (MMP) and forms part of NRR's overall Environmental Management System (EMS).

1.5 Previous work completed

A number of previous BBLF marine risk assessments have been undertaken by the original proponent (Western Desert Resources (WDR)) including:

- Initial risk assessments as part of the 2012 Roper Bar Iron Ore Project Environmental Impact Statement (EIS);
- A series of subsequent BBLF marine risk workshops (conducted in 2013), which included a more detailed identification and assessment of the BBLF's marine risks;
- Refer to Section 10 and 11 below for a summary of the 2013 marine risk assessment work including risk identification and assessment outcomes, and proposed management, mitigation and monitoring controls. Note that this 2013 assessment was based on an expanded Project scope compared to that proposed by NRR in the 2024 MMP;
- BBLF construction-related risks, whereas NRR risks will be related to operational activities only; and
- An operational intensity of up to 3 million tonnes per annum (Mtpa) of direct-shipping ore (DSO) being barged/shipped from the BBLF, whereas NRR's proposed barging/shipping intensity will be a nominated 1 Mt over the period of the MMP which is one half to one third the intensity of the activities that the WDR risk assessment assessed.

2 LEGISLATIVE AND POLICY REQUIREMENTS

The Commonwealth and Northern Territory legislative requirements applicable to the proposed dredging activities at BBLF are summarised in the sections below.

2.1 Commonwealth Legislation and Policies

The MaMP does not require referral to the Commonwealth under the *Environment Protection and Biodiversity Conservation Act* 2000 (EPBC Act) as the 'prior authorisation' provisions of section 43 of the EPBC Act apply. NRR does not consider the action to trigger a matter of national environmental significance.

2.2 Northern Territory Legislation

The key pieces of NT legislation applicable to the planned operations at BBLF are listed below in **Table 2-1**.

Table 2-1 NT legislation relevant to this MaMP

Legislation	Relevance to activities
NT Mining Management Act 2001	'Authorisation' for operation of the NRP is subject to annual revision and approval of an MMP. Activities not addressed in the MMP, including maintenance dredging, require separate approval from DITT. An MMP amendment will be submitted to DITT seeking approval for the proposed maintenance dredging activities, whereby this DMMP is a key component of the MMP amendment.
NT Water Act 1992	Under section 74 of the Water Act, a Waste Discharge License (WDL) is required to authorise the discharge of decant water from the spoil containment pond to the receiving environment. NRR has recently submitted an application for a WDL for the proposed dredging activity.
NT Territory Parks and Wildlife Conservation Act 1976	The TPWC Act lists flora and fauna of conservation significance in the Northern Territory. This MaMP aims to limit any potential impacts on protected species under this Act associated with operations at the BBLF.

2.3 NRR Environmental Compliance Requirements

As a condition of NRR's mining authorisation 1062-01 issued by DITT under the MM Act, there are two main annual plans/reports which are required to demonstrate compliance with environmental regulations/conditions of approval and commitment to continual improvement. These include:

- the Mining Management Plan (MMP) revision (if any); and
- the Environmental Mining Report (EMR).
-

The NRP operates under a broader Environmental Management System (EMS) (NRR 2024) that has been developed to provide a methodology for the environmental management of the NRP in accordance with its environmental policy, legal responsibilities, relevant guidelines and site-specific requirements.

The EMS has been created to identify environmental risks, establish performance measures and develop performance indicators for all aspects of the NRP. This also includes the design and implementation of monitoring and management programs. The EMS establishes the review, reporting and communication processes for the NRP, as they apply to both internal and to external stakeholders as well as administering authorities. This includes the reporting of incidents, registering of complaints and communicating of environmental management responsibilities to NRP employees, contractors and visitors. The NRP's General Managers are responsible for the implementation of all on site work programs under this policy and the EMS.

The overarching objectives of the NRP EMS include compliance with:

- All regulatory approval conditions including applicable DITT Authorisation and Commonwealth EPBC approval; and
- NRR's Environmental Policy (NRR 2024), which includes the intent of preventing negative impact on the environment and the community.

2.4 Agreements with McArthur River Mine (MRM)

NRR's shipping operations at the BBLF takes into consideration the other operator and overall controller of the port, Glencore's McArthur River Mining (MRM). Since the recommencement of shipping activities, NRR has developed a strong relationship with MRM, and operates under their direction should MRM be shipping at the same time as NRR. This strong relationship between the two port operators allows for safe and efficient shipping operations to occur at the BBLF. To continue to ensure safe shipping operations for both operators at the BBLF, maintenance dredging of the BBLF transhipment zone is required. The proposed maintenance dredging program will service both NRR and MRM shipping operations at the BBLF.

2.5 Guidelines and strategies

The following guidelines have been referenced in this Plan:

- ANZECC 2000 Guidelines for Aquatic Ecosystems (marine);
- ANZECC 2000 Interim Sediment Quality Guidelines;
- Handbook for Sediment Quality Assessment (Simpson and Batley 2016);
- Queensland Acid Sulfate Soil Technical Manual (Dear et al. 2014):
- Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013);
- Marine Dredging Guidelines (NT EPA 2023); and
- National Assessment Guidelines for Dredging, Commonwealth of Australia, Canberra 2009 (Australian Government 2009).

3 PURPOSE

The purpose of this MaMP is:

a) To comply with regulatory approval conditions including:

    - NT Mining Authorisation 1062-01;
    - Commonwealth EPBC Approval No. EPBC 2012/6242, and specifically:
        - Condition 19 – "To protect marine turtles, dugong (Dugong dugon) and in- shore dolphins, vessels must not exceed a speed of 6 knots, unless otherwise stated";
        - Condition 20 – "Within the dredged channel and swing basin of the Port of Bing Bong vessels must not exceed a speed of 4 knots"; and
        - Condition 21 – "Any injury to, or mortality of, marine turtles, dugong (Dugong dugon) or in-shore dolphins must be reported to the [Australian Government Minister for the Environment] within one business day".

b) To provide NRR with sufficient controls and management strategies to minimise any potential impacts to marine fauna environmental values as far as reasonably practicable; and

c) To comply with NRR's Environment Policy, which includes the intent of preventing negative impact on the environment and the community.

To achieve this, the MaMP has drawn on the findings of:

- The WDR Roper Bar Iron Ore Project EIS, which was approved by the NT Government in 2012; and
- The WDR Roper Bar Iron Ore Project BBLF Marine Risk Workshops, undertaken in 2013.

Further to the above, this MaMP provides a management framework including:

- Roles and responsibilities;
- Monitoring requirements; and
- Auditing and reporting requirements.

4 MANAGEMENT ROLES AND RESPONSIBILITIES

The number of employees working at the BBLF will vary according to the level of activity at the time, as follows:

- 20 land-based personnel during ship loading activities;
- Three tugs with six crew each (total of 18 personnel) during ship loading activities; and
- When there are no shop loading activities occurring the marine crew is demobilised plus a portion of the land-based crew, with approximately 10 employees reaming on the BBLF.

4.1 General Manager – Marine

A dedicated General Manager - Marine will be based on the site, reporting directly to the NRR CEO. The General Manager will be responsible for the implementation of the MaMP. To maximise the effective implementation of the MaMP, the General Manager will be responsible for:

- Providing resources and equipment to meet objectives;
- Initiating reviews of the MaMP when required;
- Reporting non-compliances;
- Reporting environmental incidents;
- Implementing monitoring plans;
- Maintaining site records; and
- Daily/monthly reporting.

The General Manager - Marine will also be responsible for identifying training needs so that all BBLF personnel receive an appropriate level of training to understand and implement the requirements of the MaMP. To achieve this, they will use a combination of training and communication tools including:

- Site induction: this will provide staff with an understanding of the environmental values of the site, the MaMP framework and a general overview of the objectives of the MaMP. The induction will provide staff with an understanding of their general environmental duty, incident reporting requirements and required standards of environmental performance;
- Toolbox talks: the toolbox talks will communicate specific aspects of the MaMP relevant to the activities being undertaken that day. They will inform the operational methodology and provide staff with appropriate management strategies to manage potential environmental impacts; and
- Reference hard copies of the MaMP available in the main office.

4.2 Personnel

All staff have a general environmental duty as outlined in Section 12 of the WMPC Act 1998. This means that all staff are responsible for the actions they take that affect the environment. Staff will be responsible for:

- Carrying out environmental management activities (including routine inspections) as directed by the General Manager – Marine;
- Routine vessel servicing and inspections;
- Observing and informing the General Manager – Marine regarding general environmental performance of the BBLF;
- Notifying the General Manager – Marine of any environmental incidents;
- Notifying the General Manager – Marine of any sightings of marine megafauna;
- Notifying the General Manager – Marine of any non-conformances; and
- Participating in induction processes and daily toolbox talks to build a suitable understanding of site environmental values.

5 ENVIRONMENTAL VALUES

The following sub-sections provide details on identified environmental values relating to marine megafauna. The identification of these values will enable NRR to develop specific:

- Management measures, with the objective of minimising any potential impacts to such values as far as reasonably practicable; and
- Monitoring measures, designed to monitor the effectiveness of the management measures in achieving the set objective.

5.1 Dugongs

The Dugong is listed as migratory under the EPBC Act and Near Threatened under the TPWC Act. Dugongs are large marine mammals that forage as individuals or pairs on seagrasses. They inhabit sheltered coastal waters and estuaries where seagrasses form extensive colonies. Shallow waters, such as sand banks and estuaries are used for calving.

Dugongs are highly mobile and move constantly in a search of seagrass beds and warm waters (Marsh et al. 2002). They move daily with the tides and can execute long migrations (100-600 km) in response to seasonal conditions (Gales et al. 2004; Marsh et al. 2002). Such migrations are more common in southern waters, where cool sea temperatures may make shallow waters less favourable for Dugongs in winter. In contrast to southern populations, Dugongs in the Gulf of Carpentaria do not exhibit major seasonal changes in distribution or abundance (Bayliss and Freeland 1989). Dugongs tend to move on from anyone foraging area after five or six days, when 30% of the area has been grazed (Anderson and Birtles 1978).

Potential seagrass beds are mapped surrounding the BBLF; therefore, it is possible for the species to be affected by activities associated with the BBLF.

5.2 Marine Turtles

Six species of marine turtle inhabit the oceans and coastlines of northern Australia. These species vary in their habitat requirements, ranging from shallow coastal waters with sandy floors to coral reefs, seagrass beds and open and pelagic waters. Shallow, protected waters along coastlines with soft, sandy floors are used as shelter by all species and unimpeded access to suitable sandy beaches with limited or no light exposure is required for successful nesting. Islands off the coast of the Northern Territory are known to be important breeding and nesting sites for some species.

The six turtle species' status classification under the EPBC Act and TPWC Act are as follows:

- Loggerhead (*Caretta caretta*) - Endangered (EPBC Act) and Vulnerable (TPWC Act);
- Olive Ridley (*Lepidochelys olivacea*) - Endangered (EPBC Act) and Vulnerable (TPWC Act);
- Green Turtle (*Chelonia mydas*) - Vulnerable (EPBC Act) and Near Threatened (TPWC Act);
- Hawksbill (*Eretmochelys imbricata*) - Vulnerable (EPBC Act) and Vulnerable (TPWC Act);
- Flatback (*Natator depressus*) - Vulnerable (EPBC Act) and "Data Deficient" (TPWC Act); and
- Leatherback (*Dermochelys coriacea*) - Endangered (EPBC Act) and Critically Endangered (TPWC Act).

A National Turtle Nesting Area is located on West Island approximately 10 km east of the BBLF; however, operations at the BBLF are unlikely to impact this area.

5.3 Dolphins

Coastal waters in northern Australia support ten species of dolphins:

- Australian Humpback Dolphin (*Sousa sahulensis*) - Migratory (EPBC Act) and Data Deficient (TPWC Act);
- Bottlenose Dolphin (*Tursiops truncatus*) – Least Concern (TPWC Act);
- Spotted Bottlenose Dolphin (*Tursiops aduncus*) – Least Concern (TPWC Act);
- Australian Snubfin Dolphin (*Orcaella heinsohni*) – Migratory (EPBC Act) and Data Deficient (TPWC Act);
- Killer Whale (*Orcinus orca*) – Migratory (EPBC Act) and Data Deficient (TPWC Act);
- False Killer Whale (*Pseudoica crassidens*) – Data Deficient (TPWC Act);
- Risso's Dolphin (*Grampus griseus*) – Data Deficient (TPWC Act);
- Spotted Dolphin (*Stenella attenuata*) – Data Deficient (TPWC Act);
- Spinner Dolphin (*Stenella longirostris*) – Migratory (EPBC Act) and Data Deficient (TPWC Act); and
- Melon-headed Whale (*Peponocephala electra*) - Data Deficient (TPWC Act).

Habitats vary between species but may include open water, estuaries and shallow coastal waters around offshore islands and the mainland. Australian Humpback Dolphins, Bottlenose Dolphins and Australian Snubfin Dolphins frequently utilise waters within 20 km of the coast and are the most likely cetaceans to be affected by the project. All the ten species are protected as cetaceans under the EPBC Act, and four are further protected as migratory species under the EPBC Act. Most of these species of dolphins are listed as Data Deficient under the TPWC Act.

6 RISK IDENTIFICATION AND ASSESSMENT

6.1 Overview

A series of specialist panel marine risk workshops was conducted in 2013 by the original Project proponent (WDR). These workshops were held in Darwin and drew on the initial findings of the Roper Bar Iron Ore Project EIS as well as the knowledge and experience of the workshop participants. These participants comprised a cross-section of marine specialists from several organisations including:

- NT Environment Protection Authority;
- James Cook University;
- Charles Darwin University;
- NT Department of Land and Resource Management;
- Western Australia Department of Environment and Conservation;
- Monoora Marine Consultants; and
- GHD Consultants.

The workshops reviewed the original marine risks as identified in the EIS and further developed the BBLF marine risk profile including identifying and assessing specific construction- and operations- phase risks as well as documenting management and monitoring measures in order to reduce the risks to acceptable levels.

As mentioned in **Section 1.4**, this 2013 assessment was based on a larger NRP scope than that proposed by NRR in the superseded 2019 MMP or the 2024 MMP and included consideration of:

- BBLF construction-related risks, whereas NRR risks will be related to operational activities only; and
- An operational intensity of up to 3 Mtpa of DSO being barged/shipped from the BBLF, whereas NRR's proposed barging/shipping intensity will be a nominated 1-1.5 Mtpa over the period of the MMP which is significantly less than the intensity of the activities (including barge trips) that the WDR risk assessment assessed.

6.2 Risk Identification

Risk is defined as the combined likelihood and consequence of a hazard occurring. Therefore, the first step in the risk assessment process was to identify the hazards that could potentially impact on marine species.

Eight such hazards were identified, either through degradation of habitat quality or via direct species impacts. These included:

- Reduced water and sediment quality;
- Direct mortality from marine vessel strikes;
- Acoustic pollution and disturbance;
- Introduction of invasive marine species;
- Introduction of rubbish/waste
- Light pollution;
- Exclusion from access to important habitat during critical life history stages; and
- Disease and loss of fitness.

6.3 Risk Assessment

The risk assessment process was conducted in accordance with standard risk assessment and management methodologies including:

- AS/NZS ISO 31000:2009: Risk management - Principles and Guidelines (Standard);
- HB 203:2006: Environmental risk management - Principles and process (Guide); and
- HB 158:2010: Delivering assurance based on ISO 31000:2009 - Risk management - Principles and Guidelines (Guide).

6.3.1 Risk Framework

Each of the eight hazards identified in **Section 6.2** above was analysed for likelihood and consequence and a risk ranking was developed for the inherent value. The risk ratings matrix, and the definitions of likelihood and consequences are described in **Section 6.3.1.1**, **6.3.1.2** and **6.3.1.3**, respectively.

6.3.1.1 Risk ratings matrix

The following risk ratings matrix was adopted:

Table 6-1 Risk matrix

		Consequence				
		1	2	3	4	5
Likelihood	A	1	3	6	10	15
	B	2	5	9	14	19
	C	4	8	13	18	22
	D	7	12	17	21	24
	E	11	18	20	23	25

Red = Extreme risk (Intolerable), Orange = High risk (Intolerable or tolerable), Yellow = Medium risk (Tolerable or acceptable), Green = Low risk (Acceptable)

6.3.1.2 Likelihood

The likelihood criteria framework used for this plan is summarised below in **Table 6-2**.

Table 6-2 Likelihood criteria

Likelihood definitions			% likelihood associated with scale
A	Rare	Practically impossible, will only occur in exceptional circumstances. Has never occurred in the industry.	0-1
B	Unlikely	Could occur at some time but highly unlikely. Has occurred in the industry previously.	2-10
C	Moderate	Might occur at some time. Has occurred previously in other companies associated with the same industry.	11-50
D	Likely	Known to occur or will probably occur in most circumstances. Has occurred several times/year in other companies associated with the same industry.	51-90
E	Almost Certain	Common or repeating occurrence. Is expected to occur several times/year in other companies associated with the same industry.	91-100

6.3.1.3 Consequence ratings

Consequence definitions used to determine risk are summarised below in **Table 6-3**. It should be noted that these include environment, health and safety (to people) and financial consequence definitions. Some of the health and safety and financial definitions below may not be directly applicable to marine fauna.

Table 6-3 Consequence Criteria

Consequence		
1	Insignificant	• No measurable impact on the environment. • No injuries. • Low-nil financial loss.
2	Minor	• Minor, temporary environmental impact. • No publicity likely and no stakeholder concerns. • First aid treatment required. • Medium-low financial loss.
3	Moderate	• Substantial temporary or permanent minor, localised environmental damage. • Stakeholder enquires (this may include government, unions or public). • Medical attention required. High-medium financial loss.
4	Major	• Substantial or permanent environmental damage. • Prosecution possible. • Loss of company credibility and high stakeholder interest. • Permanent injuries. High financial loss.
5	Catastrophic	• Widespread severe and permanent Environmental damage. • Major stakeholder and media interest. Prosecution likely. • Permanent injury or death. Extreme financial loss.

6.3.2 Risk Rating Outcomes

Table 6-4 summarises the outcomes of the risk assessment process (as it applies to marine biodiversity) for operational activities at the BBLF. As mentioned in **Section 9.1**, this assessment was based on a larger Project scope than that proposed by NRR in the superseded 2019 MMP or the 2024 MMP. Therefore, the below risk scores could be considered conservative (i.e., elevated compared to NRR's proposed scale of activity).

Table 6-4 Risk assessment

Potential hazard/impact	Description	Inherent risk/score	Management measures	Residual risk
Reduced water and sediment quality (through sediment disturbance and increased turbidity, and fugitive ore and dust)	**Disturbed sediment** may temporarily increase turbidity. Shipping activity and movement or removal of anchorages and cyclone moorings may result in seabed disturbance. **Spilling of Direct Shipping Ore (DSO)** material or dust during barge loading or transhipping, or during an accident or equipment failure may impact the marine environment through increased sedimentation and smothering. The iron ore itself is not toxic to marine organisms in most circumstances, however dissolved iron in water could theoretically result in algae bloom and seagrass loss.	13	**Disturbed Sediment:** Vessels will move at low speeds (4 to 6 knots) during operations, especially in areas where increased sediment disturbance is most likely to occur (i.e., shallow depths of the swing basin and navigation channel). Sediment disturbance from anchorages and cyclone moorings will be minor and temporary during operations and do not require additional mitigation measures. **Direct Shipping Ore (DSO) Spills:** Incidents are unlikely if the correct dust controls, and other procedural controls, are followed during normal operations. These include: • Dust control measures in accordance with Dust Management Plan. • Pre-conditioning materials to the Dust Extinction Moisture Level prior to loading. • Conveyer transfers, long reclaim and overland conveyers to be partially enclosed. • Regular maintenance and testing of equipment. • Standard operating procedures and training to be employed, including visual inspections in barge loading areas and transhipment anchorages with remediation measures implemented as required. • Cleanup procedures will be established and enforced. Spillage containment to be achieved through complete enclosure of the overland and barge loading conveyors, which will be designed and constructed to relevant Australian Standards and best practice to pull away under a blocked chute and loaded condition. • Transfer stations and the barge loading and refuelling area will be fully enclosed and sheeted, with floors of transfer stations fully sealed and bunded. During heavy rain/high wind events the loading of the barges will cease until conditions improve. • Slurry will not be released into receiving waters as all reclaim conveyors, where practicable, will be covered to prevent collection of rainwater build up inside the conveyor; transport barges will have open decks that are sealed and bunded with runoff and rainwater collected in a series of sumps and, when berthed, any water and slurry collected will be piped back to the transfer station sump, then on to the Stockyard to the collection ponds. Stormwater from the stockpile area will also be contained by a perimeter bund and directed through open drains and sediment traps, then settlement and collection ponds (designed for a 1 in 10-year event). Water will be reused in the Stockyard for ore conditioning and dust control.	2

Potential hazard/impact	Description	Inherent risk/score	Management measures	Residual risk
Direct mortality from marine vessel strikes	There is a potential for increased incidence of boat strikes on marine megafauna, notably turtles, dugong and cetaceans given the cumulative shipping operations between both operators at the BBLF. NRR's shipping operation requires multiple trips over the life of the project, transporting iron ore from the loading facility to Ocean Going Vessels (OGVs) moored approximately 20km offshore, and then to market. Boat speed is considered to be the causative factor influencing the outcome of boat strikes to marine mammals, and as with any vehicle collision, the higher the speed, the less chance the animal has to take evasive or avoidance action. Risk of boat strike is also thought to be correlated with the density of vessels, with vessel size and bathymetry also influencing the level of risk. Any increases in injury or mortality would potentially be expected within the access channel and transit routes as vessel activity will be concentrated within these designated areas. In deeper open waters outside of the access channel and at the transhipment anchorages, the probability of boat strike is reduced as animals are less likely to be crushed between the boat and the substrate; however individuals may still be struck when surfacing to breathe. Overall however, given the large size and slow speeds associated with project vessels, the risk is considered to be low.	13	• Pre-determined transport routes will be adhered to. • A mandatory speed restriction of 4 knots will be in place inside the channel and swing basin. The OGVs associated with transport of the product offshore are also expected to be large and slow, reducing the overall threat of vessels striking and injuring cetaceans or marine mammals. No important habitat areas are known to occur within the proposed route to the transhipment anchorages, therefore reduction of boat speeds external to the entrance channel and basin (which are already slow at 4 knots) is not considered necessary. • Barge crew/s to observe area for marine megafauna prior to barge leaving the BBLF and during its voyage to and from the bulk vessel. If marine megafauna are sighted, barge will slow down to 4 knots (if empty) within 50 m of the animal. If the animal is moving within 50 m of the vessel, the vessel will slow down to 4 knots until animal has moved beyond 50 m. • Personnel aboard all vessels will be responsible for remaining vigilant and avoiding cetaceans, dugong and turtles. Barges and OGVs carrying iron ore are slow moving vessels, which have lower potential risk of boat strike to marine fauna than faster moving vessels. • The workforce is to be educated on the importance of compliance with speed restrictions and the need to be vigilant whilst operating vessels, to reduce the potential for negative vessel/fauna interactions. • All incidents of boat strike and associated injury/mortality are to be maintained in a register and reported to the Parks and Wildlife Commission of the NT. Drivers of all marine vessels are to remain alert to marine megafauna and document all sightings with the Marine Superintendent. • Small vessels to be fitted with propeller guards where possible. • 10% under keel clearance.	7
Acoustic pollution and disturbance	Sound and vibration from operations can impact on marine fauna behaviour, in ways specific to different marine species. Sources include large vessels producing low frequency sounds. The OGVs, barges and	18	• A 'go-slow' zone (4 knots) will be in place for the access channel and swing basin. • Vessels are to avoid interactions with marine mammals where possible – noting the limitations imposed by the lack of manoeuvrability of barges. • Equipment is to be maintained onsite to ensure efficient operation and eliminate unnecessary noise.	8

Potential hazard/impact	Description	Inherent risk/score	Management measures	Residual risk
	supply vessels will be the most significant sound sources and are all expected to be in the range of 180-190dB (re 1µPa), and tug boats in the range of 145-171dB when operational at the source level (as opposed to the received level, which is the level experienced by the organism of interest). High levels of background noise may also reduce the ability of marine fauna to detect oncoming vessels, with speed also documented as influencing the ability of animals to detect approaching vessels (see ***Direct mortality from marine vessel strikes*** above). Noise disturbances can lead to local habitat displacement and a temporary threshold shift in hearing, including a loss of awareness.		• Machinery is to be used correctly (e.g., the correct ore fraction is to be used during processing).	
Introduction of invasive marine species and disease	Barges, OGVs and other vessels have the potential to introduce marine pests and disease through fouling of ship's hulls or ballast water. The introduction of marine pests can result in ecological effects including competition with native species, predation, parasitisation, and through disruption of trophic pathways. Other impacts can include the extension of a pest species range, including to other Australian Ports, and impacts upon local fisheries.	12	Ships from International ports are currently required to exchange ballast water outside of Australia's territorial sea under the *Biosecurity Act 2015* which is believed to be somewhat effective in preventing outbreaks in coastal areas. It will be a mandatory requirement that all ships comply with federal quarantine and biosecurity measures with respect to the management of ballast water. Any vessels originating from foreign ports will be subject to best practice Quarantine Management to ensure the continued protection of Australia's native flora and fauna from introduced pest species and diseases. Where vessels are from outside of Australia, a hull inspection is required, and vessels that have been outside of Australian waters in the previous 12 months may also necessitate inspection. Improved methods that treat ballast water to destroy entrained organisms will be adopted in accordance with best practice and current legislation. Monitoring for invasive/pest marine species is to form a part of mitigation measures.	7
Introduction of rubbish/waste	• **Hydrocarbon spills** (diesel fuel and other engine/vessel oils) may occur during refuelling and barge/support vessel loading and unloading procedures at both the BBLF and at sea. This may also occur in a worst-case scenario of equipment failure,	12	**Hydrocarbon Spills:** • Fuel will be stored at the barge facility (2 x 45,000 L). These are self-bunded and 30 metres from the tug wharf. Transfer stations and refuelling area will be fully enclosed and sheeted, with floors of transfer stations fully sealed and bunded. • Visual inspection of berth decks for cracks or seal damage will be undertaken routinely.	5

Potential hazard/impact	Description	Inherent risk/score	Management measures	Residual risk
	grounding, or collision. A significant release event may result in impacts on water quality and marine fauna, including (but not limited to) marine megafauna and other vertebrates. • **Marine debris**, including solid materials such as rubbish and waste, may enter the marine environment as a result of poor housekeeping in the Port and Stockyard Facility, and from vessels transiting the access channel and transit routes. Rubbish may be blown off-site and into surrounding waters during strong winds and cyclone conditions, or deliberately dumped from ships. The presence of marine debris may result in localised habitat degradation and fauna mortality through entanglement and ingestion. • **Sewage** discharge from vessels can result in reductions of local water quality, and increased nutrient and pathogen loads. This can promote epiphytic algae (impacting seagrass and macroalgal communities) and increase in disease. These impacts are particularly pronounced in poorly flushes areas, i.e., bays and lagoons.		• The fuel pipeline will have an automatic cut-off valve to prevent large spills, however it is acknowledged that small spills may occur infrequently. No refuelling will be undertaken during inclement weather conditions to minimise the chance of a spill. • Standard operating procedures including appropriate training, visual monitoring of hoses and the sea surface, initial shutdown, and spill response procedures will be implemented. • An emergency management plan has been developed and equipment supplied to deal with any spill that occurs and this will further detail how offshore and inshore spill risks will be minimised. This will describe the fuel handling and storage procedures in greater detail and will include specifications for oil spill kits including booms and absorption materials on board barges and tugs at all times. • The transport, storage, recycling and disposal of any hydrocarbon waste, and regular servicing and inspection of vessels and machinery to identify and address any leaks, will be addressed in standard operating procedures. • Twice daily servicing and inspection of vessels and machinery will identify and address any leaks or other problems. **Marine Debris:** • Waste management and storage controls have been outlined in Waste Management Plan and will be implemented during operations. • A regular litter collection program (targeting anthropogenic items) will be undertaken within the area of the BBLF and Stockyard area. • Signage and rubbish bins targeted at recreational fishers in the area will be put in place. • Cyclone procedures are to be detailed as part of the Emergency Management Plan prepared for the site, to ensure that no waste or other materials enter the marine environment during heavy storms or cyclones. **Sewage Discharge:** All sewage waste from the barges and support vessels will be stored at the BBLF until it is disposed of by a third-party contractor at an appropriate off-site facility. Sewage disposal in coastal areas which may cause serious environmental harm are prohibited under the *Marine Pollution Act 1999*, and all legislative requirements will be complied with in full.	

Potential hazard/impact	Description	Inherent risk/score	Management measures	Residual risk
Light pollution	Lighting of the BBLF and ancillary structures has the potential to disrupt critical behaviours of adult female nesting turtles and hatchlings, such as nest selection and sea-finding behaviour, through disorientation from bright light sources. The likely consequences are an increased rate of hatchling mortality and reduced nesting rates. Nesting or roosting seabirds and shorebirds may also become disoriented from bright lights associated with lighting of coastal and marine infrastructure. Less documented are impacts of light pollution associated with shipping. Shipping is likely to increase greatly in volume and where ships are anchored (i.e. the transhipping anchorage points) anecdotal evidence suggests that hatchlings are drawn to the lights of anchored vessels (DSEWPC 2011d). Hatchlings may become trapped along the hulls, subsequently exposing them to higher rates of predation.	18	Turtle nesting is not thought to be occurring adjacent to or within close proximity to the loading facility, however, cumulative light emissions may still serve to disorientate nesting females, as well as acting as a form of habitat degradation to nesting beaches in the nearby Sir Pellew Island group. Consequently, in order to minimise cumulative light emissions from the BBLF, the following measures will apply: • Mooring buoys will be located over the horizon from any turtle nesting sites. Consideration will be given to fitting buys with radar and light reflectors. • Light intensity is to be reduced from a nominal range of three nautical miles to one nautical mile. • Light flashing frequency is to be reduced. • Use of orange and red lights, or yellow low pressure sodium vapour lamps for external lighting of buildings. • Where white and other lights are required, install shades or modify light orientation to minimise light spill; • Position lights low to the ground wherever possible; and • Use reflective tape to reduce the amount of ambient light required. • Consideration will be given to the positioning and lighting of cyclone moorings. The use of orange and red lights or preferably reflective tape is to be utilised in preference of white lights.	7

7 REPORTING

Reporting will consist of both internal and external reports. Internal reports will make up the majority of the reporting requirements and include daily and monthly reporting. External reports will be required as a condition of approval at the specific request of a key stakeholder or after a notifiable environmental incident.

7.1 Required Reports

7.1.1 Marine Fauna Sighting Logbook

All staff have a responsibility to report sightings of marine megafauna (dugongs, turtles and dolphins). These sightings are to be entered into a Marine Fauna Sighting Logbook, which has a format as shown in **Table 7-1**.

Table 7-1 Template for marine fauna sighting logbook

Date	Time	GPS Location	Species	No.	Actions taken to avoid collision	Was there an incident? (Y / N) *

*In the event of an incident, an Incident Report is to be prepared by the General Manager – Marine.

All columns of the logbook must be filled in for each fauna sighting. If the species is not known, identify to group (turtle, dugong and/or dolphin) or genus where possible. The sighting must be entered by the observer before the end of the work shift during which the sighting was made. The General Manager – Marine is responsible for entering the contents of the logbook into a digital version on at least a monthly basis.

7.1.2 Incident reports

In the event of an injury or death of marine megafauna, the General Manager – Marine is to be informed immediately. An incident report is to be prepared by the General Manager – Marine, in consultation with staff members involved in the incident. This report is to include the same details as are to be entered into the Marine Fauna Sighting Logbook, in addition to further details about the nature of the incident, the actions taken in an attempt to avoid the incident, and possible actions that could be taken in the future to avoid other such incidents.

The General Manager – Marine is to prepare the Incident Report on the day the incident occurred and, within 24 hours of the incident, inform the relevant NT departments. This will be undertaken in accordance with NRR's incident reporting process, as described in the NRP's EMS.

7.1.3 Non-compliance Reports

Non-conformance incidents will be documented in accordance with NRR's Incident Reporting Procedure and is further described in the NRP's EMS.

7.1.4 MaMP Audit Report

Audits of this MaMP will be undertaken annually or in accordance with specific regulatory approval conditions. Outcomes of the audit will be provided in the annual Environmental Mining Report.

7.2 Document Control

NRR have a document control system for the implementation of the MaMP during the operation of the BBLF and the trans-shipment. This MaMP and the Marine Fauna Sighting Logbook template are to be managed by senior NRR management. No other staff are authorised to make changes to these documents. Hard copies of the MaMP will be kept onsite. It is the responsibility of the General Manager – Marine to ensure that the latest version is being implemented.

8 ENVIRONMENTAL TRAINING

Environmental training will be facilitated through site inductions and toolbox talks. The site induction will be provided to all staff and include the following:

- Identification of site environmental values;
- An understanding of the requirements of this MaMP;
- Roles and responsibilities of site personnel;
- Environmental emergency response procedures;
- Site environmental controls;
- Environmental incident identification and response; and
- The potential consequences (for both NRR and individuals) of not meeting environmental obligations/responsibilities.

9 EMERGENCY CONTACTS AND PROCEDURES

Emergency contacts and procedures are found in the following NRR documents:

- Mining Management Plan;
- Environmental Management System;
- Emergency Management Plan; and
- Where required, specialist advice will be sought from recognised marine fauna specialists.

9.1 Animal Sightings

In the event that marine megafauna are sighted, the observer should:

- Record the time and location of the sighting;
- Take measures to avoid collision with the fauna; and
- Notify the General Manager – Marine.

The General Manager – Marine is then to enter details of the sighting into the Marine Fauna Sighting Logbook (see **Section 7.1.1**).

9.2 Animal Injuries and Mortalities

In the event that an animal is injured, tangled, dead or otherwise in need of assistance, the observer is to immediately notify the General Manager – Marine, and is to call the Northern Territory Marine Wildwatch hotline (1800 453 941) to seek advice on appropriate action. Under the guidance of the Marine Wildwatch experts, a rescue attempt may be deemed appropriate.

Following any emergency rescue attempts, the General Manager – Marine is to prepare an Incident Report in consultation with staff members involved in the incident (see **Section 5.1.2**). An incident report is to be prepared on the day the incident occurred and, within 24 hours of the incident, inform the relevant NT departments.

10 MONITORING

An extensive suite of management and mitigation measures are provided in **Section 6.3**. Some of these key controls, in terms of their likely effectiveness on managing the high inherent risks, medium residual risks and/or addressing multiple risk line items, include:

- Marine fauna observations;
- BBLF operating procedures (includes measures to manage water quality, light pollution and reporting of marine megafauna); and
- Vessel operating procedures (including speed restrictions and compliance with pre- determined transit routes).

Table 10-1 provides further details on key management measures, performance targets and monitoring programs to confirm such management measures are effective. In addition, corrective actions are identified in the event that monitoring programs indicate exceedance of a performance target.

Table 10-1 Management measures, performance targets and monitoring

Potential Impact	Performance Target	Monitoring Program	Corrective Action
Vessel strike on marine megafauna	No vessel strikes on marine megafauna.	Any vessel strikes or near misses are to be recorded by the Marine Superintendent in an Incident Report. All incidents are to be entered by the Marine Superintendent into an Incident Register.	• Any observed injuries or mortality of marine fauna as a result of a vessel strike will be reported to the relevant regulatory agencies (both NT and Commonwealth) within one day of the incident. • Data collected will inform the need for further controls of vessel movements.
Light pollution	No lighting to be visible from any sea turtle nesting sites.	In the unlikely event that any marine megafauna (including sea turtles) are observed on land during the course of operational activities, or the presence of tracks are observed in the vicinity of the loading area, this will be recorded in the Marine Fauna Sightings Logbook, and will trigger corrective actions.	Review of appropriate management plan(s).
Introduction of rubbish/waste and hydrocarbons	Compliance with Waste Management Plan, and other relevant procedures and management plans.	The Waste Management Plan will detail the checks and controls to be in place at the BBLF. It will also describe the triggers for corrective actions, should the Waste Management Plan not be adhered to.	• Corrective actions to be taken in the event of non-compliance with the relevant management plans and operating procedures.

Acoustic pollution and disturbance	Compliance with barge transit routes and speed restrictions	• GPS tracking of barge transit
		• routes.
		• Marine megafauna sighted during barge movements will be recorded in the species observation register. Information to be recorded will include:
		  ○ Species
		  ○ Date and time
		  ○ Approximate location
		  ○ Distance to barge
		  ○ Any corrective actions taken by barge to maintain a 20 m reduction
		• General description of animal's behaviour.
		• Failure of barge crew to adjust speed limits or maintain transit routes will trigger corrective actions.
			In the event that performance targets fail to be met, all staff will be re-educated on their responsibilities under the MMMP. Ongoing failure by certain persons to meet performance targets may trigger disciplinary actions based on NRR policies.

Invasive species and disease	Compliance with ballast water management regulatory requirements.	Routine inspections/auditing of shipping ballast water management procedures.	In the event of a ballast water management system failure, the operator must notify the Maritime National Coordination Centre as soon as they are aware of the failure, to seek the department's advice on contingency measures.
Loss of sediment and water quality	Compliance with Waste Management Plan, and	To focus on sources of potential pollution during operations including:	• Corrective actions are to be implemented in the event that inspections identify a failure to meet performance targets.

Potential Impact	Performance Target	Monitoring Program	Corrective Action
	other relevant procedures and management plans.	• Visual inspection of berth decks for cracks or seal damage will be undertaken routinely • Routine visual inspections to permit loads to be fully contained and avoid material spillage during loading, at both the loading facility and the transhipment anchorages • Twice daily inspection of vessels and machinery to identify and address any leaks or other problems; • Routine water quality monitoring program in accordance with NRR's Water management and Monitoring Plan. • Implementation of NRR Water Management and Monitoring Plan Annual audits to assess compliance with MMMP.	• An incident investigation will be undertaken and appropriate corrective actions documented. • Corrective actions will be appropriate to the size, nature and scale of the incident identified.

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APPENDIX C – NRP EMERGENCY MANAGEMENT PLAN

Nathan River Resources

EMERGENCY MANAGEMENT PLAN

Contents

1. INTRODUCTION

1.1 PURPOSE

The purpose of this plan is to provide site with information on how to respond to various emergency situations that could occur due to unwanted incidents during normal operations.

This document forms part of the NRR Crisis and Emergency Management system, which comprises plans, procedures, responsibilities, forms, checklists etc. necessary to effectively manage emergency situations at NRR projects.

1.2 SCOPE

This Emergency Response Plan (ERP) forms part of the Crisis and Emergency Management System of NRR and covers, as far as practicable, all major emergency events that may occur on or about any of NRR sites.

It is not the intention to provide specific procedures for every possible emergency event, but to provide a general course of action that will ensure a systematic and flexible approach to each event.

This plan applies to all NRR operations, personnel, contractors, visitors and assets associated with the NRR Projects.

The Accountable Manager is responsible for ensuring the Emergency Response Plan is up to date and maintained.

2. POTENTIAL EMERGENCY INCIDENTS

Site risk assessments are used to identify and assess possible emergency events across NRR Operations. This review identified events that could have a significant impact on NRR Operations.

Specific responses to these incidents were identified which would complement the preventive controls that form part of the NRR Occupational Health and Safety Program. These Emergency Response Plans describe the response to the potential critical incident/emergency situations identified from the completed risk assessments. Each of these plans discusses.

- The main “threats” associated with the incident;
- Potential alarms or methods to alert persons of an emergency;
- The management response required (i.e., who should be notified, what action should be taken);
- Any special instructions;
- Contact details for specialist advice;

Emergency Response Teams are a resource that may be deployed at the "front-line" to combat an emergency situation. Team personnel will have specific skills and knowledge in emergency response (e.g., firefighting, vehicle extrication, at heights rescue, hazardous chemicals response and first aid and patient management).

3. RESPONSE PLANS

An emergency is a situation which can rapidly escalate, and if not brought under control quickly may well result in major property/environmental damage, serious injury or death.

The person discovering an emergency is responsible for initiating the first level of the emergency procedures.

3.1 FIRE

A fire can occur at any location where fuel and ignition source exist.

3.1.1 MAIN RISKS

- Injury to employees;
- Loss of company assets;
- Adverse impact on company reputation;
- Disruption to production;
- Explosion.

3.1.2 ALARMS

- Area evacuation;
- Fire alarms;
- Two way radio communication.

3.1.3 RESPONSE

- Identify type of fire and any potential for the fire to spread, evacuate area under threat.
- Notify Accountable Manager.
- Call out Emergency Response Teams (ERT) with full breathing apparatus and fire response equipment if available or notify external emergency provider. Refer to Emergency Contacts list for contact details.
- Secure area with ERT members or other site personnel.
- Account for all personnel onsite.
- Notify crisis management team Leader (Corporate Office) and determine regular briefing as required.
- Notify other department and request provision of any equipment that may assist (water carts, grader, etc.)
- Prepare for likely media interest.
- Notify hospital if injury occurs.

- Notify Police (if potentially fatal).
- Notify DMP.
- Notify contractor if contractor infrastructure or personnel are affected.
- Notify Department of Environmental Protection (if environmental impact results).
- Maintain security of affected area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.1.4 EXTERNAL HELP

- Mutual aid providers.
- FES.
- Refer to "Emergency Information Directory" for contact numbers.

3.2 BUSHFIRE

A major bushfire in the local area could have a significant impact on the site operations. If a major bush fire occurred and threatened company and site assets, assistance from site personnel would be requested and require the provision of firefighting equipment / personnel and heavy earthmoving equipment (e.g., dozers, loaders, water trucks etc.) to cut fire breaks.

3.2.1 MAIN RISKS

- Injury to employees;
- Loss of company assets;
- Disruption to production.

3.2.2 ALARMS

- Area evacuation;
- Fire alarms;
- Two way radio communication.

3.2.3 RESPONSE

- Identify type of fire and any potential for the fire to spread, evacuate area under threat.
- Notify Accountable Manager.
- Notify site personnel.
- Call out Emergency Response Teams (ERT) with fire response equipment if available and notify external emergency provider (FES). Refer Emergency Contacts list for contact details.
- Account for all personnel onsite
- Notify other department and request provision of any equipment that may assist (water carts, grader etc.).
- Ensure personnel due to arrive to site are informed of delays or cancellations of travel arrangements.
- Ensure any critical areas are protected by fire breaks (power lines, fuel storage areas, etc.) Only construct fire breaks if safe to do so.

- Notify Crisis Management Team Leader (Corporate Office) and determine regular briefing as required.
- Notify hospital if injury occurs.
- Notify Police (if potentially fatal).
- Notify Regulatory Authority.
- Notify Contractor if contractor infrastructure or personnel are affected.
- Maintain security of affected area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.2.4 EXTERNAL HELP

- Mutual aid providers.
- FES.
- Refer to "Emergency Information Directory" for contact number.

3.3 FLOODING / INRUSH OF MATERIAL

Flooding of the operations area, village and connecting roads may occur as a result of heavy rains. In the event of flooding in any work area, road or the camp, the Accountable Manager responsible for that area shall assess the extent of the flooding, possible underlying earth weakness or slips and associated hazards for operational activities and personnel.

3.3.1 MAIN RISKS

- Injury to employees;
- Loss of access to open pits or site;
- Loss of company assets;
- Adverse impact on company reputation;
- Disruption to production;
- Wet/Slippery roads increased potential for heavy equipment & light vehicle incidents.

3.3.2 ALARMS

- Two way radio communication.

3.3.3 RESPONSE

- Notify Accountable Manager.
- Assessment of operational activities that may be affected by the rain or flooding by the relevant managers. Any activity that may be adversely affected by the rain or flooding shall cease immediately and only recommence once the rain or water has subsided, and then not at normal operational capacity until all effects cease.
- Notify site personnel.
- Activate Emergency Management Plan and Duty cards (refer cover for location).
- Notify Crisis Management Team Leader (Corporate Office) and determine regular briefing as required.

- Obtain up to date information from BOM or police.
- Notify supervisors of approaching rain/flood waters/ over flow from channels or water storage areas.
- Assess likely impact.
- Monitor local creeks/rivers/drainage/ storage dams old pits.
- Ensure personnel due to fly to site are informed of delays or cancellations of flights.
- Ensure hazardous roads or ramps are closed with appropriate signage and barriers to prevent entry.
- Exploration activities and vehicle movement on all main roads should be limited.
- Contact neighbouring stations to provide assistance as required.
- Consider closing haul roads /pit ramps/ site access if affected.
- Call out ERT if further resource or support required.
- Check Status of essential supplies (water fuel food etc.).
- If flooding is likely to be severe consider closing operations.
- Notify Contractor if contractor infrastructure or personnel are affected.
- If flooding of open pits is likely with draw personnel and stop operations.
- Maintain accurate log of all events.

3.3.4 EXTERNAL HELP

- FES.
- Pump hire contractors.
- Refer to “Emergency Information Directory” for contact numbers.
- inform personnel in the operations area to use 4WD on vehicles at all times.

3.4 GROUND FALL / SLIP/ RAMP FAILURE

Open Pit wall or access ramp failures are often preceded by cracking and ground movements, which may be visible. Regular monitoring of pit walls, crests and berms may help identify any potential failures. If a sudden failure occurs, evacuation to a safe place within the pit itself is usually the best course of action. Egress from the pit can then be made once an access way is re-cut. The possibility of having to evacuate injured persons quickly over the pit wall (if no vehicle access) may require Emergency Response Team call-out.

3.4.1 MAIN RISKS

- Injury to employees.
- Loss of company assets.
- Adverse impact on company reputation.
- Disruption to production.

3.4.2 ALARMS

- Area evacuation.
- Fire alarms.
- Two way radio communication.

3.4.3 RESPONSE

- Evacuate area under threat and barricade area if possible.
- Notify Accountable Manager.
- Activate Emergency Management Plan and Duty cards (refer cover for location).
- Secure area with Emergency Response Teams (ERT) members or other site personnel.
- Account for all personnel onsite.
- Call out ERT if available or notify external emergency provider. Refer Emergency Contacts list for contact details.
- Notify Crisis Management Team Leader (Corporate Office) and determine regular briefing as required.
- Prepare for likely media interest.
- Notify hospital if injury occurs.
- Notify Police (if potentially fatal).
- Notify Contractor if contractor infrastructure or personnel are affected.
- Notify Department of Environmental Protection (if environmental impact results).
- Maintain security of affected area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.4.4 EXTERNAL HELP

- Mutual aid providers
- FES
- Refer to “Emergency Information Directory” for contact numbers.

3.5 INJURY

Injuries to personnel could have a significant impact on the site operations. If a serious injury was to occur assistance from site personnel would be requested to provide first aid and possible transport of injured personnel to offsite medial aid. The severity of the injury and the location of the injured person would determine the level of response from the Emergency Management Team and Crisis management Team.

3.5.1 MAIN RISKS

- Injury to employees.
- Loss of company assets.
- Adverse impact on company reputation.
- Disruption to production.

3.5.2 ALARMS

- Area evacuation.
- Fire alarms.
- Two way radio communication.

3.5.3 RESPONSE

- Notify site medic or first aid personnel and direct them to injured person(s) if area is safe or injured person(s) have been moved to safe area.
- First aid treatment to be provided in accordance with the DRSABCD action plan (Appendix 16.2) and within the qualifications of the site medic or first aid personnel.
- Notify Accountable Manager.
- Activate Emergency Management Plan and Duty cards (refer cover for location) and log all events.
- Call out Emergency Response Teams (ERT) to assist with patient management if available or notify external emergency provider. Refer Emergency Contacts list for contact details.
- Notify Crisis Management Team Leader if required (Corporate Office) and determine regular briefing as required.
- Prepare for likely media interest.
- Notify hospital if transporting to hospital.
- Notify Police (if potentially fatal).
- Notify Contractor if contractor personnel are affected.
- Maintain security of incident area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).

3.5.4 EXTERNAL HELP

- Mutual aid providers.
- FES/ St Johns.
- Refer to “Emergency Information Directory” for contact numbers.

3.6 CYCLONE

A cyclone coming down from the coastline is likely to maintain its form or change to a rain-bearing depression. Cyclone season generally runs from November through to April and can result in considerable rainfall.

3.6.1 MAIN RISKS

- Loss of company assets or mine.
- Loss of access and egress to the pit / mine.
- Loss of essential supplies.
- Disruption to production.
- Medical emergency/ injury.

3.6.2 ALARMS

- Media reports (i.e., Television, news, radio, newspaper).
- Bureau of Meteorology (BOM) will notify of emerging cyclones in the area.
- Perth Cyclone Manager.
- Cyclone.
- Fire alarms.
- Two way radio communication.

3.6.3 RESPONSE

- Obtain up to date information from BOM or local police.
- Assess likely impact.
- Check status of site essential supplies.
- Notify Accountable Manager.
- Activate Cyclone Management Plan.
- If likely to be severe consider the closure of all operations.
- Prepare for possible flooding.
- Notify contractors and employees of proposed actions.
- Ensure personnel due to arrive to site are informed of delays or cancellations of flights.
- Notify suppliers of proposed action, if required.
- If medical emergency occurs and cannot evacuate by usual means, contact DFES via local police for assistance or RFDS.
- If cyclone hits site, evacuate persons to “cyclone evacuation points” in the camps.
- Check availability of tarpaulins with ERT.
- Consider call out of ERT to control damage if required.
- Refer to “Emergency Information Directory” for contact numbers.
- Notify Crisis Management Team Leader if required (Corporate Office) and determine regular briefing as required.
- Notify Contractor if contractor personnel are affected.
- Maintain accurate log of all events.

3.6.4 EXTERNAL HELP

- Mutual aid providers.
- FES/ St Johns.
- Bureau of meteorology (BOM).
- Refer to “Emergency Information Directory” for contact numbers.

3.7 MISSING PERSONNEL

NRR personnel at times travel or work in isolated areas. Travel management plans are used to track and to check on personnel. At times personnel travelling or working in isolated area have not checked in or may require assistance.

3.7.1 MAIN RISKS

- Injury to employees.
- Loss of company assets.
- Adverse impact on company reputation.
- Disruption to production.

3.7.2 ALARMS

- Two way radio communication.
- Mobile phone.

- Satellite phone.
- SPOT notification.
- EPIRB.

3.7.3 RESPONSE

- Notify Accountable Manager.
- Attempt to contact party.
- Activate Emergency Management Plan and Duty cards (refer cover for location).
- Call out Emergency Response Teams (ERT) to assist if available or notify external emergency provider. Refer Emergency Contacts list for contact details.
- Use other employees to assist as required.
- Notify Crisis Management Team Leader if required (Corporate Office) and determine regular briefing as required.
- Notify hospital if potential of casualties.
- Notify Police.
- Notify Contractor if contractor personnel are affected.
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.7.4 MISSING PERSON

- Stay with the vehicle, make vehicle as visible as possible (flagging tape, rags etc.).
- If lost on foot, do not continue to walk, find shade and wait for rescue.
- Erect shade or move under vehicle.
- Stay calm and conserve energy.
- Ration water supplies.
- Continue to try and make contact by radio (if not broken).

3.7.5 EXTERNAL HELP

- Mutual aid providers.
- FES/ St Johns.
- Refer to “Emergency Information Directory” for contact numbers.

3.8 CHEMICAL SPILL / OIL SPILL

A release of a hazardous chemical or a reagent spill can have a significant impact. It can cause considerable environmental damage and (in some cases) result in hazardous vapors or dust which can affect people over a wide area, particularly those working down-wind of the release.

3.8.1 MAIN RISKS

- Injury to employees.
- Injury to employees responding to incident.
- Environmental impact.
- Impact to company image/ reputation (if significant environmental impact).

3.8.2 ALARMS

- Area evacuation.
- Fire alarms.
- Two way radio communication.

3.8.3 RESPONSE

- Identify type of spill and any potential for the spill to spread if required evacuate area under threat.
- Notify Accountable Manager.
- Call out Emergency Response Teams (ERT) (full breathing apparatus or respirators may be required) if available or notify external emergency provider. Refer Emergency Contacts list for contact details.
- Activate Emergency Management Plan and Duty cards (refer cover for location).
- Refer to Material Safety Data Sheet for further information.
- Secure area with ERT members or other site personnel.
- Account for all personnel onsite.
- Notify Crisis Management Team Leader (Corporate Office) and determine regular briefing as required.
- Notify site environmental department.
- Notify hospital if injury occurs.
- Notify Police (if potentially fatal).
- Notify Contractor if contractor infrastructure or personnel are affected.
- Notify Department of Environmental Protection (if environmental impact results).
- Maintain security of affected area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.8.4 EXTERNAL HELP

- Mutual aid providers.
- FES.
- Refer to “Emergency Information Directory” for contact numbers.

3.9 VEHICLE INCIDENT ONSITE /OFFSITE

Incidents involving vehicles onsite or offsite may require response from site personnel. The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require an onsite Emergency Response Team or external response from police or FES.

An incident involving members of the public (e.g., unauthorised tourists) on NRR roads or NRR vehicles is likely to generate considerable public concern and could have a significant impact on the community and company image.

3.9.1 MAIN RISKS

- Injury to employees or other person/s.
- Impact on public /local community.
- Adverse impact on company reputation.

3.9.2 ALARMS

- Two way radio communication.
- Phones.

3.9.3 RESPONSE

- Notify Accountable Manager.
- Call out ERT if available or notify external emergency provider.
- Initiate appropriate emergency response (first aid/medical/fire/vehicle extrication).
- Secure area.
- Isolate any energy sources or contain any substances (e.g., power lines, gas, diesel or reagents).
- Activate Emergency Management Plan and Duty cards (refer cover for location) if required.
- Notify Crisis Management Team Leader (Corporate Office) and determine regular briefing as required.
- Call ambulance if required.
- Prepare for likely media interest.
- Notify environment department if an environmental impact results.
- Notify hospital if injury occurs.
- Notify Police.
- Maintain security of affected area(s).
- Initiate appropriate investigation (may need to maintain security of area until completed).
- Maintain accurate log of all events.

3.9.4 EXTERNAL HELP

- Mutual aid providers.
- FES.
- Refer to “Emergency Information Directory” for contact numbers.

4. APPENDICES

4.1 EMERGENCY CONTACTS LIST

The emergency contacts list is to be developed by the relevant department or site and placed in place of this document. The below template is the minimum of what is required.

Site: Sawfish
Site Radio Channels: CH20
Site Emergency Contact information Medic Sat Phone PH: 0488823923

EMERGENCY

Police Borroloola Police station	8975 8770	000
Ambulance Borroloola Health Clinic	8975 8757	000
FES	8999 3473	000
Hospital Katherine	8973 9211	
RFDS	1800 733 768	
Care flight	8928 9777	
RFDS from satellite phone	08 8922 8888	
Other medical contact in area		

NRR SITE REPRESENTITIVES

NATHAN RAMM	GM MINING	0402 618 759
MICHEAL RAKUITA	PROJECT MANAGER	0477 733 741
DAVID WESLEY	ALT PROJECT MANAGER	0447 268 191
MARIO VORWERG	PROJECT SUPERINTENDENT	0439 987 090
PAUL HUMPHRIS	MAINTENANCE SUPERINTENDENT	0475 411 866
KRYSTEN ROBERTS	GM MARINE OPERATIONS	0419 044 936
LANCE SHEWARD	MARINE OPERATION	0488 622 142

4.2 DRSABDC MANAGEMENT PLAN

DRSABCD Action Plan

In an emergency **call triple zero (000)** and ask for an ambulance

D DANGER

Ensure the area is safe for your self, others and the patient

↓

R RESPONSE

Check for response—ask name—squeeze shoulders

No response

↓

Response
Make comfortable
Monitor response

S SEND for help

Call triple zero (000) for an ambulance
or ask another person to make the call

↓

A AIRWAY

Open mouth—if foreign material present
Place in recovery position
Clear airway with fingers

↓

B BREATHING

Check for breathing—look, listen, feel

Not normal breathing
Start CPR

↓

Normal breathing
Place in recovery position
Monitor breathing

C CPR

Start CPR—30 chest compressions : 2 breaths
Continue CPR until help arrives
or patient recovers

↓

D DEFIBRILLATION

Apply defibrillator if available
and follow voice prompts

Learn First Aid with St John Ambulance Australia | **Free call 1300 360 455** | **www.stjohn.org.au**

St John

APPENDIX D – MRM MARINE SEDIMENT AND DGT MONITORING DATA

Marine Sediment Data

Monitoring Location	Date	Fraction Wet Sieving <63µm	Al	Mn	Fe	Co	Ni	Cu	Zn	As	Ag	Cd	Sb	Pb	Hg
		%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MS1B	20/11/2020	12.1%	2,600	230	8,400	4.8	2.7	5.8	8.2	1.8	<0.02	0.05	<0.2	9.8	<0.01
MS1B	1/03/2022	7%	2,100	260	7,300	4.3	2.4	5.3	7.7	3.4	<0.02	0.05	<0.2	11	<0.01
MS1B	28/11/2022	7%	1,800	280	7,500	4.1	2.3	5.9	8.2	3.8	0.02	0.05	0.2	11	0.01
MS1B	30/11/2023	6%	2,300	300	9,100	4.8	2.6	7.6	8.9	4.7	0.02	0.05	<0.2	12	0.01
MS2	20/11/2020	40.2%	2,600	330	11,000	5.1	2.8	8.5	24	2.6	0.03	0.07	<0.2	18	<0.01
MS2	1/03/2022	38%	2,500	400	11,000	5.2	2.7	8.7	23	5.4	0.03	0.06	<0.2	19	<0.01
MS2	28/11/2022	21%	2,500	340	11,000	5.1	2.7	10	40	4	0.04	0.1	0.2	30	0.01
MS2	30/11/2023	74%	2,800	490	13,000	5.8	3.1	11	27	5.7	0.04	0.06	<0.2	21	<0.01
MS3	20/11/2020	39.8%	3,200	310	13,000	5.3	3.2	13	52	2.9	0.04	0.17	<0.2	34	<0.01
MS3	1/03/2022	6%	2,100	250	8,100	4.1	2.3	7.8	19	3.9	0.02	0.08	<0.2	20	<0.01
MS3	28/11/2022	12%	2,100	230	6,700	4	2.2	8.3	23	2.2	0.03	0.08	0.2	17	0.01
MS3	30/11/2023	68%	2,900	340	14,000	5.2	3.1	14	44	4.5	0.04	0.15	<0.2	32	<0.01
MS4	20/11/2020	47.9%	3,200	300	13,000	5.2	3.1	28	250	4.1	0.05	0.71	<0.2	190	<0.01
MS4	1/03/2022	40%	2,500	280	9,200	4	2.2	18	120	2	0.04	0.32	<0.2	75	<0.01
MS4	28/11/2022	29%	2,500	300	10,000	4.9	2.8	21	140	4.6	0.05	0.43	0.2	96	0.01
MS4	30/11/2023	55%	2,700	330	8,700	5.2	2.9	17	88	4.5	0.05	0.25	<0.2	55	<0.01
MS5A	20/11/2020	33.6%	3,300	300	11,000	4.6	2.9	41	430	4.8	0.06	1.2	<0.2	350	<0.01
MS5A	1/03/2022	73%	2,700	330	8,800	4	2.4	30	240	4.3	0.06	0.74	<0.2	200	<0.01
MS5A	28/11/2022	20%	2,300	320	12,000	4.3	3.4	35	330	6	0.06	0.98	0.2	210	0.01
MS5A	30/11/2023	73%	2,600	350	11,000	4.3	2.7	37	320	5.7	0.08	0.97	<0.2	270	<0.01
MS5B	20/11/2020	42.0%	3,200	300	10,000	4.4	2.8	32	350	4.2	0.05	0.97	<0.2	270	<0.01
MS5B	1/03/2022	62%	2,600	330	16,000	3.2	2.4	32	250	3.1	0.05	0.79	<0.2	190	<0.01
MS5B	28/11/2022	30%	2,600	340	9,000	4.4	2.7	30	190	5.5	0.06	0.65	0.2	140	0.01
MS5B	30/11/2023	51%	2,700	360	13,000	4.1	2.6	35	270	5.2	0.07	0.89	<0.2	200	<0.01
MS6A	20/11/2020	60.9%	3,000	320	8,800	5.5	3	28	320	4.9	0.06	0.69	<0.2	170	<0.01
MS6A	1/03/2022	56%	2,600	290	11,000	3.8	2.4	37	310	4.1	0.06	0.97	<0.2	270	<0.01
MS6A	28/11/2022	39%	2,500	320	13,000	4.7	2.8	36	330	5.4	0.06	0.99	0.2	230	0.01
MS6A	30/11/2023	49%	2,500	350	8,600	6.2	3.3	13	72	4.9	0.04	0.17	<0.2	50	<0.01
MS6B	20/11/2020	41.4%	2,500	340	7,400	6.1	2.5	16	95	2.6	0.03	0.23	<0.2	61	<0.01
MS6B	1/03/2022	16%	2,200	240	11,000	3.9	2.4	28	240	3.5	0.06	0.73	<0.2	210	<0.01
MS6B	28/11/2022	35%	2,200	420	9,700	4	2.5	37	270	5.5	0.06	0.81	0.2	180	0.01
MS6B	30/11/2023	75%	2,600	380	14,000	4.2	2.8	37	300	5.9	0.07	0.97	<0.2	220	<0.01
MS7A	20/11/2020	31.0%	2,600	330	7,800	5.9	2.7	22	200	3.2	0.04	0.52	<0.2	150	<0.01
MS7A	1/03/2022	74%	2,600	340	17,000	4	2.9	33	240	3.9	0.07	0.82	<0.2	220	<0.01
MS7A	28/11/2022	22%	2,500	290	17,000	4.1	2.8	47	470	6.4	0.06	1.4	0.2	320	0.01
MS7A	30/11/2023	23%	2,500	360	13,000	3.9	2.3	35	300	5.6	0.06	0.94	<0.2	230	<0.01
MS7B	20/11/2020	10.9%	2,400	270	15,000	3.7	2.6	26	200	3.8	0.04	0.69	<0.2	190	<0.01
MS7B	1/03/2022	4%	2,000	340	13,000	4.2	2.7	27	320	9	0.04	1	<0.2	400	<0.01
MS7B	28/11/2022	42%	2,100	300	7,200	5.2	2.3	21	120	3.2	0.04	0.28	0.2	95	0.01
MS7B	30/11/2023	22%	2,600	280	13,000	4	2.6	33	330	4.7	0.06	1	<0.2	240	<0.01

DGT Field Parameters

Monitoring Location	Date	Time	Comments	Temperature	Field pH	Field EC	Field TDS	DO	DO	ORP (mV)	Salinity
				°C	pH units	µS/cm	mg/L	mg/L	% Sat	mV	psu
DGT1	4/08/2022	10:52		24.6	7.78	61,065	39,692	7.00	106.3	212	41.0
DGT1	9/08/2022	11:23		24.9	7.82	55,659	36,178	6.59	98.1	240	36.9
DGT1	13/11/2022	10:50	Missing Data	30.5	7.59	57,498			93.4	224	38.1
DGT1	18/11/2022	10:29	Brown algae	30.7	7.76	58,123	37,780	5.46	90.3	192	38.6
DGT1	2/03/2023	11:27		29.9	7.05	37,306	24,249	6.08	91.4	276	23.5
DGT1	8/03/2023	13:26	Seaweed on bouys	28.5	7.64	51,447	33,441	6.71	104.3	223	33.7
DGT2	4/08/2022	10:59		24.2	7.90	60,792	39,515	6.92	104.1	206	40.8
DGT2	9/08/2022	11:37		24.8	7.85	55,789	36,263	6.59	98.1	114	37.0
DGT2	13/11/2022	10:59	Missing Data	30.5	7.87	57,705			94.6	202	38.3
DGT2	18/11/2022	10:24	Brown algae	30.7	7.62	58,163	37,806	5.61	92.8	247	38.6
DGT2	2/03/2023	12:15		30.2	7.54	37,537	24,399	6.16	93.1	191	23.7
DGT2	8/03/2023	12:37	Seaweed on bouys	28.6	7.44	51,917	33,746	6.57	102.4	128	34.1
DGT3	4/08/2022	10:27		26.3	7.62	62,230	40,449	5.82	91.3	229	41.9
DGT3	9/08/2022	12:27		24.5	7.88	57,413	37,318	6.25	93.3	190	38.3
DGT3	13/11/2022	10:25	Excessive weed, Missing data	30.6	7.57	58,443			80.7	258	38.9
DGT3	18/11/2022	11:16	Brown algae	32.0	8.18	59,968	38,979	5.8	98.6	207	40.0
DGT3	2/03/2023	11:02	Seaweed	29.2	6.50	28,620	18,603	5.38	77.4	246	17.6
DGT3	8/03/2023	13:49	Small amount of seaweed on bouys	29.5	7.69	52,045	33,829	6.25	98.8	184	34.1
DGT4	4/08/2022	10:40		26.6	7.70	62,444	40,589	6.32	99.7	215	42.0
DGT4	9/08/2022	12:20		24.4	7.89	57,448	37,341	6.58	97.9	224	38.3
DGT4	13/11/2022	10:40	Missing Data	32.5	7.91	60,358			98.3	213	40.2
DGT4	18/11/2022	11:06	Brown algae + Biofouled	32.3	8.18	60,223	39,145	6.34	108.3	236	40.1
DGT4	2/03/2023	11:15	Seaweed	29.6	6.53	29,925	19,451	6.27	91.1	278	18.4
DGT4	8/03/2023	13:41		29.3	7.57	52,025	33,816	6.40	101.0	205	34.1
DGT5	4/08/2022	11:13		24.7	7.84	60,415	39,270	6.87	104.1	205	40.5
DGT5	9/08/2022	12:00		24.5	7.80	55,070	35,796	6.72	99.2	235	36.5
DGT5	13/11/2022	11:10	Missing Data	30.6	7.96	57,569			91.0	119	38.2
DGT5	18/11/2022	10:12	Brown algae	30.6	7.39	58,400	37,960	6.03	99.6	293	38.8
DGT5	2/03/2023	12:33		29.7	7.74	47,194	30,676	6.22	96.8	159	30.6
DGT5	8/03/2023	12:18		28.4	7.20	50,777	33,005	6.72	104.0	297	33.2
DGT6	4/08/2022	11:39		23.7	7.88	60,545	39,354	6.94	103.6	174	40.7
DGT6	9/08/2022	10:56		24.8	7.79	55,280	35,932	6.65	98.8	273	36.7
DGT6	13/11/2022	11:45	Missing Data	31.0	8.23	58,754			98.4	174	39.1
DGT6	18/11/2022	9:50	Brown algae	30.6	7.03	57,609	37,446	6.12	100.9	332	38.2
DGT6	2/03/2023	11:54		30.0	7.53	46,275	30,078	6.07	94.5	223	29.9
DGT6	8/03/2023	13:06	Seaweed on bouys	29.0	7.22	51,736	33,628	6.42	100.7	245	33.9

DGT Labile Metal Concentrations

		Parameter	Mn	Fe	Co	Ni	Cu	Zn	Cd	Pb	
		Reporting limit	0.100	0.010	0.010	0.500	0.010	0.060	0.005	0.002	
Monitoring Location	Replicate	Date	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	Comments
DGT1	1	9/08/2022	3.92	3.27	0.029	1.55	0.11	<0.060	0.006	0.008	Clean, slight disscolouration, clean chelex
DGT1	2	9/08/2022	3.72	2.43	0.026	<0.50	0.10	<0.060	0.006	0.011	Clean, slight disscolouration, clean chelex
DGT1	3	9/08/2022	4.35	6.07	0.033	0.73	0.13	0.13	0.007	0.022	Clean, slight disscolouration, clean chelex
DGT2	1	9/08/2022	3.89	2.45	0.028	<0.50	0.10	0.20	<0.005	0.005	Clean, slight disscolouration, clean chelex
DGT2	2	9/08/2022	3.98	3.35	0.028	2.52	0.10	0.21	0.005	0.005	Clean, slight disscolouration, clean chelex
DGT2	3	9/08/2022	4.73	4.58	0.032	0.67	0.11	0.20	0.005	0.007	Clean, slight disscolouration, clean chelex
DGT3	1	9/08/2022	6.77	3.82	0.059	<0.50	0.42	3.10	0.018	0.203	Signs of growth, slight disscolouration, few small particles
DGT3	2	9/08/2022	6.80	3.06	0.063	<0.50	0.46	3.19	0.019	0.211	Signs of growth, slight disscolouration, clean chelex
DGT3	3	9/08/2022	6.34	1.42	0.059	<0.50	0.42	2.93	0.018	0.191	Signs of growth, slight disscolouration, clean chelex
DGT4	1	9/08/2022	5.00	7.02	0.053	0.66	0.16	0.99	0.011	0.091	Signs of growth, slight disscolouration, few particles on edge of chelex
DGT4	2	9/08/2022	5.31	6.91	0.053	<0.50	0.16	0.95	0.011	0.098	Signs of growth, slight disscolouration, few particles on edge of chelex
DGT4	3	9/08/2022	5.84	7.08	0.059	<0.50	0.17	1.17	0.012	0.095	Signs of growth, slight disscolouration, few particles on edge of chelex
DGT5	1	9/08/2022	2.48	3.69	0.019	<0.50	0.11	0.22	0.005	0.009	Signs of growth, slight disscolouration, clean chelex
DGT5	2	9/08/2022	2.67	2.34	0.022	<0.50	0.13	0.20	0.006	0.006	Signs of growth, slight disscolouration, clean chelex
DGT5	3	9/08/2022	2.83	5.80	0.024	<0.50	0.14	0.08	0.005	0.009	Signs of growth, slight disscolouration, clean chelex
DGT6	1	9/08/2022	2.07	5.02	0.023	<0.50	0.11	<0.060	0.005	0.011	Signs of growth, slight disscolouration, clean chelex
DGT6	2	9/08/2022	2.07	2.54	0.023	<0.50	0.11	0.07	0.005	0.008	Signs of growth, slight disscolouration, clean chelex
DGT6	3	9/08/2022	2.04	3.87	0.022	<0.50	0.11	0.22	0.005	0.008	Signs of growth, slight disscolouration, clean chelex
DGT1	1	18/11/2022	1.70	1.83	0.019	<0.20	0.062	<0.40	0.006	0.005	Slight discolouration, minimal growth, clean chelex
DGT1	2	18/11/2022	1.85	2.11	0.020	<0.20	0.066	<0.40	0.006	0.009	Slight discolouration, minimal growth, clean chelex
DGT1	3	18/11/2022	1.97	3.64	0.022	<0.20	0.068	<0.40	0.006	0.034	Slight discolouration, minimal growth, clean chelex
DGT2	1	18/11/2022	2.15	5.87	0.024	<0.20	0.069	<0.40	0.010	0.010	Slight discolouration, minimal growth, clean chelex
DGT2	2	18/11/2022	1.95	3.70	0.022	<0.20	0.073	<0.40	0.009	0.016	Slight discolouration, minimal growth, clean chelex
DGT2	3	18/11/2022	2.25	5.70	0.024	<0.20	0.072	<0.40	0.012	0.010	Slight discolouration, minimal growth, clean chelex
DGT3	1	18/11/2022	5.49	3.80	0.045	<0.20	0.16	1.46	0.017	0.133	Slight discolouration, minimal growth, clean chelex
DGT3	2	18/11/2022	5.64	1.65	0.045	<0.20	0.14	1.35	0.019	0.115	Slight discolouration, minimal growth, clean chelex
DGT3	3	18/11/2022	4.98	2.21	0.043	<0.20	0.14	1.40	0.019	0.117	Slight discolouration, minimal growth, clean chelex
DGT4	1	18/11/2022	4.57	0.85	0.040	<0.20	0.079	<0.40	0.008	0.060	Slight discolouration, some growth, clean chelex
DGT4	2	18/11/2022	4.22	1.62	0.042	<0.20	0.077	0.41	0.007	0.064	Slight discolouration, some growth, clean chelex
DGT4	3	18/11/2022	3.62	2.06	0.040	<0.20	0.067	0.47	0.007	0.062	Slight discolouration, some growth, clean chelex
DGT5	1	18/11/2022	1.13	4.31	0.015	<0.20	0.10	0.51	0.009	0.008	Slight discolouration, some growth, clean chelex
DGT5	2	18/11/2022	1.21	3.66	0.017	<0.20	0.12	<0.40	0.011	0.019	Slight discolouration, some growth, clean chelex
DGT5	3	18/11/2022	1.23	5.54	0.017	<0.20	0.11	0.52	0.013	0.010	Slight discolouration, some growth, clean chelex
DGT6	1	18/11/2022	1.59	3.09	0.018	<0.20	0.070	<0.40	0.009	0.003	Slight discolouration, more growth than 2,3, clean chelex
DGT6	2	18/11/2022	1.94	8.05	0.020	<0.20	0.069	<0.40	0.013	0.008	Slight discolouration, some growth, clean chelex
DGT6	3	18/11/2022	1.49	2.58	0.018	<0.20	0.11	<0.40	0.006	0.004	Slight discolouration, some growth, clean chelex
DGT1	1	8/03/2023	1.86	11.4	0.025	0.13	0.089	0.51	0.007	0.012	Growth on holder and filter, clean chelex
DGT1	2	8/03/2023	5.13	12.6	0.033	0.18	0.14	0.51	0.021	0.012	Growth on holder and filter, clean chelex
DGT1	3	8/03/2023	2.33	16.1	0.030	0.18	0.10	0.35	0.008	0.014	Growth on holder and filter, clean chelex
DGT2	1	8/03/2023	0.78	1.09	0.016	0.11	0.074	<0.20	0.007	<0.005	Growth on holder and filter, clean chelex
DGT2	2	8/03/2023	2.20	17.0	0.028	0.13	0.10	0.28	0.009	0.018	Growth on holder and filter, small particles on edge of chelex
DGT2	3	8/03/2023	1.50	8.26	0.030	0.16	0.10	0.37	0.009	0.008	Growth on holder and filter, clean chelex
DGT3	1	8/03/2023	7.19	2.42	0.048	0.13	0.10	1.69	0.014	0.059	Some growth on holder and filter, clean chelex
DGT3	2	8/03/2023	7.98	3.73	0.056	0.15	0.11	2.13	0.024	0.074	Some growth on holder and filter, clean chelex
DGT3	3	8/03/2023	7.21	1.56	0.052	0.15	0.11	3.33	0.014	0.057	Some growth on holder and filter, clean chelex
DGT4	1	8/03/2023	3.66	2.44	0.034	0.13	0.081	1.05	0.009	0.016	Growth on holder and filter, small particles on edge of chelex
DGT4	2	8/03/2023	4.10	6.72	0.038	0.14	0.087	0.67	0.008	0.024	Some growth on holder and filter, clean chelex
DGT4	3	8/03/2023	4.62	5.62	0.041	0.13	0.094	0.60	0.008	0.023	Some growth on holder and filter, clean chelex
DGT5	1	8/03/2023	1.76	16.3	0.025	0.14	0.10	<0.20	0.007	0.016	Growth on holder and filter, small particles on edge of chelex
DGT5	2	8/03/2023	1.97	19.6	0.025	0.13	0.10	<0.20	0.007	0.018	Growth on holder and filter, small particles on edge of chelex
DGT5	3	8/03/2023	1.48	13.2	0.020	0.12	0.094	<0.20	0.007	0.012	Growth on holder and filter, small particles on edge of chelex
DGT6	1	8/03/2023	2.39	14.2	0.027	0.12	0.080	<0.20	<0.005	0.011	Growth on holder and filter, clean chelex
DGT6	2	8/03/2023	2.27	14.1	0.024	0.12	0.078	0.29	0.006	0.010	Growth on holder and filter, clean chelex
DGT6	3	8/03/2023	2.09	8.38	0.022	0.13	0.076	0.27	0.006	0.008	Growth on holder and filter, clean chelex

APPENDIX E – BBLF MAINTENANCE DREDGING RISK ASSESSMENT

Table 1 **Categories used to assess the severity of potential impacts**

More Severe			Less Severe
Scale			
Widespread Impact occurs across the broader Gulf of Carpentaria and/or extends to the marine waters of Limmen Bight and associated coastal floodplains and Estuarine rivers.	**Regional** Impact occurs outside the boundaries of mineral lease/s and/or swing basin and channel.	**Localised** Impact is confined within the boundaries of mineral lease/s and/or swing basin and channel.	**Limited** Impact occurs only within the direct disturbance footprint.
Intensity			
High Impact alters the integrity of environmental values.	**Moderate** Impact compromises the integrity of environmental values.	**Low** Impact alters the quality, abundance or distribution of environmental values without compromising their ecological integrity.	**Very Low** Impact does not noticeably alter the quality, distribution or abundance of environmental values.
Timing, duration and frequency			
Permanent Impact that is permanent; values will never recover.	**Long-term** Impact that is measurable for many years post-dredging.	**Medium-term** Impact that is measurable during dredging and for some months following.	**Short-term** Impact that is measurable during dredging only.

Table 2 **Likelihood categories adopted in risk assessment**

Probability/Likelihood			Likelihood Criteria
1	Rare	The impact is very unlikely to occur. The impact has not occurred on similar projects and/or in similar environments.	0-1%
2	Unlikely	The impact is not expected to occur. The impact occurs very infrequently on similar projects and/or in similar environments.	2-10%
3	Possible	The impact could occur in some circumstances. The impact has occurred infrequently on similar projects and/or in similar environments.	11-50%
4	Likely	The impact will probably occur in most circumstance but there is some uncertainty about the likelihood. The impact has occurred on more than one occasion in association with similar projects and/or in similar environments.	51-90%
5	Almost Certain	The event/impact will occur or is expected to occur. The impact occurs regularly in association with similar projects and/or in similar environments.	91-100%

Table 3 Consequence categories adopted in risk assessment

Score	Consequence	Description
1	Insignificant	No measurable impact on the environment No injuries. Low-nil financial loss.
2	Minor	A minor impact has two or more of the following characteristics: **Limited** = Impact occurs within the immediate disturbance footprint only (swing basin zone of impact) **Very Low Intensity** = Impact does not noticeably alter the quality, distribution or abundance of environmental values. **Short-term** = Impact that is felt during the mining operations phase only. No publicity likely and no stakeholder concerns. First aid treatment required. Medium-low financial loss.
3	Moderate	A moderate impact has two or more of the following characteristics: **Localised** = Impact to environmental values within boundaries of mineral lease/s or swing basin and channel. **Low Intensity** = Impact alters the quality, abundance or distribution of environmental values without compromising ecological integrity. **Medium term** = Impact that is felt during operations and for some months post-closure. Stakeholder enquires (this may include government, unions or public). Medical attention required. High-medium financial loss.
4	Major	A major impact has two or more of the following characteristics: **Regional** = Impact occurs over a larger area than the Mineral Lease/s and/or beyond channel. **Moderate to High Intensity** = Impact compromises the integrity of environmental values. **Long-term** = Impact that is felt for many years post-closure. Prosecution possible. Loss of company credibility and high stakeholder interest. Permanent injuries. High financial loss.
5	Severe	A severe impact has two or more of the following characteristics: **Widespread** = Impact occurs across the broader Roper Gulf Region and/or extends to the marine waters of Limmen Bight and associated coastal floodplains, and/or extends within the Gulf of Carpentaria **High Intensity** = Impact alters the integrity of environmental values. **Permanent** = Impact is permanent - values will never recover. Major stakeholder and media interest. Prosecution likely. Permanent injury or death. Extreme financial loss.

Table 4 **Risk matrix adopted in risk assessment**

			CONSEQUENCE				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Severe
LIKELIHOOD	5	Almost Certain	Medium	Medium	High	Very High	Very High
	4	Likely	Medium	Medium	High	Very High	Very High
	3	Possible	Low	Medium	Medium	High	Very High
	2	Unlikely	Low	Low	Medium	Medium	High
	1	Rare	Low	Low	Low	Medium	High

Table 5 **Risk level and target action matrix used in evaluate risks**

Risk level	Target action
Very High	Risk is unacceptable. Specific action plans required to reduce risk to an acceptable level. Director/CEO level management attention required.
High	Risk is generally unacceptable without action. Specific action plans required to reduce risk to 'as low as reasonably practicable' (ALARP). Senior management attention required.
Medium	Risk is generally acceptable. Proactive action is required to reduce risk to ALARP. Requires routine monitoring and adaptive management in accordance with EMPs. Line management attention is required.
Low	Risk is acceptable. Management by routine policies and procedures. Reduce risk to ALARP and monitor to ensure risk level remains low.

Table 6 BBLF Maintenance Dredging Risk Assessment

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
Dredge Spoil Pond	Vegetation clearing	Removal of vegetation for the construction of the spoil pond.	Terrestrial biota	- Removal of environmental significant coastal vegetation resulting in impacts to local ecosystem functioning at the BBLF and surrounding environment.	3	4	**High**	- Vegetation within the proposed spoil pond area has been mapped, with vegetation type being common and widespread throughout the BBLF and surrounds. No vegetation of legislative significance is proposed to be removed. - The location for the dredge spoil pond has avoid environmental sensitive and significant vegetation communities (ie. Melaleuca swamp).	3	3	**Medium**
Dredge Spoil Pond	Receiving water quality	Dredge Spoil Pond Operation	Terrestrial biota Groundwater Surface water	- Seepage of highly saline and/or poor-quality water from the spoil pond to the surrounding environment. - Spill of dredge spoil pond to the receiving environment.	3	4	**High**	- Engineered design pond foundations and bund walls. Engineering certification prior to pond commission. - In-situ compaction testing during pond construction to ensure maximum amount of compaction is achieved. - Decant and discharge of excess water from spoil pond to promote drying of spoil material and reduce evaporative loss which can increase material salinity. - Surrounding vegetation of the area is generally tolerant of high saline conditions. - Routine visual inspections of pond bund walls. - Continued water monitoring programs to identify changes in water chemistry (e.g. groundwater monitoring program). - Dredge spoil pond to be operated below its designated Maximum Operating Level (MOL).	3	2	**Medium**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
								Should the dredge pond water volume be at or greater than the designated MOL, it will trigger the immediate cessation of dredge spoil deposition into the pond and dewatering of the pond to another nearby water storage at the BBLF, such as BBSP03 or SP04 in efforts to prevent uncontrolled discharge to the receiving environment.			
Dredge Spoil Pond	Receiving water quality	Potentially Acid Sulfate Soils (PASS)	Terrestrial biota Groundwater Surface water	- Excavation and exposure of PASS material causing material oxidation. - Seepage poor-quality water from the spoil pond to the surrounding environment.	3	4	**High**	- Engineered design pond foundations and bund walls. Engineering certification prior to pond commission. - In-situ compaction testing during pond construction to ensure maximum amount of compaction is achieved. - Previous assessments have concluding low risk of the potential presence of PASS at the proposed spoil pond location or within the BBLF marine sediment targeted by this dredge program. - Sampling of dredge spoil material during the first week of dredging program commencing to confirm presence of PASS.	3	1	**Low**
Dredge Spoil Pond	Vegetation	Terrestrial vegetation dieback	Terrestrial vegetation surrounding pond	- Seepage of highly saline / poor quality water from spoil pond impacting vegetation surrounding the pond, resulting in vegetation dieback.	2	4	**Medium**	- Surrounding vegetation of the area is generally tolerant of high saline conditions. - Routine (weekly) visual inspections of vegetation around the perimeter of the spoil pond will be undertaken.	2	2	**Low**
Dredge Spoil Pond	Marine surface water quality	Discharge of dredge spoil decant water	Marine surface water quality	- Contamination of marine surface waters within the BBLF associated with the	3	4	**High**	- Implementation of surface water monitoring plan including monitoring surface water quality at the decant pond, discharge point	3	2	**Medium**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
		to the BBLF swing basin		release of contaminated water. - Contamination of surface waters with the BBLF associated with the release of turbid decant water.				and within the mixing zone to assess for potential environmental impact from the release of decant water. - Visual monitoring of mixing zone during discharge of decant water to ensure there is not an excess of silt within the mixing zone. - Decant water is held in the decant basin for as long as possible to allow for suspended particulate matter to settle before been discharged. - Discharge of decant water will be controlled by the conditions of a waste discharge license.			
Dredging Operations	Marine habitat	Removal of benthic marine habitat	Marine biota	- Dredging of marine sediments removing benthic habitat (i.e. seagrass).	2	3	**Medium**	- The BBLF transhipment zone is a previously dredged area whereby limited benthic habitat existing owing to the historic capital dredging programs. - Some benthic biota may colonise previously dredged areas between maintenance events. However, further impacts on these directly-affected biota are not considered to be a key consideration in the assessment of maintenance dredging proposals. This is due to those direct impacts being largely unavoidable and recolonising biota being well-adapted to surviving within dynamic benthic habitats.	2	2	**Low**
Dredging Operations	Marine Surface water quality	Deterioration of marine water quality	Marine biota Marine water quality	- Reduction in marine water quality impacting light attenuation within water column.	3	4	**High**	- Selection and use of a cutter-suction dredge as the dredge method. This dredge method is commonly used in sensitive environments owing to the less intensive interaction with	3	2	**Medium**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
				- Mobilisation of metals into water column, impacting marine biota health.				sediments and vessel's ability to be stationary whilst operating. - Implementation of turbidity plume monitoring, allowing the detection of plume extent and magnitude. - Aerial survey (via drone) of dredging area. - Dredge rates will be altered in response to environmental conditions and monitoring data collected, with dredging rates decreased as required to minimise the extent of the turbidity plume. - Waste Discharge Licence to condition mixing zone (transhipment zone) water quality triggers. Should trigger values be exceeded at the compliance monitoring location, dredging operations will cease until mitigative controls are implemented.			
Dredging Operations	Coastal hydrology	Change in coastal hydrology	Marine biota Marine water quality	- Changes to transhipment zone's coastal hydrology associated with the removal of marine sediment and discharge of decant water.	2	3	**Medium**	- The BBLF has previously undergone extensive capital dredging programs since its construction. Maintenance dredging is not expected to cause any additional changes to coastal hydrology within the BBLF or surrounds given its an already dredged zone. - The transhipment zone experiences good tidal flushing with hydrology unlikely to be impacted from the discharge of decant water into the BBLF.	2	2	**Low**
Dredging Operations	Marine ecosystem	Invasive Marine Species	Marine biota	Impacts on marine ecology within the BBLF and surrounds.	2	3	**Medium**	- Ships from international ports are required to exchange ballast water outside of	2	2	**Low**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
								Australia's territorial sea under the *Biosecurity Act 2015*. - Mandatory requirement that all ships comply with Australian regulatory requirements with respect to the management of ballast water (ie. any vessels originating from foreign ports, a hull inspection is required, or vessels that have been outside of Australian waters in the previous 12 months may also necessitate inspection.			
Dredging Operations	Marine megafauna	Vessel strike	Marine megafauna	- Impacts on marine biodiversity caused by vessels striking megafauna.	4	3	**High**	- Mandatory speed restriction of four knots inside the channel and swing basin. - 10% under keel clearance. - Speed-restricted vessels. - Offshore six knots (mandatory go-slow zone of six knots). - Drivers of all marine vessels are to remain alert to marine megafauna and document all sightings with the General Manager. - Noise from dredge vessel expected to deter megafauna from the immediate area.	3	2	**Medium**
Dredging Operations	Marine habitat quality	Noise and light pollution	Marine megafauna	- Disorientation of megafauna. - Impacts on turtle nesting sites.	2	3	**Medium**	- Light intensity reduced from a nominal range of three nautical miles to one nautical mile. Light colour changed from white to flashing yellow. - Short duration program only spanning over three to forth months.	2	1	**Low**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
								- The BBLF is an operational port whereby noise and light impacts are already presence. The proposed dredging program is not expected to increase the impact of noise or light at the BBLF. - No turtle nesting sites within 10km of the BBLF.			
Dredging Operations	Marine habitat quality	Waste pollution	Marine biota Marine water quality	Introduction of rubbish/waste into the marine environment causing impact to marine ecology and water pollution.	3	3	**Medium**	- Appropriate collection and disposal of all vessel waste onshore in accordance with regulatory requirements (and by licensed waste contractor) and vessel operating procedures. - All materials and equipment on board vessels and plant are to be appropriately covered and/or stored to prevent waste overboard. - Dredge contractor to receive induction and training in relation to waste management procedures. - NRR Waste Management Plan developed and implemented. The Procedure will include details of waste types, quantities and methods of containment/disposal.	3	2	**Medium**
Dredging Operations	Vessel Refuelling	Hydrocarbon Spill	Marine biota. Marine surface water quality.	- Contamination of marine water quality. - Deterrent of marine fauna from habitat in the vicinity of spill.	3	3	**Medium**	- Fuel storage area is away from the wharf's edge, secure and appropriately bunded. - Fuel delivery pipeline has an automatic cut-off valve to prevent large spills. - No refuelling will be undertaken during inclement weather conditions to minimise chance of a spill.	3	2	**Medium**

Item	Aspect	Incident / Event	Receptor	Potential Impact	C[1]	L[2]	IR[3]	Management and Mitigation Measures	C[1]	L[2]	RR[4]
				- Impacts to mucous membranes of sensitive marine fauna. - Impacts on Turtle nesting beaches.				- Standard operating procedures including appropriate training, visual monitoring of hoses and the sea surface, initial shutdown, and spill response procedures will be implemented. - Twice daily servicing and inspection of vessels and machinery to identify and address any leaks or other problems. - Emergency response plan has been developed and implemented outlining the spill clean up procedure. - Hydrocarbon spill kits of sufficient capacity including booms and absorption materials will be onboard tugs/barges at all times, with a spill kit emergency response trailer also located at the BBLF wharf. - Automatic shut down on loss of pressure within marine vessel fuel systems in-place.			

Notes: [1] Consequence, [2] Likelihood, [3] Inherent Risk, [4] Residual Risk