

RUM JUNGLE REHABILITATION - STAGE 2A

DETAILED ENGINEERING DESIGN

**Technical Specification
Main Pit Backfill
Issued for Client and External Peer Review**

Prepared for:

Northern Territory Government
Rum Jungle Stage 2A, Mines Division
Department of Primary Industry and Resources
GPO Box 4550, Darwin, NT, 0801

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PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
12 Cannan Street
South Townsville QLD 4810 Australia
(PO Box 1012 Townsville QLD 4810)
T: +61 7 4722 8000
E: townsville@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

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APPENDICES

Appendix A 680.10421. MPS - Detailed Design Drawings

GLOSSARY

Abbreviation/Acronym	Full form
AHD	Australian Height Datum
AMD	Acid and Metalliferous Drainage
ANC	Acid Neutralising Capacity (or Acid Neutralisation Capacity)
AP	Acid Producing Potential
AS (/NZS)	Australian Standard (and New Zealand Standard)
bgs	Below Ground Surface
BoM	Bureau of Meteorology
CCGC	Coomalie Community Government Council
DIPL	NT Department of Infrastructure, Planning and Logistics
DPIR, the Proponent	NT Department of Primary Industry and Resources
EA Act	<i>Environmental Assessment Act 1982</i> (NT)
EBFR	East Branch of the Finniss River
EC	Electrical Conductivity
EFDC	East Finniss Diversion Channel
EIS	Environmental Impact Statement
EMP	Emergency Management Plan
ERA	Energy Resources of Australia
ESCP	Erosion and Sediment Control Plan
FRALT	Finniss River Aboriginal Land Trust
GPS	Global Positioning System
LDWQO (s)	Locally Derived Water Quality Objective (s)
Mt	Mount
NAF	Non Acid Forming
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
NTG	Northern Territory Government

GLOSSARY

Abbreviation/Acronym	Full form
PAF	Potentially Acid Forming
PPE	Personal Protective Equipment
Project	Rum Jungle Stage 3 Rehabilitation Project
QA/QC	Quality Assurance/Quality Control
RJ	Rum Jungle
RJCS	Rum Jungle Creek South
TARP	Trigger Action Response Plan
TO	Traditional Aboriginal Owners
TSS	Total Suspended Sediment
Qld	Queensland
WA	Western Australia
WRD	Waste Rock Dump (existing)
WSF	Waste Storage Facility (planned)
WTP	Water Treatment Plant

1 Preliminaries

This technical specification is intended for Main Pit Backfill Operations. This technical specification is to be read in conjunction with the Main Pit Water Management Plan and Technical Specifications. The Main Pit Water Management Plan and Technical Specification is the responsibility of the Water Treatment Plant Operations. Main Pit Backfill Operations are to work cooperatively and under the instruction of Water Treatment Plant Operations.

1.1 General

The Northern Territory Government (NTG), represented by the Department of Primary Industry and Resources (DPIR), proposes the rehabilitation of the former Rum Jungle Mine site (the Project), located 6 km north of Batchelor, Northern Territory (NT).

SLR Consulting Australia Pty Ltd (SLR) was engaged by DPIR to undertake the detailed design to meet the engineering requirements for the construction of the rehabilitation strategy.

The purpose of this specification is to describe the scope of the Main Pit backfilling works and to outline the standard of construction to be achieved. This specification is to be read in conjunction with the associated design drawings and the SLR Main Pit Backfill Strategy Report [1].

Where a difference of information occurs, the Specification shall take preference. Figured dimensions shall be taken in preference to scale. The Contractor shall verify all dimensions on site prior to commencing any work and be responsible for their accuracy.

1.2 Main Pit Background

The Rum Jungle Main Pit is located in the central mine reach along the pre-mining course of the East Branch of the Finnis River (EBFR). The pit was mined out in the 1950s and 1960s to about 105 m below ground level (bgl), approximately RL -35 m AHD, with a crest diameter of approximately 350 m with steep side walls and a spiralling haul road leading from the surface to the base of the pit.

Mining ceased in the early 1970s and a rehabilitation program for the site was established during the 1980s by the Commonwealth and NT Governments. Part of this rehabilitation program included the removal of tailings that were deposited on surface to the north west of the Main Pit and storing them at depth within the Main Pit. This was placed from the northern wall. The original thickness of backfilled tailings was estimated to be about 60 m. The remaining void was flooded to an approximate level of RL 61 m AHD (40 m head of water) by overflow water from the Finnis River and groundwater from the local bedrock aquifer [2].

The groundwater surrounding the Main Pit varies in quality with groundwater to the west of the pit being impacted by the former copper leach process but the groundwater to the east of the pit being relatively good quality. During the 1980s rehabilitation the pit lake water was treated through a water treatment plant along with lime dosing the water body to develop a stratified system [2]. At present, the waters within the Main Pit are stratified with a high-density chemocline present a few meters above the deposited tailings though mixing of the upper water layers does occur during the wet season inflows. Recent monitoring indicates the chemocline is approximately 4m thick with a top elevation of around RL 19m AHD [3].

1.3 Rehabilitation Strategy Overview

The scope of works for the Rehabilitation Project was developed from an understanding of current site conditions, contamination processes and a Land Use Plan goal.

1.3.1 Rehabilitation of Contamination

The actions planned to address contamination processes are:

- Slow down or halt the acid and metalliferous drainage (AMD) production reactions from waste rock onsite by consolidating waste rock into one of three new facilities based on potentially acid forming (PAF) characteristics. These facilities are:
 - Main Pit backfill zone;
 - Eastern Waste Storage Facility (WSF); and
 - Western WSF.
- Treat existing groundwater sources (i.e. the Main and Intermediate Waste Rock Dumps (WRDs)) that contaminate the EBFR by pumping and treating these impacted waters.
- Treat other AMD-impacted groundwater that does not contribute to the EBFR copper load (i.e. old ore stockpile area) by pumping and treating these impacted waters.
- Isolate radiological and AMD affected soils at the Rum Jungle site and Mt Burton from environmental and human receptors by relocating these soils to the new WSFs on site.
- Isolate asbestos materials at the Rum Jungle site from environmental and human receptors by removing from surface soils and relocating to the new WSFs or by another approved means offsite.
- Slow down or halt the future generation and transportation mechanisms for copper and other metals in the new WSF by adopting leading practice methodology for storage of PAF waste rock.

1.3.2 Reestablishment of Cultural Values

The actions that are planned to address the compromised environmental and cultural values that are not related to contamination processes are:

- Return the EBFR to its original course as far as possible.
- Restore land parcels that are poorly vegetated such as the Old Tailings Dam area and vine thicket stand.
- Revegetate new landforms to stabilise the surface and restore ecological function as far as practicable.

1.3.3 Scope of Works

To meet the above requirements, a number of work packages have been developed. These works will be concurrent, and all packages must take into consideration parallel works:

1. New Waste Storage Facilities (performed under Earthworks Works Package);
2. Backfill of Main Pit (**this scope of works**);
3. Water Treatment Plant;
4. Groundwater extraction bores (performed under Earthworks Works Package);

5. Access roads and river crossings (performed under Earthworks Works Package);
6. Remediation of excavated footprints (performed under Earthworks Works Package); and
7. Realignment of the EBFR (performed under Earthworks Works Package).

It is important to note that multiple Contractors may be on site at one time. **A Head Contractor will be appointed who will have overall responsibility for the Project Site.** It is envisaged that this will be the Civil Earthworks Contractor, hence all earthworks related activities, such as site set up, material haulage, haul road maintenance etc. will be the Head Contractor responsibility.

1.4 Main Pit Backfilling Objectives

The aim of the remediation strategy is to allow the:

1. Submergence and indefinite storage of the maximum possible volume of high-grade potentially acid forming (PAF) waste rock which is currently stored in various waste rock dumps (WRD) across Rum Jungle mine site. Submergence is to be achieved within the Main Pit with the backfilling strategy. Objectives are as follows:
 - a. Ensuring that the indefinite waste rock matrix is the correct pH to improve chemical stabilisation of the waste rock by dosing neutralant to the waste rock prior to placement within the pit at the correct dose rates;
 - b. Minimising disturbance of the chemocline layer, which can mobilise further contaminants;
 - c. Preventing bearing capacity failure of the in-situ tailings (i.e. ensure that placement of fill on tailings do not cause the tailings to displace, which can mobilise further contaminants);
 - d. Mitigating and minimising slope instability risk inherent within the Pit walls during and following construction;
 - e. Backfilling at rates compatible with the treatment of displaced Main Pit water by Water Treatment Plant (WTP); and
 - f. Ensuring the safety of people and equipment during construction.
2. Development of a final landform acceptable to Traditional Owners and sacred site Custodians. This includes long-term shallow pit lake therefore the backfill approach must allow for:
 - a. PAF placed to a final level no greater than RL 56 m AHD (after allowing for potential settlement of the in-situ tailings and placed backfill); and
 - b. Finished capping level placed to a level no greater than RL 58 m AHD.
3. Stabilisation and amelioration of the pit crest and upper pit wall slopes to a landform suitable for revegetation and safe future access; and
4. Realignment of EBFR back to its original course via the Main Pit final landform lake.

1.5 Performance Requirements and Design Criteria

Key performance requirements applicable to the preferred rehabilitation strategy for the wider Rum Jungle site are set out in Section 4.4 - *Scope of Works* [4], with specifics to the Main Pit backfilling provided in Section 4.4.2.1 – *Pit Backfilling Strategy*. The objectives are generally qualitative and are summarised below:

- Backfill the Main Pit with the most sulfatic rock possible; and

- Re-evaluate any preliminarily proposed backfilling methodologies based on further information and evaluate any alternatives, inclusive of:
 - Consideration to costs and impacts to the wider referred rehabilitation strategy.

Quantitative performance requirements and design criteria have been developed in conjunction with previous Main Pit backfill proposed strategies and waste rock characterisation including:

- Technical specifications - O’Kane’s Consultants: Rehabilitation of the Former Rum Jungle Mine: Stage 2 Works Specification, 2016 [5];
- Conceptual alternative approaches - Robertson GeoConsultants (RGC): Main Pit Backfilling Concept Approaches, 2016 [3];
- Completion Criteria, Completion and Framework Presentation – Department of Mines and Energy, Northern Territory Government, 2016 [4]; and
- Robertson GeoConsultants (RGC) and Dr Jones Environment Excellence, Physical and Geochemical Characteristics of Waste Rock and Contaminated Materials (Rev 2), 2019 [6].

The overarching performance requirements as defined by SLR are summarised below:

- Safe and acceptable stability, considering short-term and long-term for backfilling and final landform with additional long-term seismic considerations;
- Serviceability performance relating to target filling levels to aid in the re-alignment of the EBFR within the Main Pit’s footprint; and
- Technically feasible, cost effective methodology which adheres to anticipated wider project timelines with a high probability of success.

Environmental criteria [4]:

- Maximise the volume of PAF waste rock within the submerged storage facility at the Main Pit;
- Do not allow pit lake overtopping to occur except in extremely high flow events such as a cyclone;
- Maintain vegetation stands around the Main Pit unless removal has been expressly permitted in writing by the DPIR Project Director;
- Conformance to requirements of the site Aboriginal Areas Protection Authority Certificate for site;
- Water quality released from the Intermediate Pit must meet criteria established for Zone 2 Locally Derived Water Quality Objectives [7];
- Neutralant must be dosed with the waste rock at the rate nominated by the project Geochemist [6];
- Long term final pit lake landform must meet criteria established for Zone 2 Locally Derived Water Quality Objectives [7];
- Pit lake water levels are to be maintained at the operational levels as noted with in the Environmental Impact Statement 2020. Deviation from this may occur if required to protect groundwater and surface water conditions or for the purposes of safety;
- Long term final pit lake landform must meet criteria established for Zone 2 Locally Derived Water Quality Objectives [7];
- Safe for people, flora and fauna (short and long-term);

- Chemically, radiologically and physically stable (short and long-term);
- Significantly reduces acid and metalliferous (AMD) contaminant loads and concentrations travelling beyond the mine boundaries through placement of PAF waste rock below groundwater level.
- Culturally appropriate including the protection and preservation of Aboriginal cultural heritage; and
- Design life in keeping with the wider Rum Jungle remediation specifications.

1.6 Remediation Strategy

To achieve the objectives the remediation strategy includes sub-aqueously backfilling of the Main Pit to near surface water level using a mix of inert granular material for initial bedding layers and final clean cap and PAF waste rock for back fill material from the existing waste rock dumps on Site. During placement, removal and treatment of displaced pit lake water will be undertaken to offset the volume of backfill material being added. Incoming surface waters from rainfall within the Pit catchment will also need to be managed through the Water Treatment Plant (WTP).

The **backfill placement methods are to be developed by the Contractor and approved by the Superintendent** and shall be required to minimise the disturbance of the tailings and chemocline and therefore reduce the impact on the water which is treated.

Backfill Operations will work cooperatively and under instruction with Water Treatment Plant Operations to manage the water quality and water level within the Main Pit throughout the duration of backfilling operations.

Sub-aqueous placement will require preparatory works including establishment of preliminary pit lake pH to control geochemical risks, construction of access ramps into the Main Pit suitable for the required placement barge vessels. The former open cut pit haul road access offers the most convenient entry point, reducing the required cut back distance from the Main Pit. The access ramp will be cut adjacent to the pit rim at a maximum gradient of 1V:7H (preferably shallower). During backfilling operations, a minimum standoff distance of 40 m from the rim of the Main Pit is required for stockpiles and heavy infrastructure. Heavy vehicle movement near the pit edge should be managed to avoid excess localised loading.

Initially a 3.0 m thick graded sand bedding layer will be placed to improve bearing capacity and reduce the risk of capping instability occurring over the soft tailings. It is considered likely that a proportion of the initial fine bedding layer (having D85 < 1.18 mm, also referred to as “1 mm minus” or “-1 mm”) may penetrate the soft tailings resulting in some near-surface strength improvement due to mixing-in of initial granular material. Estimated volume adjustments for such mixing losses, settlements, backfill compression and bulking are presented in the SLR Main Pit Back Fill Strategy Report [1]. The Contractor is to make appropriate allowances for these losses when considering the volumes required to achieve target filling levels set out in this specification. Furthermore to the volumes provided, particularly for the lower layer sand bedding and waste rock lense, the nature of project specification dictates that the design reduced levels and thicknesses are “minimums” in order to achieve required geotechnical and geochemical stabilities. To this end, it is anticipated that some ‘over filling’ volume will be incurred during construction due to the limited control allowed in subaqueous placement. It is noted a key objective is to maximise the waste rock placed within the Main Pit, overfilling above design levels should be minimised with practicable, however there should be no compromise to achieving the specified fill levels, especially for the initial bedding and lens layers.

Based on the limiting angle of repose formed by the tailings materials in the Main Pit, the outer edge of the main tailings body is considered to be contained within the existing RL 19m AHD contour. As such, sand bedding material will be placed to this minimum lateral extent to achieve a minimum 3m thickness at RL 22m AHD within this contour and extending horizontally outside this area. Placement rates will be limited by the rate of water treatment and by geometry rules governing the height and gradient of temporary slopes of backfill material placed over the tailings.

To fill in the shallow 'bowl' shape formed above the existing tailings surface by the uniformly thick basal sand capping layers, a central lens of gravelly waste rock backfill material will be placed to achieve a target level of 22 m AHD across the pit. Restrictions on backfilling geometry and placement rates will again be based on geometry of backfill temporary slopes and rate of water treatment.

Given the poor strength of the tailings initially, waste rock placement will also be controlled in stages as filling is completed to RL 26 m AHD then RL 35 m AHD. Thereafter, the risk of instability and bearing failure is considered low and waste rock placement will be limited only by the rate of water treatment and a maximum temporary differential backfill height (Ref **Section 5.2.1**). Waste rock will be placed to a maximum height of 56m AHD. A final Inert Capping Layer with a minimum thickness of 2 m will be placed to a maximum elevation of RL 58m AHD.

After backfilling, the steepest existing side slopes along the rim of the Main Pit will be re-profiled by filling with granular borrow material to form shallow slopes with a gradient no steeper than 1 Vertical to 6 Horizontal (1V:6H) for stability and erosion management purposes. 200mm thick, non-dispersive topsoil layer is to be applied to re-profiled slopes that are located above the dry season water line (RL 59 m AHD). Finally, the EBFR will be re-aligned back to its original course through the Main Pit.

1.7 Nomenclature

For the purpose of this technical specification, the following terminology shall apply:

Drawings – The designated drawings, standard plans, profiles, typical cross-sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Design Consultant, which shows the location, character, dimensions and details of the Work(s) performed.

Construction Quality Assurance (CQA) – A planned and systematic pattern of all means and actions designed to provide confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service. CQA refers to means and actions employed by the CQA Consultant or Superintendent on behalf of the Principal, to assure conformity of the Works to the Design documentation.

Construction Quality Control (CQC) – Those actions which provide a means to measure and regulate the characteristics of an item or service to contractual requirements. Construction Quality Control refers to those actions taken by the Contractor to ensure the materials and the workmanship meet the requirements of the Design documentation.

Contract – The written agreement between the Contractor and the Principal covering the performance of the Work(s). The Contract shall include all tender documents, the Contractor's tender, drawings, specifications, contract bonds (if applicable), and all supplemental agreements amending or extending the Work(s) contemplated and which may be required to complete the Work(s) in a substantial and acceptable manner.

Contractor – The individual, partnership, corporation, joint venture, alliance, or other legal entity having a Contract with the Principal to perform the Work and includes the Contractor’s representatives or other parties such as sub-contractors, manufacturers, suppliers etc. The Contractor will undertake the execution of the Works under the terms of the Contract.

CQA Consultant – The Company responsible for undertaking quality assurance associated with the Works.

Design Consultant – The Company responsible for design and preparation of the Design documentation. All design changes must be approved by the Design Consultant (SLR Consulting).

Design documentation – All drawings and documents presenting the Main Pit Backfill Design and approved for use by the Principal.

Head Contractor – The Contractor who is to carry out construction work or supply related goods and services for the Principal under a construction contract (the "Main Contract") and for whom construction work is to be carried out or related goods and services supplied under a construction contract as part of or incidental to the work or goods and services carried out or supplied under the main contract.

The Head Contractor will take account of the health and safety risks to everyone affected by the work (including members of the public), in planning and managing the measures needed to control them.

Independent Testing Laboratory – The NATA-accredited Contractor(s) responsible for conducting all required laboratory tests.

NT DPIR – Northern Territory Department for Primary Industry and Resources.

Principal – The person or persons, firm or company or other body who owns and has responsibility for the Main Pit Backfilling and has entered into the Contract with the Contractor.

Project – The rehabilitation of the former Rum Jungle Mine

Site – Former Rum Jungle Mine and associated borrow areas.

Superintendent – Person(s) authorised by the Principal to manage and oversee the construction and CQA works.

Work(s) – All actions, tools, equipment, supervision, labour and materials or supplies necessary to complete the Main Pit backfilling in accordance with the Design documentation.

Work(s) Area – The portion within the Site associated with the Works.

1.8 Glossary

Table 1 Glossary of Terms

Term	Definition
AHD	Australian Height Datum
CPT	Cone Penetrometer Test
EBFR	Eastern Branch Finnis River

Term	Definition
ICL	Inert Capping Layer. 2.0 m thick clean, inert, non-dispersive fill layer overlaying backfilled waste rock
SBL	Sand Bedding Layer. Initial layer placed over tailings to facilitate backfill works.
WR	Waste Rock
-1.00 mm	Sand with 85% finer than 1.00 mm
+1.00 mm	Sand with 85% coarser than 1.00 mm

1.9 Drawing List

The Construction Drawings as summarised in **Table 2** shall be read in conjunction with this Specification.

Table 2 List of construction drawings

Drawing Number	Drawing Description
680.10421.MPS.D01	Existing Main Pit Site Conditions
680.10421.MPS.D02	Main Pit Rehabilitation Plan
680.10421.MPS.D03	Main Pit Access and Laydown Area
680.10421.MPS.D04	Main Pit Entry Ramp Detail
680.10421.MPS.D05	Main Pit Rehabilitation Sections
680.10421.MPS.D06	Main Pit Section B - Typical Backfill Details Sheet 1 of 8
680.10421.MPS.D07	Main Pit Section B - Typical Backfill Details Sheet 2 of 8
680.10421.MPS.D08	Main Pit Section B - Typical Backfill Details Sheet 3 of 8
680.10421.MPS.D09	Main Pit Section B - Typical Backfill Details Sheet 4 of 8
680.10421.MPS.D10	Main Pit Section B - Typical Backfill Details Sheet 5 of 8
680.10421.MPS.D11	Main Pit Section B - Typical Backfill Details Sheet 6 of 8
680.10421.MPS.D12	Main Pit Section B - Typical Backfill Details Sheet 7 of 8
680.10421.MPS.D13	Main Pit Section B - Typical Backfill Details Sheet 8 of 8
680.10421.MPS.D14	Main Pit Backfill Methodology Details
680.10421.MPS.D15	Re-profiling Infill Layout Plan
680.10421.MPS.D16	Re-profiling Infill - Typical Sections

1.10 Scope of Works

This Specification document details the activities surrounding the backfilling and rehabilitation of the Main Pit.

The scope of works includes the following Construction items:

- Site Establishment (Earthworks Works Package, Water Treatment Package and Main Pit Backfill Operations Package);
- Sand Bedding Material and Waste Rock Material Haulage (performed under Earthworks Works Package);

- Lime Supply;
- Materials processing and Stockpile Management;
- Placement of Sand Bedding Layers:
 - Fine Sand Bedding Layer (1 mm minus, -1 mm, SBL-1);
 - Unscreened Sand Bedding Layer, SBL-U/S; and
 - Coarse Sand Bedding Layer (1 mm plus, +1 mm, SBL+1).
- Placement of Waste Rock Layers;
- Placement of Inert Capping Layer;
- Monitoring and survey operations;
- Re-profiling of the Main Pit side slopes (*performed under Earthworks Works Package*); and
- Re-alignment of the EBFR (*performed under Earthworks Works Package*).

1.10.1 Site Establishment

The works for site establishment includes the following scope:

- Superintendent to perform Main Pit Slope Risk Assessment (SRA) and general site suitability assessment prior to establishment;
- Superintendent to install exclusion zone demarcation and assess proposed locations for Main Pit backfill operations (Offices, Laydown Yard, Stockpile Area, Material Processing Area, Crane outrigger locations, Conveyor locations/foundation (if applicable), etc);
- Site clearance, including de-vegetation where required, and setting out Works area (performed under Earthworks Work Package);
- Construction of diversion bunding around Main Pit to prevent surface water run-off entering Main Pit (performed under Earthworks Work Package);
- Construction Main Pit inlet flow exclusion and Diversion Channel Modifications (performed under Earthworks Work Package);
- Construct and Commission Main Pit dewatering system (performed under Water Treatment Plant Work Package);
- Construction of access ramp to Main Pit (Earthworks Contractor under instruction of Main Pit Backfill Contractor);
- Construction of site compounds and platforms for lay-down and stockpile areas, vehicle parking, amenities, site accommodation (Earthworks to be performed under Earthworks Work Package under instruction from Main Pit Backfill Contractor); and
- Install pontoon;
- Mobilise barge, punt(s) and required equipment;
- Bathymetric survey of the Main Pit to establish a baseline survey for backfill design; and
- Screen and stockpile sand bedding layer materials.

1.10.1.1 Exclusion Zone

A 40 m exclusion zone has been nominated around the Main Pit Perimeter as a risk mitigation measure against the anticipated poor Main Pit wall conditions.

It is anticipated some works and equipment will likely be required to operate within the exclusion zone, especially Main Pit backfill operations.

Prior to site establishment, equipment, infrastructure and operational areas to be set-up within the exclusion zone, are required to be assessed by a suitability qualified geotechnical engineer prior to establishment. As a minimum, the geotechnical engineer is to assess the proposed area for its intended use and impact to Pit wall stability. The Contractor is to follow any recommendations and guidance provided by the Geotechnical Engineer.

As a means of expediting works, zones that may be progressively established over the life of the works can be assessed pre-emptively prior to site establishment. If the anticipated equipment and loading type is unknown at the time of assessment, the geotechnical engineer is to provide maximum allowable loads and off-sets for the areas assessed. A copy of any assessment report is to be provided to the Superintendent for review and approval prior to site mobilisation.

1.10.2 Materials haulage, processing and stockpile management

Haulage of waste rock and sand bedding materials to the Main Pit Backfill Operations will be performed under the Earthworks Works Package.

The works for material processing and stockpile management includes the following:

- Construction of facilities for housing screening, mixing and materials testing plant for inspection and acceptance of site-won, imported backfill materials and lime on to the Works area;
- Supply of hydrated and granulated lime;
- Operation of segregating, stockpiling, screening, testing, lime dosing/mixing and managing stockpiles of various materials; and
- Measurable, demonstratable and auditable lime dosing/mixing appropriate to the backfill material prior to sub-aqueous placement.

1.10.3 Placement of Sand Bedding Layer Material

The works for placement of Sand Bedding Layer material includes the following, placed using the controls identified in **Section 5.2.1** and as shown in **Drawing 680.10421MPS.D06 to D09 and D14**:

1. A **minimum** 1.0 m thick bed (comprising two (2) 0.5 m layers) of -1 mm Sand Bedding Layer (SBL-1) shall be mixed with hydrated lime at 1.7% w/w rate and placed sub-aqueously to a target elevation not less than 1m above the existing tailings surface level within an area defined by the 19m AHD pit wall contour, and in other areas to a level not exceeding 20 m AHD (above the RL 19 m AHD pit wall contour);
2. A **minimum** 1.0 m thick bed of Unscreened Sand Bedding Layer (SBL-U/S) shall be mixed with hydrated lime at 1.7% w/w rate and placed sub-aqueously to a target elevation not less than 1m above the SBL-1 surface level within an area defined by the RL 19 m AHD pit wall contour, and in other area to a level not exceeding RL 21 m AHD; and
3. A **minimum** 1.0 m thick +1 mm Sand Bedding Layer (SBL+1) shall be mixed with hydrated lime at 1.7% w/w rate and placed sub-aqueously to a target elevation not less than 1m above the SBL-U/S surface level within

an area defined by the RL 19 m AHD pit wall contour, and in other areas to a level not exceeding RL22 m AHD.

All target levels above are to be achieved within tolerances defined in **Section 2.2**

1.10.4 Placement of Waste Rock Layer Material

The works for placement of Waste Rock Layer material includes the following, placed using the controls identified in **Section 5.3.2** and as shown in **Drawings 680.10421.MPS.D10 to D12 and D14**:

1. Within extent of Main Pit shown on **Drawing 680.10421.MPS.D02**, processed PAF Waste Rock, dosed with lime in accordance with dosing rates applicable to waste rock source, shall be placed sub-aqueously onto the surface of the finished Sand Bedding Layers and existing pit floor materials by spreader pontoon to achieve a uniform surface across the pit to a target level of RL 22 m AHD (Ref: **Drawing 680.10421.MPS.D10**)
2. Subsequent layers of waste rock shall be placed sub-aqueously and dosed with lime in accordance with dosing rates applicable to waste rock source, to achieve a uniform surface across the pit to a level not exceeding 56m AHD (Ref: **Drawing 680.10421.MPS.D11 to D12**).

1.10.5 Placement of Inert Capping Layer Material

The works for placement of Inert Capping Layer material includes the following, placed using the controls identified in **Section 5.3.3** and as shown in **Drawings 680.10421.MPS.D13, D13 and D16**:

1. A **minimum** 2.0 m thick layer of Inert Capping material shall be placed sub-aqueously, to cover the surface of the waste rock, to a level not exceeding RL 58 m AHD.

1.10.6 Monitoring and Surveying Operations

The minimum works for monitoring and surveying operations during backfilling shall include the following:

1. Weekly bathymetric surveys of the Main Pit surfaces as backfilling progresses;
2. Periodic testing of material grading conformity as per the specification;
3. Periodic Cone Penetration Testing (CPT) of placed sand bedding layer materials backfilling progresses as per the specification;
4. Volumetric (m³) and weight (tonnes) recording of backfilled materials that is measurable and auditable; and
5. Volumetric (m³) and weight (tonnes) recording of lime dosing (rates and total) against waste rock source that is measurable and auditable.

Main Pit Water body (quality and water level) will be managed by the Main Pit Water Management Plan to be the responsibility of the Water Treatment Plant Operations with specifications detailed in Main Pit Water Management Technical Specification. Backfill Operations are to work cooperatively and under instruction of Water Treatment Plant Operations to manage the Main Pit Water body.

1.10.7 Re-profiling Pit Rim Side Slopes

Reprofiling of the Pit Rim Side Slopes will be performed under the Earthworks Work Package.

The works for the reprofiling of the Main Pit crest side slopes includes the following:

1. Re-profile over-steep and potentially unstable slopes along the rim of the Main Pit using conventional earth moving equipment and side casting style techniques to buttress the pit crest and shallow slopes to no steeper than 1 vertical to 6 horizontal (1V:6H);
2. Strip surface waste rock from within the 40 m exclusion zone at the pit perimeter;
3. Installing erosion protection to the re-profiled side slopes consisting of coarse granular borrow material as detailed in **Drawing 680.10421.MPS.D15** and **D16**; and
4. Removal of diversion bunding around Main Pit (performed under Earthworks Work Package).

1.10.8 Re-alignment of EBFR

Re-alignment of the Eastern Branch Finnis River will be performed under the Earthworks Work Package.

The works for the re-alignment of the EBFR includes the following:

1. Re-direct EBFR into inlet to Main Pit; and
2. Remediate EBFR diversion channel by cut and fill earthworks.

1.10.9 Demobilisation

1. Final bathymetry survey of final surface (upon completion of capping and following landform contouring);
2. Removal of Barge;
3. Removal of Barge anchor points and pontoon;
4. Removal of surplus stockpiles; and
5. Removal of office backfill infrastructure/equipment and rehabilitation of area.

1.11 Management Plans

The Management Plans as summarised in **Table 3** shall be read in conjunction with this Specification.

The Contractor will be required to participate in the development of a site Main Pit Water Management Plan that outlines the communication and protocols required between the Backfill and Water Management operations to ensure safe and efficient delivery of these work packages.

Table 3 Management Plans

Management Plan	Application
Main Pit Water Management Plan	<ul style="list-style-type: none"> • Surface water controls over Main Pit and Intermediate Pits to reduce risk of overtopping. • Water quality and water level management during backfilling operations.
Erosion and Sediment Control Plan	
Cultural heritage engagement	
Waste Management Plan	

1.12 Construction Quality Control and Construction Quality Assurance

Construction Quality Control (CQC) and Construction Quality Assurance (CQA) will be provided by the CQA Consultant to ensure all materials used in the Works meet the material requirements as set out in this Specification and the Works are carried out and completed in accordance with the Contract Documents and with this Specification.

1.12.1 Construction Quality Control

All CQC testing shall be arranged by the Contractor at the direction of the CQA Consultant and shall be carried out by appropriately qualified personnel.

Copies of all test results shall be sent to the Superintendent within two days of becoming available to the Contractor. The minimum testing frequencies shall be as nominated within the various parts of the Specification.

At any stage throughout the Works, the Superintendent may arrange for independent testing or surveying to be carried out. If that testing reveals that any Works are found to be non-compliant with the Contract, the Contractor shall undertake rectification of the non-compliant items and conduct any re-testing required in accordance with the Specification.

1.12.2 Construction Quality Assurance

A CQA Plan will be developed in conjunction with the design and will be implemented by the Principal to ensure that the Works are undertaken in a manner that demonstrates compliance with the Contract Documents and with this Specification.

The Principal shall appoint a CQA Consultant to undertake all aspects of quality assurance for the Works. If required by the Principal, the CQA Consultant shall supply a CQA Representative to site, who has suitable experience in undertaking CQA activities. All following references to the CQA Consultant are subject to the role being engaged by the Principal.

The Contractor shall allow the CQA Consultant and the Superintendent (or their designated representatives) full access to the Works to undertake their responsibilities.

1.13 Meetings

1.13.1 Pre-construction Meeting

A Pre-Construction Meeting will be called prior to initiating construction works between the Contractor, Superintendent, CQA Consultant and other representatives as determined by the Principal. As a minimum, the following items will be covered in the meeting:

- Reviewing the Contract Scope of Works;
- Reviewing the responsibilities of each party;
- Reviewing the lines of authority and communication;
- Defining the boundary of the Works;

- Welfare, health and safety (WH&S) issues and areas needing particular attention or consideration (flooding and extreme weather, safe working distance from Main Pit edge, site services, infrastructure and traffic management, implementation of a construction risk register, etc.);
- Reviewing the procedures for review and approval of construction submittals and requests for information;
- Reviewing the proposed work method statements for the various phases of construction (including equipment), with specific emphasis on methods of select grading, haulage, lime dosing and mixing, placement, stockpiling, processing, CQC/CQA activities and other items as determined by the Superintendent;
- Reviewing the procedures for field and laboratory CQC/CQA testing;
- Compiling field and laboratory CQC and CQA test data for inclusion in the weekly and monthly periodic reporting and construction completion reports;
- Establishment of procedures for correcting construction deficiencies and documenting remediation of construction deficiencies; and
- Reviewing and agreeing the baseline construction schedule and completion dates.

1.13.2 Project Control Meetings

Throughout the construction phase of the Works, regular project control meetings will be held as required to ensure the activities of all parties are coordinated effectively and efficiently. Construction and design issues shall also be reviewed and discussed at project control meetings. The following documentation shall be developed by the Contractor and updated weekly (minimum) and provided by the Contractor for integration with the Head Contractor:

- Risk Register; and
- Construction Schedule.

1.13.3 Meeting Agendas and Meeting Minutes

Preparation of an agenda and minutes for all formal meetings involving the Contractor, Superintendent and other support personnel shall be taken by the Superintendent and distributed to all attending personnel/parties.

1.13.4 Periodic Reporting

The Contractor is to provide the following Progress Reports:

Weekly

- Backfilling activities and completion status;
- Survey Reports including heat-maps of backfill gradient*, elevation (RL m AHD), maximum differential fill height*;
- Results of relevant CQC tests;
- Summary of incremental and total placed volumes and weight of each material type including waste rock source, liming rates for each Waste Rock source (**Table 8**) and lime quantities mixed;
- Neutralant (lime) consumption and forecast use for supply management;

- Production rate issues and rectification plans;
- Plant availability and utilisation rates and lost production including mode; and
- Earned value reporting of placed material volume up to the agreed contract sum as a basis for payment claims.

* within the nominated areas and using the survey grid resolutions identified in the Specification

Monthly

- Construction Lot activities and completion status;
- Earned value reporting as a basis for payment claims;
- Summary of RFIs, changes and variations;
- Design delivery program update, including look ahead for review;
- Issues affecting construction and backfilling delivery, including information outstanding;
- HOLD/WITNESS Point Register;
- Risk Register;
- Resources; and
- External meetings (who the Contractor has communicated with).

1.14 Personnel and Relevant Experience

The Contractor shall give or provide all necessary supervision during the execution of the Works and as long thereafter as the Superintendent may consider necessary. Such supervision shall be given by an experienced person having adequate knowledge of the operations to be carried out (including the construction methods and techniques required, construction quality control procedures, the hazards likely to be encountered and the methods of preventing and responding to accidents) as may be requisite for the satisfactory construction of the Works.

The Contractor shall maintain an experienced management, supervisory and quality control team under the nominated Project Manager that is committed to achieving and maintaining the standards specified for the Works.

Prior to commencement of the Works, the Contractor shall provide to the Superintendent a list of key personnel they propose to employ, together with a resume of their experience and qualifications. The list of key personnel shall include the name of the full-time Project Manager as well as contact details for all key personnel. The list will be accompanied with a chart showing the key personnel on the project and who / what they are responsible for. The list of key personnel shall be maintained and updated by the Contractor throughout the construction period.

The contractor shall document plans to conform with the Northern Territory Department of Primary Industry and Resources project employment targets for local staff, indigenous Australians and Traditional Owners.

1.15 Plant and Equipment

The Contractor shall use plant of suitable and appropriate capacity to carry out the work in accordance with the Specification. Each item of plant will be maintained and operated in a safe manner in accordance with the plant manufacturer's recommendations. Plant operators are to be trained and certified by an approved body for the plant they are operating. The Contractor will consider the potential safety hazards of the proposed works and adapt plant and vehicles accordingly.

1.16 Non-conformances

Any non-conformance will be documented by the contractor, detailing the non-conformance and proposed rectification measures undertaken to rectify the non-conformance.

1.17 Construction Compound

The Contractor shall provide as a minimum the following in the Compound:

- Offices;
- Telecommunications;
- Car parking;
- Electricity supply (diesel generators);
- Drinking water supply;
- First aid treatment room; and
- Crib sheds.

Requirements include:

- Located more than 50 m away from a waterway;
- Have ready access to road network;
- Be sited on relatively level land;
- Require minimal vegetation clearing (preferably none);
- Be above the 20 ARI Flood level unless a contingency plan to manage flooding is prepared and implemented;
- Provide sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries outside standard construction hours; and
- Located at least 100 m from any Aboriginal significant sites.

On closure all facilities and access points shall be rehabilitated to at least their pre-construction condition or better unless otherwise agreed by FRALT where relevant.

1.18 Information Outside of Contract

Additional information concerning Main Pit Backfilling may be provided to the Contractor from time to time, if such information is considered likely to assist the Contractor in the Works. Such information is not part of the Contract and shall be used by the Contractor at their discretion and at their risk.

2 Site Establishment and Survey

The Contractor shall establish whatever survey control that is necessary for set out of the Works and shall ensure all available survey reference stations are suitably protected from disturbance at all times. The Superintendent will make available plans (AutoCAD compatible) of the site and works area and suitable survey benchmarks to enable the Contractor to set out the work in accordance with the Issued for Construction Drawings and the Specification. The Contractor shall set out the Works from the data shown in the Detailed Design Drawings.

Drawing **680.10421.MPS.D13** and **D15** provide an indication of current ground levels and proposed final backfilled level of the Main Pit and shall provide a basis for measurement purposes. Drawing **680.10421.MPS.D03** and **D05** present the most recent (2015) bathymetric survey of the Main Pit which has been used in the development of the backfilling strategy.

The Contractor shall undertake a detailed topographic and multi-beam bathymetric survey of the Site and Main Pit floor to be submitted to the Superintendent to form baseline surveys. The bathymetric survey shall be reviewed by an independent 3rd Party employed by the Contractor with subsequent review report provided to the Superintendent and Principal. The baseline survey will be used to measure against the target filling elevations during filling and to confirm acceptance that each backfill layer (by material type and/or by monthly time milestones) have achieved the target elevations and so that fill areas may be progressively released for subsequent layer filling.

Any discrepancies identified by the Contractor between the site conditions and the levels within the Issued for Construction Drawings are to be notified to the Superintendent immediately.

If the Contractor's survey of pre-construction ground and submerged surface levels differs to the ground and submerged surface levels shown in the Issued for Construction Drawings the Contractor's survey shall be sent to the Superintendent for confirmation and issuance to the Design Consultant to ensure the proposed backfill design is still applicable.

2.1 Survey and Monitoring of Backfilling Materials

The Contractor shall monitor all backfilling activities and shall be responsible for verifying the quantities of backfill material delivered to the works area. Estimates of quantities of backfill material are summarised in **Table 6**. Estimated liming quantities are also provided. The quantities are provided for bidding purposes only and do not account for material lost to soft tailings and settlement (expect an allowance for 1m settlement during a 26-month backfilling program), shrinkage and swell, excess material or waste. It is therefore important that the contractor make allowance for additional material that may be required to account for these losses. Priority is for the Contractor to maximise the volume of Waste Rock Placed into the Main Pit whilst adhering to the Specifications and Main Pit Water Management requirements.

Furthermore, it shall be the Contractors responsibility to ensure sufficient material is sourced and placed within each of the required layers to **ensure the target elevations are reached and verified** prior to continuing filling with the next layer. The Contractor shall verify the completion of each layer by confirming the target elevation for that layer has been achieved and provide the bathymetric survey data to the Superintendent for Approval.

A bathymetric survey audit shall be performed by an independent 3rd Party employed by the Contractor and approved by the Superintendent at a minimum of once every 2 months (8 weeks). The audit shall comprise of a bathymetric survey and subsequent report. The report will provide, as a minimum, commentary and comparison

on the accuracy and suitability of the survey methodology employed by the Contractor. The audit bathymetric survey is to be performed at similar time to the Contractor survey. The audit report is to be provided to the Superintendent and Principal. The Superintendent and Principal reserve the right to amend the Bathymetric survey protocols if outcomes of the audit prove the survey methods employed by the Contractor to be unsatisfactory.

Fill lots will be progressively released according to the elevation gates defined in **Table 6**. Volume estimates are shown for guidance only; The Contractor shall not rely on these volume estimates of material placed for any layer as this may fluctuate depending on bulking, mixing, fill compression and consolidation of underlying materials.

Lime dosage rates are provided in **Table 4** and **Table 5**. Contractor shall dose and mix the lime with the Waste Rock prior to sub-aqueous placement. Lime dosage and mixing methodology are to be demonstrable, recordable and auditable and provided to the Principal for approval prior to commencement of works as per **Section 1.13**.

The Contractor shall apply lime dosing and mixing methods that minimise double handling where possible. The Contractor is made aware, material processing and/or backfilling are likely sufficient to mix the lime. The critical aspect is to ensure dose rates are in accordance with those provided below and are applied to the material that is backfilled (as opposed to processed).

Table 4 Main Pit Hydrated Liming Rates

Material to Treat	Placement Location	Hydrated Lime Treatment*	Total Lime Weight [#]
Sand Bedding Layers	Main Pit	1.7% by weight of Bedding Layer Material Backfilled	3,105 tonnes

Table 5 Main Pit Granulated Liming Rates

Material to Treat	Placement Location	Granulated Lime Treatment*	Total Lime Weight [#]
Intermediate WRD	Main Pit	24 kg CaCO ₃ per tonne of WRD	44,652 tonnes
Dyson's Overburden WRD	Main Pit	24 kg CaCO ₃ per tonne of WRD	26,940 tonnes
Main WRD	Main Pit	15 kg CaCO ₃ per tonne of WRD	11,168 tonnes

Table Notes: [*] The weight of lime required will be calculated from the liming rates provided in **Table 4** and **Table 5** and factored for lime efficiency according to the formula provided below:

$$\text{Lime rate required} = \text{Lime Rate (as per Table 4 or Table 5)} \times 100 / \text{Lime Efficiency (as \%)}$$

[#]: The total lime volumes presented in **Table 5** have been factored for a 79% Lime Efficiency as a typical lime efficiency for local Northern Territory Lime Quarries.

Table 6 Backfilling Layer Sequence and Volume Summary

Time Step	Water Level	Surface RL	Load Change	Total	Description	Time to Place	Cumulative Thickness	Top RL	Unbulked Volume	In Pit Volume [#]	In Pit Cumulative Volume
	(m AHD)	(m AHD)	(kPa)	(kPa)		(months)	(m)	(m AHD)	(m ³)	(m ³)	(m ³)
	61	16	0	0	Tailings						
4A-1	61	16.5	4.595	4.595	0.5m Fine Sand Bedding (Pontoon)	1.6	0.5	16.5	14,409	14,409	14,409
4A-2	61	17	4.595	9.19	0.5m Fine Sand Bedding (Pontoon)	1.5	1	17	14,072	14,072	28,481
4B	61	18	9.190	18.38	1m Unscreened Sand Bedding (Barge)	1.2	2	18	26,834	26,834	55,315
4C	61	19	9.190	27.57	1m Coarse Sand Bedding (Barge)	1.1	3	19	24,881	24,881	80,196
5A	61	20	9.190	36.76	1m WR Fill (Barge) Lens	0.4	4	20	17,185	22,340	102,536
5B	61	22	18.38	55.14	2m WR Fill (Barge) Lens (Max 2m thick)	0.6	8	22	25,758	33,485	136,021
5C	61	27	36.76	101.09	5m WR Fill (Barge/Conveyor)	2.8	11	27	126,440	164,372	300,393
5D	61	31	36.76	137.85	4m WR Fill (Barge/Conveyor)	1.3	15	31	129,912	155,894	456,287
5E	61	35	36.76	174.61	4m WR Fill (Barge/Conveyor)	1.5	19	35	135,227	175,795	632,082
5F	61	39	36.76	211.37	4m WR Fill (Barge/Conveyor)	1.7	23	39	152,023	197,630	829,712
5G	61	43	36.76	248.13	4m WR Fill (Barge/Conveyor)	1.9	27	43	169,302	220,092	1,049,804
5H	61	47	36.76	284.89	4m WR Fill (Barge/Conveyor)	2.1	31	47	193,339	251,341	1,301,145
5I	61	51	36.76	321.65	4m WR Fill (Barge/Conveyor)	2.4	35	51	221,046	287,360	1,588,505
5J	61	56	45.95	367.60	5m WR Fill (Barge/Conveyor)	3.5	40	56	313,870	408,031*	1,996,536
6	61	58	18.38	385.98	2.0m Inert Capping Fill (Barge/Conveyor)	1.5	42	58	176,692	176,692	2,173,228
TOTAL VOLUME											2,173,228
Notes: [*]: Includes allowance for 1m settlement of tailings during 26 months of backfilling [#]: Volume available for storage.										Waste Rock Only	1,916,340
										-1.0mm Fine Sand	28,481
										Unscreened Sand	26,834
										+1.00mm Coarse Sand	24,881
										Inert Capping	176,692

The Contractor shall carry out as-constructed surveys to confirm and record finished surface elevations at each of the following stages of backfilling and at other times as may be deemed necessary to confirm compliance with the Construction Drawings, with the Specification and to measure quantities for payment purposes:

- During site establishment and prior to any construction or backfilling Works (survey to form baseline of design);
- On completion of the Main Pit access ramp (performed under Earthworks Works Package);
- Weekly until completion of -1 mm Bedding Layer (survey to confirm compliance with placement controls, backfill elevation and area of coverage);
- Weekly until completion of Unscreened Bedding Layer (survey to confirm minimum thickness and area of coverage);
- Weekly until completion of +1 mm Bedding Layer (survey to confirm compliance with placement controls, backfill elevation and area of coverage);
- Weekly until completion of Waste Rock up to RL 56 m AHD (survey to confirm compliance with placement controls, backfill elevation and area of coverage);
- On completion of re-profiling Main Pit rim side slopes (survey to confirm achievement of design criteria (performed under Earthworks Work Package); and
- On completion of the re-alignment of the EBFR (survey to confirm achievement of design criteria (performed under Earthworks Work Package).

The Contractor shall give sufficient notice of the intention to survey to enable the Superintendent to conduct a joint survey or check the Contractor's survey. No finished survey shall be undertaken until the Works represented by the survey have been approved by the Superintendent.

The Contractor shall forward a hard copy drawing and electronic copy (in an AutoCAD compatible format) of the topographic and bathymetric surveys within two (2) days of undertaking the topographic and bathymetric surveys to the Superintendent.

A bathymetric survey audit shall be performed by an independent 3rd Party employed by the Contractor and approved by the Superintendent at a minimum of once every 2 months (8 weeks). The audit shall comprise of a bathymetric survey and subsequent report. The report will provide, as a minimum, commentary and comparison on the accuracy and suitability of the survey methodology employed by the Contractor. The audit bathymetric survey is to be performed at similar time to the Contractor survey. The audit report is to be provided to the Superintendent and Principal. The Superintendent and Principal reserve the right to amend the Bathymetric survey protocols if outcomes of the audit prove the survey methods employed by the Contractor to be unsatisfactory.

Proceeding with backfilling of an overlying layer shall not commence until the target elevation and extent of the preceding layer has been approved by the Superintendent. The Superintendent will assess the topographic surveys and provide initial response to the Contractor within two (2) days from the day the topographic survey is received.

2.2 Tolerance Limits

The tolerance limits for backfill material layers shall be as follows:

- Elevation tolerance: -100 mm to +100 mm (SBL-1, SBL-U/S, SBL+1);
- Elevation tolerance: -300 mm to +300 mm (WR and ICL); and
- Final grade tolerance: +/- 1%.

The tolerance limits for all other Works shall be as follows:

- Elevation tolerance: -100 mm to + 100mm;
- Final grade tolerance: +/- 1%; and
- Unless agreed to by the Design Consultant and Superintendent, the level at any point of the works shall not differ by more than 50 mm from the Construction Drawings.

2.3 Existing Services and Utilities

The locations of all existing services within the area of the Works shall be identified by the Contractor prior to commencement of works. Such services may include newly installed surface water pipes, drainage channels and associated features, as well as any telecommunications, electrical and water supply services. There may be a need to either relocate or redirect a number of existing services to complete the Works as specified, which shall be arranged by the Superintendent.

The Contractor shall make every effort to avoid damage or disturbance to any existing services or structures located within the site. The Contractor shall erect and maintain temporary barriers, hoardings etc. and shall alter their work practices, as may be required, for the protection of such installations.

Should any service be damaged, the Superintendent is to be notified immediately. Damage to services caused by the Works, or by the Contractor's activities, is to be repaired at the Contractor's expense and shall be carried out in the shortest possible time.

2.4 Main Pit Access (Performed under Earthworks Works Package)

The Contractor is to ensure all safe entry and exit requirements to the Main Pit are met. The Contractor is to instruct and guide Earthworks Contractor on Main Pit Access requirements if differing to details below.

2.4.1 Access Ramp

The following is only applicable if the Contractor requires an entry/exit access ramp for the launching and removal of vessels to the Main Pit water body. Access Ramp construction will be performed under the Earthworks Work Package (if required). Should alternate means of launching vessels and craft to the Main Pit (for example crane) be preferred by the Contractor, Access Ramp construction may be withheld. Furthermore, changes to Ramp details may be subject to Contractors Backfill Methodology. Any alternate access arrangements proposed by the Contractor (e.g. installation of loading bay) shall be designed and provided to the Principal for review and approval prior to works.

2.4.1.1 Ramp Alignment

The Main Pit Access ramp shall align as reasonably practicable with the pre-existing old Main Pit Haul Road. The pre-existing old Main Pit Haul Road is currently submerged and nearest to surface at the south-western quadrant of the Main Pit based on 2014 Bathymetry Survey Data. Estimate Main Pit Access Ramp alignment is shown in **Drawing 680.10421.MPS.D03**.

Main Pit Access Ramp Construction and alignment shall have a minimum set back of 3m from the pre-existing old Main Pit Haul Road crest. The 3m setback to be demarcated with hi-visibility buoys or similar at 3m centre spacings along the haul road alignment.

2.4.1.2 Ramp Width

Ramp width shall be at a minimum 3m wider than the required ramp width for the widest anticipated vessel to use the Access Ramp. Anticipated vessel widths to use the Main Pit Access Ramp shall be provided to the Superintendent along with Access Ramp dimensions for approval prior to construction works.

2.4.1.3 Access Ramp Toe Depth

The ramp surface shall be sealed down to a depth of 2.5m below the Design Low Water Level (RL 59 m AHD).

If a 1.0m depth below the Design Low Water Level cannot be practically achieved due to site constraints, a useability assessment should be undertaken to assess the viability of the access ramp facility. This shall involve a comparison between the available toe depth at the site over a water level record and the depth required for safe launching along with anticipated frequency of use.

2.4.1.4 Ramp Slope

The slope of the ramp should be steep enough so that a tow vehicle does not need to enter the water to launch a vessel and not so steep that the tow vehicle is unable to pull the vessel and trailer safely from the water. The ramp slope shall be no steeper than 1V:7H. The pre-existing Main Pit Haul Road has a slope of 1V:20H (~5% grade) based on 2014 Bathymetry data.

2.4.1.5 Ramp Crest

The ramp crest is the uppermost part of the ramp including the vertical curve. The crest of the ramp shall not be submerged during Design High Water Level (RL 61 m AHD).

2.4.1.6 Ramp Length

The length of ramp below the ramp crest that is exposed at the Design High Water Level (RL 61 m AHD) shall be greater than or equal to 10 m.

2.4.1.7 Ramp Surface Finish

The surface finish of the ramp shall provide sufficient traction for tow vehicles and sound footing for pedestrians. Surface finish may include cast-in-situ concrete, precast concrete slabs or other alternatives to be approved by Superintendent prior to construction. Surface finishes shall allow the drainage of excess water and debris.

2.4.1.1 Access Ramp Batter Slopes

Access Ramp batter slopes are to be cut back at a minimum slope of 1V:2H.

2.4.1.2 Erosion Protection

Access ramp batter slopes shall be overlain with geotextile or similar erosion protection products installed as per supplier requirements. Erosion protection shall cover all cut batters to mitigate against erosion for the duration of Main Pit Backfilling works. Erosion protection and installation methodology shall be submitted to Superintendent for approval prior to construction.

2.4.1.3 Inspection/Monitoring

Visual inspection at low water for scour and/or other signs of degradation shall be performed every 6 months.

2.4.2 Access Pontoon

As a minimum, a temporary pontoon shall be constructed for quick access to the Main Pit water body. Pontoons shall be fit for purpose including, holding, loading, boarding and the provision of life saving equipment (e.g. lifesaving rings.)

Pontoon will serve as the emergency egress point for Main Pit backfilling operations for persons on the Main Pit water body and shall have capacity at all times for emergency vessel access (launching and docking).

2.4.2.1 Pontoon Alignment

Pontoon alignment may be along the alignment of the Main Pit Access Ramp (on-ramp pontoon) (if constructed) or at a preferred alignment suitable for backfilling operations. If an on-ramp pontoon is to be constructed, the width required for the ramp will be as per **Section 2.4.1.2** plus the required width for the pontoon.

2.5 Sand Bedding Materials Supply

The supply of sand bedding materials to the Main Pit Operations shall be the responsibility of the Earthworks Contractor.

The Main Pit Backfilling Operations shall be responsible for instructing the Earthworks Contractor for the delivery of sand bedding materials from Borrow Area B to the required working area. The Main Pit Operations Contractor must liaise with the Earthworks Contractor and inform volumes, timing, and delivery location with a minimum of 48 hrs notice. Unless pre-approved by the Superintendent, all sand bedding materials supply shall occur during the Main Pit Backfill Operations regular operating hours.

The Contractor shall be responsible for the processing and safe storage of sand bedding materials following delivery. Any sand bedding materials delivered under instructions not used in backfilling and not stored in accordance with **Section 2.9** must be returned to Borrow Area B. Screened stockpiled materials to be used at later stages (i.e. within the inert capping layer) are exempt from stockpile time restrictions and may be stockpiled at Site until required for backfilling. If volumes are not to be used for backfilling or for the Waste Storage Facility, the material is to be returned to Borrow Area B at the Contractor's cost.

2.6 Waste Rock Supply

The supply of waste rock to the Main Pit Operations shall be the responsibility of the Earthworks Contractor.

The Main Pit Backfilling Operations shall be responsible for instructing the Earthworks Contractor for delivery of waste rock materials to the required working area. The Main Pit Operations Contractor must liaise with the Earthworks Contractor and inform volumes, timing and delivery location with a minimum of 48 hrs notice. Unless pre-approved by the Superintendent, all waste rock supply shall occur during the Main Pit Backfill Operations normal business hours.

The Contractor shall be responsible for the processing and safe storage of waste rock materials following delivery. Any waste rock delivered in accordance with instructions not used in backfilling and not stored in accordance with **Section 2.9** must be returned to the source Waste Rock Dump until time to use for Main Pit Backfilling or delivered to the Waste Storage Facility (if Main Pit capacity exhausted) at the Contractor's cost.

2.7 Waste Rock Processing

The Main Pit Backfilling Operations shall be responsible for the crushing, screening, stockpiling and conveying (if applicable) of Waste Rock materials delivered from Waste Rock Dumps. Crushing and screening is to be performed in accordance with waste rock particle size requirements presented in **Table 9**. Stockpiles are to be managed in accordance with **Section 2.9**. Granulated lime dosing is to be introduced within the processing phase with the lime dosed at a rate specified in **Table 8** and mixed with the waste rock to the satisfaction of the Superintendent. The Main Pit Backfill Operations must liaise with the Earthworks Contractor and inform volumes, timing and delivery location with a minimum of 48 hrs notice. Unless pre-approved by the Superintendent, all waste rock and lime supply shall occur during the Main Pit Backfill Operations normal business hours.

2.8 Lime Supply

The supply of lime neutralant to the Main Pit Operations shall be the responsibility of the Main Pit Backfill Operations.

The Main Pit Operations Contractor shall be responsible for the delivery of lime neutralant materials to the required working area. Unless pre-approved by the Superintendent, all lime neutralant supply shall occur during the Main Pit Backfill Operations normal business hours.

The volume of lime required will be calculated from the liming rates provided in **Table 5** and factored for lime efficiency according to the formula provided below:

$$\text{Lime rate required (kg CaCO}_3 \text{ / tonne of WRD (in-situ))} = \text{Lime Rate (as per Table 5)} \times 100 / \text{Lime Efficiency (as \%)}$$

Lime efficiency is to be tested and provided by the Contractor to the Superintendent for approval every 3,000 tonnes of lime supplied. The lime efficiency is to be traceable and auditable to its application in backfilling.

The Contractor shall be responsible for the processing and safe storage of lime materials following delivery. Any lime delivered in accordance with instructions not used in backfilling and not stored in accordance with **Section 2.10** must be returned to the lime source until time to use for Main Pit Backfilling or delivered to the Waste Storage Facility (if required) at the Contractor's cost.

2.9 Stockpiles (Bedding Layer Materials and Waste Rock)

The Contractor shall agree with the Principal regarding the location and management of material stockpiles. The proposed operations and stockpile areas are indicated on **Drawing 680.10421.MPS.D02**.

The Principal's prior approval must be obtained for all stockpiles on the site particularly with respect to the volume. Stockpiles shall not be surcharged, or otherwise loaded and multiple handling shall be kept to a minimum.

Formation and excavation from stockpiles shall be carried out in such a manner that the stockpiles are maintained in a stable condition at all times. It is the Contractor's responsibility to ensure stockpiles do not adversely affect the stability of any other excavation at the site. A Stockpile Management Plan must be developed by the contractor to ensure stability of stockpiled material and a safe working environment is maintained.

Stockpiles should be graded, and surface tamped down to limit water ingress and promote surface water run-off at the end of each shift. No stockpile shall be left uncovered during extended breaks or remain following cessation of works.

Stockpile drainage measures shall be constructed to ensure all run-off from stockpiles is directed into the Main Pit. For example, the stockpile floor shall be graded to a perimeter cut off drain which diverts surface run-off from the stockpile area into the Main Pit.

All stockpiles shall:

- Have maximum slopes not exceeding 1V:3H or otherwise determined by the Superintendent;
- Have adequate management measures for dust suppression/control;
- Minimise sediment run-off by surrounding stockpiles with filter/ sedimentation fences and straw bales;
- Have graded floor and perimeter cut off drains to capture and direct surface water run-off to the Main Pit;
- Minimise time of exposure of PAF materials to oxidation to mitigate Water Quality issues when backfilling; and
- No stockpile volume greater than one working week (as per backfilling operations) worth of movement.

2.10 Lime Storage

The Contractor shall agree with the Superintendent regarding the location and management of lime. The proposed operations and storage area are indicated on **Drawing 680.10421.MPS.D02**.

Lime shall be stored in a sealable container(s) and prevent its exposure to the environment and people. Bunding is to be placed around the container(s) perimeter to ensure containment of any spillage. Lime Storage shall have:

- Adequate measures for exposure prevention;
- Storage facility to minimise double handling, ease of delivery for dosing and minimise exposure to persons;
- Adequate measures for neutralising spills to a neutral pH (pH of 7);
- Nearby personal emergency wash bays; and
- No storage volume greater than one-week (as per backfilling operations) worth of movement.

2.11 Pit Lake Water

Removal (de-watering) and processing of all pit lake water inside the rim of the Main Pit will be managed under the Water Treatment Plant Operations and is detailed in Main Pit Water Management Specification.

In principle, the pit lake water levels shall be managed during back filling by sufficient de-watering and treatment of the pit lake water to ensure a minimum depth adequate for barge mobilisation/demobilisation. Typical barge requirement is a depth of 2.50 m.

2.12 Groundwater

Monitoring of groundwater quality upstream and downstream of the Main Pit backfilling shall be undertaken by Water Treatment Plant Operations. The groundwater monitoring regime includes:

- Multiple Monitoring points and depths as detailed in **Table 12** and **Drawing 680.10421.MPS.D02** and **D03**.
- Schedule of water level and water quality monitoring including sampling frequency, analytes for testing, and trigger threshold levels (Trigger Action Response Plan) are detailed in the Main Pit Water Management Specification and summarised in **Section 5.6** and **Section 5.7**.

2.13 De-watering (Surface Works)

Outside the Main Pit lake, the Contractor must carry out all works necessary to prevent ponding in the Works areas and carry out all necessary de-watering works. The Contractor's construction schedule must make allowances for these works and no extensions of time will be granted for failure to comply with this requirement.

Any water captured from surface works shall be tested to assess its quality and any contaminated water should be discharged into the Main Pit for treatment following approval by the site superintendent.

2.14 Sediment and Erosion Control

Any surface water run-off which contacts or is exposed in any way, to waste rock in the vicinity of the Main Pit backfill operations shall be captured and diverted to the Main Pit lake. The Contractor shall employ acceptable methods to minimise the opportunity for surface water to contact waste rock through the installation of diversion drains or perimeter cut off bunds to re-direct surface water away from the Main Pit back filling work area. Where the water is unable to be directed to the Main Pit, the water shall be captured and disposed of as directed by the Superintendent, the costs of which shall be covered by the Principal.

Soil and water management works include:

- Diversion of up gradient waters around the Works areas;
- Erosion and sediment control measures that minimise sediment pollution to down gradient lands and waterways;
- Erosion and sediment control measures to minimise soil migration within the Works area;
- A progressive rehabilitation program that lowers the erosion hazard to a negligible level upon completion; and
- Measures to avoid altering the drainage pattern in relation to adjoining land.

2.15 Existing Roads and Drainage

All existing roads and surface water drainage systems affected by the Works shall be inspected regularly and immediately after periods of inclement weather by the Contractor to ensure no construction-related debris, silt or other materials pollute the site or adjacent properties. The Contractor shall notify the Superintendent prior to conducting these inspections.

Any damage to perimeter roads or other structures caused by the actions of the Contractor in executing the Works shall be repaired to the satisfaction of the Superintendent, at the Contractor's expense.

2.16 Site Maintenance and Cleanliness

The Works area and surrounding roads affected by the Contractor's operation shall be kept in a clean and tidy condition for the duration of the Works. Waste material, debris, etc. shall be removed regularly to minimise their accumulation. On completion of the Works and before acceptance by the Principal, the Contractor is to clean up all debris, to the satisfaction of the Superintendent and leave the Works areas in an orderly condition for future works to continue.

2.17 Traffic Management

Traffic control and management measures are required where earthmoving plant must cross on-site thoroughfares, including haul roads, driveways and pedestrian paths. The Contractor is to prepare a Traffic Management Plan for review and approval by the Superintendent prior to commencement of the Works, so that Works do not adversely affect traffic at the Site.

2.18 Deliveries to Site

The Contractor shall be responsible for the safe delivery of all necessary materials to the required working area. Prior to scheduled deliveries, the Contractor must liaise with the Superintendent and shall give the Superintendent at least 48 hours' notice. Unless pre-approved by the Superintendent, all deliveries shall occur during the Site's normal business hours.

The Contractor shall arrange for all plant and equipment required to undertake the Works. The Contractor shall be responsible for the unloading and safe storage of the plant/materials on site. The Superintendent or Site staff shall not take delivery of the Contractor's plant, equipment or materials. Any unsatisfactory items must be removed from site at the Contractor's cost.

3 Culture, Health, Safety and Environment

3.1 Culture

The Main Pit is an area significant to the Traditional Owners of the site – the Kungarakan and Warai. Staff working at the Main Pit will be required to undergo cultural awareness training and learn from sacred site Custodians what they must do to respect and care for the sites around the Main Pit.

3.2 Occupational Health and Safety

The attention of the Contractor is drawn to the *Work Health and Safety Act 2011*, which requires that employers ensure the health, safety and welfare of their employees.

The Contractor shall prepare a Work Health and Safety Plan (WH&S Plan) following best practice for review by the Superintendent before Work commences at the site. The Contractor's WH&S Plan will be submitted to the Superintendent a minimum of two weeks prior to the scheduled commencement of construction works.

It is important to note that the site is located in the Tropics and as such, hazards unique to these environments exist including crocodiles, feral pigs, extreme weather events such as cyclones and a challenging outdoor wet season working climate. It is important to note that the work area is adjacent to a water course and may be subject to flooding.

3.3 Testing Standards

Topographic and bathymetric survey standards:

- Detailed Surface Survey; and
- Multi-beam Sonar Bathymetry:
 - 2014 Standard for the Australian Survey Control Network, Version 2.1, ICSM;
 - 2014 Guideline for the Adjustment and Evaluation of Survey Control, Version 2.1, ICSM;
 - 2014 Guideline for Control Surveys by GNSS, Version 2.1, ICSM;
 - 2014 Guideline for Control Surveys by Differential Levelling, Version 2.1;
 - ICSM 2014 Guideline for Conventional Traverse Surveys, Version 2.1;
 - ICSM 2014 Guideline for the Installation and Documentation of Survey Control Marks, Version 2.1, ICSM;
 - AS 1100.401-1984 Technical drawing Engineering survey and engineering survey design drawing;
 - AS/NZS ISO 9001:2016 Quality Management Systems; and
 - IHO Standards for Hydrographic Surveys, Special Publication 44, 5th Edition, February 2008.

Cone Penetrometer Testing standards:

- AS 1289.6.5.1-1999 Rec: 2013;
- SS-EN ISO 22476-1:2012; and

- P.K., Robertson & K.L., Cabal (Roberston), *Guide to Cone Penetration Testing for Geotechnical Engineering*, Gregg Drilling & Testing, Inc., 6th Edition, 2014.

Geotechnical soil and rock testing standards to confirm material compliance:

- Methods of Sampling AS1411.11 & AS1141.12;
- Particle Size Distribution AS1289.3.6.1;
- Atterberg Limits AS1289.3.1.1 & 3.2.1; and
- Emerson Dispersion AS 1289 3.8.1.

3.4 Nuisance

The Contractor shall minimise inconvenience to local residents and site workers/visitors on/near the site of the Works by avoiding or controlling noise, vibration, dust, mud and any other nuisance.

The Contractor shall maintain their plant in good working condition. Operation of plant will be subject to the approval of the Superintendent. The Superintendent may, from time to time, determine on site what constitutes an inconvenience to local residents/site workers/site visitors on/near the site and require the Contractor to change the way plant is being operated or the construction site is managed.

3.5 Site Security

Prior to ceasing works on each day, any

- Fencing, or gates, removed by the Contractor for the purpose of the Works shall be reinstated by the Contractor; and
- Open excavation(s) shall be made safe by barricading with a minimum exclusion zone, provision of emergency access and egress points into/out of the excavation, benching and/or battering of excavation walls or, preferably, temporarily backfilling the excavation if possible.

3.6 Work Method Statements

The Contractor shall produce work method statements for each major element of the Works included herein. Work method statements shall detail how the works are to be undertaken, in a safe manner, in order to meet the Specification, site rules and regulatory requirements.

All work method statements are to be reviewed by the Superintendent and the CQA Consultant. Method statements shall be provided to the Superintendent for distribution to the other parties for comment at least 1 week prior to commencing the specific task.

3.7 Relevant Standards

The Contractor shall comply with all regulations of local and other legally constituted authorities and give all notices, obtain all permits and certificates and pay all fees required by such Authorities. Plant, materials and workmanship shall comply (at a minimum) with the requirements of current industry standards and Codes of Practices, as well as the most current applicable Australian Standard in effect at the time of construction. All materials and workmanship not covered by an Australian Standard shall be of such kind as is suitable for the environment and conditions under which the Works are to be constructed.

3.8 Inclement Weather

Works will be suspended when weather conditions are such that the quality of the Works, or the conditions of the materials, may be impaired or the risk to workers is unacceptable. The decision to suspend work on account of inclement weather will be made following agreement between the CQA Consultant, the Contractor and the Superintendent. The Contractor shall notify the Superintendent whenever Works are suspended due to inclement weather and shall advise the Superintendent on the proposed date that Work shall be resumed.

Where, in the opinion of the Superintendent, any Works carried out in inclement weather conditions have been adversely affected, these Works shall be removed and made good.

Following inclement weather conditions, any standing water on the surface of the Works which may delay the resumption of Work or impact the quality of the Works shall be removed by the Contractor at the earliest opportunity, or as directed by the CQA Consultant or the Superintendent.

The Contractor shall provide in the construction schedule for inclement weather delays.

4 Sequence and Hold Points

The Superintendent shall make regular inspections of the works in progress. Works shall not proceed until each Hold Point (or portion of Hold Point) has been approved by the Superintendent and CQA Consultant.

Where the Hold Point involves an inspection of the Works by the Superintendent and/or CQA Consultant (i.e. the ramp construction, re-profiling works), the Contractor shall give the Superintendent at least 24 hours' notice of the required inspection. The Contractor shall uncover at their own expense any Work which is buried, concealed or made inaccessible to the Superintendent or CQA Consultant for purposes of undertaking a Hold Point inspection.

Where the Hold Point relates to verification of back fill layers, the Contractor shall verify via bathymetric survey that the completed surface has achieved full conformance with all respects of the Specification. The Superintendent's approval of the completed backfill layers (or portion thereof) is required prior to the release of each hold point and shall be subject to the provision of CQC/CQA test results confirming the backfill material has met the required specification and testing frequency i.e. for the sand bedding layer.

Note: Discrete sections of a layer may be approved by the Superintendent to allow continuation of filling successive layers as long as the specification outlined in Section 5.3.1 are adhered to. Furthermore, the Superintendent will assess areas which require further filling and notify the Contractor prior to approval.

Table 7 below includes a summary of activities to which Hold Points apply in the Specification with additional details discussed in the following points.

Table 7 Hold Point Summary

Hold Point	Description	Approval Criteria
1	Management plans	Submitted to Superintendent for approval.
2	Topographic and bathymetric survey	Submitted to Superintendent for approval.
3(Provisional)	Construct access ramp to allow entry to Main Pit	Principal's Geotechnical Representative to inspect and confirm safe and suitable for use (performed under Earthworks Works Package)
4A-4C	Sand Bedding Layer placement	Contractor to provide minimum weekly survey and volumes to Superintendent for approval.
CPT-1 SBL-1	Cone Penetrometer Test (CPT)	Contractor to provide confirmatory CPT results to Superintendent for approval.
CPT-2 SBL+1	Cone Penetrometer Test (CPT)	Contractor to provide confirmatory CPT results to Superintendent for approval.
5A-5J	Waste Rock Backfill placement	Contractor to provide minimum weekly survey and volumes to Superintendent for approval.
6	Inert Capping Layer placement	Contractor to provide minimum weekly survey and volumes to Superintendent for approval.
7	Re-profile Pit Crest	Contractor to submit finished topographic and bathymetric survey to Superintendent for Approval (performed under Earthworks Works Package). Superintendent to inspect works.

Hold Point	Description	Approval Criteria
8	Re-alignment of EBFR	Contractor to submit finished topographic and bathymetric survey to Superintendent for Approval (performed under Earthworks Works Package). Superintendent to inspect works.

4.1 Management plans

Hold Point 1 – Management plans submitted to the Superintendent for approval.

4.2 Setting Out and Site Establishment

Hold Point 2 – Detailed topographic and bathymetric survey using multi-beam sonar of the Site and Main Pit to be submitted to the Superintendent for confirmation of the baseline surveys.

4.3 Main Pit Access

Hold Point 3 – Construct a ramp into the Main Pit for access as shown in **Drawing 680.10421.MPS.D02** and **D03**. The ramp should be inspected by the Principals geotechnical representative and deemed safe and suitable for use. This will be performed under the Earthworks Works Package.

4.4 Sand Bedding Layer Placement

Hold Points 4A to C – Placement of sand bedding layers as shown in **Table 6**

4.5 CPT-1 SBL-1

Hold Point CPT-1 SBL-1 – Performance and Reporting of Cone Penetrometer Testing in accordance with **Section 5.3.1.2**.

4.6 CPT-2 SBL+1

Hold Point CPT-2 SBL+1 – Performance and Reporting of Cone Penetrometer Testing in accordance with **Section 5.3.1.2**.

4.7 Waste Rock Layer Placement

Hold Point 5A to 5J – Placement of lime amended Waste Rock backfill layers as shown in **Table 6**.

4.8 Inert Capping Layer Placement

Hold Point 6 – Placement of Inert Capping Layers to 58 m AHD with a maximum lateral extent equal to the 58 m AHD pre-filling surface level baseline contour.

4.9 Re-profile Pit Crest

Works to be performed under Earthworks Work Package.

4.10 Re-Alignment of the EBFR

Works to be performed under Earthworks Work Package.

5 Backfill Material Specifications

5.1 Material Requirements

All backfill material is to be free of unsuitable material defined as follows:

- Organic materials from swamps, marshes or bogs;
- Logs, stumps and perishable material;
- Large predominantly clay materials (material > 30% passing 0.075mm);
- Clay of liquid limit exceeding 80% and/or plasticity index exceeding 55%; and
- Hazardous or contaminated materials other than those permitted in the Contract.

It is anticipated that materials for the Bedding Layers shall be sourced from the nearby Borrow Area B on Finnis River Aboriginal Land Trust (FRALT) and hauled to site under the Earthworks Works Package and screened to the required maximum size. It should be noted the Unscreened Bedding Layer will still be required to undergo an initial screening to remove oversize particles greater than 53 mm. It is envisioned the coarse fraction of material screened off the SBL-1 may be stockpiled and should be suitable for use as the SBL+1 layer.

In addition, SBL materials are to be mixed with neutralant (hydrated lime) at a 1.7% w/w rate. The purpose of this is to neutralise the top layers of tailings and the chemocline which are acidic. This will reduce the risk of acidic water releasing heavy metals into the water column above.

Further detail on the material sourced from Borrow Area B are provided in the Geotechnical Investigation Report.

It is anticipated that materials for the Waste Rock Layer shall be sourced from existing on site PAF Waste Rock Dumps. Waste Rock considered to have the highest potential of acid formation will be placed preferentially and shall be mixed with finely crushed limestone as per the dosing rates outlined in **Table 8**.

The order of sourcing and placing Waste Rock backfill material shall be defined by the season (wet or dry) in which the backfilling of waste rock material commences (i.e. following completion of sand bedding layer placement). The rationale dictating the priority order is due to the requirement to deconstruct at least one third of Dyson's WRD in order for the WRD to have capacity to capture run-off. Therefore, priority is to source waste rock from Intermediate WRD should wet weather be imminent and time not sufficient to deconstruct at least one third of Dyson's WRD. The prioritisation of waste rock source for backfilling is summarised as follows:

Main Pit Backfilling Waste Rock Source if Commenced in Wet Season

Order of waste rock material sourced (1 = first, 3= last):

1. Dyson's Overburden Waste Rock Dump;
2. Intermediate Waste Rock Dump; then
3. Main Waste Rock Dump.

Main Pit Backfilling Waste Rock Source if Commenced in Dry Season

Order of waste rock material sourced (1 = first, 3= last):

1. Intermediate Waste Rock Dump;
2. Dyson's Overburden Waste Rock Dump; then
3. Main Waste Rock Dump.

Table 8 Lime Dosing Rate for Waste Rock Backfill

Material to Treat	Placement Location	Granulated Lime Treatment	Estimated Total Lime Weight ¹
Intermediate WRD	Main Pit	24 kg CaCO ₃ /Tonne Waste Rock	44,652 tonnes
Dyson's Overburden WRD	Main Pit	24 kg CaCO ₃ /Tonne Waste Rock	26,940 tonnes
Main WRD	Main Pit	15 kg CaCO ₃ /Tonne Waste Rock	11,168 tonnes

¹ Volume will vary depending on final mass of waste rock required for backfilling and the activity of the finely crushed limestone.

Stockpiles shall be managed to avoid dilution and manage run-off to contain and neutralise acid leachate. Further detail on the physical and chemical characteristics of the Waste Rock material is provided in the SLR Main Pit Backfill Strategy Report [1].

Inert Capping Layer material will comprise coarse granular borrow material abstracted from well-weathered upper horizons at Borrow Area B and shall meet the specifications outlined in **Table 9** for engineering properties.

5.2 Material Testing Requirements

To confirm that all material placed meets the parameters in accordance with the Specifications, control testing for material characteristics (see **Section 5.1** for material requirements) shall be conducted on samples from all material that is to be used for backfilling, including Sand Bedding Layers, Waste Rock and Inert Capping material. Laboratory testing will be performed under the Earthworks Package of Works.

Control testing will involve field testing by an appropriately qualified and experienced geotechnical engineering consultant with collection of representative samples to be submitted for laboratory testing by a NATA accredited geotechnical laboratory to verify the material properties.

Testing shall be performed by the contractor to ensure all material used for the backfill layers achieve the properties identified in **Table 9** and is tested at the minimum frequency outlined in **Table 10**. Control testing is to be arranged by the Contractor as per test locations stipulated by the CQA Consultant.

Table 9 Specification Requirements for Engineering Properties of Backfill Materials

Constituent/Property	Test Method	Sand Bedding Layer (-1 mm) (SBL-1)	Sand Bedding Layer Unscreened ¹ (SBL-U/S)	Sand Bedding Layer (+1mm) (SBL+1)	Waste Rock Lens (WR) to RL 22m AHD	Waste Rock (WR) RL 22m AHD to 27m AHD	Waste Rock (WR) Above RL 27m AHD	Inert Capping Layer (ICL)
Maximum Passing		Particle Size Distribution						
% passing 1000 mm	AS1141.11, AS1141.12 or AS1289.3.6.1	-	-	-	-	-	100	-
% passing 500 mm		-	-	-	-	-	-	-
% passing 300 mm		-	-	-	-	-	-	-
% passing 200 mm		-	-	-	-	100	-	-

Constituent/Property	Test Method	Sand Bedding Layer (-1 mm) (SBL-1)	Sand Bedding Layer Unscreened ¹ (SBL-U/S)	Sand Bedding Layer (+1mm) (SBL+1)	Waste Rock Lens (WR) to RL 22m AHD	Waste Rock (WR) RL 22m AHD to 27m AHD	Waste Rock (WR) Above RL 27m AHD	Inert Capping Layer (ICL)
% passing 100 mm		-	-	-	100	-	-	-
% passing 75 mm		-	-	100	-	-	-	-
% passing 53 mm		-	100	-	-	-	-	-
% passing 19.0 mm		-	-	-	-	-	-	-
% passing 9.5 mm		-	-	-	-	-	-	-
% passing 2.36 mm		100	-	-	-	-	-	-
% passing 1.18 mm		85	-	15	-	-	-	-
% passing 75 µm		≤ 25	≤ 25	-	≤ 30	≤ 30	-	-
		Dispersity						
Emerson Dispersion	AS1289.3.8.1	NA	NA	NA	NA	NA	NA	≥ Class 4

Notes:

1. Initial screening required to remove oversize, > 53mm portion

Table 10 Minimum Number of Tests per 5,000 Tonnes of Stockpiled / Sourced Material^{1,2}

Property	Sand Bedding Layer (-1 mm) (SBL-1)	Sand Bedding Layer Unscreened (SBL -U/S)	Sand Bedding Layer (+1 mm) (SBL+1)	Waste Rock (WR) Lens to RL 22 m AHD	Waste Rock (WR) To RL 27 m AHD	Waste Rock (WR) Above RL 27 m AHD	Inert Capping Layer (ICL)
Particle Size Distribution	10	10	10	5	5	2	NA
Emerson Dispersion	NA	NA	NA	NA	NA	NA	5

NA – Not Applicable

Notes:

1. Where certified stockpiles or lots are smaller than 5,000 tonnes, a proportional reduction (rounded up) is permitted to the number of tests required above with a minimum of at least one test for stockpiles or lots of less than 1,000 tonnes.
2. Sampling must be carried out in accordance with the requirements of AS 1141. The testing must be undertaken by a NATA accredited laboratory, which must supply certificates identifying:
 - a. The Stockpile source reference (if site-won) of Supplier's name (if imported);
 - b. Material type and blend constituents;
 - c. Bulk sample number and certified stockpile identification number; and
 - d. Quantity of material represented by the test results.

5.2.1 Lime Dosage Validation

To confirm that material backfilled has been adequately dosed in accordance with applicable liming rates, weight and volume of lime dosed shall be measured and recorded against waste rock source on a per tonne of waste rock backfilled basis. Records shall be auditable and the measurement and recording methodology demonstrable to the satisfaction of the Superintendent. The lime dosage will be measured at a point in the material processing chain that ensures lime dosed is not lost in material processing and reflects the dosage rate of backfilled material. The liming rate applicable to waste rock source will remain fixed, however, the Principal reserves the right to amend liming rates if required (ref: **Section 5.9**).

Measured and recorded lime dosage rates shall be in real-time and continually monitored with compiled data sets provided to the Superintendent on a weekly basis. Minimum data to be presented in the record shall include the following:

- Time and Date of backfill;
- Main Pit floor Reduced Level (m AHD) at time of backfill;
- Lime volume (m³) and Weight (kg) that has been applied to backfilled material;
- Type of lime applied and lime efficiency rate (as provided by Supplier);
- Waste Rock Source, Volume (m³) and Weight (Tonnes) that has been dosed and backfilled; and
- Applied dose rate (kg of lime/per tonne backfill material).
- Applicable calibration certificates of mass/weight/volume measuring equipment

5.3 Backfilling Requirements and Placement Controls

5.3.1 Sand Bedding Layer

The Sand Bedding Layers shall be deposited over water using the Contractor's chosen method(s) which achieve a controlled and accurate placement to meet the geometric and water quality requirements specified herein.

No sand shall be placed until the pit lake pH is confirmed to be greater than or equal to pH 7 ($\text{pH} \geq 7$) throughout the water column by Water Treatment Plant Operations and approved by the Superintendent. Additionally, no sand bedding layer placement will occur until:

- the Main Pit water level is RL 58 m AHD; and
- the Intermediate Pit water level is RL 49 m AHD.

The sequence of Sand Bedding Layer placement is outlined in **Section 4.4** and shown in **Drawing 680.10421.MPS.D06 to D09**.

The rate of placement of all backfill materials shall not exceed the limits set by the maximum rate of water treatment from the Main Pit of 6,900 m³/day over a 24hr period.

The rate of placement shall be such that significant impact or disturbance of the chemocline is minimised and where practicable, impact to the water treatment process, and downstream groundwater monitoring bores minimised. The water quality and geochemical specifications are detailed in Main Pit Water Management Technical Specification and in **Section 5.6**. Where unacceptable changes to the water quality and/or tailings instability or failure occur, the method and rate of the deposition shall be halted and reassessed under the Trigger Action Response Plan (**Section 5.6.2**).

As detailed within the SLR Main Pit Backfill Report, to manage the potential for instability or failure within the tailings temporary slopes formed within the Bedding Layer materials shall not exceed:

- a maximum overall gradient of 1V:10H within any 20 m x 20 m area (using a 2 m survey grid); and
- a maximum height difference of 2.0 m within any 100 m x 100 m area (using a 2 m survey grid) between the lowest and highest elevation of the placed sand bedding backfill.

Sand bedding placement shall commence from the Main Pit centre outwards towards the RL 19 m AHD contour for every layer. Continued placement shall proceed from low bedding elevations to high elevation zones to buttress slopes, minimise slope angles and minimise height differentials in accordance with the abovementioned dot point geometric placement controls.

Where changes to the water quality and/or tailings instability or failure occur the method and rate of deposition shall be reassessed.

5.3.1.1 Tailings and Backfill Material Stability

To provide confirmation that placement is being conducted in accordance with the Specifications, control surveying (such as multibeam surveys) for changes in the tailings and backfill material surface level shall be conducted in real-time during Bedding Layer placement.

Where the tailings surface exhibits change or disturbance from the placement of material, the method and rate of placement may require revision.

Where exceedances in the maximum temporary slope gradient and height occur placement must focus on rectification and filling in lower elevations to maintain stability.

5.3.1.2 Sand Bedding Layer Thickness and Distribution

To provide confirmation that placement is being conducted in accordance with the Specifications, control testing via over water Cone Penetration Testing (CPT) for Bedding Layer distribution shall be conducted in order to confirm the extent and thickness of Bedding Layer material. CPTs will extend into the tailings to record changes in strength properties.

CPTs will involve in-situ testing under the supervision of an appropriately qualified and experienced geotechnical engineer. CPTs are to be arranged by the Contractor as per test locations stipulated by the CQA Consultant at the following frequencies:

- 10 tests inside the RL 19 m AHD baseline contour on a maximum 50 m grid after completion of the SBL-1 layer to RL 12 m AHD; and
- 10 tests inside the RL 19 m AHD baseline contour on a maximum 50m grid after completion of the SBL+1 layer to RL 12 m AHD.

Reporting CPT Results

In addition to a published report, the measured results in engineering units shall be presented in digital form (.xls, .csv, .txt or similar) consisting of the following:

- Depth of penetration (m);
- Cone Tip Resistance (MPa);
- Skin (Sleeve) Friction (kPa);
- Pore pressure (kPa); and
- Jacking (or thrust) during test (kN).

Graphical Presentation

The following corrected/derived parameters shall be provided in digital form (.xls, .csv, .txt or similar) and plotted in a scale deemed suitable for presentation along with the measured results above. CPT plots will be presented from a minimum of 3 m above the Main Pit Backfilled floor to termination depth (minimum RL 12 m AHD):

- Corrected cone penetration resistance $q_t = q_c + (1-a)u$
 - q_t = corrected cone resistance
 - q_c = cone resistance
 - a = cone area ratio
 - u = pore pressure measured directly behind the cone
- Friction Ratio

Table 11 Additional CPT Reporting Requirements

Additional CPT Reporting Requirements			
Location	Cone geometry and dimensions	Zero readings of all sensors before and after each test.	Any irregularities during testing
Date and Time of Test	Capacity of sensors	Observed wear or damage on tip or sleeve	Water depth to Main Pit floor during test
Cone Serial Number	Calibration Certificates	Penetration rate	Corrections due to water level fluctuations (if any)

CPT cone, method and jacking force shall be suitable to penetrate sand bedding layers and tailings to a minimum depth of RL 12 m AHD.

5.3.2 Waste Rock

The Waste Rock Layer material shall be deposited over water using the Contractor's chosen method(s) which achieve a controlled and accurate placement, in accordance with the following requirements:

- No waste rock filling until the Sand Bedding Layers have been finished to full depth over the whole pit floor area and approved by Superintendent;
- Waste Rock below RL 22 m AHD shall be placed in accordance with the Construction Methodology Report, as follows:
 - maximum overall gradient of 1V:10H within any 20 m x 20 m area (using a 2 m survey grid); and
 - maximum height difference of 2.0 m within any 100 m x 100 m area (using a 2 m survey grid) between the lowest and highest elevation of the placed sand bedding backfill.
 - Waste Rock placement shall commence from the Main Pit centre outwards for every layer. Continued placement shall proceed from low elevation to high elevation zones to buttress slopes, minimise slope angles and minimise height differentials in accordance with the abovementioned dot point geometric placement controls.

- Waste Rock placed between RL 22 m and 27 m AHD shall be placed in accordance with the Construction Methodology Report as follows:
 - maximum overall gradient of 1V:4H within any 20 m x 20 m area (using a 2 m survey grid); and
 - maximum relative height difference rock backfill of 4.0 m within any 100 m x 100 m area (using a 2 m survey grid) between the lowest and highest elevation of the placed waste.
 - Waste Rock placement shall commence from the Main Pit centre outwards. Continued placement shall proceed from low elevation to high elevation zones to buttress slopes, minimise slope angles and minimise height differentials in accordance with the abovementioned dot point geometric placement controls.
- Waste Rock placed between RL 27 m AHD and 35 m AHD shall be placed in accordance with the Construction Methodology Report as follows:
 - maximum overall gradient of 1V:3H within any 20 m x 20 m area (using a 2 m survey grid); and
 - maximum relative height difference of 8.0 m within any 100 m x 100 m area (using a 2 m survey grid) between the lowest and highest elevation of the placed waste rock backfill.
 - Waste Rock placement shall commence from the Main Pit centre outwards for every layer. Continued placement shall proceed from low elevation to high elevation zones to buttress slopes, minimise slope angles and minimise height differentials in accordance with the abovementioned dot point geometric placement controls.
- Waste Rock placed above RL 35 m AHD contour shall be placed in accordance with the Construction Methodology Report, with temporary slopes limited to their angle of repose and not exceeding:
 - maximum relative height difference of 8.0 m within any 100 m x 100 m area (using a 2 m survey grid) between the lowest and highest elevation of the placed waste rock backfill.
 - Waste Rock placement shall commence from the Main Pit centre outwards for every layer. Continued placement shall proceed from low elevation to high elevation zones to buttress slopes, minimise slope angles and minimise height differentials in accordance with the abovementioned dot point geometric placement controls.
- Backfilling above RL 27 m AHD, placement of predominantly clay material (> 30 % passing 0.075 mm) must be avoided. Assessment of clay content is to be performed visually, with predominantly clay material to be remixed with granular materials prior to sub-aqueous placement.

The sequence of Waste Rock Layers to be deposited in the Main Pit are shown in the **Drawings 680.10421.MPS.D08 to D12**.

5.3.3 Inert Capping Layer

The Inert Capping Layer material shall be deposited over water using the Contractor's chosen method(s) which achieve a controlled and accurate placement, in accordance with the following requirements:

- No placement of this layer until the pit lake water quality meets the Zone 2 Locally Derived Water Quality Objectives (Table 4-4 Hydrobiology, Rum Jungle Impact Assessment - Final Report, June 2016 [7]);
- Minimum Inert Capping Layer thickness of 2.0 m;
- Minimum elevation of RL 58 m AHD; and
- Temporary slopes no steeper than 25°.

The Inert Capping Layer to be deposited in the Main Pit is shown in the **Drawing 680.10421.MPS.D13**.

5.4 Finished Surface of Respective Backfill Layers

Prior to beginning placement of each type of successive Sand Bedding Layer, Waste Rock or Inert Capping backfill material, the Contractor shall provide the CQA Consultant with the relevant survey, testing and placement records to enable CQA sign off within a specified area of the Main Pit.

The Superintendent shall accept in writing to the Contractor that the each of the final layer surfaces comply with the Specification, or whether any additional works are required for acceptance. The acceptance of the final layer surfaces shall not relieve the Contractor of their responsibility to continuously maintain the stability within the Main Pit, including differential settlement.

5.5 Remedial Works

5.5.1 Placement

Where control testing indicates non-compliances with the Specification, the Contractor is required to:

- Undertake additional works on the area represented by the failed test or survey as necessary such that subsequent testing or surveying of the area meets the requirements. Additional works may include ceasing Works, decreasing/increasing placement in one area of the Main Pit, reduced rate of placement and addition of neutralant.

Re-testing or surveying shall be conducted on all remediated areas to assess the effectiveness of the remedial actions taken.

The CQA Consultant shall record all locations/areas of non-compliance together with remedial actions taken and shall advise the Superintendent not to permit placement of a subsequent layer on the area until compliance is achieved and documented.

It is anticipated that the Contractor's Works program will include consideration of control testing so as to avoid or minimise project delays. Any backfill placement, testing and surveying works undertaken by the Contractor, in advance of confirmation that the placed backfill material meets Specification requirements, are undertaken at the Contractor's risk.

5.5.2 Lime Dosage

Where control testing indicates non-compliances with the Specification, the Contractor is required to:

- Sand bedding: Where a less than 1.7% w/w hydrated lime has been dosed to the backfilled sand bedding layer. The Contractor is to cease backfilling the sand materials immediately and apply a hydrated lime slurry to the underdosed area via pipeline delivery system (Ref: **Section 5.6.1**). The hydrated lime slurry shall be applied at or proximal (within 4.0m 3-dimensional radius) to the backfill placement location. The slurry shall have a hydrated lime content equal to 1.7% w/w of the underdosed backfilled sand bedding materials.

- **Waste Rock:** Where less than the applicable granulated lime dose rate has been applied to the backfilled waste rock. The Contractor is to cease backfilling waste rock materials immediately and backfill with only granulated lime until such time that the required dosage rate is met. The Contractor is to make every effort to ensure the granulated lime is placed in the same or similar location to the underdosed waste rock. In addition to the granulated lime, the Contractor is to apply a hydrated lime slurry to the underdosed area via pipeline delivery system (Ref: **Section 5.6.1**). The hydrated lime slurry shall be applied at or proximal (within 4.0m 3-dimensional radius) to the backfill placement location. The lime slurry shall have a hydrated lime content equal to 15% weight hydrated lime / volume of slurry water. The volume of applied slurry shall be equal to 40% of the non-dosed backfilled waste rock volume.
 - It is noted, if waste rock is to be released from Main Pit water surface, a time factor must be allowed for the waste rock materials to settle through the water column before reaching the Main Pit floor. Only when majority of the untreated backfilled material has reached the Main Pit floor shall the hydrated lime slurry be applied.
 - Slurry velocity at the outlet of the hydrated lime slurry pipeline shall be managed such that risk to contaminate remobilisation is minimised.

The CQA Consultant shall record all locations/areas of non-compliance together with remedial actions taken and shall advise the Superintendent not to permit placement of a subsequent layer on the area until compliance is achieved and documented. Remedial lime will be at the Contractors own cost.

It is anticipated that the Contractor's Works program will include consideration of control testing so as to avoid or minimise project delays. Any backfill placement, testing and surveying works undertaken by the Contractor, in advance of confirmation that the placed backfill material meets Specification requirements, are undertaken at the Contractor's risk and cost.

5.6 Water Quality and Geochemical Considerations

The placement of PAF waste rock into the Main Pit will cause the water quality within the Main Pit to change due to the likely mixing of the chemocline into the water column and the dissolution of solutes and acids from the placed waste rock into the water column. The geochemical hazards to be reduced within the backfilling operation are:

1. Chemical stabilisation of the waste rock for long term storage. The pore solution formed within the placed waste rock should have a circum-neutral pH at placement. This will avoid the loss of long-term neutralising capacity. This requires operating the pit lake at a pH ≥ 7 during backfilling (Responsibility of Water Treatment Plant Operations and Main Pit Backfill Operations).
 - a. Main Pit pH operating requirement will be periodically reviewed by the Principal throughout backfilling works to assess feasibility and efficiency.
2. The impacted water quality at the Main Pit lake must not be allowed to enter the EBFR. Only water meeting the quality limits (Locally Derived Water Quality Objectives) can be released from site and only under certain conditions to be established by the NT EPA.
3. Treatment load to the WTP is likely to be impacted by:
 - a. The mixing of the chemocline and/or tailings into the water column will introduce acid and heavy metals into the water column. This may impact the entrained waste rock pore matrix.
 - b. The dissolving of existing acids and heavy metals and salts from the waste rock into the water column.

As such, the rate and method of placement shall be carried out in a way that reduces disturbance of the chemocline in order to reduce load to the WTP.

The pit lake pH shall be maintained at $\text{pH} \geq 7$ during backfill. It is important to note, the Main Pit backfill water quality will be monitoring by both the Water Treatment Plant Operations and Backfill Operations. The Backfill Operations will be responsible for maintaining Main Pit water quality proximal to backfill material placement location as detailed in **Section 5.6**. The larger Main Pit water body water quality will be monitored and maintained by the Water Treatment Plant Operations. It is important to note, the two operations are not mutually exclusive and a Water Quality Management Plan is to be drafted and submitted to the Principal for approval prior to backfilling works.

The Water Management Plan [8] shall be followed to eliminate risk of poor water quality entering the EBFR. This plan includes elements such as maintenance of water levels in the Main and Intermediate Pits for surge capacity and diversion of surface water catchment from these pits.

No water quality testing is required of the backfill operators for the purpose of payment or construction specification as this is within the scope of the Water Management operators. The backfill operators are expected to assist the Water Management operators with access to continual monitoring equipment and pumping equipment installed within the Main Pit.

The backfill contractor shall monitor pH and over the profile of the pit water column in order to demonstrate that the impact of the backfilling layers on the chemocline has been understood and the placement methodology adjusted to minimise disturbance. This is to the advantage of the backfill operations as it will allow the WTP to continue operations at maximum flow rates.

Control monitoring for water quality within the Main Pit proximal to the backfill placement location shall be the responsibility of the Backfill Operations and conducted continuously from the backfill material delivery system (barge/conveyor or similar) at multiple depths to understand vertical and horizontal mixing of the chemocline and changes to the pit lake water quality from waste rock placement at the point of placement. This data will be used to inform the feed water for the WTP for operational purposes as well as instruct backfilling operations. The water quality monitoring is shown in **Table 12**.

Water quality monitoring instrumentation must use telemetry, be robust, able to withstand backfilling operations and collected data accessible by key operators (WTP and Main Pit Backfill) in real time.

It is noted, the probe parameter requirements of Electrical Conductivity and Oxidation Reduction Potential may not used in the QA/QC, however they will be monitored to enable characterisation of the pit water not captured by pH measurement.

Table 12 Main Pit Water Quality In-situ Multi-Probe (within Main Pit) Testing Frequency

Backfilling Stage	Locations	Depth of probe(s) (m below pit lake surface)	Probe Parameter Requirements	Frequency
SBL	Off Backfill Material Delivery System.	10, 20, 30 & within 3.0m of Main Pit floor.	pH, Electrical Conductivity, Depth of Probe, Oxidation Reduction Potential, Time & Date of test	Continuous

Backfilling Stage	Locations	Depth of probe(s) (m below pit lake surface)	Probe Parameter Requirements	Frequency
WR < 27 m AHD	Off Backfill Material Delivery System.	10, 20 & within 3.0m of Main Pit Floor	pH, Electrical Conductivity, Depth of Probe, Oxidation Reduction Potential, Time & Date of test	Continuous
WR < 35 m AHD	Off Backfill Material Delivery System.	5, 10 & within 2.0m of Main Pit Floor	pH, Electrical Conductivity, Depth of Probe, Oxidation Reduction Potential, Time & Date of test	Continuous
WR < 56 m AHD	Off Backfill Material Delivery System.	Within 2.0m of Main Pit Floor	pH, Electrical Conductivity, Depth of Probe, Oxidation Reduction Potential, Time & Date of test	Continuous
ICL < 58 m AHD	Off Backfill Material Delivery System.	Within 2.0m of Main Pit Floor	pH, Electrical Conductivity, Depth of Probe, Oxidation Reduction Potential, Time & Date of test	Continuous

Notes: SBL = Sand Bedding Layer, WR = Waste Rock, ICL = Inert Capping Layer

Should the pit lake water quality at the elevation of waste rock layer placement alter below a pH of 7, backfilling operations are to be conducted in accordance with the Tigger Action Response Plan (**Section 5.6.2**), the water quality is to be adjusted until the pH is achieved. At this time, operations can recommence.

5.6.1 Hydrated Lime Contingency

A hydrated lime slurry delivery system shall be installed to deliver hydrated lime as a slurry directly to the existing Main Pit floor via submerged pipeline, with the pipe outlet able to be positioned within a minimum of 4.0 m radius of the pit backfilled floor level and within minimum 4.0 m radius of the material backfill placement location. Slurry delivery via pipeline will be necessary to prevent the dissolution of the hydrated lime into the water column prior to reaching the affected zone at the pit floor. The pipeline delivery system maybe contained on the backfill delivery vessel or batched and pumped via floating pipeline from the Main Pit crest.

The lime slurry shall have a hydrated lime content equal to 15% weight hydrated lime / volume of slurry water. Main Pit water may be used as slurry water.

- Slurry velocity at the outlet of the pipeline shall be managed in such a way that risk to contaminate remobilisation is minimised.

The intention of the lime delivery system is to neutralise a drop in pH that may be trigger by backfill material placement and ensure entrained pore water within the backfill materials is pH ≥ 7 . The lime required is considered as a contingency is intended to serve the TARP (**Section 5.6.2**). The lime, if required, is in addition to quantities provided in **Table 4** and **Table 5**.

The pipeline shall deliver the lime to the main pit floor (or within 4.0 m) at the location of backfill placement (within 4.0 m radius) as dictated by Trigger Action Response Plan (ref: **Section 5.6.2**).

The lime delivery system shall be setup such that delivery can occur within 15 minutes of requirement. The pipeline system is recommended to be able to retract as the backfill materials are placed, and the depth of the Main Pit water column decreases. Furthermore, due to the nature of materials to be placed, it is recommended the delivery system be retractable to mitigate against the risk of damage during backfilling.

5.6.2 Main Pit Backfilling Water Quality Trigger Action Response Plan (TARP)

A Trigger Action Response Plan (TARP) will be dictated by the Off Backfill Material Delivery System (Barge/Conveyor or alternative) Water Quality Monitoring Probes (Drawing Ref: 680.10421.MPS.D05). The TARP will be applicable to all probes at depth.

- $\text{pH} \geq 7$ = green – continue backfilling as normal
- $6.5 < \text{pH} < 7$ for 10 consecutive minutes or for more than 20 total minutes in a 60 min period = amber – report to Superintendent, alert water treatment plant, increase monitoring frequency, and slow backfill rate until pH stabilises above the amber trigger. Begin hydrated lime delivery if pH does not increase to the green trigger level after 20 minutes. Monitor until pH stabilises to $\text{pH} \geq 7$ for 10 consecutive minutes, at which time revert to green level controls.
- $\text{pH} \leq 6.5$ for 10 consecutive minutes or 20 total minutes in a 60-minute period = red – Notify superintendent and water treatment plant, cease all backfill operations and begin hydrated lime delivery. Monitor until pH stabilises to $\text{pH} \geq 7$ for 10 consecutive minutes, at which time revert to green level controls.

5.7 Water Level Monitoring

The Main Pit and Intermediate Pit water levels are to be maintained throughout backfilling as specified:

- Main Pit: RL 58 to 59 m AHD; and
- Intermediate Pit: RL 49 to 50 m AHD.

Water Level monitoring is to be continuous with alarm to the Pit Backfill operators to stop operations should these limits be breached. Once the water level conformance is achieved, operations can re-commence.

Details on the water level monitoring device(s) required are provided in the Water Treatment Facility Design Report. Installation of water level monitoring device will be the responsibility of the Water Treatment Plant Contractor. Real-time water level data will be made available to the Backfill contractor via telemetry or similar throughout backfill operations.

5.7.1 Main Pit Backfilling Water Level Trigger Action Response Plan (TARP)

A Trigger Action Response Plan (TARP) will be dictated by the Off Backfill Material Delivery System (Barge/Conveyor or alternative) Water Quality Monitoring Probe (Drawing Ref: 680.10421.MPS.D05). The TARP will be applicable to all probes at depth.

- Main Pit Water Level RL 58 to 59 m AHD = green – continue backfilling as normal
- Main Pit Water Level $< \text{RL } 58$ or $> \text{RL } 59$ m AHD for 10 consecutive minutes or for more than 30 total minutes in a 60 min period = amber – report to superintendent, alert water treatment plant, increase monitoring frequency and slow backfill rate until level stabilises above the amber trigger.

- Main Pit Water Level < RL 57 or > 59.50 m AHD for any time = red – Notify superintendent and water treatment plant, cease all backfill operations. Monitor until water level stabilise to the green trigger levels at which time revert to green level controls.

5.8 Main Pit Water Management Plan

The following provides the minimum headings expected within the Main Pit Water Management Plan. The plan is envisioned to be developed cooperatively between the Main Pit Backfill Operations and Water Treatment Plant Operations and submitted to the Principal for approval prior to works;

- Description of requirements
- Any relevant limits or performance measures/criteria
- Specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development of any management measures
- Description of measures that would be implemented to comply with relevant requirements, limits or performance measures/criteria;
- Protocols between Main Pit Backfilling and Water Treatment Plant Operations including but not limited to;
 - Trigger events;
 - Communication pathways;
 - Person(s) responsible; and
 - Actions to be performed.
- A program to monitor and report on the:
 - Impacts and environmental performance
 - Effectiveness of any management measures
- Contingency plan to manage any unpredicted impacts and their consequences;
- A protocol for managing and reporting any:
 - Incidents
 - Complaints
 - Non-compliances; and
 - Exceedances of the Trigger Action Response Plan levels
- Protocol for periodic review of plan

5.9 Neutralant Dose Rate Adjustment

The Superintendent may from time to time request adjustment to the neutralant dose rate for the lime amended waste rock. This may be in response to confirmation testing carried out by the Principal from the waste rock dumps to confirm that the predicted neutralant dose rates are suitable. The confirmation test work is the responsibility of the Superintendent however the Pit backfill contractor may be required to adjust dose rates accordingly.

6 Construction Quality Assurance

Backfilling of the Main Pit and associated surface remediation works shall be carried out in quality assured conditions, in conjunction with this Specification and under the supervision of a CQA Consultant.

A CQA Report is to be prepared in sufficient detail to meet the following requirements:

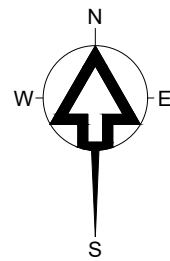
- Details of the works and monitoring devices installed, including surveys, work-as executed drawings, and an updated site plan showing the location of the works;
- Diary records by the CQA Consultant giving details of the works progress, the rate of backfill material filling and a summary of any problematic conditions;
- Photographs of all aspects and stages of the construction;
- Details and results of all material testing, including data and certifications provided by manufacturers of supplied materials;
- Details showing that the Construction Quality Assurance Plan was followed;
- An account of all variations from the approved design, specifications and Construction Quality Assurance Plan; and
- A declaration by the CQA Consultant that there is sufficient information to demonstrate that the remediation works were constructed in accordance with the approved designs and specifications.

7 References

- [1] SLR, "Rum Jungle Rehabilitation - Stage 2A Detailed Engineering Design, Main Pit Backfill Strategy," 2020a.
- [2] T. Verhoeven, "Rum Jungle Rehabilitation Project," Power and Water Authority, Darwin, 1988.
- [3] Robertson GeoConsultants, "Main Pit Backfilling Concept Approaches, Rum Jungle," DPIR, Darwin, 2016.
- [4] Northern Territory Government, "Rum Jungle Mine Rehabilitation Project - Stage 2 Detailed Design," Department of Mines and Energy, Darwin, 2016.
- [5] O'Kane Consultants, "Rehabilitation of the former Rum Jungle Mine: Stage 2 Works Specification," DPIR, Darwin, 2016.
- [6] Robertson GeoConsultants & Dr Jones Environmental Excellence, "Physical and Geochemical Characteristics of Waste Rock and Contaminate Materials (Rev2)," DPIR, Darwin, 2019.
- [7] Hydrobiology, "Rum Jungle Impact Assessment - Final Report," DPIR, Darwin, 2016.
- [8] Department of Primary Industry and Resources, "Rum Jungle Mine," 17 October 2019. [Online]. Available: <https://dpir.nt.gov.au/mining-and-energy/mine-rehabilitation-projects/rum-jungle-mine/photo-gallery>. [Accessed 12 2019].
- [9] D. o. I. a. Resources, "Darwin - Consultancy - Detailed Engineering Design - Rum Jungle Rehabilitation Stage 2A," DPIR, Darwin, 2017.
- [10] P. F. Williams, "Geology of the Rum Jungle District, With Particular Reference to the Origin of the Uranium Orebodies," 1963.
- [11] M. & C. F. M., *Rum Jungle 14-253-RFQ-RS Bathymetric Survey*, Darwin, 2015.

APPENDIX A

Drawings



LEGEND	
	EXISTING CONTOURS (1m INTERVALS)
	AREA OF IMPACTED MATERIAL
	DRAINAGE LINES

EXISTING DILAPIDATED STRUCTURES

RADIOACTIVE SOILS AREA 'A'

OLD STOCKPILE AREA

EXISTING TAILINGS IN MAIN PIT TO BE COVERED BY BRIDGING SAND THEN PIT TO BE BACKFILLED WITH WASTE ROCK TO RL. 56m
WASTE ROCK TO BE CAPPED WITH CLEAN FILL TO RL. 58m

EXISTING MAIN PIT OUTLET CULVERT

EXISTING MAIN PIT BATHYMETRY

DRILL RIG SITE

EXISTING MAIN PIT INLET CULVERT

RADIOACTIVE SOILS AREA 'B'

COPPER EXTRACTION AREA

MAIN NORTH WASTE ROCK DUMP

EXISTING INTERMEDIATE PIT BATHYMETRY

EAST BRANCH FINNISS RIVER DIVERSION DRAIN

EAST BRANCH FINNISS RIVER

SALT IMPACTED AREA 'A'

MAIN WASTE ROCK DUMP LEVEE

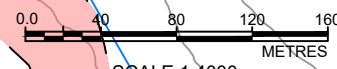
FITCH CREEK

INTERMEDIATE WASTE ROCK DUMP

MAIN WASTE ROCK DUMP

SALT IMPACTED AREA 'C'

SALT IMPACTED AREA 'B'



PLOTTED ON: 12/06/2020 10:41 AM
 USER: JORDAN MUGFORD
 FILE LOCATION: H:\Projects-SLR\620-BNE\680-DRW\680.10421 - Rum Jungle\CAD\JM-Working\Design Drawings\Implementation Issue - week 08062020\680.10421-MPS-SERIES.dwg

No.	DESCRIPTION	DATE	INIT.	DEPT./COMPANY
1	ISSUED FOR IMPLEMENTATION	12/06/20	JM	SLR
B	ISSUED FOR EXTERNAL REVIEW	05/05/20	JM	SLR
A	ISSUED FOR CLIENT APPROVAL	30/04/20	JM	SLR

AMENDMENTS

Plot Date: 12/06/2020

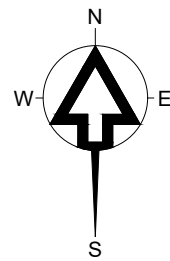


UNIT 5 / 21 PARAP ROAD
DARWIN
NT 0820
AUSTRALIA
T: 61 8 8998 0100
F: 61 8 8998 0101
www.slrconsulting.com

DRAWN J Mugford DATE: 12/06/2020	CHECKED D OToole/B Tarrant DATE: 12/06/2020
DESIGNED B Tarrant DATE: 12/06/2020	CHECKED D OToole DATE: 12/06/2020
DESIGN PROJECT LEADER D OToole DATE: 12/06/2020	NTG PROJECT MANAGER J Hartnett DATE: 12/06/2020



RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
EXISTING MAIN PIT SITE CONDITIONS				
NTG PROJECT No. N/A	NTG ASSET No. N/A	SHEET No. 01 of 16	NTG DRAWING No. 680.10421.MPS.D01	AMENDMENT 1
				SHEET SIZE A3



LEGEND	
	EXISTING CONTOURS (1m INTERVALS)
	AREA OF IMPACTED MATERIAL
	PROPOSED WSF FOOTPRINT
	DRAINAGE LINES
	DESIGN CONTOURS (1m INTERVALS)
	INDICATIVE BARGE ANCHOR POINT
	OPERATIONS AND STOCKPILE AREA

INDICATIVE WATER TREATMENT PLANT LOCATION

RADIOACTIVE SOILS AREA 'A'

OLD STOCKPILE AREA

PROPOSED WSF WEST FOOTPRINT

NOMINAL 40m EXCLUSION ZONE AROUND MAIN PIT RIM

EXISTING TAILINGS IN MAIN PIT TO BE COVERED BY BRIDGING SAND THEN PIT TO BE BACKFILLED WITH WASTE ROCK TO RL. 56m WASTE ROCK TO BE CAPPED WITH CLEAN FILL TO RL. 58m

INDICATIVE BARGE ANCHOR POINTS MIN. 50m OFFSET FROM PIT RIM

BARGE

EXISTING MAIN PIT BATHYMETRY

SITE HAULAGE ROAD REFER DRAWING SERIES 'HR' FOR DETAILS (HAUL ROAD DRAWINGS BY MEC MINING)

COPPER EXTRACTION AREA

CONSTRUCT PIT ACCESS RAMP REFER DRAWING 680.10421.MPS.D04 FOR DETAILS

LAYDOWN AREA REFER DRAWING SERIES 'HR' FOR DETAILS (HAUL ROAD DRAWINGS BY MEC MINING)

EXISTING INTERMEDIATE PIT BATHYMETRY

MAIN NORTH WASTE ROCK DUMP

MAIN PIT BACKFILL OPERATIONS AND STOCKPILE AREA FOOTPRINT = 35,600m²

PROPOSED RIVER CROSSING REFER DRAWING SERIES 'C' FOR DETAILS (DIVERSION DRAIN CROSSING DRAWINGS BY PRITCHARD FRANCIS)

EAST BRANCH FINNISS RIVER DIVERSION DRAIN

A D05

SALT IMPACTED AREA 'A'

MAIN WASTE ROCK DUMP LEVEE

INTERMEDIATE WASTE ROCK DUMP

MAIN WASTE ROCK DUMP

FITCH CREEK

SALT IMPACTED AREA 'C'

SALT IMPACTED AREA 'B'



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A	ISSUED FOR CLIENT APPROVAL	30/04/20	JM	SLR

AMENDMENTS

Plot Date: 12/06/2020

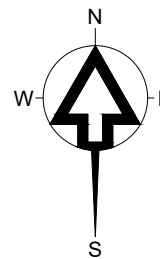
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DESIGN PROJECT LEADER D OToole DATE: 12/06/2020	NTG PROJECT MANAGER J Hartnett DATE: 12/06/2020

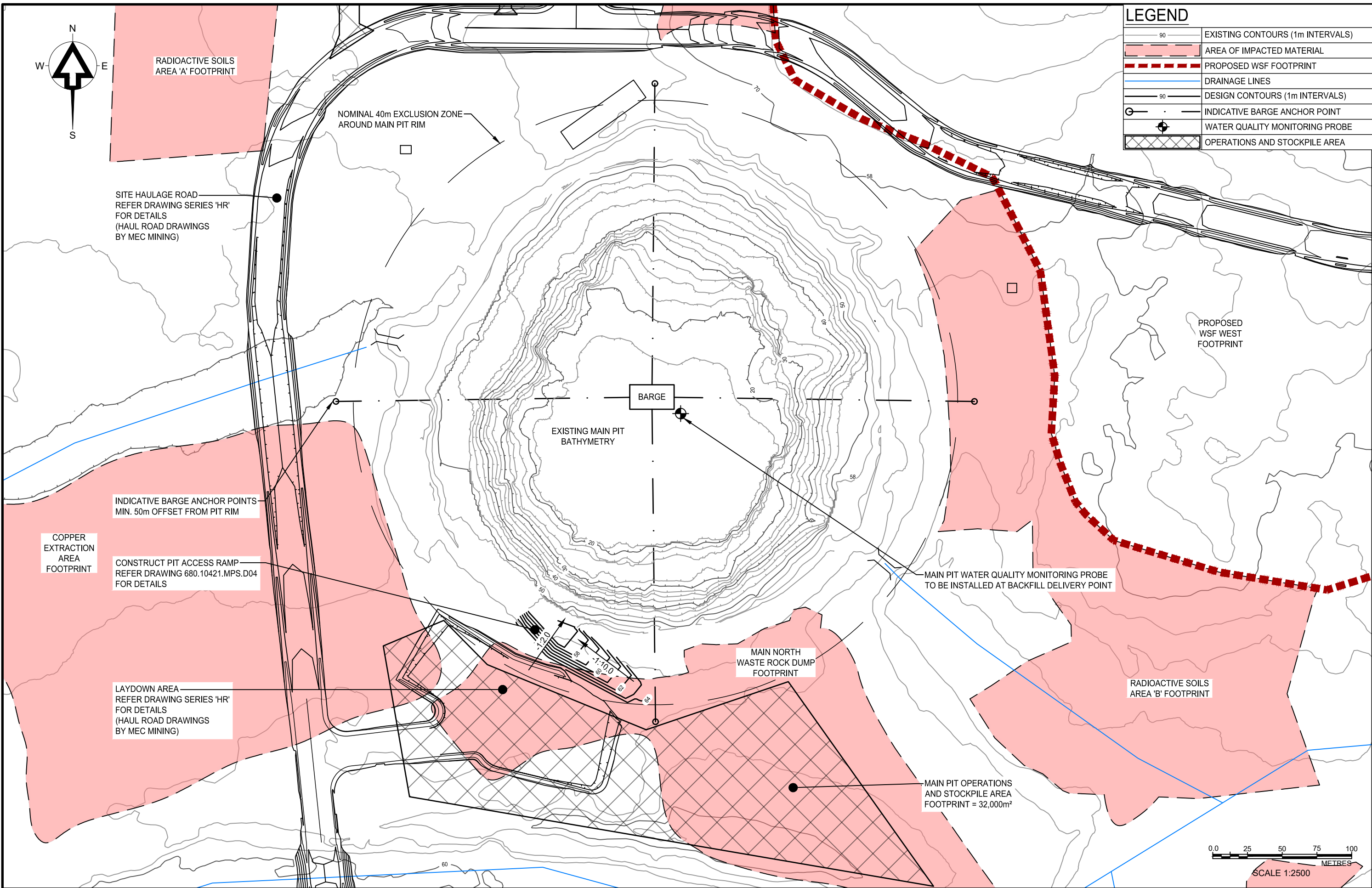
Northern Territory Government

RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
MAIN PIT REHABILITATION PLAN				
NTG PROJECT No. N/A	NTG ASSET No. N/A	SHEET No. 02 of 16	NTG DRAWING No. 680.10421.MPS.D02	AMENDMENT 1
				SHEET SIZE A3

Ver. Jan' 2020



LEGEND	
	EXISTING CONTOURS (1m INTERVALS)
	AREA OF IMPACTED MATERIAL
	PROPOSED WSF FOOTPRINT
	DRAINAGE LINES
	DESIGN CONTOURS (1m INTERVALS)
	INDICATIVE BARGE ANCHOR POINT
	WATER QUALITY MONITORING PROBE
	OPERATIONS AND STOCKPILE AREA



RADIOACTIVE SOILS AREA 'A' FOOTPRINT

NOMINAL 40m EXCLUSION ZONE AROUND MAIN PIT RIM

SITE HAULAGE ROAD REFER DRAWING SERIES 'HR' FOR DETAILS (HAUL ROAD DRAWINGS BY MEC MINING)

BARGE

EXISTING MAIN PIT BATHYMETRY

PROPOSED WSF WEST FOOTPRINT

INDICATIVE BARGE ANCHOR POINTS MIN. 50m OFFSET FROM PIT RIM

COPPER EXTRACTION AREA FOOTPRINT

CONSTRUCT PIT ACCESS RAMP REFER DRAWING 680.10421.MPS.D04 FOR DETAILS

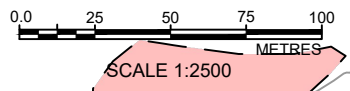
MAIN PIT WATER QUALITY MONITORING PROBE TO BE INSTALLED AT BACKFILL DELIVERY POINT

MAIN NORTH WASTE ROCK DUMP FOOTPRINT

LAYDOWN AREA REFER DRAWING SERIES 'HR' FOR DETAILS (HAUL ROAD DRAWINGS BY MEC MINING)

RADIOACTIVE SOILS AREA 'B' FOOTPRINT

MAIN PIT OPERATIONS AND STOCKPILE AREA FOOTPRINT = 32,000m²



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AMENDMENTS

Plot Date: 12/06/2020

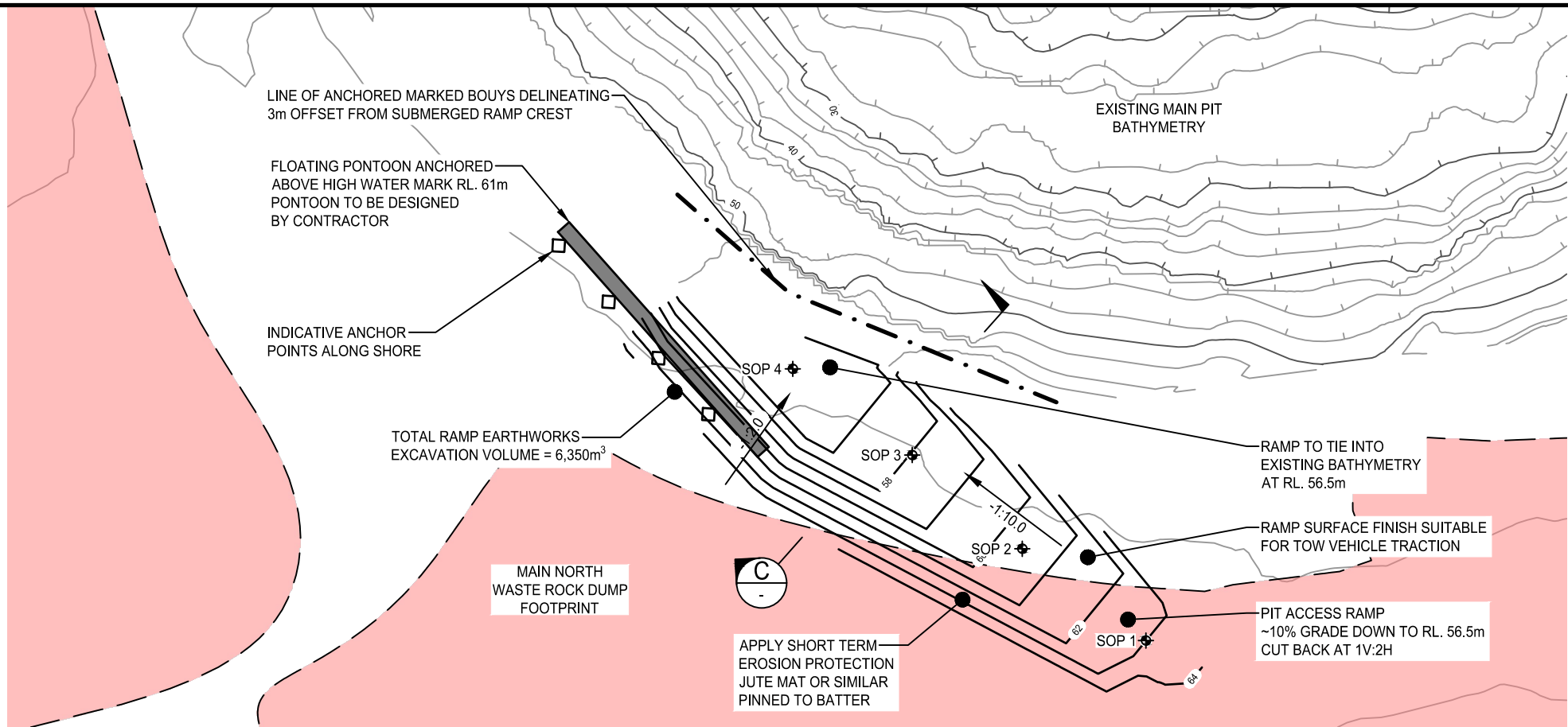
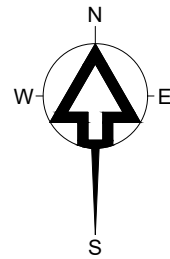


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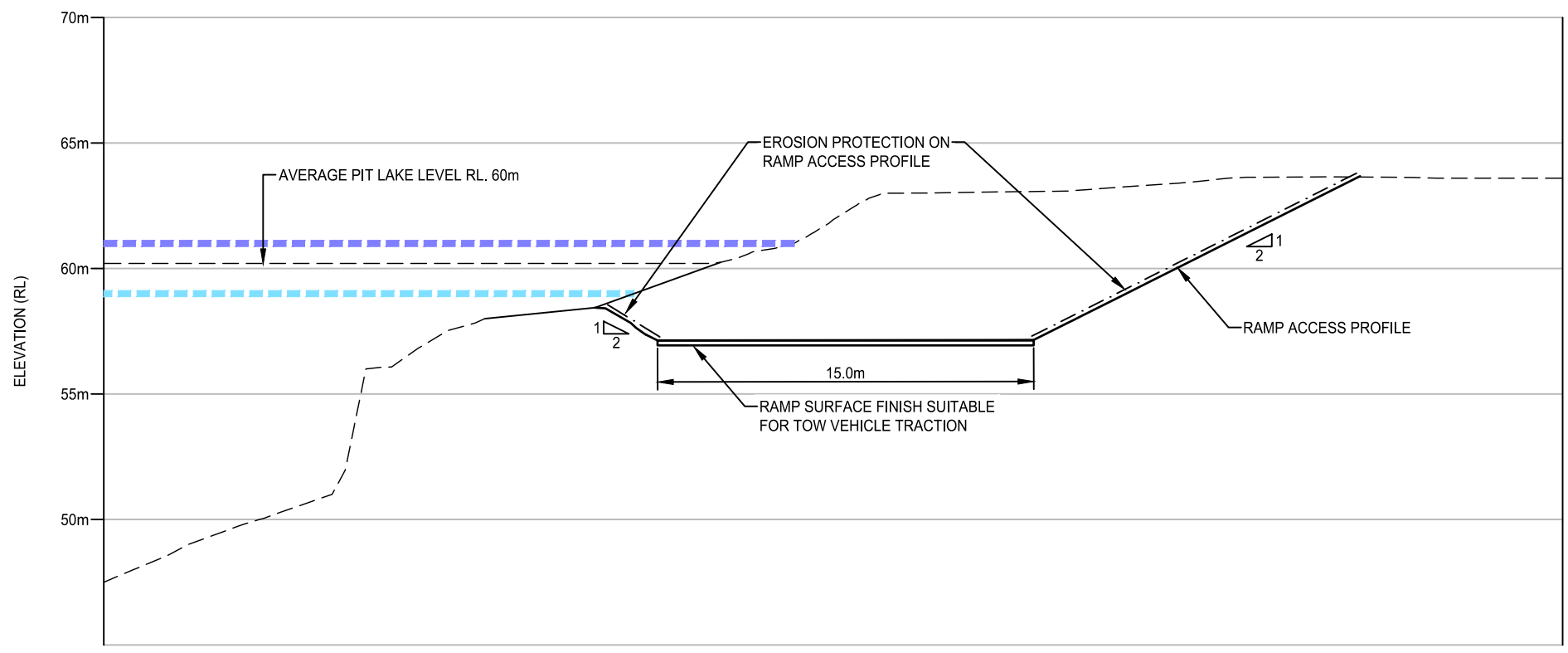
RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
MAIN PIT ACCESS AND LAYDOWN AREA				
NTG PROJECT No. N/A	NTG ASSET No. N/A	SHEET No. 03 of 16	NTG DRAWING No. 680.10421.MPS.D03	AMENDMENT 1
			SHEET SIZE A3	Ver. Jan' 2020



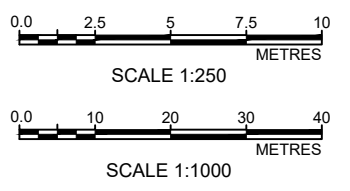
LEGEND	
	EXISTING CONTOURS (1m INTERVALS)
	AREA OF IMPACTED MATERIAL
	DESIGN CONTOURS (1m INTERVALS)
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE
	PONTOON
	INDICATIVE PONTOON ANCHOR POINTS
	CENTRELINE OF MARKED BOUYIS

MAIN PIT ENTRY RAMP SETOUT POINT TABLE			
SOP REF	EASTING	NORTHING	ELEVATION
SOP 1	717,846.26	8,563,173.03	63.00
SOP 2	717,825.71	8,563,188.29	60.44
SOP 3	717,807.41	8,563,203.88	58.04
SOP 4	717,787.57	8,563,218.21	56.50

MAIN PIT ENTRY RAMP DETAIL PLAN
SCALE 1 : 1000



PIT RAMP DETAIL SECTION C
SCALE 1:250



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AMENDMENTS

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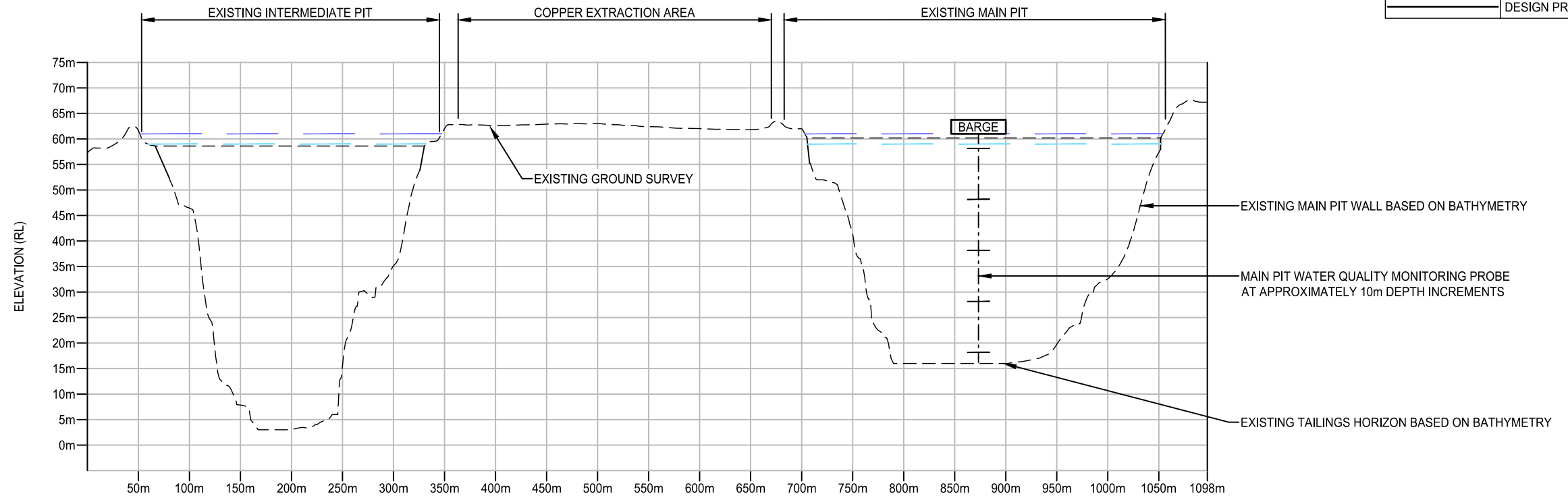
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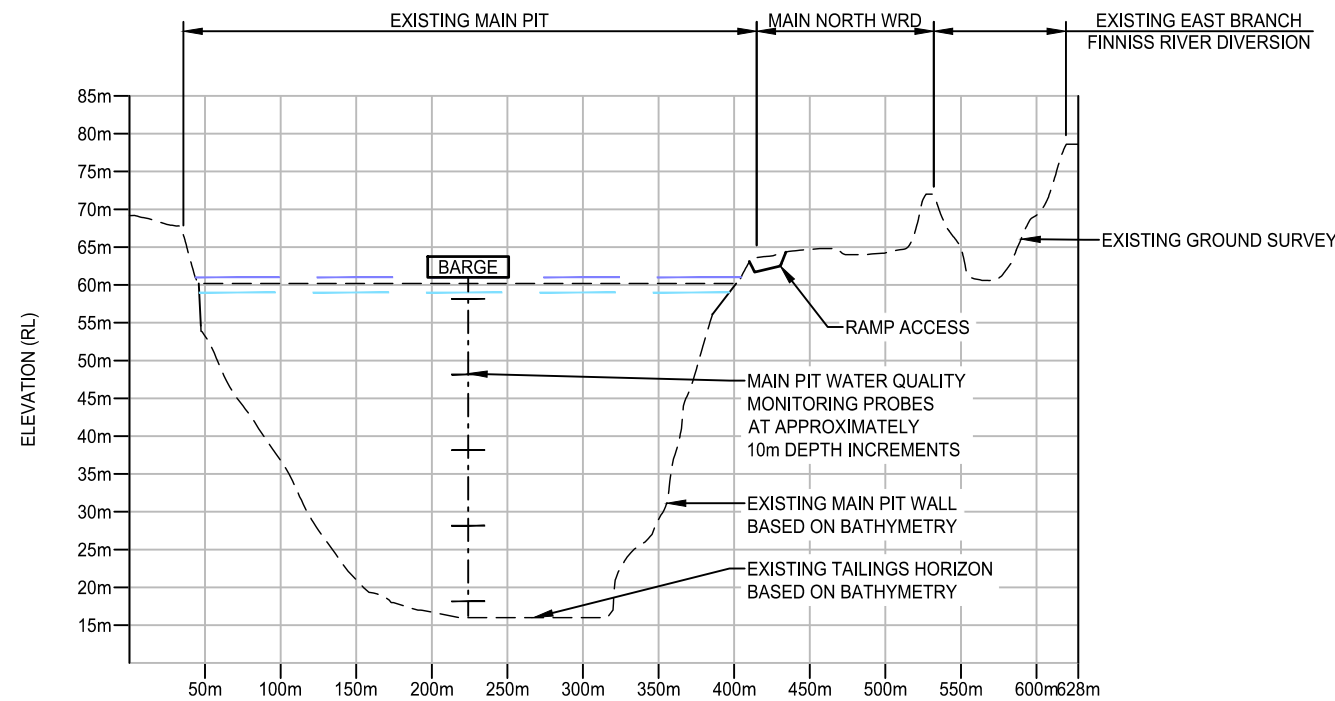
Northern Territory Government

RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
MAIN PIT ENTRY RAMP DETAIL				
NTG PROJECT No. N/A	NTG ASSET No. N/A	SHEET No. 04 of 16	NTG DRAWING No. 680.10421.MPS.D04	AMENDMENT 1
				SHEET SIZE A3

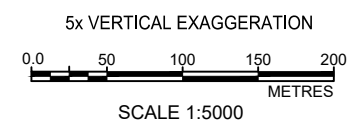
LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE



A-A - LONGSECTION SECTION A D02 SCALE 1:5000



B-B - LONGSECTION SECTION B D02 SCALE 1:5000



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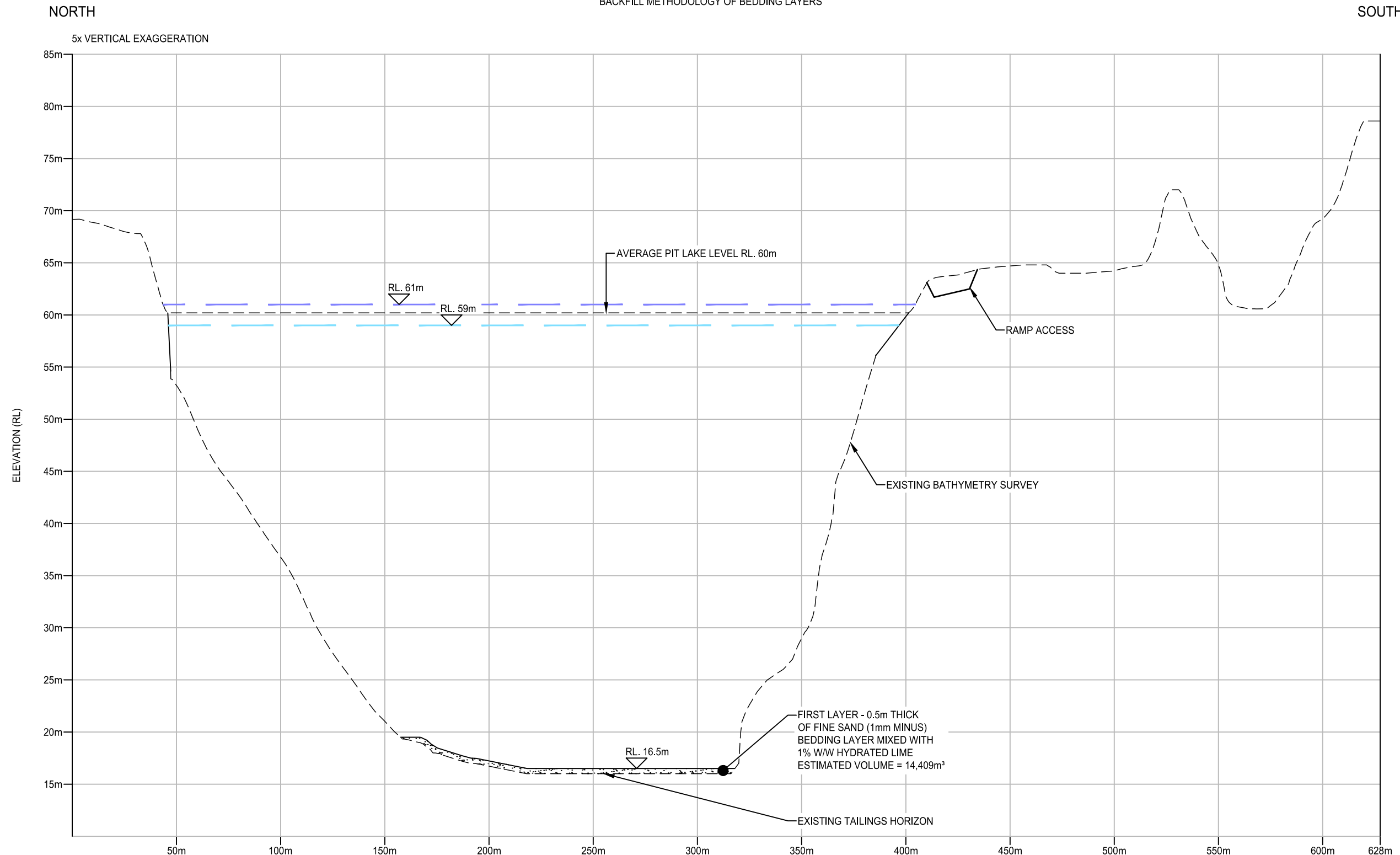
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RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
MAIN PIT REHABILITATION SECTIONS				
NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT
N/A	N/A	05 of 16	680.10421.MPS.D05	1
				SHEET SIZE A3

LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR
BACKFILL METHODOLOGY OF BEDDING LAYERS



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

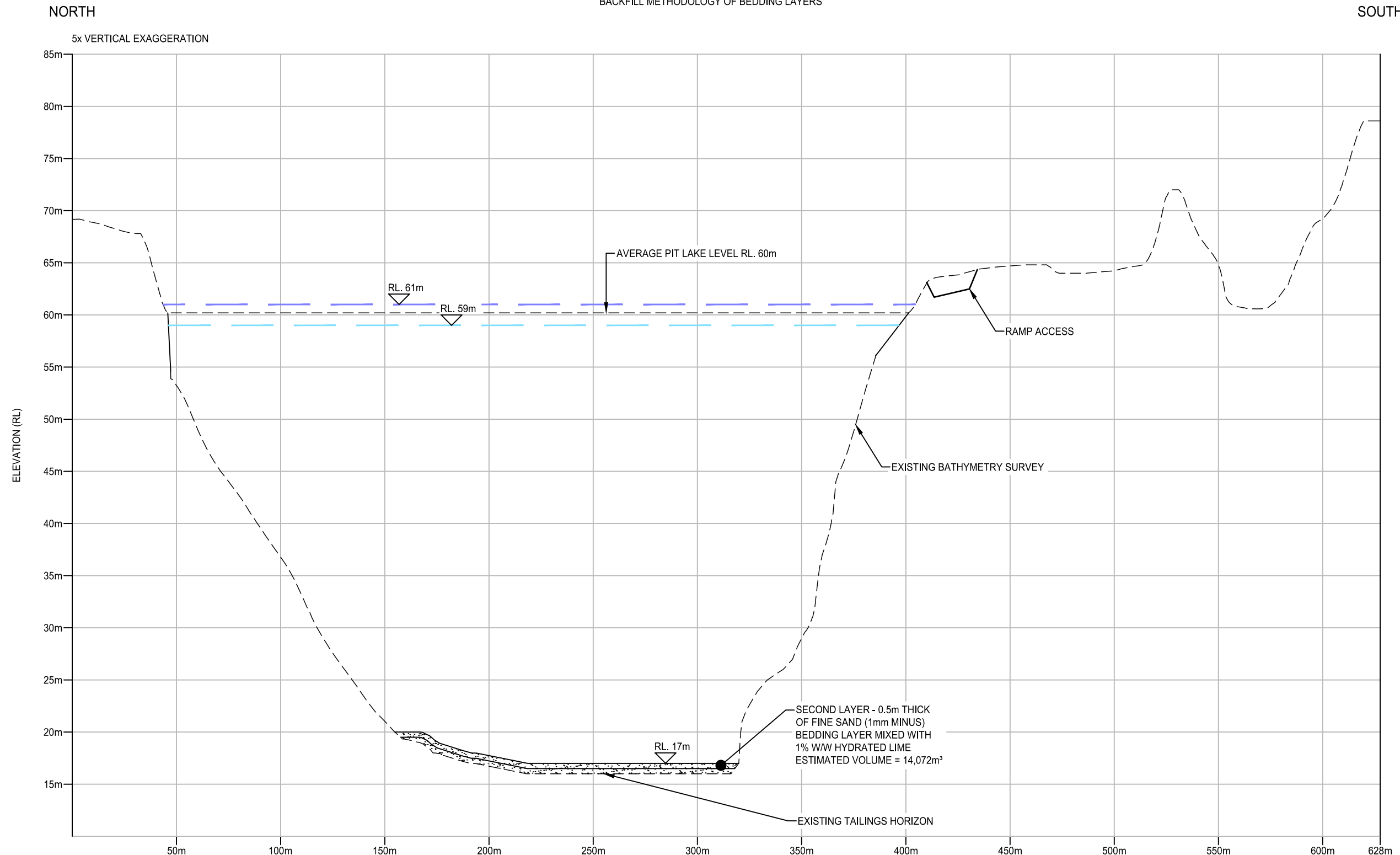
TYPICAL MAIN PIT BACKFILL SECTION
SHEET 1 OF 8

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Ver. Jan' 2020

LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR
BACKFILL METHODOLOGY OF BEDDING LAYERS



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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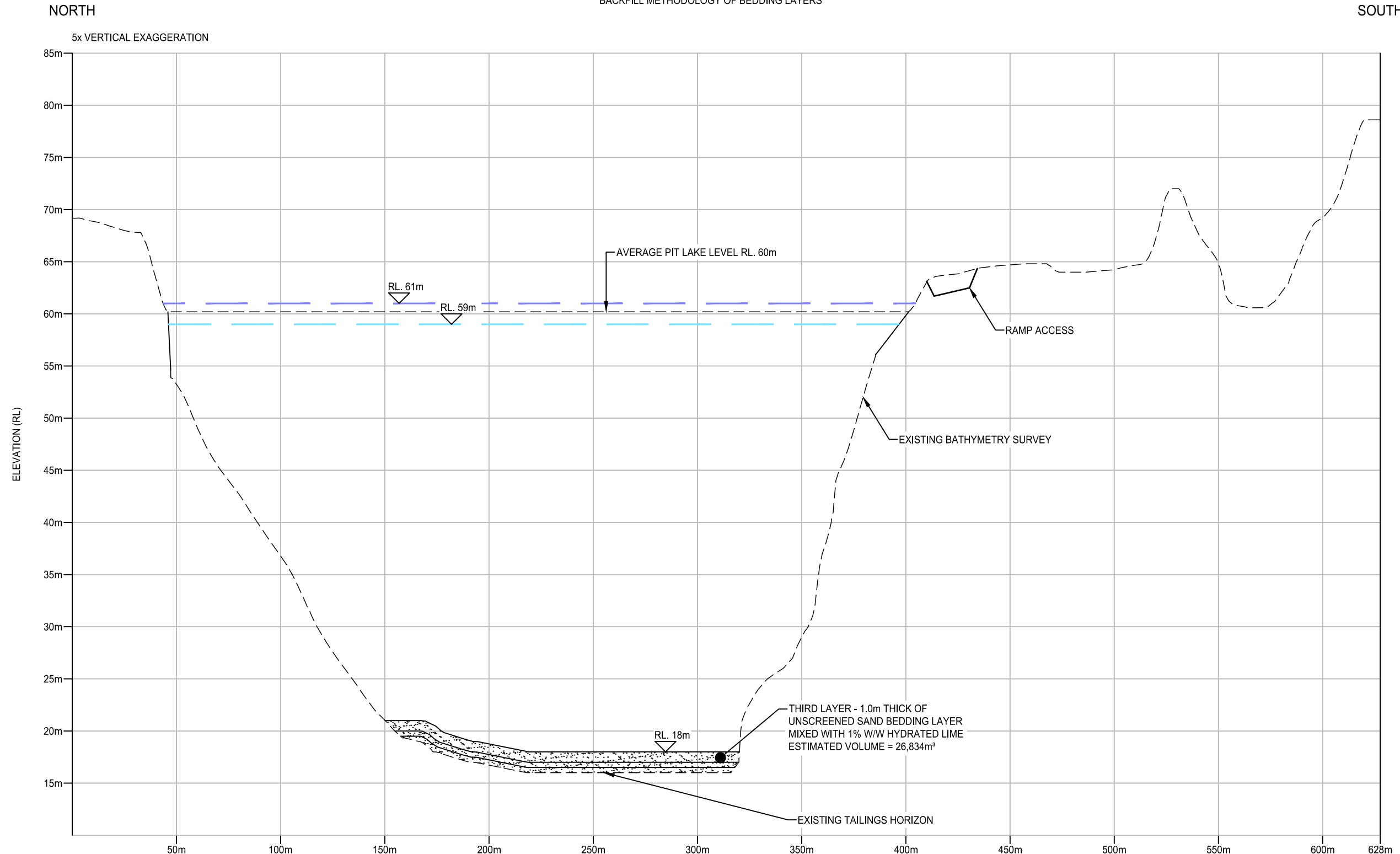
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTION
SHEET 2 OF 8

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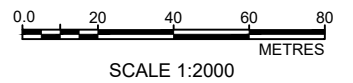
LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
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BACKFILL METHODOLOGY OF BEDDING LAYERS



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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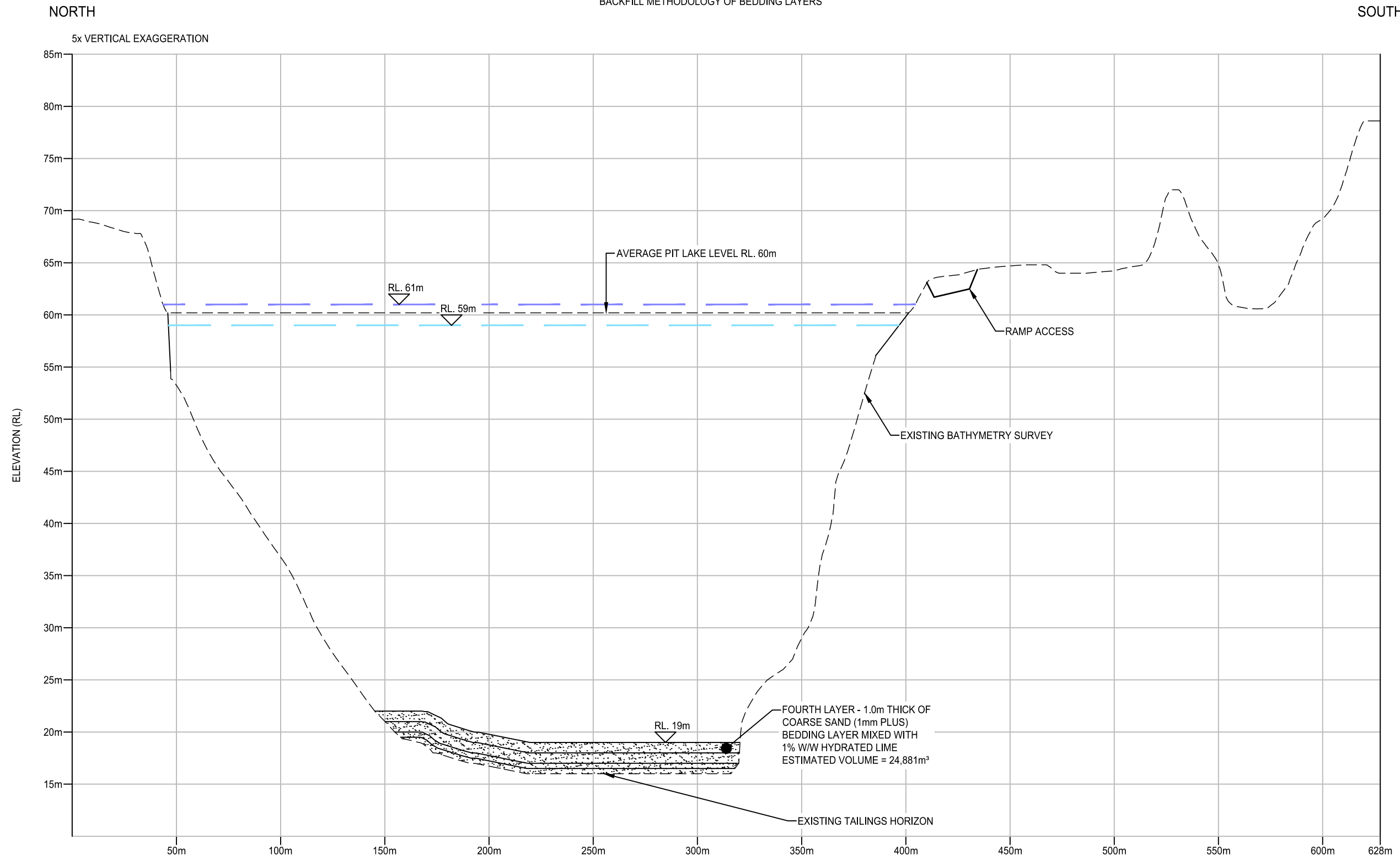
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTION
SHEET 3 OF 8

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
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LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR
BACKFILL METHODOLOGY OF BEDDING LAYERS



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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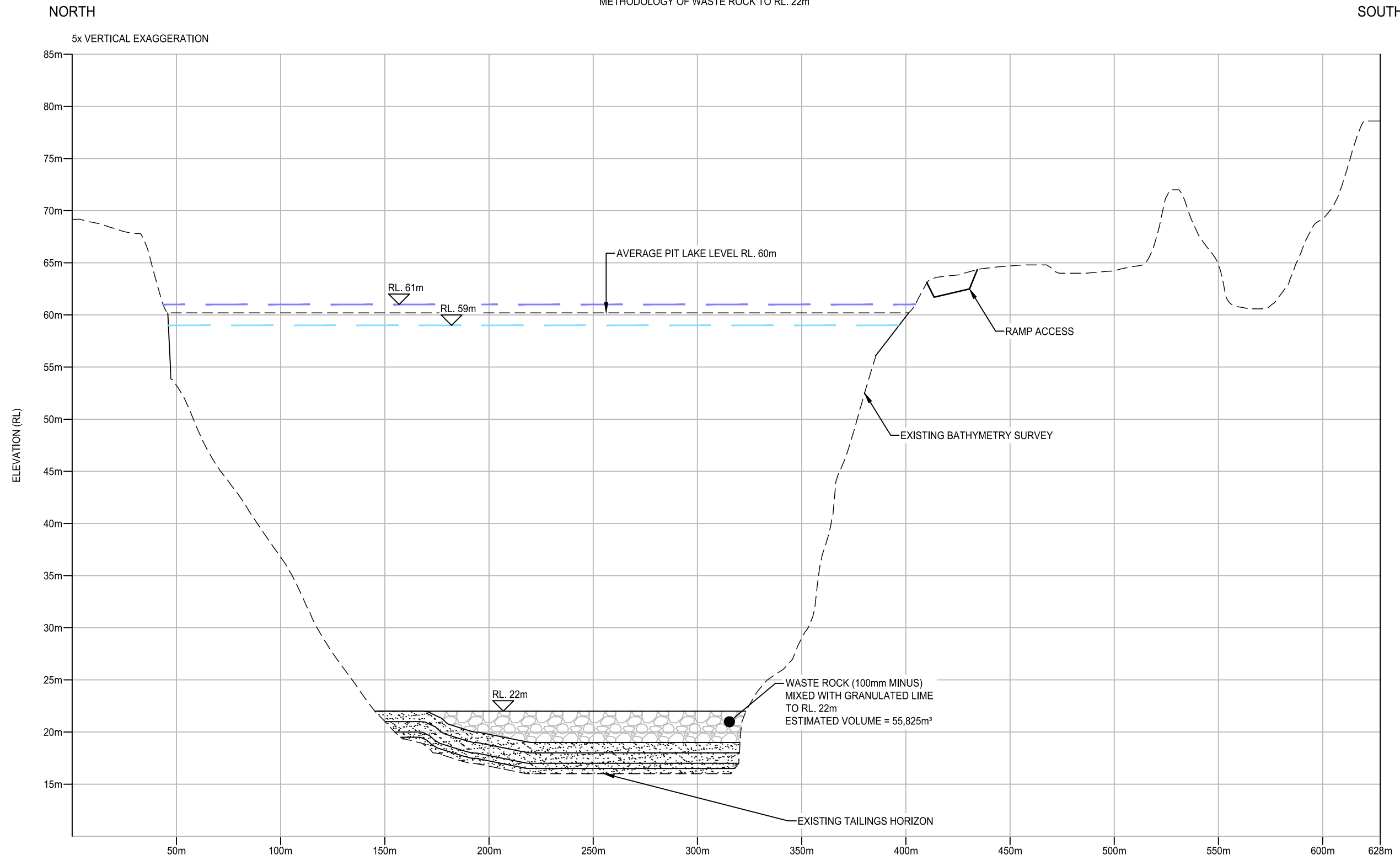
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTION
SHEET 4 OF 8

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
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LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR BACKFILL
METHODOLOGY OF WASTE ROCK TO RL. 22m



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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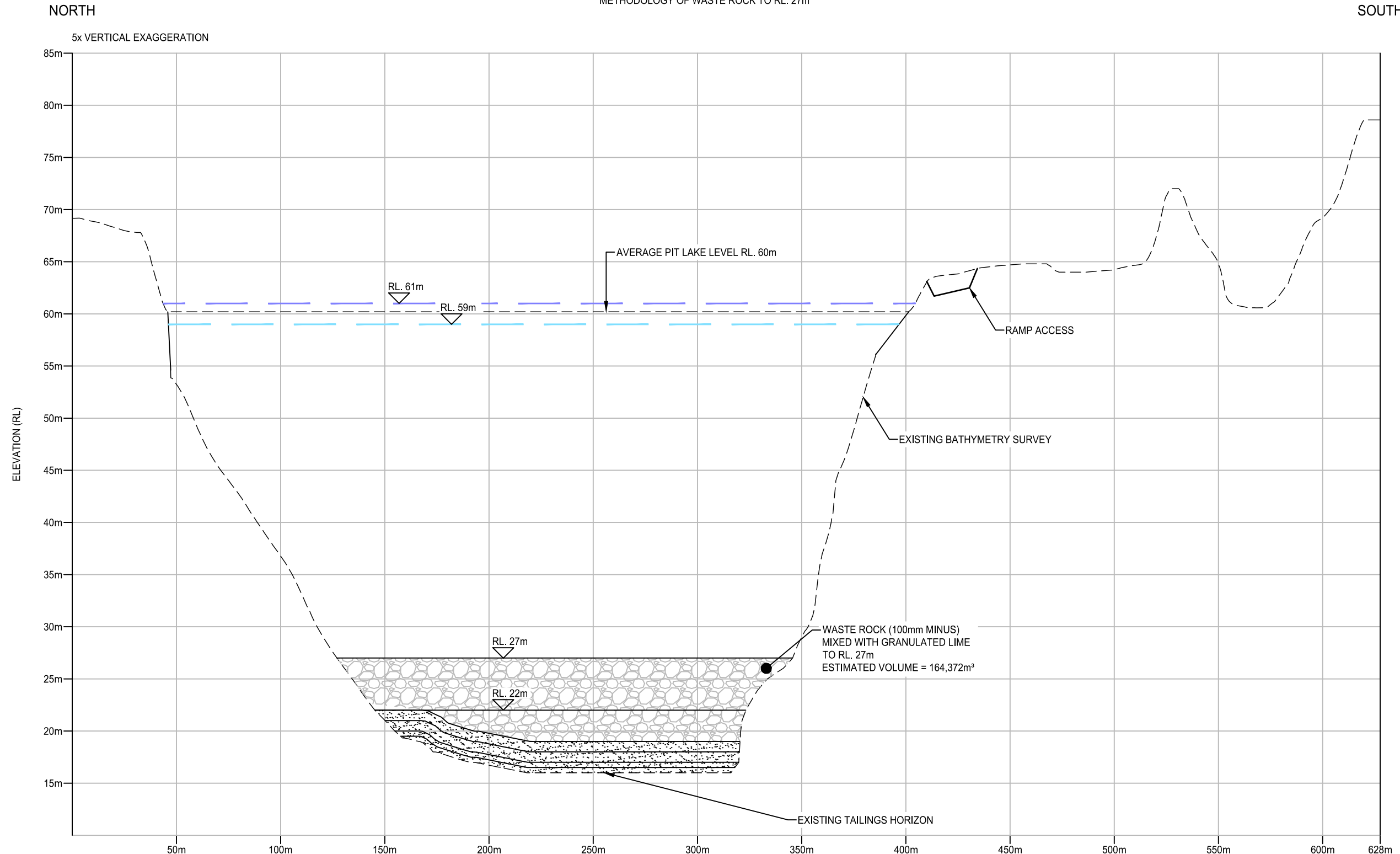
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTION
SHEET 5 OF 8

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
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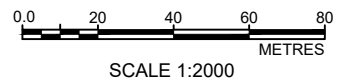
LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR BACKFILL
METHODOLOGY OF WASTE ROCK TO RL. 27m



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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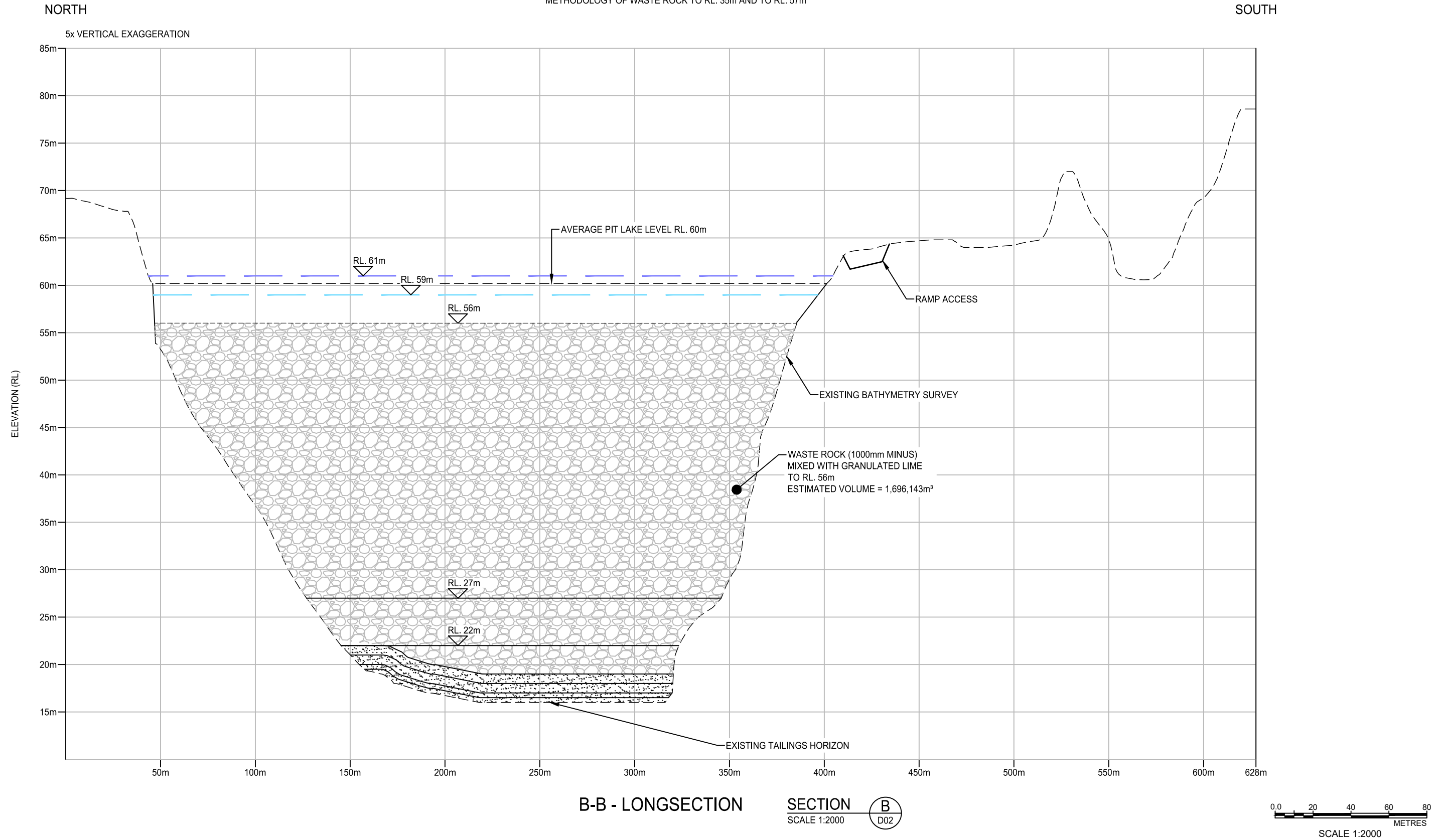
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTIONS
SHEET 6 OF 8

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
N/A	N/A	11 OF 16	680.10421.MPS.D11	1	A3

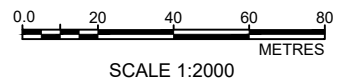
LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE

NOTE:
REFER DRAWING 680.10421.MPS.D14 FOR BACKFILL
METHODOLOGY OF WASTE ROCK TO RL. 35m AND TO RL. 57m



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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No.	DESCRIPTION	DATE	INIT.	DEPT/COMPANY
1	ISSUED FOR IMPLEMENTATION	12/06/20	JM	SLR
B	ISSUED FOR EXTERNAL REVIEW	05/05/20	JM	SLR
A	ISSUED FOR CLIENT APPROVAL	30/04/20	JM	SLR

AMENDMENTS

Plot Date: 12/06/2020



UNIT 5 / 21 PARAP ROAD
DARWIN
NT 0820
AUSTRALIA
T: 61 8 8998 0100
F: 61 8 8998 0101
www.slrconsulting.com

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DESIGN PROJECT LEADER D OToole DATE: 12/06/2020	NTG PROJECT MANAGER J Hartnett DATE: 12/06/2020



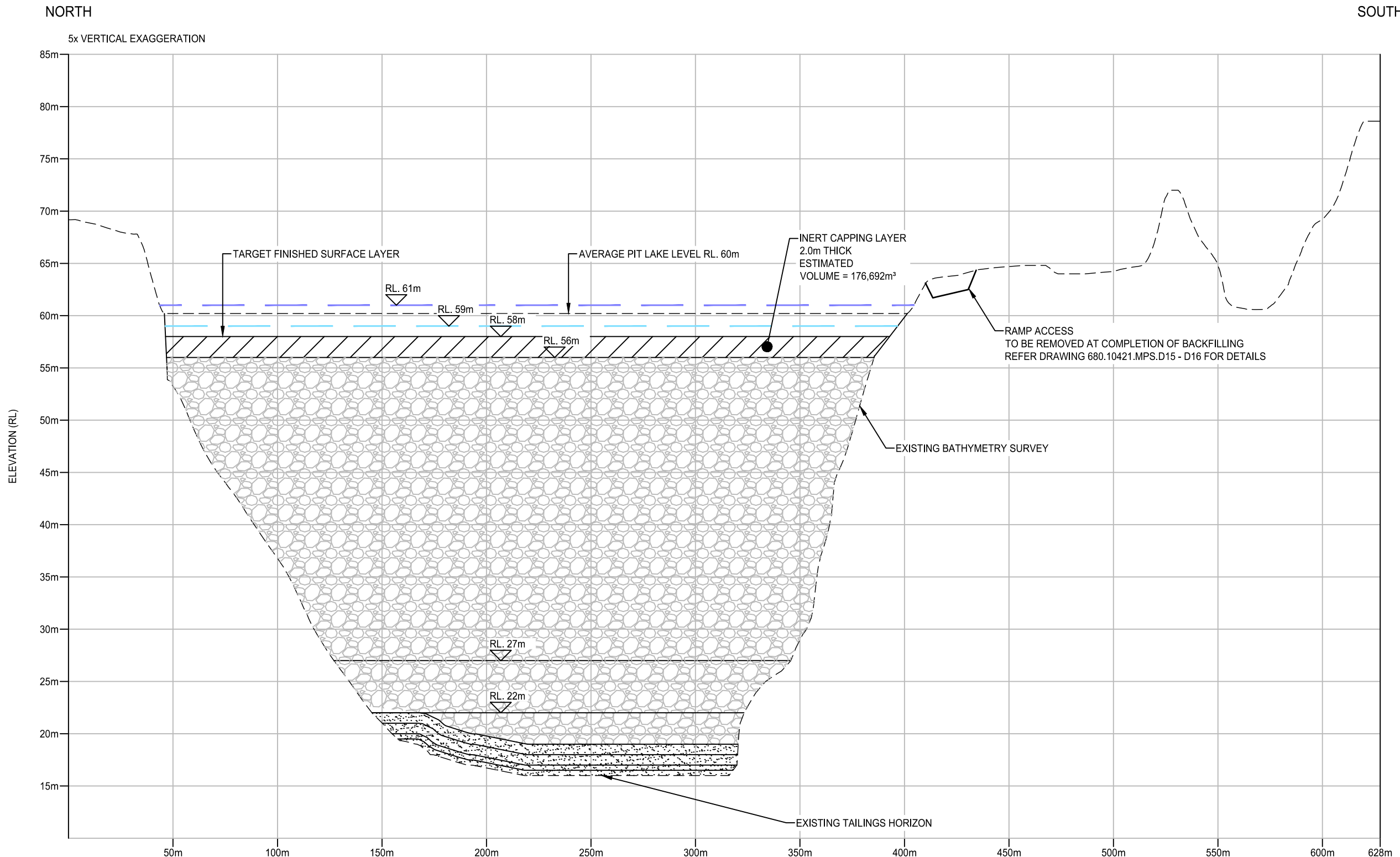
RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTION
SHEET 7 OF 8

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
N/A	N/A	12 OF 16	680.10421.MPS.D12	1	A3

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LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE



B-B - LONGSECTION

SECTION **B**
SCALE 1:2000



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AMENDMENTS

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DARWIN
NT 0820
AUSTRALIA
T: 61 8 8998 0100
F: 61 8 8998 0101
www.slrconsulting.com

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DESIGN PROJECT LEADER D OToole DATE: 12/06/2020	NTG PROJECT MANAGER J Hartnett DATE: 12/06/2020

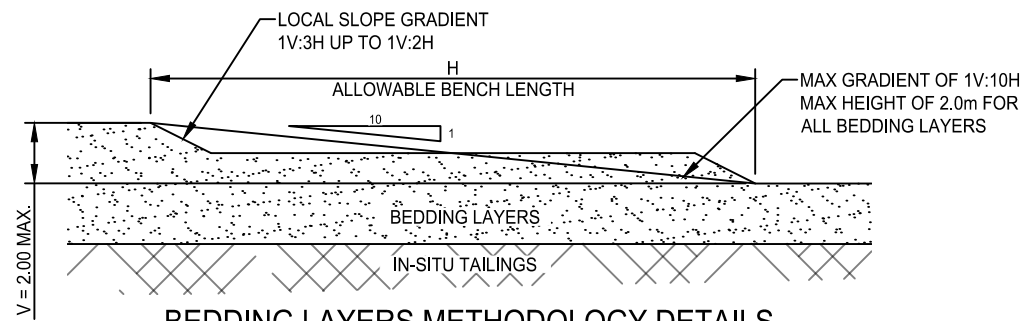


RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

TYPICAL MAIN PIT BACKFILL SECTIONS
SHEET 8 OF 8

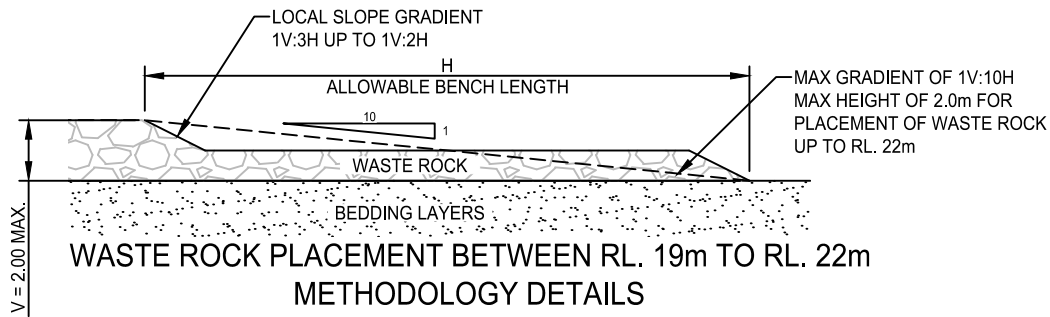
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NOTE:
REFER DRAWING 680.10421.MPS.D06 - D09 FOR
RELEVANT MAIN PIT SECTIONS



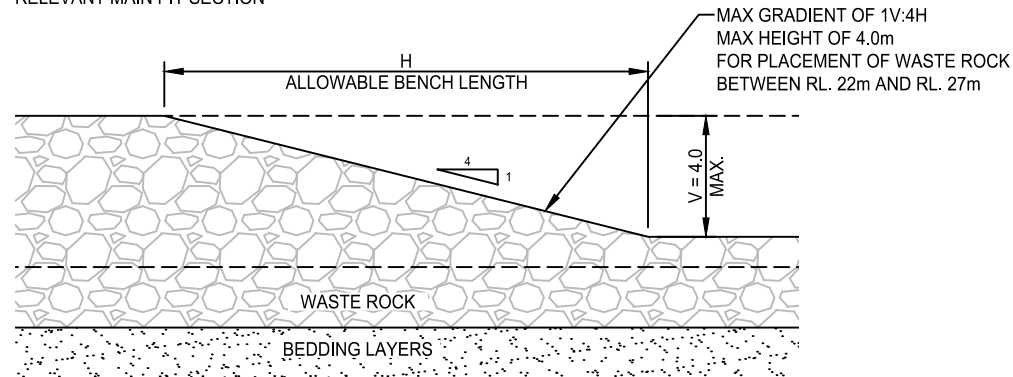
BEDDING LAYERS METHODOLOGY DETAILS
SCALE 1 : 250

NOTE:
REFER DRAWING 680.10421.MPS.D10 FOR
RELEVANT MAIN PIT SECTIONS



**WASTE ROCK PLACEMENT BETWEEN RL. 19m TO RL. 22m
METHODOLOGY DETAILS**
SCALE 1 : 250

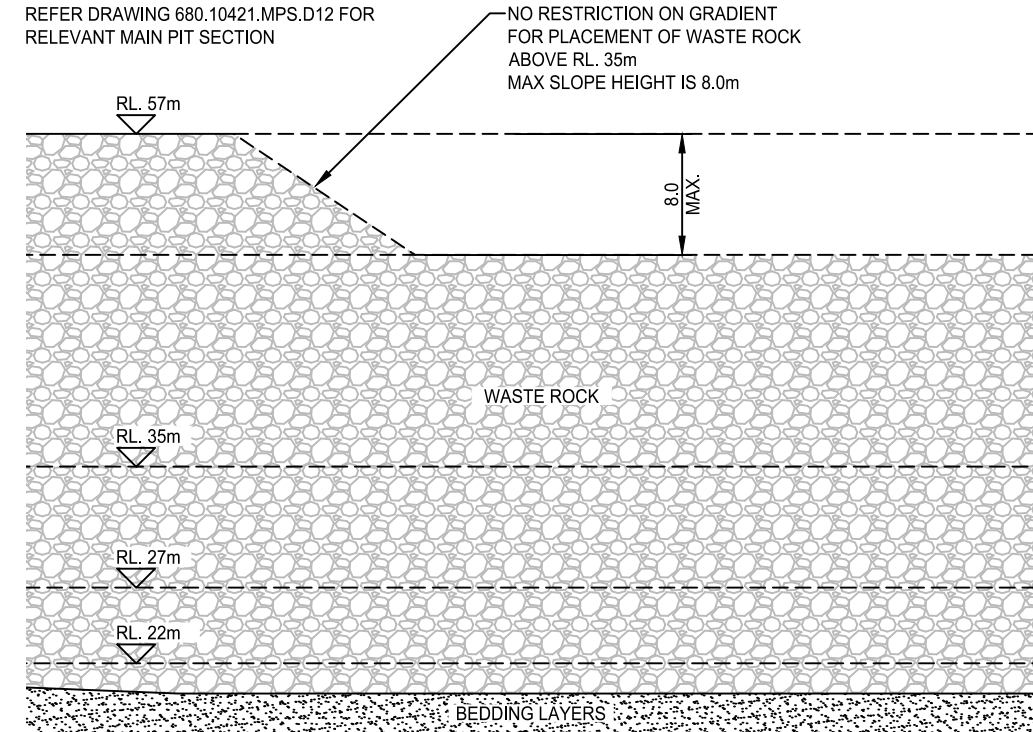
NOTE:
REFER DRAWING 680.10421.MPS.D11 FOR
RELEVANT MAIN PIT SECTION



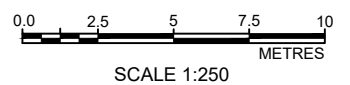
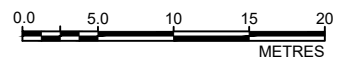
**WASTE ROCK PLACEMENT BETWEEN RL. 22m TO RL. 27m
METHODOLOGY DETAILS**
SCALE 1 : 250

BACKFILL MATERIAL	RL FROM (m AHD)	RL TO (m AHD)	V MAX (m)	V MAX (MIN AREA)	(V:H) MAX	(V:H) MAX (MIN AREA)
BEDDING SAND	16	22	2	20m x 20m	1V:10H	100m x 100m
WASTE ROCK	19	22	2	20m x 20m	1V:10H	100m x 100m
WASTE ROCK	22	27	4	20m x 20m	1V:4H	100m x 100m
WASTE ROCK	27	35	8	20m x 20m	1V:3H	100m x 100m
WASTE ROCK / INERT CAPPING LAYER	35	-	8	100m x 100m	-	100m x 100m

NOTE:
REFER DRAWING 680.10421.MPS.D12 FOR
RELEVANT MAIN PIT SECTION



**WASTE ROCK PLACEMENT ABOVE RL. 35m
METHODOLOGY DETAILS**
SCALE 1 : 500



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AMENDMENTS

Plot Date: 12/06/2020



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DARWIN
NT 0820
AUSTRALIA
T: 61 8 8998 0100
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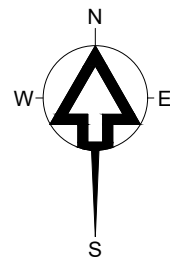


RUM JUNGLE REHABILITATION
STAGE 2A DETAILED ENGINEERING DESIGN

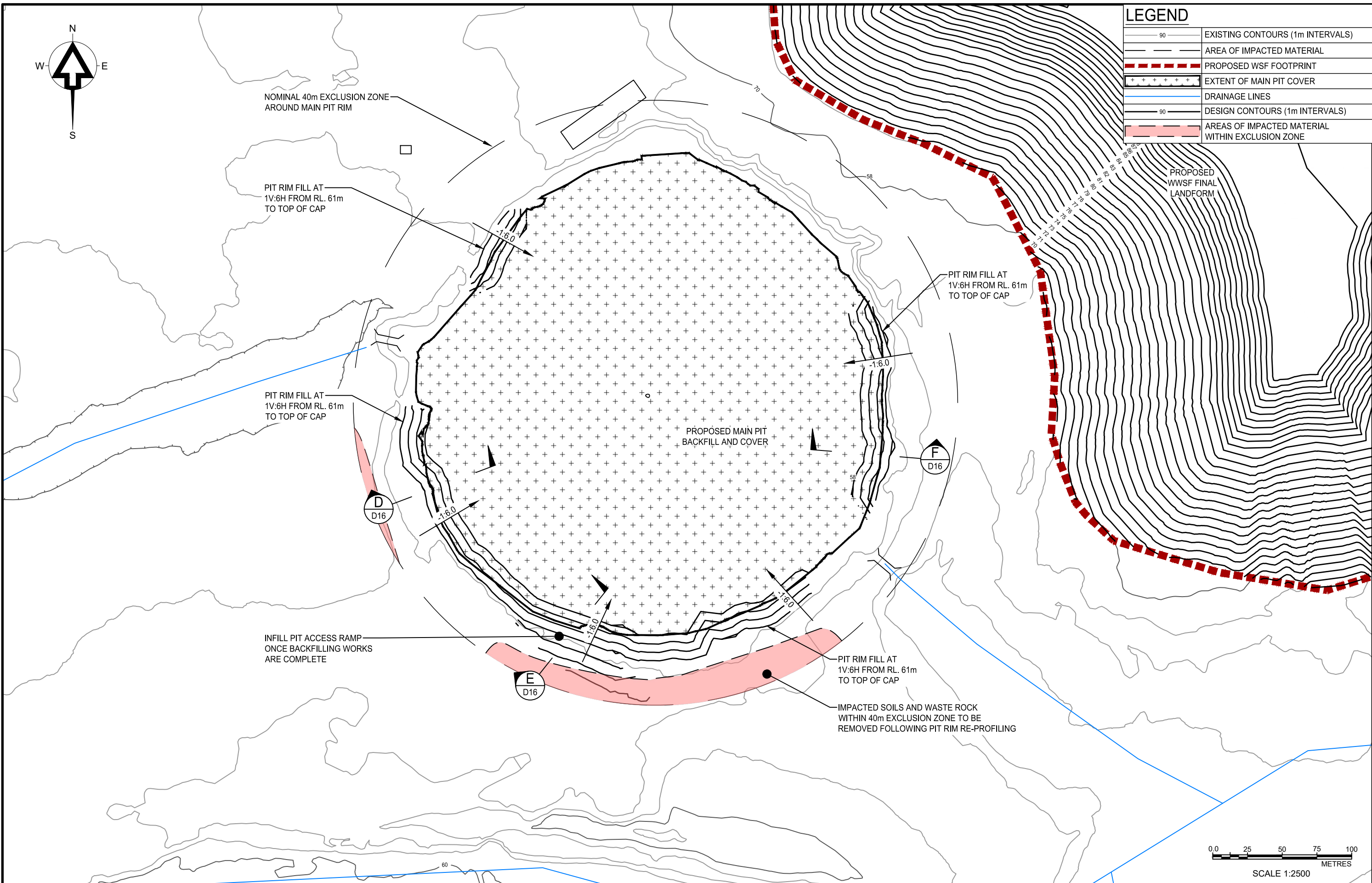
MAIN PIT BACKFILL METHODOLOGY DETAILS

NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT	SHEET SIZE
N/A	N/A	14 of 16	680.10421.MPS.D14	1	A3

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LEGEND	
	EXISTING CONTOURS (1m INTERVALS)
	AREA OF IMPACTED MATERIAL
	PROPOSED WWSF FOOTPRINT
	EXTENT OF MAIN PIT COVER
	DRAINAGE LINES
	DESIGN CONTOURS (1m INTERVALS)
	AREAS OF IMPACTED MATERIAL WITHIN EXCLUSION ZONE



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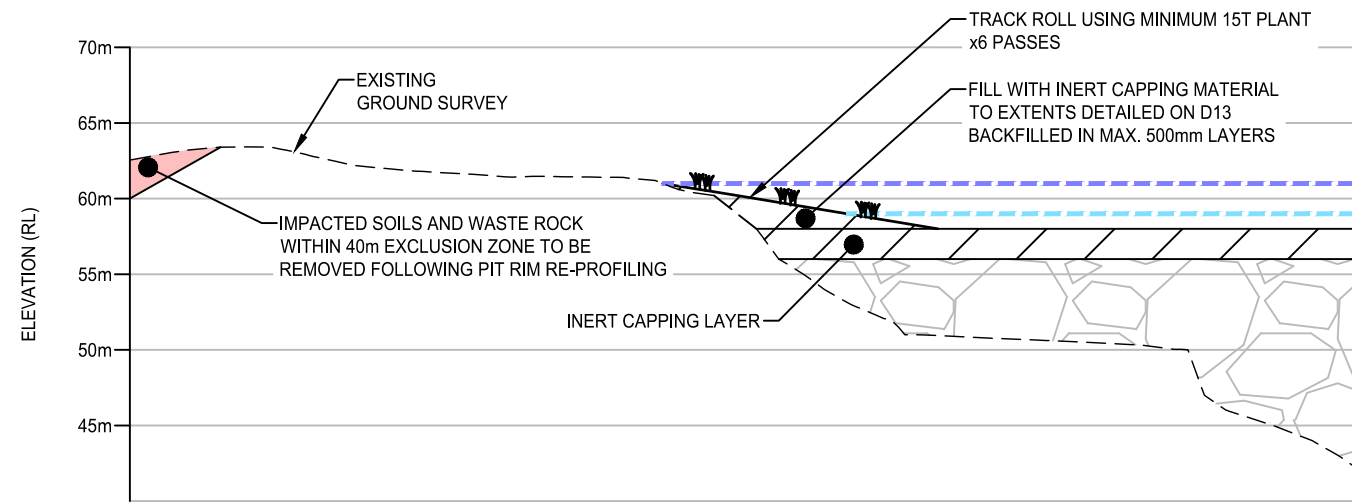
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Northern Territory Government

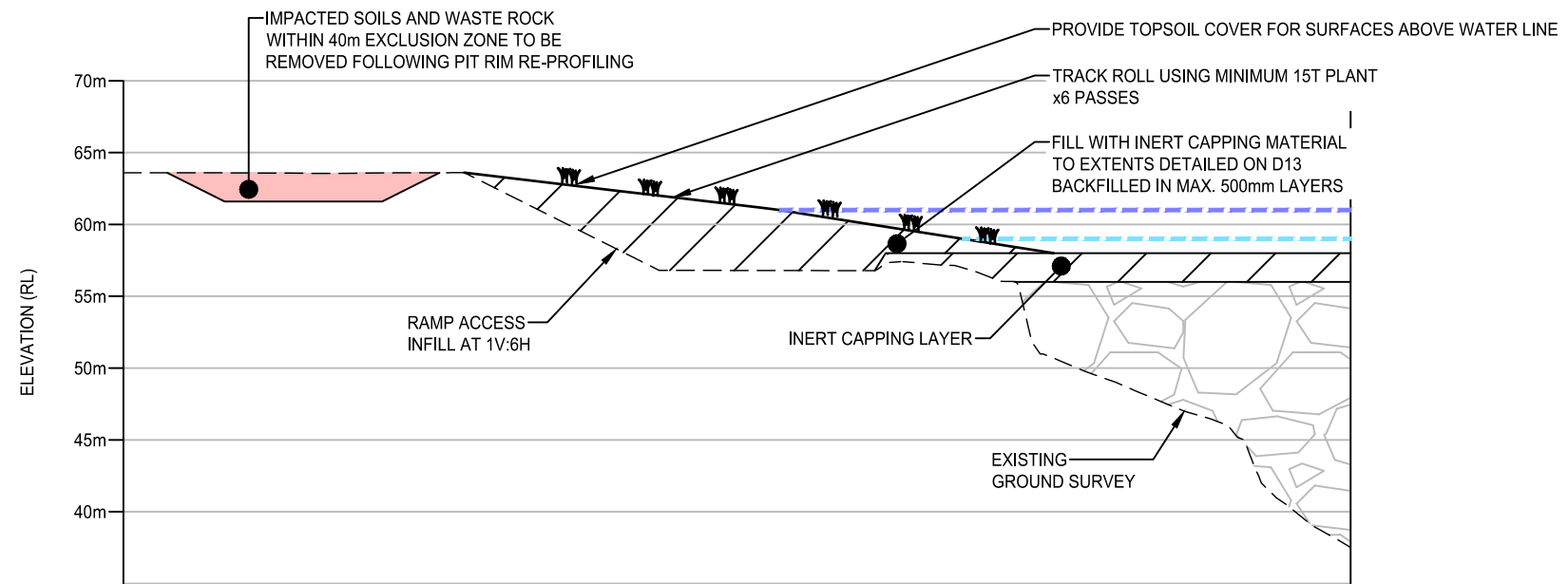
RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
RE-PROFILING INFILL LAYOUT PLAN				
NTG PROJECT No. N/A	NTG ASSET No. N/A	SHEET No. 15 of 16	NTG DRAWING No. 680.10421.MPS.D15	AMENDMENT 1
				SHEET SIZE A3

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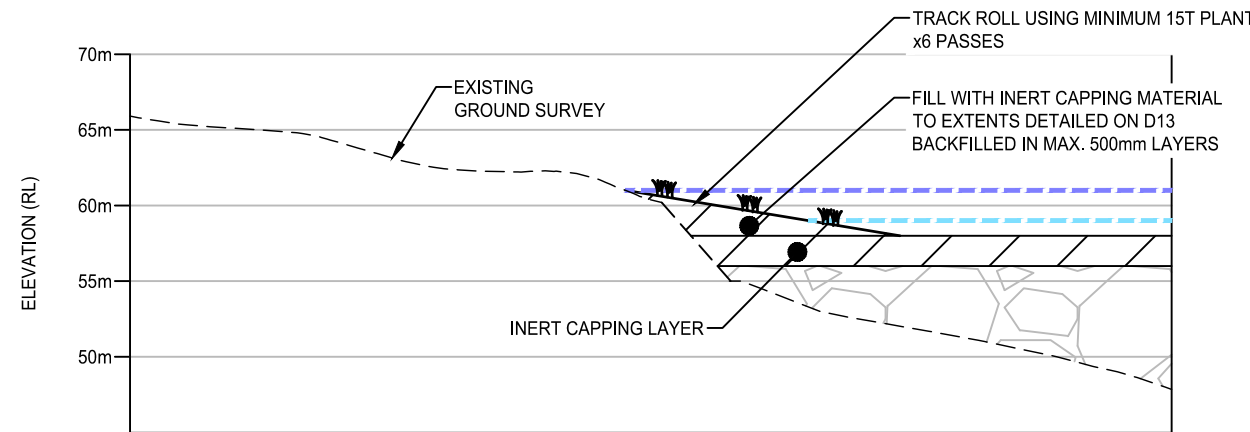
LEGEND	
	EXISTING SURVEY PROFILE
	TOP WATER LEVEL - DRY SEASON
	TOP WATER LEVEL - WET SEASON
	DESIGN PROFILE
	AREAS OF IMPACTED MATERIALS WITHIN EXCLUSION ZONE



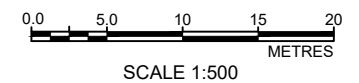
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SCALE 1:500 D15



E - E - SECTION SECTION **E**
SCALE 1:500 D15



F - F - SECTION SECTION **F**
SCALE 1:500 D15



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 NT 0820
 AUSTRALIA
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 F: 61 8 8998 0101
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RUM JUNGLE REHABILITATION STAGE 2A DETAILED ENGINEERING DESIGN				
RE-PROFILING INFILL - TYPICAL SECTIONS				
NTG PROJECT No.	NTG ASSET No.	SHEET No.	NTG DRAWING No.	AMENDMENT
N/A	N/A	16 of 16	680.10421.MPS.D16	1
				SHEET SIZE A3

ASIA PACIFIC OFFICES

BRISBANE

Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA

GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN

Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST

Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY

21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE

Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE

10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH

Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY

2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE

Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

TOWNSVILLE SOUTH

12 Cannan Street
Townsville South QLD 4810
Australia
T: +61 7 4772 6500

WOLLONGONG

Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 404 939 922

AUCKLAND

68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

NELSON

6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628