Appendix 13

RSF2 Design Report

prepared by

GHD Pty Ltd

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TGO RSF 2 Stage 1

Detailed Design Report

Tomingley Gold Operations Pty Ltd

19 January 2022

→ **The Power of Commitment**

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Executive Summary

Background

GHD has been engaged by Tomingley Gold Operations Pty Ltd (TGO) to undertake the detailed design for the Stage 1 of the Residue Storage Facility 2 (RSF2). This report has been produced to document the Stage 1 embankment design findings.

This report has been prepared to detail the works undertaken as part of the detailed design and construction requirements for the development of the new RSF.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.5 and the assumptions and qualifications contained throughout the Report.

Consequence Category Review

RSF2 is located to the south of RSF1 and to the west of the Wyoming 1 pit. RSF 2 comprises of two square shaped cells covering a total of 57ha. As part of the detailed design of Stage 1, a detailed dambreak assessment has been undertaken to assess the impacts of a failure of RSF2.

Based on the dambreak assessment, the calculated Population at Risk (PAR) is <1, therefore, with a 'Major' severity of damage and loss to the business and the natural environment due to the release of tailings and contaminated water, the Dam Flood Consequence Category (DFCC) is '**Significant**'. Similarly, the impact of an environmental spill has been assessed as '**Low**' for the Environmental Spill Consequence Category (ESCC) due to the impact extent and the level of damage to the environment.

The consequence category sets the design criteria which is summarised in Section 2.2 this design criteria is based on a '**Significant**' consequence category for both the DFCC and ESCC.

RSF2 Landform Arrangement

Following an Options Assessment to determine the preferred residue storage arrangement, RSF2 has been designed as a paddock facility with a dual cell arrangement to allow for separated tailings deposition between the two cells. Each cell utilises a central decant tower and pump surrounded by drainage rock to allow for the removal of the decant water and rainfall from each of the cells. RSF2 has been developed such that future raises utilise a centreline raise arrangement to optimise stability whilst minimising footprint impacts.

The Stage 1 dam geometry consists of an upstream embankment slope of 2H:1V and a downstream slope of 3H:1V which allows for increased stability in the Stage 1 embankment whilst minimising the storage footprint.

The Stage 1 embankment allows for a 6 m wide crest on the outer and central embankments allowing for 2-way light vehicle traffic, tailings deposition line, safety bunding on each side, and sufficient space to undertake operational and maintenance tasks on the pipeline.

Tailings Management

The dual cell paddock facility allows for the cycling of deposition as required to improve the density of the tailings over the life of the facility. As such the tailings are proposed to be deposited using perimeter discharge with spigots spaced at 50 m centres along the embankment cycling 4 spiggots every 2.5 days to allow for a maximum deposition depth of 300 mm before shifting to the next 4 spiggots. Allowing for the time required for filling of both cells, the 300mm deposition results in a maximum rise rate of 1.95 m/year taking into account the mines maximum throughput capacity.

Water Management

The RSF has been designed to store a 1:200,000 AEP 72 hour storm within the tailings beach and store the Probable Maximum Flood (PMF) within the embankment extents prior to being pumped back into the plant via the decant structure for reuse.

In addition to this, an emergency spillway has been allowed for on the southern wall of Cell 1 capable of passing a 1:1,000 AEP 72 hour rainfall event from both Cell 1 and Cell 2 with sufficient freeboard for wave run-up during a 1:10 AEP wind event. The spillway consists of a 6 m wide rock-lined trapezoidal spillway which has been designed to convey the design flow event of 1.71 m^3/s.

Risk Assessment

A Safety in Design review was carried during the design phase where design improvements were identified to eliminate hazards and improve overall safety. GHD has prepared a summary of the risks identified and mitigation measures adopted or recommended as detailed in the risk register included in Appendix F. Residual risks are presented for TGO's further mitigation in Appendix F which should be reviewed and maintained as a live document prior to construction, throughout construction and operation, and throughout closure of the RSF to ensure the residual risks are addressed.

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1. Introduction

1.1 Overview

Tomingley Gold Operations (TGO) has commenced underground mining in the Wyoming 1 pit at their Tomingley Gold Mine, located approximately 50 km southwest of Dubbo, NSW.

The current active Residue Storage Facility (RSF) has been constructed to Stage 7 height in 2020 with Stage 8 raise planned in 2021/2022 to allow for continuous operation of the mine. GHD Pty Ltd (GHD) has developed the concept designs up to Stage 9 and a concept for a new RSF to cater for further mine development.

Tomingley Gold Operations (TGO) plans to extend their mine production for at least another 7 years of operation to extend their production by 14.9 Mt to FYE2033. GHD have recently completed an initial options assessment and preliminary design for a new Residue Storage Facility (RSF2) immediately south of the existing RSF (herein referred to as RSF1) which was submitted to the NSW Resources Regulator for approval in December 2020. Following this submission and the approval to proceed with the construction of RSF2 Stage 1 and Stage 2, geotechnical investigations were undertaken within the area to the south of RSF1 by GHD to better understand the foundation and construction materials to be used in RSF2. TGO has since engaged GHD Pty Ltd (GHD) to provide engineering services related to the detailed design of RSF2 for the storage of the tailings resulting from the ongoing operations.

This report documents the detailed design of RSF2 Stage 1 to allow for sufficient storage to extend TGO's project life to end of December 2025. This document provides detailed design for Stage 1 of RSF 2 and the conceptual design for Stages 2 to 9 to allow sufficient storage for the proposed extended mining operations. It is GHD's understanding that a further approval application for the Tomingley Gold Extension Project, allowing for the further raising of RSF2 Stages 3 to Stage 9 is in progress.

1.2 Purpose of this report

This report has been prepared to detail the works undertaken as part of the detailed design of the Residue Storage Facility 2 (RSF2) starter dam (herein known as Stage 1).

1.3 Scope of Work

GHD's scope of work for the detailed design of the proposed raise, covered in this report, has comprised:

- Review the available data from the recent geotechnical investigation to confirm design parameters for use in analysis in this report.
- Update the existing Dam Consequence Category in accordance with ANCOLD 2012 Guidelines on the Consequence Categories for Dams (ANCOLD, 2012) and Guidelines on Tailings Dams (ANCOLD, 2019).
- Undertake Stage 1 Embankment Design including:
  - Embankment geometry design.
  - Foundation lining and drain system design.
  - Undertake stability and seepage analysis on the embankment.
  - Undertake Finite Element Analysis of the RSF1/RSF2 connecting wall.
- Undertake groundwater analyses.
- Undertake water balance modelling.
- Undertake hydrology and hydraulic design.
- Undertake instrumentation design.
- Undertake conceptual closure design.
- Undertake safety in design risk assessment for RSF 2 Stage 1 embankment.

1.4 Assumptions

The design for RSF 2 Stage 1 assumes the following:

- RSF2 Stage 1 and 2 dam embankment construction material will be won from the dam footprint and existing waste rock dump on site.
- Detailed design of the subsequent stages of the RSF2 embankment will be undertaken prior to the construction of the embankment raise.

1.5 Limitations

This report: has been prepared by GHD for Tomingley Gold Operations and may only be used and relied on by Tomingley Gold Operations for the purpose agreed between GHD and Tomingley Gold Operations as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Tomingley Gold Operations arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions, and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions, and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Tomingley Gold Operations and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions, and any recommendations in this report are based on information obtained from, and testing was undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services, and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

Any reports, drawings, memos, or other deliverables produced by GHD shall be produced in a traditional and generally accepted format. Accessible reports, drawings, memos, or other deliverables can be provided by GHD at an additional cost if necessary.

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2. Background and Design Basis

2.1 Background

TGO currently produces approximately 1.1Mt of process residue per year, and stores this residue within a twin paddock-style facility known as the Residue Storage Facility (RSF1). RSF 1 is located to the south of the plant area

The existing RSF1 (shown as RSF Cell 1 and RSF Cell 2 in Figure 2.1 below) is approved to Stage 9, Stage 8 is anticipated to be full by June 2022. As a result, RSF2 will be required to be available prior to this to cater for the remaining residue to be stored from future processing. Additional capacity (RSF2 Stages 3 to 9) will be required for the Tomingley Gold Extension Project subject to the relevant approvals being obtained.

The current site layout is presented in Figure 2.1.

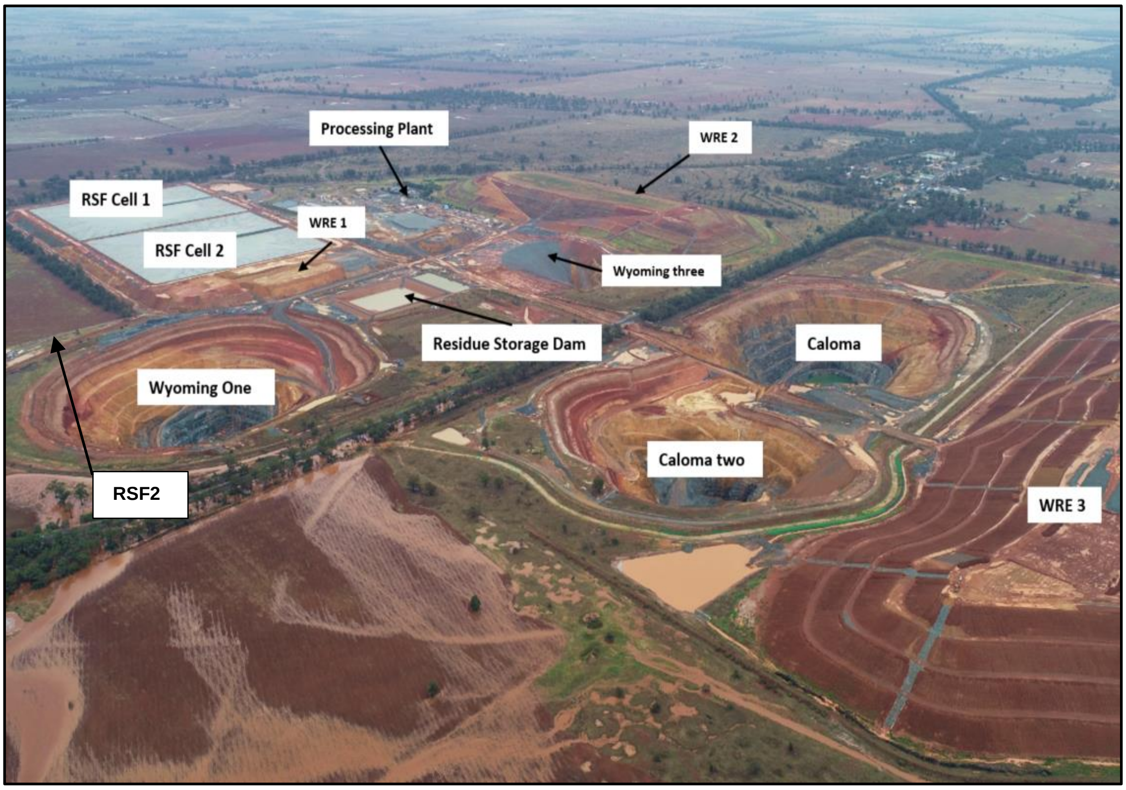
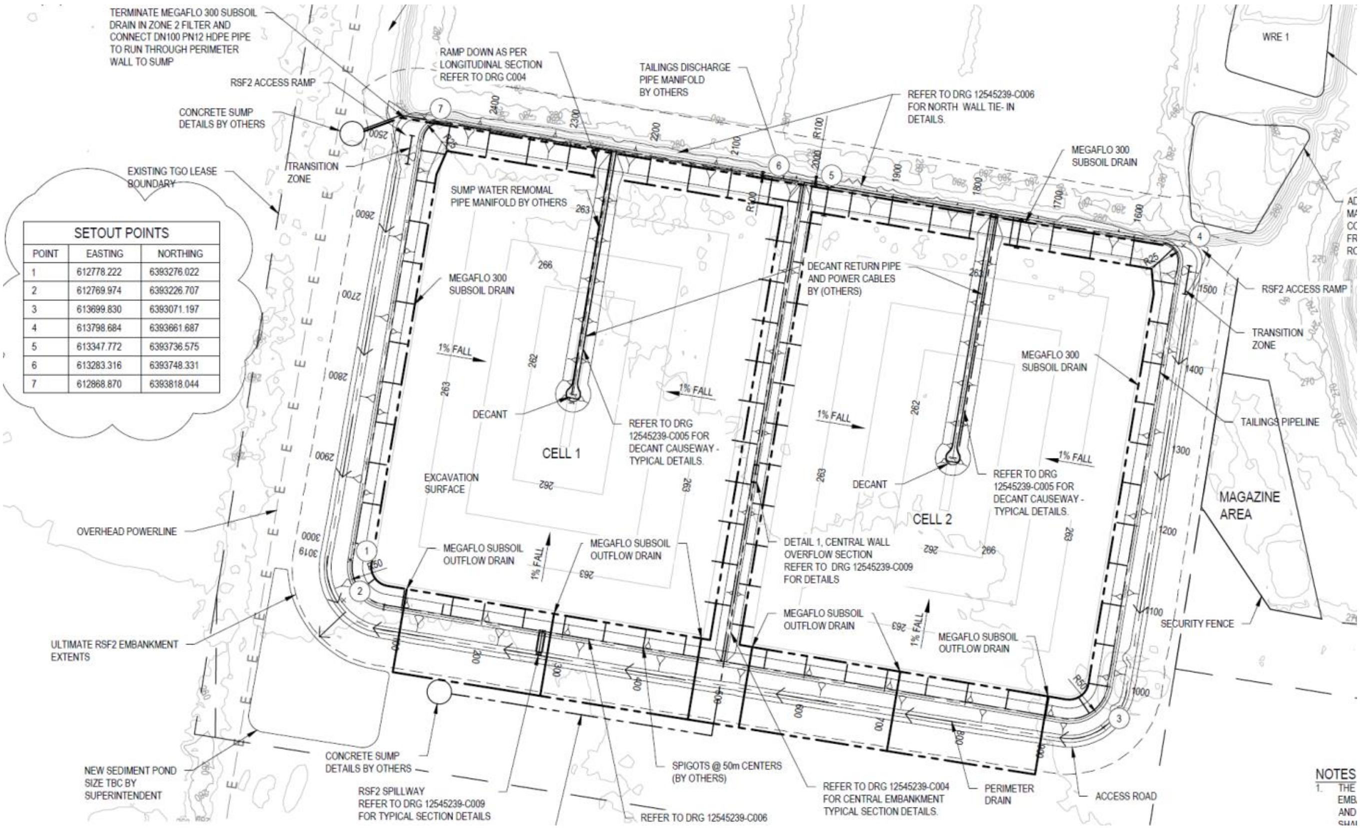


Figure 2.1 Current Site Layout

2.1.1 Preferred Site Arrangement

Based on the Options Assessment report outcomes outlined in GHD (2020), Option 1 was identified as the preferred location, as such the new RSF is to be located adjacent to the existing RSF. Due to the topography around the preferred location, the new RSF has been designed as a turkey's nest arrangement minimising hydrological impacts and simplifying depositional and residue management requirements. The facility has been designed such that the southern wall of the existing embankment will be utilised as a part of the new RSF to optimize earthworks and ensure a stable landform arrangement. This will also allow for a single closure landform at the end of mine life. The facility arrangement can be found in Figure 2.2.



SETOUT POINTS

POINT	EASTING	NORTHING
1	612778.222	6393276.022
2	612769.974	6393226.707
3	613699.830	6393071.197
4	613798.684	6393661.687
5	613347.772	6393736.575
6	613283.316	6393748.331
7	612868.870	6393818.044

Figure 2.2 Preferred Site Arrangement – Stage 1 Extent Plan

2.1.2 Climate

TGO mine is located on the south-western outskirts of Tomingley town and falls in a warm temperate climate zone. TGO has been recording daily rainfall data at the mine since 2013. Data prior to 2013 have been collected by the Bureau of Meteorology at the Peak Hill Post Office (Station Number 050031) with an average rainfall of 560 mm/year.

2.1.3 Geology

The local area geology map (refer to Figure 2.3 and Table 2.1) was obtained from the NSW Department of Primary Infrastructure and indicates the following:

- A combination of alluvium deposits (Qa), Colluvium (Qv), undifferentiated sediments (Czs), and Ordovician sedimentary rocks (Os) are present.
- Multiple fault zones in close proximity to the mine location.

The map also includes the extents of the existing mining lease as sourced from Planning, Industry & Environment MinView and the proposed future mining lease extents as provided by TGO.

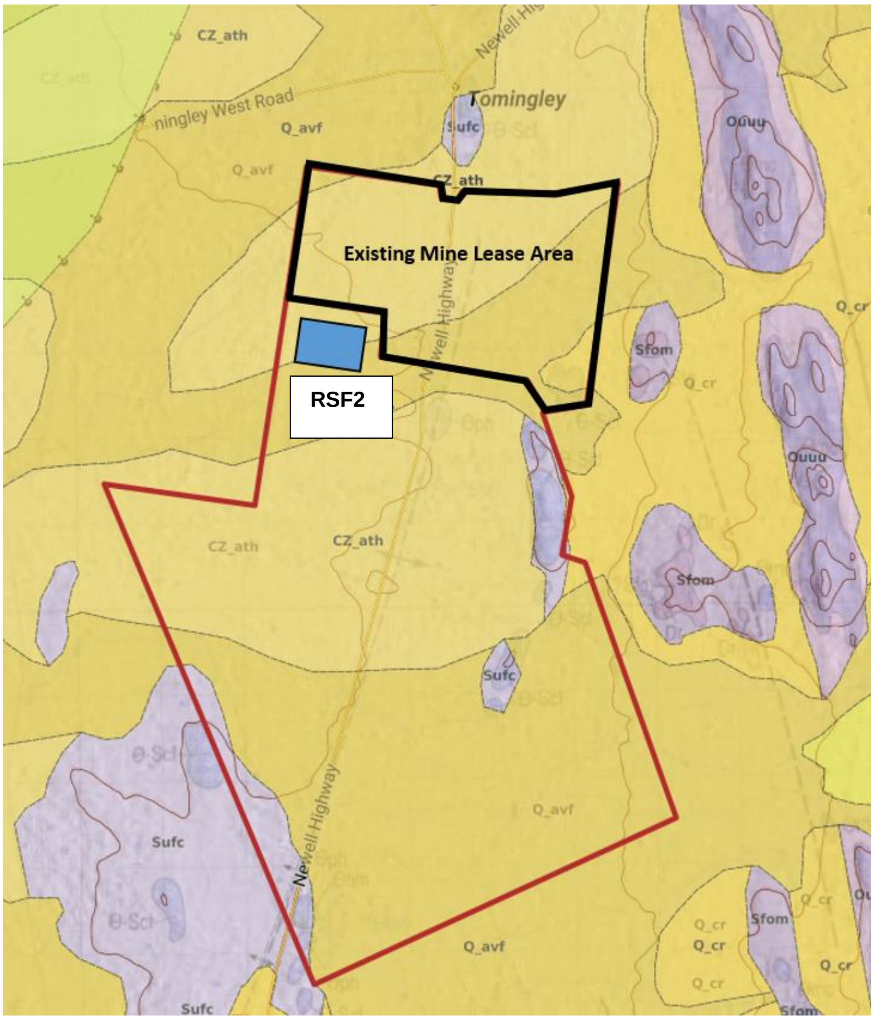


Figure 2.3 Local Geology (Image Sourced from NSW Department of Primary Infrastructure)

Table 2.1 Local Geological Summary

Unit code	Unit name	Dominant Lithology
Q_avf	Alluvial Terrace deposits-high stand facies	Biogenic sediment
CZ_ath	Alluvial fan deposits	Mud
Sform	Mumbridge Formation	Siltstone
Sufc	Cotton formation	Siltstone
Ouuu	Mugincoble Chert	Chert

A high-level local geological review has been undertaken for the mine site previously as discussed in “Wyoming 3 In-pit Residue Storage Facility Preliminary Design Report”. Key findings from this review have been summarised below:

- In the vicinity of the Wyo3 pit (beyond the ore body), alluvial clay / sandy clay and saprolite clay generally extend up to 70 m below ground level (bgl).
- The weathered zone is underlain by fractured siltstone, sandstone, and shale extending beyond 100 m bgl.

2.1.4 Geotechnical Investigations

Previous geotechnical investigations for embankment materials and foundations were undertaken during the initial embankment design and construction phases [ref: Cooper and Associates] as well as the Stage 2-6 raises, which also included in-situ and laboratory testing for the residue. The previous investigations can be summarized as follows:

- Foundations for the current RSF 1 (cells 1 and 2) generally consisted of stiff clay, beneath 1m thickness of topsoil. The foundations were found to be low permeability, between 2 x 10^{-8} and 2 x 10^{-9} m/s.
- The residue geochemistry is classified as Non-Acid Forming (NAF).
- The proposed construction material for the embankment raise consists of generally low permeability (less than 1 x 10^{-9} m/s as per EPA requirements) sandy clay from the footprint of the TSF area and overburden.
- Investigations of the residue as foundations for upstream raises found that they were generally low strength, low permeability, clayey silt, and the residue is susceptible to liquefaction with low residual shear strength ie, unsuitable.

2.1.5 Hydrogeology and Groundwater Investigations

A groundwater impact assessment report has been previously completed for Wyoming In-pit Tailings Study (GHD, 2016). Key findings from this study related to the existing groundwater conditions at the mine site have been summarized below.

- Perched groundwater occurs within the shallow alluvium, however, it is generally not continuous across the mine site.
- The hydraulic conductivity of the upper clay is generally low to very low.
- A deeper confined saline groundwater system occurs within the fractured sandstone, siltstone, and volcanic materials. This groundwater would be classified as less productive fractured rock groundwater under the NSW Aquifer Interference Policy.
- Coffey (2007) investigated this groundwater system as a potential water supply for the mine and found it to be inadequate in terms of both yield and quality.

2.1.6 Hydrology

Surface water drainage surrounding the mine site typically flows to the southwest. Gundong Creek flows for the north of Tomingley before passing through the north-western section of the mine site. Other named creeks in the vicinity of the Mine Site include Fiddlers and Tomingley Creeks (upstream) to the north and Bulldog Creek to the south. Each of these, together with Gundong Creek, flow to the west and merge with the Bogan River approximately 11 km to the southwest of the mine.

2.2 Design Basis

The design was collated from a number of sources, including TGO input, RSF Stage 6 Raise Design Report (GHD, 2018), Stage 7-9 Concept Report (GHD, 2019), Stage 7 Design Report (GHD, 2021), industry guidelines, GHD’s TGO site experience, and GHD’s industry experience.

Whilst the majority of parameters and design basis remain consistent throughout the RSF life, it is important to note that some will vary over time and should be checked and verified at each stage of the design, construction and operation. In some cases, various values for the same parameters have been sources and included as an example. In each case, the most recent source should be relied upon for current and future designs.

The assumptions and requirements used as the basis of design supplied and agreed by TGO are presented in Table 2.2.

Table 2.2 RSF 2 Basis of Design

Design Aspect	Design Basis	Design Source
Storage Capacity		
Facility Duration	7 years (scalable to 10 years)	TGO Requirement
Ultimate Height	RL 286.0 m (for 10 year storage)	GHD Proposed
Ultimate Capacity	15 Mt	TGO Requirement
Annual Residue Production Rate	1.5 Mtpa (Scaleable to 1.75 Mtpa for short durations)	TGO Requirement
Long-term Residue Stored Dry Density	1.4 t/m^3	Based on density reconciliation of RSF1
Rate of Rise	Maximum 2 m raise/annum (with 700mm freeboard)	Industry experience for upstream and centreline raising
Consequence Category (ANCOLD)	Significant	GHD Assessed
Embankment Arrangement		
Embankment Type	Centreline	As discussed with TGO
Upstream Face	2:1 (H:V)	GHD Proposed
Downstream Face	3:1 (H:V)	GHD Proposed
Crest Width	6 m	GHD Proposed
Foundation Liner	1 m Compacted Clay Liner (CCL) with permeability of $1x10^{-9}$ or better.	Environmental Protection Authority Tailings Dam Liner Policy Letter (2016)
Construction Material	Stage 1 and 2 embankments will be constructed using excavated material from the footprint of the RSF and existing NAF waste rock at the site.	As discussed with TGO
Construction Fleet	Mining fleet where possible, civil construction fleet where geometry does not suit mining fleet.	As discussed with TGO
Mining Fleet	TGO to confirm mining fleet.	TGO to confirm
Closure Arrangement	Water shedding cover with spillway	GHD Proposal
Seismic Loading		
Operating Basis Earthquake (OBE)	1:475 0.028 PGA	ANCOLD 2019 GHD 2021
Safety Evaluation Earthquake (SEE)	1:10,000 0.180 PGA This PGA is recommended based on the dams susceptibility to the failure from liquefaction of the tailings and foundations.	ANCOLD 2019 GHD 2021
Maximum Credible Earthquake (MCE) (Closure)	1:10,000 0.180 PGA	ANCOLD 2019 GHD 2021
Hydrology		
Catchment Area	RSF Footprint Area	GHD Assessed
Flood storage requirements	Facility to be designed as a non-release facility, capable of storing a Probable Maximum Precipitation (PMP) event.	GHD Assessed
Decant	Central decant tower. Excess water discharged either to Process Water Dam or Residue Decant Storage Dam.	GHD Assessed
Emergency Spillway	Emergency spillway is designed to pass a 1:1,000 AEP 72 hour Rainfall Event with suitable	ANCOLD (2019)

Design Aspect	Design Basis	Design Source
	freeboard, following the storage of a PMP rainfall event	
Residue Information and Infrastructure		
Residue Classification	Non-Acid Forming (NAF), pumped as a slurry at 45 % solids	RSF1 Stage 7 Pre-Construction Report
Specific Gravity	2.7	
Beach Angle	1V:140H	Based on a survey of the existing RSF
Deposition Infrastructure	Deposited from spigots on the perimeter pipe	Based on RSF1 Design
Deposition Methodology	Sub-aerial deposition	Based on RSF1 Design
Water Management Philosophy	Decant pond kept as low as possible with water return to Process Water Dam for re-use and excess to Residue Decant Storage Dam	Based on RSF1 Design
Water Recovery Infrastructure	Central decant tower with a single submersible pump. The submersible pump is to be sized in accordance with the following Normal Operations and Emergency Operations. **Minimum Normal Operational**: 22L/s: **Minimum Emergency Operations**: 50ML/Day	Based on RSF1 Design
Seepage Recovery Infrastructure	Liner graded to the central decant tower at 1% to capture seepage runoff. Underdrainage located at the upstream toe of the stage 1 embankment.	GHD Proposed
Monitoring	Automated monitoring system where practicable.	GHD Proposed
Dam Break Modelling		
Failure Modes	Sunny Day Failure (SDF): Piping Flood Failure (FF): Piping	GHD Assessed
Storm Event (AEP) for Flood Failure Scenario	1% AEP, 0.01% AEP and PMP-DF	GHD Assessed
Breach Locations	East, South, and West Walls	GHD Assessed
Water Depth in Impoundment	SDF: Max Operating Level FF: Peak Water Level due to Flood Run-Off	GHD Assessed

2.3 Design Criteria

The design criteria have been developed and agreed with TGO for the RSF Stage 1 embankment and have been based on the following:

- Currently accepted practices for dam engineering in Australia;
- Australian National Committee on Large Dams (ANCOLD) Guidelines;
- NSW Environmental Protection Authority, Tailings Dam Liner Policy Letter (2016); and
- Dam Safety NSW regulations 2019.

3. Consequence Category Review

3.1 Overview

The consequence category assessments (CCA) for RSF2 Stage 1 have been undertaken in accordance with the ANCOLD Guidelines on the Consequence Categories for Dams (ANCOLD, 2012) and ANCOLD Guidelines on Tailings Dams (ANCOLD, 2019a). The consequence category assessment is used to categorise dams based on the consequences of a potential dam break which sets the basis for design criterion based on risks and determines dam safety management requirements.

The previous consequence category assessment was based on the high-level dam break consequence assessment undertaken during the RSF2 Concept Design. The Population and Risk (PAR) was assessed to be <1 for both Sunny Day and Flood Failure.

The highest severity of damage and loss due to the dam failure was assessed as being 'Major' based on the impact on the business and the natural environment due to the release of tailings and contaminated water. Based on a damage and loss level of 'Major' and a PAR <1, the DFCC was determined to be 'Significant' for both Sunny Day and Flood failure scenarios.

The ESCC was conservatively assessed to be 'Significant' due to the release of contaminated decant water stored in the RSF 2 that would have a 'Major' impact on the environment with PAR<1.

3.2 Dam Break Modelling

3.2.1 Failure Modes

The failure modes considered were piping failure through the embankment causing a breach of the dam down to the foundation elevation which are shown in Figure 3.1. These locations are as follows:

- Cell 1 West wall,
- Cell 1 South wall, and;
- Cell 2 East wall.

The level of ponded water in RSF2 Stage 1, Cell 1 and Cell 2 at the time of failure has been adopted as follows:

- Sunny day Failure (SDF): Pool elevation at normal operating level (RL 268.3 m AHD) with piping failure leading to a breach of the embankment.
- Flood Failure (FF) condition, which includes representation of different storm event: The pool elevation at each flood level with piping failure leading to a breach of the embankment are listed below:

1:100 AEP:	RL 268.9 m AHD.
1:10,000 AEP:	RL 269.4 m AHD.
PMP-DF:	RL 269.6 m AHD.

3.2.2 Breach Locations and Scenarios

Three breach locations were selected to assess the potential differences to downstream impacts based on height and volume of tailings and pondwater released as shown in Figure 3.1.

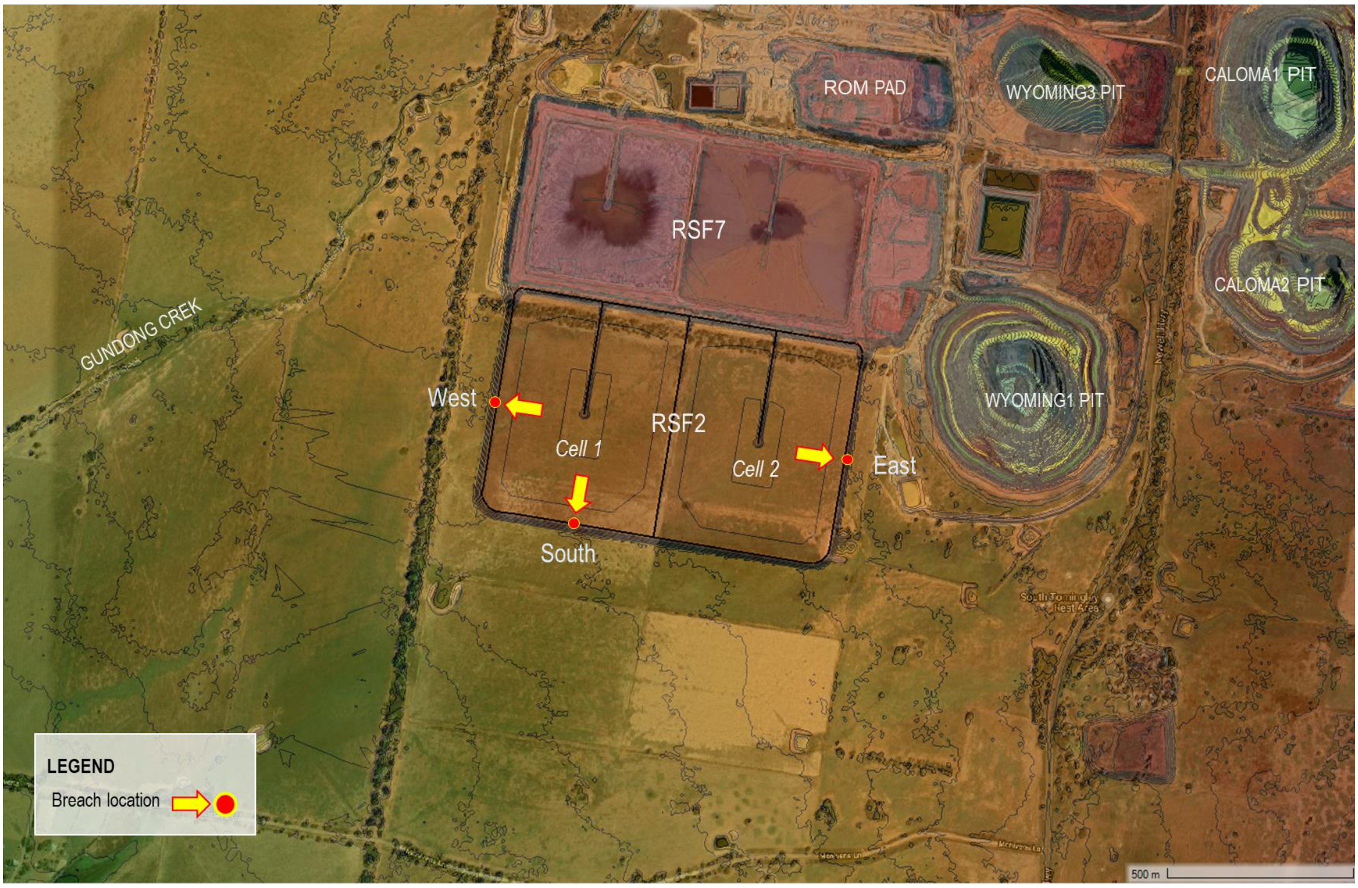


Figure 3.1 RSF2 Breach Locations

The scenarios considered in the analysis are summarized in Table 3.1.

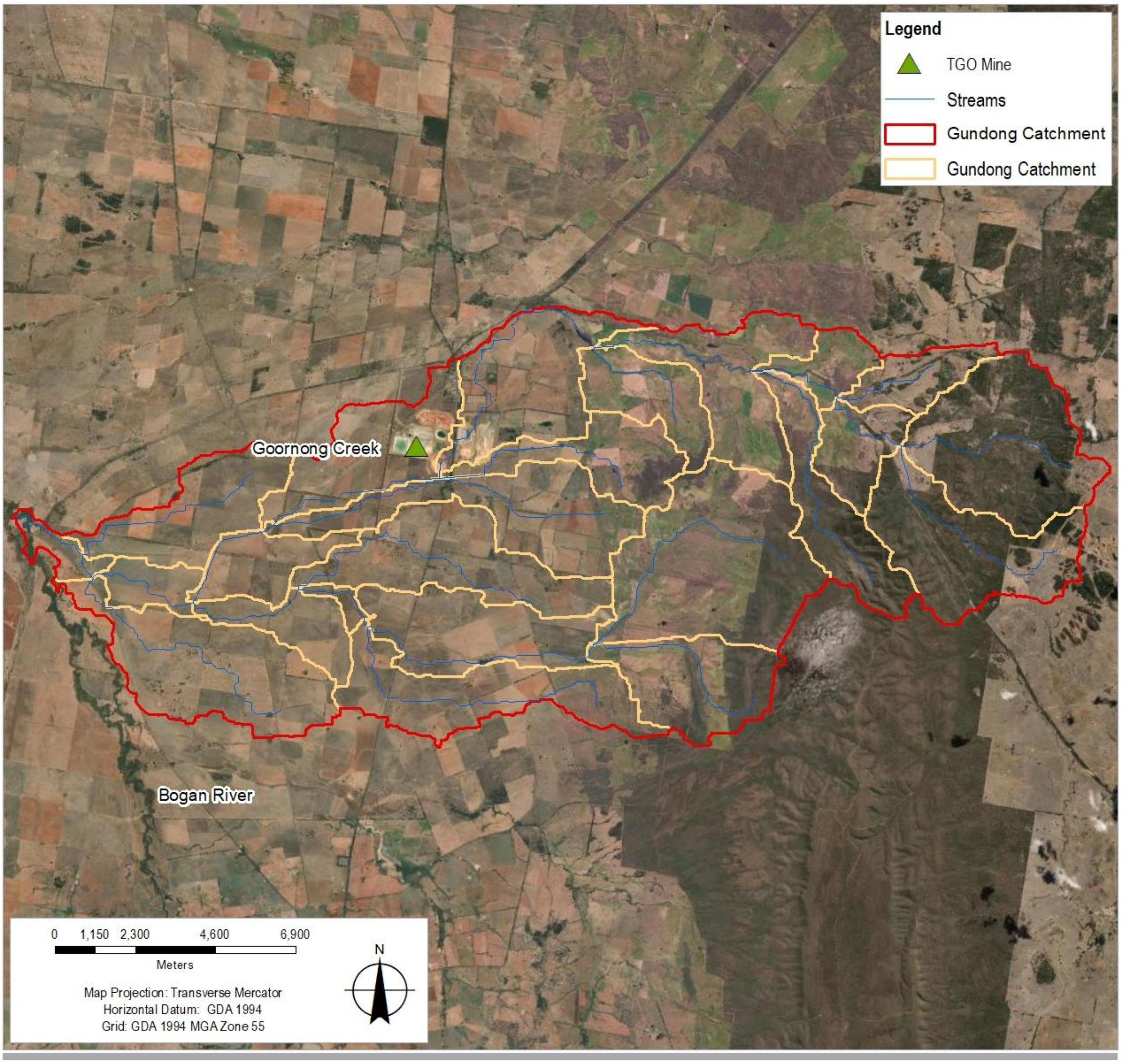
Table 3.1 Dam Break Assessment Scenarios

Scenario	Breach location	Failure event/mode	Pool water level at failure (m AHD)	Maximum tailings level (m AHD)
1	Cell 2 East Wall	SDF, Piping	268.3	269.3
2	Cell 2 East Wall	FF – 1:100 AEP, Piping	268.9	
3	Cell 2 East Wall	FF – 1:10,000 AEP, Piping	269.4	
4	Cell 2 East Wall	FF – PMP-DF, Piping	269.6	
5	Cell 1 South Wall	SDF, Piping	268.3	
6	Cell 1 South Wall	FF – 1:100 AEP, Piping	268.9	
7	Cell 1 South Wall	FF – 1:10,000 AEP, Piping	269.4	
8	Cell 1 South Wall	FF – PMP-DF, Piping	269.6	
9	Cell 1 West Wall	SDF, Piping	268.3	
10	Cell 1 West Wall	FF – 1:100 AEP, Piping	268.9	
11	Cell 1 West Wall	FF – 1:10,000 AEP, Piping	269.4	
12	Cell 1 West Wall	FF – PMP-DF, Piping	269.6	

3.2.3 Catchment Hydrology of Receiving Environment

Hydrologic modelling was undertaken to determine required design event hydrographs using the XP-RAFTS model developed as part of the TGO RSF Stage 7 Dam Break Study (GHD, 2021). A brief overview of the hydrologic model is provided below. For a more detailed description of the model used, refer to the 2021 RSF Stage 7 Dam Break Study.

Figure 3.2 presents the Gundong Creek catchment boundary and its sub-catchments. The hydrologic model was intended to determine the concurrent flooding within the mine site and its downstream receiving environment. The antecedent flood conditions considered are 1 in 100 AEP, 1 in 10,000 AEP and PMPDF for the Rainy Day Failure scenarios. No hydrologic modelling was considered for the Sunny Day Failure scenarios.



Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Created by:ccsalang

Figure 3.2 Gundong Creek Sub-Catchments

3.2.4 Dam breach estimation

3.2.4.1 Release Volume

The proportion of tailings released was estimated based on the post-liquefied shear strength of the tailings and assessment of the breach width due to various failure modes and correlated against empirical equations.

The three-dimensional (3D) software package Civil3D was used to estimate the tailings failure discharge volume based on average beach slope for the critical static liquefaction failure modes. The volume estimation in the 3D model is based on a “cone” formed by static gravitation forces at the angle of repose for saturated tailings material.

With the breach slope of 1.72 degrees and empirical equation-derived breach width, failure cones were modelled in Civil3D for estimation of the tailings volume in a runout event. These slopes/cones were projected from the external toe of the starter dam using recent LiDAR data provided by TGO. The 3D surface model for different breach locations is illustrated in Figure 3.3.

Water and tailings have been assumed to mix in a single volumetric release for the hydrographs modelled. The summary of the discharge volume estimated is given in Table 3.2.

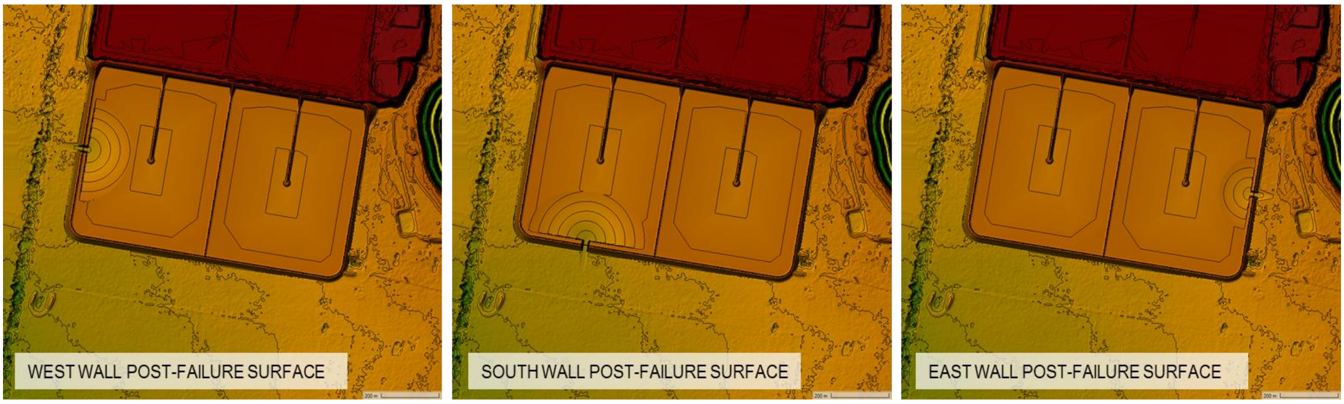


Figure 3.3 Post-Failure Surface Model of the Three Breach Locations

Table 3.2 Estimated Breach Discharge Volume

Scenario	Breach location	Failure event/mode	Discharge Water Volume ($x10^6$ m^3)	Discharge Tailings Volume ($x10^6$ m^3)	Total Breach Volume ($x10^6$ m^3)	Sediment Concentration by Volume, Cv
1	Cell 2 East Wall	SDF, Piping	0.015	0.029	0.044	33%
2	Cell 2 East Wall	FF – 1:100 AEP, Piping	0.122	0.029	0.151	10%
3	Cell 2 East Wall	FF – 1:10,000 AEP, Piping	0.336	0.029	0.365	4%
4	Cell 2 East Wall	FF – PMP-DF, Piping	0.438	0.029	0.467	3%
5	Cell 1 South Wall	SDF, Piping	0.015	0.113	0.128	44%
6	Cell 1 South Wall	FF – 1:100 AEP, Piping	0.122	0.113	0.235	24%
7	Cell 1 South Wall	FF – 1:10,000 AEP, Piping	0.337	0.113	0.449	13%
8	Cell 1 South Wall	FF – PMP-DF, Piping	0.438	0.113	0.551	10%

Scenario	Breach location	Failure event/mode	Discharge Water Volume ($x10^6$ m^3)	Discharge Tailings Volume ($x10^6$ m^3)	Total Breach Volume ($x10^6$ m^3)	Sediment Concentration by Volume, Cv
9	Cell 1 West Wall	SDF, Piping	0.015	0.079	0.094	42%
10	Cell 1 West Wall	FF – 1:100 AEP, Piping	0.122	0.079	0.202	20%
11	Cell 1 West Wall	FF – 1:10,000 AEP, Piping	0.337	0.079	0.416	10%
12	Cell 1 West Wall	FF – PMP-DF, Piping	0.438	0.079	0.517	8%

All references within this report to sediment concentration or the terms: water flow, mud flood, mud flow and landslide have their understanding based on the CDA's recent technical bulletin on tailing dam breach analysis (CDA, 2019). In this publication the authors refer to the different states that tailings leave the TSF upon failure. Refer to Figure 3.4 for these flow types as a function of solids concentration, including graphical examples of each.

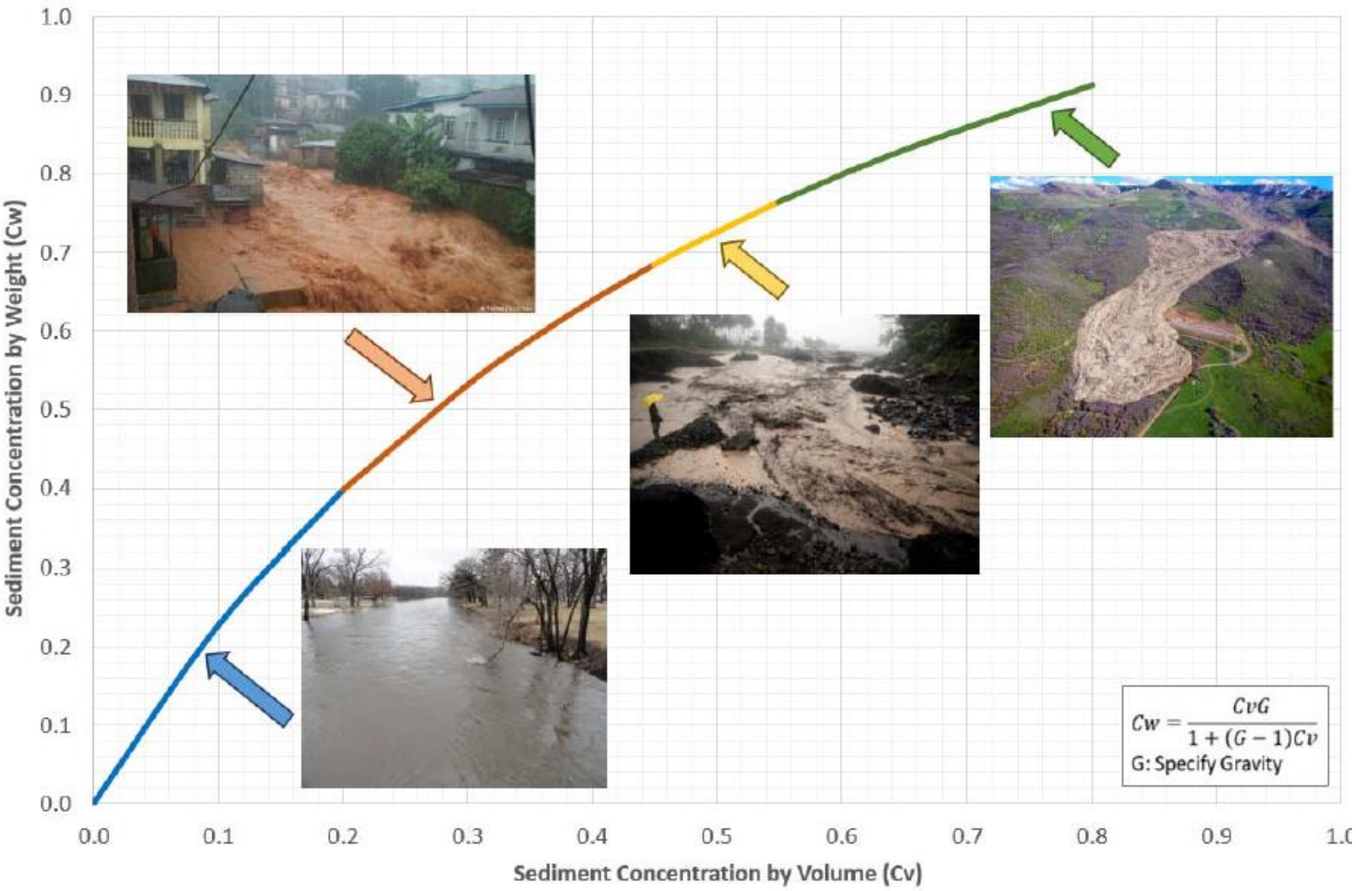


Figure 3.4 Flow Types as a Function of Solids Concentration (CDA, 2019)

Analysis of the geotechnical data, specifically the dry density and specific gravity of the tailings (data provided by TGO), suggested that the in-situ sediment concentration of the TSF varied between around 50% percent, without the influence of an elevated decant pond and 33% to 44% considering the amount of decant water for the SDF scenarios. This sediment concentration is typically representative of a mud flow case. However, for the FF scenarios, the volume of water run-off in the RSF2 is relatively high, resulting in a lower sediment concentration, Cv that ranges from 3% to 24% which can be considered as Newtonian fluid based. Therefore, a mudflow case is considered a highly credible scenario for the SDF scenarios.

3.2.4.2 Dam Breach Parameters

The breach parameters were estimated adopting the average results from five different empirical equations such as MacDonald et al, Froelich (1995), Froelich (2008), Von Thun & Gillete and Xu & Zhang. A summary of the breach parameters derived for all scenarios is provided in Table 3.3.

Table 3.3 Summary of Breach Parameters

Scenario	Breach location	Failure event/mode	Pool water level at failure (m AHD)	Estimated Breach Volume (x10^6 m^3)	Breach Formation Time (hours)	Breach bottom width (m)	Side Slopes (1:X)
1	Cell 2 East Wall	SDF, Piping	268.3	0.044	0.30	5.20	0.67
2	Cell 2 East Wall	FF – 1:100 AEP, Piping	268.9	0.151	0.43	7.60	0.67
3	Cell 2 East Wall	FF – 1:10,000 AEP, Piping	269.4	0.365	0.57	10.40	0.67
4	Cell 2 East Wall	FF – PMP-DF, Piping	269.6	0.467	0.62	11.60	0.67
5	Cell 1 South Wall	SDF, Piping	268.3	0.128	0.34	7.00	0.66
6	Cell 1 South Wall	FF – 1:100 AEP, Piping	268.9	0.235	0.40	8.60	0.66
7	Cell 1 South Wall	FF – 1:10,000 AEP, Piping	269.4	0.449	0.49	11.20	0.66
8	Cell 1 South Wall	FF – PMP-DF, Piping	269.6	0.551	0.52	12.20	0.66
9	Cell 1 West Wall	SDF, Piping	268.3	0.094	0.32	6.40	0.66
10	Cell 1 West Wall	FF – 1:100 AEP, Piping	268.9	0.202	0.42	8.20	0.67
11	Cell 1 West Wall	FF – 1:10,000 AEP, Piping	269.4	0.416	0.50	11.00	0.67
12	Cell 1 West Wall	FF – PMP-DF, Piping	269.6	0.517	0.54	11.80	0.67

3.2.4.3 Breach Results

Breach hydrographs were estimated in HEC-RAS which provided the parameters presented in Figure 3.5, Figure 3.6 and Figure 3.7 while Table 3.4 summarizes the breach peak discharge and volume.

Table 3.4 Summary of Breach Flows

Scenario	Breach location	Failure event/mode	Peak breach discharge (m^3/s)	Breach volume (m^3)
1	Cell 2 East Wall	SDF, Piping	40.46	43,877
2	Cell 2 East Wall	FF – 1:100 AEP, Piping	72.53	150,980
3	Cell 2 East Wall	FF – 1:10,000 AEP, Piping	108.74	365,187
4	Cell 2 East Wall	FF – PMP-DF, Piping	126.37	466,653
5	Cell 1 South Wall	SDF, Piping	130.5	127,582
6	Cell 1 South Wall	FF – 1:100 AEP, Piping	169.73	234,776

Scenario	Breach location	Failure event/mode	Peak breach discharge (m^3/s)	Breach volume (m^3)
7	Cell 1 South Wall	FF – 1:10,000 AEP, Piping	231.55	449,164
8	Cell 1 South Wall	FF – PMP-DF, Piping	251.98	550,717
9	Cell 1 West Wall	SDF, Piping	92.54	94,308
10	Cell 1 West Wall	FF – 1:100 AEP, Piping	127.31	201,502
11	Cell 1 West Wall	FF – 1:10,000 AEP, Piping	187.5	415,890
12	Cell 1 West Wall	FF – PMP-DF, Piping	208.16	517,443

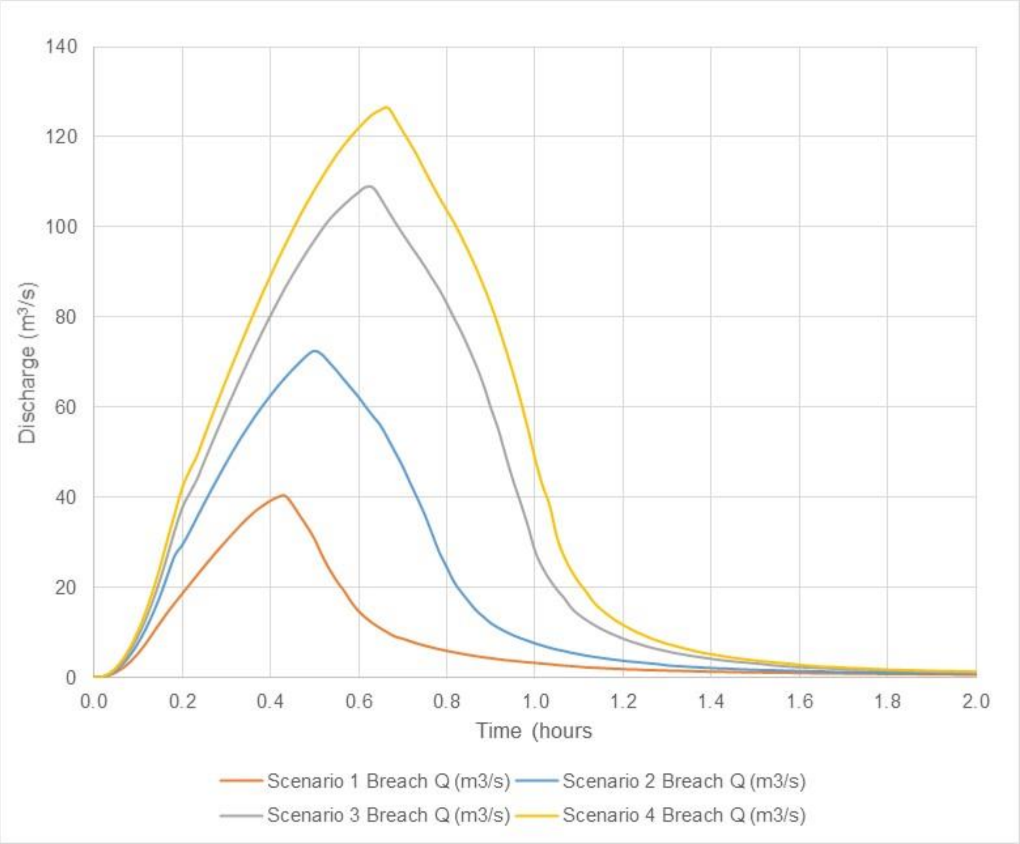


Figure 3.5 *East Wall Breach Hydrographs*

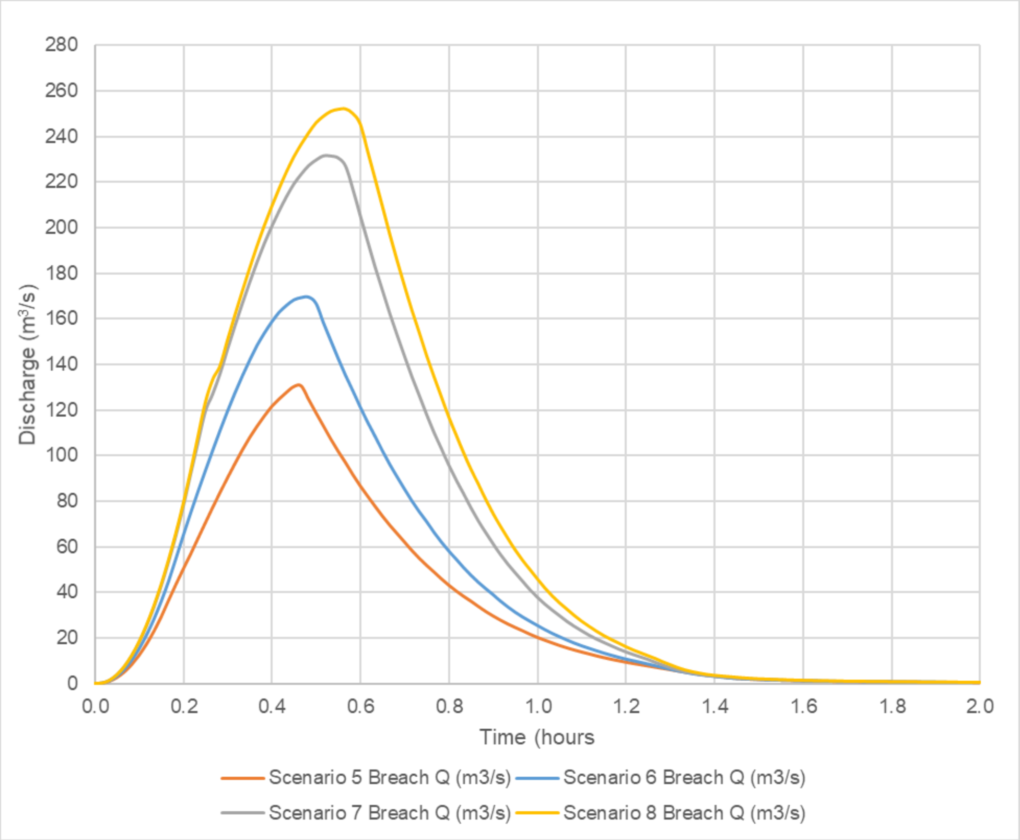


Figure 3.6 South Wall Breach Hydrographs

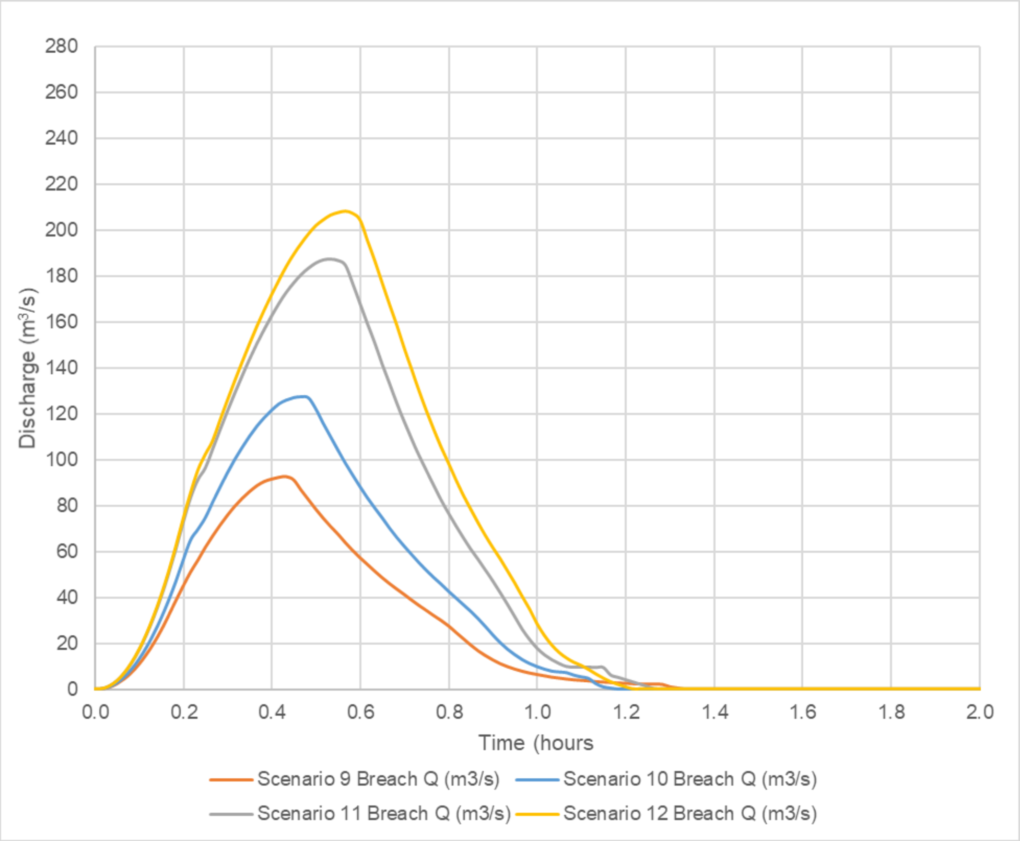


Figure 3.7 West Wall hydrographs

3.2.5 Hydraulic modelling

3.2.5.1 Modelling Objectives

The purpose of the dam hydraulic (flood routing) modelling was to estimate flood levels and extents resulting from a possible failure of RSF2 Stage 1. The modelling simulated a number of breach scenarios with varying model parameters, breach conditions, and breach locations. The modelled scenarios are described in detail in the previous sub-sections.

3.2.5.2 Modelling Software

The same HEC-RAS models used to estimate the breach hydrographs were utilized in routing the flood to the receiving environment. HEC-RAS capability of simulation mudflows were used for the SDF scenarios, and the FF scenarios were simulated as Newtonian fluid based on the assessment of the tailings and water volume and densities.

3.2.5.3 Model Extent

The two-dimensional hydraulic model extends from TGO mine site down to the confluence of Gundong Creek and Bogan River as presented in Figure 3.8. The model consists of over 149,000 composite cells ranging from 2mx2m to 20x20m cell sizes. The LiDAR supplied by TGO and the downloaded 5-m resolution DEM from ELVIS were combined to build the surface terrain for the hydraulic model.

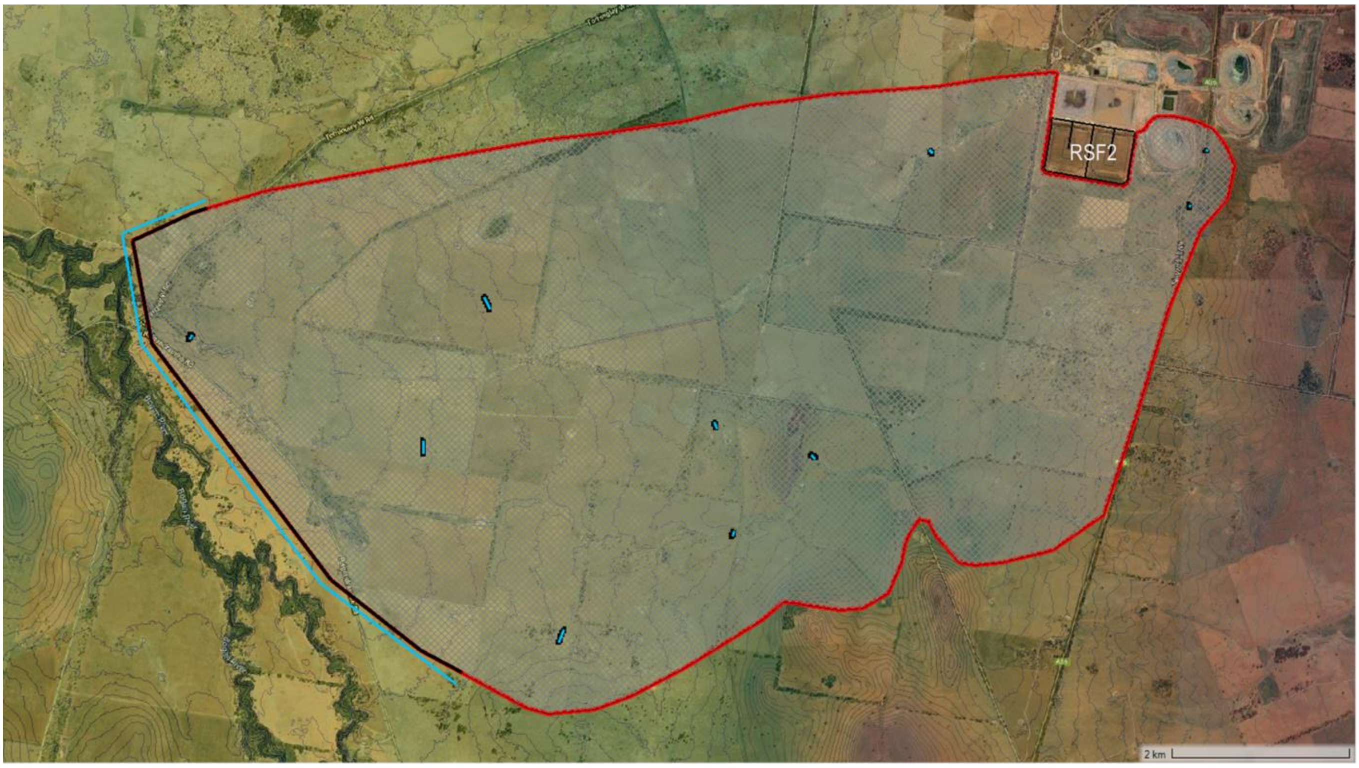


Figure 3.8 Hydraulic Model Extent

Roughness

The HEC-RAS model uses Manning's 'n' values to represent hydraulic resistance (notionally channel or floodplain roughness). Discrete regions of continuous vegetation types and land uses were mapped, and an appropriate roughness value assigned to each region.

The model domain covers the mining plant extending to the agricultural plains past the Tomingley West Road up to the Bulgandramine Road just before Bogan River. Visual inspection of available aerial imagery (Google Earth, ESRI Basemap) showed that the land within the model domain is mostly agricultural plains. In lieu of any other information, the main channel was assumed to be clean with minimal debris. Therefore, the Manning's roughness coefficient was set to 0.035 all throughout the model domain.

3.2.5.4 Boundary Conditions

Inflow hydrographs developed from the XP-RAFTS model were input at the upstream end of each waterway. These were the inflow hydrographs for the 1:100 AEP, 1:10,000 AEP and PMPDF design flood events.

The "normal flow" outflow boundaries were assigned where water slope (based on the model topography).

3.2.6 Modelling results

The full set of inundation mapping flood depths and velocities is provided in Appendix B. Based on the hydraulic model, among the three Flood Failure events, the 1:100 AEP Flood Failure has the larger incremental flood extent, thus 1:100 AEP FF event is considered to be critical among the three FF scenarios. It should be note that for all modelled scenarios, no dwellings experienced flooding directly from the dambreak flood. Also, there is no flood impact observed in Wyoming1 Pit which is approximately 200m from the East wall.

The summary of flood depth, velocity and flood run-out distance from each breach location is tabulated in Table 3.5.

Table 3.5 Summary of Depth, Velocity, and Run-Out Distance

Scenario	Breach location	Failure event/mode	Depth (m)	Velocity (m/s)	Run-out distance (m)
1	Cell 2 East Wall	SDF, Piping	0.5 - 1.0	<1.0	900
2	Cell 2 East Wall	FF – 1in100 AEP, Piping	0.3 – 1.0*	<1.0	700*
3	Cell 2 East Wall	FF – 1:10,000 AEP, Piping	0.2 – 0.6*	<1.3	340*
4	Cell 2 East Wall	FF – PMP-DF, Piping	0.1 – 0.3*	<1.1	160*
5	Cell 1 South Wall	SDF, Piping	0.5 – 2.0	0.5 – 1.5	950
6	Cell 1 South Wall	FF – 1in100 AEP, Piping	0.3 – 1.0*	0.5 – 2.0	1,800*
7	Cell 1 South Wall	FF – 1:10,000 AEP, Piping	0.2 – 0.8*	<2.6	1,750*
8	Cell 1 South Wall	FF – PMP-DF, Piping	0.1 – 0.7*	<2.8	830*
9	Cell 1 West Wall	SDF, Piping	0.5 – 2.0	0.5 - 1.5	1,200
10	Cell 1 West Wall	FF – 1in100 AEP, Piping	0.5 – 1.0*	0.5 – 2.0	760*
11	Cell 1 West Wall	FF – 1:10,000 AEP, Piping	0.2 – 0.8*	0.5 – 2.6	1,500*
12	Cell 1 West Wall	FF – PMP-DF, Piping	0.1 – 0.1*	0.5 – 2.8	1,000*

*based on incremental depth

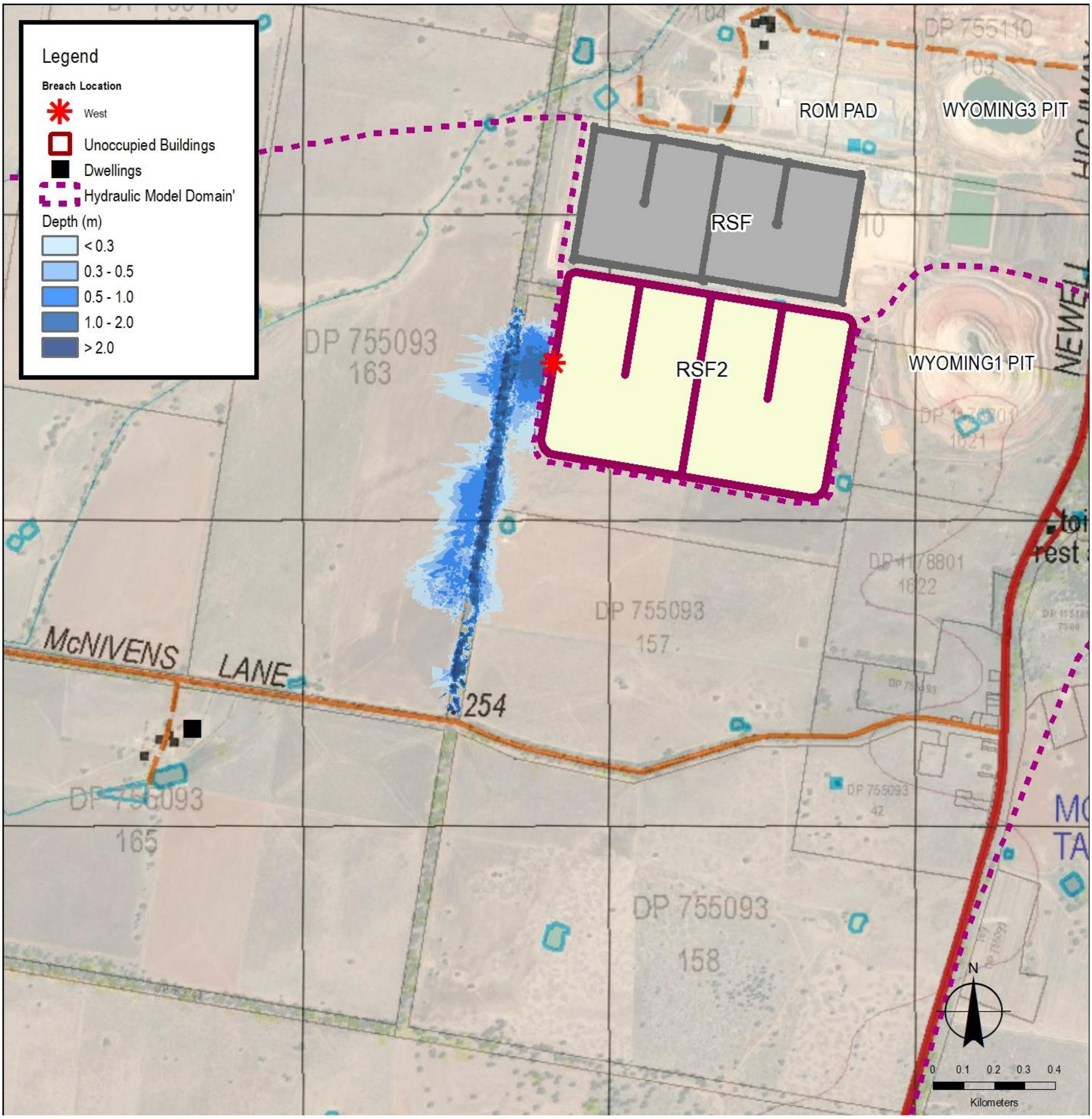


Figure 3.9 *West Wall SDF Flood Extent*

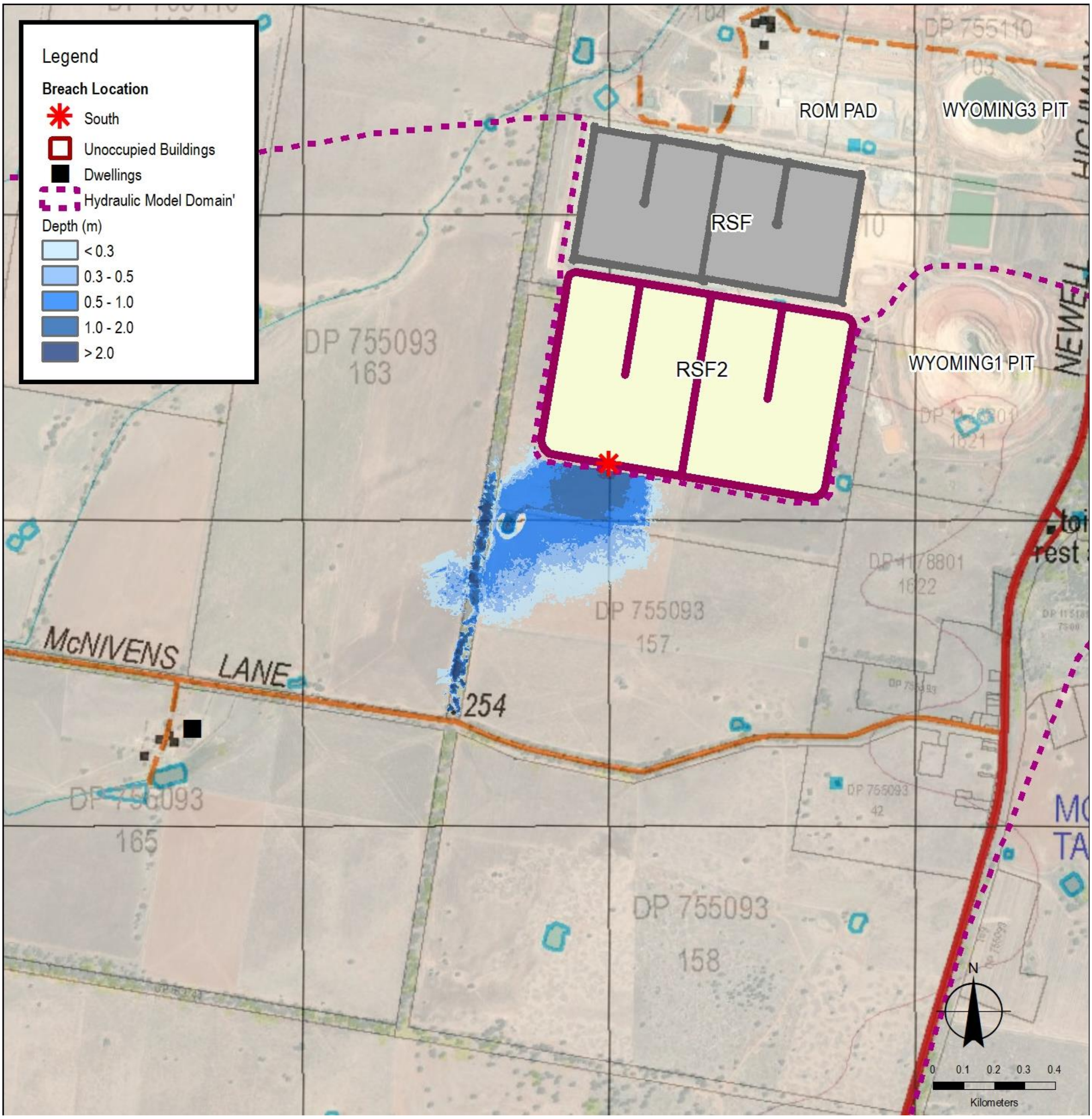


Figure 3.10 *South Wall SDF Flood Extent*

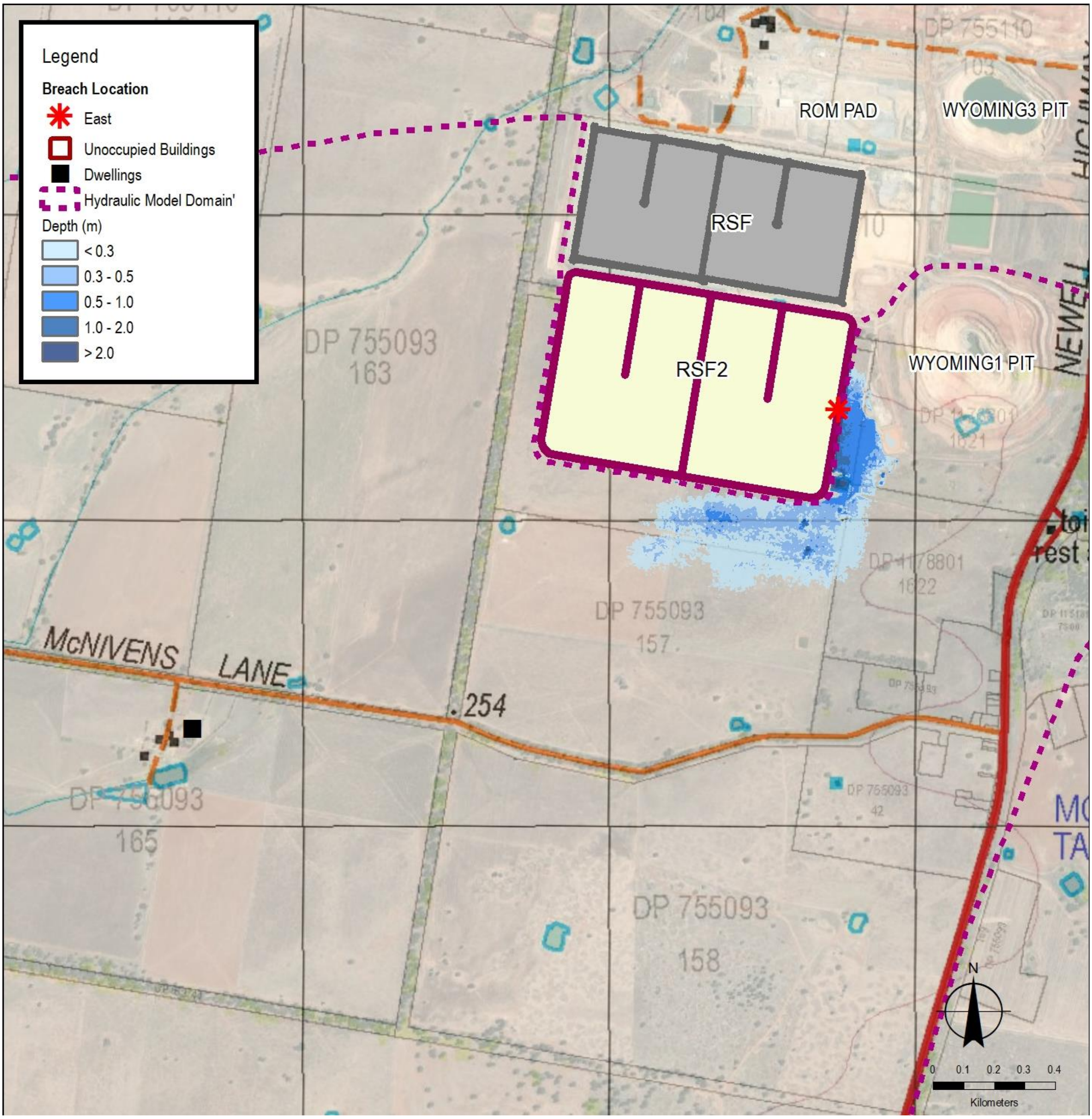


Figure 3.11 *East Wall SDF Flood Extent*

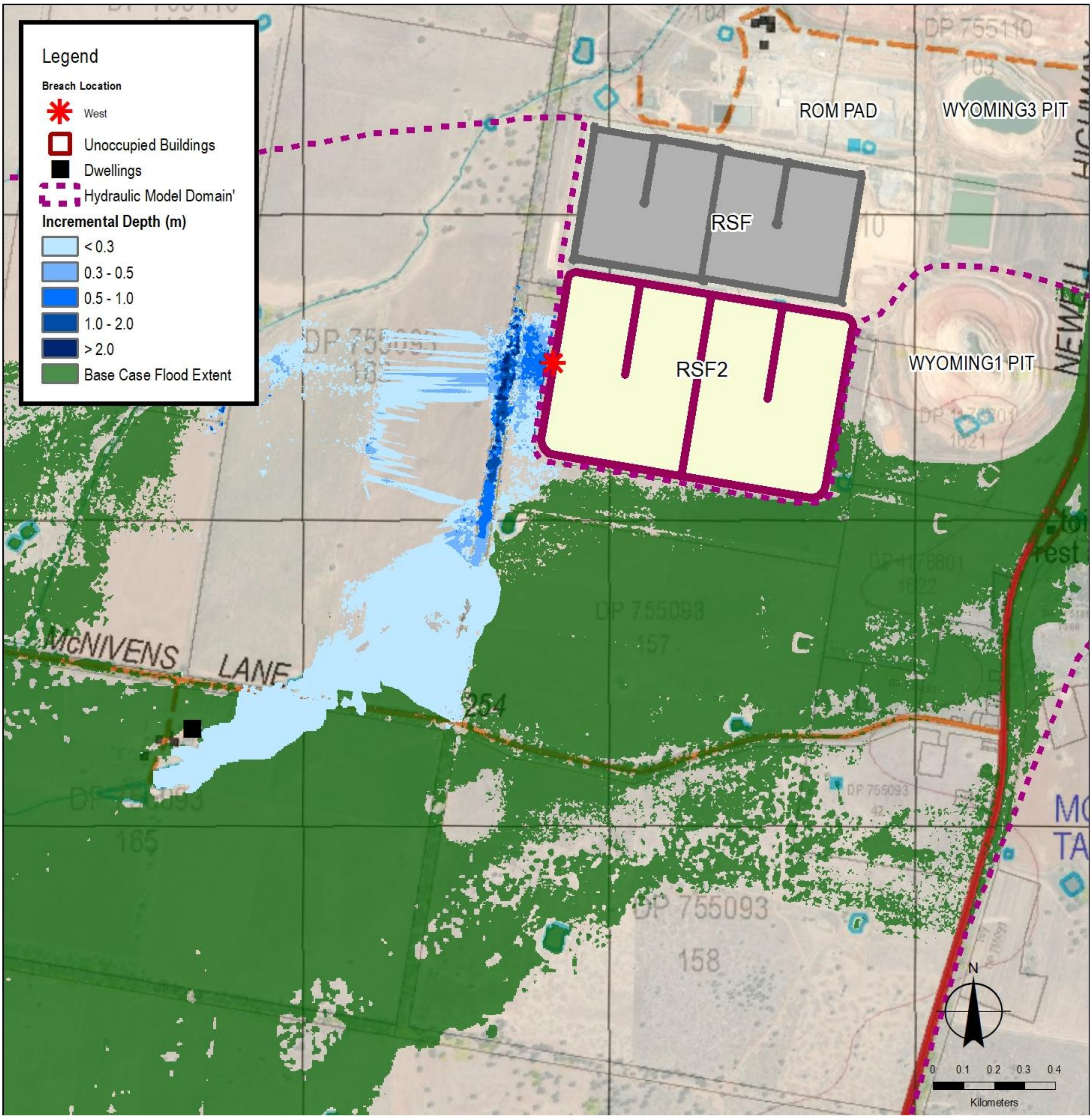


Figure 3.12 West Wall 1:100 AEP FF Flood Extent

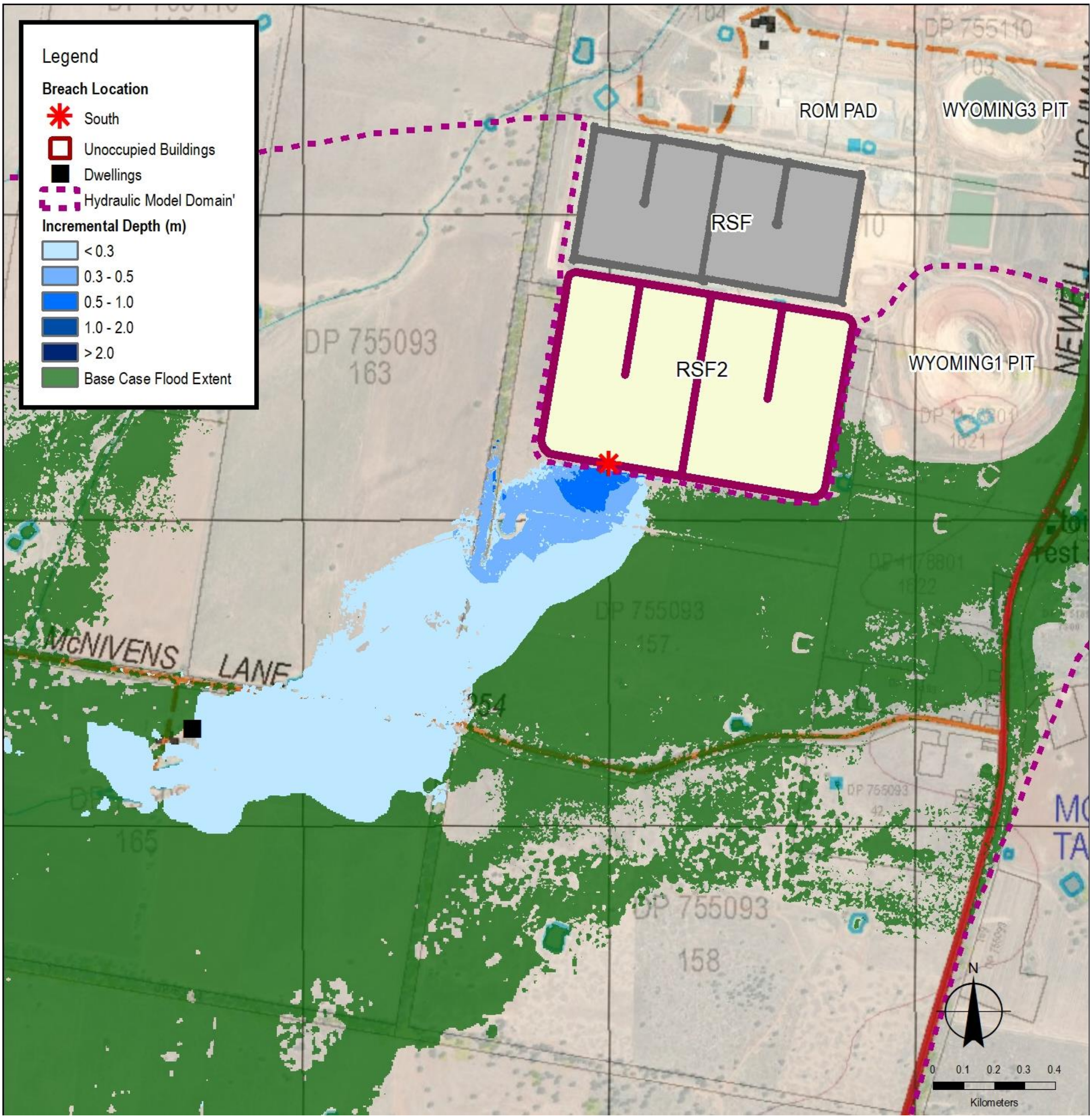


Figure 3.13 South Wall 1:100 AEP FF Flood Extent

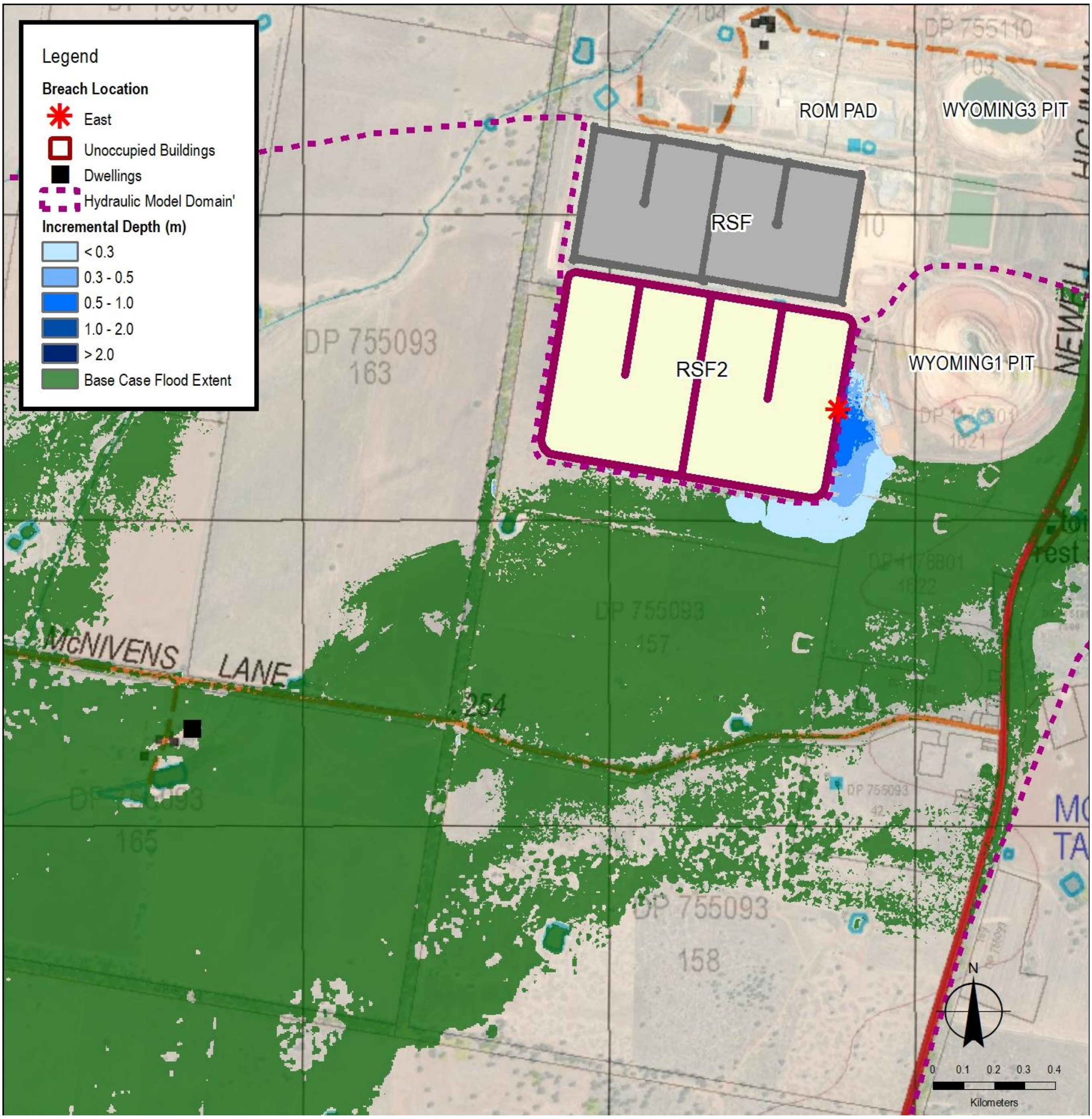


Figure 3.14 East Wall 1:100 AEP FF Flood Extent

3.3 Dam Failure Consequence Category (DFCC)

The Tomingley Gold Mine is surrounded by farming land which generally falls to the southwest. Both RSF1 and RSF2 are located to the south of the plant site.

The underground mining is currently operating from a portal within the Wyoming 1 pit which is to the east of the RSF2 Cell 2. It is estimated that there will be 1 Mm^3 of tailings in each cell when they are filled to Stage 1/Stage 2 design level.

The highest severity of damage and loss due to the dam failure remains as being ‘Major’ based on the impact on the business and the natural environment due to the release of tailings and contaminated water. The population at risk (PAR) is estimated below based on a high-level dam break assessment.

3.3.1 Sunny Day Failure

The most probable failure mode on a sunny day for RSF2 is piping through the embankment which would require water against the embankment wall.

Base on the simulations for the three breach locations, the Population at Risk (PAR) has been assessed to be <1 resulting in a Consequence Category of ‘**Significant**’ based on ‘**Major**’ impacts to the business.

3.3.2 Flood Failure

The flood failure scenario would provide adequate warning time for any site personnel to be evacuated in the event of a catastrophic failure as the plant and underground would likely be stopped and evacuated due to the flood.

Base on the simulations for the three breach locations and three rare and extreme storm events such as 1:100 AEP, 1:10,000 AEP and PMPDF, the population at Risk (PAR) has been assessed to be <1.

The critical flood failure event would consist of poor operational management at the site, i.e. the storage being overfilled with tailings and a large ponded area combined with a 1:100 AEP event occurring causing overtopping. However, this can be avoided with good operational management, including minimizing the pond level, not filling beyond the design limits, daily inspections by trained personnel, and consistent monitoring.

The DFCC for Flood Failure is considered to be ‘**Significant**’.

3.4 Environmental Spill Consequence Category (ESCC)

The Environmental Spill Consequence Category has been reviewed for the RSF2 Stage 1 and Stage 2 dam and assessed to be ‘**Low**’ due to the release of decant water stored in the RSF that would have a “**Medium**” impact on the environment with PAR<1. The main contributing factors to the ESCC are related to the potential contamination of water supplies used by stock and fauna with no anticipated health impacts and the short-term impacts on the local ecosystems.

3.5 Summary of CCA

GHD has reviewed the consequence category of the RSF2 Stage 1 as summarised in Table 3.6.

Table 3.6 Summary of Consequence Category Assessment

Assessment	The severity of Damage and Loss	PAR	Consequence Category
Dam Failure CC	Major	(SDF)<1	Significant
		(FF)<1	Significant
Environmental Spill CC	Medium	<1	Low

3.6 Implications of Consequence Category Assessment

The RSF 2 should be designed to meet the standards in accordance with ANCOLD guides for a '**Significant**' DFCC and '**Low**' ESCC, as outlined below.

3.6.1 Design Parameters

Key design parameters based on the Consequence Category Assessment are detailed below.

Design Flood and Freeboard

ANCOLD gives guidance on flood design parameters based on both the Dam Failure Consequence Category and the Environmental Spill Consequence Category of the dam. The design hydraulic performance parameters adopted based on ANCOLD Guidelines on Tailings Dams (ANCOLD, 2019) is as follows:

- Minimum wet season water storage allowance: 1:10 AEP wet season runoff.
- Minimum extreme storm storage: 1:1,000 AEP, 72 hour flood event[1].
- Contingency freeboard: 300 mm.
- Emergency spillway design capacity: 1:1,000 AEP flood event with sufficient freeboard for wave run-up during a 1:10 AEP wind event[1].

Note 1: Minimum extreme storm storage design event is only suggested in ANCOLD as 1:100 AEP 72 hour, however, given the importance of the structure to the business moving forward and the impacts of a failure through the external embankment this minimum storage requirement has been increased as outlined in Section 7.

Design Earthquake Loading

For a '**Significant**' Sunny Day Failure Consequence Category dam, ANCOLD (2019a) suggests a 1:475 AEP Operating Basis Earthquake (OBE) and 1:1,000 AEP Safety Evaluation Earthquake (SEE).

ANCOLD (2019a) highlights that if the structure is susceptible to liquefaction or has components that will fail at ground motions only a little greater than those recommended, to check the design for the critical ground motion and assess the adequacy of the design using risk assessment methods. Where liquefaction of tailings is likely to affect the stability of the dam, the design may need to consider a 1:10,000 AEP earthquake, unless an appropriate risk assessment is undertaken to confirm that an adequate risk profile is achieved with a lower earthquake loading. ANCOLD (2019b) also recommends 1:10,000 AEP Maximum Credible Earthquake (MCE) be used in the design of the closure arrangement.

3.6.2 Monitoring, Surveillance, and Reporting Requirements

ANCOLD's Guidelines on Dam Safety Management (ANCOLD, 2003) gives guidance on the frequency of dam monitoring and surveillance for different consequence category tailings dams. For a '**Significant**' Dam Failure Consequence Category dam, ANCOLD suggests the inspection and monitoring types and frequencies as shown in Table 3.7 and Table 3.8, respectively. The recommended surveillance and monitoring requirements are detailed in Section 15.

Table 3.7 Inspection Types and Frequencies

Inspection Type	ANCOLD Recommended Frequency
Routine Visual	Twice Weekly to Weekly
Intermediate	Annual to 2-Yearly
Comprehensive	On Commissioning then 5-Yearly
Special	As Required

Table 3.8 Monitoring Types and Frequencies

Monitoring Type	ANCOLD Recommended Frequency
Rainfall	Twice Weekly to Weekly
Storage Level	Twice Weekly to Weekly
Seepage	Twice Weekly to Weekly
Chemical Analysis of Seepage	Consider
Pore Pressure	3-Monthly to 6-Monthly
Surface Movement Control	Consider
Surface Movement Normal	Consider
Internal Movement / Stresses	Consider
Seismological	Consider

3.6.3 Operation Maintenance and Surveillance Manual

An Operations Maintenance and Surveillance (OMS) Manual has been prepared as part of the RSF2 Detailed Design. The principal objective of this manual is to provide a documented operation procedure to assist in the safe and efficient management of tailings and water around the material stockpile.

The OMS manual has been developed in accordance with minimum regulatory requirements (ANCOLD, 2003) and includes:

- Roles and responsibilities.
- Design intent.
- Regular operations and inspections.
- Water and tailings management procedures.
- Operational requirements for mechanical equipment and instrumentation.
- Maintenance schedules and procedures.
- Surveillance requirements.
- Examples of potential damages and associated repair works.
- Trigger Action Response Plans.

The OMS manual outlines key monitoring activities which will include:

- Routine monitoring of RSF.
- Routine monitoring of water levels and process plant return water rates.
- Routine monitoring of groundwater level fluctuations.
- Underdrainage system return rates and volume.

The OMS Manual has been provided to TGO as a separate deliverable.

3.6.4 Dam Safety Emergency Planning

ANCOLD (ANCOLD, 2003) states a Dam Safety Emergency Plan (DSEP), otherwise known as an Emergency Response Plan (ERP), be prepared where any persons, infrastructure, or environmental values could be at risk if the dam were to fail. An ERP is therefore required for both the construction and operation of the RSF2 impoundment. There is an existing DSEP for RSF1, which has been updated to include RSF2 also as a combined facility.

4. Geotechnical Data

4.1 Overview

An intrusive geotechnical ground investigation was carried out between 17 November and 5 December 2020 to confirm the foundation characteristics and geotechnical design parameters at the RSF2 location. The geotechnical investigation comprised of the following:

- A desktop review of publicly available information and previous geotechnical investigations nearby the proposed site.
- A program of geotechnical fieldwork, consisting of test pit investigations and borehole investigations.
- Laboratory tests on samples obtained from test pitting and boreholes.

The geotechnical investigation focused on foundation soil up to depths of 20 m. The geotechnical characteristics and shear strength parameters adopted for materials such as tailings or borrows have been adopted as similar to those characterized as part of RSF 1 Stage 8 (GHD 2021), as later summarized in Section 4.7.

4.2 Geotechnical Site Investigation

The geotechnical investigation comprised of the following activities:

- Mechanical excavation of 20 test pits (TP01 to TP20) across the proposed reservoir storage area. Test pits were excavated to a maximum depth of 4.0 m below ground level.
- Drilling of 10 boreholes (BH01 to BH10) within the alignment of the proposed embankment foundation. The boreholes were advanced using sonic drilling techniques from the ground surface to achieve a maximum depth of 20 m below ground level.

The location of these test pits and boreholes are shown in Figure 4.1.

During test pitting and drilling, the following in-situ testing was undertaken:

- Pocket penetrometer testing to assess the in-situ consistency of the shallow soils and aid in the identification of any potentially soft or low strength zones.
- Dynamic Cone Penetrometer (DCP) testing was undertaken at select locations to assist in determining the density of the near-surface material.
- Standard Penetration Tests (SPT) were undertaken within the boreholes at approximately 1.5 m intervals (where appropriate) to assess the consistency of the soils and to recover disturbed samples.

Figure 4.1 Test Pits and Boreholes Location

4.3 Laboratory Testing

Laboratory testing was undertaken on samples collected from the test pits and boreholes to confirm field logging and assess material properties. The following tests were undertaken according to the relevant Australian Standard test methods:

- Particle Size Distribution, including Hydrometer.
- Atterberg Limits.
- Field Moisture Content.
- Bulk Density.
- Emerson Class (dispersion).
- Standard Compaction Tests (98% MDD).
- Constant Head Permeability (Triaxial Cell).
- X-ray Computed Tomography (XCT) scan.
- Single Stage Triaxial Consolidated Undrained (CU) Strength Tests with Pore Pressure Measurement.
- One-dimensional consolidation (Oedometer) tests.

Testing was conducted in the NATA accredited Fugro AG Laboratory in Perth, and GHD's NATA accredited facility in Sydney.

4.4 Foundation

4.4.1 General

The area is dominated by alluvial sequences of clays, sands, and gravel of Quaternary to Tertiary age. The subsurface conditions encountered within the test pits and boreholes generally comprised of topsoil overlying alluvial (sandy) clays with varying proportions of gravels. The topsoil encountered typically comprises of low plasticity, sandy clay with rootlets. The alluvial material encountered comprises of very stiff to hard, sandy clay/clay with varying proportions of gravels. The clay was typical of low to medium plasticity with a field moisture condition generally equal to, or less than, the plastic limit (i.e. dry to moist).

4.4.2 PSD, Atterberg Limits and Permeability

The foundation material corresponds to clay to sandy clay material with traces of gravel. The fines content is highly variable and within a range of 13% to 95%. The PSDs for the samples recovered during the 2021 geotechnical investigation are shown in Figure 4.2. The fine fraction generally classifies as a low to intermediate plasticity clay (CL - CI) following the Casagrande Plasticity Chart, as shown in Figure 4.3. Standard compaction tests conducted in samples collected from test pits show maximum dry densities between 1.62 (t/m^3).and 1.87 (t/m^3). Optimum moisture content was found between 14.5% and 20% with field moisture contents typically between 10% to 17.4%.

The in-situ unit weight for the materials in the upper 10 m is approximately 1.40 t/m^3 to 1.85 t/m^3. The specific gravity of the material is approximately 2.6. Oedometer tests conducted on samples collected from boreholes at depths greater than 3 m show Compression Index (C_c) in the range of 0.09 to 0.12.

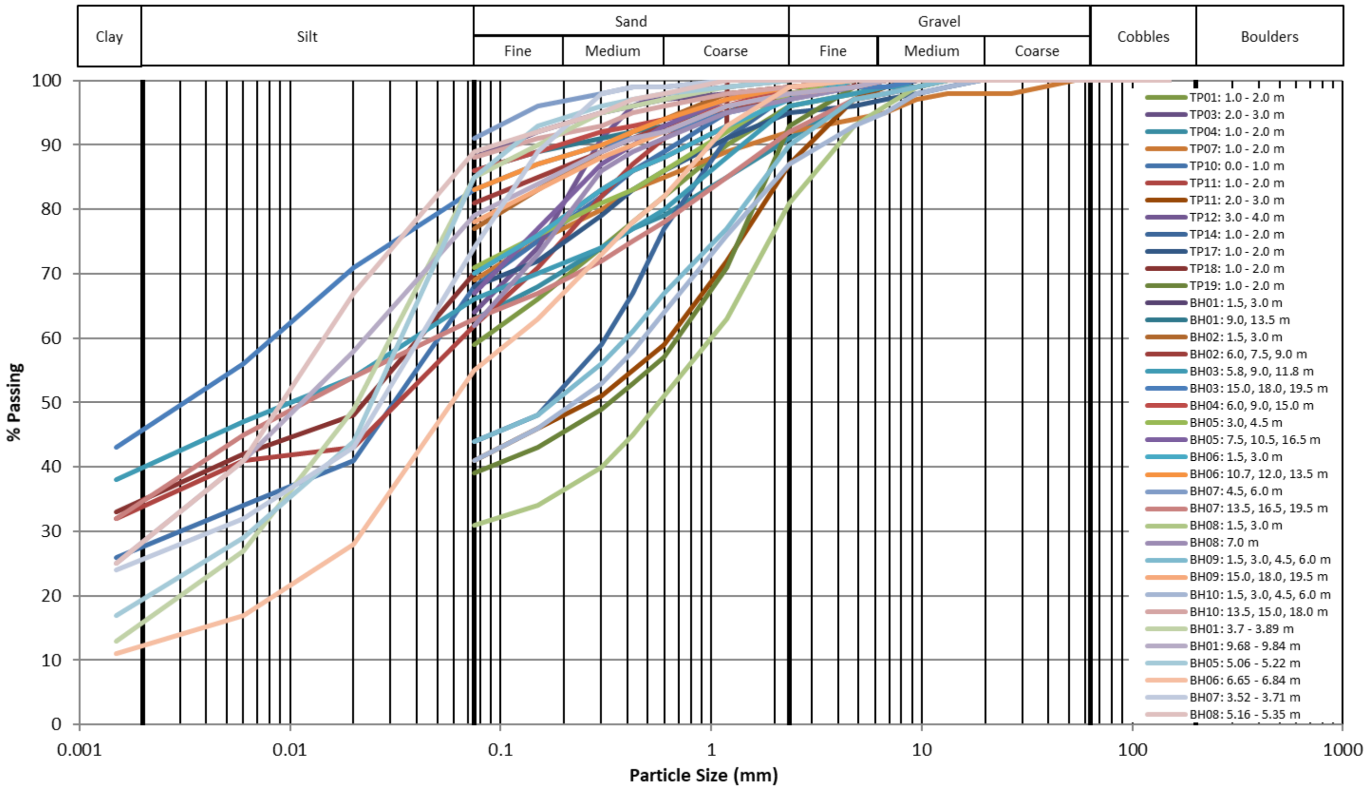


Figure 4.2 Particle Size Distribution Plot

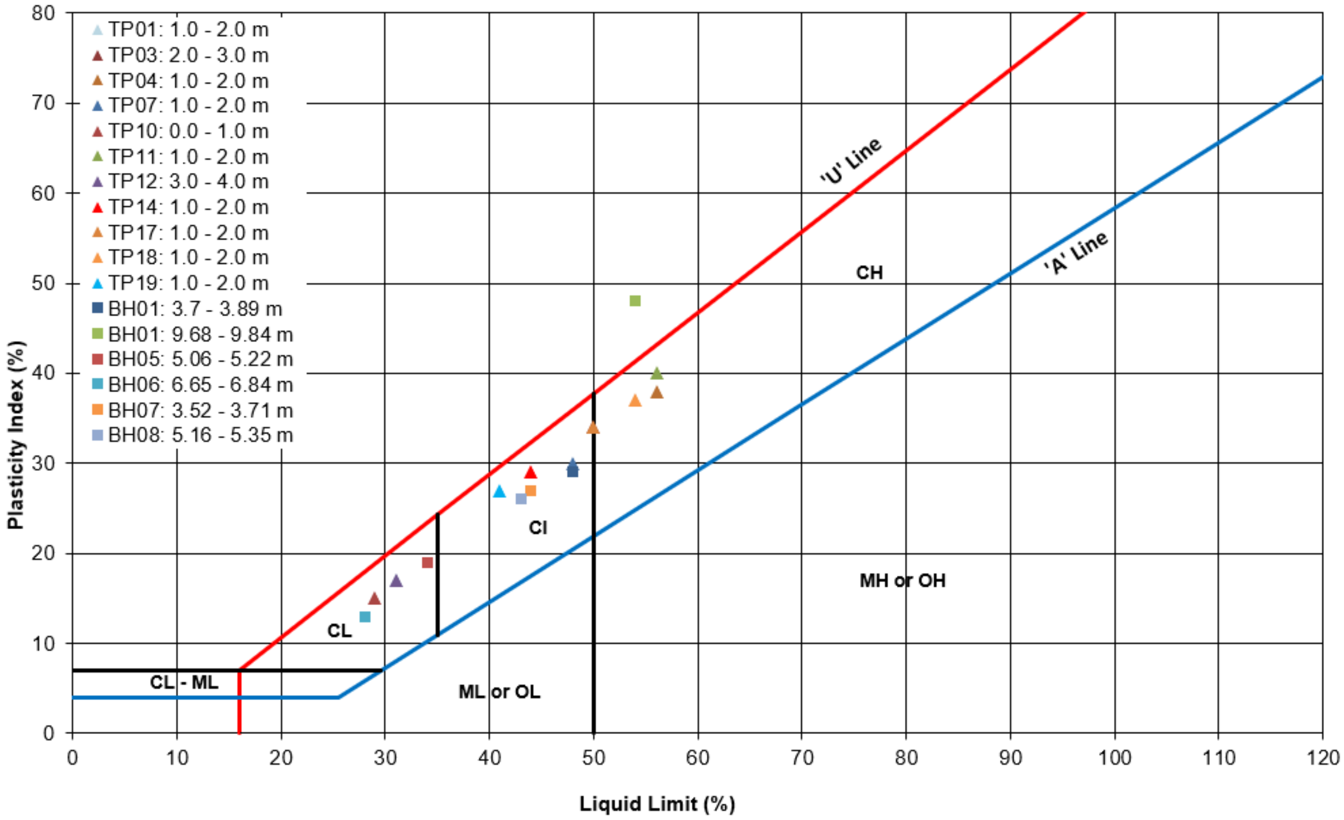


Figure 4.3 *Atterberg Limits Plot*

The clayey foundation material show, after Constant Head Permeability testing, a coefficient of permeability between 10^{-10} m/s to 10^{-11} m/s, Table 4.1.

Table 4.1 *Laboratory Permeability Testing*

Test ID	Depth (m)	Description	Coefficient of permeability, k (m/sec)
TP03	2.0 – 3.0	CLAY trace sand	2×10^{-10}
TP10	0.0 – 1.0	Sandy CLAY, trace gravel	2×10^{-10}
TP11	1.0 – 2.0	Sandy CLAY	4×10^{-11}
TP18	1.0 – 2.0	Sandy CLAY, trace gravel	1×10^{-10}

Tabulated summaries of the respective soil laboratory test results are presented in Table 4.2.

Table 4.2 *Soil Classification Testing*

Test ID	Depth (m)	Soil Description	MC (%)	Plasticity (%)		LS (%)	Particle Size Distribution (%)				Emerson Class
				LL	PI		Clay	Silt	Sand	Gravel	
TP01	1.0 - 2.0	Sandy CLAY, trace gravel	10.0	31	17	–	59		37	4	2
TP03	2.0 - 3.0	CLAY with sand, trace gravel	16.9	50	34	–	32	56	11	1	2
TP04	1.0 - 2.0	CLAY with sand, trace gravel	13.9	56	38	–	30	33	28	9	2
TP07	1.0 - 2.0	CLAY with sand, trace gravel	17.7	48	30	–	69		23	8	2
TP10	0.0 - 1.0	Sandy CLAY, trace gravel	11.5	29	15	–	28	40	31	1	2
TP11	1.0 - 2.0	Sandy CLAY	17.4	56	40	–	35	27	36	2	2
TP11	2.0 - 3.0	Sandy CLAY with gravel	–	–	–	–	41		46	13	–
TP12	3.0 - 4.0	Sandy CLAY	14.1	31	17	–	64		36	0	2
TP14	1.0 - 2.0	Sandy CLAY, trace gravel	14.1	44	29	–	44		54	2	2
TP17	1.0 - 2.0	Sandy CLAY, trace gravel	14.4	50	34	–	66		29	5	2
TP18	1.0 - 2.0	CLAY with sand, trace gravel	14.7	54	37	–	35	35	27	3	2
TP19	1.0 - 2.0	Sandy CLAY, trace gravel	8.1	41	27	–	39		54	7	–
BH01	1.5 and 3.0*	Sandy CLAY trace gravel	–	–	–	–	95		35	5	–
BH01	3.7 - 3.89	CLAY with sand	22.7	48	29	9.0	17	68	15	–	–
BH01	9.0 and 13.5*	CLAY, trace sand & gravel	–	–	–	–	86		12	2	–
BH01	9.68 - 9.84	CLAY with sand	17.0	54	48	10	31	48	19	2	
BH02	1.5 and 3.0*	CLAY with sand, trace gravel	–	–	–	–	77		22	1	–
BH02	6.0, 7.5, and 9.0*	CLAY with sand, trace gravel	–	–	–	–	81		17	2	–
BH03	5.8, 9.0, and 11.8*	Sandy CLAY, trace gravel	–	–	–	–	40	26	30	4	–
BH03	15.0, 18.0 and 19.5*	CLAY with sand, trace gravel	–	–	–	–	45	38	14	3	–
BH04	6.0, 9.0, and 15*	CLAY trace sand	–	–	–	–	86		13	1	–
BH05	3.0 and 4.5*	CLAY with sand, trace gravel	–	–	–	–	71		27	2	–
BH05	5.06 - 5.22	CLAY with sand	19.1	34	19	6	20	65	15	–	–
BH05	7.5, 10.0, and 16.5*	Sandy CLAY, trace gravel	–	–	–	–	67		32	1	–
BH06	1.5 and 3.0*	CLAY with sand, trace gravel	–	–	–	–	70		27	3	–
BH06	6.65 - 6.84	Sandy CLAY	12.2	28	13	6	13	42	44	–	–
BH06	10.7, 12.0, and 13.5*	CLAY with sand, trace gravel	–	–	–	–	83		16	1	–
BH07	3.52 - 3.71	CLAY with sand	17.5	44	27	10	26	48	26	–	–
BH07	4.5 and 6.0*	CLAY trace sand	–	–	–	–	91		9	0	–
BH07	13.5, 16.5, and 19.5*	CLAY with sand, trace gravel	–	–	–	–	34	29	29	–	–
BH08	1.5 and 3.0*	Clayey SAND with gravel	–	–	–	–	31		50	19	–
BH08	5.16 - 5.35	CLAY trace sand	20.1	43	26	11.5	30	59	11	–	–
BH08	7.5 - 7.95	Sandy CLAY trace gravel	–	–	–	–	62		35	3	–
BH09	1.5, 3.0, 4.5, and 6.0*	Sandy CLAY trace gravel	–	–	–	–	44		46	10	–
BH09	15.0,18.0, and 19.5*	CLAY with sand, trace gravel	–	–	–	–	78		20	2	–
BH10	1.5, 3.0, 6.0, and 9.0*	Sandy CLAY trace gravel	–	–	–	–	41		46	13	–

BH10	13.5,15.0, and 18.0*	CLAY trace sand and gravel	–	–	–	–	88	11	1	–

*Note: MC = Moisture Content; LL = Liquid Limit; PI = Plasticity Index; LS = Linear Shrinkage, * Multiple depths indicate blended samples*

4.4.3 Shear Strength

Four multi-stage and three single-stage isotropically consolidated triaxial (CIU) tests with measurement of pore water pressure, have been completed on undisturbed samples. Samples were tested with the consideration of the future consolidation pressure. The test results are summarised in Table 4.3. Effective shear strength parameters show a mean friction angle of 34° and zero-effective cohesion. Similarly, the undrained shear strength ratio (s_u/p_o') is generally greater than 0.6.

Table 4.3 Triaxial Test Results

Sample Locations	**Consolidation Pressure, po' (kPa)**	**Maximum Stress Ratio (M=q/p')**	**Effective Peak Friction Angle, Φ (°)**	**Peak Undrained Shear Strength, S_u (kPa)**	**Shear Strength Ratio, s_u/po'**
BH01 9.68 – 9.84 m	130	1.61	39.40	126	0.97
	330	1.24	30.92	234	0.71
	530	1.09	27.47	318	0.6
BH05 5.06 – 5.22 m	120	1.39	34.35	102	0.85
	300	1.21	30.23	180	0.6
	480	1.15	28.85	269	0.56
BH06 6.65 – 6.84 m	120	1.51	37.10	119	0.99
	300	1.38	34.12	240	0.8
	480	1.33	32.98	379	0.79
BH08 5.16 – 5.35 m	120	1.66	40.55	134	1.12
	300	1.33	32.98	228	0.76
	480	1.18	29.54	302	0.63
BH01 3.51 – 3.70 m	100	1.5	36.87	119	1.19
BH01 3.70 – 3.86 m	200	1.39	34.35	160	0.8
BH07 3.52 – 3.71 m	400	1.23	30.69	240	0.6

These CIU results were also compared against the outcomes of the geotechnical investigations completed as part of the RSF1 detailed design for Stage 7 and Stage 8. The investigations were undertaken during 2017 and 2020 geotechnical investigation programs and explored the undrained shear strength of the foundation soil. The peak undrained shear strength parameters were obtained from single-stage triaxial testing and the final stage of the multistage triaxial tests. The shear strength was then reduced to account for direct simple shear conditions (intermediate strength between triaxial compression and extension) which is expected along the failure surfaces of both RSF1 and RSF2.

Figure 4.4 and Figure 4.5 show the undrained shear strength functions for both peak and the residual conditions for both the RSF2 and RSF1 data. The ultimate residual strength of the foundation was generally not attained even at 15% axial strain. As such, the response at 15% was adopted in the analysis (this strain well exceeds RSF serviceability criteria). The resulting S_u/σ'_{vo} functions were adjusted using a polynomial function considering the minimum values between drained and undrained shear strength.

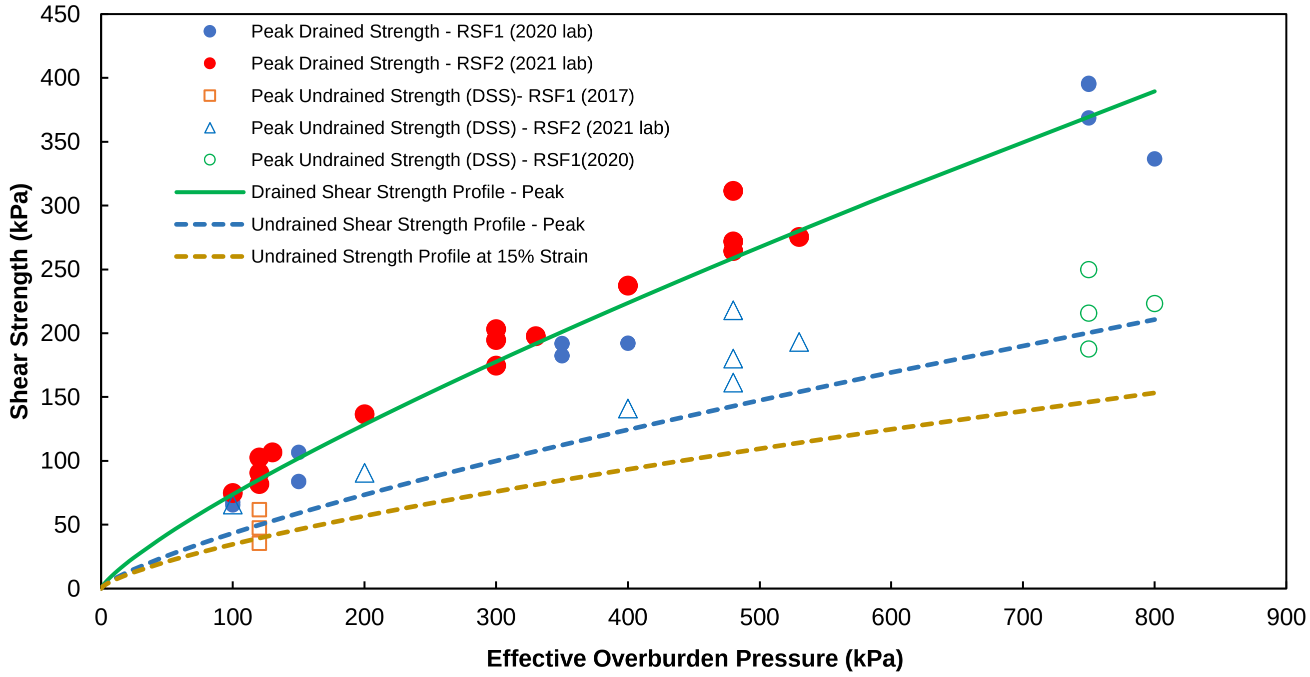


Figure 4.4 *Peak Undrained Shear Strength.*

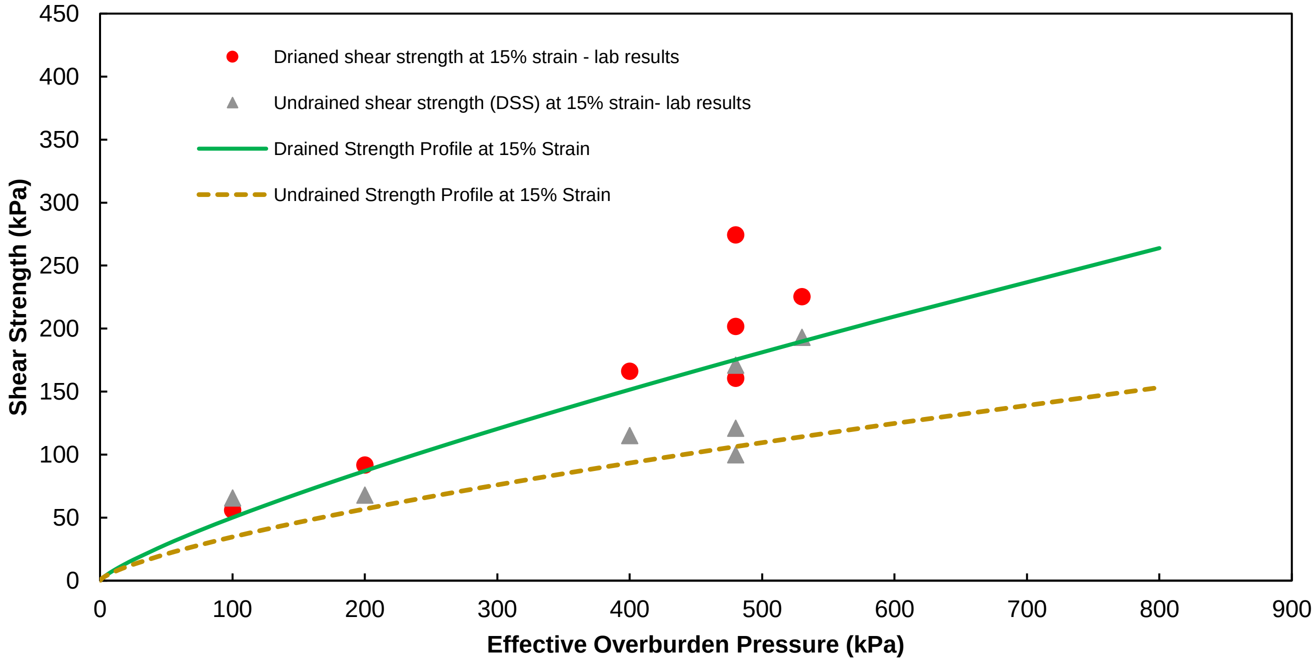


Figure 4.5 *Peak Undrained Shear Strength.*

4.4.4 SPTs

Standard Penetration Tests (SPT) were undertaken within the boreholes at approximately 1.5 m intervals (where appropriate) to assess the consistency of the soils and to recover disturbed samples. The uncorrected results of the SPTs are plotted in Figure 4.6. The N value increases monotonically with depth with a minimum value of N≈16 at z≈6 m. Refusal was observed at different depths. The corrected N value is later used to evaluate the liquefaction susceptibility of the foundation materials.

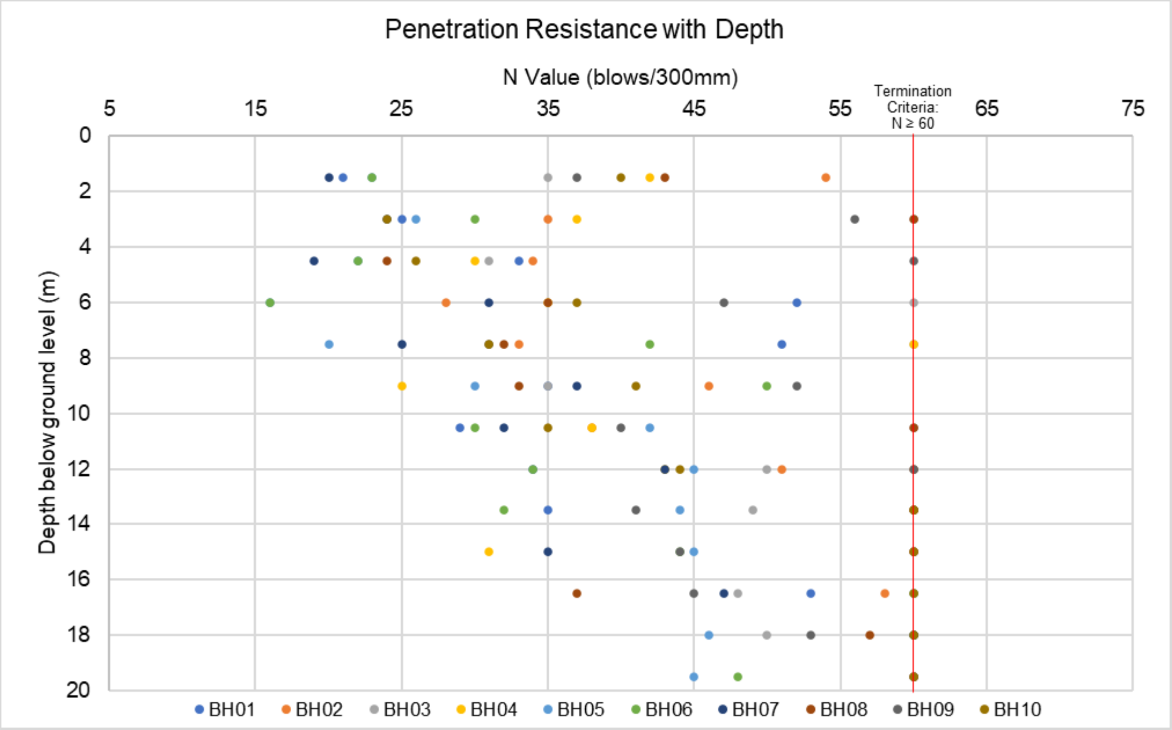


Figure 4.6 ***Relationship between SPT N value and depth***

4.5 Tailings

4.5.1 General

A thorough characterisation of the physical properties of the tailings materials can be found in Section 13.1. The characterisation considered 5 CPTu holes taken through the Stage 2/3 embankments, and 4 CPTu holes on the tailings beaches.

The CPTu - SBT charts show that the upper section of the RSF1 tailings (from surface to 5 m deep) are likely to respond similarly to sand-like material in accordance with Jefferies and Davies (1993). At greater depths, the tailings are highly interbedded with clay-like and very thin layers of sand-like material. Interlayering and segregation in the RSF is likely a result of variable settlement rates of tailings, environmental effects, over-consolidation of material, and changes in ore characteristics/processing over time.

4.5.2 Index properties

The particle size distributions (PSDs) for the tailings show that the fines content for the “clay-like” and “sand-like” tailings range between 60% to 85%, and between 40% to 55%, respectively. The material mostly classifies as low plasticity silty (ML), according to the Unified Soil Classification System (USCS). The fine portion (finer than 0.075 mm) of the “clay-like” and “sand-like” material are classified, according to Casagrande Plasticity Chart, as low to intermediate plasticity Clay (CL-CI) and low plasticity silt (ML), respectively. The plasticity index of the tailings is generally below 10% with an average liquid limit of 28%. The specific gravity (G_s) of the material was found to be equal to 2.55.

The tailings unit weight is variable within RSF1. Based on the 2018 density testing on the beach surface, the unit weight of the tailings has been estimated to be 1.50 t/m^3 with an in-situ moisture content between 8% and 18%. These results give a saturated unit weight of 1.95 t/m^3 and a bulk unit weight of 1.8 t/m^3 for tailings at shallow depths.

4.5.3 Shear strength

The sand-like tailings, which are conservatively adopted as representative for materials in the RSF2, show CPTU tip resistance between 1 MPa and 3 MPa in the RSF1. The Soil Behaviour Type (Ic) value is typically between 2 and 2.6, and CPTu excess pore pressure ratio (B_q) is between 0 and 0.1.

The shear strength parameters were defined from CPTs and consolidated drained and undrained triaxial tests undertaken on re-constituted RSF1 tailings samples (GHD, 2021). The inspection of CPTu-SBTn charts presented shows that the “sand-like” portion is near the dilation-contraction contour and deposited in a loose state. As such, the undrained shear strength is expected to be significantly lower than the drained shear strength. As a reference, this type of tailings shows an effective friction angle generally greater than 25 degrees and yields a strength versus effective overburden ratio of no less than 0.46.

A $S_{u,peak}/\sigma'_{vo}\approx0.20$ for tailings was inferred from the CPTu tests adopting the first quartile for S_u values as a reasonable criterion for LE analysis. Similarly, the residual shear strength ratios ($S_{u,r}/\sigma'_{vo}$) were obtained using the Critical State Line (CSL) and the state parameter ψ (defined as the difference in void ratios between the in-situ state and the Critical State under the same effective confining stress) for the ‘sand-like’ tailings. The in-situ state parameters (ψ_0) were obtained from 2020 CPTu tests and the expression proposed by Jefferies and Been (2016) which relates ψ and normalised CPTu tip resistance as shown in Figure 4.7. The ‘sand-like’ tailings shown in Figure 4.7, show that the upper quartile of the data points is $\psi_{Q3}\geq-0.05$, and thus slightly dilative. Based on this, a residual undrained shear strength ratio of 0.2 is adopted for the tailings in the RSF1.

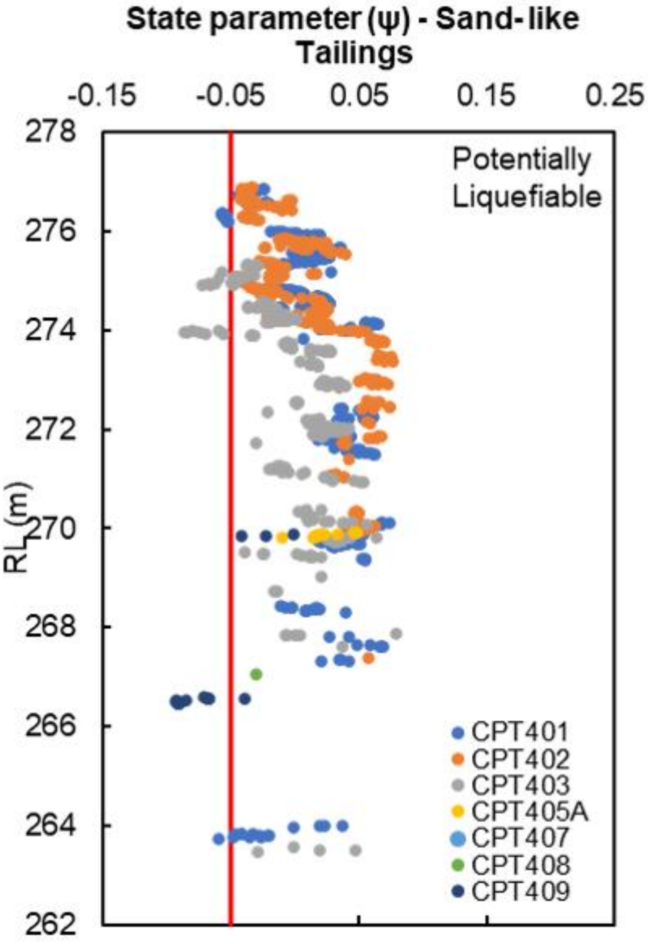


Figure 4.7 State Parameter for Tailings

4.6 Embankment Clay

4.6.1 General

The clayey material has been extensively used in the construction of the RSF1. This material will be also used in the RSF2. Previous as-constructed reports for Stages 6 and 7 (GHD, 2019; GHD, 2020) and previous geotechnical investigation provide an adequate characterisation of the material.

4.6.2 Index properties

The embankment material corresponds to a sandy silty clay or silty clay with sand. The fine portion of the material (finer than 0.075 mm) shows low to medium plasticity with PI between 13% and 33%. Fines content is generally greater than 60% with a coefficient of permeability of approximately 10^{-9} m/s. The material is generally compacted to a target density of 98% of Standard Maximum Dry Density (SMDD).

4.6.3 Shear strength

Two material samples were collected during both the Stage 3 and Stage 5 construction stages in 2016 and 2018, respectively. Multistage Consolidated Undrained (CU) triaxial tests were conducted on the Stage 3 embankment material at effective confining pressures of 50, 100, and 200 kPa. Single Stage CU triaxial tests were conducted on remoulded materials (prepared at 98% SMDD) on the Stage 5 materials at effective confining pressures of 40, 80, and 160 kPa.

For long-term loading conditions, the drained shear strength parameters have been obtained from the effective stress paths (p'-q) as described in GHD (2021) and shown in Figure 4.8. Considering the lower bound envelope, an effective friction angle of 30° and zero cohesion is found for the embankment material.

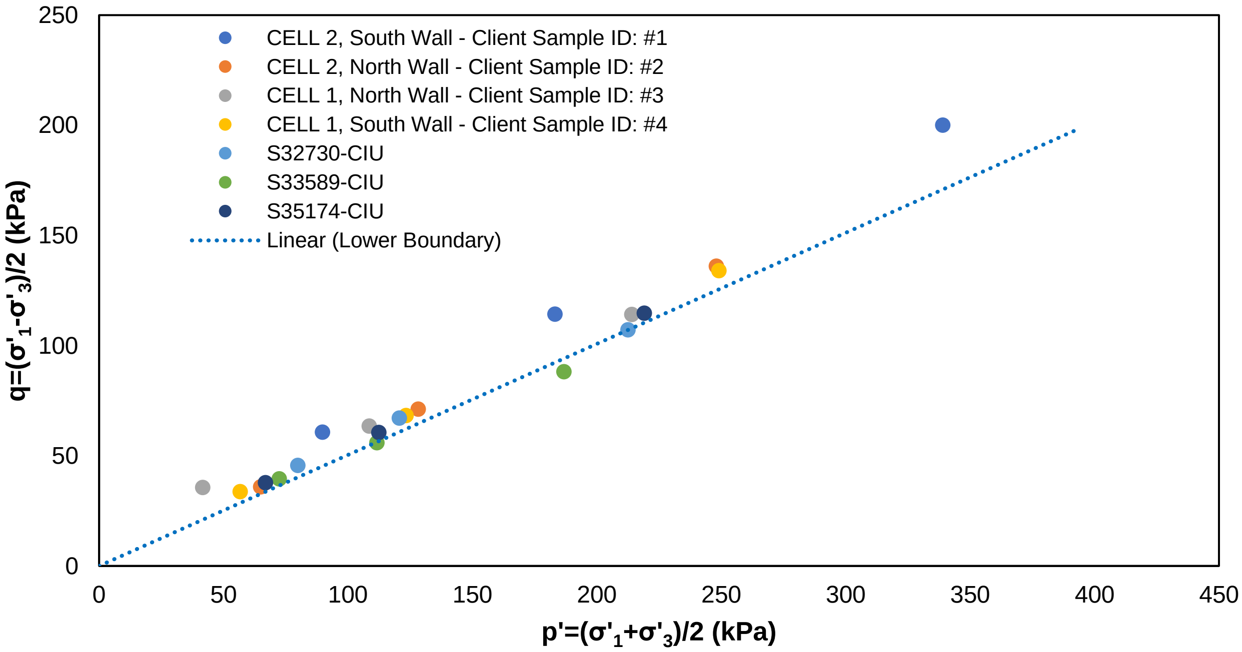


Figure 4.8 Drained Shear Strength – Embankment Clay

Similarly, the undrained shear strength ratio was obtained from CU tests. The resistance has been reduced by a factor of 0.57 to represent in situ direct simple shear (DSS) conditions. Figure 4.9 below shows the lower bound envelope (in the τ-σ'_{vo} plane) for the equivalent DSS shear strength, which yields $S_{u,}/\sigma'_{vo}\approx0.23$ for the material.

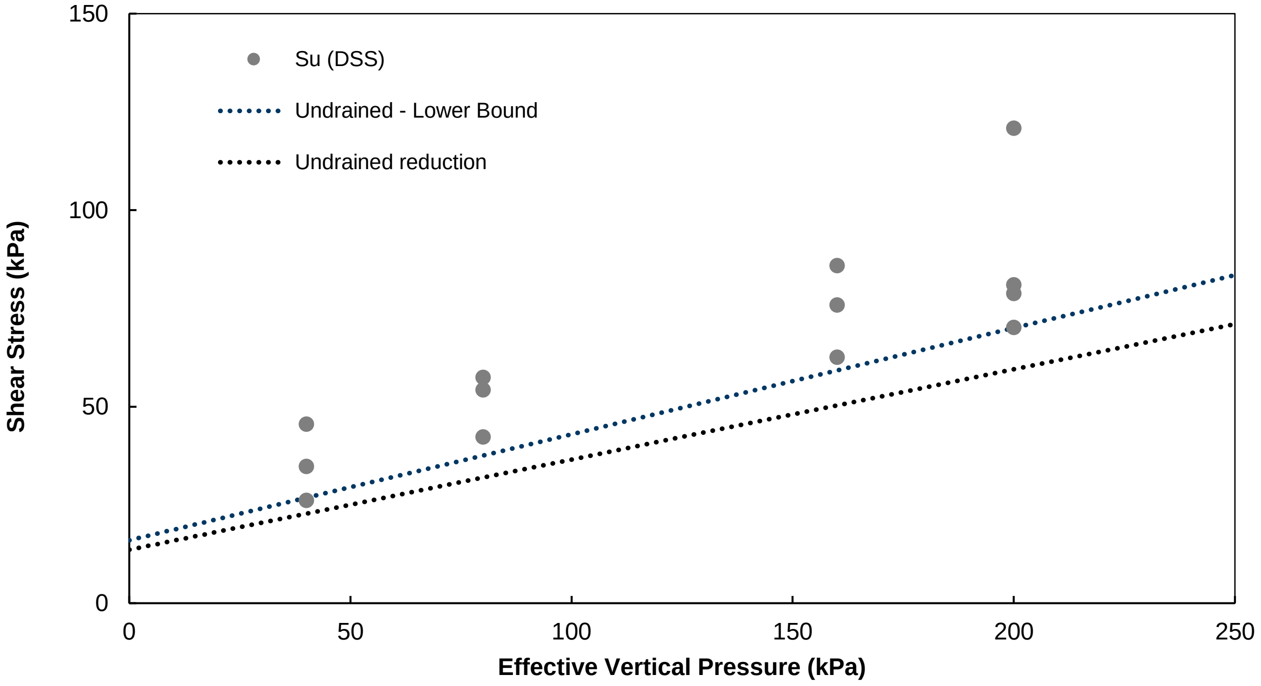


Figure 4.9 Undrained Shear Strength – Embankment clay

4.7 Adopted Material Strength Parameters

Material strength parameters have been developed based on both previous parameters and the results of the geotechnical investigation carried out in the RSF2 footprint. Table 4.4 summarises materials shear strength parameters adopted in the stability assessment of the facility. Liquefied shear strength parameters have been estimated from the post-liquefaction analysis as discussed in Section 13.4.

Table 4.4 Adopted Material Strength Parameters

Material Description	Bulk Unit Weight (kN/m³)	Drained Shear Strength (kPa)	Undrained Shear Strength (kPa)	
			Pre-seismic Peak	Post-seismic Strength
Sand-like Tailings	18	Refer Note 1	S_u/σ'_v = 0.20	$S_{u(liq)}/\sigma'_v$ = 0.038
Embankment Clay	20	c’ = 0 kPa ϕ’ = 30°	Normal/Shear function (see Figure 4.9)	Normal/Shear reduction function (see Figure 4.9)
Foundation	21	c’ = 0 kPa ϕ’ = 26°	Normal/Shear function	Normal/Shear function
General Fill	20	c’ = 0 kPa ϕ’ = 35°	Same as the left	Same as the left
Zone 2	18	c’ = 0 kPa ϕ’ = 33°	Same as the left	Same as the left
Zone 3	22	c’ = 0 kPa ϕ’ = 40°	Same as the left	Same as the left

5. Tailings Deposition Options Assessment

5.1 Overview

During the preliminary design and leading into the detailed design of RSF2, a number of deposition options and RSF arrangements were considered for the RSF2 storage, in order to determine the best solution for the site. The following options were considered:

- Upstream Constructed RSF
- Downstream Constructed RSF
- Centreline Constructed RSF
- In-Pit Deposition RSF
- Dry Stacking Deposition RSF
- GeoTube RSF

Each of these options was assessed on a range of criteria including:

- Footprint impacts.
- CAPEX.
- OPEX.
- RSF Stability.
- Suitability for Closure.

This assessment was undertaken as a desktop assessment involving both GHD and TGO and incorporated readily available information and high-level conceptual arrangements for each of the options to inform the discussions.

5.2 Options Assessment

5.2.1 Upstream Constructed RSF

Upstream constructed TSF's have traditionally been constructed across the world as the preferred methodology for raising tailings facilities due to their low cost and efficient approach. However, recent developments within the industry, specifically large-scale failures of these types of facilities and the need for additional buttressing on the downstream face, have raised questions as to the suitability of this type of dam. At TGO, RSF1 has been constructed as an upstream raised facility with additional buttressing to meet stability requirements. However, when assessing the suitability of this option, the following was identified as key considerations:

- Low baseline option. However, there it is a high likelihood that costs may increase significantly, due to buttressing requirements.
- Reduced footprint area required under the base case scenarios which consists of purely upstream raises when compared with downstream raise arrangements. However, this is expected to increase with future buttressing requirements on site.
- Increased operational requirements to closely monitor and manage tailings deposition and pond extents such that the decant is far enough away from the external embankments to manage the risk of embankment instability.
- Reliance on non-engineered tailings materials of potentially variable consistency for the foundation/stability of the embankments, leading to significantly increased risk for the RSF.
- It is expected that significant work will be required for the stabilisation and encapsulation of the RSF prior to closure, including the effective compaction of tailings, capping, and development of long-term stable buttressing due to the risk of liquefaction of the tailings post closure when compared with alternative options.

Whilst this option was identified as the lowest potential cost option for the construction of a new embankment with no change to the process plant and minimal sustaining CAPEX required with each raise, the increased risk of instability both during operation and to satisfy closure requirements was not considered by TGO to be justifiable.

5.2.2 Downstream Constructed RSF

Downstream constructed RSF's are traditionally rarer than upstream constructed dams, largely due to the increased initial and ongoing capital costs. Because the embankment is constructed using the same geometry as a traditional water storage embankment, utilising natural foundations and is not dependent on the strength of the tailings for stability. The stability of these structures is thus inherently greater than for other embankment types. In particular, compared to upstream construction, which relies on the strength of the tailings for stability.

When assessing the suitability of this option, the following points were identified as key considerations:

- High baseline and ongoing cost option requiring significant capital input.
- Larger footprint area for the embankment than other options considered resulting in increased land clearance and preparation requirements.
- Potential for reduced operational requirements due to the greater stability of the structure, however the reduced operational requirements are considered to be marginal when considering the centreline option discussed below.
- Increased stability when compared with upstream raised tailings dams due to founding on the embankments (other than starter embankment) on natural ground rather than tailings.
- It is expected that a moderate amount of work (less than upstream for upstream) will be required for encapsulation of the RSF, prior to closure including the effective compaction of tailings and capping. However, buttressing is not anticipated, subject to confirmation by stability analysis of the embankment.

This option was identified as the highest potential cost option for the construction of the RSF. The stability and decreased operational risk benefits were seen to be outweighed by the magnitude of sustaining CAPEX and the footprint extents required for this arrangement. Accordingly, this was not considered to be a justifiable option for TGO, over say a Centreline Raise.

5.2.3 Centreline Constructed RSF

Following some recent failures of upstream constructed embankments, centreline constructed embankments are becoming more common in the industry due to increased safety of the structures. When compared with the downstream constructed RSF's, previous projects have shown up to a 50% reduction in embankment volume requirements resulting in reduced sustaining CAPEX costs. Additionally, because the centreline arrangement doesn't rely solely on the strength of the tailings for foundational strength this option is considered to be more stable than the upstream arrangement considered previously.

When assessing the suitability of this option, the following points were identified as key considerations:

- Moderate baseline and ongoing cost option requiring moderate capital input for the life of the facility.
- Similar initial footprint area to that of the upstream raise arrangement however smaller than downstream requirements, thus resulting in relatively similar land clearance and preparation requirements to the base case upstream raise arrangement.
- Potential for reduced operational requirements due to the increased stability of the structure, however the reduced operational requirements are considered to be similar to that of the downstream option discussed above.
- Increased stability when compared with upstream raised tailings dams due to founding 50% of each raise on natural ground rather than entirely on tailings.
- It is expected that a moderate amount of work (less than upstream construction) will be required for encapsulation of the RSF, prior to closure including the effective compaction of tailings and capping.

This option was identified as a moderate potential cost option for the construction of the RSF. The significant benefits for the centreline option are; increased stability, decreased operational risk benefits and the reduced sustaining CAPEX when compared with the downstream raise arrangement.

5.2.4 Dry Stacking Arrangement RSF

Dry stacking of the tailings, a more recent option adopted by mine owners in Australia, in conjunction with a transition to paste storage, which was considered as an alternative to the embankment tailings storage by TGO. The benefits of dry stacking are seen to be increased stability, reduced CAPEX for embankment construction decreased risk, and decreased cost of closure compared with the embankment options.

When assessing the suitability of this option, the following were identified as key considerations:

1. Low embankment CAPEX and sustaining earthworks CAPEX. However, high CAPEX associated with the plant required, OPEX of the mechanical dewatering operations, and of ongoing placement/compaction of the tailings.

- Additional storages for traditional tailings deposition during plant maintenance and runoff water management were identified as being essential.
- Whilst the overall footprint of the dry stack was considered to be reduced when compared to embankment options, the footprint allowance for the water management dam and the slurry RSF was considered to increase the land clearance and preparation requirements, as such the footprint area was comparable if not greater to that of the centreline arrangement.
- Due to the facility location, and the increased risk of wind-blown and eroded tailings (when compared with conventional deposition arrangements) this option was considered to be a significant environmental risk.
- This option was identified as potentially resulting in decreased inspection requirements. However, there are increased operational costs with regard to surface drainage management and avoiding high pore pressures forming in the deposit which can adversely affect stability.
- It was expected that this option would result in the most cost-effective closure arrangement with the ability to cap and close the facility progressively during operation and the ability to use inert waste rock as a buttressing material on the external slopes.
- Dry stacking can enable progressive capping of the RSF with ongoing placement of tailings. Also, the potential for use of waste rock for confining embankments and co-disposal of both tailings and waste rock.

Whilst this option was identified as the lowest potential CAPEX cost option for the storage of tailings in the dry stack earthworks formation, the additional requirement for the construction of two additional storages for wet tailings during filter maintenance and surface runoff partially negates these saving in CAPEX. Additionally, the OPEX associated with the dewatering and placement of the tailings and the identified environmental risks meant that this was not considered to be a justifiable option for TGO at this stage of the mine. However incorporation of additional filtering technology is being considered by the mine for use in the future to maximise capacity and stability of the existing arrangements.

5.2.5 In-Pit Deposition

In-pit deposition of the tailings is generally considered to be a cost-effective solution for deposition of tailings as it eliminates the risk of a tailings dam failure. However, there are numerous elements that need to be considered with respect to this option. The benefits of in-pit deposition are the elimination of the risk of dam failure, reduced CAPEX and sustaining CAPEX, and improved visual amenity following closure and no need for embankment strengthening works during closure. When assessing the suitability of this option, the following were identified as key considerations:

- No embankment CAPEX and sustaining CAPEX, however, previous assessments have indicated there is a risk of groundwater impacts resulting in a need to line the pit using a geosynthetic lining system.
- No additional facility such as a water management dam or emergency storage (as per the requirements for a dry stacking facility) will be required with respect to this option.
- Due to the facility arrangement, there are risks associated with the storage of tailings within the pit due to groundwater impacts, whilst this can be mitigated with the lining of the facility, the use of geosynthetic liners would likely pose a construction difficulty.
- This option was identified as potentially resulting in decreased inspection requirements. However, there will be increased operational costs with regard to dewatering from the pit due to increased pump head. Plus requirements for environmental management of groundwater.

- Due to the storage of tailings within the pit shell, it was determined that there is no risk of embankment failure either during operation or closure.
- This option would result in the elimination of capping external embankments. However, the management of the tailing surface during closure is expected to be difficult due to reduced densities, the closure timeframes are expected to be longer due to dewatering, longer ongoing maintenance of the capping is expected due to ongoing consolidation and creep of the tailings, as well as the long-term risks of environmental impacts to groundwater.

Whilst this option was identified as one of the lowest potential CAPEX cost options for the storage of the tailings, the additional requirement for the lining of the pit negates any savings made in not having to construct an embankment for the storage of the residue. Additionally, the risk of impacting groundwater even with the installation of a geosynthetic lining system was considered too high for TGO as such this option was not considered to be justifiable.

5.2.6 GeoTube Storage

The final option considered was a geotube storage, whereby the tailings are pumped into 'dewatering bags' which passively decant the water out of the tailings through the bag, whilst leaving the tailings solids inside. This deposition arrangement is a relatively new development within the industry and one that allows for effective passive separation of the tailings from the decant water resulting in reduced CAPEX and Sustaining CAPEX throughout the life of the facility and increased stability during closure. When assessing the suitability of this option, the following were identified as key considerations:

- Low embankment CAPEX and sustaining CAPEX are required throughout the life of the facility.
- The overall footprint of the geotubes stack was considered to be similar or greater to that of a centreline raise arrangement due to loss of storage capacity due to the voids between the bags and a maximum limit on the geotube stacking height.
- Additional infrastructure including deposition pipelines will be required for the effective filling of the geotubes.
- This option was identified as potentially resulting in decreased inspection requirements. However, increased operational costs were anticipated with regard to managing the storage.
- This option was identified as providing increased stability in the structure when compared with other storage options as the bags are self-containing and effectively unable to fail in the same way a typical RSF would fail. However, it was identified that failures could still occur due to functional failure of the bags themselves or failure of the deposition pipeline.
- It was expected that this option would result in the second most cost-effective closure arrangement with the ability to immediately cap and close the facility following the operation.

Whilst this option was identified as the second lowest potential CAPEX cost option for the storage of the tailings, the additional requirement for the construction of the water management facility, storage area required and the OPEX costs for the deposition management negates these saving in CAPEX. Ultimately this was seen as a good option for potential consideration for future expansion but with the need for more experience in use prior to adoption by TGO eg, further case studies etc.

5.3 Preferred Solution

Based on the analysis, the preferred solution identified throughout this process was the use of traditional slurry storage, using centreline construction for future raises with a compacted clay liner placed across the floor of the storage area of RSF2. This option was selected as the preferred arrangement due to the expected CAPEX and sustaining CAPEX associated with this option, which minimised the footprint of the facility, the anticipated long-term stability of RSF2, and the ease of capping the facility when required. As stated in Section 5.1, taking into account the preliminary nature of the work preparatory leading into the RSF2 detailed design, a number of potential options were considered. However, these options were deemed unsuitable on grounds of cost, environmental risks, and increased delivery risk due to uncertainty in performance. The preferred arrangement is detailed in Section 6 and is in accordance with the project approval conditions.

6. Landform Design

6.1 RSF Arrangement

Based on the Options Assessment detailed above, RSF2 has been designed as a paddock facility with a dual cell arrangement to allow for separated tailings deposition between the two cells to improve the drying capability of the tailings. Whilst a single cell would also allow for adequate drying and rate of rise in the TSF, the use of a central embankment mitigates impacts of an external embankment failure by allowing for an alternative deposition location and aids in construction staging. Each cell of RSF2 utilises a central decant tower and pump surrounded by drainage rock to allow for the removal of the supernatant water and rainfall from each of the cells as required. Further staging of the RSF2 has been developed using a centreline arrangement to reduce reliance on the strength of the tailings for construction whilst minimising the impact of the footprint.

A detailed description of the proposed landform including external and internal embankment geometry and the connection to the existing RSF1 embankment buttress is provided in the following sections.

6.2 External Embankment Geometry

The RSF 2 Stage 1 (starter embankment) has been designed to allow the Stage 2 embankment and all future raises to be constructed as centreline embankments. The RSF2 Stage 1 dam geometry will consist of upstream embankment slopes of 2H:1V which allows for an increased depositional capacity whilst allowing for sufficient stability on the upstream side of the embankment. The downstream slope of the Stage 1 embankment is 3H:1V which allows for increased stability in the Stage 1 embankment whilst minimising the storage footprint.

The design of the Stage 1 embankment allows for a 6 m wide crest on the outer and central embankments to allow for potentially 2-way light vehicle traffic, a tailings deposition line, safety bunding on each side, and sufficient space to undertake operational and maintenance tasks on the pipeline.

The decant access embankments for each cell will be formed also with a 6 m wide crest with 1.5H:1V embankment batters.

6.3 Embankment Zoning

Embankment zoning of the external embankments will consist of Zone 1 (Core and Liner), Zone 2 (filter material), and Zone 3 (General Fill).

6.3.1 Zone 1 Core

The Zone 1 core material will consist of low permeability clay material (as specified in the Technical Specification in Appendix G), nominally 5 m wide, sourced from the storage footprint which shall be placed on the upstream side of the RSF 2 Stage 1 embankment.

The upstream Zone 1 slope will be 2H:1V and the internal slope will be 1H:1V. The Stage 1 Zone 1 material will be keyed into the foundation and connected to the storage liner to minimise the risk of a seepage path forming beneath the embankment.

6.3.2 Zone 1 Liner

Zone 1 Liner will comprise of 1 m thick zone of in-situ clay material (as specified in the Technical Specification in Appendix G), which will be ripped and recompacted to form a low permeability layer (of 1×10^{-9} m/s minimum) across the foundation of RSF2 to limit seepage through the foundation during operation and closure of the facility.

6.3.3 Zone 2 Transition Material

Zone 2 transition material will be used as a filter layer between the RSF2 northern wall and the existing buttressing on the downstream side of Cell 1 and Cell 2 of RSF1 as specified in the Technical Specification in Appendix G.

6.3.4 Zone 3 General Fill

Zone 3 material will consist of general fill material as specified in the Technical Specification in Appendix G. The foundation will need to be stripped to nominally 300 mm depth to remove topsoil and organic matter and ensure a strong competent foundation material. The Zone 3 material will be selectively placed such that the finer material will be placed against the Zone 1 core and the coarser material will be on the downstream face. This placement methodology is to reduce the risk of fines migrating into the Zone 3 material and assist in the stability and erosion protection of the embankment.

The Zone 3 material is also proposed to be used on the upstream face of the embankment and foundation liner to protect the Zone 1 material from desiccation cracking increasing susceptibility to seepage.

6.3.5 Crest Wearing Course

The wearing course material to form the embankment pavement will likely consist of course durable material found onsite.

6.4 Embankment Connections

RSF 2 eastern and western embankments will abut to the existing RSF 1 Cell 1 and Cell 2 southern embankment and utilize the existing embankment to form RSF 2 northern embankment. A Zone 1 clay liner will be placed against the existing embankment following treatment of the existing buttressing.

RSF 1 includes buttressing on the downstream side of the south embankments which comprises of uncompacted material. The buttressing material contains a matrix of dispersible highly weathered to moderately weathered material, containing boulders up to an approximate size of 600 mm. This uncompacted material when loaded will likely settle resulting in cracking of the Zone 1 clay liner and presenting a risk for piping failure or internal erosion.

To mitigate this risk, a filter (Zone 2) will be required between Zone 1 and the existing buttressing, and Finite Element Modelling (FEM) has been undertaken to model these deformations and assess the impacts on the storage.

The transition filter zone to the existing buttressing will consist of placing a layer of compacted General Fill against the existing buttress and retaining the existing batter slope. Due to the existing geometry of buttressing for Cell 1 being different to Cell 2, additional General Fill will be placed against the buttress as required to create a consistent Northern Wall Profile for RSF2. The General Fill would be required to comprise of appropriately graded material to allow for the construction of a filter zone to be placed against it.

A subsoil drain will be placed in the filter zone to collect and prevent any seepage from RSF1/2 from building up within the embankment and pass any seepage to the external surface toe drains for measurement.

7. Tailings and Water Management

7.1 Overview

This section outlines the proposed deposition arrangement for RSF2 and the water management requirements for the facility to allow for suitable drying to increase the density of the tailings and maximise the capacity within the TSF.

7.2 Tailings Deposition/ Filling Schedule

RSF2 has been designed as a Paddock type facility with a dual cell arrangement to allow for the cycling of deposition as required to improve the density of the tailings over the life of the facility. The tailings will be deposited using perimeter discharge with spigots spaced at 50 m centres along the embankment to allow for even coverage of tailings across the RSF. The following deposition cycle is proposed which is shown graphically in Figure 7.1 and described below.

- Tailings will be deposited from the western wall of Cell 1 of RSF2 cycling 4 spigots every 2.5 days to achieve a deposition depth of 300 mm.
- Following the completion of deposition on the western wall, deposition of tailings will continue around the cell at 4 spigots every 2 days until all sides of the RSF have been deposited in.
- Move deposition to the western wall of Cell 2 of RSF2 and continue cycling 4 spigots every 2.5 days around the entire cell to achieve a deposition depth of 300 mm across the cell.

This deposition cycling, dependent on the variability in the throughput and management of the decant water level, should result in a maximum tailings depth of approximately 300 mm during each cycle optimising the dewatering and increasing the dry density of the materials.

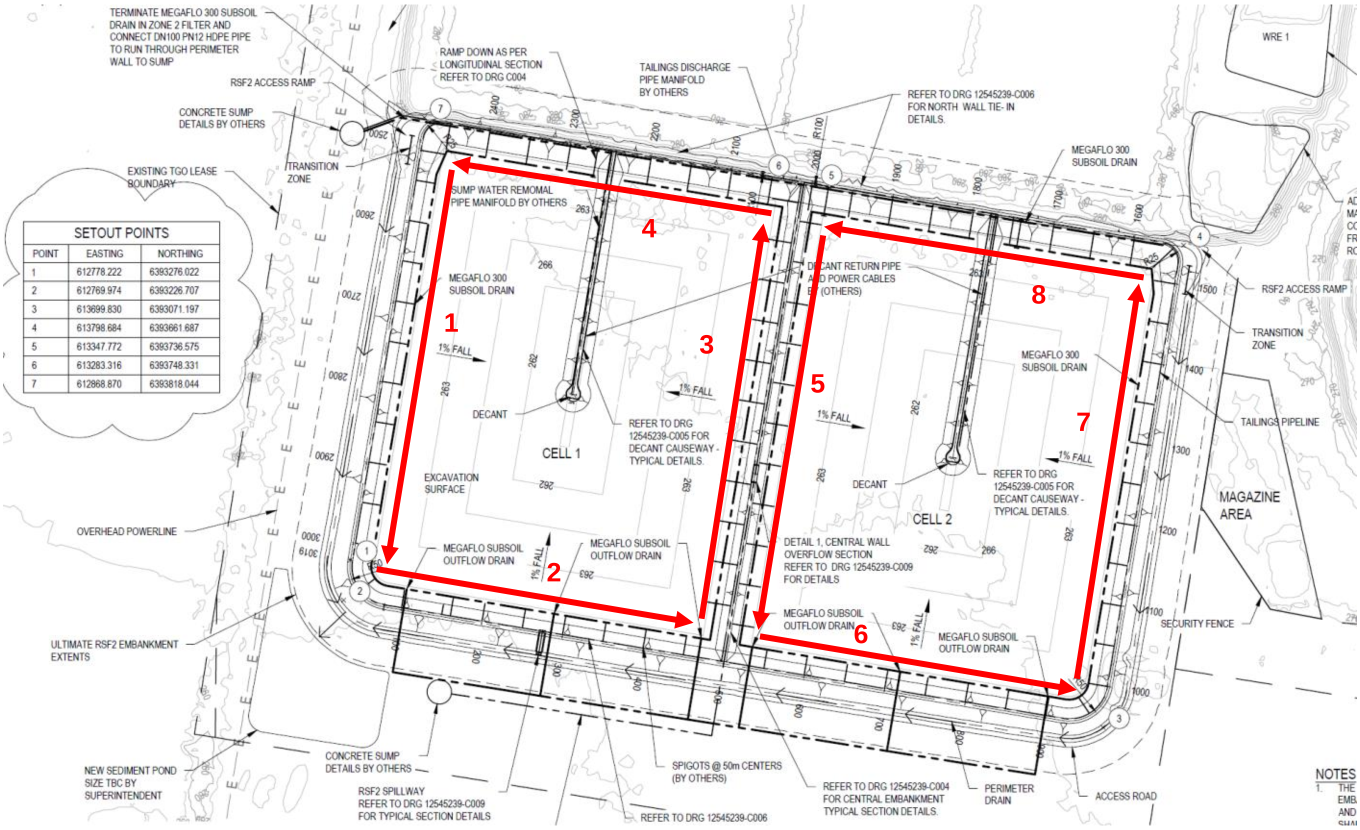


Figure 7.1 Proposed tailings deposition

7.3 Hydrology

As a '**Significant**' Consequence Category dam, the RSF has been designed to have a minimum capacity to store the following rainfall events in accordance with ANCOLD guidelines *Guidelines to Tailings Dams* (ANCOLD, 2019):

- Minimum wet season water storage allowance: 1:10 AEP wet season runoff
- Minimum extreme storm storage: 1:1,000 AEP, 72 hour flood event[1]
- Contingency freeboard: 300 mm

In addition to this, the RSF has been designed to store a 1:200,000 AEP storm within the tailings beach and store the PMF within the embankment extents such that the flood water will be temporarily stored in RSF2 to be pumped back into the plant via the decant structure for reuse or to the Residue Storage Dam (RSD) used for excess flood water storage.

Note 1: The minimum extreme storm storage design event is suggested in ANCOLD as 1:100 AEP 72 hour, however, given the importance of the structure to the business moving forward and the impacts of a failure through the external embankment this minimum storage requirement has been increased.

In addition to this, an emergency spillway has been designed for in the southern external embankment of Cell 1 capable of passing a 1:1,000 AEP rainfall event from both Cell 1 and Cell 2 with sufficient freeboard for wave run-up during a 1:10 AEP wind event.

The design rainfall events have been estimated by using *Very Rare to Extreme Flood Estimation* (ARR 2019) as shown in Table 7.1.

Table 7.1 Storm events for various AEP (2 cells)

AEP (years)	1:100	1:1,000	1:2,000	1:10,000	1:200,000	PMP
Design Rainfall (mm) 72 hr event	192	310	347	470	676	996
RSF 2 Storage Volume	109 (ML)	177 (ML)	198 (ML)	268 (ML)	385 (ML)	568 (ML)

It should be noted that the storage requirements estimations are indicative only and are based on 57 Ha footprint

Given the internal cell dimensions of 475 m x 600 m for each cell, and assuming a beach slope of 1V: 140H based on the previous survey undertaken on RSF 1 Cell 1 and 2, and assuming the decant pond is kept to a maximum level with a 150 m of beach, and the crest height is 0.7 m above the tailings beach, the storage available for each separate cell is summarised in Table 7.2.

Table 7.2 RSF2 storage capacity

Storage Area	Single Cell Volume (ML)	Dual Cell Volume (ML)
With 150 m beach (Maximum Decant Extents)	11	22
With 50 m Beach	73	146
Top of the tailings beach	193	386
Between embankment crest and top of tailings beach including 300 mm freeboard	114	228
TOTAL	**307**	**607**

7.4 Flood Storage

The catchment area for RSF 2 is the surface area of the facility, estimated at 57ha which comprises of 28.5 ha for each Cell. The runoff coefficient has been assumed as 1.0. For a 'Significant' dam, the RSF is required to store a minimum of 568ML without spilling to cater for the 72 hour Probable Maximum Flood (PMF).

7.5 Spillway

An emergency spillway has been allowed for in accordance with ANCOLD guidelines *to Tailings Dams* (ANCOLD, 2019), the spillway has been designed allowing for a 1:1,000 AEP 72 hr rainfall event immediately following the PMP. The maximum flood level following the 72 hr PMP event has been assumed as 269.70 m. The 1:1,000 AEP rainfall depth has been calculated by the Bureau of Meteorology and obtained from their website. The temporal pattern that has been adopted from the ARR 2019 Datahub. XPRAFTS has been used to calculate the runoff from storage and route the runoff through the storage prior to discharge through the spillway.

A 6 m wide rock-lined trapezoidal spillway has been designed to convey the design flow event of 1:1,000 AEP event based on a discharge coefficient of 1.56, this allows for a maximum flow rate of 1.71 m^3/s occurring between a 4.5-hour and 6-hour event. Based on these flows the critical flow depth through the spillway is 0.285 m.

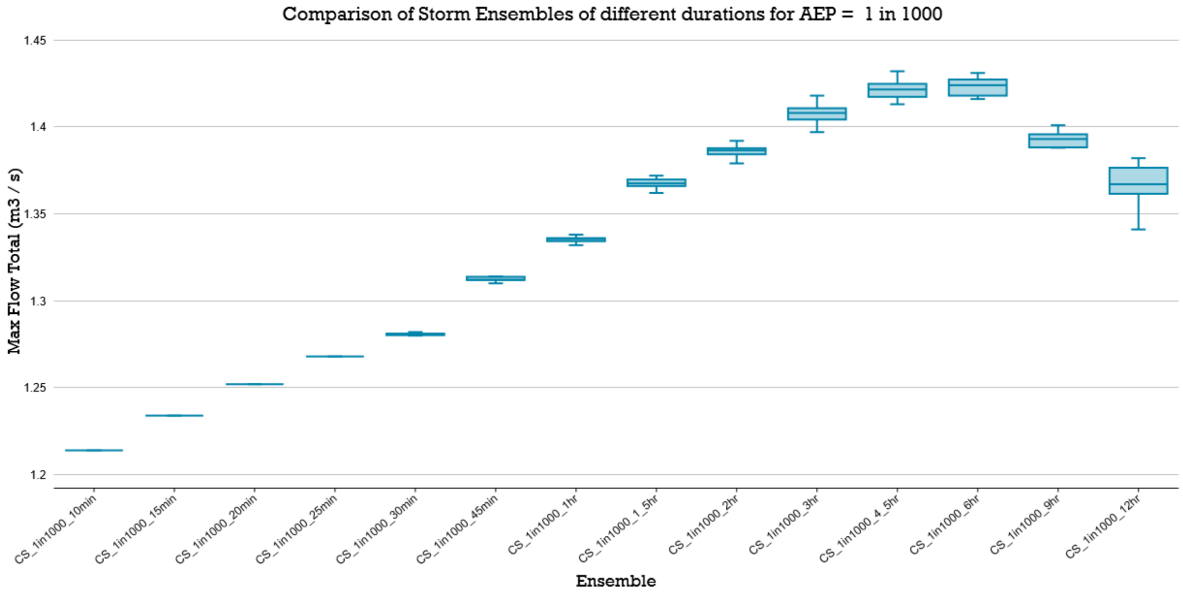


Figure 7.2 Peak outflow for 1:1000 AEP storm following PMP, 6 m Spillway

The spillway crest will consist of a rock-lined earthen approach channel with a concrete crest block, flowing into a geofabric lined, rip rap protected, trapezoidal chute on the downstream face to convey flows to the downstream toe. The erosion protection through the spillway chute has been designed to accommodate the 1.71 m^3/s flow as detailed below.

7.5.1 Spillway Erosion Protection

The rip rap sizing through the spillway has been calculated using CHUTE software developed by the Cooperative Research Centre for Catchment Hydrology, utilising the model arrangement shown in Figure 7.3 and model parameters detailed in Table 7.3.

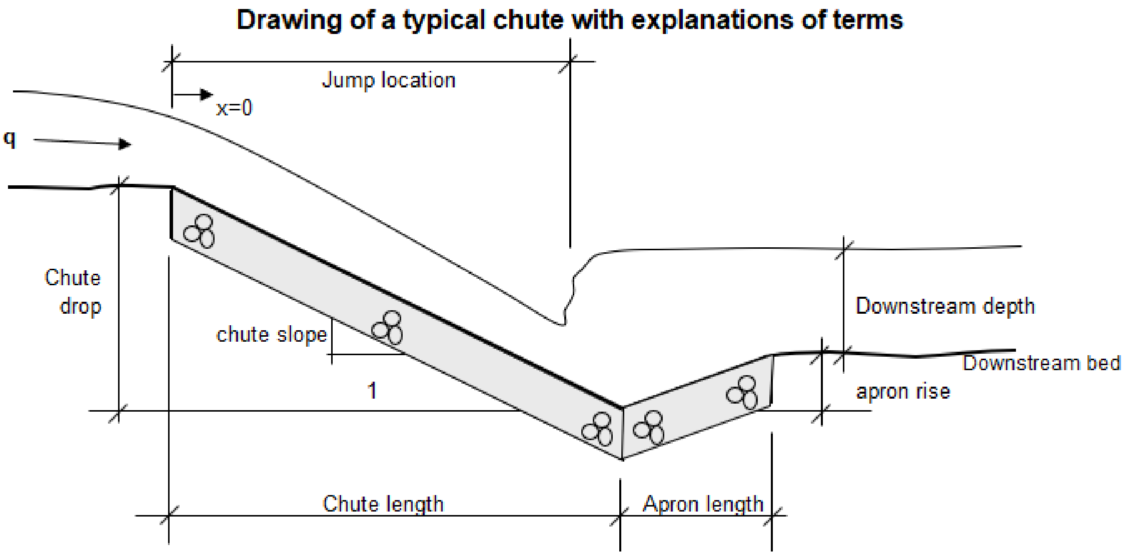


Figure 7.3 CHUTE Modelling Parameter Description

Table 7.3 CHUTE Modelling Parameters

Input Parameter	Value	Unit
Chute Drop	8.5	m
Chute Length	26	m
Apron Rise	1.5	m
Apron Length	2	m
Maximum Flow Rate	1.713	m^3/s
Chute Width	6	m
Rock Angle of Repose	42	Degrees
Specific Gravity	2.65	
Factor of Safety	1.5	
Mannings Roughness	0.04	

Based on these model parameters, the following spillway profile in Figure 7.4 was developed to determine the water surface elevation through the chute, expected velocities, and the location of the hydraulic jump which indicates the hydraulic jump occurs within the chute effectively dissipating velocities.

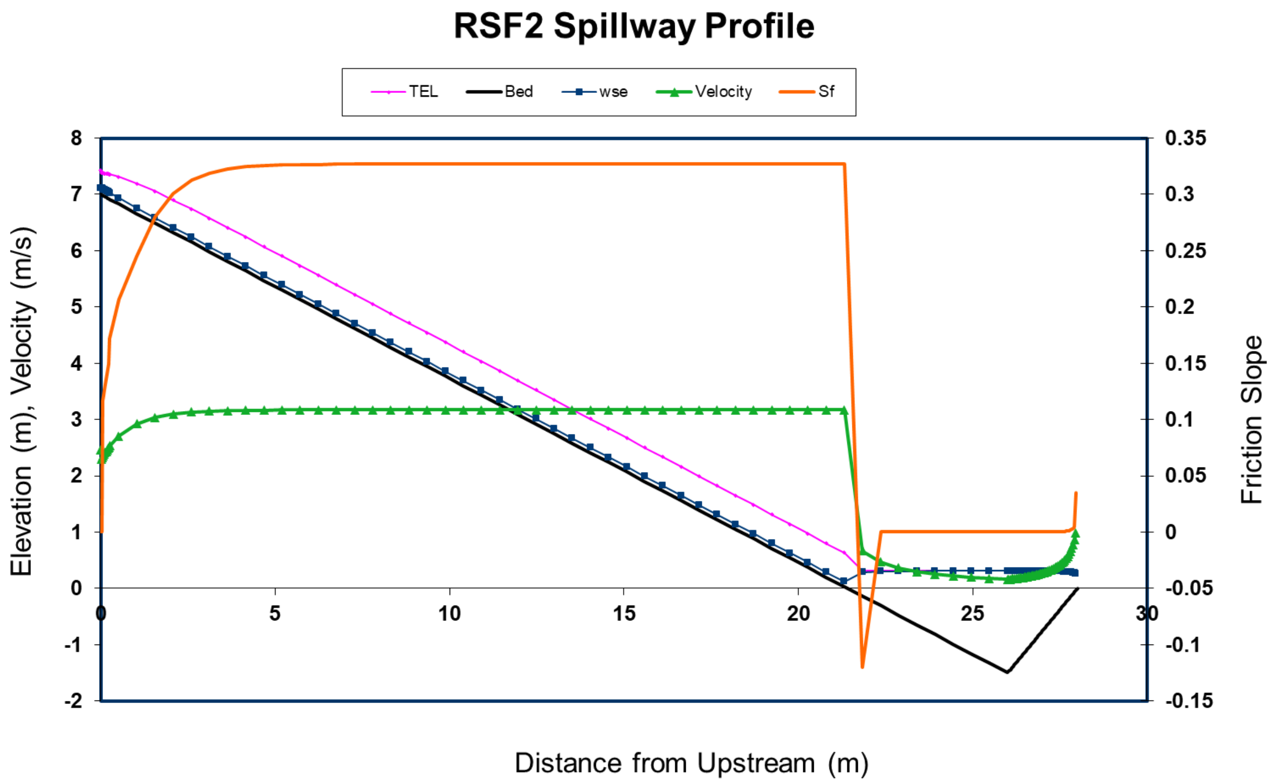


Figure 7.4 *RSF2 Spillway Hydraulic Profile*

Based on the proposed spillway arrangement, the rip rap erosion protection requirements are outlined in Table 7.4.

Table 7.4 *RSF2 Spillway Erosion Protection Requirements*

Rip Rap Sizing	Value	Unit
D10	0.25	m
D50	0.55	m
D90	0.75	m
Thickness	1	m

7.6 Decant System

The RSF decant area will capture residue bleed water and incidental run-off from the catchment area associated with each of the cells. This water will be returned to the plant for reuse as required.

The pumps required for the decant tower have been sized to allow for the expected runoff from the initial settlement of the material allowing for expected evaporation and seepage into the deposited residue profile as per Table 7.5 below.

Table 7.5 *Decant Management Requirements*

Parameter	Value	Unit
Production Rate	1.5	Mtpa
% solids in the slurry	45	%
Particle density/ SG	2.7	t/m^3
The volume of water in the slurry	1.83	Mm^{3}pa
The volume of solids in the slurry	0.56	Mm^{3}pa

Parameter	Value	Unit
The dry density of the slurry	0.63	t/m^3
Residue dry density	1.40	t/m^3
Saturated tails density	1.88	t/m^3
Water retained in residue	0.48	t/m^3
Water retained in the residue (volume)	0.52	Mm^3pa
Water released (volume)	1.32	Mm^3pa
Water released (volume)	3,609	m^3pa
Water released (volume)	42	l/s
Minimum estimated Required Pump Capacity Range for a Single Pump (Refer Note 1)	60 - 80	m^3/hour
Minimum estimated Required Pump Capacity Range for a Single Pump (Refer Note 1)	22	L/second

Note 1 – The required pump capacity does not currently take seepage, evaporation, or emergency dewatering requirements into account.

During normal operations, the decant pumps are only required to flow at 22 L/s, in order to manage the pond level in the RSF, however, a pumping allowance of 50 ML/day per cell should be allowed for by the mine using additional pumping as required. An additional 50ML/day pump in each cell allows for enough capacity to remove ponded water from a 1:10,000 AEP, 72 hr rainfall event in 3 days, and a 1:200,000 AEP, 72 hr rainfall event in 4 days which minimises the inundation of the beach.

Decant towers in each of the cells will be accessed via a causeway constructed from readily available fill materials. Throughout the life of the RSF, the decant causeway will be raised utilising a centreline raise arrangement to meet the crest level of each raise.

The proposed decant tower will be a slotted concrete ring type of arrangement whereby ponded water decants through the slots in the concrete ring tower which will be raised incrementally to remain elevated above the rising residue. The variable speed submersible pump will be installed at the base of the tower for water return to the plant.

In order to remove excess decant and rainfall water from the RSF, a decant pipeline to the existing Residue Storage Dam (RSD) is required. The proposed pipeline arrangement from each decant pump consists of a DN180 HDPE PN12.5, running approximately 1,800 m from each decant pump to the RSD.

8. Water Balance

A site water balance model has previously been prepared for TGO (GHD, 2019). The model was simulated from 1 July 2021 to 1 July 2029, with an initial inventory of process water volume of 18 ML and a mining water volume of about 636 ML. The water balance has been updated by including the catchment of the proposed RSF 2 commencing in May 2022 and reflecting the proposed production schedule with a nominal 1.5 Mtpa production commencing in May 2022 and continuing until July 2029. All other model parameters and inputs were as documented in GHD (2019).

8.1 Process Water

The range of total process water inventory under various potential rainfall conditions are shown in Figure 8.1.

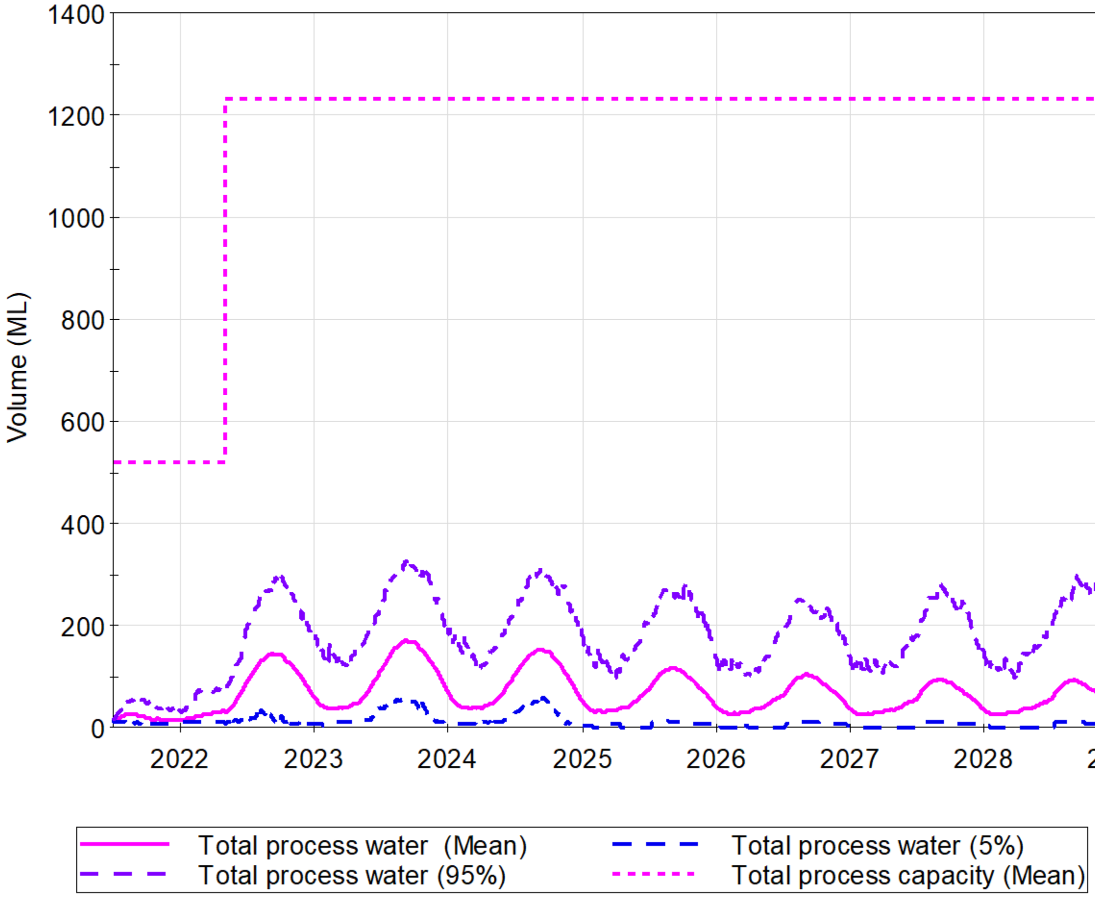


Figure 8.1 Total Process Water Inventory

Figure 8.1 shows that process water inventory is likely to continue to vary, potentially exceeding the 150 ML capacity of the RSD in above average rainfall conditions. However, the total process water inventory is not expected to exceed the combined physical water storage capacity of RSD and the RSFs, especially following the commissioning of RSF 2. Figure 8.1 shows that the potential range of total process water inventory is expected to be increase compared to current conditions. This reflects that the additional process water from runoff of the additional RSF catchment area across RSF 1 and RSF 2.

A sensitivity run was performed, with minimal production demand of 0.5 Mtpa. The results are shown in Figure 8.2.

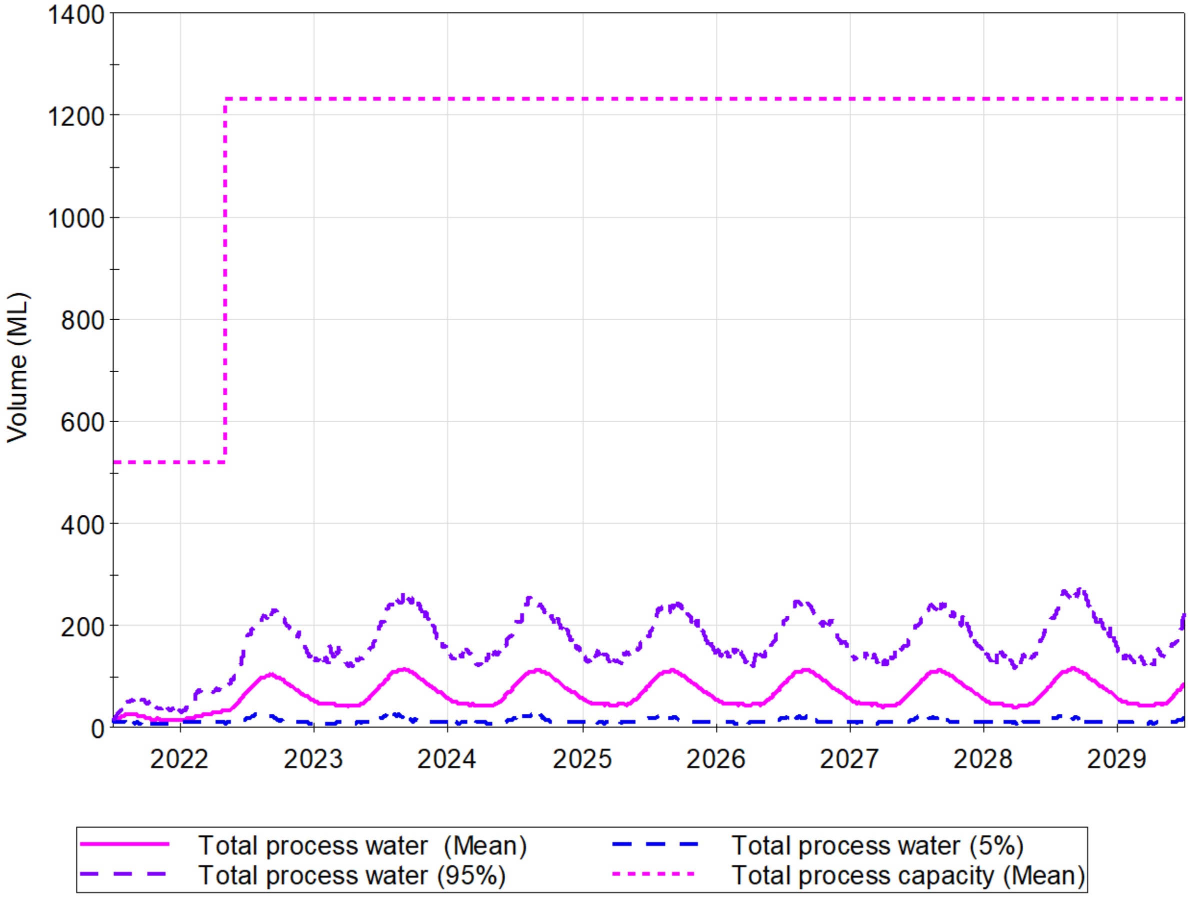


Figure 8.2 Total Process Water Inventory – Minimal Production Case

Figure 8.2 shows a similar process water inventory compared to Figure 8.2, which remains well within the total water storage capacity of the combined process water storage. Therefore, operating the proposed RSF 2 while the existing RSF1 remains uncapped is not expected to result in an unmanageable process water excess.

8.2 Mine Water Inventory and Water Security

The overall forecast site water inventory is shown in Figure 8.3.

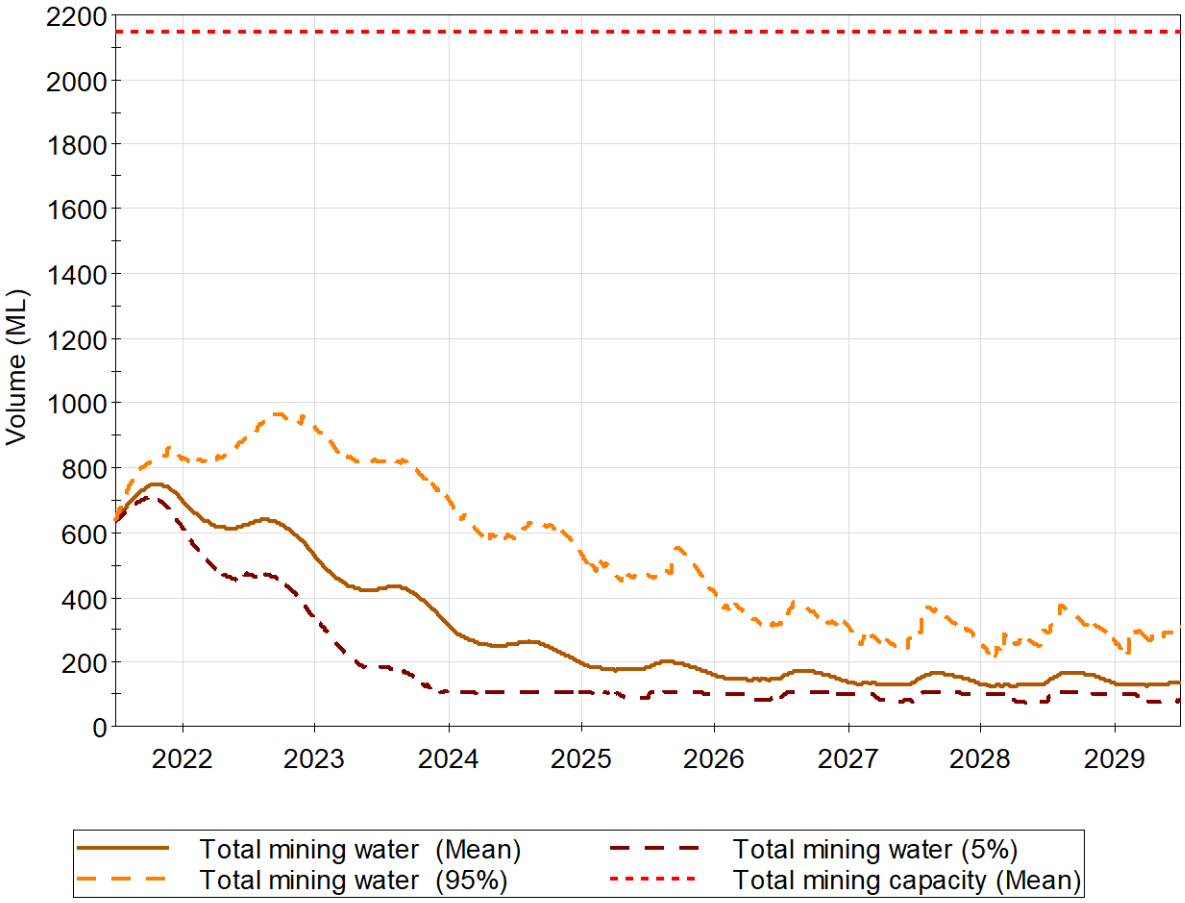


Figure 8.3 Forecast Total Mining Water Inventory

Figure 8.3 shows that mining water inventory is likely to increase until 2022, corresponding to the peak in predicted groundwater inflows, then starts to decline until mid-2026. Total mining inventory remains within the total water storage capacity. The average annual water balance for the year 2026 is summarised in Table 8-1 which is expected to be typical over the remainder of operations at TGO.

Table 8.1 Average Annual Water Balance for TGO

Water management feature	The year 2026 (ML)
Inputs	
Direct rainfall and catchment runoff	678
Supplied from woodlands borefield	960
External water delivery	3
Moisture in ore	75
Secondary release from residue	22
Groundwater inflows	3
Total Inputs	**1741**
Outputs	
Evaporation from water storages	168
Discharge from sediment dams	5
Potable use	1

Water management feature	The year 2026 (ML)
Water in residue	692
Evaporation from active residue	174
Losses from rewetting of inactive residue	493
Dust suppression	493
Losses from underground workings	7
Total Outputs	**2033**
Change in Storage	**-294**

Table 8.1 shows that, on average, the largest inflow into the site water balance is coming from water supplied from Woodlands borefield, accounting for about 55% of total inflows. This may be attributable to the decline in groundwater inflows after the year 2022. With a higher production rate, the largest site demand is ore processing, where water ultimately remains entrained in residue or is lost to evaporation. Table 8.1 indicates an overall decrease in site water inventory on average.

The site water balance model simulated the available borefield allocation over the prediction period. A plot of allocation is shown in Figure 8-4.

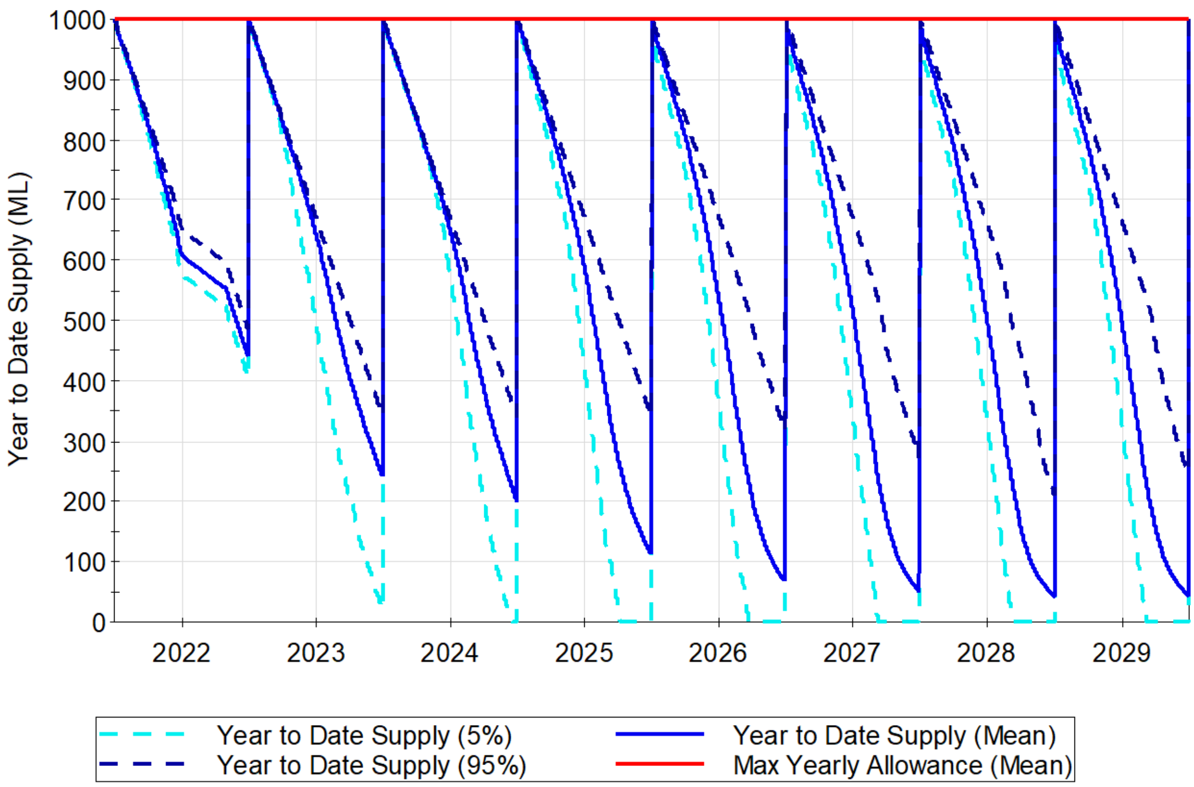


Figure 8.4 Forecast Borefield Allocation

Figure 8.4 shows that with a higher production rate and lower forecast groundwater inflows, water demand from borefield allocation has the potential to be almost completely utilized in the last four years of operations at TGO.

9. Groundwater Impact

9.1 Local Hydrogeology

There are three distinct groundwater systems within the vicinity of TGO's mining leases, as identified by The Impax Group (2011) and Jacobs (2021):

- Shallow alluvium – discrete, shallow alluvium (less than 10-20 m deep) dissects the plains surrounding the mine site along creek flow paths. These aquifers are believed to be recharged from rainfall infiltration. Groundwater within these systems is of relatively good quality, however, yields are relatively low and dependent on rainfall. Perched groundwater occurs within the shallow alluvium underlying the RSF, however, it is generally not continuous across the mine site. Shallow groundwater appears to be more permanent along Gundong Creek to the northwest of the RSFs.
- Deep alluvium – up to 100 m deep and located approximately 10 km to the northwest and west of TGO. Groundwater yields are believed to be low and of poor quality. These systems may have some interaction with underlying bedrock however are believed to be primarily recharged from rainfall.
- Fractured rock – the area surrounding Tomingley is underlain by a confined saline groundwater system within the fractured sandstone, siltstone, and volcanics at a depth of greater than 80 m. Groundwater yields range from 0-3 L/s, generally less than 1.5 L/s, and water quality is poor with high salinity (average electrical conductivity (EC) exceeds 20,000 µS/cm). Coffey (2007) investigated this groundwater system as a potential water supply for the mine and found it to be inadequate in terms of both yield and quality.

The hydraulic conductivity of the clay, which comprises the foundation of the existing RSF is generally low to very low. Falling head tests on clayey strata between 1.55 and 42.5 m bgl at the existing RSF area indicate hydraulic conductivities of 0.0002 to 0.002 m/d or 2.3 x 10^{-8} to 1 x 10^{-9} m/s (DEC, 2011). In addition, for the recent RSF 2 geotechnical investigation (GHD 2021a), permeability testing was undertaken on four samples (TP03, TP10, TP11, and TP18) collected from the site. The results of the permeability testing are summarized in Table 9.1.

Table 9.1 Laboratory Permeability Testing (GHD 2021a)

Test ID	Depth (m)	Description	Coefficient of permeability, k (m/sec)
TP03	2.0 – 3.0	CLAY trace sand	2 x 10^{-10}
TP10	0.0 – 1.0	Sandy CLAY, trace gravel	2 x 10^{-10}
TP11	1.0 – 2.0	Sandy CLAY	4 x 10^{-11}
TP18	1.0 – 2.0	Sandy CLAY, trace gravel	1 x 10^{-10}

Shallow perched groundwater, where it occurs throughout the TGO site, is typically at a depth of less than 10 m bgl. For the RSF 2 geotechnical investigation, 10 groundwater bores (BH01 to BH10) were installed within the alignment of the proposed embankment foundation to a target depth of 20 m. Groundwater was encountered in BH01, BH04, and BH08 at 7.5 m (RL 257.2 m), 8.0 m (RL 255.8 m), and 7.5 m (RL 258.4 m) below ground level, respectively (GHD 2021a).

The water-bearing zone within the deep confined fractured rock groundwater system occurs at an elevation below 190 m AHD, based on observed groundwater inflows into the WYO3 pit and groundwater monitoring bore data. The groundwater is under pressure, as indicated by the monitoring bore data showing groundwater levels ranging from approximately 200 m and 240 m AHD.

Groundwater usage is limited in the vicinity of the mine site. The closest active production bores (i.e. non-test or monitoring bores) are over 3 km to the north of the mining lease area within shallow alluvium (GW034897, GW037395, and GW803148) with all reported yields less than 1.5 L/s. These bores are registered for stock and domestic, irrigation use, and town water supply, respectively.

9.2 Analysis of Foundation Seepage

Although seepage through the foundation from the existing RSF has not been detected by the existing shallow groundwater monitoring bore network, a conceptual analysis of potential seepage through the foundation of RSF2 Stage 1 and 2 has been undertaken.

9.2.1 Methodology

The seepage analysis involved a one-dimensional calculation of vertical advective flow from the RSF 2 decant pond into the underlying foundation. The calculation was based on the Darcy flow equation. For both RSF 2 stage 1 and stage 2, the rate of seepage and time for seepage to occur were calculated under two scenarios:

- Scenario 1: seepage to shallow strata through the residue and CCL only.
- Scenario 2: seepage to shallow groundwater through the residue, CCL, and foundation.

The conceptual analysis of the seepage through the foundation of RSF 2 stage 1 and stage 2 are shown schematically in Figure 9.1 and Figure 9.2.

The following inputs and assumptions were applied:

- For Stage 1, the decant pond water level was assumed to be managed at RL 268.05 m and 0.5 m deep, while for Stage 2 the decant pond water level was assumed to be managed at RL 270.05 m and 0.5 m deep.
- Maximum decant pond area of 0.49 ha (70 m x 70 m).
- The base of the residue was assumed to be RL 264.0 m.
- The residue has a permeability of 1 x 10^{-8} m/s (DEC, 2011).
- The CCL is 1 m thick and has a permeability of 1 x 10^{-9} m/s (refer to Table 2.2).
- The influence of the embankment on seepage was not considered.
- Negligible water pressure at the base of the tailings.
- Foundation permeability of 2 x 10^{-10} m/s was adopted (based on GHD 2021a).
- Groundwater level at the RSF 2 of RL 258.4 m. This is based on the groundwater level recorded at BH08 at 7.5 m (GHD 2021a). It should be noted that this is generally a conservative approach since regional groundwater occurs within a confined groundwater source at elevations below RL 190 m, and recorded groundwater levels reflect water under pressure. However, it is noted that groundwater levels at WYMB06 are also influenced by water levels within the old McPhail workings.
- Seepage rates are calculated under steady-state conditions.

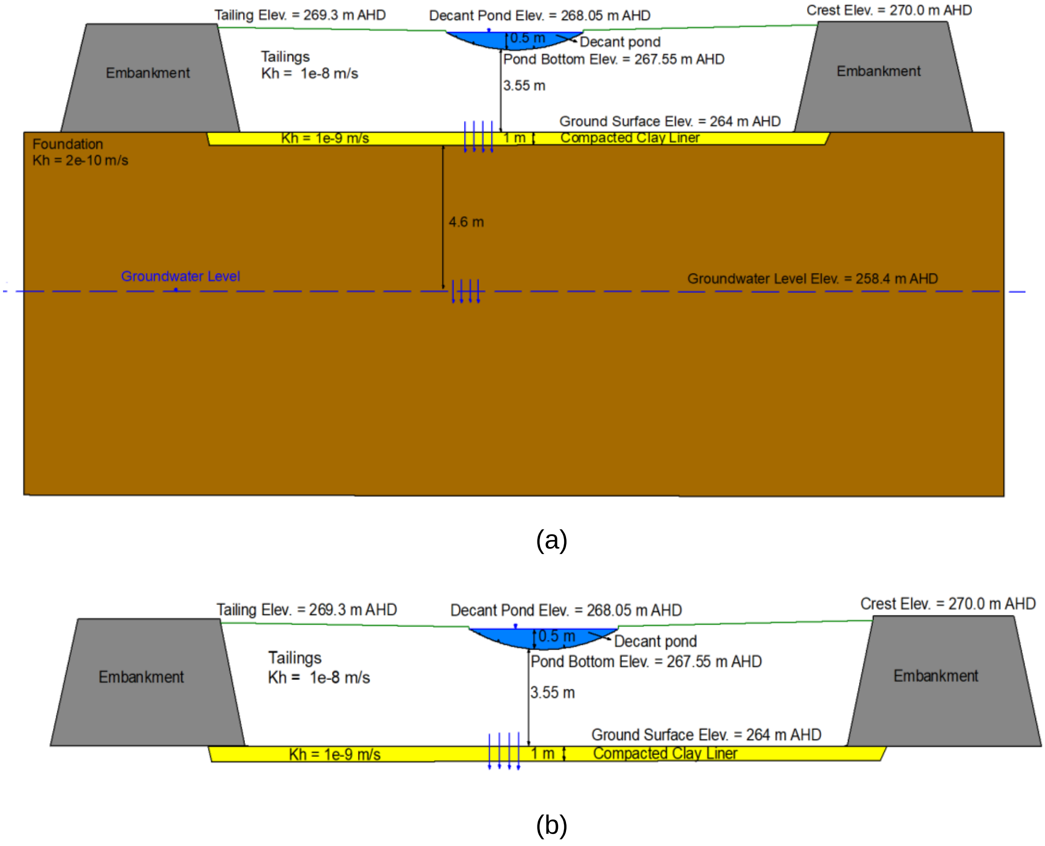


Figure 9.1 *Stage 1 Conceptual Seepage Cross-Section Through the (a) Residue, CCL and Foundation, and (b) Residue and CCL*

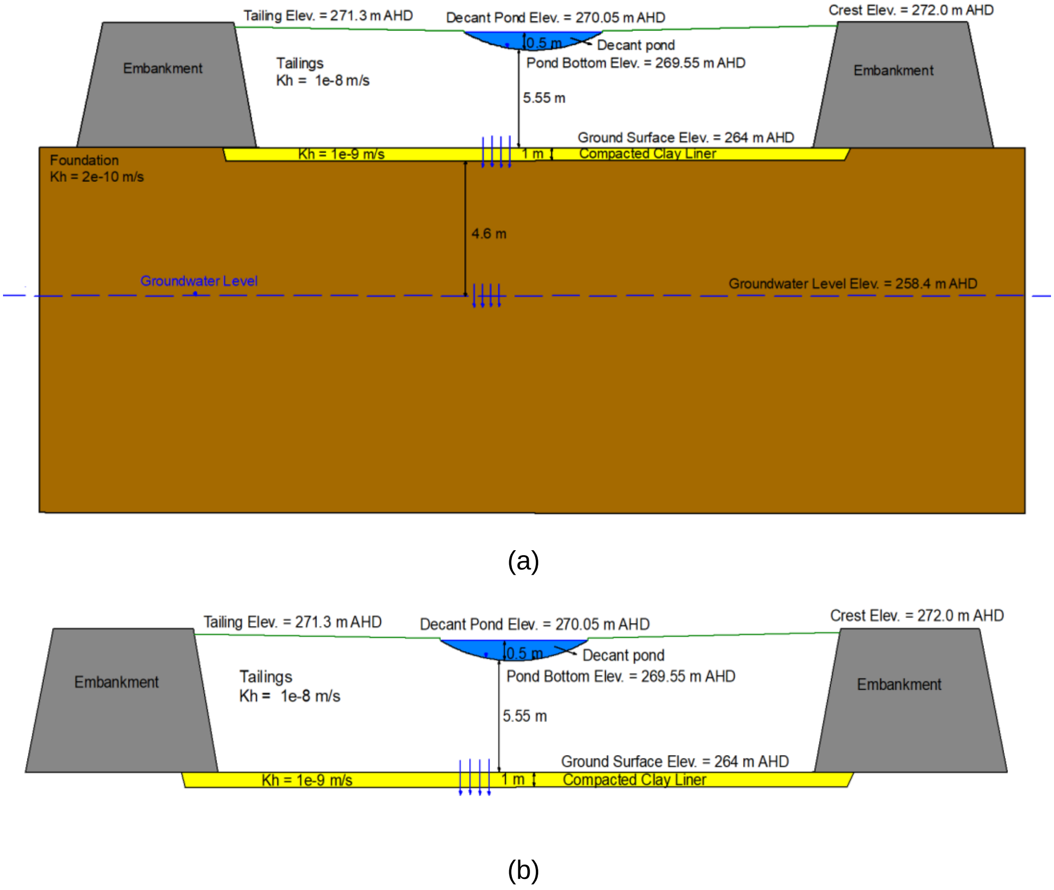


Figure 9.2 *Stage 2 Conceptual Seepage Cross-Section Through the (a) Residue, CCL and Foundation, and (b) Residue and CCL*

9.2.2 Results

The results of the seepage analysis are shown in Table 9.2. The calculated seepage rates below the CCL to shallow strata are 1.6 kL/day for Stage 1 and 1.9 kL/day for Stage 2. Seepage is calculated to occur after approximately 40 years. The calculated seepage rate to shallow groundwater is approximately 0.2 kL/day and is predicted to occur after a timeframe of approximately 900 years. These calculations are subject to the assumptions outlined in Section 9.2.1, however, they indicate a low risk of seepage of RSF decant through the CCL and RSF foundation throughout the current 7-year life of the facility. Once the RSF is closed and rehabilitated, and the residue is dewatered, the risk of foundation seepage is further reduced.

The analysis suggests a negligible incremental change in seepage rate to shallow groundwater and seepage time between Stage 1 and Stage 2 rise.

Table 9.2 RSF2 Stage 1 and Stage 2 Seepage Analysis Results

Scenario	Stage 1		Stage 2	
	Calculated seepage volume (kL/day)	Seepage time (yrs)	Calculated seepage volume (kL/day)	Seepage time (yrs)
Scenario 1	1.6	39	1.9	46
Scenario 2	0.154	796	0.182	823

9.3 Analysis of Embankment Seepage

Seepage through RSF2 has been undertaken for Stage 1 and Stage 9 raises. The analysis is consistent with the results and input data adopted for the foundation seepage analysis, as previously presented. The seepage and hydraulic gradients found are later used as input in the LEM slope stability assessment.

9.3.1 Model Characteristics

Seepage analysis was executed only for the perimeter embankment as there are no major water gradients between the two residue storage facilities. The Rocscience finite element groundwater package Slide2 was used in this analysis. The upstream boundary condition was defined by a water table representing the pond at its maximum operational level, 90 m from the beach edge. Similarly, the downstream boundary condition corresponds to the encountered groundwater level as found at BH08 (GHD 2021). The upstream toe drain has been considered to be clogged, thus modelling a conservative scenario for Stage 1, while for Stage 9 this is the most likely condition to be present. In addition to the isotropic hydraulic conductivities described for the RSF materials, a $k \approx 5 \cdot 10^{-7}$ m/s has been adopted for the general fill material.

9.3.2 Results

The seepage model results for the RSF embankment are shown in Figure 9.3 and Figure 9.4 for Stage 1 and Stage 9, respectively. From the results, it can be seen that the resulting water table, shown as the light blue line, extends from the decant pond through tailings, abruptly drops in the embankment clay, and further extends within the general fill as the groundwater level is attained. The phreatic surface in the embankment generally remains near the foundation soil with average hydraulic gradients close to 3 across the embankment clay and below 0.3 across the general fill material. Therefore, piping or internal erosion risk is minor.

Based on the input parameters, the model returned seepage results of $4.5 \cdot 10^{-4}$ m^3/d/m for Stage 1, which is equivalent to 226.5 L/d for a cell side equivalent to 500 m length. As expected, the seepage for Stage 9 is significantly larger than that for Stage 1, with maximum seepage of $3.5 \cdot 10^{-3}$ m^3/d/m, equivalent to 1,750 L/d.

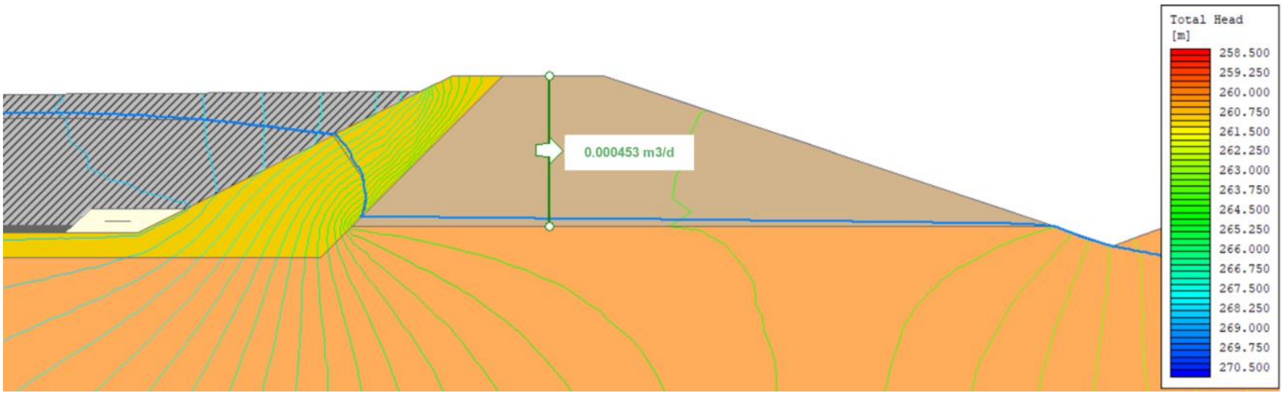


Figure 9.3 Perimeter Embankment Stage 1 Seepage Modelling Results

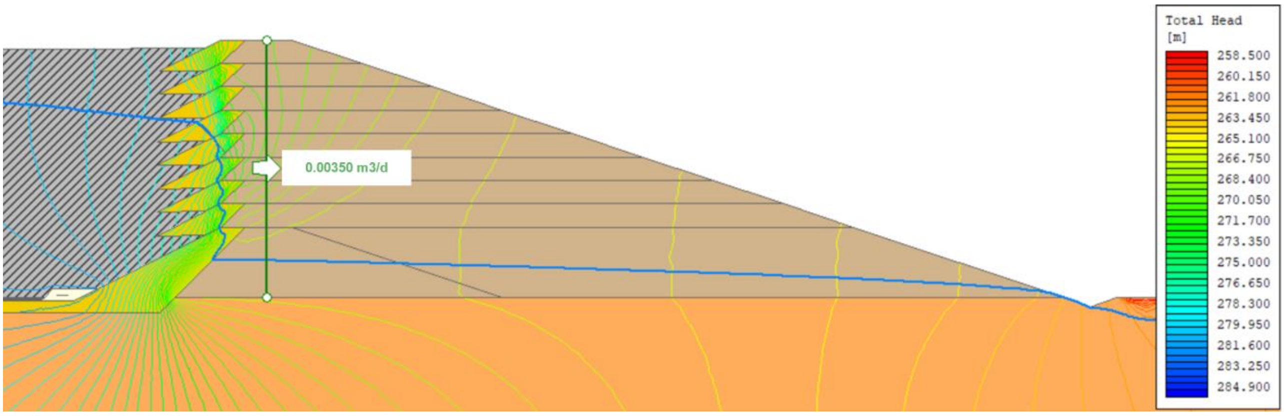


Figure 9.4 Perimeter Embankment Stage 9 Seepage Modelling Results

9.4 Monitoring Program

It is recommended that shallow monitoring bores be installed around the outside of the embankment of RSF 2 to detect seepage through the foundation. Monitoring bores should be installed to depths of 10 m below ground level (bgl) and at an interval of approximately 250 m around the perimeter of the RSF. Bores should be screened between 2 m depth and the base of the bore. The new RSF monitoring bores should be incorporated into the monthly groundwater monitoring program at TGO. Ongoing monitoring of the regional bores near the site - WYMB01 and WYMB06 – should also occur.

RSFs can influence local groundwater pressure, which can be detected by increasing groundwater levels, however, this does not necessarily mean that seepage is occurring. A line of evidence approach is necessary for interpreting monitoring data whereby the spatial and temporal trends in both groundwater levels and groundwater chemistry should be assessed to determine whether seepage is occurring.

10. Slope Stability Analysis

10.1 General

Slide2 software package was used to undertake static slope stability analysis of the RSF2 for Stage 1 and up to Stage 9. Two-dimensional analyses were performed in two representative cross-sections, the southern perimeter embankment, and common wall embankment through the RSF. The Morgenstern-Price and Spencer methods were adopted in calculating the Factor of Safety (FoS) against non-circular failures. The geotechnical parameters adopted correspond to those summarised in Section 4. Groundwater conditions were obtained from seepage analysis presented in previous Section 9.3. For the common wall, a water surface line has been included to represent phreatic conditions when the pond is at its maximum design extends (90 m beach).

10.2 Geometry

The adopted cross-sections for Stage 1 and Stage 9 are shown in Figure 10.2. Stage 1 and Stage 9 embankment crest levels are at RL 270 m and RL 286 m, respectively.

The embankment shows a 6 m wide crest with a downstream slope of 3H:1V, and an upstream slope of 2H:1V, constructed using centreline construction as shown in Figure 10.1. Tailings management strategy and geotechnical properties for tailings are expected to remain similar to those found at RSF1 during 2020 investigations. Tailings beach profile has been considered as 140H:1V in accordance with the RSF1 beach profile.

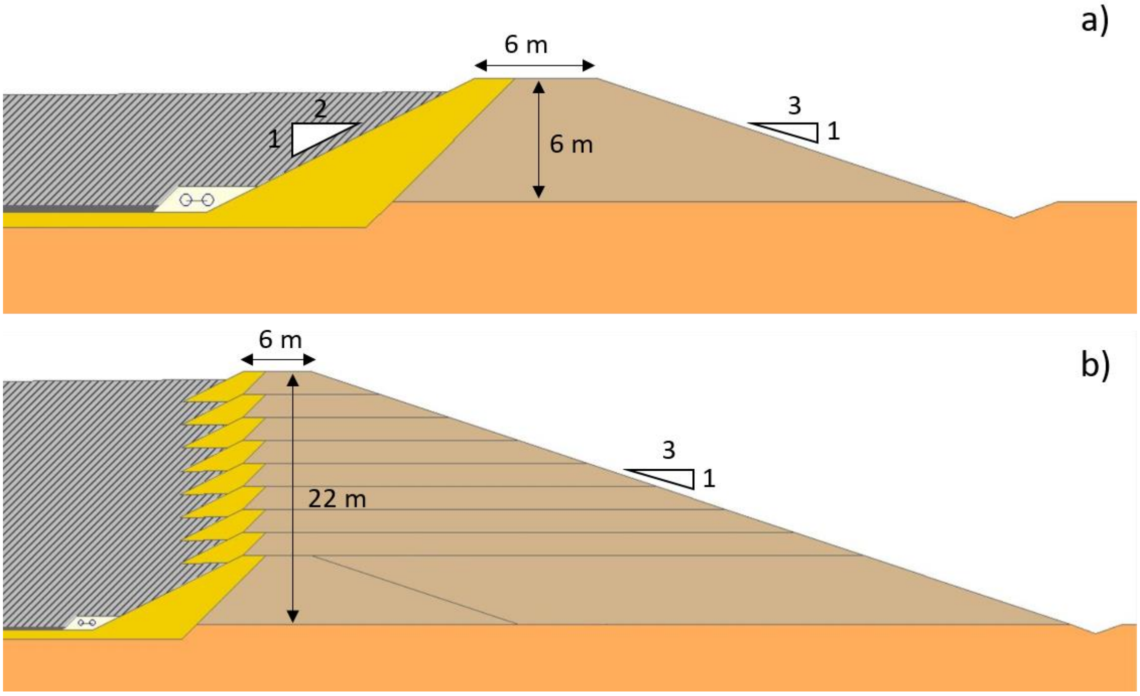


Figure 10.1 Perimeter Embankment Cross-Section. a) Stage 1. b) Stage 9

The internal embankment, located through the centre of RSF2, has been designed as a divider to create two cells to allow for better tailings management. This embankment will be raised using a ‘centreline’ construction method. The embankment geometry consists of a 6 m wide crest and 1.5H:1V slopes on both the upstream and downstream face with crest level at RL 270 m for Stage 1 and RL 286 m for Stage 9. The internal embankment cross-section is shown in Figure 10.2. \u78y

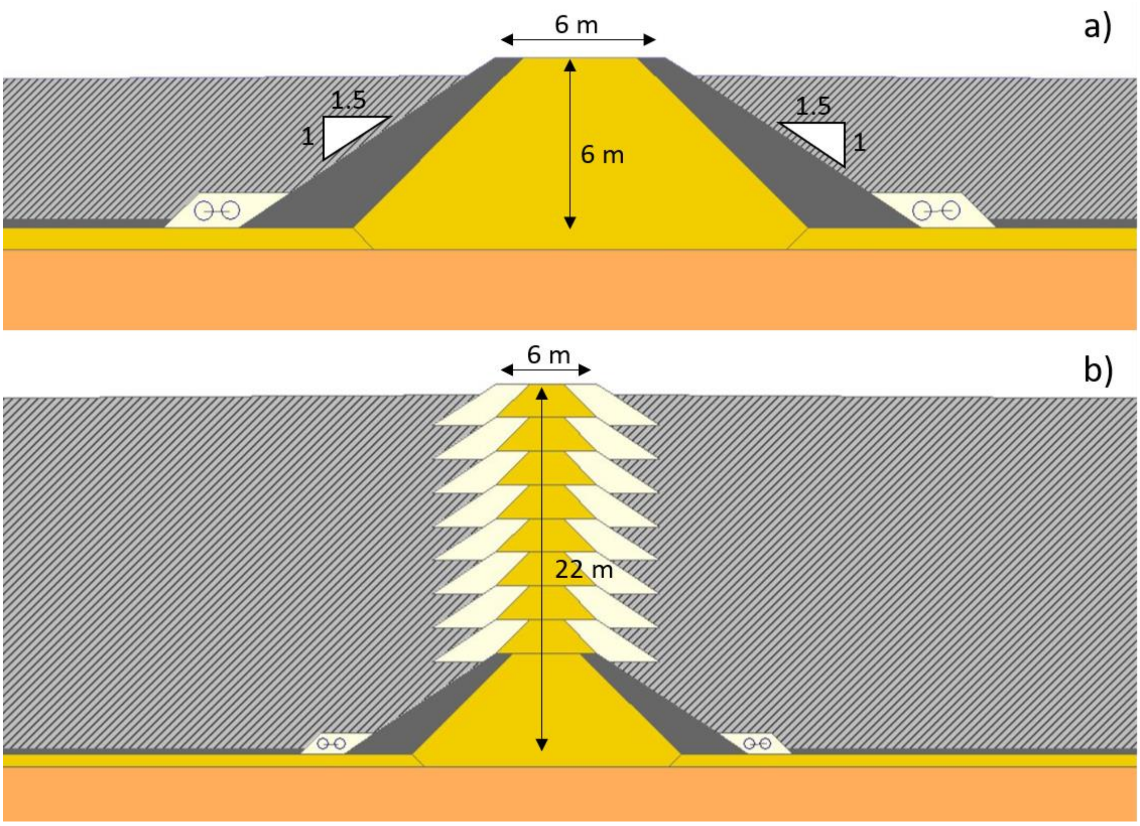


Figure 10.2 Common Wall Cross-Section. a) Stage 1. b) Stage 9

10.3 Loading Conditions

The loading conditions assessed were based on the recommendations provided by ANCOLD Guidelines on Tailings (ANCOLD, 2019) and are shown below in Table 10.1.

Table 10.1 Loading Cases Required FoS

Loading Condition	Recommended minimum safety factor for tailings dams	Shear strength to be used for evaluation
Long-term drained	1.5	Effective strength
Short-term undrained (potential loss of containment)	1.5	Consolidated undrained strength
Short-term undrained (no potential loss of containment)	1.3	Consolidated undrained strength
Post-seismic	1.0-1.2 ^{2}	Post seismic shear strength ^{3}

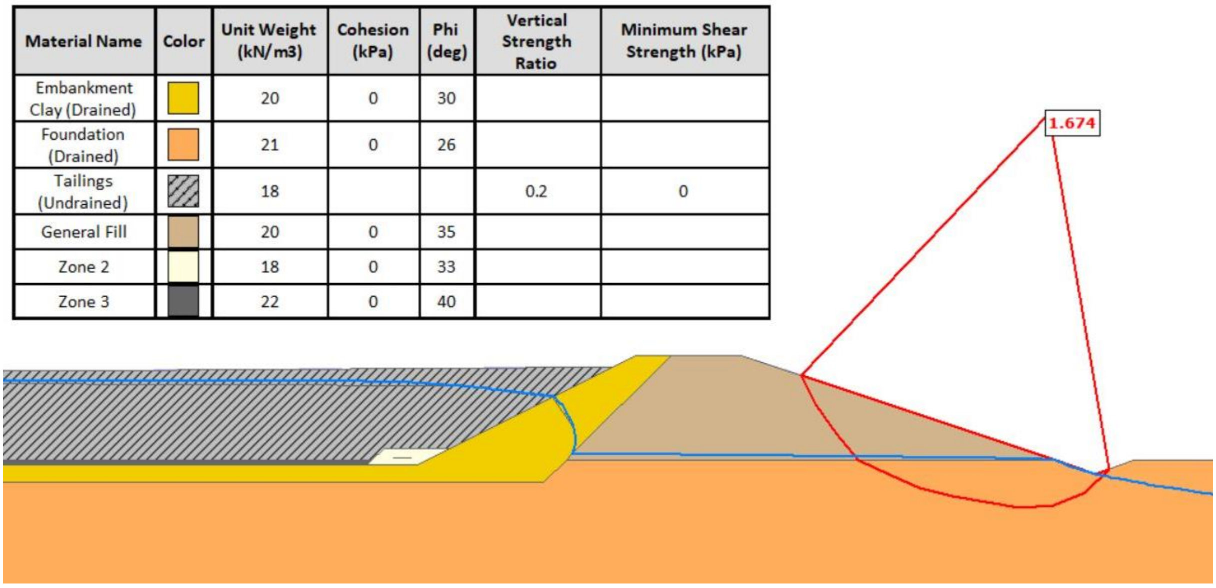
Note 1 *See Section 6.1.3 of ANCOLD (2019) of the description of loading conditions.*
Note 2 *To be related to the confidence in the selection of residual shear strength. 1.0 may be adequate for use with lower bound results.*
Note 3 *Cyclically reduced undrained/drained shear strength and/or liquefied residual shear strength for potentially liquefiable materials.*

From these loading conditions and RSF2 design, short-term undrained (potential loss of containment) applies to the perimeter embankment and short-term undrained (no potential loss of containment) applies to the common wall and upstream failure of the perimeter embankment.

10.4 Stability Analysis Results

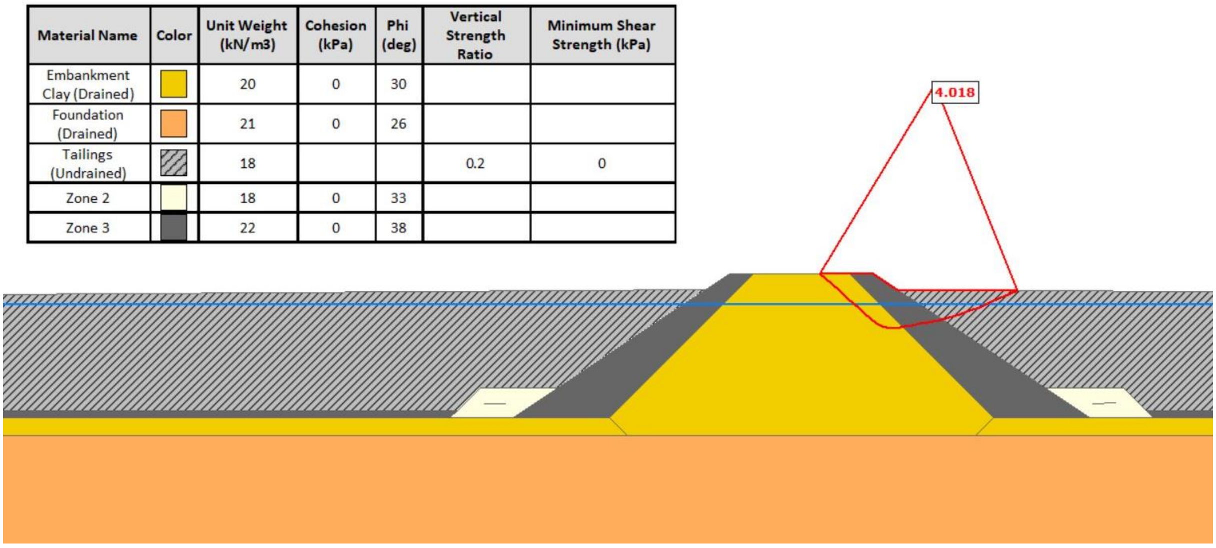
10.4.1 Stage 1 Stability Results

The FoS and slip surfaces at Stage 1 for the long-term drained condition for perimeter and internal embankment are shown in Figure 10.3 and Figure 10.4, respectively. For the former, deep slip surfaces, extending from the upper third of the buttress to toe, are found. The failure occurs within the downstream shoulder of the embankment not extending within tailings mass. The obtained FoS is 1.674, which is above the minimum required of 1.5 for this loading case. For the common wall, a high FoS is obtained due to the confining stress imposed by tailings in most of the embankment height. The slip surface is surficial and located near the crest with limited development within the tailings.



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	🟨	20	0	30		
Foundation (Drained)	🟧	21	0	26		
Tailings (Undrained)	▨	18			0.2	0
General Fill	🟫	20	0	35		
Zone 2	⬜	18	0	33		
Zone 3	⬛	22	0	40		

Figure 10.3 Slip Surface in Perimeter Embankment, Long-term Drained Loading Condition



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	🟨	20	0	30		
Foundation (Drained)	🟧	21	0	26		
Tailings (Undrained)	▨	18			0.2	0
Zone 2	⬜	18	0	33		
Zone 3	⬛	22	0	38		

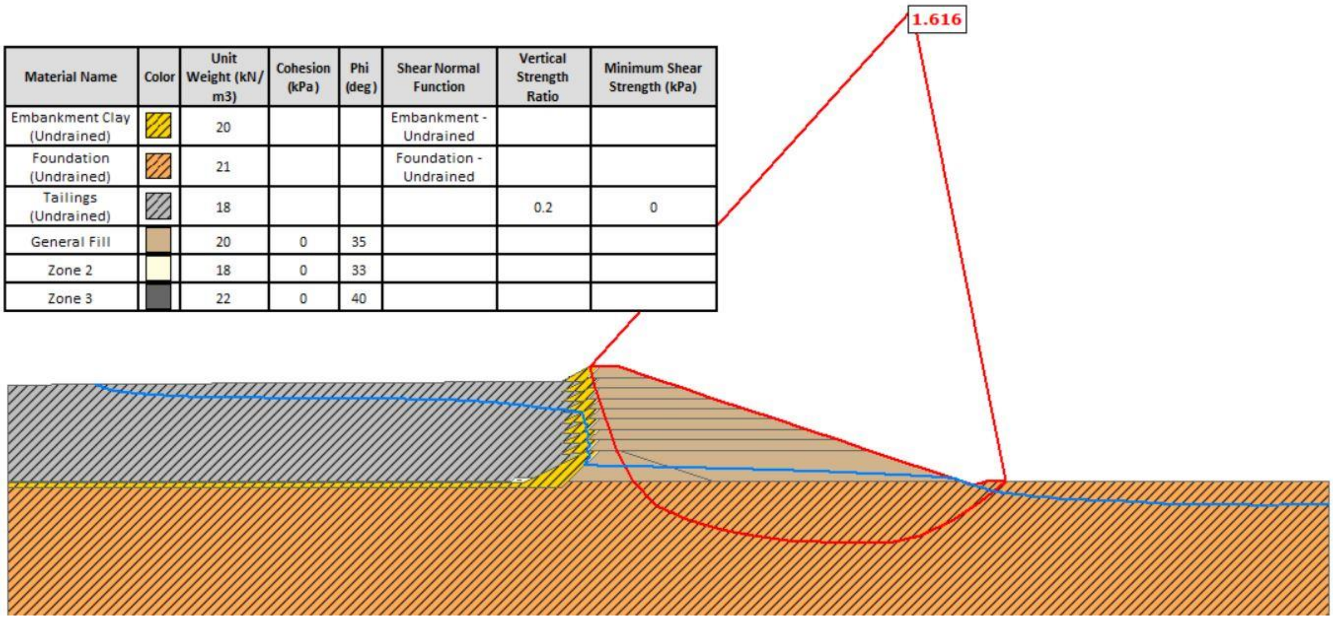
Figure 10.4 Slip Surface in Common Wall, Long-term Drained Loading Condition

The other modelled scenarios show FoS well above minimum design criteria, for both perimeter embankment and common wall, the results for which are summarised in Table 10.2. All the failure surfaces for the different scenarios modelled as well as the corresponding FoS are summarised in Appendix D.

10.4.2 Stage 9 Preliminary Stability Results

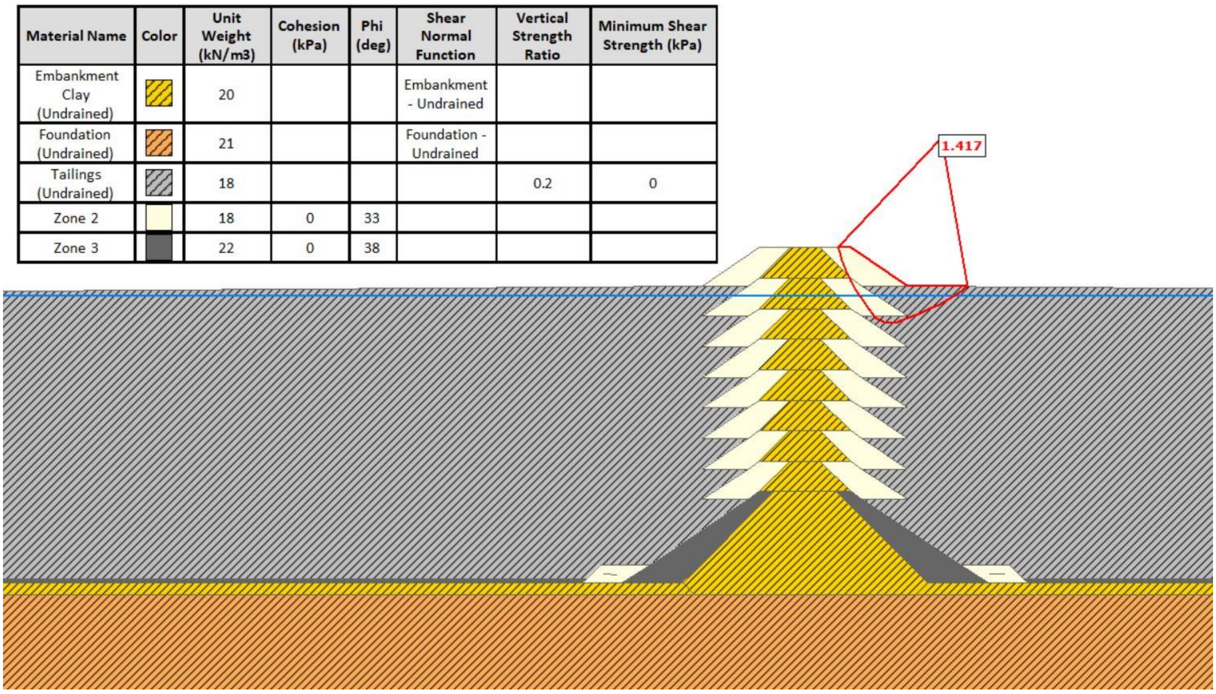
The FoS and slip surfaces at Stage 9 for the short-term undrained condition for perimeter and internal embankment are shown in Figure 10.5 and Figure 10.6, respectively.

The failure surface in the perimeter embankment extends from the upstream batter near the crest toward and elongating through general fill shoulder and foundation soil. The slip surface is contained within the general fill and foundation materials with negligible effects on the embankment clay and tailings. The FoS for this scenario is 1.62 which meets ANCOLD 2019 design criteria. The slip surface in the common wall develops within the upper raises, extending from the crest, Zone 2 filter, and tailings storage. The FoS is 1.42 which meets the criteria for a short-term undrained condition with no potential loss of containment. The FoS results for all the scenarios considered are shown in Appendix D.



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20			Embankment - Undrained		
Foundation (Undrained)	▨	21			Foundation - Undrained		
Tailings (Undrained)	▨	18				0.2	0
General Fill	■	20	0	35			
Zone 2	□	18	0	33			
Zone 3	■	22	0	40			

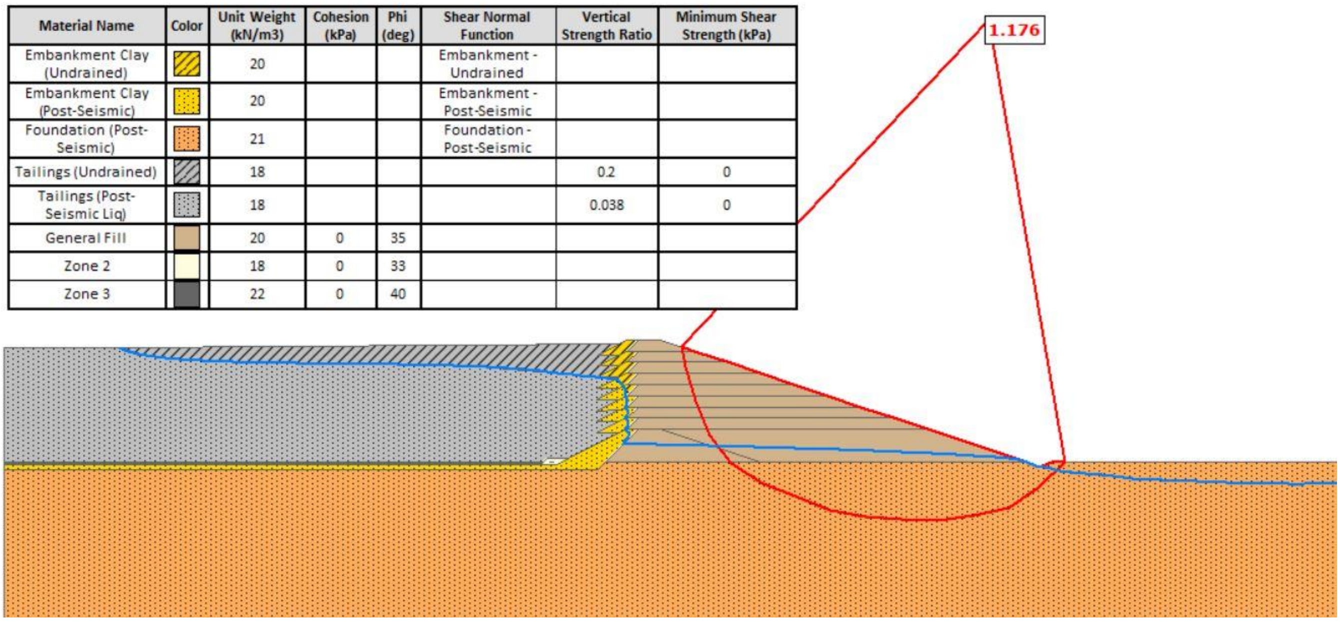
Figure 10.5 Slip Surface in Perimeter Embankment Downstream Batter Slope, Short-term Undrained Loading Condition



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20			Embankment - Undrained		
Foundation (Undrained)	▨	21			Foundation - Undrained		
Tailings (Undrained)	▨	18				0.2	0
Zone 2	□	18	0	33			
Zone 3	■	22	0	38			

Figure 10.6 Slip Surface in Common Wall, Short-term Undrained Loading Condition

For the post-seismic analysis, where residual strength parameters are adopted for the tailings, a minimum FoS of 1.176 is obtained as shown in Figure 10.7, which meets the criteria for a post-seismic conditions. The failure surface develops within the downstream shoulder and foundation soil.



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20			Embankment - Undrained		
Embankment Clay (Post-Seismic)	🟨	20			Embankment - Post-Seismic		
Foundation (Post-Seismic)	🟧	21			Foundation - Post-Seismic		
Tailings (Undrained)	▨	18				0.2	0
Tailings (Post-Seismic Liq)	░	18				0.038	0
General Fill	🟫	20	0	35			
Zone 2	⬜	18	0	33			
Zone 3	⬛	22	0	40			

Figure 10.7 Slip Surface in Perimeter Embankment Downstream Batter Slope, Post-Seismic Loading Condition

10.4.3 Summary

A summary of FoS for LEM analysis is shown in Table 10.2. The FoS shows that ANCOLD design criteria are met for all the considered scenarios.

Table 10.2 Obtained FoS from Stability Analysis

	Long-term drained condition	Short-term undrained condition (potential loss of containment)	Short-term undrained condition (no potential loss of containment)	Post-seismic
Required FoS	1.5	1.5	1.3	1.0 – 1.2
Perimeter embankment – Stage 1	1.674	1.826	1.819	1.490
Perimeter embankment – Stage 9	1.702	1.616	1.704	1.176
Common wall – Stage 1	4.018	-	1.613	3.498
Common wall – Stage 9	3.312	-	1.417	2.770

11. Static Deformation Analysis

11.1 General

This section presents information, methodology, and results related to static deformation analysis using Finite Elements Method (FEM) software package Plaxis 2D. The model was developed as a two-dimensional representation of the RSF1/RSF2 interaction zone, this being the RSF1 southern embankment and RSF2 northern embankment. The FEM analysis is useful to simulate the complex soil stress-strain behaviours and deformations experienced during the construction and tailings deposition stages.

The main objective of the deformation analysis is to assess deformations and displacements under RSF2 filling. The specific goals of the deformation analysis include:

- To assess the deformations and crest settlements on RSF1 embankment caused by RSF2 tailings deposition.
- To assess the deformations of the filter and clay materials at the drainage system located at the RSF1 toe.

11.2 Geometry and Meshing

The analysis has been undertaken on a typical cross-section at the southern embankment of RSF1 and the northern embankment of RSF2.

The geometry for RSF1 has been adopted from the RSF1 Stage 8 design (GHD, 2021b). The main geometrical features of the RSF1 embankment consists of a starter dam followed by 8 upstream lifts, including a 6 m wide embankment crest, 3H:1V downstream batter slope, 1.5H:1V upstream batter slope, downstream buttress constructed in 5 phases (starting from the fifth embankment raise stage) and tailings distribution as shown in Figure 11.1.

RSF2 tailings have been modelled considering the 9 stages, with a freeboard and beach slope similar to that adopted for RSF1. RSF2 tailings have been considered to be a sand-like type of tailings, as this is the most observed tailings type in the existing RSF1. A transition zone and a zone 1 blanket have been also modelled downstream from the buttress. These can be observed in Figure 11.2.

The phreatic conditions were adopted from seepage analyses executed for RSF1 at Stage 8. The intermediate stages and RSF2 phreatic conditions were estimated considering the expected groundwater level.

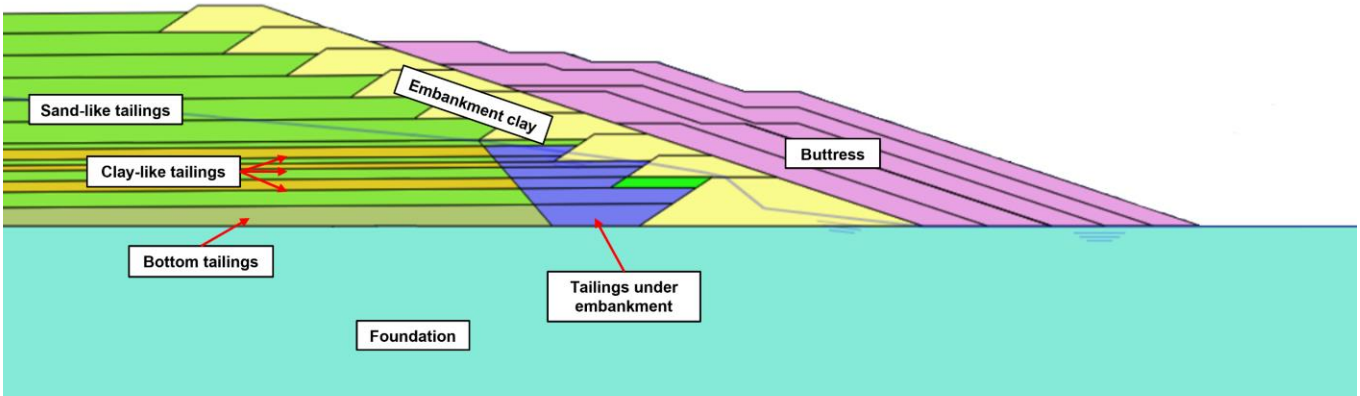


Figure 11.1 RSF 1 Extents following Stage 9 Embankment

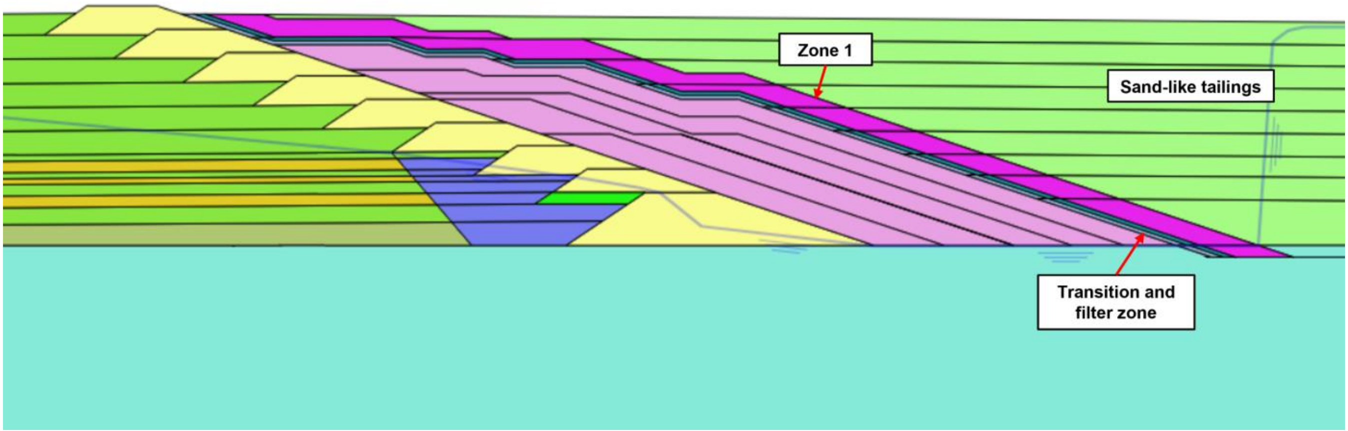


Figure 11.2 Conceptual RSF 1 Stage 9 and RSF 2 Stage 9 Connection Arrangement

The model was discretised in a mesh formed by 10,514 triangular finite elements. Each element contains 15 nodes and 9 stress points. Finite elements size varies according to material type and model geometry, but in general terms, bigger elements are presented in the foundation soil while tailings and embankments are discretised with smaller elements. More than 90% of finite elements have a quality index greater than 0.7 (1 representing the maximum value for perfectly equilateral triangles), which implies a good discretisation of the model. The phreatic surface is shown as an indicative representation assuming underdrainage remains 100% operational over the life of the facility, this will be assessed over the life of the facility based existing operations.

11.3 Material Properties

Two different constitutive models were used to model the expected behaviour of materials under static loading conditions.

The buttress, embankment clay, foundation, and zone 1, zone 2, and zone 3 materials were simulated considering a Mohr-Coulomb (M-C) constitutive model. The adopted M-C parameters are, in general, the same as those used in the limit equilibrium stability analyses, except for the effective Poisson ratio and effective Young's modulus values which were not required in the stability analyses. These parameters are detailed in Table 11.1. Most of the soil parameters adopted are consistent with previous geotechnical analyses which had already been subjected to a peer RSF1 review process.

Table 11.1 Mohr-Coulomb Parameters

Material	Bulk Unit Weight (kN/m^3)	Effective Friction Angle (deg)	Effective Cohesion (kPa)	Effective Poisson's Ratio	Effective Young's Modulus (MPa)
Buttress	18	28	0	0.3	30
Embankment Clay	21	30	0	0.2	20
Foundation	21	29	0	0.3	50
Zone 1: Clay	21	20	0	0.3	20
Zone 2: Filter	21	32	0	0.3	50
Zone 3: Transition	21	32	0	0.3	55

The tailings were simulated with the Hardening Soil (HS) constitutive model to better capture their non-linear behaviour and expected consolidation due to the dissipation of pore pressure after loading. Plaxis uses a permeability coefficient to carry out consolidation calculations. Adopted permeability values are presented in Table 4.1. The HS parameters are summarized in Table 11.2. These values are consistent with the parameters used in Stability Modelling and Liquefaction Triggering Analyses for Stage 7 RSF1 (GHD, 2021c), which has previously been subjected to a peer-review process.

Table 11.2 Hardening Soil Parameters

Material	Bulk Unit Weight	Saturated Unit Weight	Effective Friction angle	Dilatancy angle	Effective Cohesion	$E_{50\text{-}ref}$	$E_{eod\text{-}ref}$	E_{ur}	Power	Reference Pressure
	(kN/m^3)	(kN/m^3)	(deg)	(deg)	(kPa)	(kPa)	(kPa)	(kPa)	(m)	(kPa)
Sand-like tailings	18	19.5	31	0	0	29,000	29,000	87,000	0.5	100
Clay-like tailings	18	19.5	26	0	0	600	600	1,800	0.7	100
Tailing under embankment	18	19.5	26	0	0	400	400	1,200	0.7	100
Bottom tailings	18	19.5	26	0	0	1,100	1,100	3,300	0.7	100

11.4 Methodology and Modelling Sequence

11.4.1 Methodology

Plaxis 2D is a software package designed to specifically deal with highly nonlinear geotechnical problems such as deformations in complex geometries, stress-strain generation, and consolidation. A few specific features are worth noting about the deformation analysis:

- Staged construction: The construction of RSF1 and tailings deposition sequences in RSF1 and RSF2 have been modelled in stages, in order to capture as realistic as possible the stress distribution, strains generation, and excess pore pressure of the embankment and tailings materials during the life of the facility.
- Drained and undrained behaviour of tailings: The timeframe of RSF1 construction was not considered because this part of the analysis was conducted considering drained behaviour of tailings and no excess of pore pressure dissipation was modelled. For the second part of the analysis, where RSF2 tailings deposition were modelled, tailings in RSF1 were considered with an undrained behaviour to capture pore pressure generation and effective stresses. Because the focus of the analysis is RSF1 deformations, RSF2 tailings are modelled with a drained behaviour. A period of time was considered for consolidation between each RSF2 tailings deposition stage.
- Zero displacement setting: After RSF1 construction was finished, displacements were reset to zero to focus on the displacement generated only as the result of RSF2 tailings deposition. However, the stress-strain state of the different materials was maintained as calculated.

11.4.2 Modelling Sequence

Although the focus of this analysis is the deformations due to RSF2 tailings deposition, the construction and tailings deposition sequences of RSF1 have been modelled in order to realistically capture the stress distribution of the embankment and tailings materials prior to the RSF2 tailings deposition. The following sequences have been adopted in the RSF1 construction process:

- Stage 1: Set up the initial stress stage of the in-situ field prior to the construction of the Starter Dam (See Figure 11.3).
- Stage 2: Construction of the Starter Dam. Tailings deposition to RL 269.85 m.
- Stage 3: Construction of embankment raise 2. Tailings deposition to RL 271.85 m.
- Stage 4: Construction of embankment raise 3. Tailings deposition to RL 273.85 m.
- Stage 5: Construction of embankment raise 4. Tailings deposition to RL 275.85 m.
- Stage 6: Construction of embankment raise 5 and buttress 1. Tailings deposition to RL 277.85 m.
- Stage 7: Construction of embankment raise 6 and buttress 2. Tailings deposition to RL 279.85 m.
- Stage 8: Construction of embankment raise 7 and buttress 3. Tailings deposition to RL 281.85 m. (See Figure 11.4).
- Stage 9: Construction of embankment raise 8 and buttress 4. Tailings deposition to RL 283.85 m.

– Stage 10: Construction of embankment raise 9 and buttress 5. Tailings deposition to RL 285.85 m.

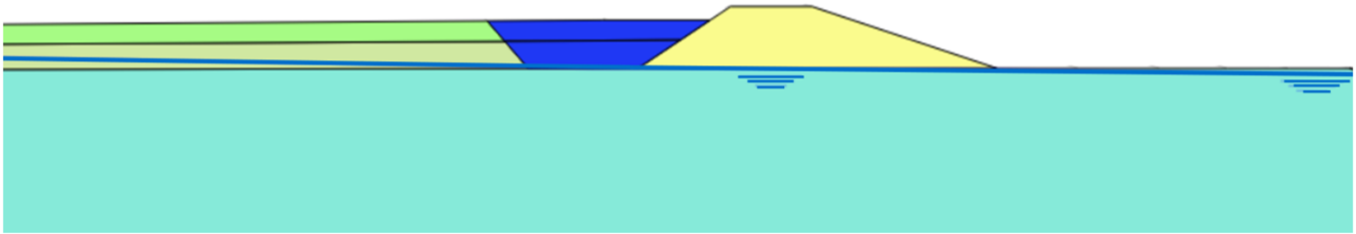


Figure 11.3 RSF1 Construction, Stage 2, after Tailings Deposition

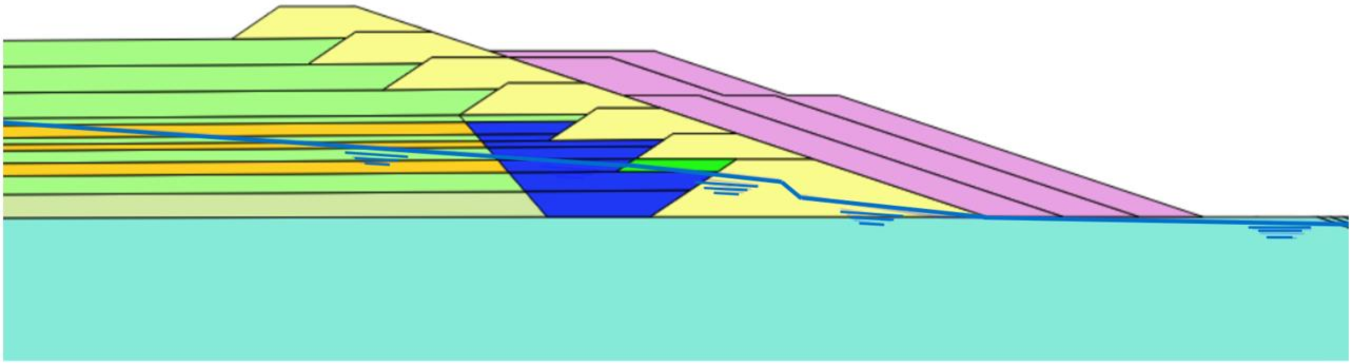


Figure 11.4 RSF1 Construction, Stage 8, before Tailings Deposition

After completion of the RSF1 construction, RSF2 tailings deposition has been modelled. The RSF2 filling has been carried out in 9 stages consistent with the 9 embankment raises considered for the life of the facility. To account for tailings consolidation and excess pore pressure dissipation, several days have been considered between each 2 m deposition stage to represent the maximum rate of rise. At the end of the RSF2 tailings deposition, the model has been run for long-term drying without any additional load, to simulate excess pore pressure dissipation. The following sequences have been adopted in the RSF2 filling process:

- Stage 11: Blanket excavation at the RSF1 downstream toe (See Figure 11.5). Consolidation phase of 10 days. Blanket construction.
- Stage 12: Drainage system construction. Tailings deposition to RL 269.85 m (RSF2 Starter Dam). Consolidation phase of 100 days.
- Stage 13: Drainage system construction. Tailings deposition to RL 271.85 m (RSF2 embankment raise 2). Consolidation phase of 100 days.
- Stage 14: Drainage system construction. Tailings deposition to RL 273.85 m (RSF2 embankment raise 3). Consolidation phase of 100 days.
- Stage 15: Drainage system construction. Tailings deposition to RL 275.85 m (RSF2 embankment raise 4). Consolidation phase of 100 days.
- Stage 16: Tailings deposition to RL 277.85 m (RSF2 embankment raise 5). Consolidation phase of 100 days (See Figure 11.6).
- Stage 17: Tailings deposition to RL 279.85 m (RSF2 embankment raise 6). Consolidation phase of 100 days.
- Stage 18: Tailings deposition to RL 279.85 m (RSF2 embankment raise 7). Consolidation phase of 300 days.
- Stage 19: Tailings deposition to RL 279.85 m (RSF2 embankment raise 8). Consolidation phase of 300 days.
- Stage 20: Tailings deposition to RL 279.85 m (RSF2 embankment raise 9). Consolidation phase of 300 days.
- Stage 21: Long-term consolidation phase of 2,074 days.

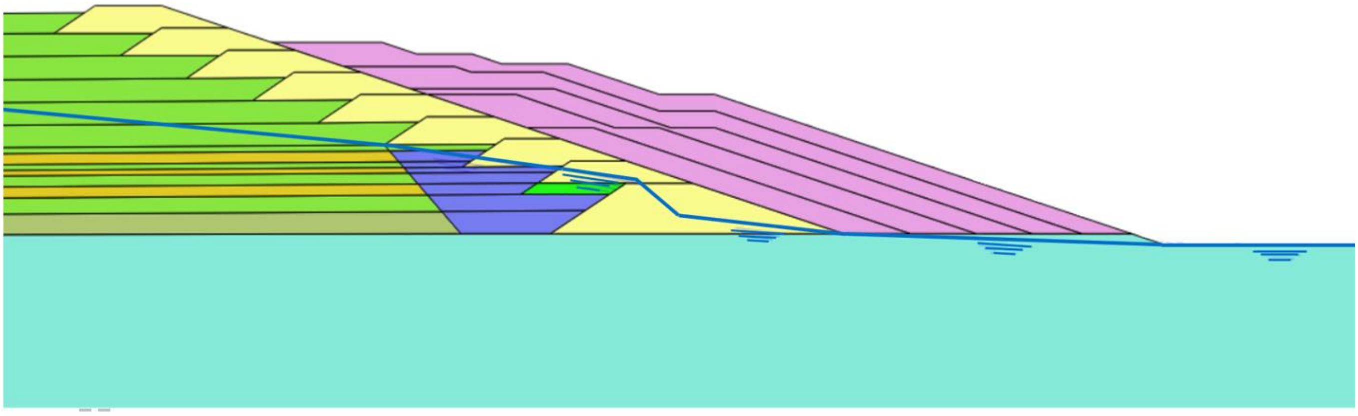


Figure 11.5 RSF2 Filling, Stage 11, Blanket Excavation

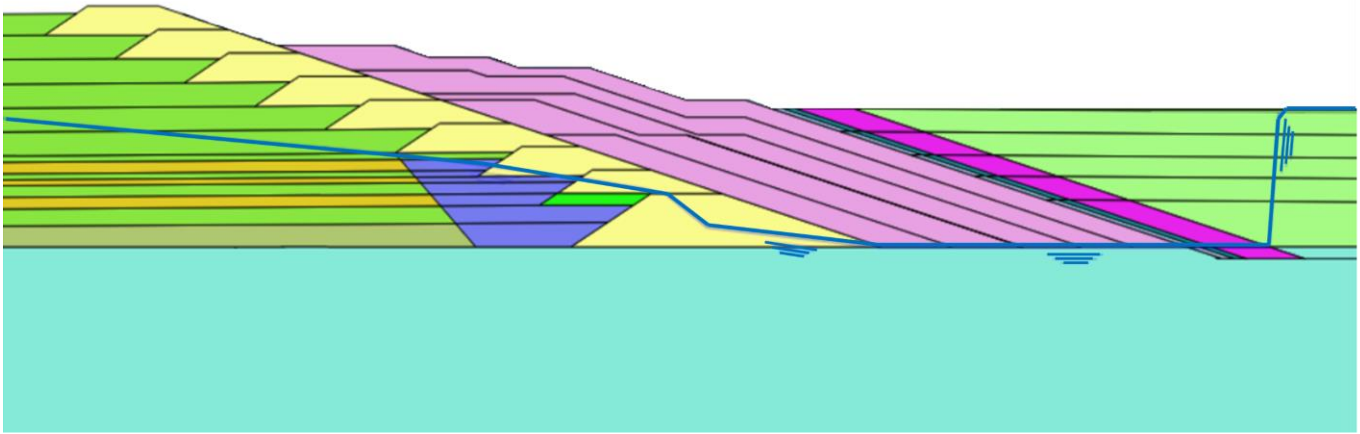


Figure 11.6 RSF2 Filling, Stage 16

11.5 Results

To understand the deformations generated in RSF1 southern embankment resulting from RSF2 tailings deposition results in terms of displacements, shear strains, and excess pore pressure are presented in the following section. Finally, the summary section presents conclusions regarding the key findings.

11.5.1 Displacements

The following results can be observed from the analysis in terms of displacements:

- The maximum total vertical displacements are located just over the tailings under the embankment, associated with the low elastic modulus of this material. Figure 11.7 shows that a large portion of the displacements is developed in the early stages of the RSF 1 construction. It is noted that displacements of 1 m occur for Stage 2 of the model, with a total displacement of 5 m at the end of RSF1 construction. This is a numerical estimation that is not necessarily perceived in the field as construction accommodates deformations over time.
- Consequently, at the beginning of RSF2 filling, these displacements have been reset to zero and no further displacement occurs at the central axis of RSF1 embankment until Stage 19 of the model when RSF2 tailings are deposited at this location. The maximum vertical displacement at the end of RSF2 filling modelling is 0.3 m at the right side of the model where tailings are fully saturated and at the central axis of RSF1 embankment. This is shown in Figure 11.8.
- The total horizontal displacements are significantly smaller than the total vertical displacements. The maximum displacement occurs in the tailings downstream of the drainage system.
- It was observed that during the blanket excavation in Stage 11 of the model, displacements are limited. Maximum total displacement occurs at the RSF2 impoundment base with a value of 6 mm The influence of

such change in the structural geometry extends toward the middle of the embankments downstream slope, however it can be seen that the displacements are smaller than 2 mm.

A sensitivity analysis has been conducted for the RSF1 buttress Young’s modulus (E’). This material has been placed using end dumped fill and is not compacted. The adopted E’ values were 30 MPa, 20 MPa, and 15 MPa. In the RSF1 embankment raises, maximum total vertical displacement increases 2.5% when E’ decreases from 30 MPa to 20 MPa and 9% when E’ decreases from 30 MPa to 15 MPa. For the same changes in E’, maximum total vertical displacement in tailings located at the central axis of RSF1 embankment increase 8% and 16%, respectively. The influence of this parameter on the drainage system is greater than in the previously commented zones of the structure. Maximum total vertical displacement increases 13% when E’ decreases from 30 MPa to 20 MPa. For an effective Young’s modulus value of 15 MPa maximum total vertical displacement is 0.15 m (30% increase from the base case with E’=30 MPa). This is still considered to be acceptable for the material.

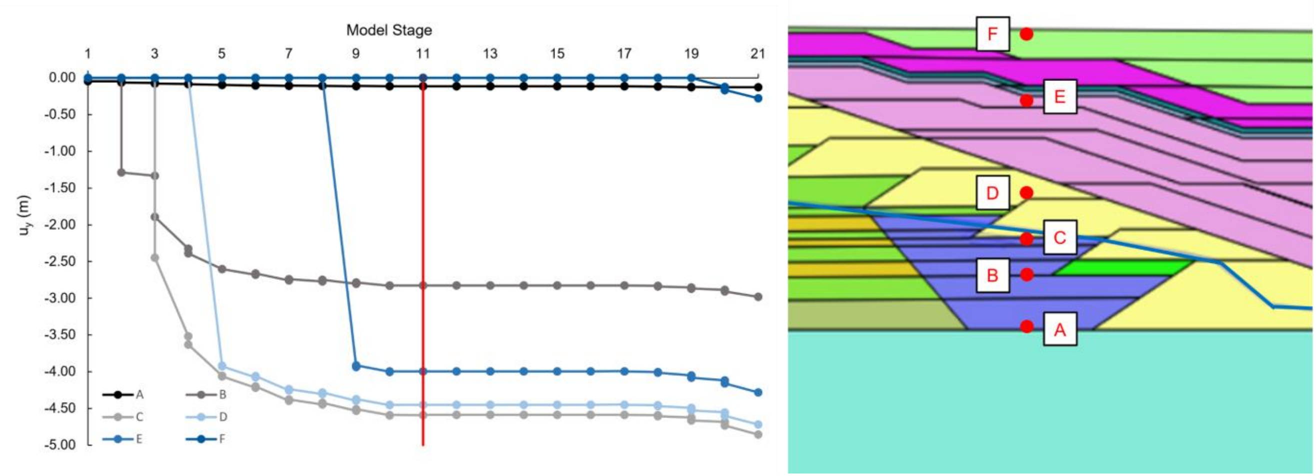


Figure 11.7 Vertical Displacement at Centre Axis of RSF1 Embankment

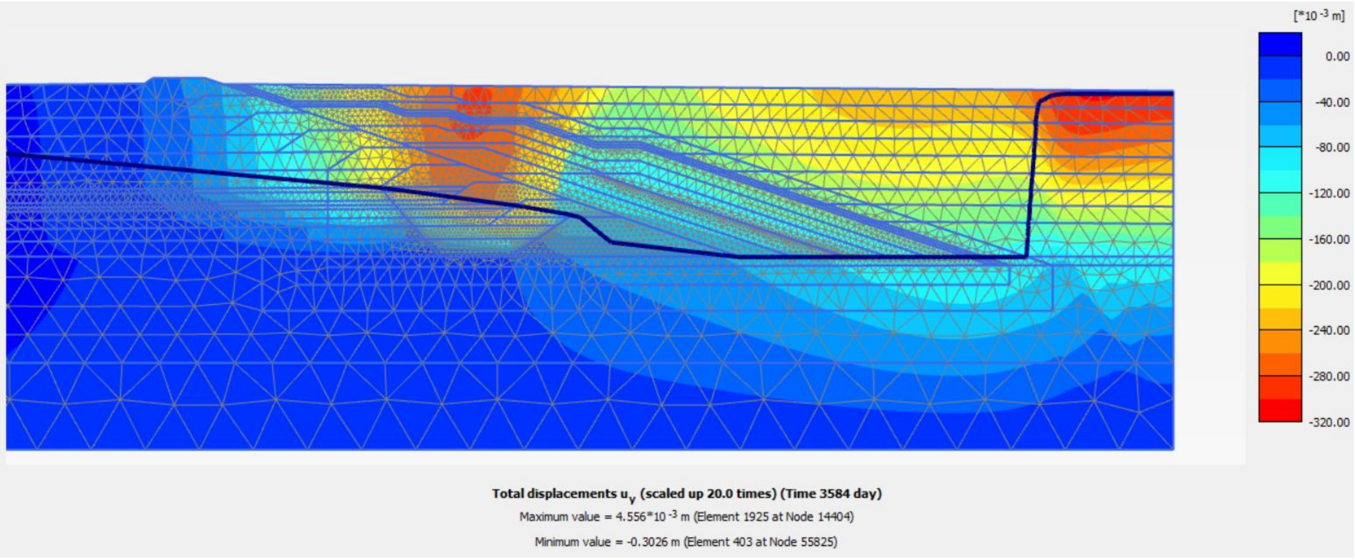
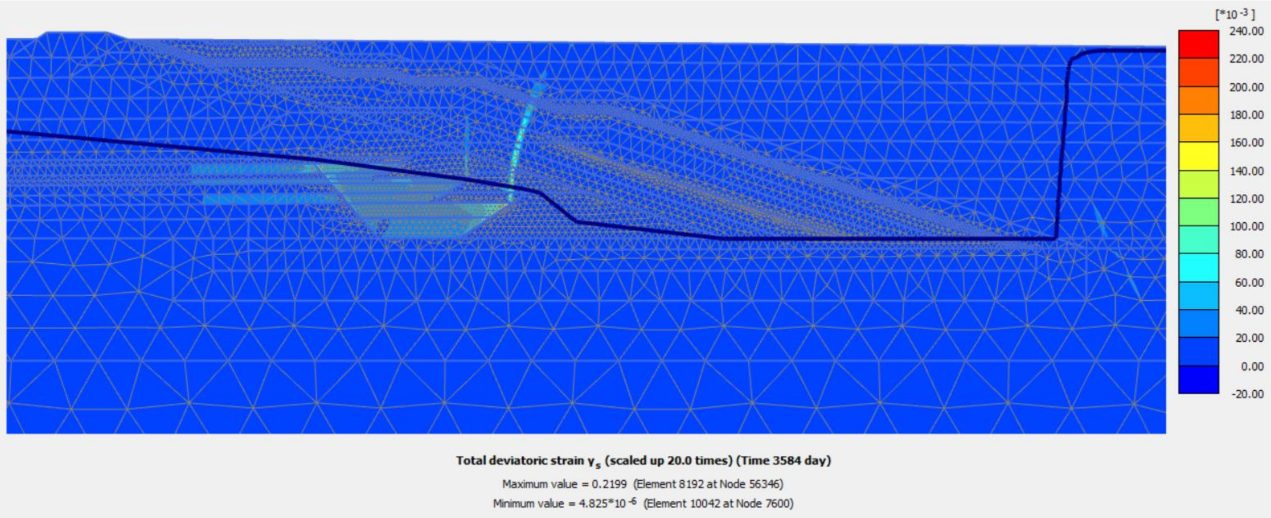


Figure 11.8 Total Vertical Displacement at Stage 21

11.5.2 Shear Strains

Shear strains are analysed in terms of total deviatoric strain. In general terms, total deviatoric strain generation during the modelling stages is quite similar to the total displacements. During RSF1 construction, the greatest values of deviatoric strain concentrate in the tailings under embankment material, again associated with the low effective Young’s modulus. When tailings deposition starts at RSF2, maximum deviatoric strains are located at the freshly deposited tailings mostly below the water table. Maximum values in these stages start at 0.3% and increase to reach maximum values of 2% at Stage 19 of the model.

At the end of tailings deposition in RSF2, maximum total deviatoric strains move back to the tailings under the embankment. Figure 11.9 shows this quantity for Stage 21, at the end of the long-term consolidation phase with a maximum value of 10.8%.



Total deviatoric strain γ_s (scaled up 20.0 times) (Time 3584 day)

Maximum value = 0.2199 (Element 8192 at Node 56346)

Minimum value = $4.825*10^{-6}$ (Element 10042 at Node 7600)

Figure 11.9 Total Deviatoric Strain, Stage 21

11.5.3 Pore Pressure

As previously commented, during RSF1 construction, tailings, embankments materials, and foundation were modelled with drained behaviour, therefore, no excess pore pressure is generated during the first 10 modelling Stages.

The timeframe between each lift in RSF2 is expected to be similar to the period between RSF1 raises; this is one year approximately. However, analysis results showed that excess pore pressure dissipation occurs in less time for the first Stages. Because of that, between Stage 12 and Stage 17 of the model, a consolidation period of 100 days was considered appropriate, reducing calculation time without affecting the modelling of the consolidation process in tailings. For the remaining deposition Stages (18 to 20 of the model) the actual timeframe between RSF2 embankment raises is adopted for consolidation, which means a significant dissipation of excess pore pressure, but not completely.

The greater values of excess pore pressure are generated in tailings under the embankment material and contiguous tailings, as presented in Figure 11.10, which shows excess pore pressure for Stage 20 of the model before consolidation, the maximum value for which is 87.9 kPa. At the end of the long-term consolidation phase (Stage 21 of the model), excess pore pressure drops to a maximum value of less than 10 kPa which is distributed uniformly within the tailings as the water migrates through the facility.

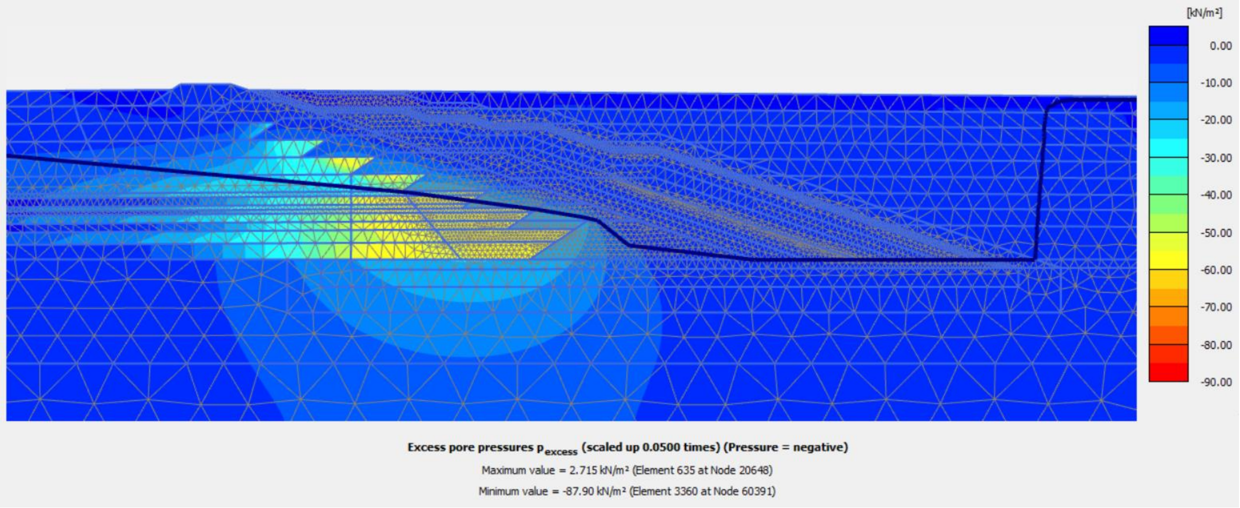


Figure 11.10 Excess Pore Pressures, Stage 20, before Consolidation Phase

11.5.4 Summary

The deformation analysis on the RSF1/RSF2 connecting embankment executed using FEM has demonstrated the final condition of the interaction between RSF1 and RSF2 is stable. The results of the analyses suggest the following.

- The maximum displacement occurs in the tailings beneath the RSF1 embankment material, due to its low stiffness. During RSF1 construction, total vertical displacements are very high in this zone of the model. This is consistent with the occurrence of settlement and cracking in RSF1 during embankment raise 2. After displacement was reset to zero at the beginning of RSF2 filling, total displacements were significantly lower, with maximum values around 0.3 m at the end of the modelling, but displacements at the axis that cross tailings under embankment are still high compared with other parts of the structure. The maximum settlement at the RSF1/RSF2 filter zone mean that the combined 2 m width of filter zones are not expected to settle enough to prevent drainage of the external RSF1 shell. It is recommended that these models be reviewed with each lift to assess actual settlement with predicted settlement to confirm the effectiveness of the connection drainage system.
- Displacements of the embankment raise and buttress are limited. Sensitivity analysis on the effective Young's modulus of the buttress shows that the greatest influence on displacement occurs at the downstream drainage system zone, however, the calculated values are still within acceptable magnitudes.
- Excavation at the RSF1 embankment toe for blanket and drainage system construction causes negligible effects on the embankment, in terms of displacement and strains, and therefore, in terms of stability.
- Excess pore pressure generation concentrates at the tailings under the RSF1 embankment material. The adopted periods used in the modelling are adequate to correctly simulate consolidation between tailings Stages. A period of 2,074 days (post-closure) is required for the final long-term consolidation phase, to dissipate excess pore pressure until a value below 10 kPa is achieved.

12. Seismicity Assessment

12.1 Overview

During the Stage 7 RSF1 embankment raise, the Seismology Research Centre (SRC), a division of Earth Sciences Pty Ltd (ESS) were engaged to undertake a site-specific seismic hazard assessment. The study can be found in SRC (2020) and is summarised in the following section.

12.2 Study Summary

Although the mine site is located in a region of low seismicity, the study reviewed the historical records of seismicity and ground motion in this zone. The review found that the largest seismic events that could occur at the site are 7.5 $M_{w,}$ although unlikely, it is expected that an earthquake of such magnitude would result in extreme amounts of damage.

The earthquake recurrence models used in the study considered the local site conditions, non-linear analyses, seismotectonic models, and active and non-active faults closer to the mine site. All these factors were assessed to obtain the maximum and minimum magnitudes to be considered, resulting in a 7.5 M_w magnitude quake for the maximum credible event, and a 4.5 M_w magnitude quake for the minimum credible event.

The ground motion models used in the construction of the hazard curves considered the variability caused by earthquake magnitude, distance, wave frequency, randomity, historical attenuation functions, and epistemic uncertainties. All of these factors were used to select the best fit ground-motion models.

As part of the site-specific seismic hazard study, a probabilistic hazard assessment was undertaken, indicating the minimum earthquake magnitude that should be considered is 4 M_w and the maximum distance for an earthquake to have an effect on the mine site is 300 km.

Calculations for this study were carried out using the weighted mean of three seismotectonic models, the AUS7 model, which has been developed by SRC, together with two smoothed seismicity models, the Cuthbertson model (CUTH) and the Risk Frontiers model (RF).

The results of the seismic hazard studies result in seismic hazard curves that present PGA and Mercalli Intensity as a function of the return period together with the sensitivity analysis of the different models used. Response spectra for different return periods are presented for informational reasons or for future works.

In addition to the seismic hazard study, a time-history analysis was carried out. Earthquake events were selected from different locations (2 Australian and 4 worldwide) with similar conditions. These event records were processed according to current methods, considering the conditions of the mine site, to generate the time-history simulations. The obtained results are consistent with those obtained from the seismic hazard curves in terms of PGA.

12.3 Study Review

ANCOLD Guidelines for Design of Dams and Appurtenant Structures for Earthquake (2019b) recommends that for a '**Significant**' consequence category dam a 1:475 AEP Operating Basis Earthquake (OBE) and 1:1,000 AEP Safety Evaluation Earthquake (SEE). However, the guidelines also note that if the structure is susceptible to liquefaction (such as the tailings or embankment foundations) or has components that will fail at ground motions only a little greater than those recommended, a check of the design for the critical ground motion. Where liquefaction of tailings is likely to affect the stability of the dam, the design may need to consider a 1:10,000 AEP earthquake. ANCOLD (2019b) also recommends 1:10,000 AEP Maximum Credible Earthquake (MCE) be used in the design of the closure arrangement. As such the SEE earthquake considered in the design is the equivalent of a 1:10,000 AEP earthquake event.

The seismicity assessment SRC (2020) shows that the actual PGA for the OBE (1:475 AEP) is slightly higher than that adopted during previous design stages, resulting in an increase from 0.015g to 0.028g. Based on the analysis, the PGA for the SEE (1:10,000 AEP) is smaller than the previously adopted value, decreasing from 0.360g to 0.180g.

A PGA of 0.360g corresponds to a return period of 40,000 years, according to the SRC study which is very unlikely to occur and exceeds the design criteria for RSF2. The complete PGA recurrence curve is shown in Figure 12.1.

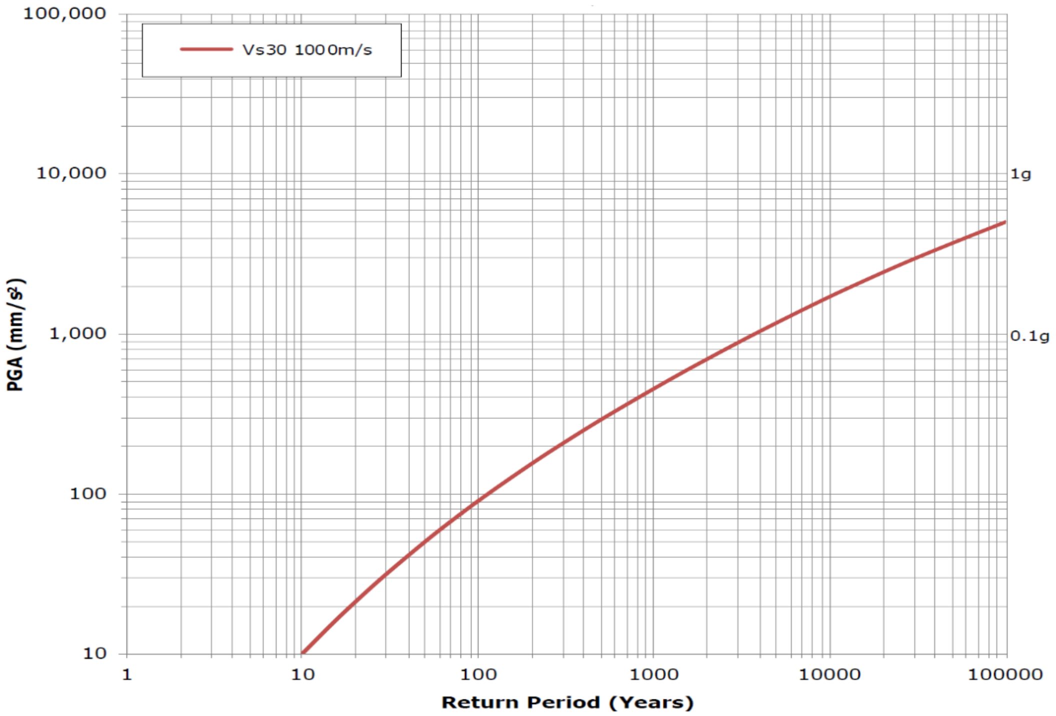


Figure 12.1 PGA Recurrences for the Tomingley Gold Mine RSF.

The study results illustrate the expected earthquake magnitude for a given return period. The magnitude values adopted for this report were estimated considering the most reasonable magnitude values, the seismic hazard assessment, the time history analysis, and previous design stages adopted values. These considerations are expected to be conservative for the RSF2 Stage 1 embankment design. A summary of the earthquake loading parameters adopted for this report is shown in Table 12.1.

Table 12.1 Seismic Loading Parameters

Event	Magnitude	PGA
OBE (1:475 AEP)	4.5 Mw	0.028 g
SEE (1:10,000 AEP)	6.5 Mw	0.180 g
MCE (1:10,000 AEP)	6.5 Mw	0.180 g

13. Liquefaction Assessment

13.1 Overview

Based on the existing tailings in RSF1, the liquefaction of tailings to be contained in RSF2 requires a strain-softening soil response and strength loss either during seismic or monotonic loadings. It has been proved that significant strains and strength loss can occur in a broad range of saturated soils, from sand to clay. Liquefaction phenomena are likely to occur in very loose sands and very sensitive low-PI clays with a large brittleness index, i.e. IB≈1. If the phenomenon is triggered within the RSF2 facility, increased loading is expected in the future stages of the retaining structures and large strains may develop. As such, it is crucial to evaluate the post-seismic response of the facility, adopting residual or liquified shear strength parameters for materials prone to liquefaction, as later discussed.

The use of the CPTu data from the existing RSF1 has been deemed to be a rational approach for the assessment of the state parameter and soil classification, and as such, is deemed adequate for the evaluation of liquefaction susceptibility of the RSF2 materials.

13.2 Liquefaction Susceptibility

13.2.1 Tailings

The 2020 CPTu test data on RSF1 was used to produce Soil Behaviour Type (SBT) Charts (Robertson, 2016) in terms of the normalised cone resistance vs normalised friction ratio, as shown in Figure 13.1 for CPT401 and CPT402.

The contour CD=70 in green indicates the contractive-dilative (CD) boundary, which separates soils with contractive or dilative behaviour at large shear strains. Normalized Cone Resistance (Q_{tn}) and Normalized Friction Ratio (F_r), are represented by the following expression (Robertson, 2016):

$$CD = 70 = (Q_{tn} - 11) \cdot (1 + 0.06F_r)^{17}$$

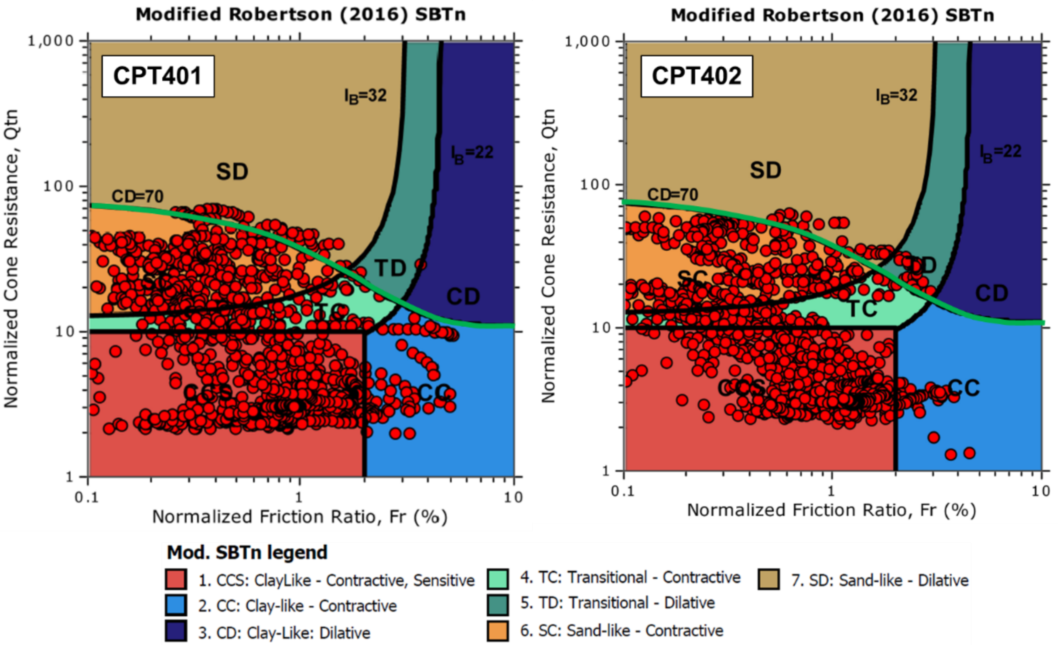


Figure 13.1 CPT401 and CPT402 SBT Plots

The main response characteristics of the material can be summarised as follows:

- In terms of soil behaviour type index (I_B) and SBT behaviour boundaries, the tailings show a mixed behaviour with sand, transitional, and a clay-like type of response. This is consistent among CPTs, which show an interbedded stratification as previously discussed.
- Inspection of the chart shows that tailings are generally below the dilation-contraction contour. Most of the data points show the material's tendency to contract upon shearing with a significant portion of the material lying in the SC regions.
- Similarly, a large portion of data points to plot in the CCS and CC zones. Thus, there exists a potential for cyclic softening and flow liquefaction and $S_{u(rem)}/\sigma'_v$ should be estimated for the stability analysis. For this type of material large strains are required to trigger strength loss.
- Figure 13.2 shows the results of the normalised penetration resistance corrected to an equivalent clean sand value ($Q_{tn,cs}$). $Q_{tn,cs}\approx 70$ represents the contractive-dilative contour. It is clear that all CPTus, except for CPT408 that commences at RL 270.5 m, show contractive behaviour at all depths.
- This $Q_{tn,cs}\approx 70$ contour is similar to the dilative/contractive boundary for the state parameter $\psi\approx -0.05$, as found by Jefferies and Been (2006) and Shuttle and Cunning (2009) for coarse grained uncemented soils. Using this approach for CPTu data, it can be confirmed that most of the soils show $\psi\geq -0.05$, and as such, tailings are susceptible to liquefaction.

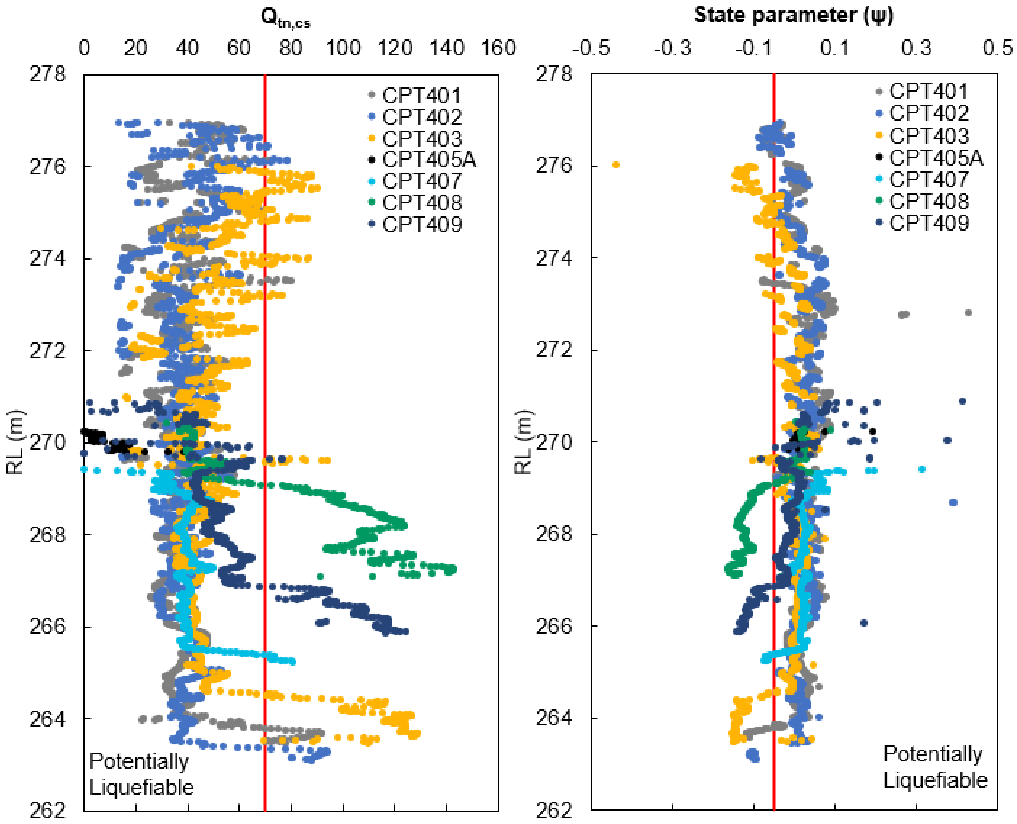


Figure 13.2 *$Q_{tn,cs}$ and State Parameter*

Regarding nature, fabric, and tailings management strategies, it is expected that tailings at RSF2 behave similarly to those existing at RSF1.

13.2.2 Foundation Soil

The foundation material for RSF2 is a clay-type soil that, in limited RSF2 CU triaxial tests, has shown strain-softening responses. Generally, for low-plasticity silts and clays, there is insufficient guidance on the engineering procedures that are most appropriate for estimating potential strains and strength loss upon undrained loading. Regarding the PI (greater than 13%) of the material, and the research of Boulanger and Idriss (2004, 2005), the soil is likely to show a clay-like behaviour with cyclic softening under cyclic loading.

Different liquefaction susceptibility criteria are commonly adopted in practice, e.g. the Chinese criteria have been widely used since the early 1980s for evaluating the liquefaction susceptibility of silts. The susceptibility of foundation material to liquefy is assessed in Figure 13.3 through the liquefaction criteria proposed by Seed et al. (2003). This criterion describes three zones on the Atterberg limits chart: Zone A soils with a PI≤12 and a LL≤37 are potentially liquefiable if w≥80% of the LL; Zone B soils with a PI≤20 and a LL≤47 are considered potentially liquefiable with laboratory testing recommended if w≥85% of the LL; and Zone C soils with a PI>20 and a LL>47 are considered generally not susceptible to cyclic liquefaction. Considering these criteria, and the testing undertaken in the RSF1 and RSF2 foundation materials which found it to be a Zone B material, the foundation is considered to be potentially liquefiable if the water content is greater than 85% of the LL.

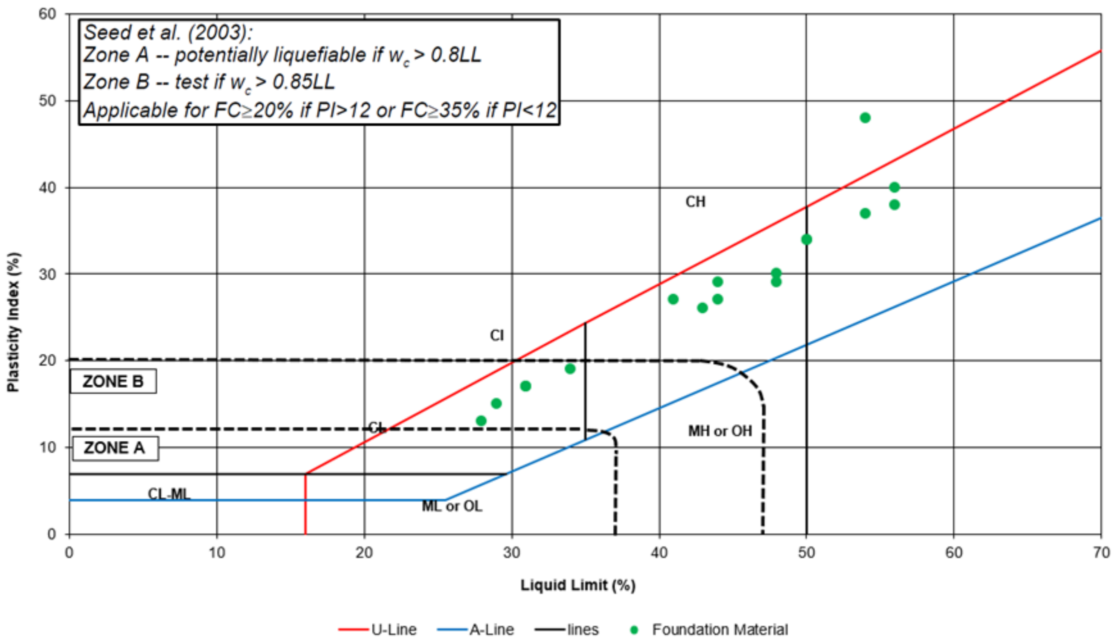


Figure 13.3 Liquefaction Criterion by Seed et al. (2003)

13.3 Seismic and Static Liquefaction

The liquefaction phenomena can be triggered under monotonic or seismic loading. The trigger can be a result of natural events, such as an earthquake; or due to anthropic activities, such as the rapid loading over the tailings. The liquefaction resistance and liquefaction triggering assessment of the RSF2 materials are discussed in the following sections with reference to experimental testing conducted in RSF1 and RSF2 footprint.

13.3.1 Dynamic Liquefaction

13.3.1.1 Tailings

CPTu tests have been used to undertake a liquefaction potential assessment for the tailings. The liquefaction potential of the soil can be determined by estimation of two variables:

- Cyclic Stress Ratio (CSR) is a measure of the cyclic load applied to the soil by the earthquake. CSR is estimated through expected PGA and a stress reduction factor:

$$CSR = 0.65 \cdot \left(\frac{a_{max}}{g}\right)\left(\frac{\sigma_{v0}}{\sigma'_{v0}}\right) \cdot r_d$$

- Cyclic Resistance Ratio (CRR) is the capacity of the soil to resist liquefaction. This can be determined from laboratory or in situ tests. For CPTu, CRR is found using the expression proposed by Robertson (2009) which is based on a review of case histories.

If the CSR is greater than the CRR, liquefaction is likely to occur. The analysis of the data was undertaken using CLiq software, and results are shown in Figure 13.4 for the OBE and SEE events. The Factor of Safety (FoS) in the figure corresponds to the ratio between CRR and CSR for a 7.5 M_w event.

For the OBE event (4.5M_w and PGA 0.028g), the CSR is smaller than the CRR, with FoS generally greater than 2 in most of the soil depths. Thus, liquefaction is unlikely to occur under this seismic scenario. For the SEE event (6.5M_w and PGA 0.18g), the FoS is generally below unity for most of CPTu, as such, the material is likely to experience seismic liquefaction.

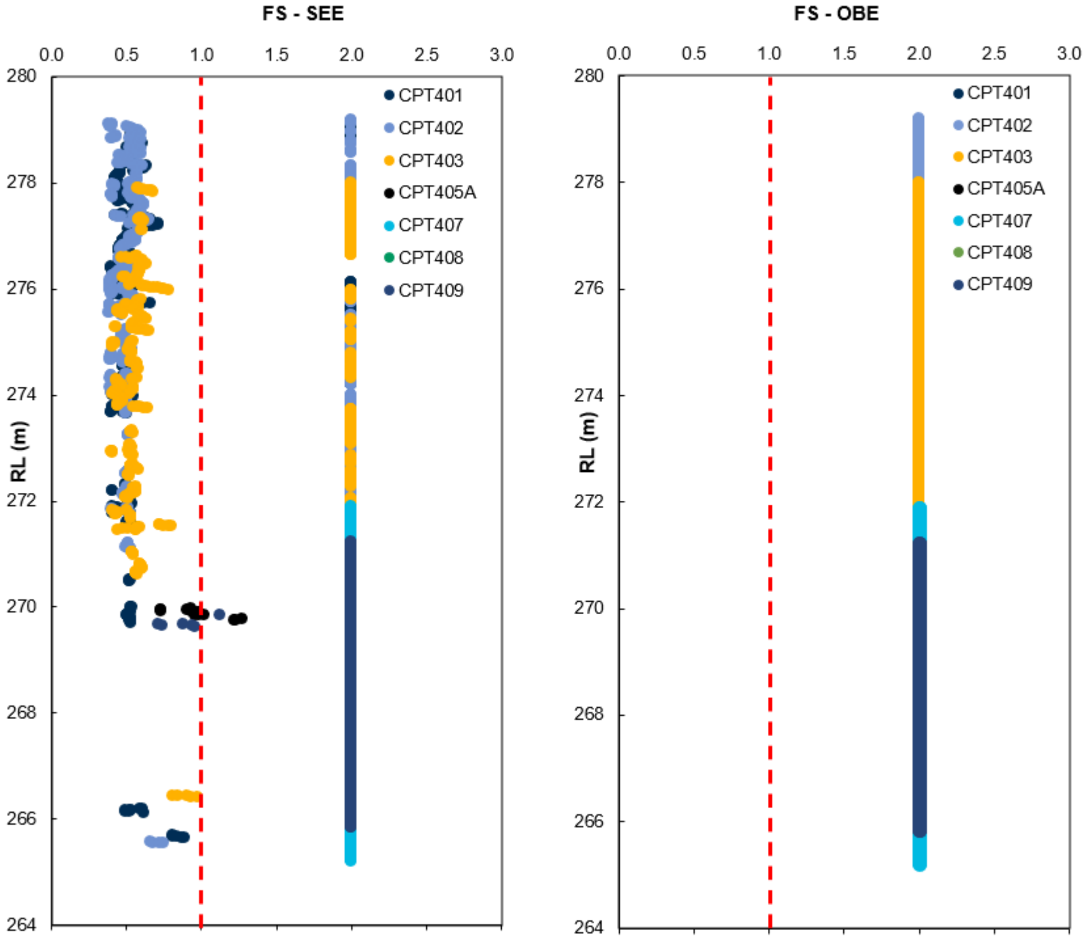


Figure 13.4 *Seismic Liquefaction Potential – SEE (0.180g 1:10,000 AEP); OBE (0.028g 1:475 AEP)*

13.3.1.2 Foundations

For the foundation soil, the seismic liquefaction assessment was undertaken considering the SPT results of the boreholes GBH01, GBH02, and GBH03. The CRR was obtained in accordance with Idriss et. al (2004) where $CRR_{M=7.5}$ for clay-like soil (PI ≥ 7) can be estimated as follows:

$$CRR_{M=7.5} = 0.8 \cdot \frac{S_u}{\sigma'_v} \cdot K_\alpha$$

Figure 13.5 shows a comparison of the calculated CSR and CRR for SPT data under OBE and SEE scenarios. The CRR is for all data points greater than CSR for both OBE and SEE earthquakes. As such, liquefaction is not likely to be triggered in the foundation soil.

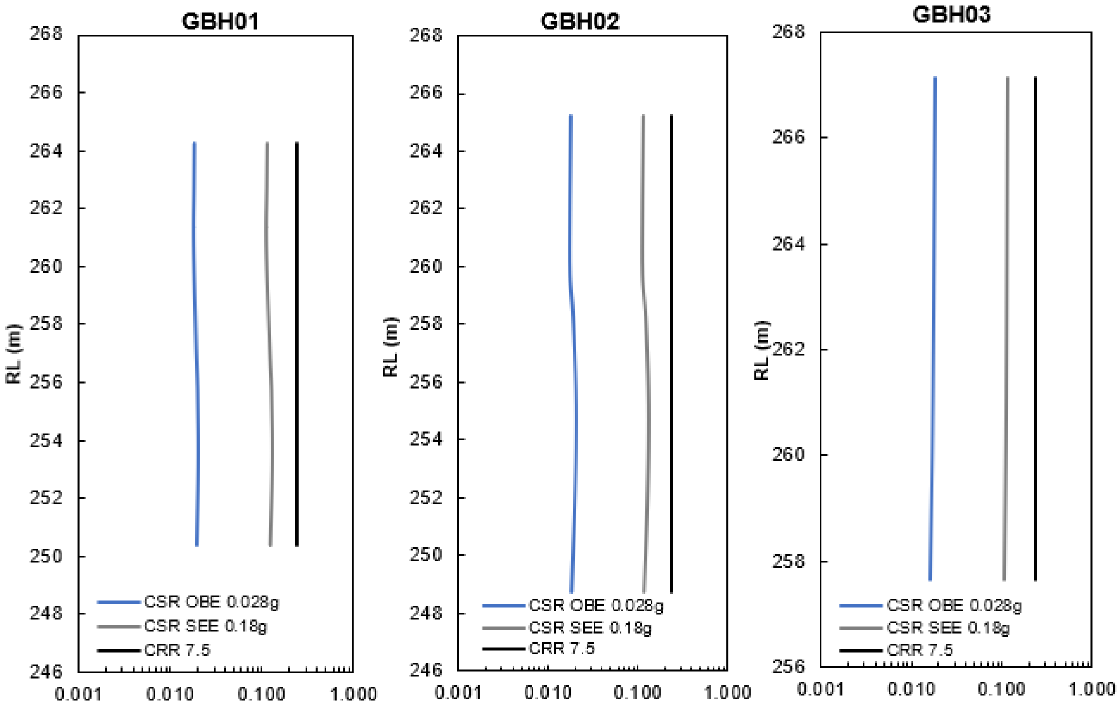


Figure 13.5 CSR vs $CRR_{7.5}$ Plots – Foundation

13.3.2 Static Liquefaction

RSF materials such as tailings and foundation soil may be susceptible to static liquefaction if one or more of the following conditions occur:

- Sudden increase of phreatic level due to run-off or seepage.
- High rate of rise or rapid vertical loading during disposal of tailings or raises construction.
- Uncontrolled shear strains due to lateral displacements of the foundation soil or as a result of excavations near RSF toe.

This can only be controlled if proper actions are undertaken to avoid static liquefaction, such as controlling material placement rates or permanent phreatic surface monitoring.

13.4 Post Liquefaction Shear Strength

13.4.1 Tailings

13.4.1.1 Post-Seismic Liquefaction

According to the results of the CPTu conducted at RSF1, a large portion of data points plot in de SC (sand-like – contractive) and TC (transitional contractive) zones, however, these tailings are located toward the top of RSF1 Stage 1. Similarly, a large portion of data points plot in the CC (Clay-like – contractive) and CCS (Clay-like – contractive – sensitive) zones. Thus, there exists a potential for cycling softening and flow liquefaction within these tailings, thus remoulded undrained shear strength ratio ($S_{u(liq)}/\sigma'_v$) should be estimated for stability analyses.

Figure 13.6 shows a histogram for $S_{u(LIQ)}/\sigma'_v$ for the CPTu data based. The sand-like material and the equations proposed by Robertson (2019) (based on the analysis of liquefied strength ratios from flow failure case histories) were chosen as a conservative approach to estimate S_u for RSF2. Adopting the first quartile as a reasonable criterion for LE analysis, $S_{uLiq}/\sigma'_v \approx 0.04$.

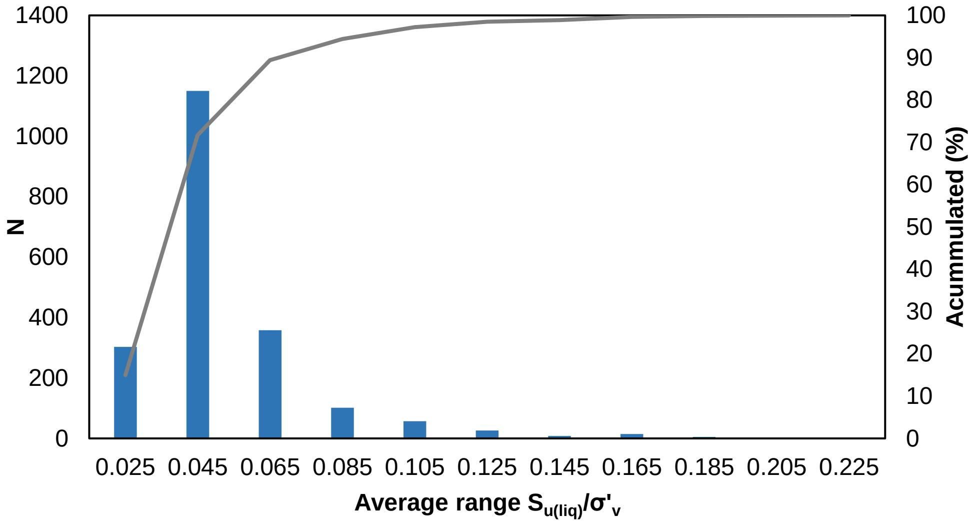


Figure 13.6 $S_{u(Liq)}/\sigma'_v$ Histogram – Sand-Like Tailings

13.4.1.2 Post-Static Liquefaction

During static liquefaction, residual undrained shear strength is attained. The $S_{u,res}/\sigma'_{vo}$ can be found using the Critical State Line (CSL) and a representative value for the state parameter ψ as discussed in GHD (2021b). For the analysis, a $S_{u,res}/\sigma'_{vo} \approx 0.15$ has been conservatively adopted for the tailings to be stored in RSF2.

13.5 Deformation

A seismic deformation assessment was carried out for the stockpile using the simplified empirical and probabilistic methods of Pells & Fell (2002), Swaisgood (2013), and Bray et al. (2007).

13.5.1 Pells and Fell (2002)

This empirical method uses PGA and earthquake magnitude to classify a dam according to expected damage (i.e. settlement and longitudinal crack width), Table 13.1.

Table 13.1 Damage Classification System, Pells & Fell (2002)

Damage Class		Maximum Longitudinal Crack Width (mm)	Maximum Relative Crest Settlement
Number	Description		
0	No or Slight	<10	< 0.03%
1	Minor	10 – 30	0.03% - 0.2%
2	Moderate	30 – 80	0.2% - 0.5%
3	Major	80 – 150	0.5% - 1.5%
4	Severe	150 – 500	1.5% - 5%
5	Collapse	> 500	> 5%

Utilising the earthquake magnitude and PGA's developed as part of the Seismicity Assessment, the OBE and SEE events result in a Number 0 Damage Class and a Number 1 Damage Class respectively. The 0 Damage Class results in a maximum crest settlement of 0.03% of the Stage 1 Embankment, whereas the 1 Damage Class results in a maximum crest settlement of 0.2% of the Stage 9 Embankment. The results of this analysis are seen in Table 13.2.

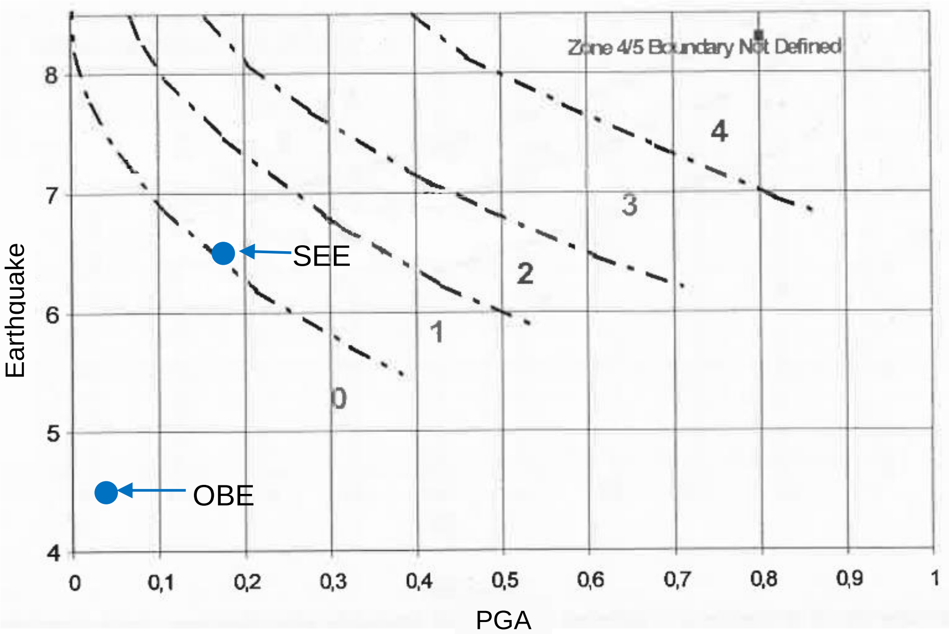


Figure 13.7 Contours of Damage Class Versus Earthquake Magnitude and PGA

13.5.2 Swaisgood (2013)

Alternatively, this method considers an extensive review of case histories of embankment dam behaviour during an earthquake. The original data considers hydraulic fill, earthfill, and other types of rockfills dams. Figure 13.8 shows historic crest settlements of embankment dams that have been subjected to major earthquakes as a function of the reported PGA (USBR. 2015).

Using the regression analysis proposed by Swaisgood, the amount of settlement expected for the embankment crest is 0.01% and 0.05% for OBE and SEE, respectively. This corresponds to a “Minor” relative degree of damage. For the maximum RSF2 Stage 9 embankment height, the settlements are summarized in Table 13.2.

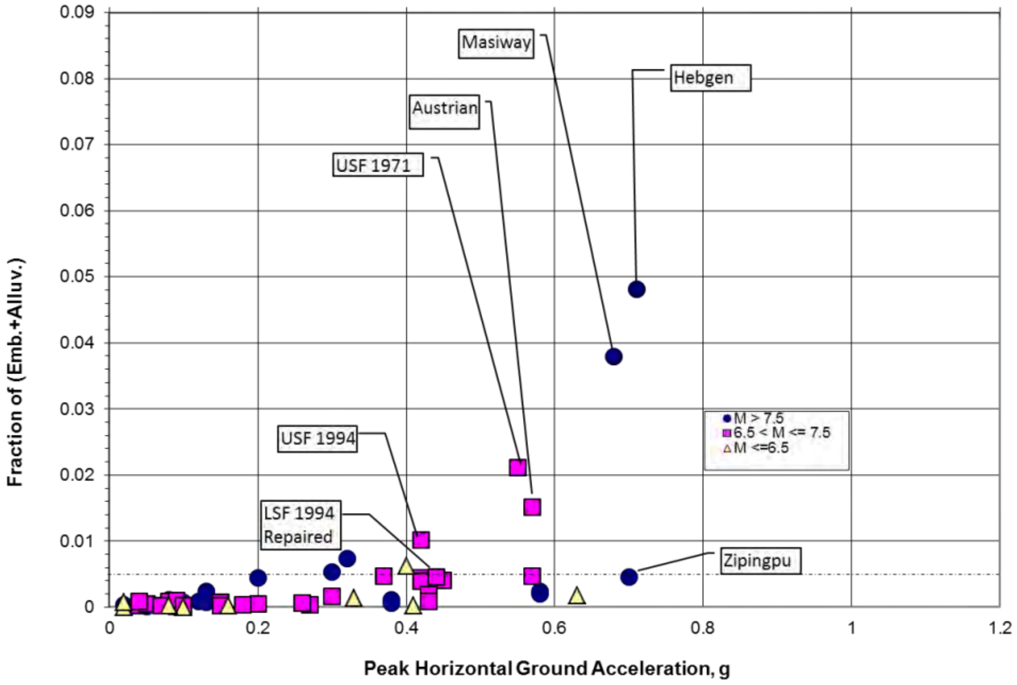


Figure 13.8 Earthquake Induced Settlements of Embankment Dams, USBR (2015)

13.5.3 Bray et al. (2007)

Bray et al. proposed a simplified procedure for estimating earthquake-induced deviatoric slope displacements. The authors, using a comprehensive database of 688 recorded ground motions, propose the following equation to compute seismic displacements.

$$\ln(D) = -1.10 - 2.83\ln(k_y) - 0.33(\ln(k_y))^2 + 0.57\ln(k_y)\cdot\ln(S_a) + 3.04\ln(S_a) - 0.24(\ln(S_a))^2 + 1.5T_s + 0.28(M-7) \pm \varepsilon$$

where k_y is yield coefficient; T_s is the initial fundamental period of the sliding mass in seconds; S_a is the 5% damped elastic spectral acceleration of the site's design ground motion at a period of $1.5T_s$ in the unit of g; M is the earthquake's moment magnitude, and ε normally distributed random variable with zero mean and standard deviation (σ) of 0.66. This method is discussed in the ANCOLD Guidelines for Design of Dams and Appurtenant Structures for Earthquake (ANCOLD 2019).

For the RSF2 Stage 9 embankment, the yield coefficient is estimated in LEM analysis and found as equal to 0.180; T_s is calculated using expression $T_s = 2.6H/V_s$. Shear wave velocity in the tailings is expected to be greater than 350 (m/s), and thus, T_s smaller than 0.238 s. S_a is obtained from design spectra for Sites class A and B. The maximum seismic displacement as obtained from this method is summarised in Table 13.2.

13.5.4 Summary of Result

Table 13.2 Maximum Settlement Results for Different Methods

Design ground motion	Maximum settlement by Fells & Pell (mm)	Maximum settlement by Swaisgrood (mm)	Maximum settlement by Bray (mm)
OBE	7	2	3
SEE	44	10	6

The results show that seismic crest settlements for the Stage 9 embankment are negligible with maximum values of less than 44 mm under SEE loading. This is expected due to relatively low seismic features in the area and the geotechnical characteristics of the RSF2.

14. RSF 2 Closure and Rehabilitation

14.1 General Requirements

Closure for the facility will conform to industry standards to develop a final landform that is:

- Physically safe to humans and animals.
- Geotechnically stable.
- Geochemically non-polluting/ non-contaminating.
- Capable of sustaining an agreed post-mining land use.
- Decommissioned and rehabilitated in an ecologically sustainable manner.

Based on these the aims of the closure design are as follows:

- Ancillary infrastructure associated with the RSF2 and stockpiles shall be removed and the RSF2 shall be made safe.
- The closure landform shall be free draining, stable, and non-polluting.
- The cover and landform design shall require minimal ongoing surveillance and maintenance post closure.
- Vegetation used in the closure of the facility shall be self-sustaining.

14.2 RSF 2 Closure Arrangement

Given the location of RSF2 in relation to RSF1 a single closure landform is being developed to assist in the assimilation of the landform into the surrounding topography and optimize water management elements of the design.

14.2.1 External Geometry

The closure arrangement of the RSF 2 involves a range of elements to assist in the successful encapsulation and isolation of tailings from the surrounding environment to assist in the successful rehabilitation of the area to achieve a safe and stable landform. The following design elements are included in the closure of the RSF.

The closure landform for the RSF2 facility will consist of a water-shedding cover as detailed below in Section 14.2.2, this cover will be graded at 1% from the centre of the northern embankment toward the southern, eastern, and western embankment to allow for effective and safe removal of rainfall. The cover then extends down to the downstream face of the existing embankment which will be constructed with a downstream face of 3H:1V. It is recommended a detailed closure plan for the RSF1 and RSF2 storages be prepared following the initiation of construction of the RSF1 Stage 8 embankment raise to detail the closure arrangement, planning and operation requirements for the two facilities.

Further detail as to the combination of RSF1 and RSF2 closure facilities to form a single landform will be assessed during the development of the aforementioned RSF Closure plan.

14.2.2 Capping Arrangement

The capping design for the tailings and embankment will consist of the following items:

- Following the completion of the tailings placement and removal of the decant water, the tailings shall be prepared (allowed to dry and or be compacted by track rolling) such that they have a suitable bearing capacity for the placement of the fill to achieve the final landform and low permeability capping layer.
- Following the conditioning of the tailings, general fill / Zone 3 material will be placed across the tailings to form the closure landform profile and a workable platform for the efficient placement of the clay capping.
- Following reprofiling, a low permeability layer shall be placed over the tailings to reduce the potential for infiltration. The conceptual arrangement of the capping allows for a minimum 0.5 m clay layer across the TSF surface for a low permeability cover, however, alternatives including reduced thickness liners, geosynthetic liner systems or geo-composite liners may be considered during further design stages.

- A 1.0 m waste rock layer will be layered from finer to coarser material directly over the low permeability to form a non-erodible growth medium with topsoil layer placed over the waste rock to form a rock mulch layer on the tailings and embankment and followed by revegetation using local occurring grassland species.

Identification of potential material sources and planning for investigations into the volume and suitability of the materials will be detailed in the aforementioned RSF Closure plan.

14.2.3 Civil Infrastructure Decommissioning

Following the final placement of tailings within the RSF, the civil infrastructure associated with RSF2 including the tailings deposition pipeline can begin to be decommissioned. The decommissioning of the civil infrastructure shall begin with the tailings deposition pipeline while the dewatering infrastructure is used to reduce the size of the pond in each of the cells. Following the removal of the decant ponds the water management infrastructure will be decommissioned including the removal of pipework and infilling and capping of the concrete decant tower.

14.3 Constructability Assessment

14.3.1 Constructability Assessment

The following key construction activities are discussed in this section:

- Dewatering of the Residue Storage Facility.
- Tailings movement and compaction.
- TSF capping construction.

14.3.2 Dewatering of RSF

Dewatering of the existing decant pond within the RSF 2 to remove as much water as reasonably practical will be required prior to construction. All dewatering works are to be undertaken in accordance with existing environmental release requirements.

The dewatering is designed to assist in reducing the saturation of the tailings, improve the workability of the material and reduce the risk of operating machinery bogging on the tailings. As such, an assessment of the bearing capacity of the material is required prior to accessing the area to ensure it is capable of safely accommodating construction equipment.

14.3.3 RSF Capping Construction

Once the tailings / fill material has been successfully dewatered enough as deemed suitable by the design engineer, the construction of the capping over the tailings can commence.

It is proposed that the capping will be constructed using material from the WRE, comprising of material won from mining of the satellite pit.

15. Instrumentation Design

This section outlines the proposed instrumentation to be installed as part of the RSF2 Stage 1 embankment to assist with the safety and performance monitoring of the RSF. The instrumentation for Stage 1 consists of Global Navigation Satellite Systems (GNSS) surface movement monuments distributed across the embankment crest, and AprilTags on the downstream face of the embankment for movement monitoring, pond level monitoring and vibrating wire piezometers across the foundation of the RSF for pressure monitoring.

15.1 Pond Level Indicator

The decant water level is currently monitored in RSF1 visually daily using markers to ensure a minimum beach, the decant level monitoring for RSF2 is proposed to consist of gauge boards installed at the decant finger monitoring the decant level.

15.2 Settlement Monitoring

A GNSS Survey arrangement and AprilTags are proposed to be installed along the crest and downstream face of the embankment as shown in the design drawings in Appendix A. A total of 11 GNSS units are proposed for installation along the crest of the dam to monitor the near real-time movement in three dimensions. A total of 120 AprilTags are proposed to be installed across each of the embankments to be surveyed on a monthly basis using photogrammetry to monitor large-scale movement across the embankment.

15.3 Vibrating Wire Piezometer

An arrangement of Vibrating Wire Piezometers (VWPs) is proposed to be installed at the upstream toe of each of the embankments as shown in the design drawings in Appendix A. A total of 12 VWPs are proposed for installation along the upstream to monitor the pore water through the tailings and the efficiency of the underdrainage system located around the upstream toe.

15.4 Monitoring Frequency

To ensure correct operation, adequate performance, and early identification of failure in the RSF, regular inspection of the facility is required during its operational life. Recommended Inspection Frequencies in accordance with a "**Significant**" Category Dam as outlined in ANCOLD (2019 – Guidelines on Tailings Dams) are shown in Table 15.1 and Monitoring Types and Frequencies as outlined in ANCOLD 2003 in Table 15.2.

Table 15.1 Inspection Types and Frequencies – Significant Consequence Category Dam

Inspection Type	ANCOLD Recommended Frequency	GHD Recommended Frequency
Comprehensive	On First Filling, Every 2 Years	On First Filling, Every 2 Years
Intermediate	Annually to 2-Yearly	Annually
Routine Visual	Twice Weekly to Weekly	Twice Weekly
Special	As Required	As Required

Note 1: Dam owners may undertake a review to determine if a reduced or increased frequency of inspection is acceptable. The review should be carried out by a dams engineer and take into account such matters as Regulator requirements, dam hazard, and risk, type and size of the dam, dam failure modes, and monitoring arrangements.

Table 15.2 Monitoring Types and Frequencies

Monitoring Type	ANCOLD Recommended Frequency	GHD Recommended Frequency
Rainfall	Twice Weekly to Weekly	Daily
Storage Level	Twice Weekly to Weekly	Telemetered - Near-Real-Time
Seepage	Twice Weekly to Weekly	Twice Weekly
Chemical Analysis of Seepage	Consider	Consider*
Pore Pressure	3-Monthly to 6-Monthly	Monthly
Surface Movement Control	5-Yearly to 10-Yearly	Telemetered - Near-Real-Time
Surface Movement Normal	2-Yearly	Telemetered - Near-Real-Time
Internal Movement / Stresses	2-Yearly	N/A
Seismology	Consider	Consider[#]
Post-Tensioning	5-Yearly to 10-Yearly	N/A

Note 1: The frequencies quoted assume manual reading of the instrumentation. Where automated readings are available more frequent reading would be appropriate. (TR- Telemetry recommended) (TC-Telemetry to be considered)

Note 2: Recommended annually for concrete dams, tailings dams, and embankments constructed from, or on, potentially dispersive materials were specified by the designer or safety reviewer

Note 3: The frequency of reading and location of the monitoring instruments need to be at the discretion of the dams engineer. Seismological instruments, where installed, are recommended to be incorporated into state-wide seismic networks.

Note 4: A control survey uses monuments that are remote from the dam site to check the location of the survey monuments at the dam site.

* Chemical analysis of the seepage should be considered on a case by case basis.

TGO should consider subscribing to an earthquake notification service given the risk posed by liquefaction of the tailings.

16. Safety in Design

16.1 Overview

Safety in design is a strategy aimed at preventing injuries by considering hazards as early as possible in the planning and design process, enhancing safety through choices in the design process. A safety in design approach considers the safety of those who construct, operate, maintain, clean, repair, and demolish an asset (includes building, structure, plant, or equipment). Parties involved in the planning and design stage of a project are in a position to reduce the risks that arise during the life cycle of the asset and have a legal requirement to do so.

At each design stage "designers" can make a significant contribution by identifying and eliminating hazards, and reducing likely risks from hazards where elimination is not possible. Often the most cost-effective and practical approach is to avoid introducing a hazard to the workplace in the first place, by eliminating hazards at the design stage.

The definition of "designer" not only affects the actual designer but also those who are connected with the design (e.g. during construction), including parties where the end product is to be used, or could reasonably be expected to be used, as, or at a workplace (e.g. during end use, inspection, operation, cleaning, maintenance, and closure/demolition). Furthermore, the "designer" must ensure, so far as is reasonably practicable, that the plant, substance, or structure is designed to minimize risks to the health and safety of workers where the design is for the purposes of a workplace.

It is, therefore, reasonable to consider the wider practical definition of "designer" to include:

- Design professionals.
- Head contractors, project managers, clients, end-users, and workers.
- Quantity surveyors, insurers, quality assurance staff, work safety professionals, and ergonomics practitioners.
- Suppliers including manufacturers, importers, those who hire plant, constructors, installers, and trades and maintenance, people.

GHD has been engaged to provide the design services described in this report. As such GHD has undertaken a component of the designer's role in this project. In this role, GHD has identified and mitigated a number of potential risks within the limitations of our scope, in consultation with other members of the design team.

During the detailed design phase, a Safety in Design review was carried out by GHD. A number of design improvements were identified to eliminate hazards and improve overall safety. GHD has prepared a summary of the risks identified and mitigation measures adopted or recommended. The risk register is included in Appendix F.

Some residual risks, both safety, and design related have been identified in the risk register. Proposed mitigation measures and responsible parties for implementing these are also identified.

GHD formally hands the responsibility of the residual risks to TGO for further mitigation and trusts that you will complete the safety in design review process for the phases of this project within your responsibility. The safety in design document should be provided to each of the parties who may be identified as being able to influence design. The safety in design risk assessment should be continually updated to reflect the current risks associated with all current activities associated with the asset.

16.2 Stakeholders

The key stakeholders involved in the design, construction and operation of the RSF 2 Stage 1 embankment project are:

- GHD – Designer.
- TGO – Owner.
- TBC – Contractor.

17. Recommendations

The following recommendations are summarised from the report relevant to the RSF2 Stage 1 design to provide guidance for construction, operational phase and closure planning:

Table 17.1 Summary of Recommendations

No.	Recommendations	Section Reference
1	ANCOLD (2019b) also recommends 1:10,000 AEP Maximum Credible Earthquake (MCE) be used in the design of the closure arrangement.	Section 3.6.1
2	It is recommended that shallow monitoring bores be installed around the outside of the embankment of RSF 2 to detect seepage through the foundation. Monitoring bores should be installed to depths of 10 m below ground level (bgl) and at an interval of approximately 250 m around the perimeter of the RSF. Bores should be screened between 2 m depth and the base of the bore.	Section 9.4
3	It is recommended that these models be reviewed with each lift to assess actual settlement with predicted settlement to confirm the effectiveness of the connection drainage system.	Section 11.5.4
4	It is recommended a detailed closure plan for the RSF1 and RSF2 storages be prepared following the initiation of construction of the RSF1 Stage 8 embankment raise to detail the closure arrangement, planning and operation requirements for the two facilities.	Section 14.2
5	TGO should consider subscribing to an earthquake notification service given the risk posed by liquefaction of the tailings.	Section 15.4

18. References

ANCOLD (2012), Guidelines on the Consequence Categories for Dams, (ANCOLD), 2012.

ANCOLD (2019a) Guidelines on Tailings Dams, (ANCOLD), 2019.

ANCOLD (2019b) Guidelines for Design of Dams and Appurtenant Structures for Earthquake (ANCOLD), 2019.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2019.

Coffey Geotechnics (2007) Preliminary Groundwater Investigation, Alkane Exploration Limited, Tomingley NSW

DE Cooper and Associates Pty Ltd (2011) Tomingley Gold Project, Residue Management, Design Report, Rev 1, August 2011

GHD (2020) TGO RSF 2 Concept Design Report, GHD, November 2020

GHD (2021) Tomingley Gold Operations TGO RSF 2 Geotechnical investigation, Geotechnical Factual Report, August 2021

Impax Group (2011) Tomingley Gold Operations Groundwater Assessment

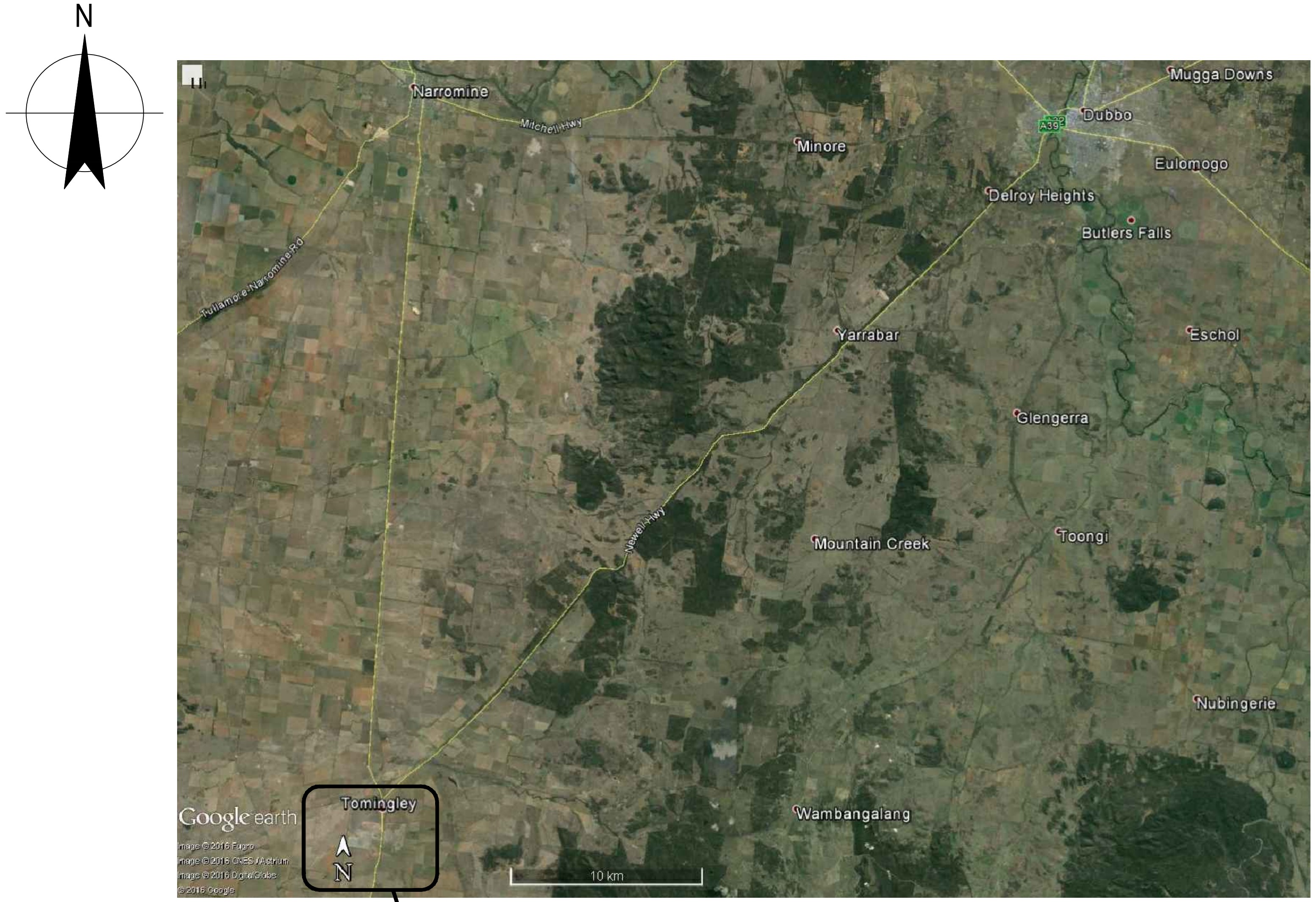
Jacobs (2021) Tomingley Gold Extension Project Groundwater Assessment, Jacobs Australia Pty Limited, September 2021.

Appendices

Appendix A

RSF2 Detailed Design Drawings

TOMINGLEY GOLD MINE
RSF 2 STAGE 1 DETAILED DESIGN
12545239



LOCALITY PLAN

NOT TO SCALE

SITE LOCATION

DRAWING LIST

DRG No.	DRAWING TITLE
12545239-C001	COVER SHEET AND DRAWING LIST
12545239-C002	GENERAL ARRANGEMENT PLAN
12545239-C003	GEOTECHNICAL INVESTIGATION PLAN
12545239-C004	TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 1 OF 4
12545239-C005	TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 2 OF 4
12545239-C006	TYPICAL SECTIONS - SHEET 3 OF 4
12545239-C007	TYPICAL SECTIONS - SHEET 4 OF 4
12545239-C008	MATERIALS SPECIFICATION
12545239-C009	TYPICAL SPILLWAY SECTION AND DETAIL
12545239-C010	INSTRUMENTATION PLAN
12545239-C011	GPS INSTRUMENTATION TYPICAL SECTIONS
12545239-C012	GNSS GPS UNIT DETAILS
12545239-C013	SURVEY REFERENCE APRIL TAG MOUNT
12545239-C014	STAND ALONE APRIL TAG MOUNT DETAILS
12545239-C015	LONGITUDINAL SECTIONS - SHEET 1 OF 5
12545239-C016	LONGITUDINAL SECTIONS - SHEET 2 OF 5
12545239-C017	LONGITUDINAL SECTIONS - SHEET 3 OF 5
12545239-C018	LONGITUDINAL SECTIONS - SHEET 4 OF 5
12545239-C019	LONGITUDINAL SECTIONS - SHEET 5 OF 5
12545239-C020	ULTIMATE TYPICAL SECTIONS
12545239-C021	CONCEPTUAL CLOSURE PLAN
12545239-C022	CONCEPTUAL CLOSURE SECTION AND DETAILS

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title COVER SHEET AND DRAWING LIST
Size **A3**
Drawing No. 12545239-C001
Rev 0

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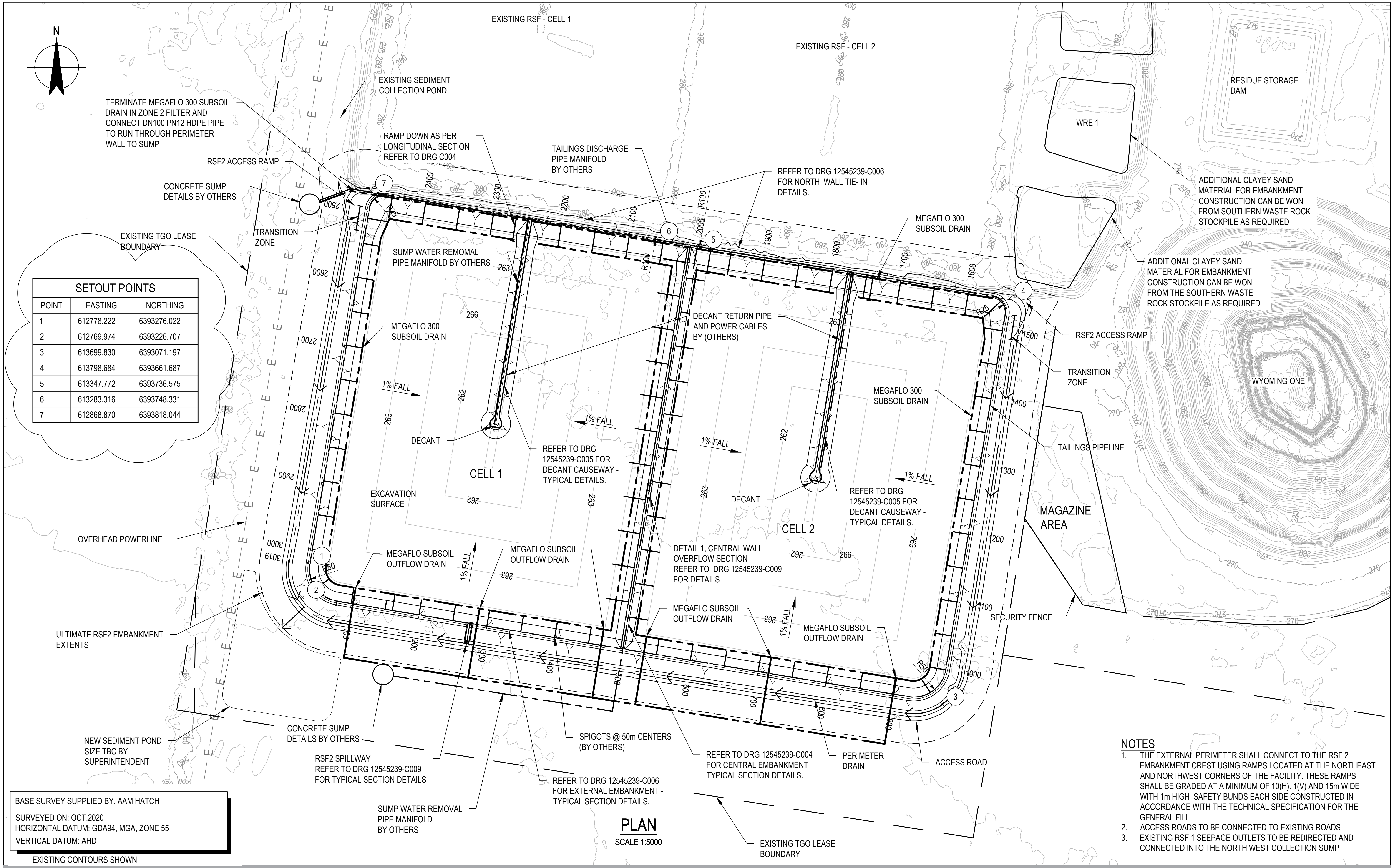

SETOUT POINTS

POINT	EASTING	NORTHING
1	612778.222	6393276.022
2	612769.974	6393226.707
3	613699.830	6393071.197
4	613798.684	6393661.687
5	613347.772	6393736.575
6	613283.316	6393748.331
7	612868.870	6393818.044

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

PLAN

SCALE 1:5000

NOTES

1. THE EXTERNAL PERIMETER SHALL CONNECT TO THE RSF 2 EMBANKMENT CREST USING RAMPS LOCATED AT THE NORTHEAST AND NORTHWEST CORNERS OF THE FACILITY. THESE RAMPS SHALL BE GRADED AT A MINIMUM OF 10(H): 1(V) AND 15m WIDE WITH 1m HIGH SAFETY BUNDS EACH SIDE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION FOR THE GENERAL FILL
2. ACCESS ROADS TO BE CONNECTED TO EXISTING ROADS
3. EXISTING RSF 1 SEEPAGE OUTLETS TO BE REDIRECTED AND CONNECTED INTO THE NORTH WEST COLLECTION SUMP

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23/12/2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title GENERAL ARRANGEMENT PLAN
Size A3
Drawing No. 12545239-C002
Rev 1

Plot Date: 23 December 2021 - 4:23 PM Plotted by: Victoria Jenkins
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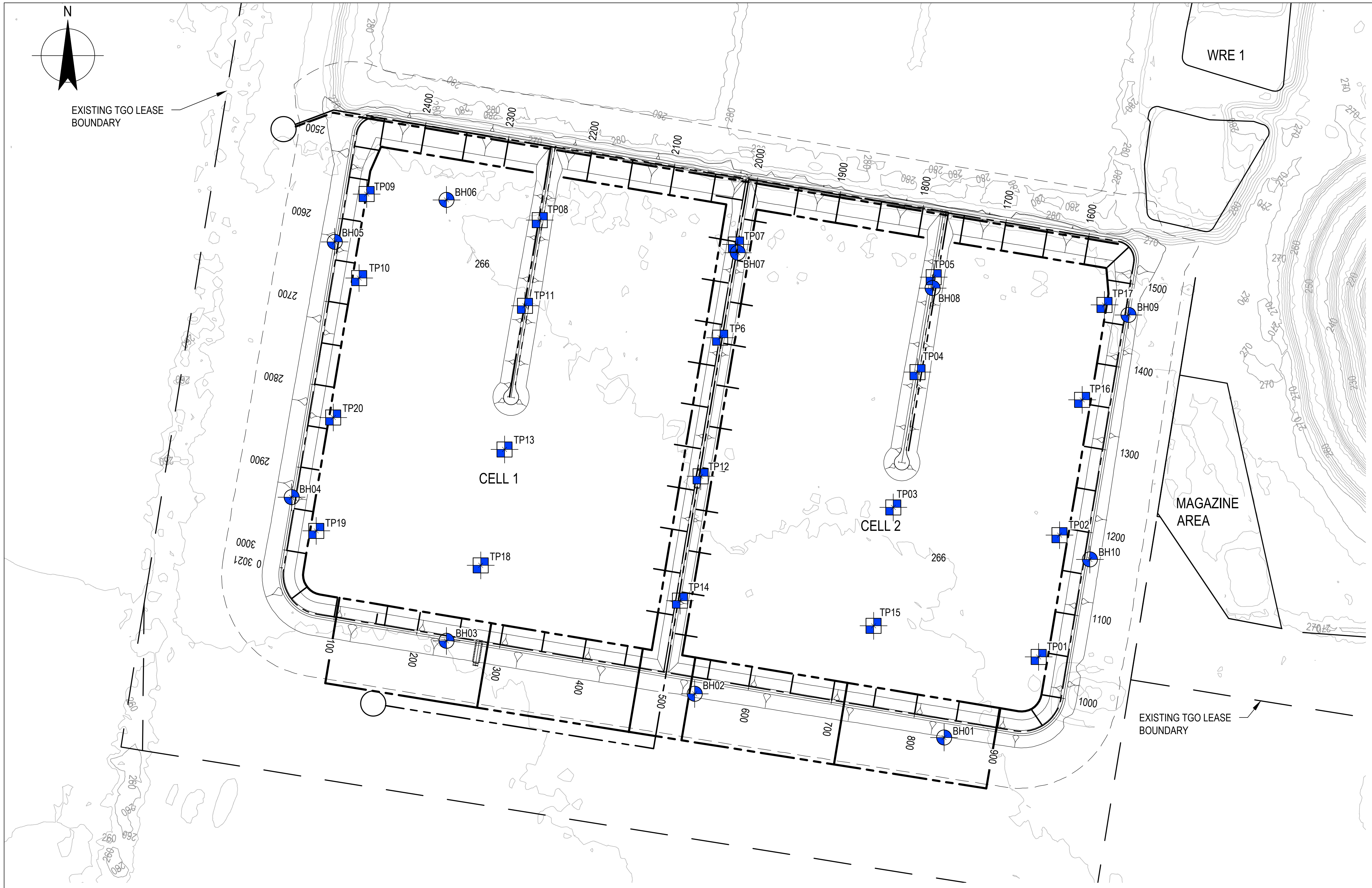

GEOTECHNICAL INVESTIGATION PLAN

SCALE 1:5000

TEST PIT SETOUT POINTS

POINT	EASTING	NORTHING
TP01	613678.800	6393170.000
TP02	613703.700	6393315.000
TP03	613505.900	6393348.000
TP04	613534.700	6393509.000
TP05	613554.000	6393622.000
TP6	613299.900	6393550.000
TP07	613318.800	6393661.000
TP08	613085.400	6393690.000
TP09	612879.500	6393721.000
TP10	612870.500	6393621.000
TP11	613067.700	6393588.000
TP12	613276.800	6393385.000
TP13	613043.500	6393417.000
TP14	613252.200	6393237.000
TP15	613482.500	6393207.000
TP16	613730.600	6393476.000
TP17	613757.100	6393589.000
TP18	613015.100	6393279.000
TP19	612819.500	6393320.000
TP20	612839.700	6393455.000

BOREHOLE SETOUT POINTS

POINT	EASTING	NORTHING
BH01	613566.300	6393074.000
BH02	613269.700	6393126.000
BH03	612974.400	6393189.000
BH04	612790.100	6393360.000
BH05	612841.400	6393664.000
BH06	612974.400	6393714.000
BH07	613320.900	6393651.000
BH08	613552.700	6393609.000
BH09	613785.600	6393577.000
BH10	613739.800	6393286.000

LEGEND:

⊕	BOREHOLE
▣	TEST PIT

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55

VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

0 50 100 150m

SCALE 1:5000 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author	P. BURBURY	Drafting Check	C. LONG
Designer	T. RIDGWAY	Design Check	R. LONGEY

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Project RSF 2 DETAILED DESIGN

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Drawing Title GEOTECHNICAL INVESTIGATION PLAN

Size A3

Drawing No. 12545239-C003

Rev 0

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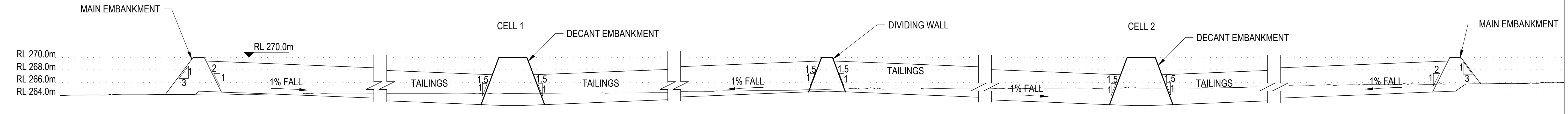


LONGITUDINAL SECTION - STAGE 1 DAM

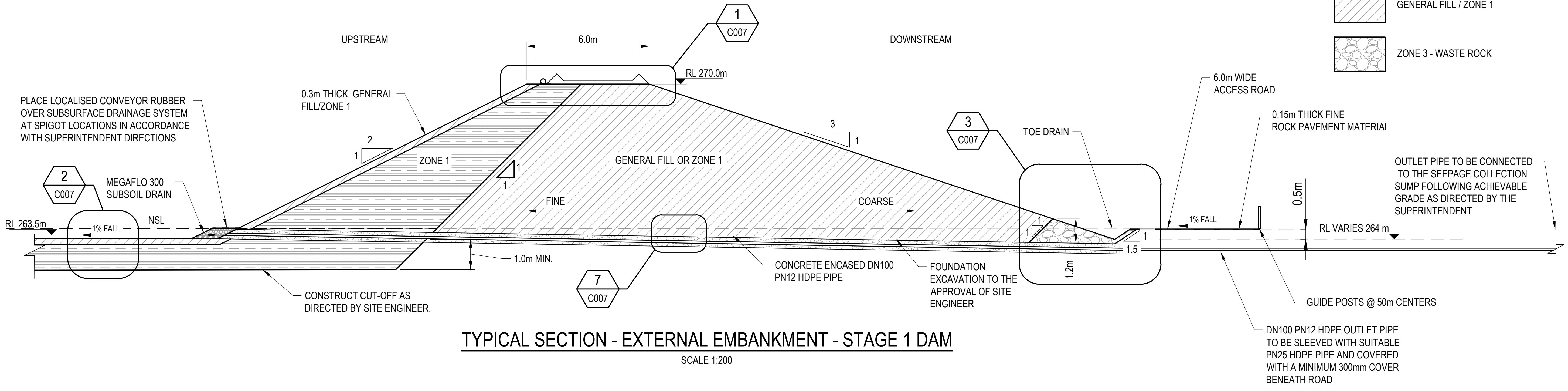
SCALE 1:2000 H/1:500 V

LEGEND:

▤ ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK

▨ GENERAL FILL / ZONE 1

▦ ZONE 3 - WASTE ROCK

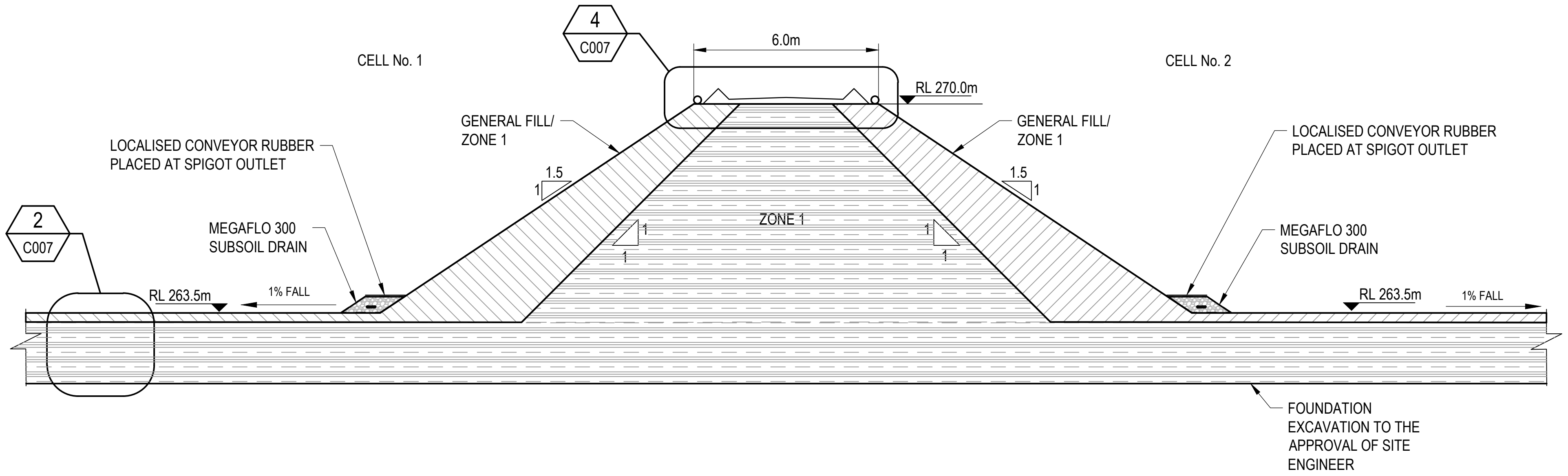


TYPICAL SECTION - EXTERNAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200

NOTES

1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
2. PROVIDE MINIMUM 0.5 OVERLAPS ON GEOFABRIC EDGES AND JOINTS



TYPICAL SECTION - CENTRAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

VERTICAL SCALE 1:500 AT ORIGINAL SIZE 0 5 10 15m
HORIZONTAL SCALE 1:2000 AT ORIGINAL SIZE 0 20 40 60m

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Drawing Title TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 1 OF 4
Size A3
Drawing No. 12545239-C004
Rev 0

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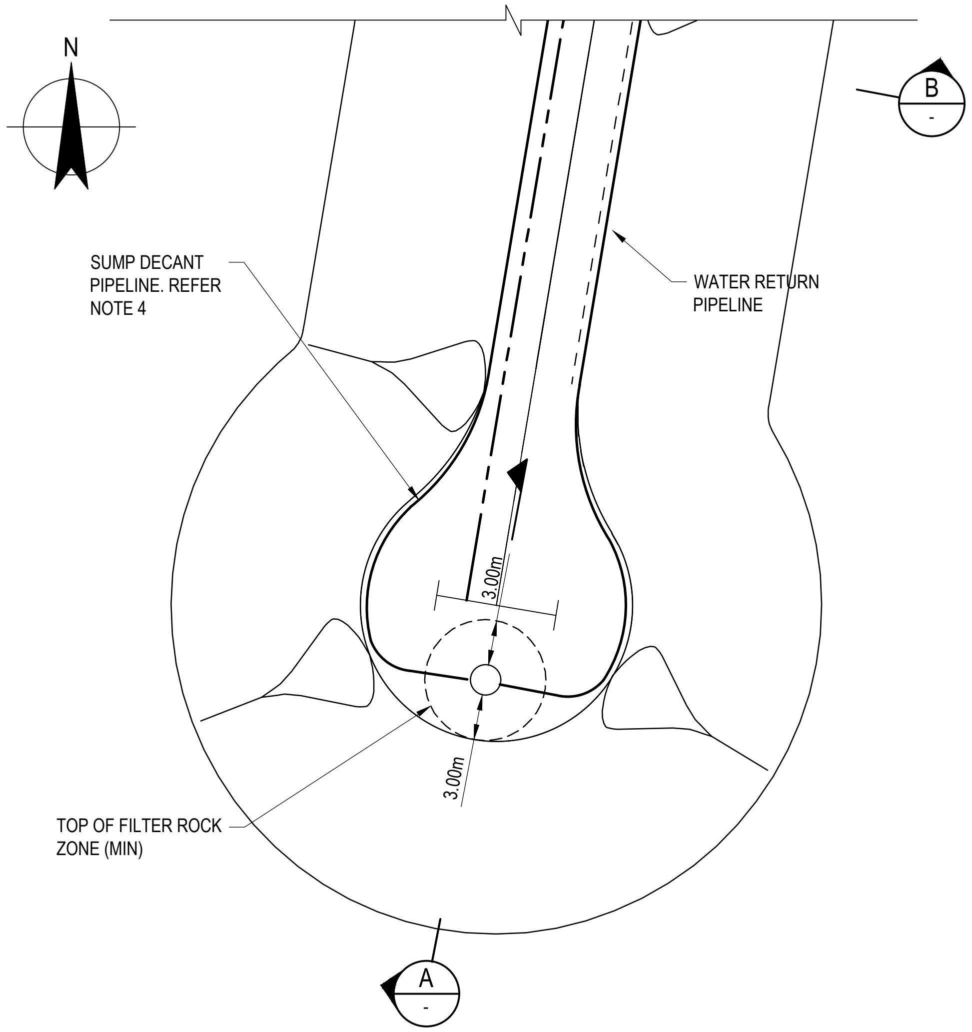
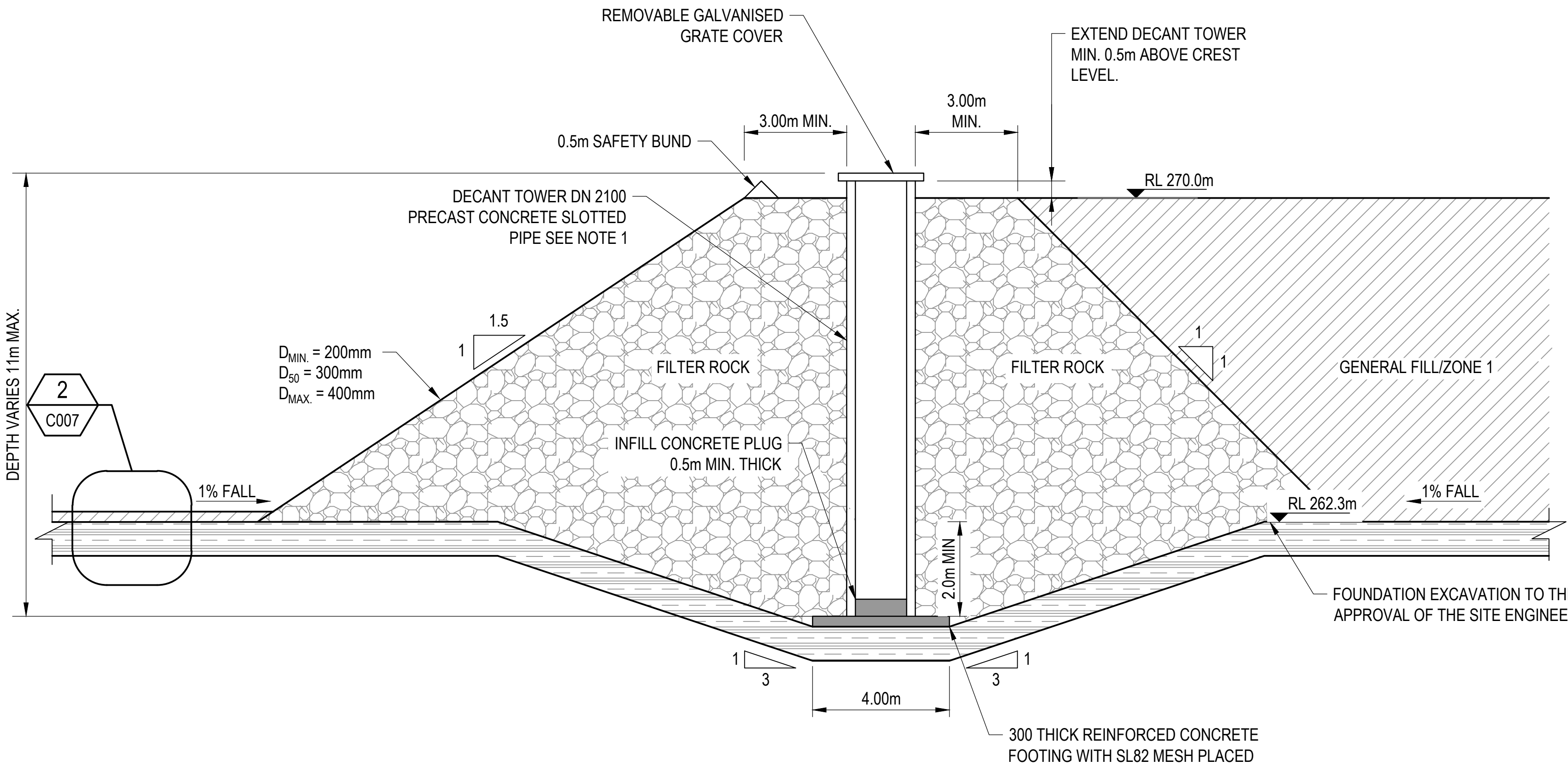


DECANT TOWER PLAN

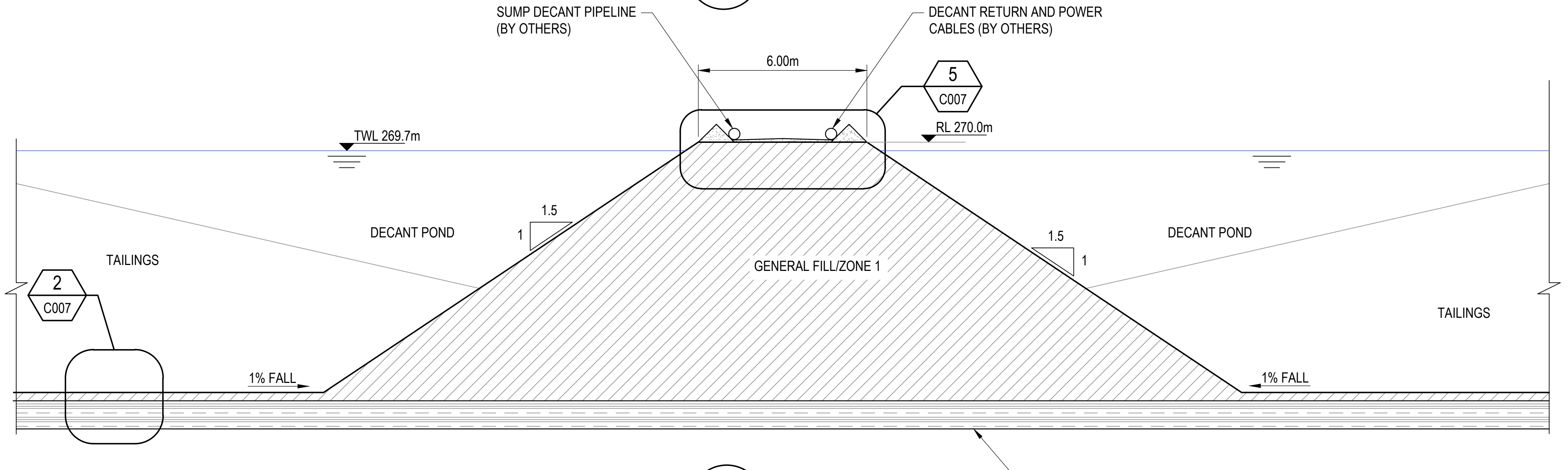
SCALE 1 : 500



A SECTION

-

SCALE 1 : 200



B SECTION

-

SCALE 1 : 200

FOUNDATION EXCAVATION TO THE APPROVAL OF THE SITE ENGINEER

LEGEND:

▤ ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK

▨ GENERAL FILL / ZONE 1

░ ZONE 3 - WASTE ROCK

NOTES

1. PRECAST CONCRETE DECANT UNITS (OR APPROVED EQUIVALENT). DN 2100, 600 HIGH CLASS 8 UNITS. EACH UNIT TO HAVE 40 SLOTS WITH SLOT DIMENSIONS OF 200 x 70mm
2. MINIMUM OPERATIONAL PUMP CAPACITY TO ACHIEVE 22L/s
3. ADDITIONAL EMERGENCY PUMP CAPACITY TO BE MAINTAINED BY THE MINE TO ACHIEVE 50ML/Day
4. SUMP DECANT PIPELINE IS FOR CELL 2 DECANT WALL ONLY

Rev	Description	Checked	Approved	Date
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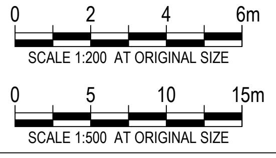
Author P. BURBURY Drafting Check C. LONG

Designer T. RIDGWAY Design Check R. LONGEY



SCALE 1:200 AT ORIGINAL SIZE

SCALE 1:500 AT ORIGINAL SIZE

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Drawing Title TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 2 OF 4

Size A3

Drawing No. 12545239-C005

Rev 0

Plot Date: 17 December 2021 - 1:12 PM Plotted by: Melvin Agomuoh

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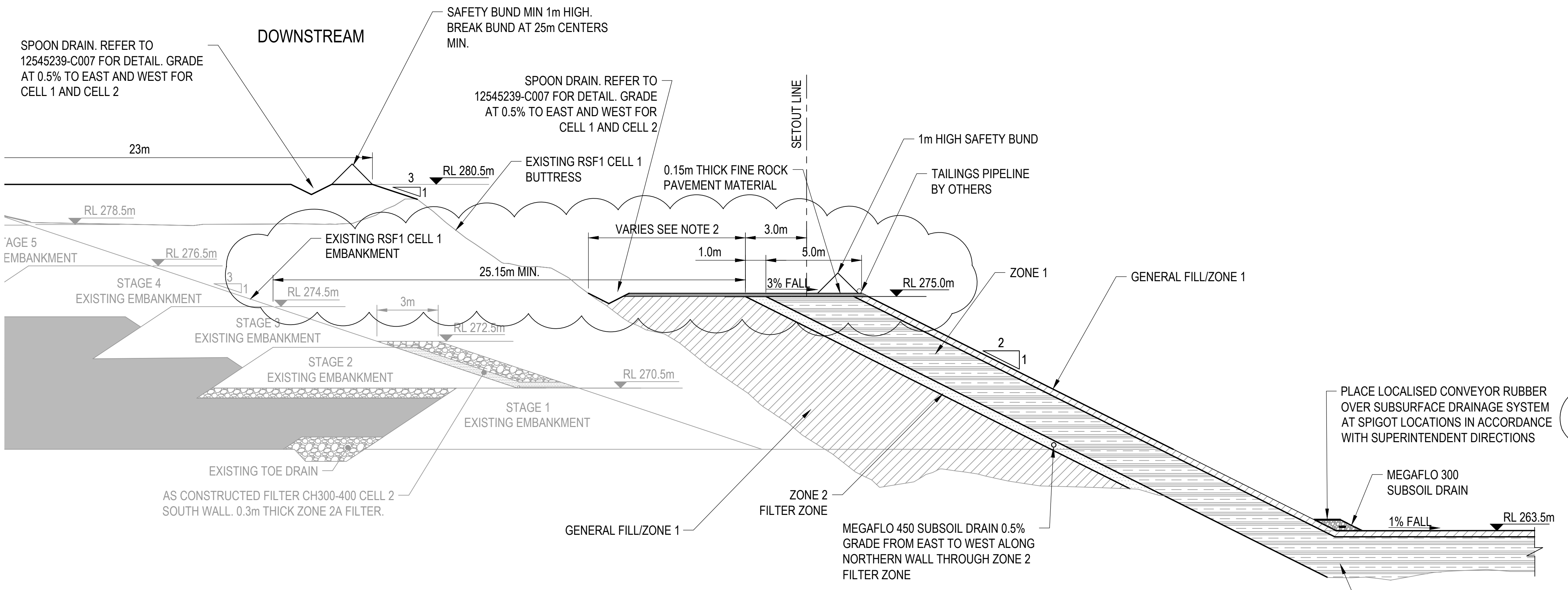
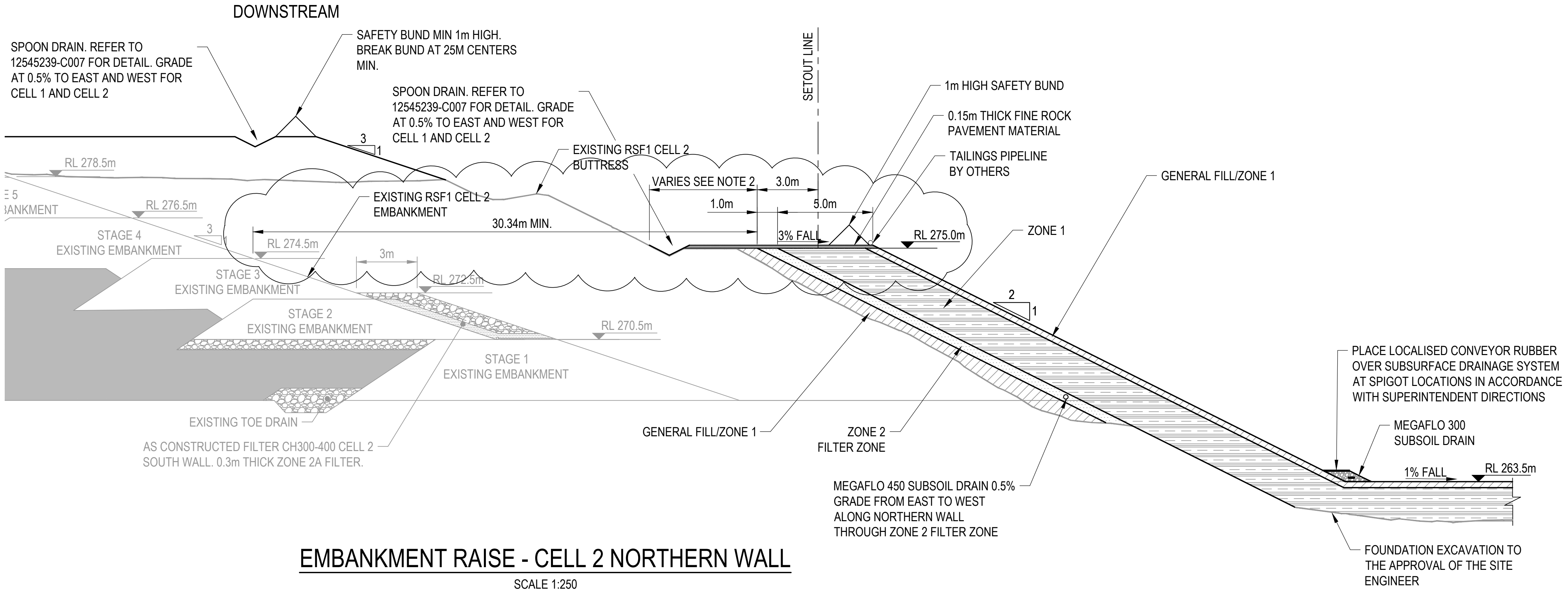


EMBANKMENT RAISE - CELL 1 NORTHERN WALL

SCALE 1:250



EMBANKMENT RAISE - CELL 2 NORTHERN WALL

SCALE 1:250

LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▩	ZONE 3 - WASTE ROCK
░	ZONE 2 FILTER ZONE

NOTES

1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
2. SETOUT OF GENERAL FILL TO BE DONE IN RELATION TO RSF 2 SETOUT. FINAL WIDTH TO BE DETERMINED ON SITE BASED ON CONDITIONS FOUND.
3. EXISTING RSF 1 SEEPAGE OUTLETS TO BE REDIRECTED AND CONNECTED INTO THE NORTH WEST COLLECTION SUMP

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23/12/2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 EMBANKMENT DETAILED DESIGN

Status
Status Code

Drawing Title TYPICAL SECTIONS
SHEET 3 OF 4

Size A3

Drawing No. 12545239-C006
Rev 1

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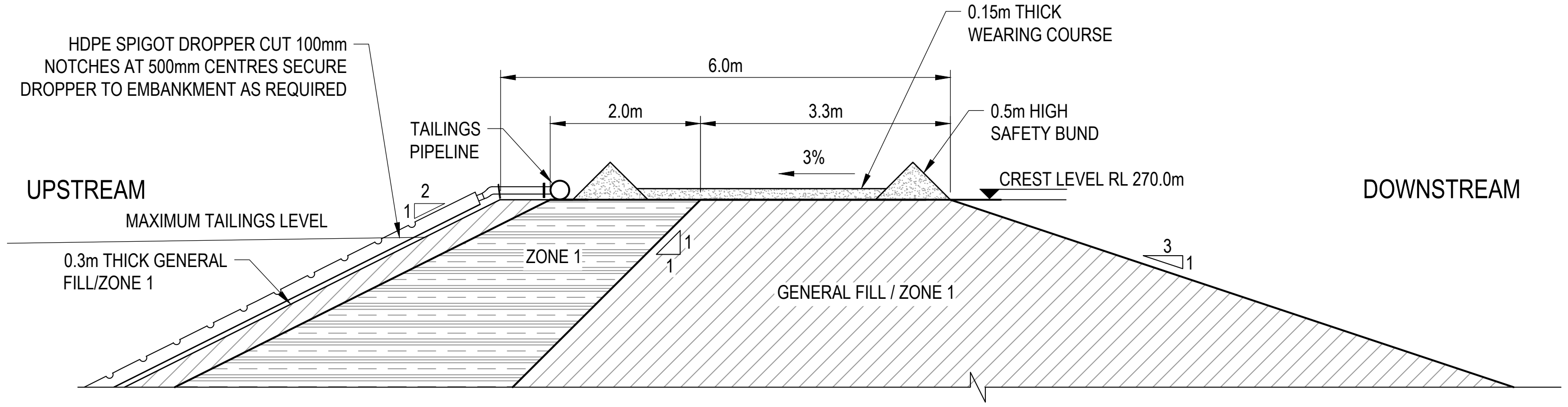
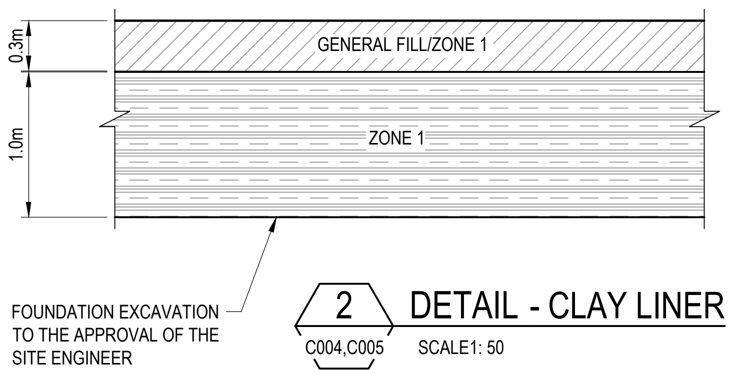


1 DETAIL - EXTERNAL EMBANKMENT

C004 SCALE 1 : 100



2 DETAIL - CLAY LINER

C004,C005 SCALE1: 50

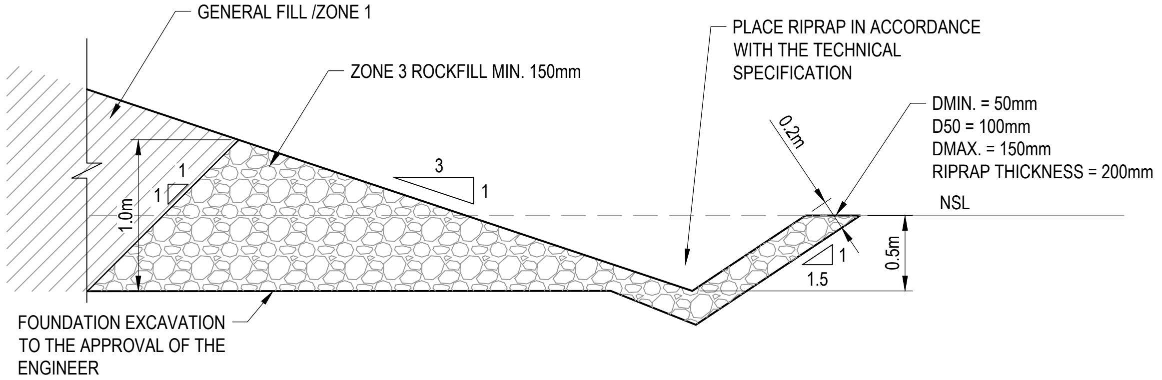
LEGEND:

▤ ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK

▨ GENERAL FILL / ZONE 1

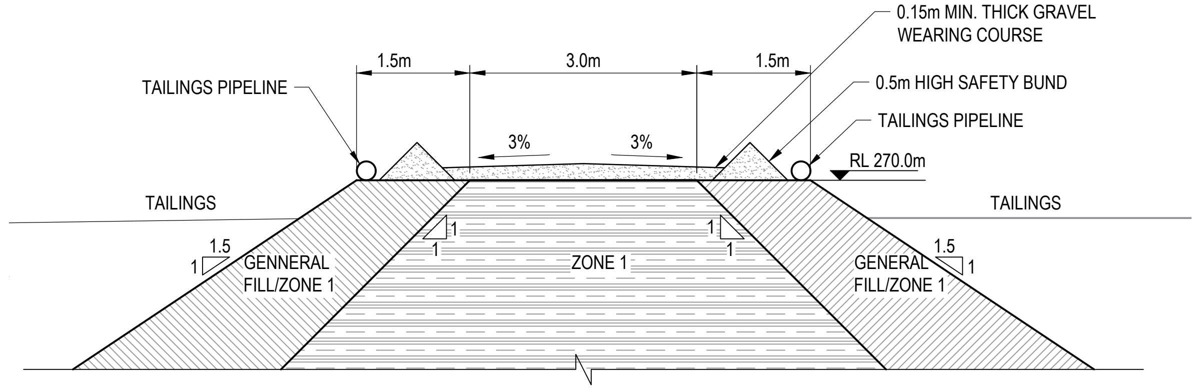
NOTES

1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION AND ASSESSED BY A QUALIFIED GEOTECHNICAL ENGINEER
2. ALL EARTHWORK MATERIALS SHALL BE IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS
3. THE EXTERNAL PERIMETER SHALL CONNECT TO THE RSF 2 EMBANKMENT CREST USING RAMPS LOCATED AT THE NORTHEAST AND NORTHWEST CORNERS OF THE FACILITY. THESE RAMPS SHALL BE GRADED AT A MINIMUM OF 10(H): 1(V) AND 15m WIDE WITH 1m HIGH SAFETY BUNDS EACH SIDE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION FOR THE GENERAL FILL
4. CENTRAL WALL DECANT TO BE GRADED AT 3% FROM CELL 2 TO CELL 1



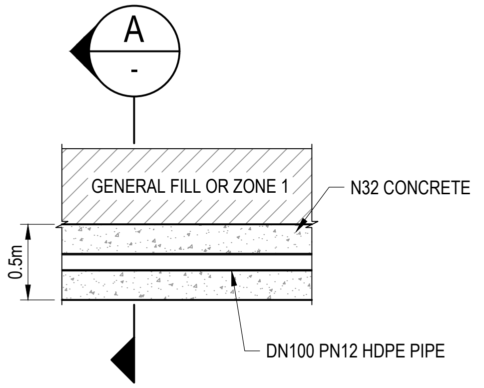
3 DETAIL -TOE DRAIN (HDPE PIPE NOT SHOWN)

C004,C011,C020 SCALE1: 50



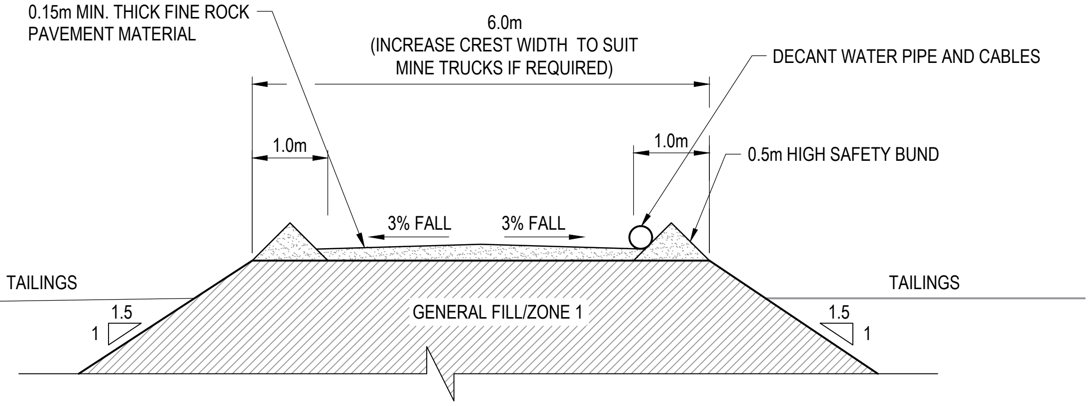
4 DETAIL - CENTRAL EMBANKMENT

C004 SCALE 1 : 100



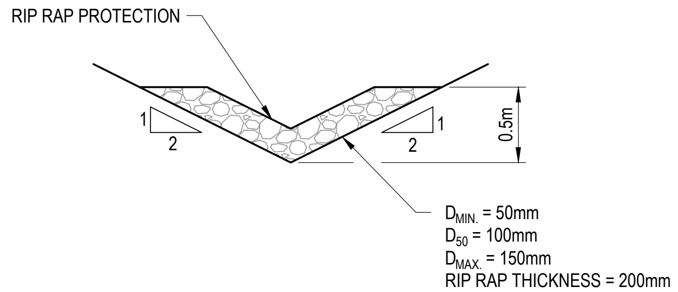
7 DETAIL - UNDER DRAINAGE OUTLET PIPE CONCRETE ENCASEMENT

C004,C009,C011 SCALE1: 50



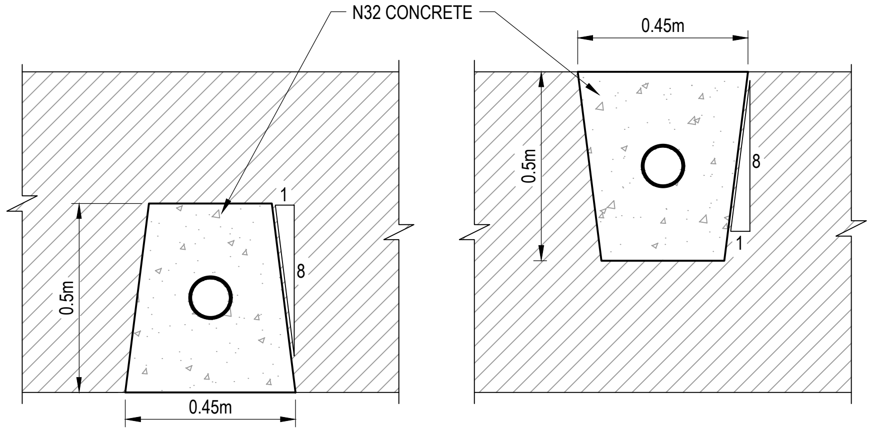
5 DETAIL - DECANT EMBANKMENT

C005 SCALE 1 : 100



6 DETAIL - SPOON DRAIN TYPICAL DETAIL

C006,C011 SCALE1: 50



A SECTION - ABOVE GROUND CONCRETING -BELOW GROUND CONCRETING

SCALE 1 :20

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 0.2 0.4 0.6m
SCALE 1:20 AT ORIGINAL SIZE

0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

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Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN

Drawing Title TYPICAL SECTIONS SHEET 4 OF 4

Size A3

Status
Status Code

Drawing No. 12545239-C007
Rev 0

Plot Date: 17 December 2021 - 1:16 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C007.dwg

TABLE 1 - MATERIAL CONSTRUCTION REQUIREMENTS

MATERIAL	DESCRIPTION	CONSTRUCTION REQUIREMENTS
ZONE 1	EXTREMELY WEATHERED SANDY CLAY OR CLAYEY SAND MATERIAL WON FROM THE FOUNDATION EXCAVATIONS, MEETING SPECIFICATIONS SETOUT IN TABLE 2.	• SPREAD IN LAYERS 150mm THICK AFTER COMPACTION. • COMPACT WITH MINIMUM 6 PASSES OF A 10 TONNE VIBRATING PAD FOOT ROLLER TO NO LESS THAN 98% MAX. DRY DENSITY (MDD). • SANDY CLAY TO BE PLACED BETWEEN 1% DRY & 3% WET OF OPTIMUM MOISTURE CONTENT (OMC)
ZONE 1/GENERAL FILL	EXTREMELY WEATHERED SANDY CLAY OR CLAYEY SAND TO GRAVELLY CLAY MATERIAL WON FROM THE FOUNDATION EXCAVATIONS, MEETING SPECIFICATIONS SET OUT IN TABLE 2.	• SPREAD IN LAYERS 300mm THICK AFTER COMPACTION • COMPACT WITH MINIMUM 6 PASSES OF A 10 TONNE VIBRATING PAD FOOT ROLLER NO LESS THAN 95% MAX. DRY DENSITY (MDD). • SANDY CLAY TO BE PLACED BETWEEN 1% DRY AND 3% WET OF OPTIMUM MOISTURE CONTENT (OMC)
ZONE 2	SAND MATERIAL SOURCED FROM CRUSHED ROCK IN ACCORDANCE WITH THE MATERIAL SPECIFICATIONS SET OUT IN SECTION 6.3 OF THE TECHNICAL SPECIFICATION.	• FILTER SAND TO BE PLACED IN ACCORDANCE WITH THE SPECIFICATION SET OUT IN SECTION 6.3 OF THE TECHNICAL SPECIFICATION.

TABLE 2 - GHD SPECIFICATION

REQUIRED PROPERTIES OF ZONE 1 FILL AFTER COMPACTION	
MINIMUM % BY WEIGHT PASSING 0.075mm AS 1152 SIEVE	30
MINIMUM % BY WEIGHT PASSING 0.3mm AS 1152 SIEVE	70
MINIMUM % BY WEIGHT PASSING 1.18mm AS 1152 SIEVE	80
MINIMUM PLASTICITY INDEX (%) (AS 1289.3.3.1)	15
LAYER THICKNESS	150mm
PERMEABILITY	K < 1 X 10^(-9) m's (SATURATED)
REQUIRED PROPERTIES OF GENERAL FILL AFTER COMPACTION	
MINIMUM % BY WEIGHT PASSING 0.075mm AS 1152 SIEVE	20 (REFER NOTE 2)
MINIMUM % BY WEIGHT PASSING 0.3mm AS 1152 SIEVE	40
MINIMUM % BY WEIGHT PASSING 1.18mm AS 1152 SIEVE	60
LAYER THICKNESS	300mm
PERMEABILITY	K < 1 X 10^(-7) m/s (SATURATED). (REFER NOTE 2).

NOTE 2: IF MATERIALS MEET THE REQUIRED PERMEABILITY SPECIFICATION THEN THIS CAN SUPERCEDE THE REQUIRED GRADING SPECIFICATION.

TABLE 3 - FOUNDATION PREPARATION

MATERIAL	REQUIREMENTS
STORAGE FOUNDATION	STORAGE FOUNDATION TO BE PREPARED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION

TABLE 4 - MATERIAL TESTING REQUIREMENTS FOR SANDY CLAY/ CLAYEY SAND

TEST DETAILS	MINIMUM TEST FREQUENCY/ VOLUME PLACE (m^3)
FIELD DENSITY & HILF COMPACTION OR STANDARD COMPACTION	EVERY 300mm AND 1,000m^3/5,000m^3)
ATTERBERG LIMITS	1,000m^3/5,000m^3
PARTICLE SIZE DISTRIBUTION	1,000m^3/5,000m^3
EMERSON CLASS TESTING - PROCESS WATER	5,000m^3/10,000m^3
EMERSON CLASS TESTING - FRESH WATER	5,000m^3/10,000m^3
TRIAXIAL	10,000m^3/20,000m^3
PERMEABILITY	5,000m^3/10,000m^3
EMBANKMENT FOUNDATION TESTING REQUIREMENTS	
PUSH TUBE SAMPLING AND TRIAXIAL TESTING	1 EVERY 500m

Rev	Description	Checked	Approved	Date
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Author P. BURBURY **Drafting Check** C. LONG
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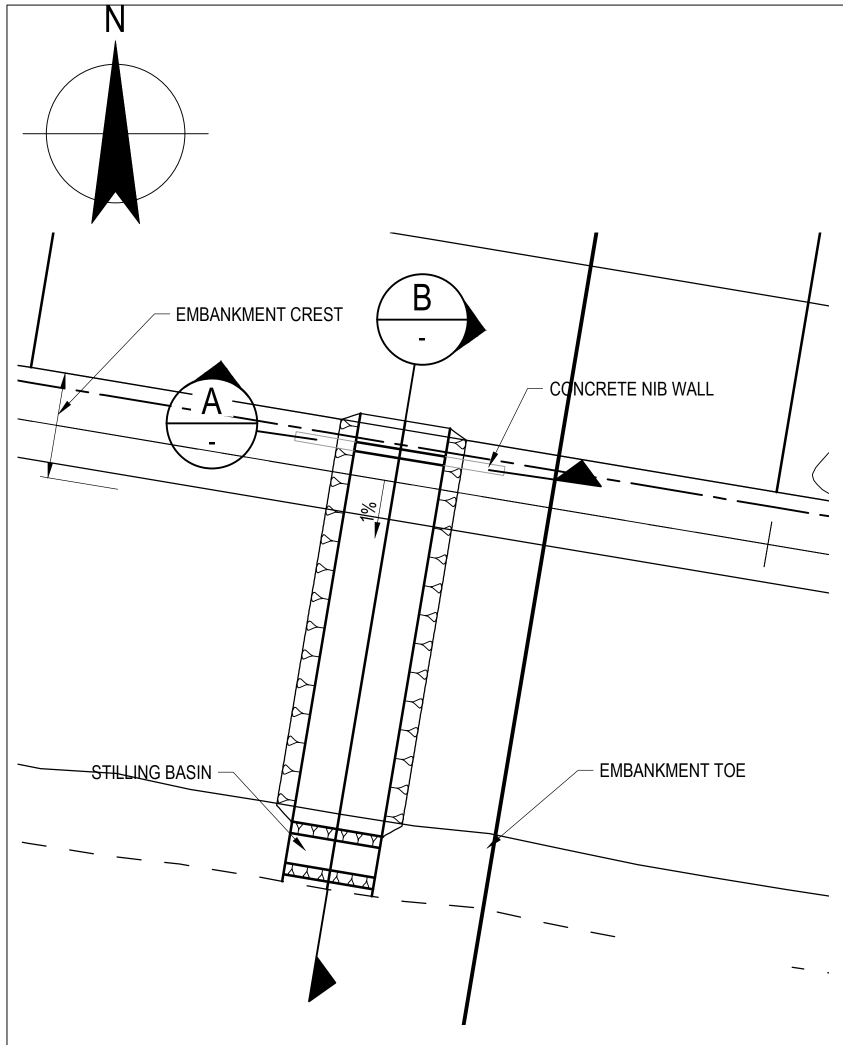
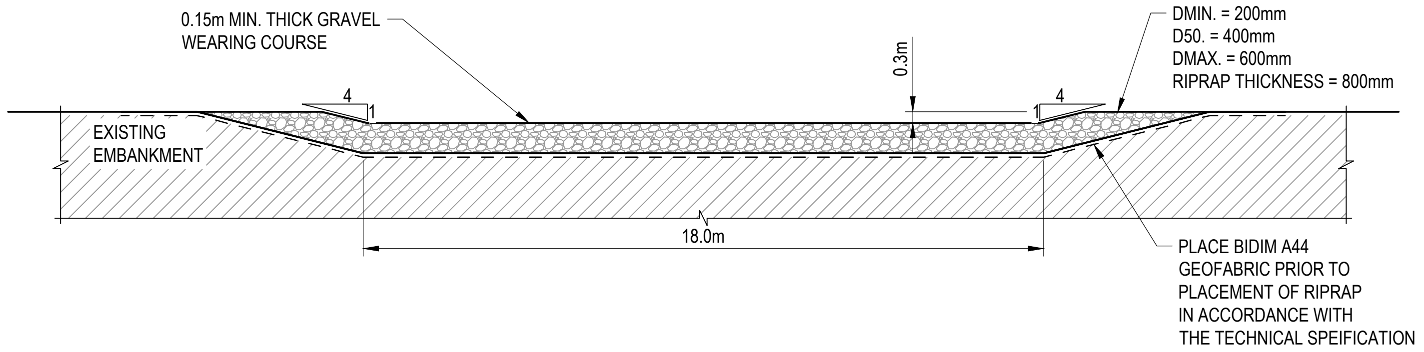
Status Code

Drawing Title MATERIALS SPECIFICATION
Size A3
Drawing No. 12545239-C008
Rev 0



CELL 1 SPILLWAY PLAN

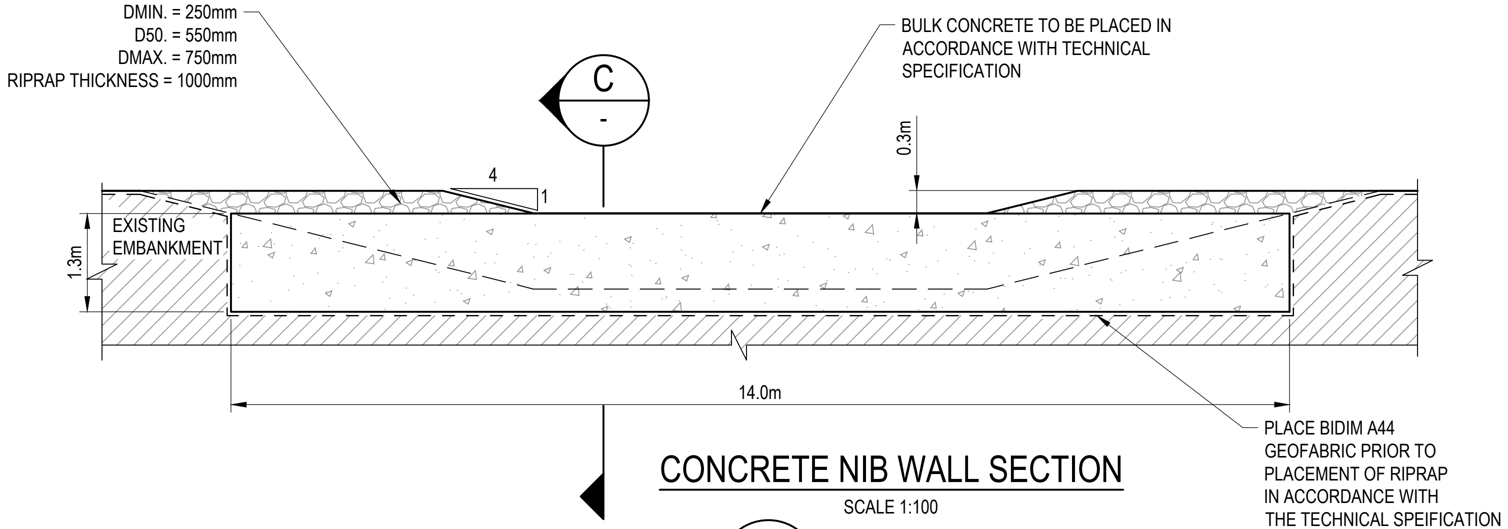
SCALE 1:500



1 DETAIL - CENTRAL WALL OVERFLOW

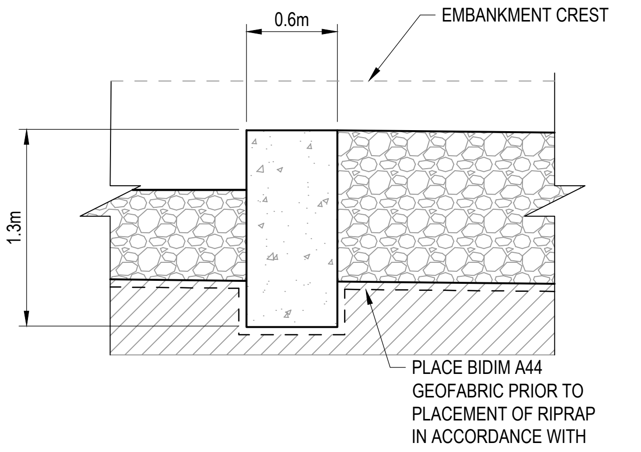
C002

SCALE 1 : 200



CONCRETE NIB WALL SECTION

SCALE 1:100



C SECTION

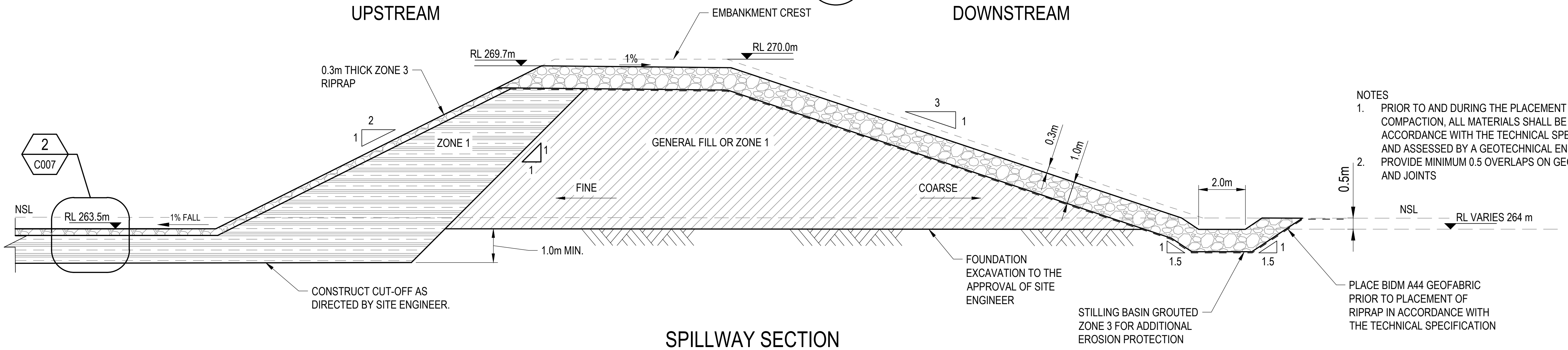
-

SCALE 1 :50

A SECTION

-

SCALE 1 :100



SPILLWAY SECTION

SCALE 1:200

LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▩	ZONE 3 - WASTE ROCK

NOTES

1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
2. PROVIDE MINIMUM 0.5 OVERLAPS ON GEOFABRIC EDGES AND JOINTS

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE

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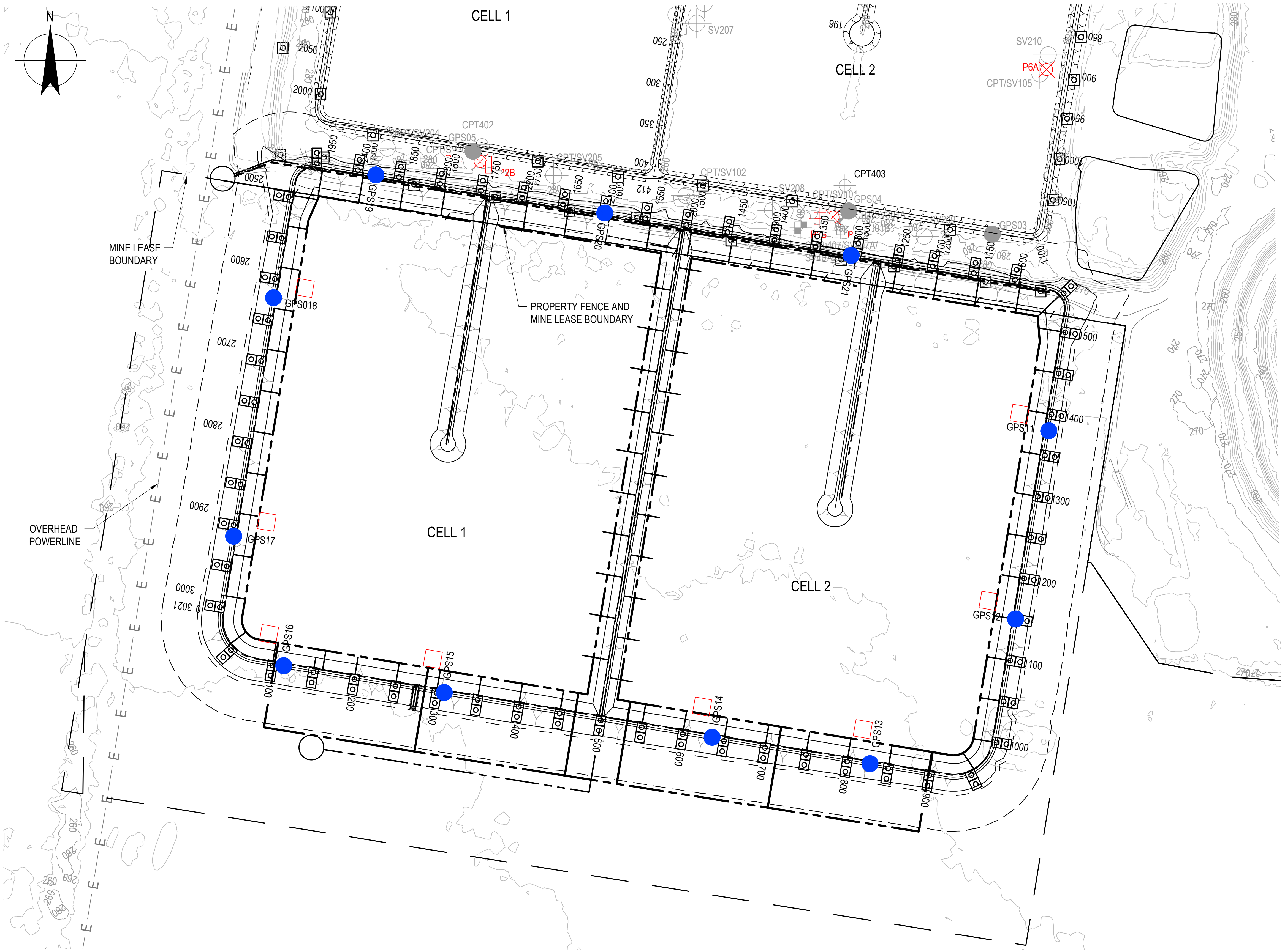
Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title TYPICAL SPILLWAY SECTION AND DETAIL

Size A3

Drawing No. 12545239-C009
Rev 0

Plot Date: 17 December 2021 - 1:22 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C009.dwg



PROPOSED GPS SURVEY LOCATIONS

POINT	EASTING	NORTHING
GPS11	613772.756	6393495.126
GPS12	613733.223	6393268.255
GPS13	613558.114	6393094.898
GPS14	613368.352	6393126.634
GPS15	613046.595	6393180.445
GPS16	612853.942	6393212.664
GPS17	612793.650	6393368.276
GPS018	612841.610	6393655.048
GPS19	612964.450	6393802.685
GPS20	613239.498	6393756.948
GPS21	613535.455	6393705.913

LEGEND:

—	VIBRATING WIRE PIEZOMETER CABLE
☒	SET A PIEZOMETERS - PUSH IN FROM STAGE 4 CREST
⊕	SET B PIEZOMETERS - PUSH IN FROM BUTTRESS
⊡	APRILTAG LOCATION
● GPSXX	GPS SURVEY MONUMENT - NEW
● GPSXX	GPS SURVEY MONUMENT - EXISTING
☐	VIBRATING WIRE PIEZOMETER

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

INSTRUMENTATION PLAN

SCALE 1:5000

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project TGO RSF STAGE 8 RAISE RL284.5m

Status

Status Code

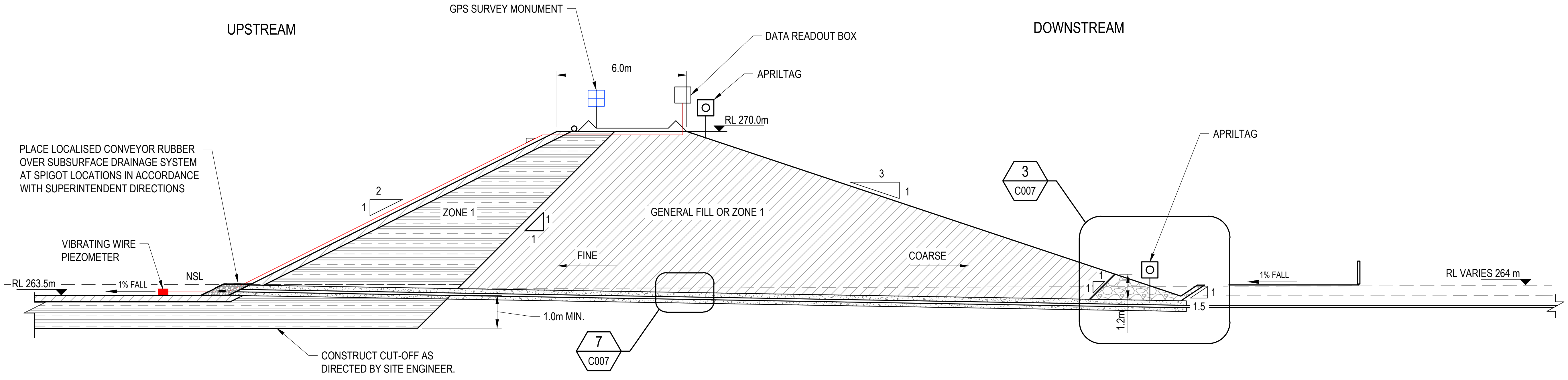
Drawing Title INSTRUMENTATION PLAN

Size A3

Drawing No. 12545239-C010

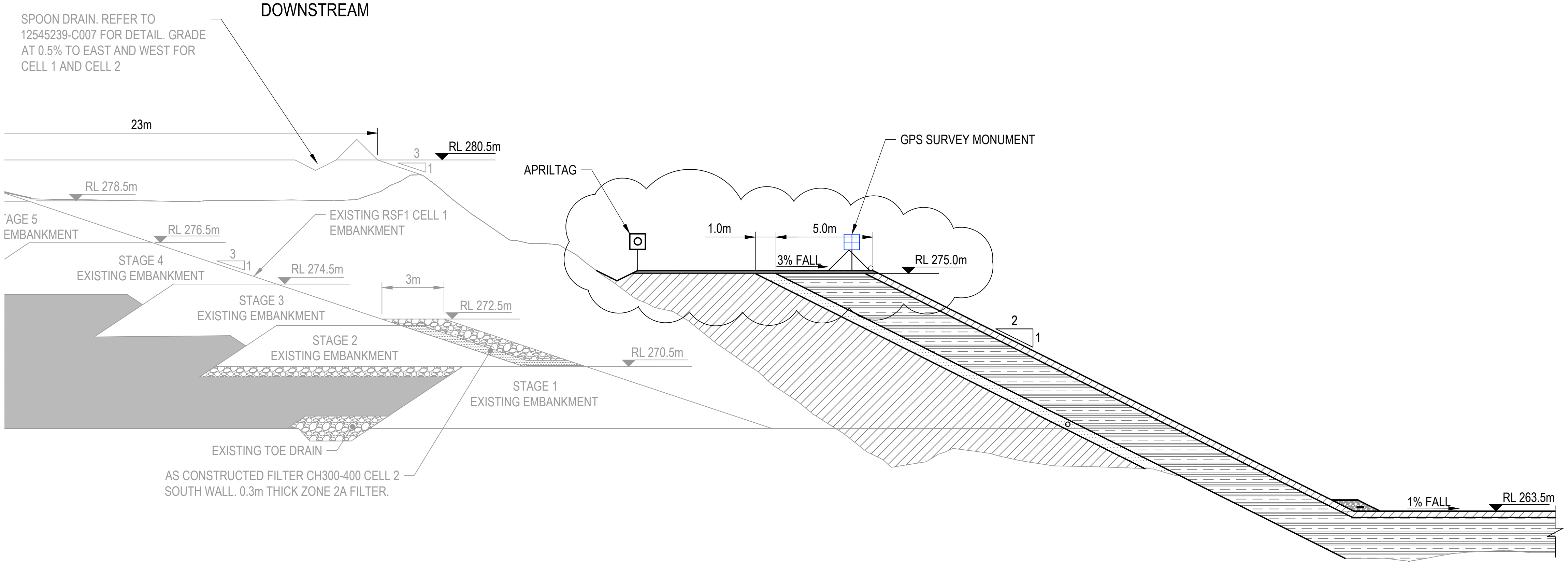
Rev 0

Plot Date: 17 December 2021 - 1:33 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C010.dwg



TYPICAL SECTION - EXTERNAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200



EMBANKMENT RAISE - CELL 1 NORTHERN WALL

SCALE 1:250

LEGEND:

─	VIBRATING WIRE PIEZOMETER CABLE
□	DATA READOUT BOX
⊞	GPS SURVEY MONUMENT
⊡	APRILTAG

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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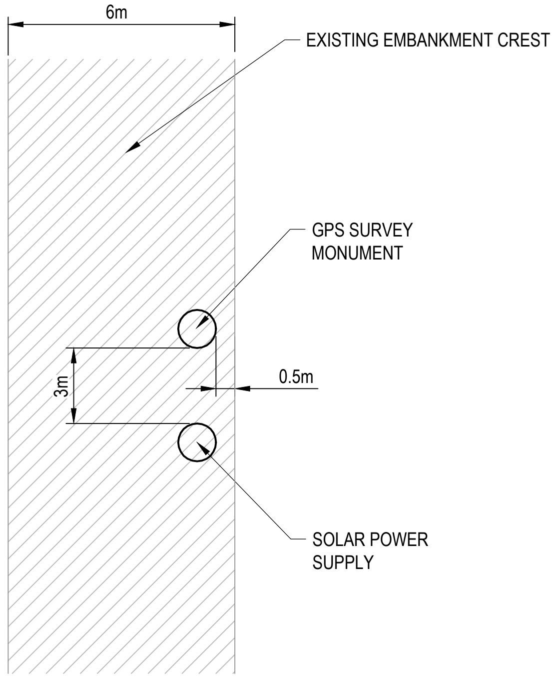
Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD
Project TGO RSF STAGE 8 RAISE RL284.5m
Status
Status Code

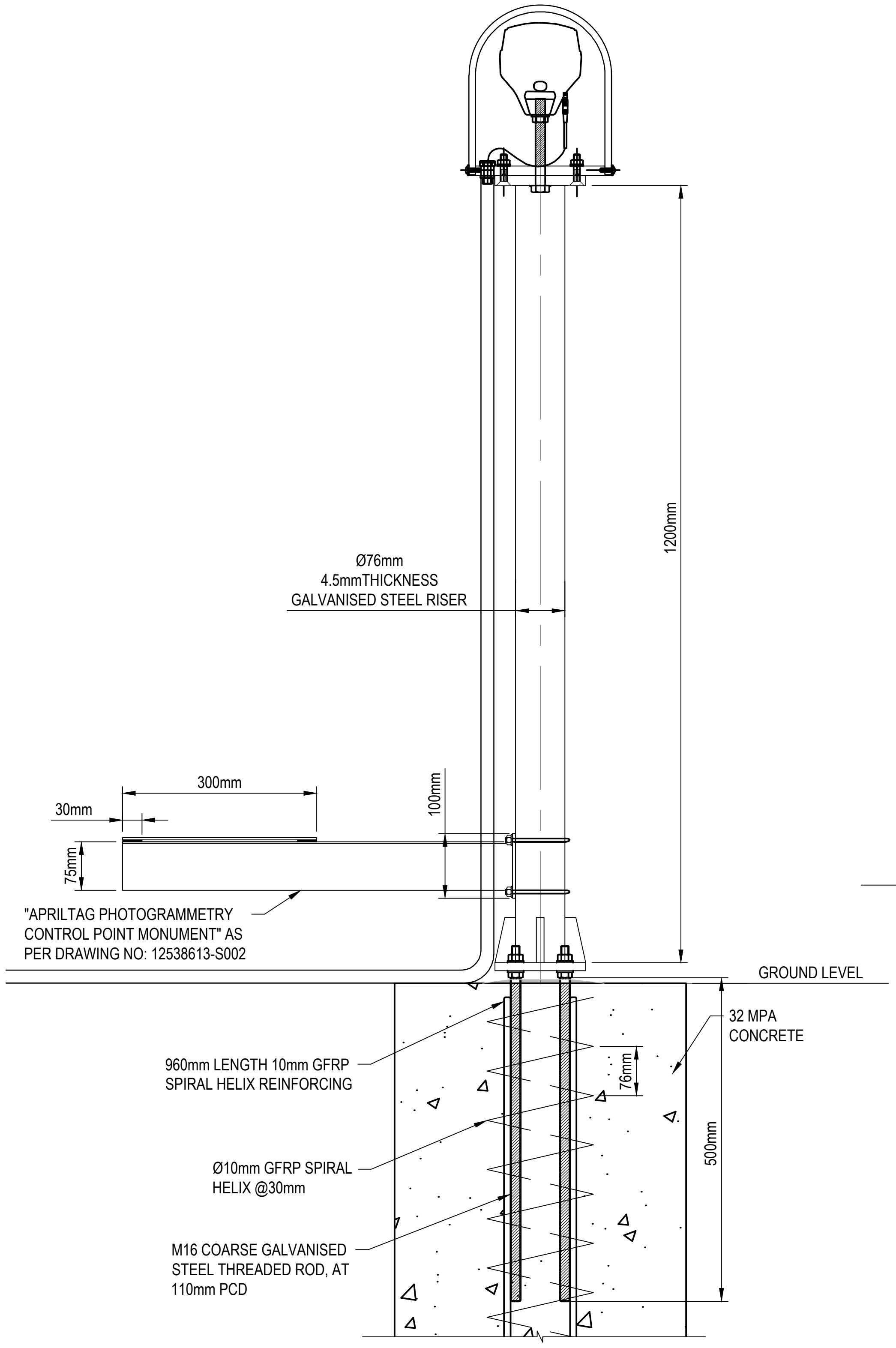
Drawing Title GPS INSTRUMENTATION
TYPICAL SECTIONS
Size A3
Drawing No. 12545239-C011
Rev 1

Plot Date: 23 December 2021 - 4:30 PM Plotted by: Victoria Jenkins
File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C011.dwg



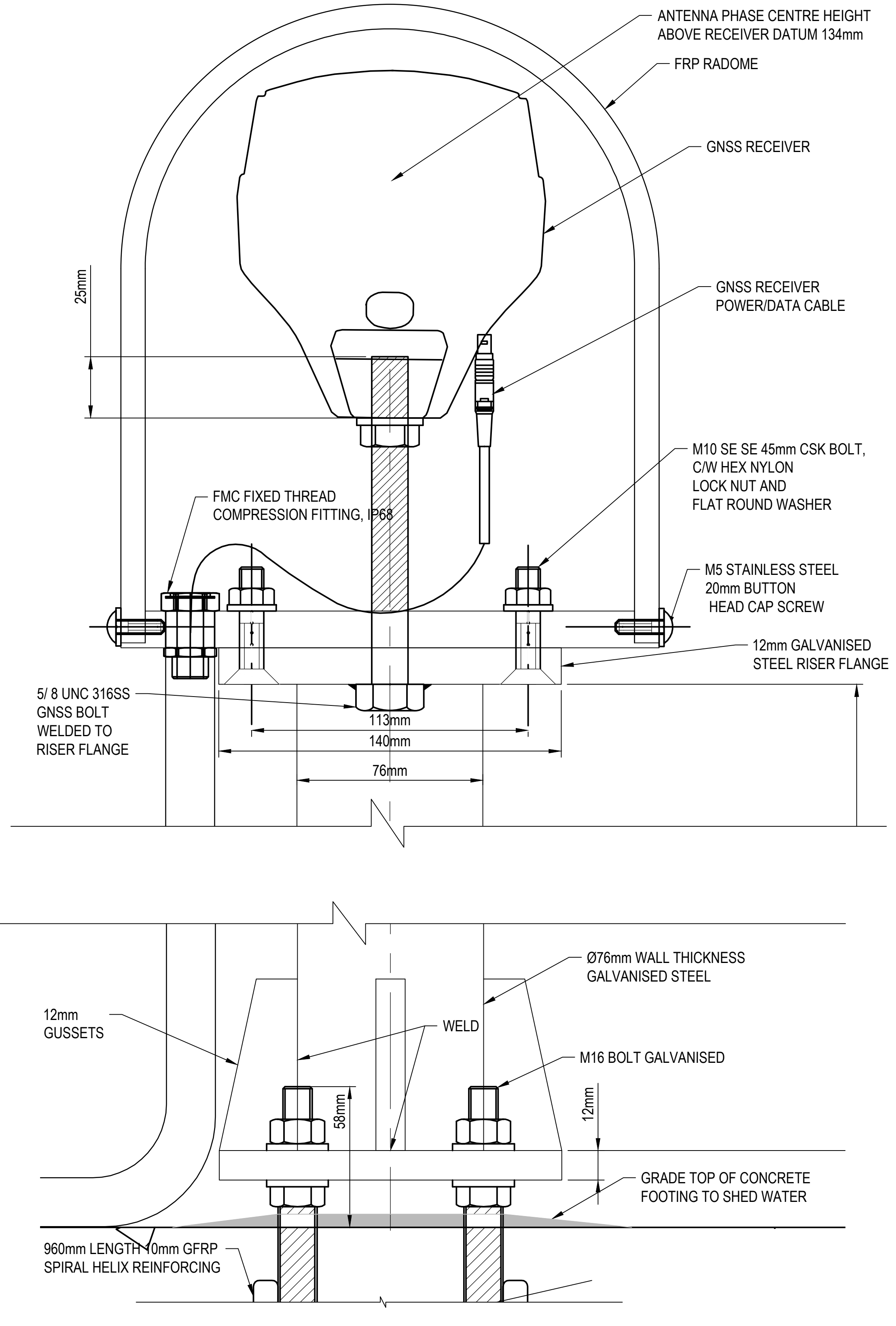
GPS LOCATION PLAN

SCALE 1:200



GNSS UNIT

SCALE 1:10



GNSS UNIT DETAILED SECTION

SCALE 1:2.5

Rev	Description	Checked	Approved	Date
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Author P. BURBURY **Drafting Check** C. LONG

Designer T. RIDGWAY **Design Check** R. LONGEY

0 25 50 75mm
SCALE 1:2.5 AT ORIGINAL SIZE

0 100 200 300mm
SCALE 1:10 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Drawing Title GNSS GPS UNIT DETAILS

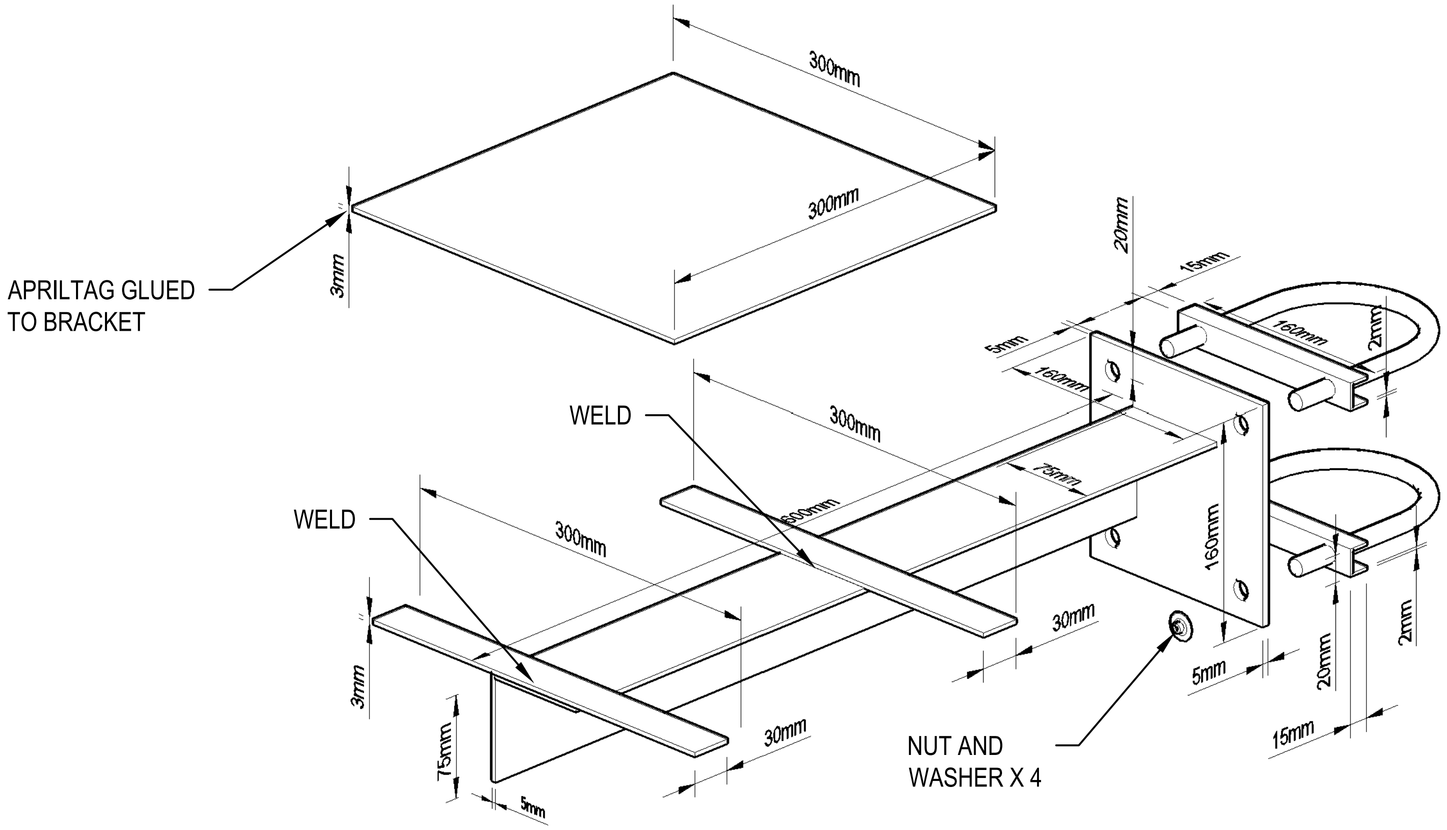
Size **A3**

Drawing No. 12545239-C012

Rev 0

Plot Date: 17 December 2021 - 1:26 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C012.dwg



SURVEY REFERENCE APRIL TAG MOUNT

SCALE 1:5

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 0.05 0.10 0.15m
SCALE 1:5 AT ORIGINAL SIZE

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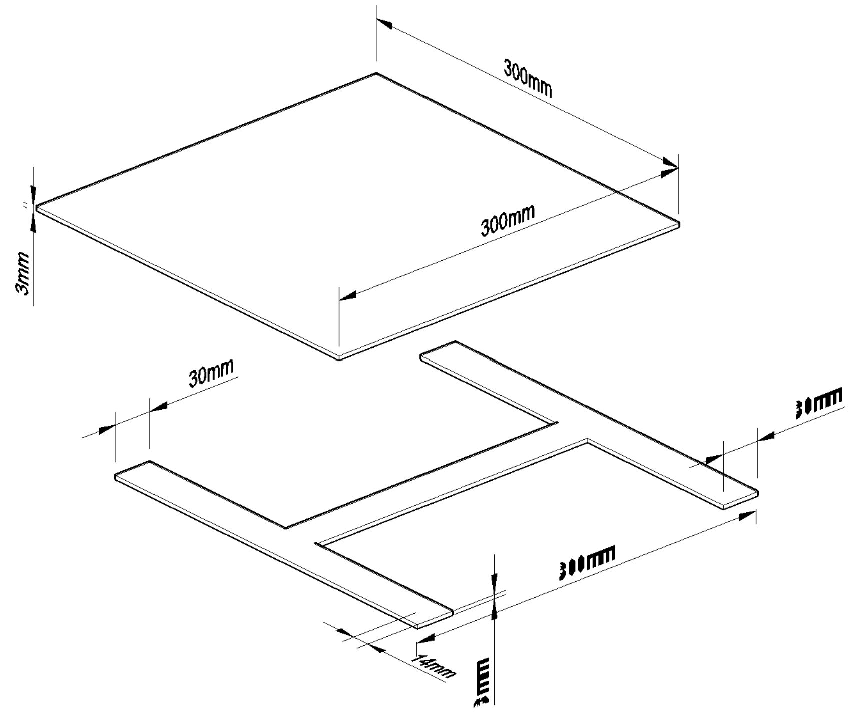
Project RSF 2 DETAILED DESIGN
Status
Status Code

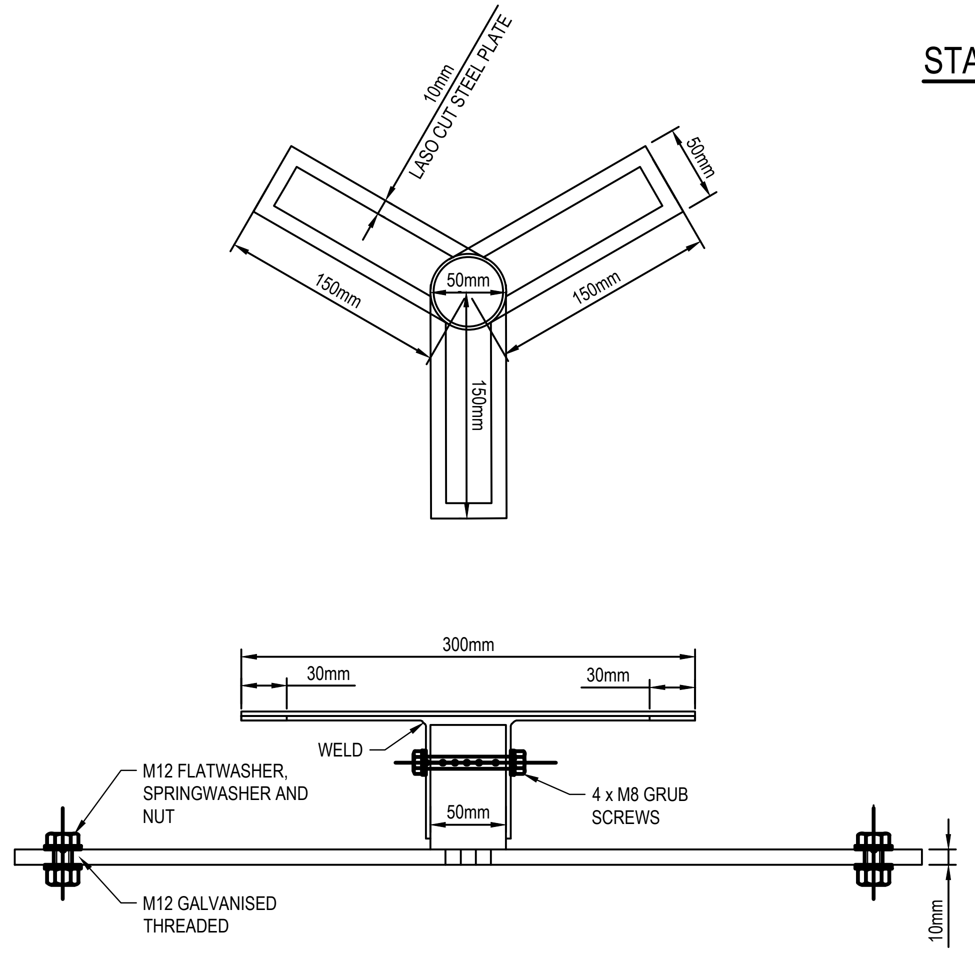
Drawing Title SURVEY REFERENCE APRIL TAG MOUNT
Size A3
Drawing No. 12545239-C013
Rev 0

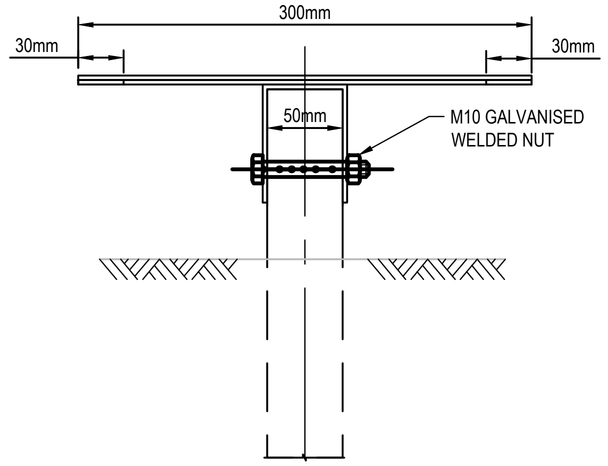
Plot Date: 17 December 2021 - 1:29 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C013.dwg



STANDALONE APRIL TAG UNDERSIDE SUPPORT BRACKET

SCALE 1:5





STANDALONE APRIL TAG ROCK MOUNT TO BE INSTALLED ON TFS BUTTRESS TOE

SCALE 1:5

STANDALONG APRIL TAG MOUNT TO BE INSTALLED ON TFS CREST

SCALE 1:5

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 0.05 0.10 0.15m
SCALE 1:5 AT ORIGINAL SIZE

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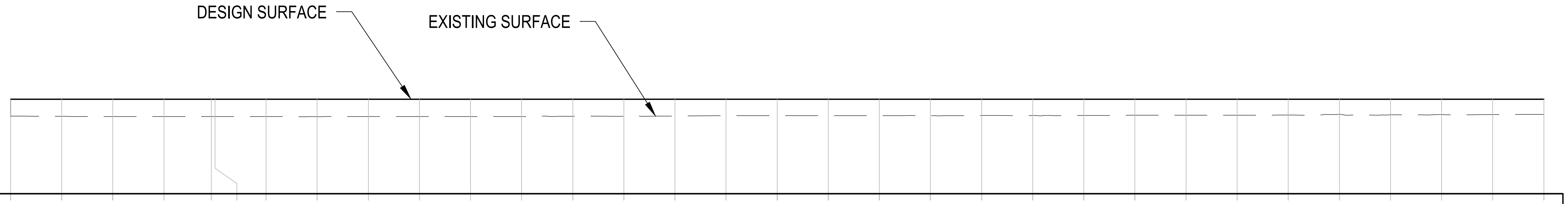
Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title STAND ALONE APRIL TAG MOUNT DETAILS
Size A3
Drawing No. 12545239-C014
Rev 0

Plot Date: 17 December 2021 - 1:31 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C014.dwg

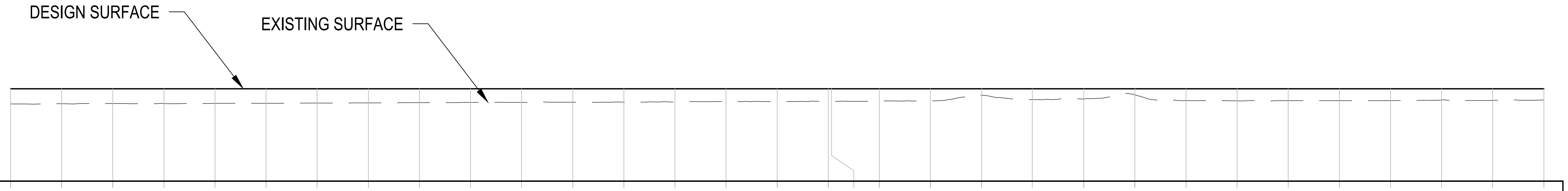


DATUM RL. 233.00

LEVEL DIFFERENCE CUT - / FILL +	6.60	6.70	6.78	6.77	6.79	6.79	6.77	6.80	6.75	6.73	6.73	6.72	6.64	6.64	6.54	6.44	6.38	6.40	6.38	6.44	6.33	6.33	6.34	6.28	6.28	6.23	6.19	5.85	6.04	6.00	5.98	5.92
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	263.40	263.30	263.22	263.23	263.21	263.21	263.23	263.20	263.25	263.27	263.27	263.28	263.36	263.36	263.46	263.56	263.62	263.60	263.62	263.56	263.67	263.67	263.66	263.72	263.72	263.77	263.81	264.15	263.96	264.00	264.02	264.08
CHAINAGE	0.00	20.00	40.00	60.00	78.54	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (0 - 600)

SCALE 1:2000



DATUM RL. 234.00

LEVEL DIFFERENCE CUT - / FILL +	5.92	5.82	5.74	5.69	5.69	5.63	5.56	5.49	5.39	5.29	5.27	5.21	5.18	5.05	5.02	4.98	4.90	4.90	4.72	4.75	2.46	4.20	3.91	2.35	4.64	4.67	4.64	4.60	4.63	4.33	4.49	4.40
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.08	264.18	264.26	264.31	264.31	264.37	264.44	264.51	264.61	264.71	264.73	264.79	264.82	264.95	264.98	265.02	265.10	265.10	265.28	265.25	267.54	265.80	266.09	267.65	265.36	265.33	265.36	265.40	265.37	265.67	265.51	265.60
CHAINAGE	600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00	920.00	921.31	940.00	960.00	980.00	999.85	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00	1160.00	1180.00	1200.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (600 - 1200)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD
Project RSF 2 DETAILED DESIGN

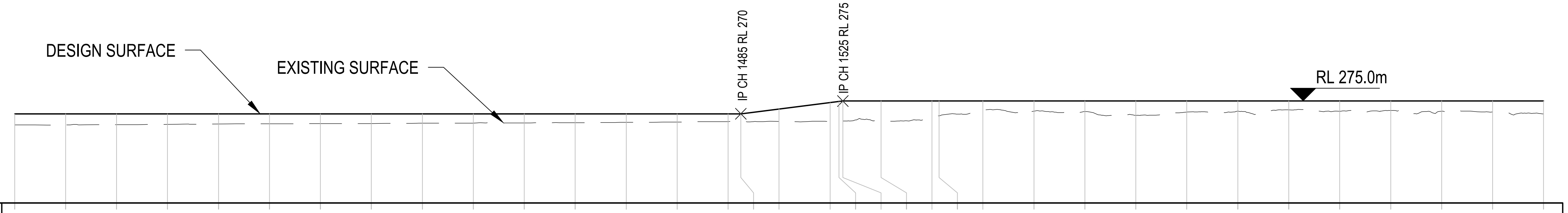
Status
Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 1 OF 5

Size A3

Drawing No. 12545239 - C015
Rev 1

Plot Date: 23 December 2021 - 4:41 PM Plotted by: Victoria Jenkins File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C015.dwg

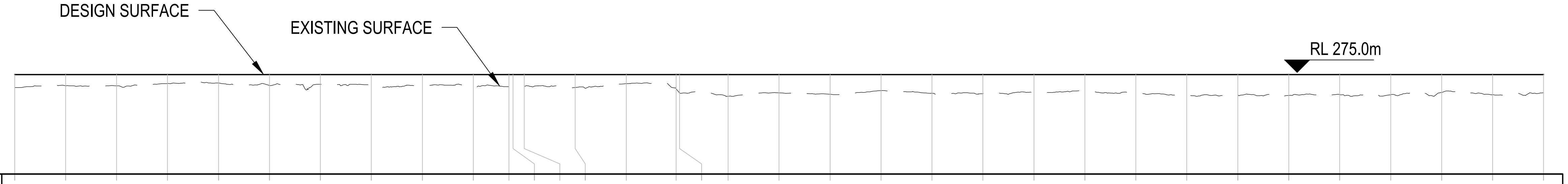


DATUM RL. 235.00

LEVEL DIFFERENCE CUT - / FILL +	4.40	4.36	4.29	4.13	4.02	3.94	3.86	3.82	3.69	3.64	3.57	3.48	3.37	3.24	3.07	3.12	4.86	7.35	7.79	7.88	7.85	6.19	5.78	3.58	3.98	4.10	5.57	4.36	3.95	3.47	3.98	3.69	4.01	4.25	5.05
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	271.875	274.375	274.814	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000
EXISTING SURFACE LEVEL	265.60	265.64	265.71	265.87	265.98	266.06	266.14	266.18	266.31	266.36	266.43	266.52	266.63	266.76	266.93	266.88	267.02	267.03	267.03	267.12	267.15	268.81	269.22	271.42	271.02	270.90	269.43	270.64	271.05	271.53	271.02	271.31	270.99	270.75	269.95
CHAINAGE	1200.00	1220.00	1240.00	1260.00	1280.00	1300.00	1320.00	1340.00	1360.00	1380.00	1400.00	1420.00	1440.00	1460.00	1480.00	1485.00	1500.00	1520.00	1523.51	1525.00	1540.00	1560.00	1562.81	1580.00	1600.00	1620.00	1640.00	1660.00	1680.00	1700.00	1720.00	1740.00	1760.00	1780.00	1800.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (1200 - 1800)

SCALE 1:2000



DATUM RL. 236.00

LEVEL DIFFERENCE CUT - / FILL +	5.05	4.35	4.41	3.47	3.32	4.26	3.77	4.36	4.12	4.73	4.69	4.76	4.57	5.05	3.55	5.60	7.19	8.50	7.16	7.68	6.31	7.32	7.48	7.01	6.34	7.16	8.05	7.94	8.20	7.87	7.90	6.96	7.92	7.10
DESIGN SURFACE LEVEL	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000
EXISTING SURFACE LEVEL	269.95	270.65	270.59	271.53	271.68	270.74	271.23	270.64	270.88	270.27	270.31	270.24	270.43	269.95	271.45	269.40	267.81	266.50	267.84	267.32	268.69	267.68	267.52	267.99	268.66	267.84	266.95	267.06	266.80	267.13	267.10	268.04	267.08	267.90
CHAINAGE	1800.00	1820.00	1840.00	1860.00	1880.00	1900.00	1920.00	1940.00	1960.00	1980.00	1993.98	1995.56	2000.00	2020.00	2040.00	2059.60	2060.98	2080.00	2100.00	2120.00	2140.00	2160.00	2180.00	2200.00	2220.00	2240.00	2260.00	2280.00	2300.00	2320.00	2340.00	2360.00	2380.00	2400.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (1800 - 2400)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD
Project RSF 2 DETAILED DESIGN

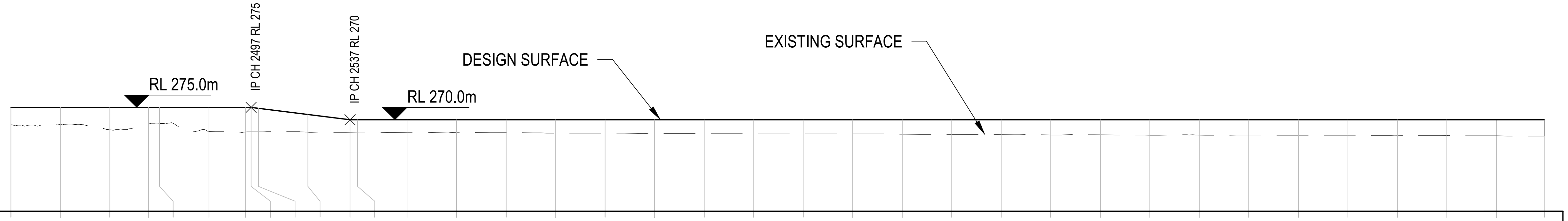
Status
Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 2 0F 5

Size A3

Drawing No. 12545239 - C016
Rev 1

Plot Date: 23 December 2021 - 4:41 PM Plotted by: Victoria Jenkins
File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C016.dwg



DATUM RL. 233.00

LEVEL DIFFERENCE CUT - / FILL +	7.10	6.90	9.01	6.68	6.44	9.66	9.93	9.90	9.50	7.14	5.02	4.96
DESIGN SURFACE LEVEL	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	274.625	272.125	270.000	270.000
EXISTING SURFACE LEVEL	267.90	268.10	265.99	268.32	268.56	265.34	265.07	265.10	265.12	264.99	264.98	265.04
CHAINAGE	2400.00	2420.00	2440.00	2455.54	2460.00	2480.00	2494.83	2497.00	2500.00	2520.00	2537.00	2540.00

LEVEL DIFFERENCE CUT - / FILL +	5.20	5.18	5.21	5.36	5.41	5.49	5.60	5.68	5.72	5.72	5.81	5.93
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.80	264.82	264.79	264.64	264.59	264.51	264.40	264.32	264.28	264.28	264.19	264.07
CHAINAGE	2560.00	2580.00	2600.00	2620.00	2640.00	2660.00	2680.00	2700.00	2720.00	2740.00	2760.00	2780.00

LEVEL DIFFERENCE CUT - / FILL +	6.00	6.13	6.10	6.18	6.19	6.18	6.21	6.24	6.27	6.36	6.51	6.60
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.00	263.87	263.90	263.82	263.81	263.82	263.79	263.76	263.73	263.64	263.49	263.40
CHAINAGE	2800.00	2820.00	2840.00	2860.00	2880.00	2900.00	2920.00	2940.00	2960.00	2980.00	3000.00	3019.36

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (2400 - 3019.36)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author	P. BURBURY	Drafting Check	C. LONG
Designer	T. RIDGWAY	Design Check	R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 3 0F 5

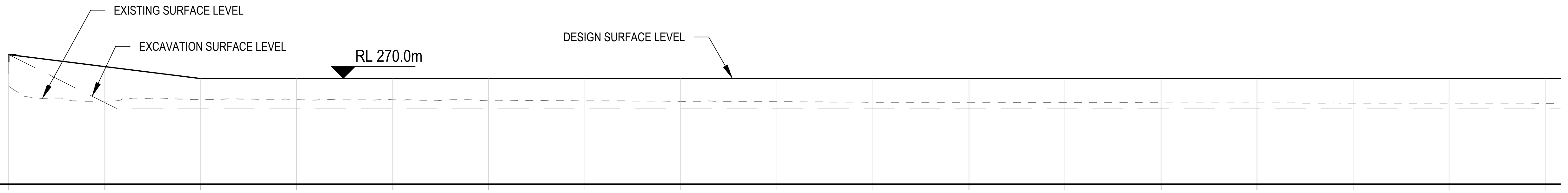
Size A3

Drawing No. 12545239 - C017

Rev 1

Plot Date: 23 December 2021 - 4:38 PM Plotted by: Victoria Jenkins

File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C017.dwg



DATUM RL. 248.00

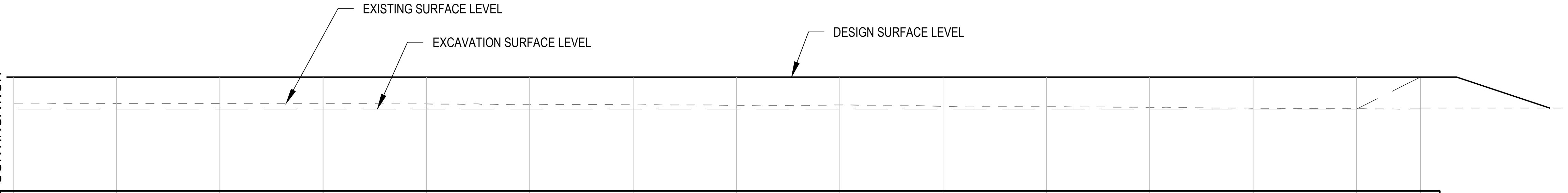
REFER BELOW FOR CONTINUATION

EXCAVATION SURFACE LEVEL	274.99	264.99	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80
LEVEL DIFFERENCE CUT - / FILL +	6.60	7.20	4.37	4.40	4.43	4.55	4.65	4.78	4.84	4.94	4.95	5.01	5.06	5.10	5.12	5.13	5.18
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	268.40	265.30	265.63	265.60	265.57	265.45	265.35	265.22	265.16	265.06	265.05	264.99	264.94	264.90	264.88	264.87	264.82
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	320.00

DIVIDING WALL EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000

REFER ABOVE FOR CONTINUATION



DATUM RL. 248.00

EXCAVATION SURFACE LEVEL	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.80	263.81	270.00
LEVEL DIFFERENCE CUT - / FILL +	5.18	5.11	5.11	5.13	5.21	5.28	5.39	5.53	5.40	5.66	5.74	5.85	6.01	6.12	6.17
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.82	264.89	264.89	264.87	264.79	264.72	264.61	264.47	264.60	264.34	264.26	264.15	263.99	263.88	263.83
CHAINAGE	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	592.39

DIVIDING WALL EMBANKMENT - LONGITUDINAL SECTION (CONTINUED)

SCALE 1:1000

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 4 0F 5

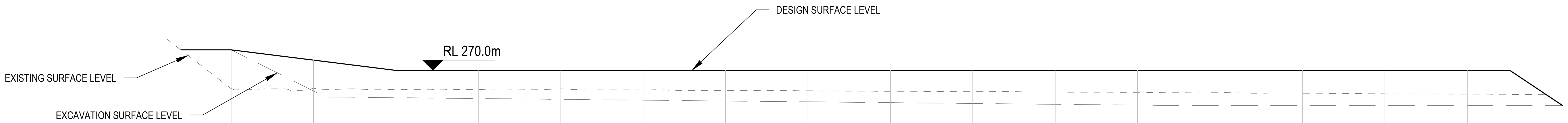
Size A3

Drawing No. 12545239 - C018

Rev 1

Plot Date: 23 December 2021 - 4:40 PM Plotted by: Victoria Jenkins

File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C018.dwg

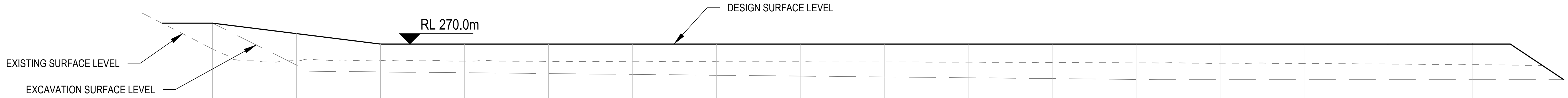


DATUM RL. 246.00

EXCAVATION SURFACE LEVEL	275.00	265.00	263.36	263.16	262.96	262.76	262.56	262.36	262.16	261.96	261.76	261.56	261.50	261.50	261.50	261.50
LEVEL DIFFERENCE CUT - / FILL +	9.43	6.90	4.65	4.61	4.50	4.78	4.88	4.96	5.08	5.16	5.27	5.32	5.43	5.53	5.69	5.75
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	265.57	265.60	265.35	265.39	265.50	265.22	265.12	265.04	264.92	264.84	264.73	264.68	264.57	264.47	264.31	264.25
CHAINAGE	-0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00

CELL 1 DECANT EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000



DATUM RL. 246.00

EXCAVATION SURFACE LEVEL	275.00	265.00	263.35	263.15	262.95	262.75	262.55	262.35	262.15	261.95	261.75	261.55	261.50	261.50	261.50	261.50
LEVEL DIFFERENCE CUT - / FILL +	6.16	6.46	3.97	4.05	4.14	4.21	4.21	4.24	4.28	4.32	4.41	4.48	4.58	4.63	4.75	4.89
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	268.84	266.04	266.03	265.95	265.86	265.79	265.79	265.76	265.72	265.68	265.59	265.52	265.42	265.37	265.25	265.11
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00

CELL 2 DECANT EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000

Rev	Description	Checked	Approved	Date
1	RE-ISSUED FOR CONSTRUCTION	MR*	RL*	23.12.2021
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 5 0F 5

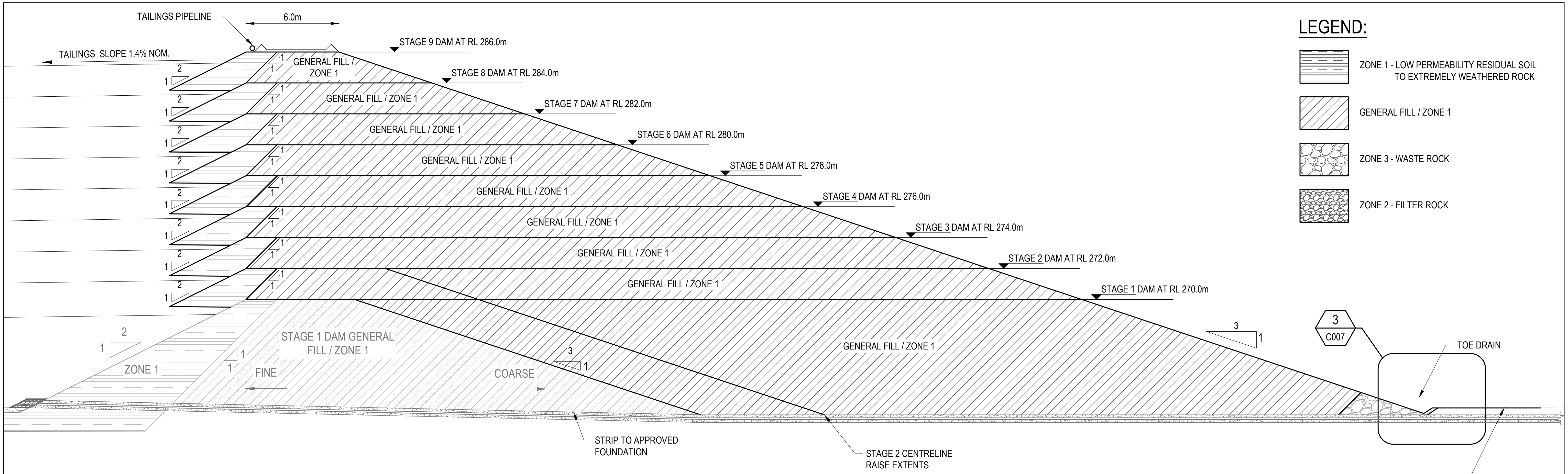
Drawing No. 12545239 - C019

Size A3

Rev 1

Plot Date: 23 December 2021 - 4:42 PM Plotted by: Victoria Jenkins

File Name: \\ghdnet\ghd\AU\hobart\Projects\32\12545239\CADD\Drawings\12545239-C019.dwg

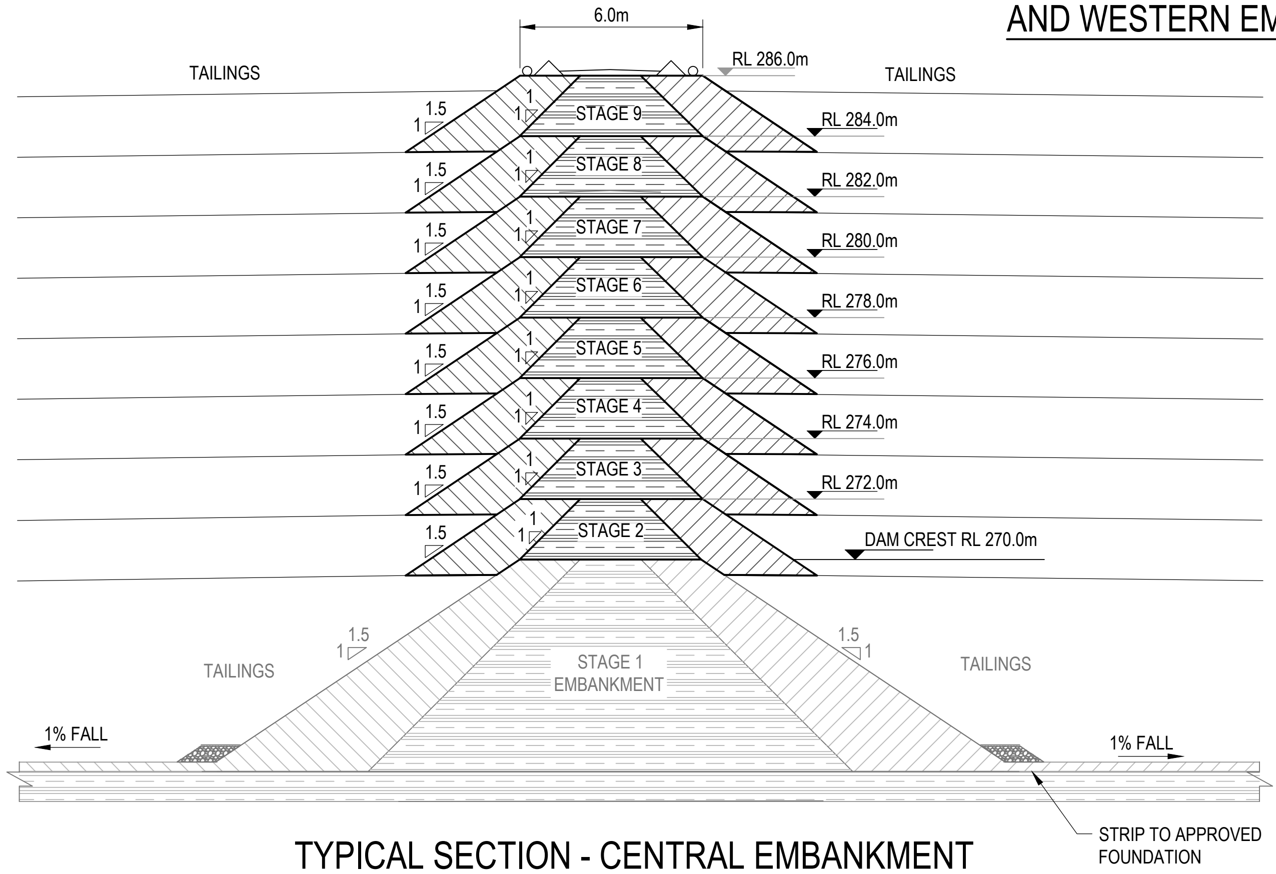


LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
○	ZONE 3 - WASTE ROCK
▩	ZONE 2 - FILTER ROCK

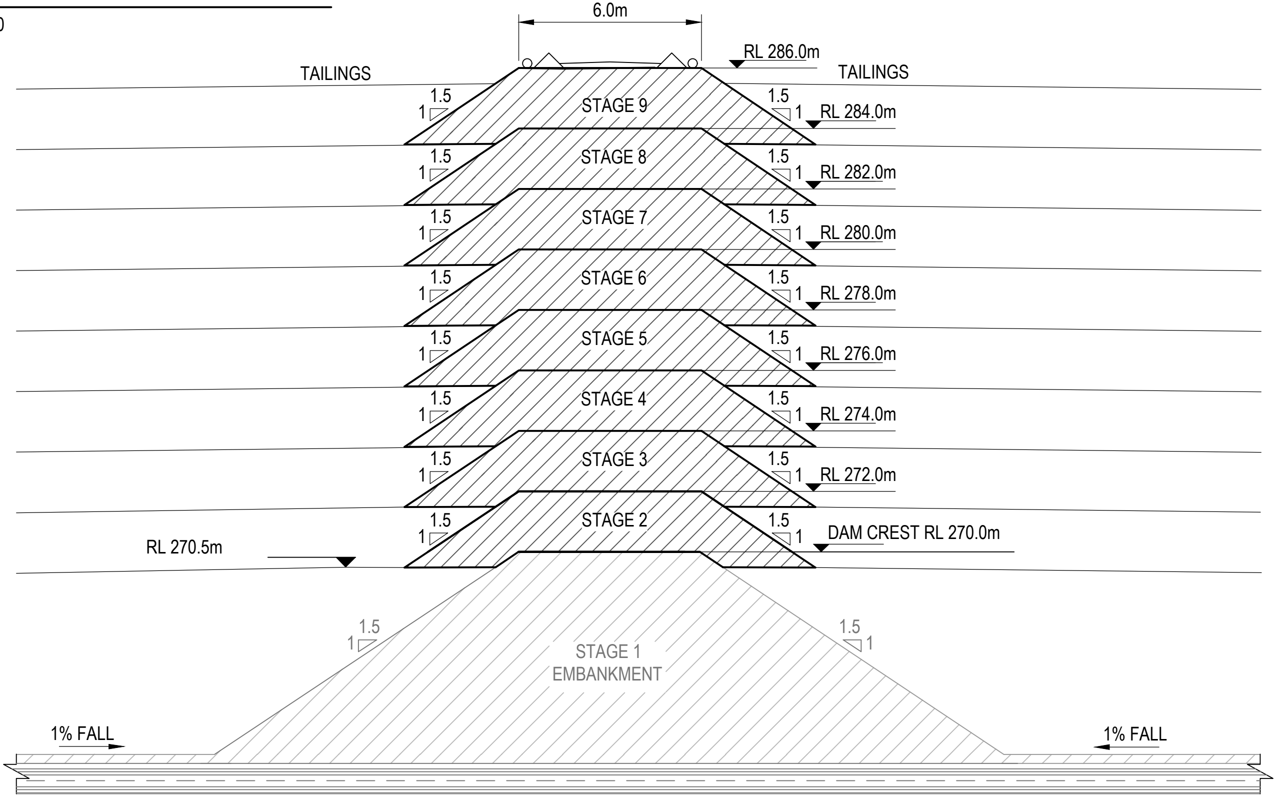
TYPICAL SECTION - EXTERNAL EASTERN, SOUTHERN AND WESTERN EMBANKMENT CENTRELINE RAISE

SCALE 1:250



TYPICAL SECTION - CENTRAL EMBANKMENT

SCALE 1:250



TYPICAL SECTION - DECANT CAUSEWAYS

SCALE 1:250

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

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Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 EMBANKMENT DETAILED DESIGN
Status
Status Code

Drawing Title ULTIMATE TYPICAL SECTIONS
Size A3
Drawing No. 12545239 - C020
Rev 0

Plot Date: 17 December 2021 - 1:51 PM Plotted by: Melvin Agomuoh
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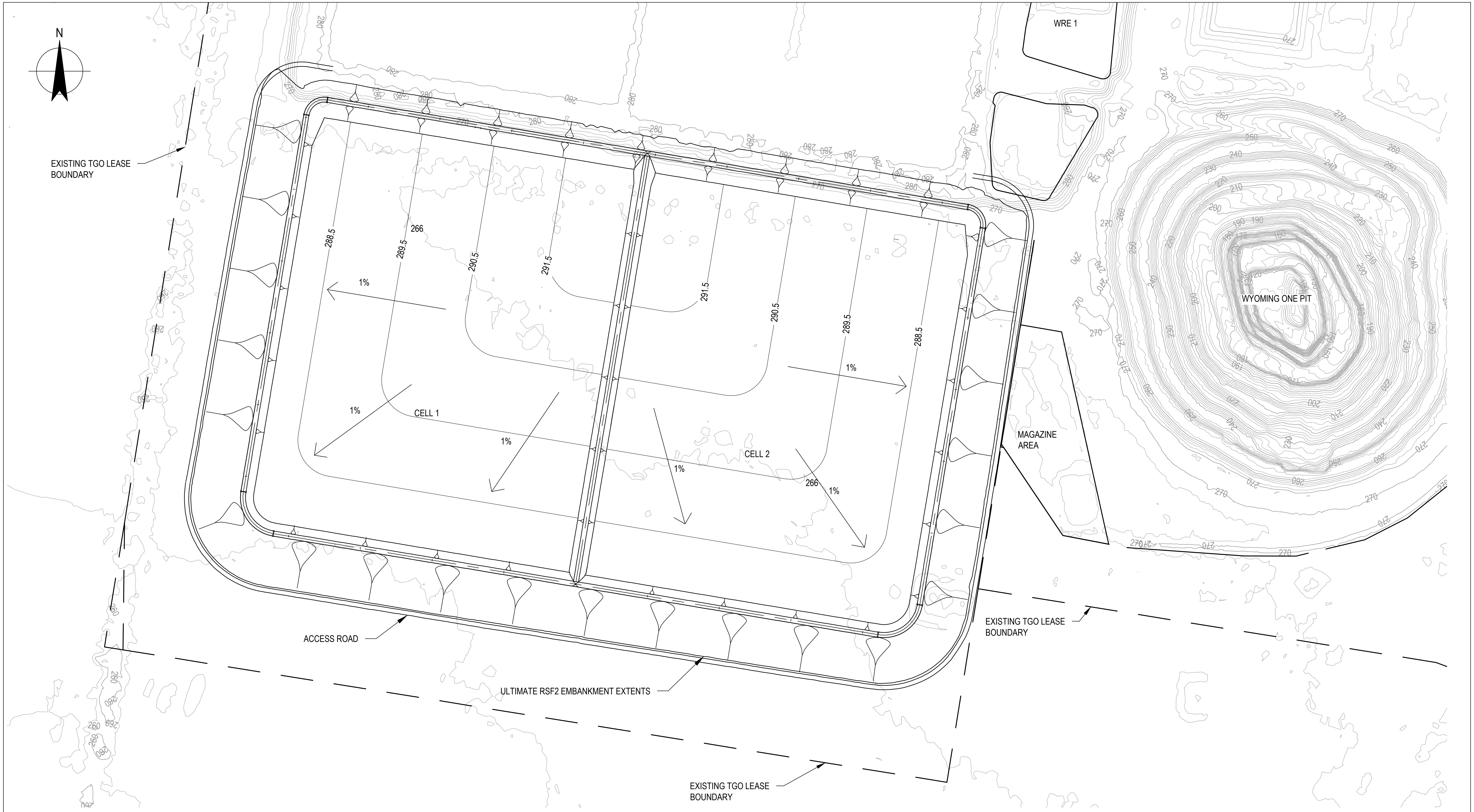

CLOSURE PLAN

SCALE 1:5000

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title CONCEPTUAL CLOSURE PLAN
Size A3
Drawing No. 12545239-C021
Rev 0

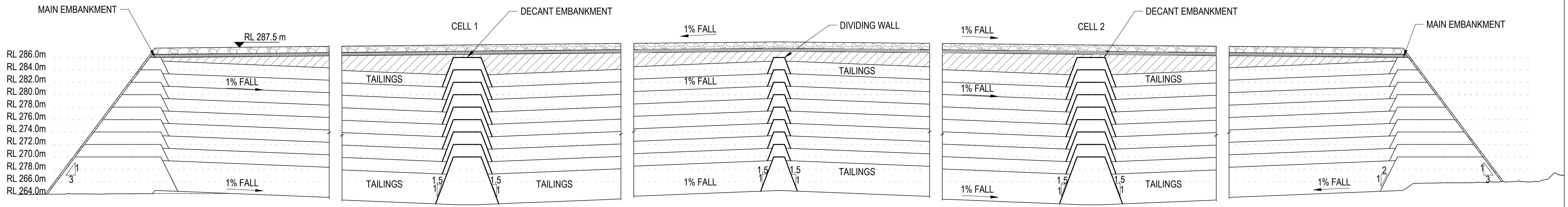
Plot Date: 17 December 2021 - 1:53 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C021.dwg

NOTES

1. DECANT WATER TO BE REMOVED FROM RSF USING EXISTING DECANT INFRASTRUCTURE
2. PRIOR TO THE PLACEMENT OF THE CLOSURE MATERIAL, THE TAILINGS ARE TO BE TRACK ROLLED FOR CONSOLIDATION
3. WASTE ROCK AND GENERAL FILL IS TO BE USED TO INFILL THE DECANT POND AREA PRIOR TO CAPPING THE RSF LANDFORM
4. ALL CONTAMINATED TAILINGS INFRASTRUCTURE SUCH AS THE TAILINGS DEPOSITION PIPELINE IS TO BE DISPOSED IN AN APPROVED LOCATION
5. THE DECANT TOWER IS TO BE INFILLED WITH BULK CONCRETE FOLLOWING THE DECANT POND WATER REMOVAL AND PRIOR TO THE CAPPING OF THE FACILITY
6. ADDITIONAL WASTE ROCK IS T BE PLACED ON THE DOWNSTREAM FACE OF THE PERIMETER EMBANKMENT FOR EROSION PROTECTION IF REQUIRED
7. THE CAPPING SURFACE AND DOWNSTREAM FACE OF THE EMBANKMENT IS TO BE REHABILITATED USING LOCALLY AVAILABLE NATIVE GRASSES

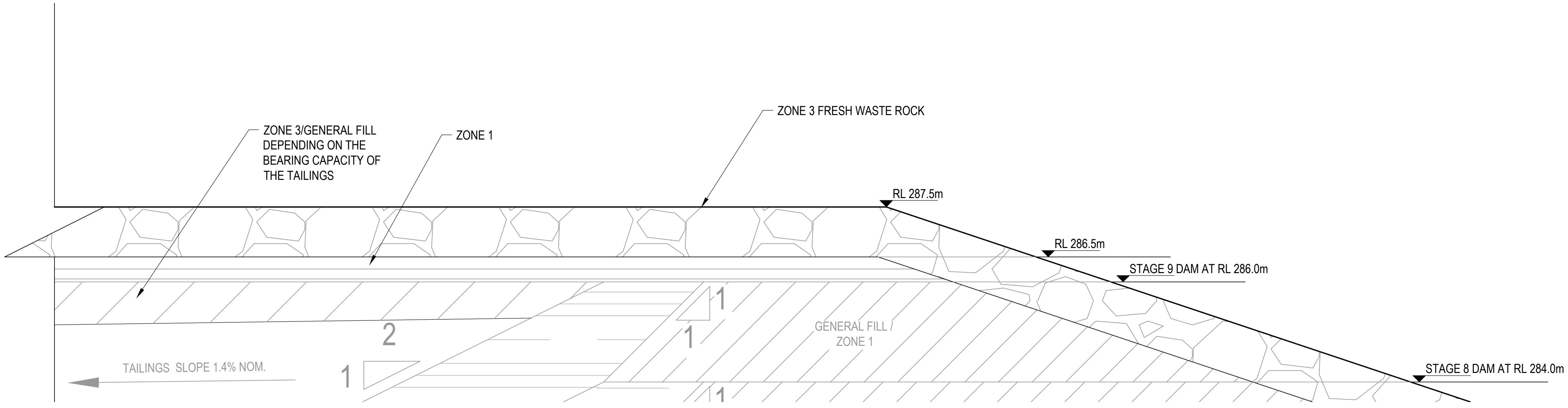
LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
◌	ZONE 3 - WASTE ROCK



ULTIMATE LONGITUDINAL SECTION

SCALE 1:2000 H/1:500 V



CLOSURE DETAIL

SCALE 1:100

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

VERTICAL SCALE 1:500
AT ORIGINAL SIZE
0 5 10 15m

HORIZONTAL SCALE 1:2000
AT ORIGINAL SIZE
0 20 40 60m

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title CONCEPTUAL CLOSURE
SECTION AND DETAILS

Size A3

Drawing No. 12545239-C022

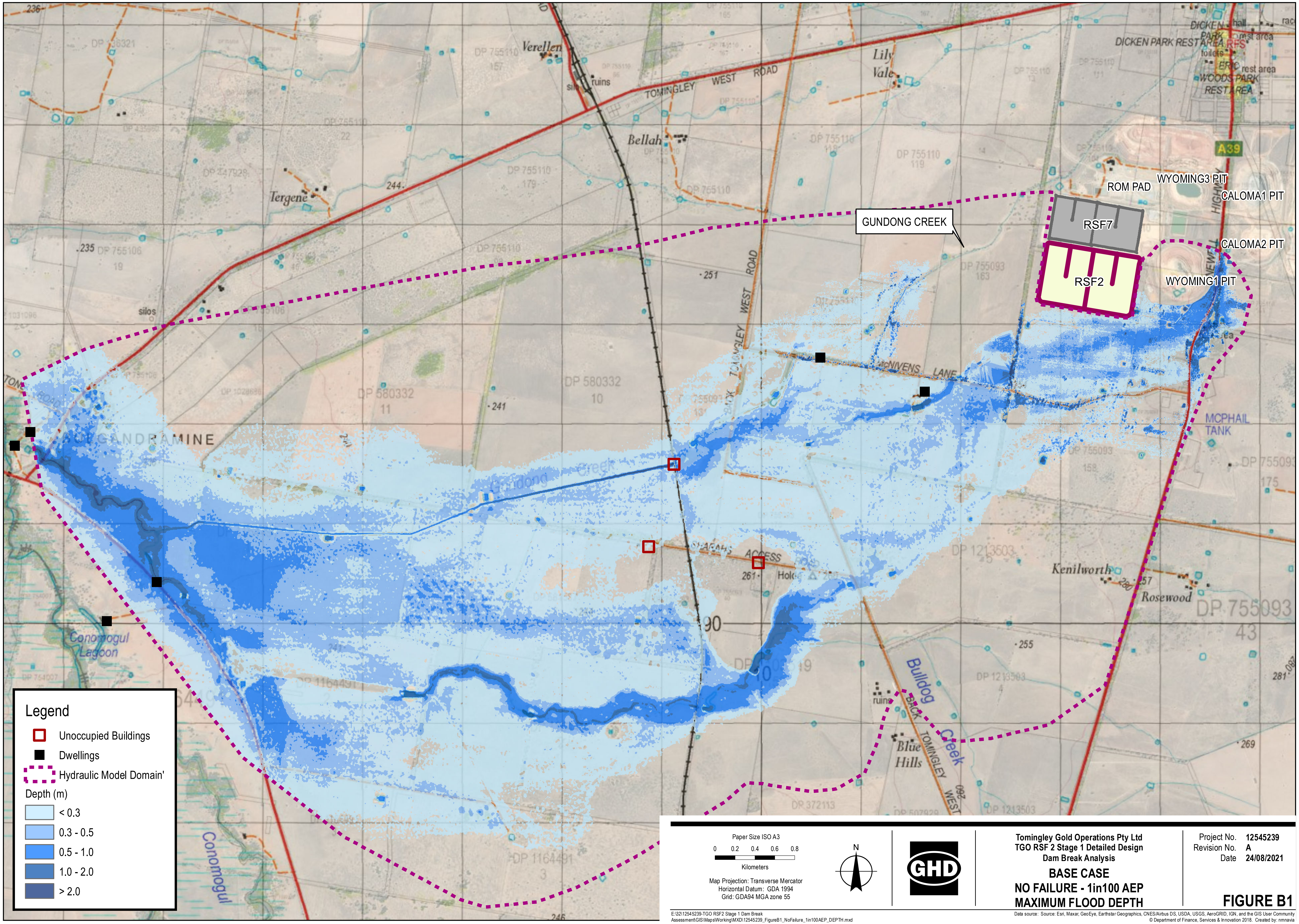
Rev 0

Plot Date: 17 December 2021 - 1:55 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C022.dwg

Appendix B

RSF2 Dam Break Modelling Results



Paper Size ISO A3

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

BASE CASE
NO FAILURE - 1in100 AEP
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B1

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB1_NoFailure_1in100AEP_DEPTH.mxd
Print date: 24 Aug 2021 - 17:09

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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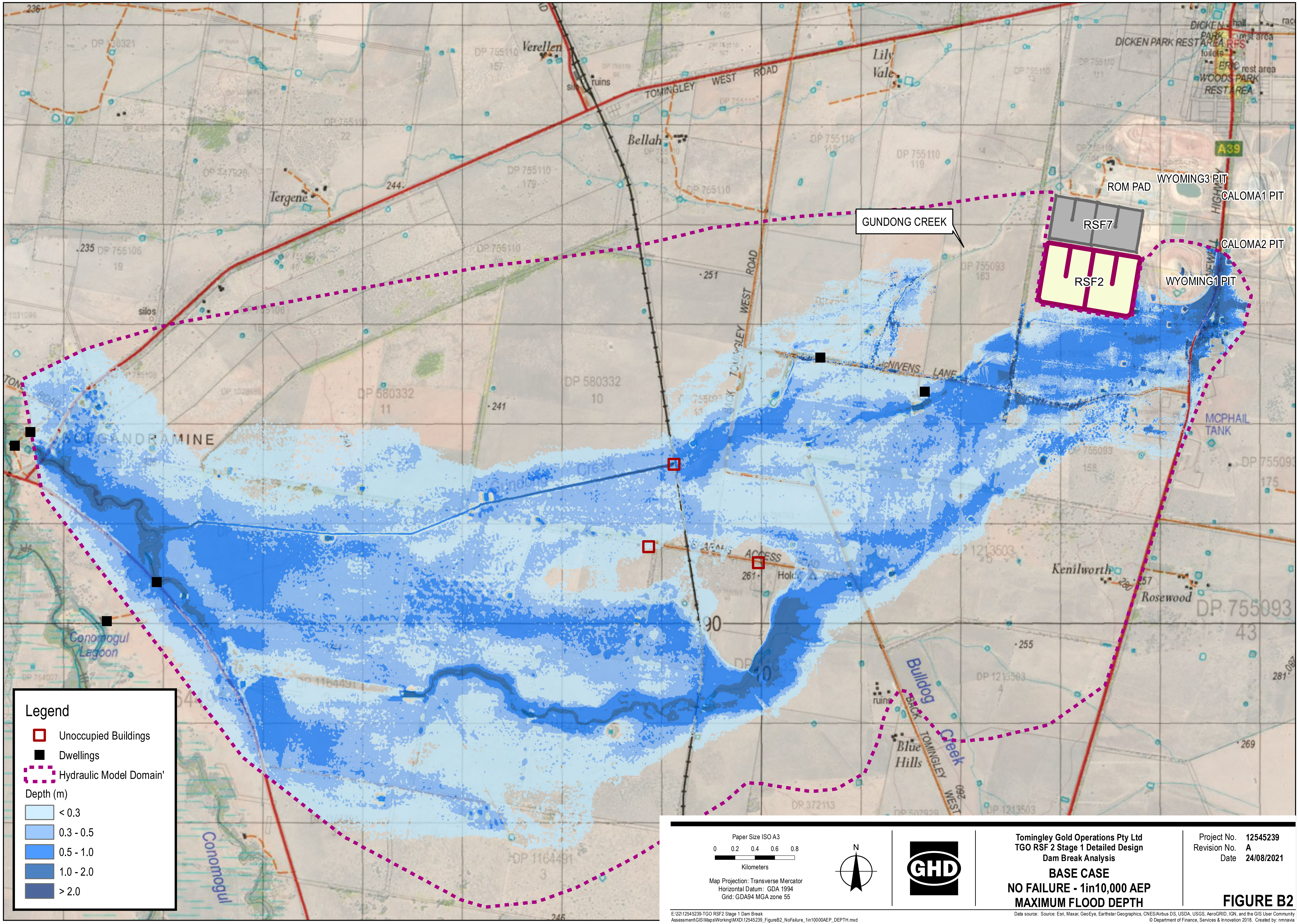

Paper Size ISO A3

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

BASE CASE
NO FAILURE - 1in10,000 AEP
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B2

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB2_NoFailure_1in10000AEP_DEPTH.mxd
Print date: 24 Aug 2021 - 17:13

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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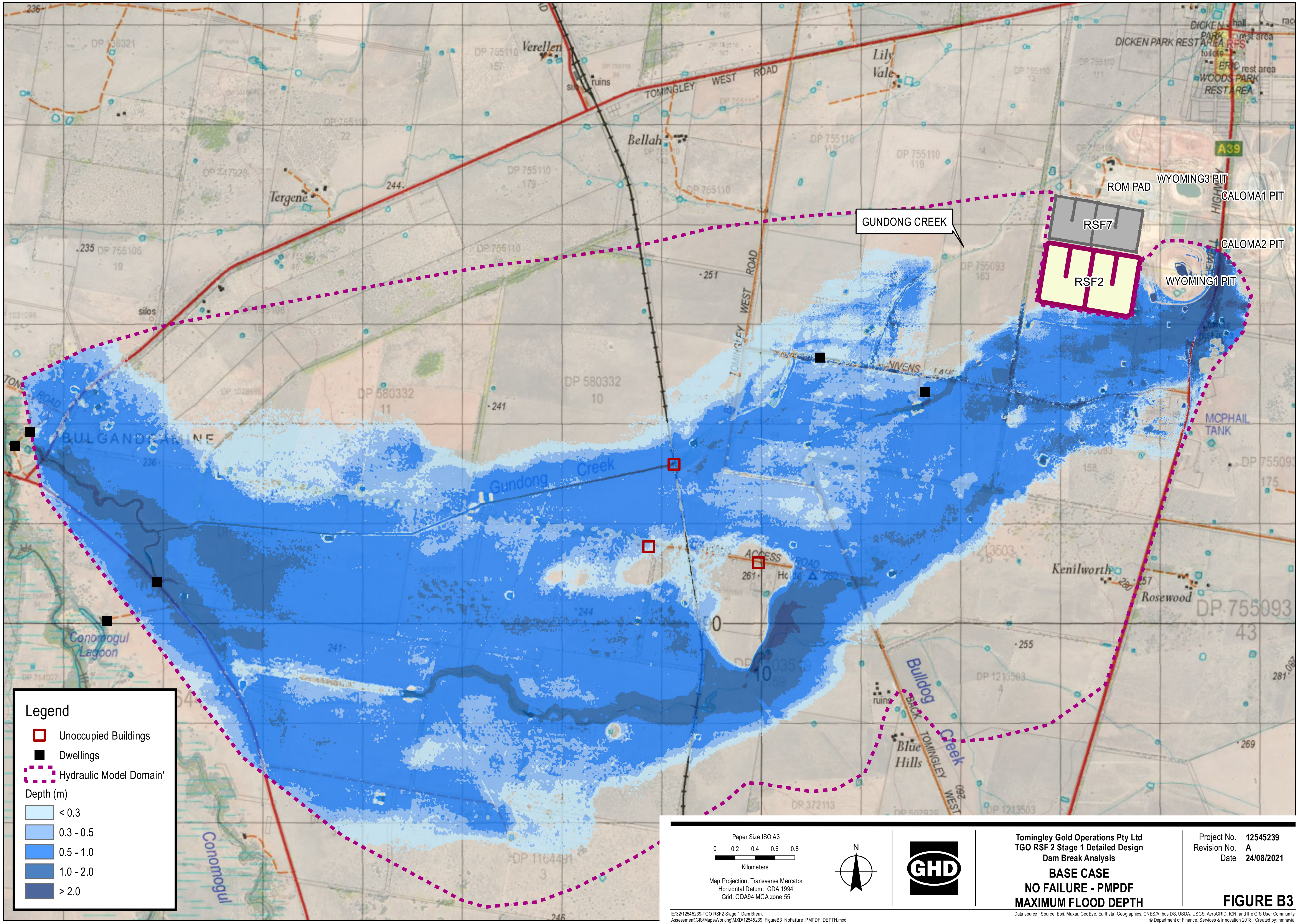

Paper Size ISO A3

0 0.2 0.4 0.6 0.8
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

BASE CASE
NO FAILURE - PMPDF
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B3

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB3_NoFailure_PMPDF_DEPTH.mxd
Print date: 24 Aug 2021 - 17:17

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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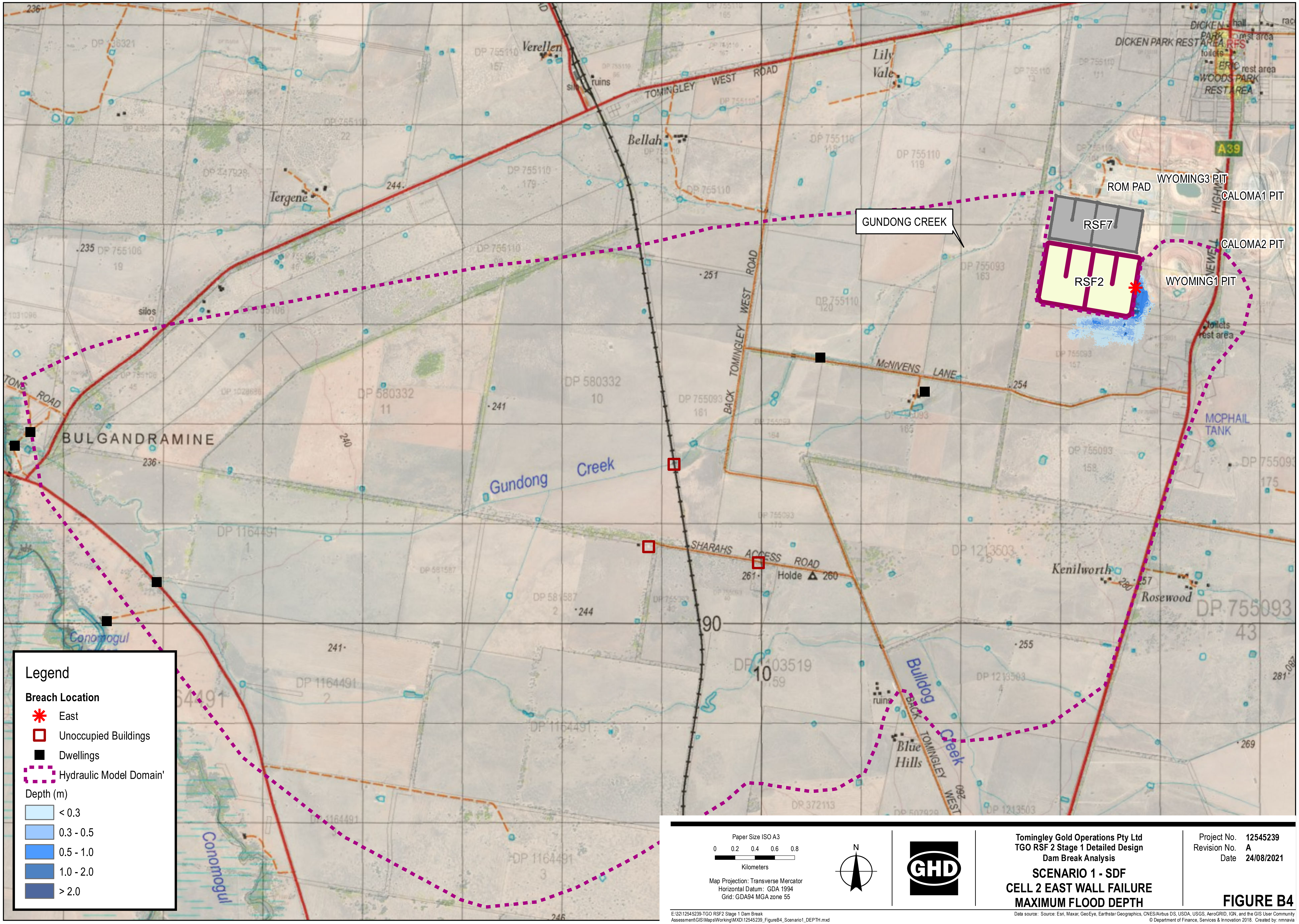

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 1 - SDF
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	12545239
Revision No.	A
Date	24/08/2021

FIGURE B4

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB4_Scenario1_DEPTH.mxd
Print date: 24 Aug 2021 - 17:20

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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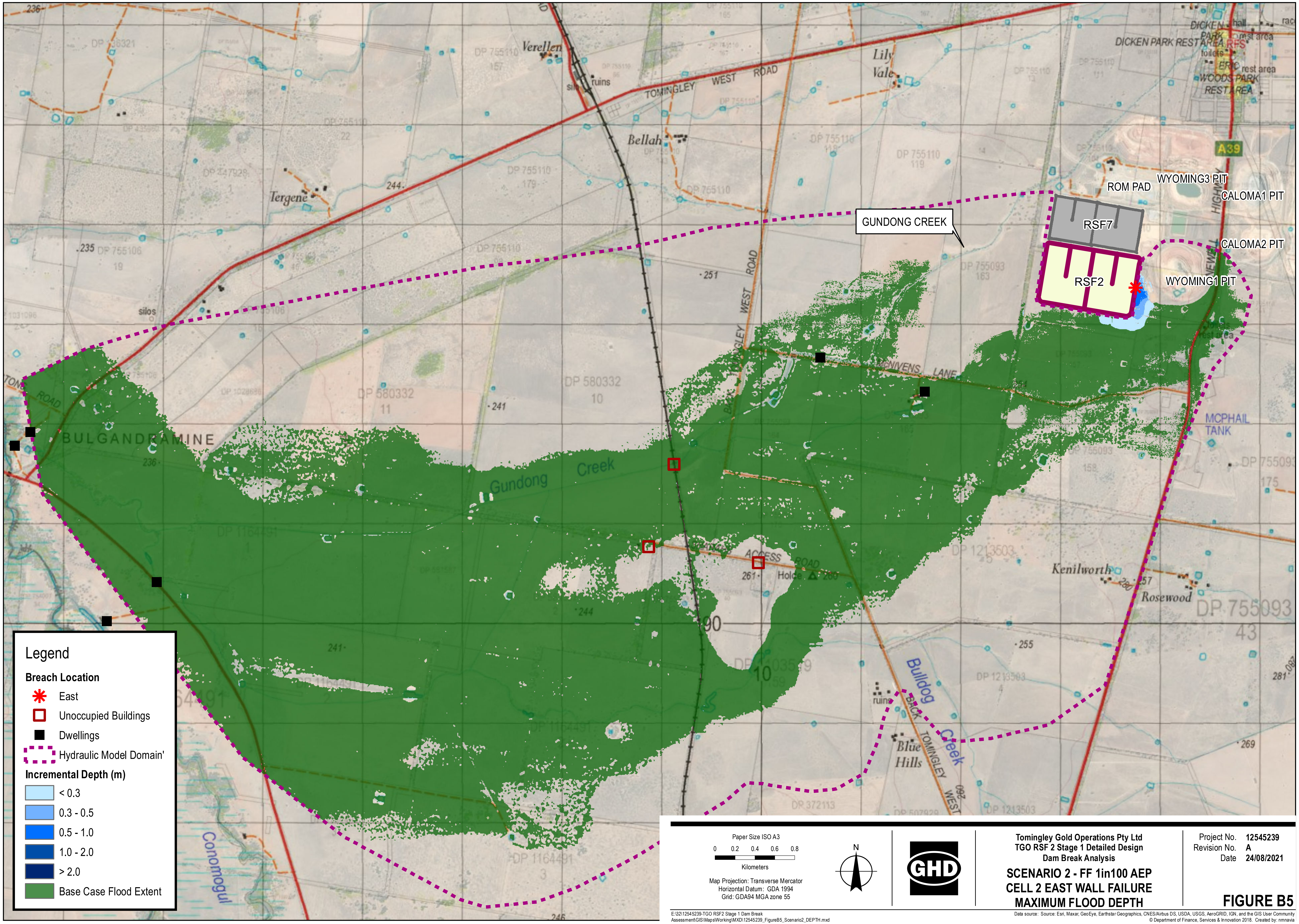


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

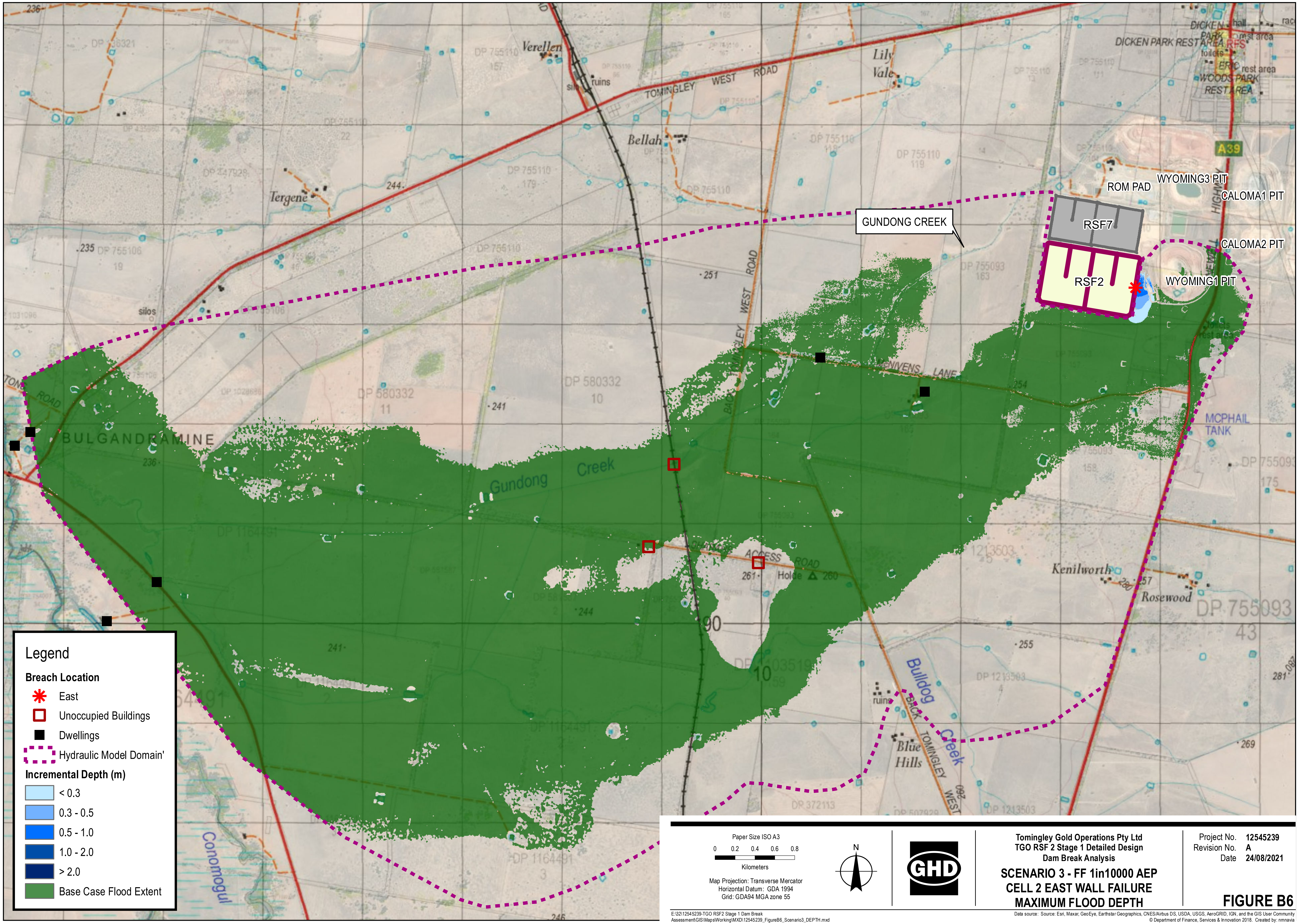
SCENARIO 2 - FF 1in100 AEP
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B5

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB5_Scenario2_DEPTH.mxd
Print date: 24 Aug 2021 - 17:20

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

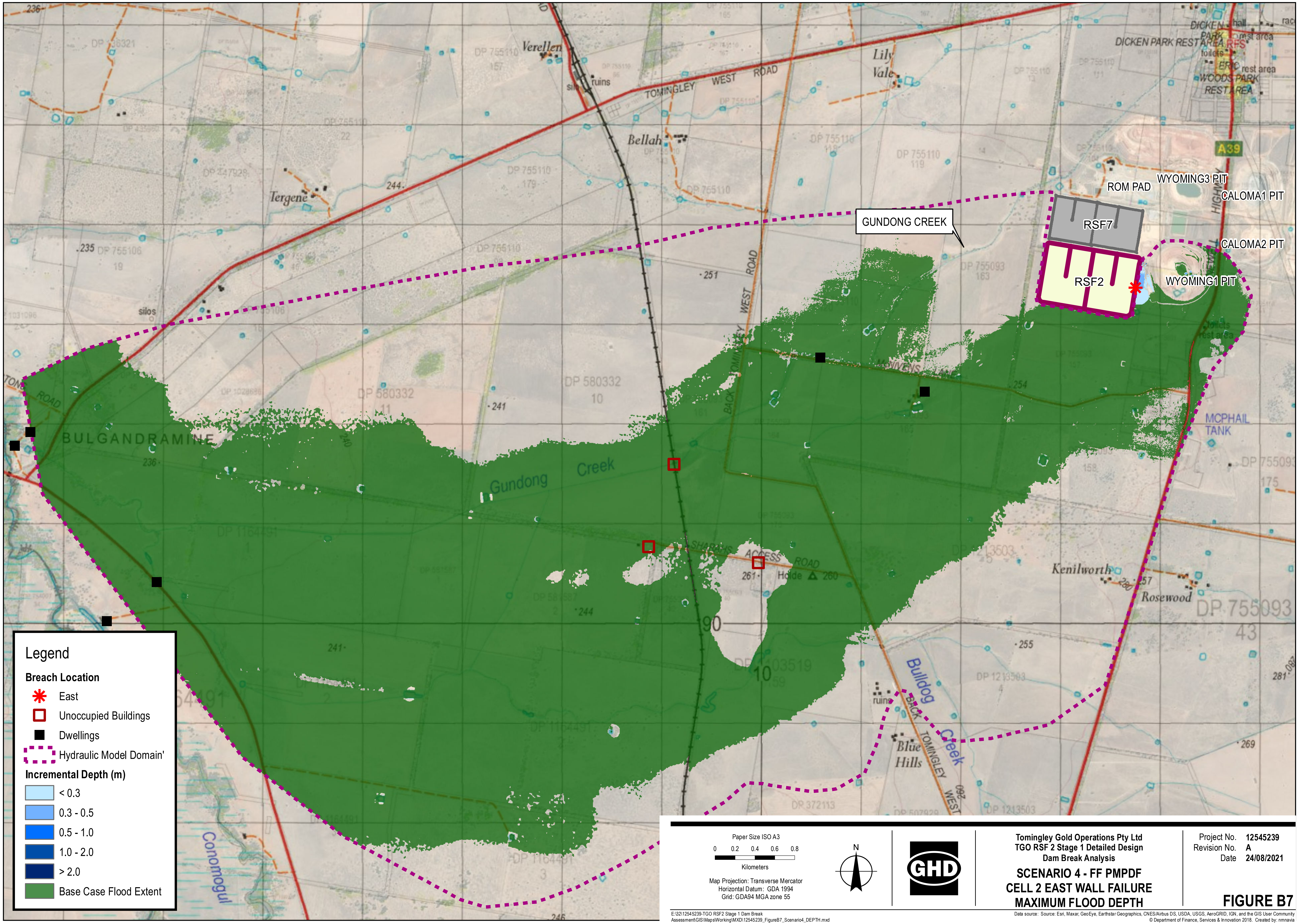
SCENARIO 3 - FF 1in10000 AEP
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B6

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB6_Scenario3_DEPTH.mxd
Print date: 24 Aug 2021 - 17:21

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 4 - FF PMPDF
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B7

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB7_Scenario4_DEPTH.mxd
Print date: 24 Aug 2021 - 17:21

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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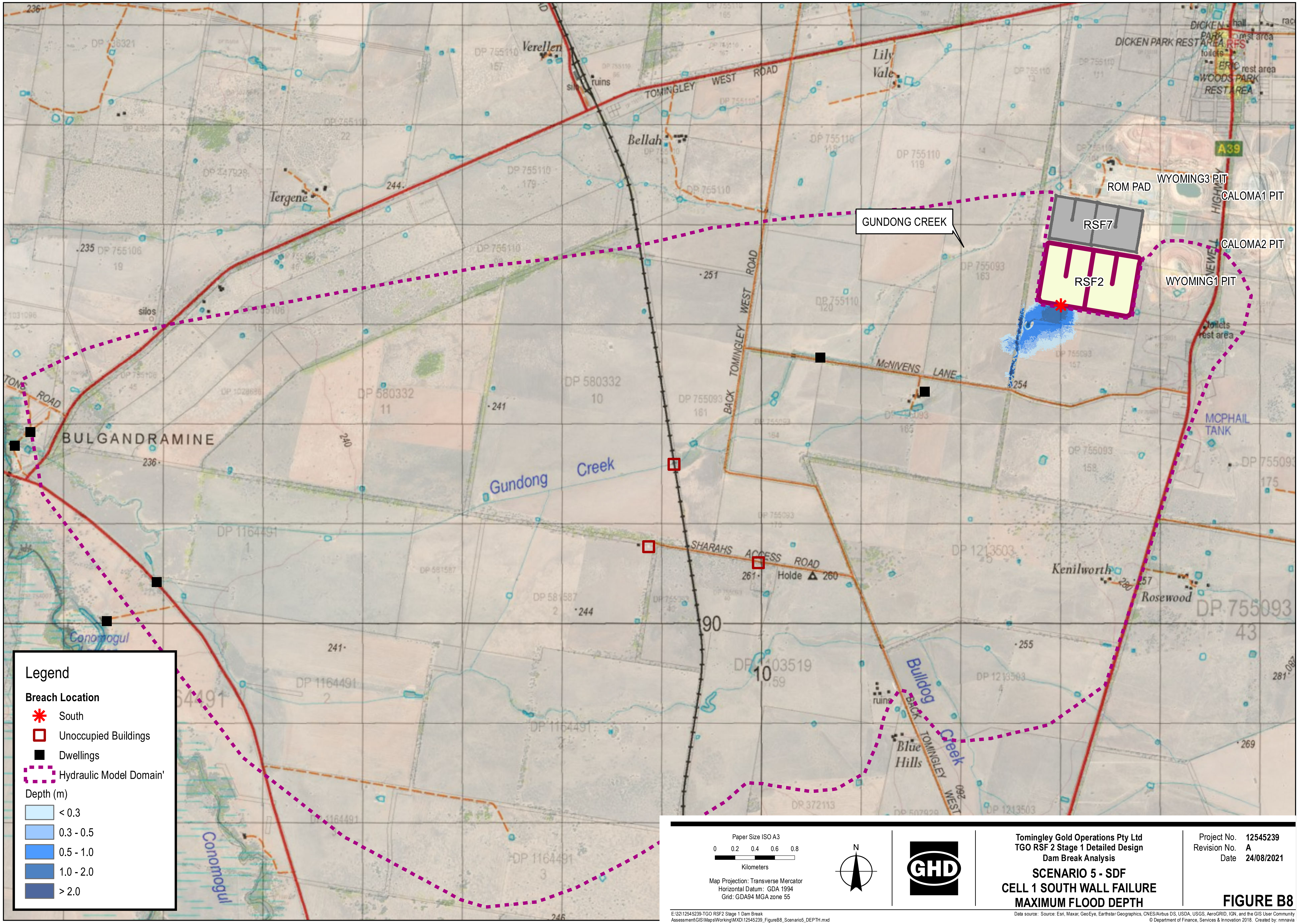

Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 5 - SDF CELL 1 SOUTH WALL FAILURE MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B8

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB8_Scenario5_DEPTH.mxd
Print date: 24 Aug 2021 - 17:22

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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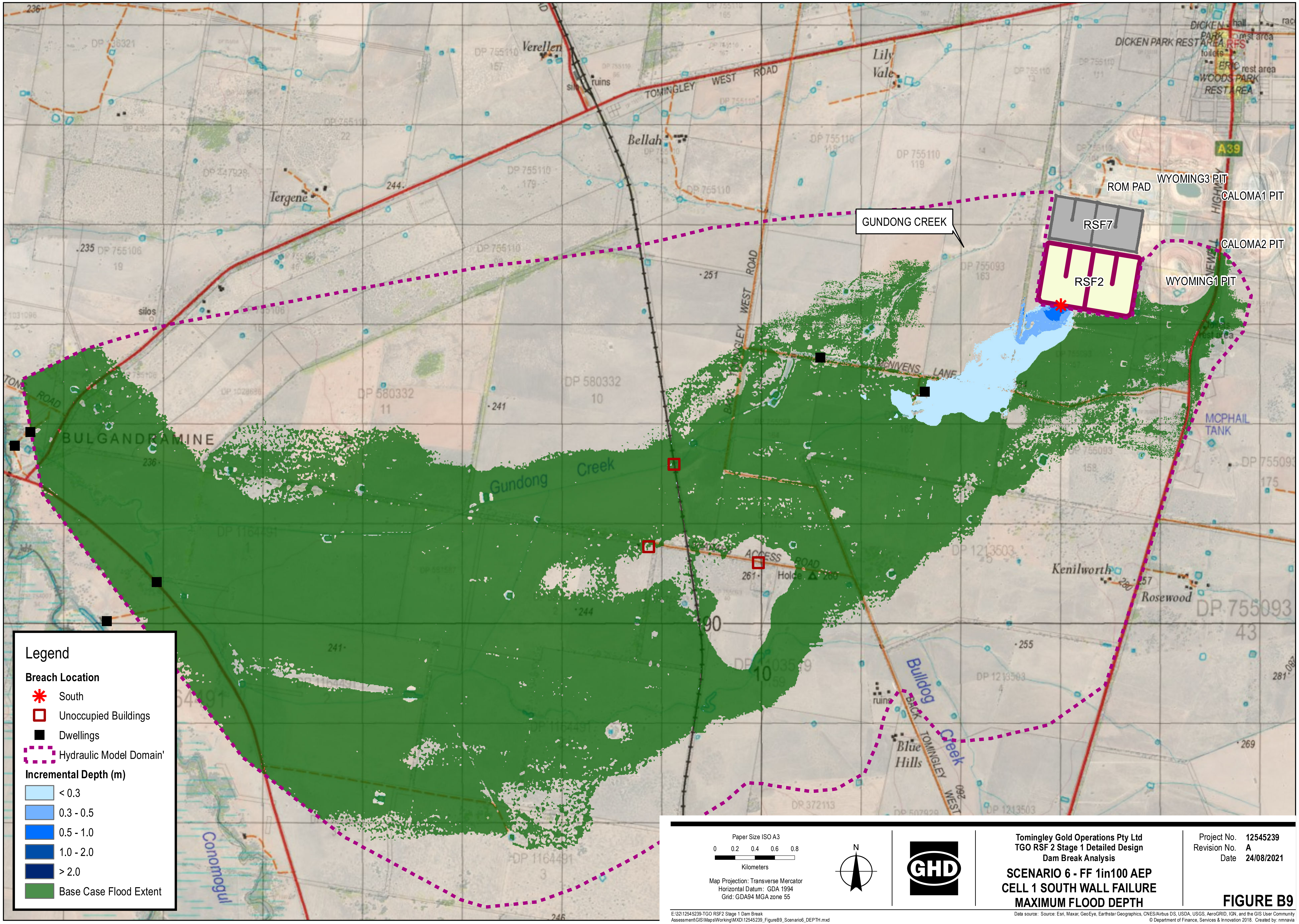


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

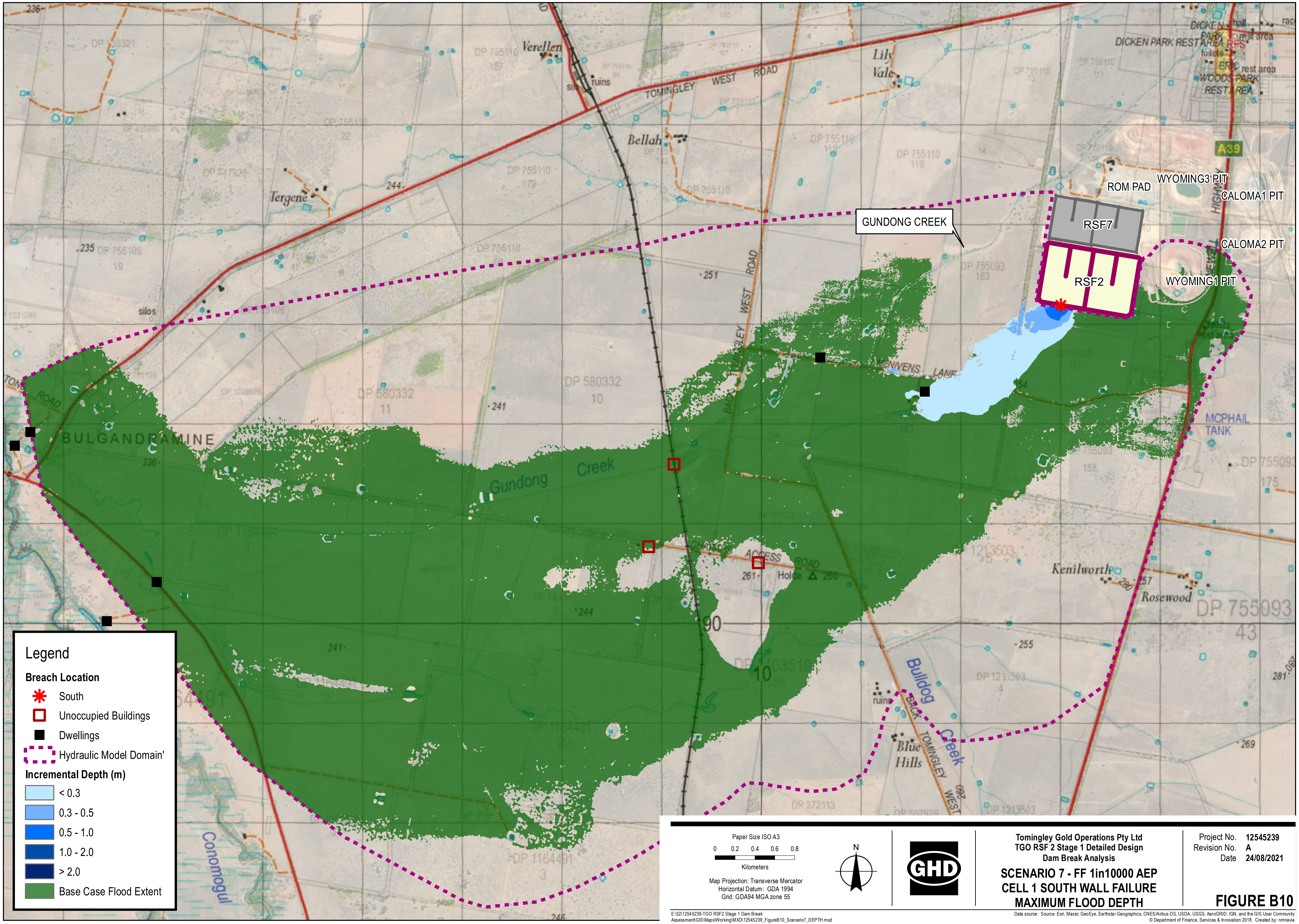
SCENARIO 6 - FF 1in100 AEP
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B9

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB9_Scenario6_DEPTH.mxd
Print date: 24 Aug 2021 - 17:23

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

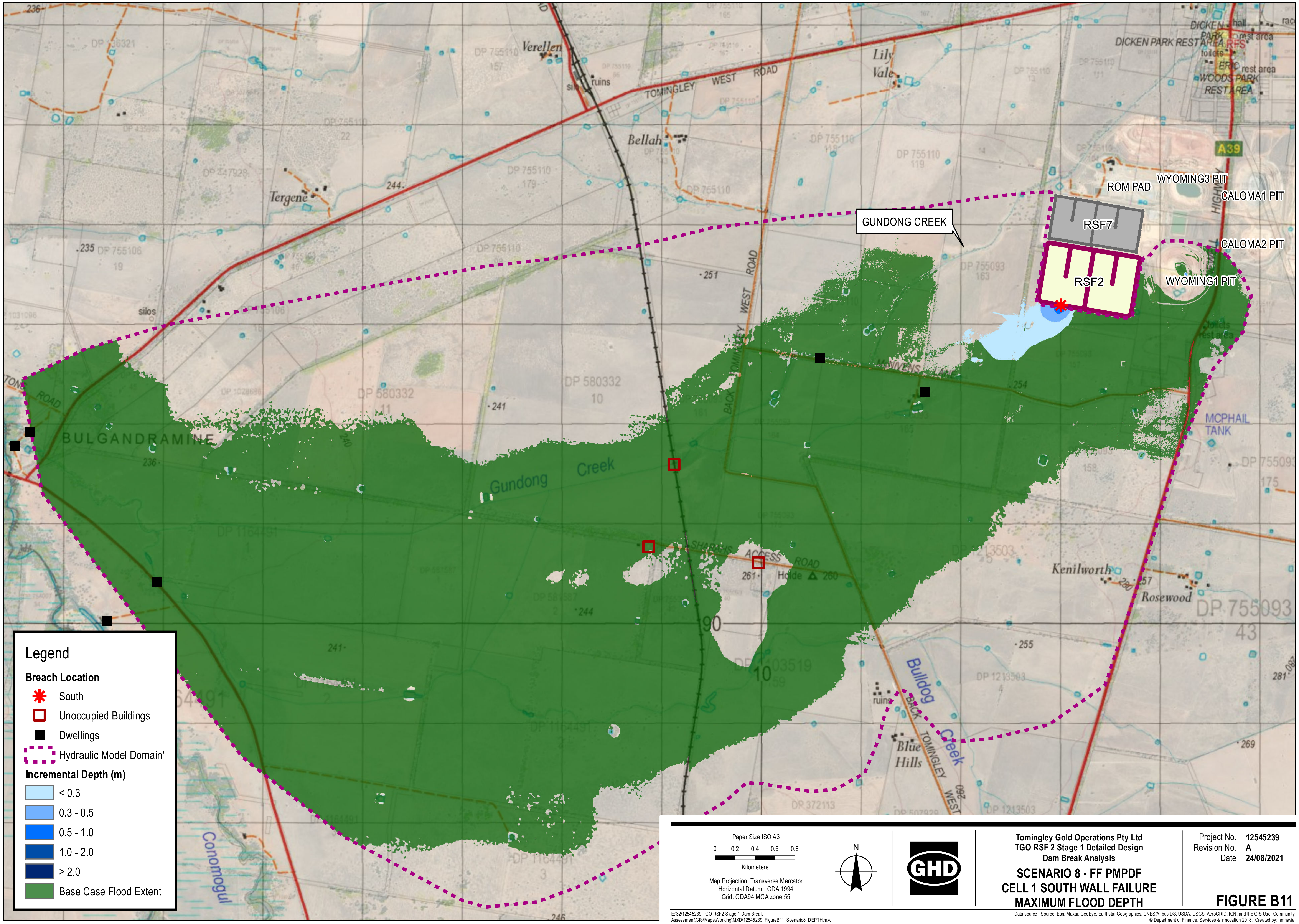
SCENARIO 7 - FF 1in10000 AEP
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	12545239
Revision No.	A
Date	24/08/2021

FIGURE B10

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB10_Scenario7_DEPTH.mxd
Print date: 24 Aug 2021 - 17:24

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

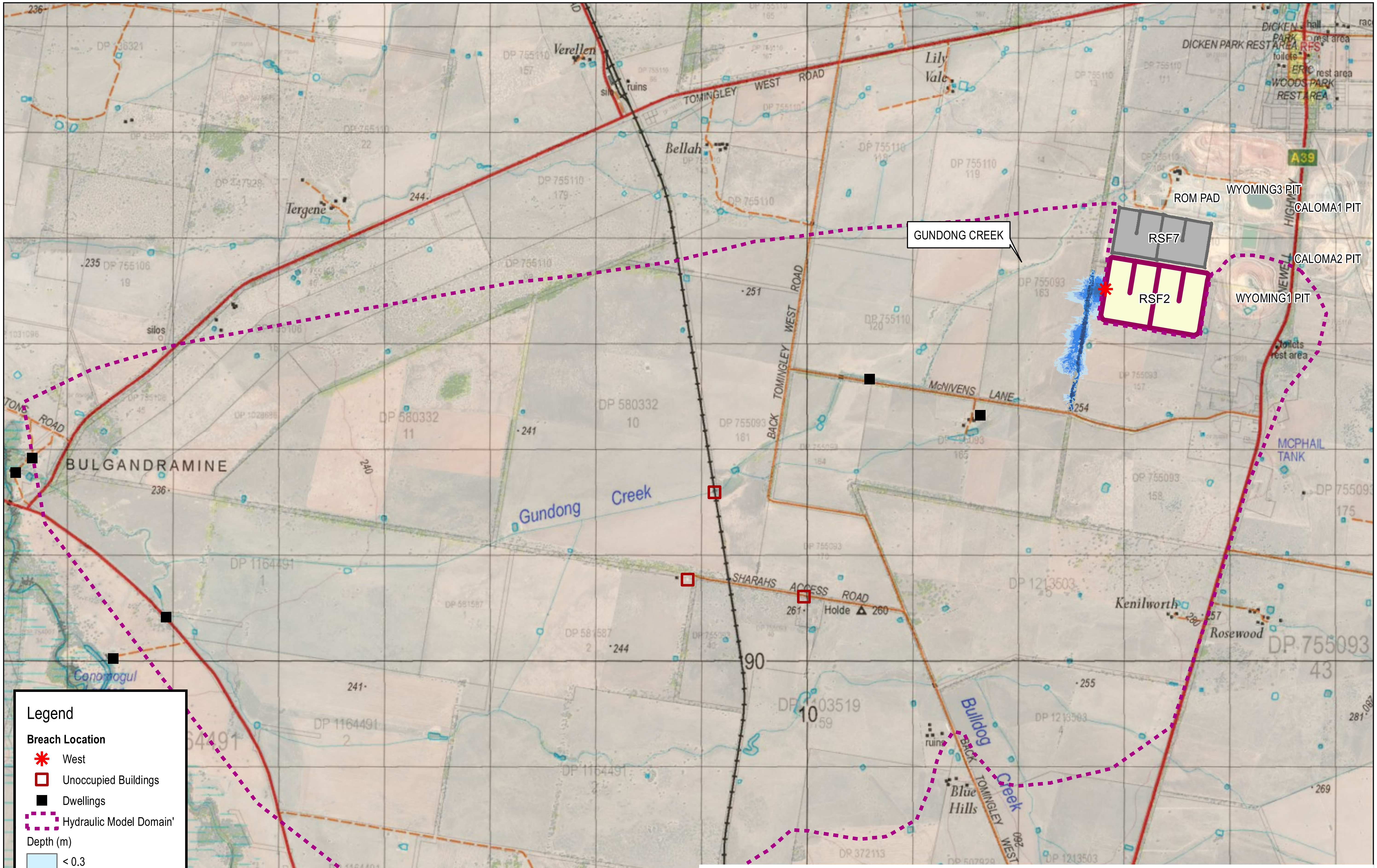
SCENARIO 8 - FF PMPDF
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B11

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB11_Scenario8_DEPTH.mxd
Print date: 24 Aug 2021 - 17:24

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 9 - SDF
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B12

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB12_Scenario9_DEPTH.mxd
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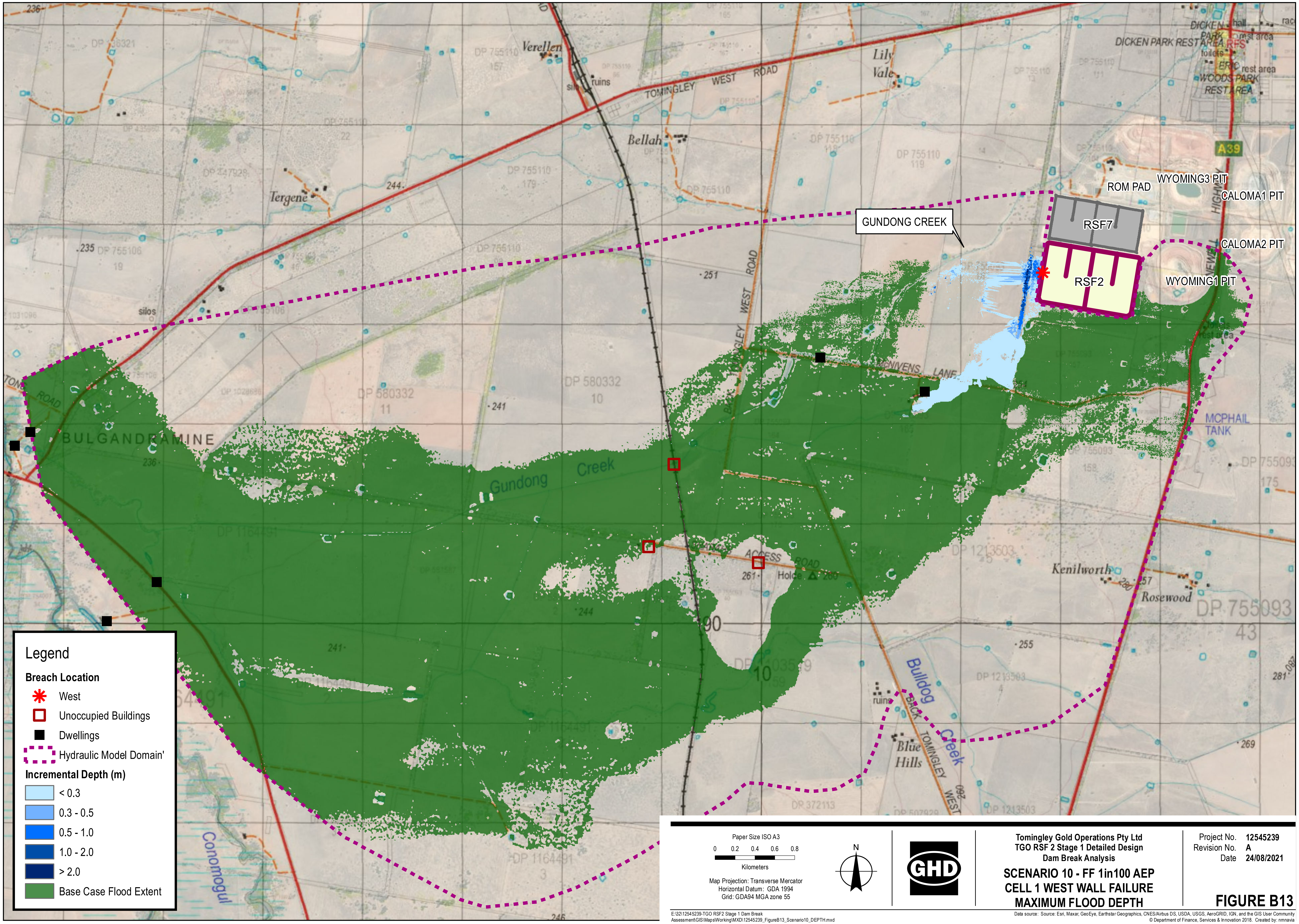


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

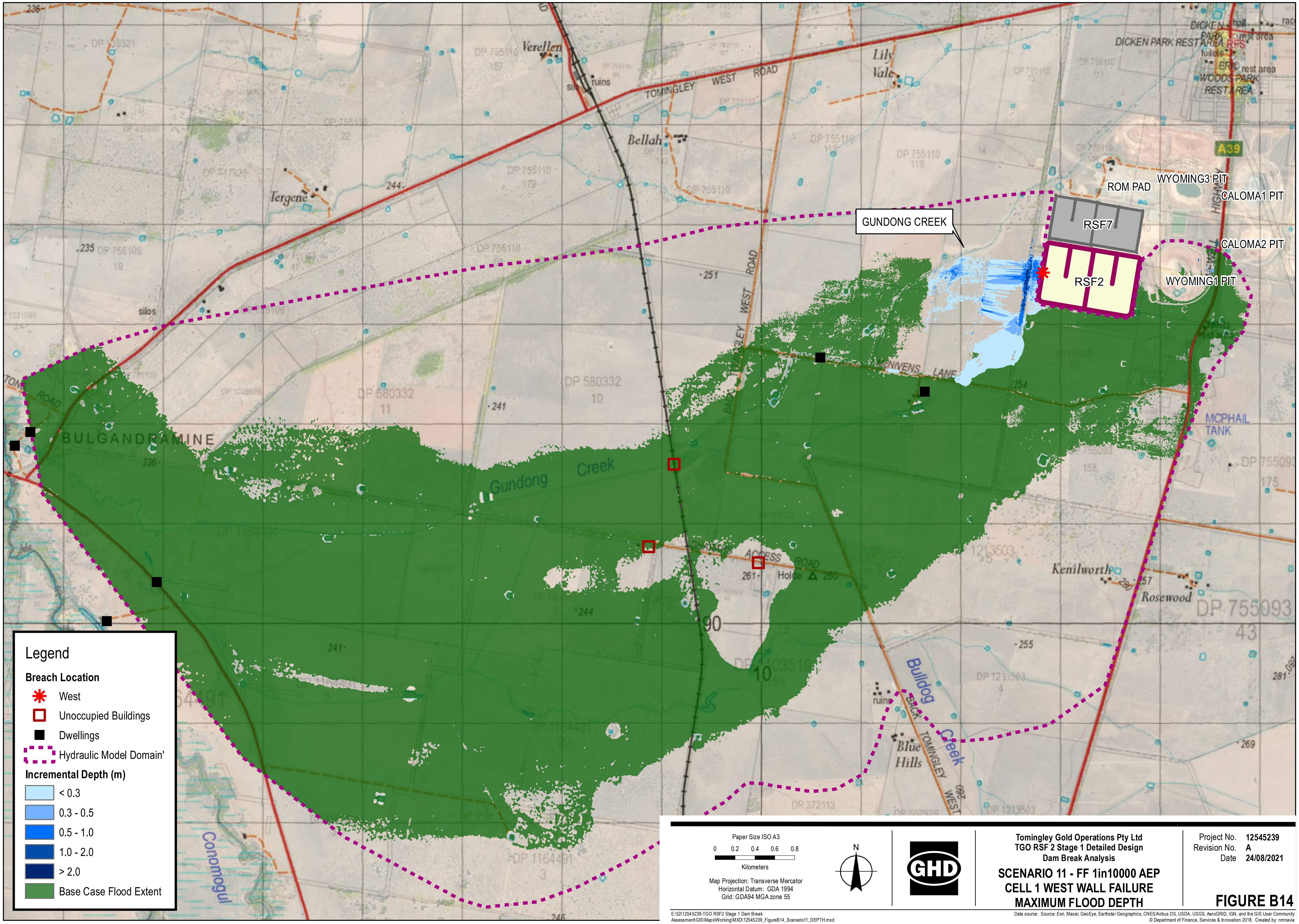
SCENARIO 10 - FF 1in100 AEP
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B13

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB13_Scenario10_DEPTH.mxd
Print date: 24 Aug 2021 - 17:26

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

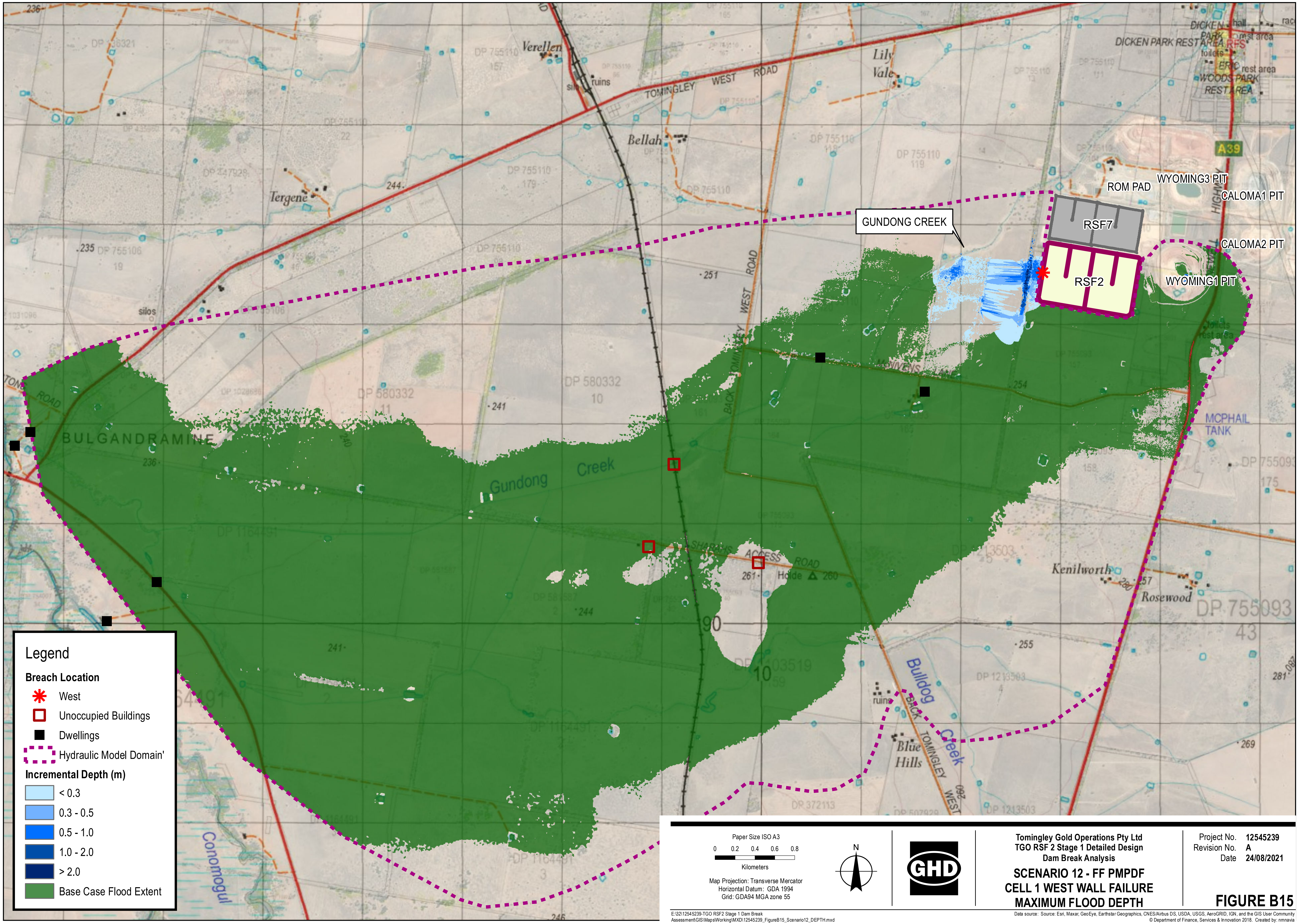
SCENARIO 11 - FF 1in10000 AEP
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B14

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB14_Scenario11_DEPTH.mxd
Print date: 24 Aug 2021 - 17:28

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 12 - FF PMPDF
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B15

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB15_Scenario12_DEPTH.mxd
Print date: 24 Aug 2021 - 17:28

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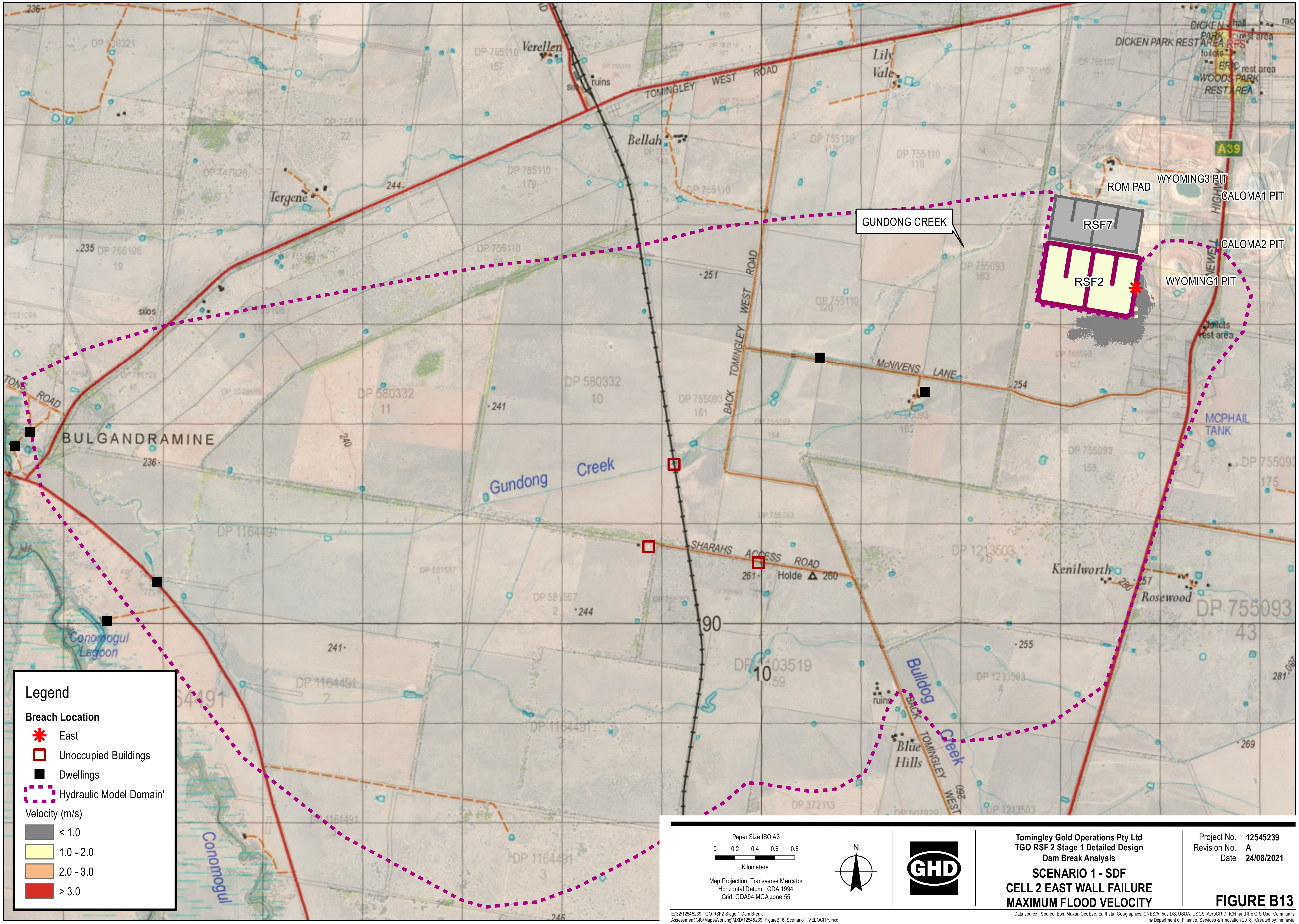


Legend

Breach Location

✳	East
☐	Unoccupied Buildings
■	Dwellings
▭	Hydraulic Model Domain'

Velocity (m/s)

▨	< 1.0
▨	1.0 - 2.0
▨	2.0 - 3.0
▨	> 3.0

Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

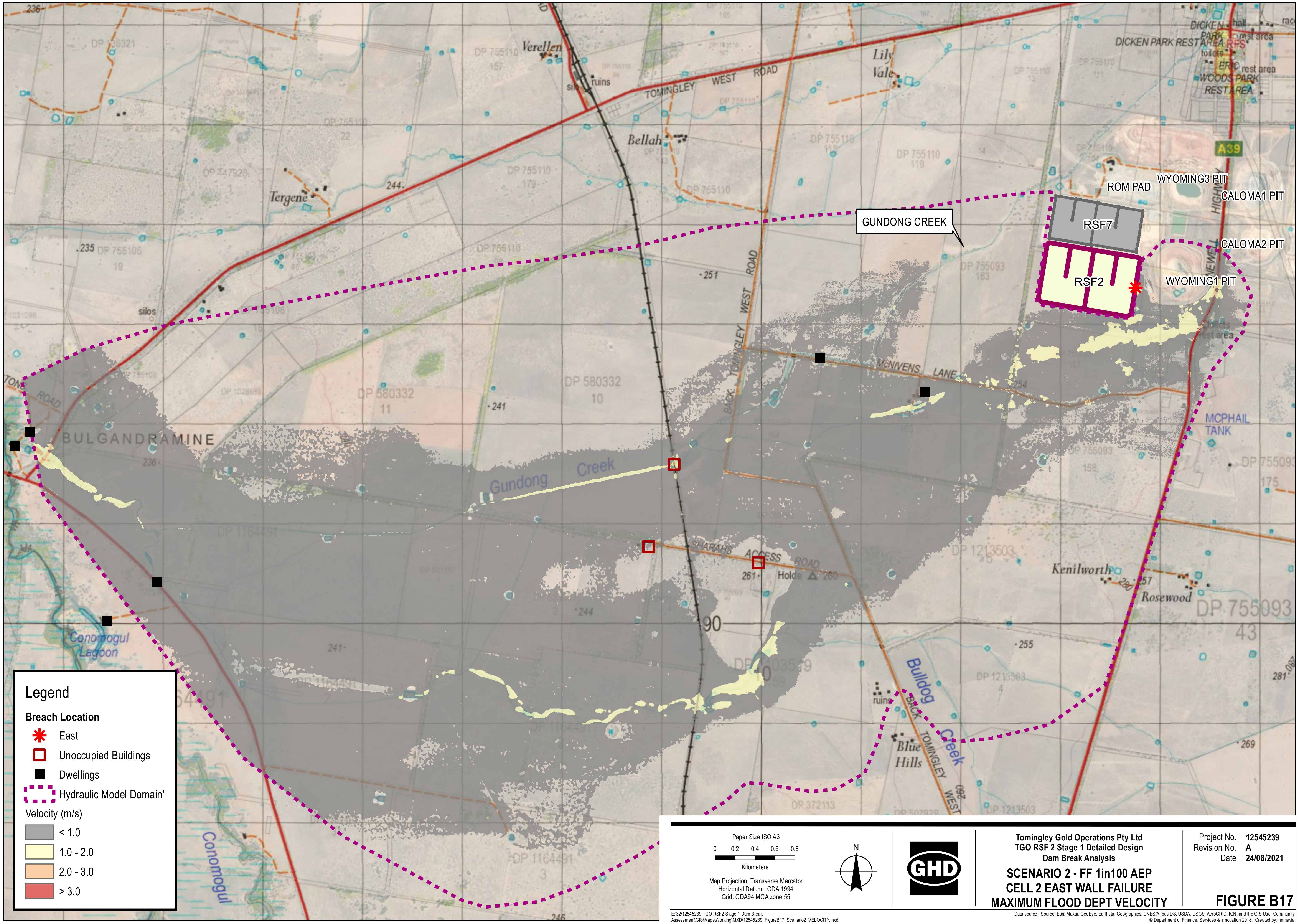
SCENARIO 1 - SDF
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B13

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB16_Scenario1_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:29

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Paper Size ISO A3
0 0.2 0.4 0.6 0.8
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 2 - FF 1in100 AEP
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD DEPT VELOCITY

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B17

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB17_Scenario2_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:29

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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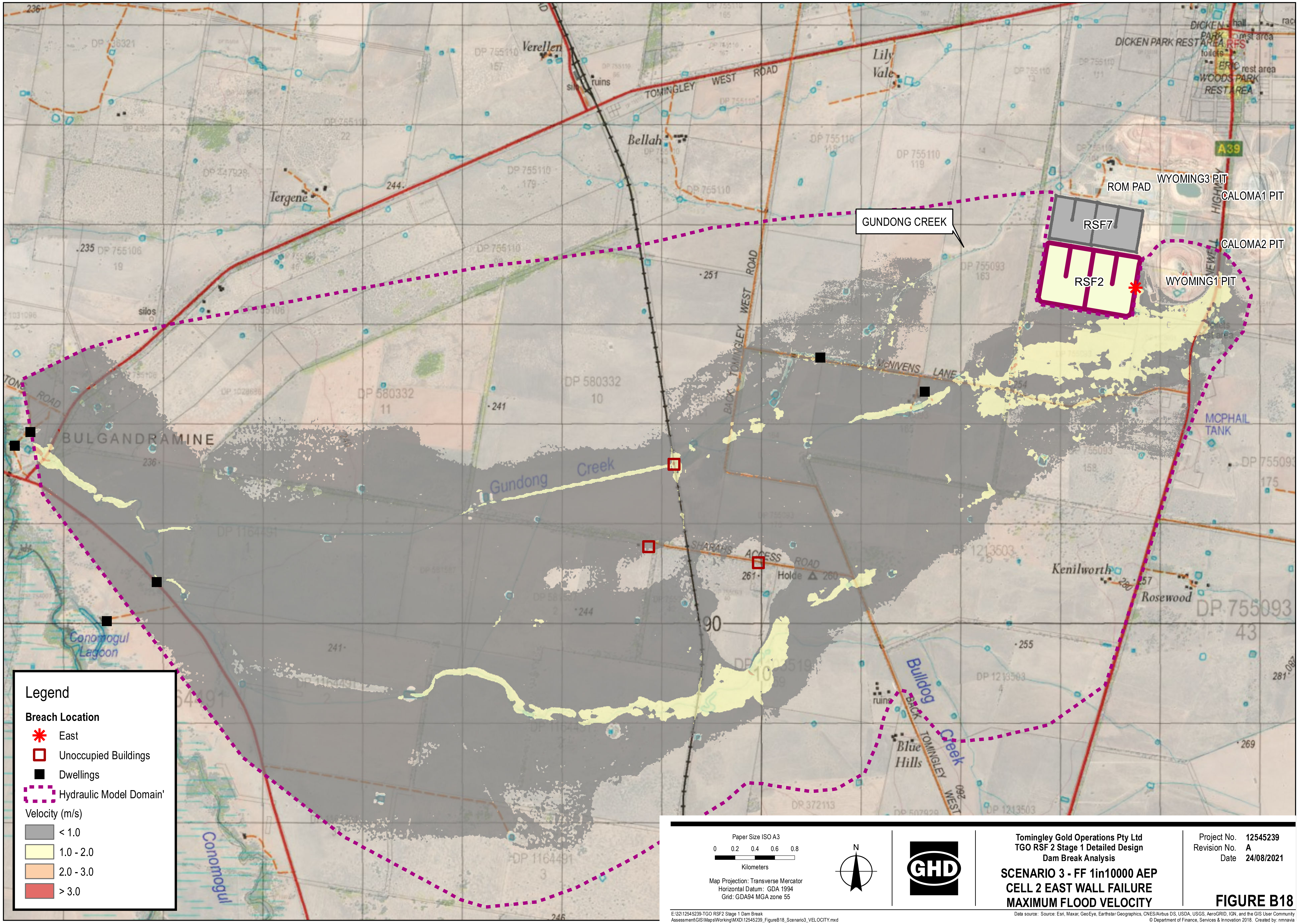


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

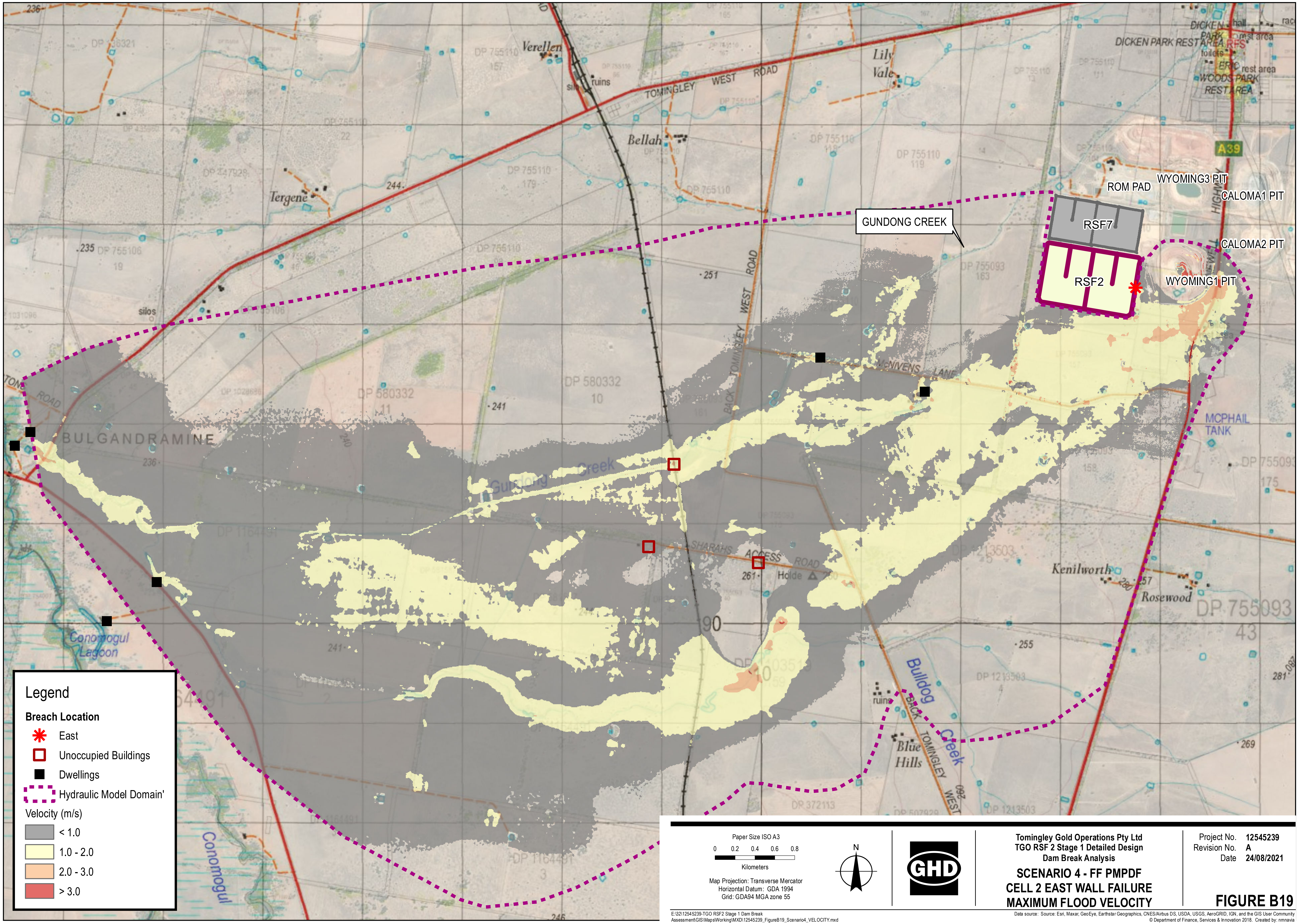
SCENARIO 3 - FF 1in10000 AEP
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No.	12545239
Revision No.	A
Date	24/08/2021

FIGURE B18

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB18_Scenario3_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:31

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

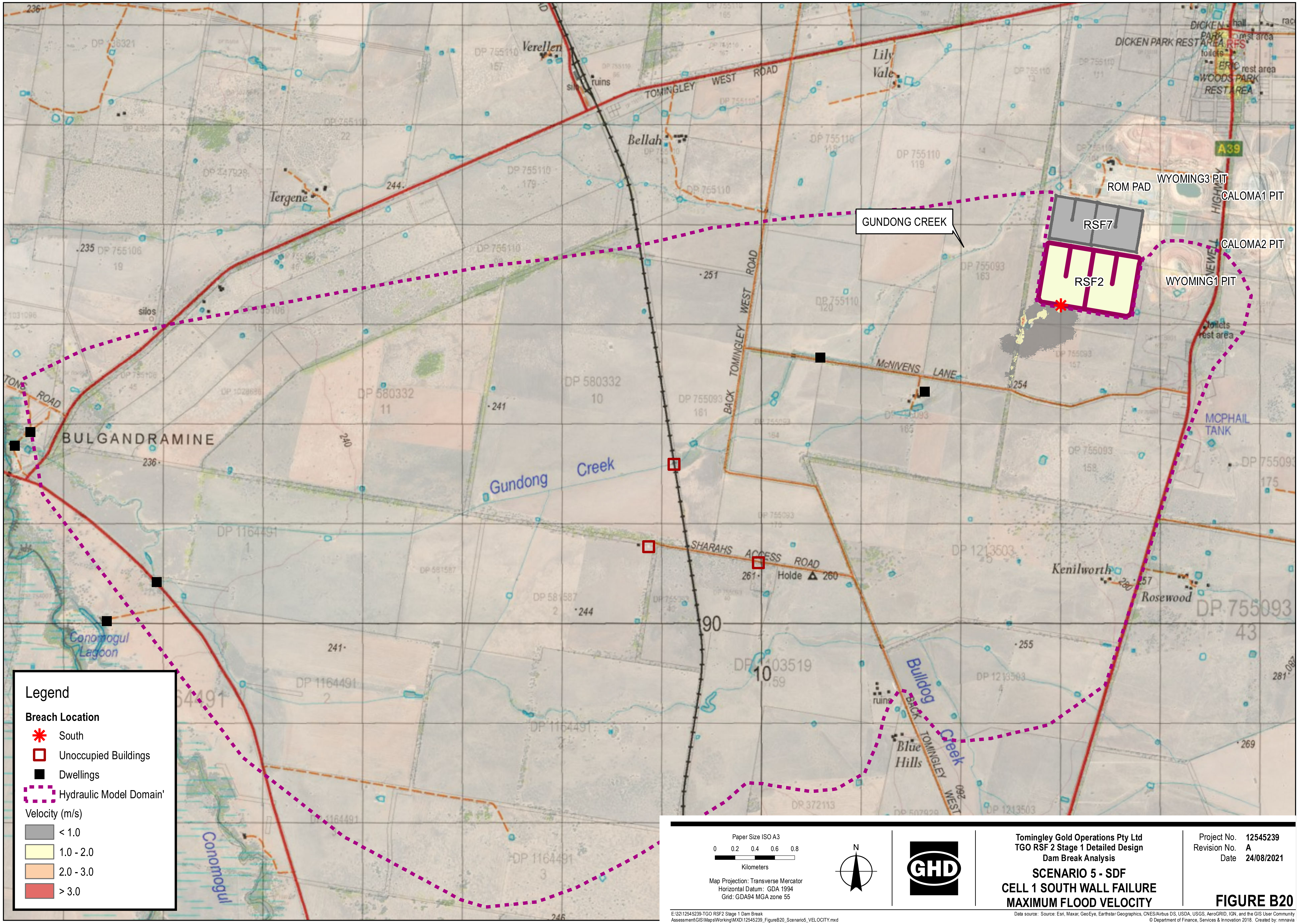
SCENARIO 4 - FF PMPDF
CELL 2 EAST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B19

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB19_Scenario4_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:31

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 5 - SDF
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B20

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB20_Scenario5_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:32

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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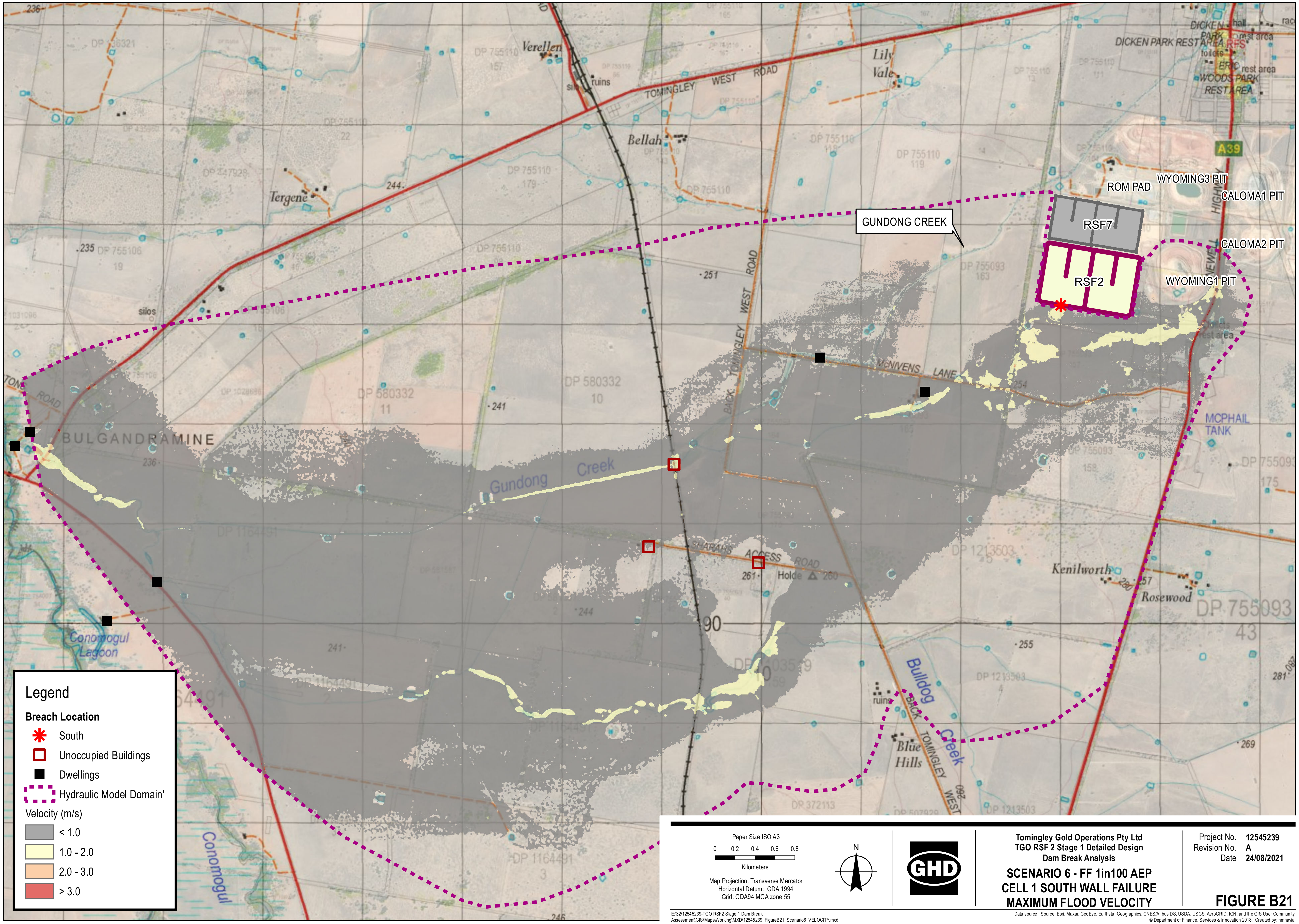


Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

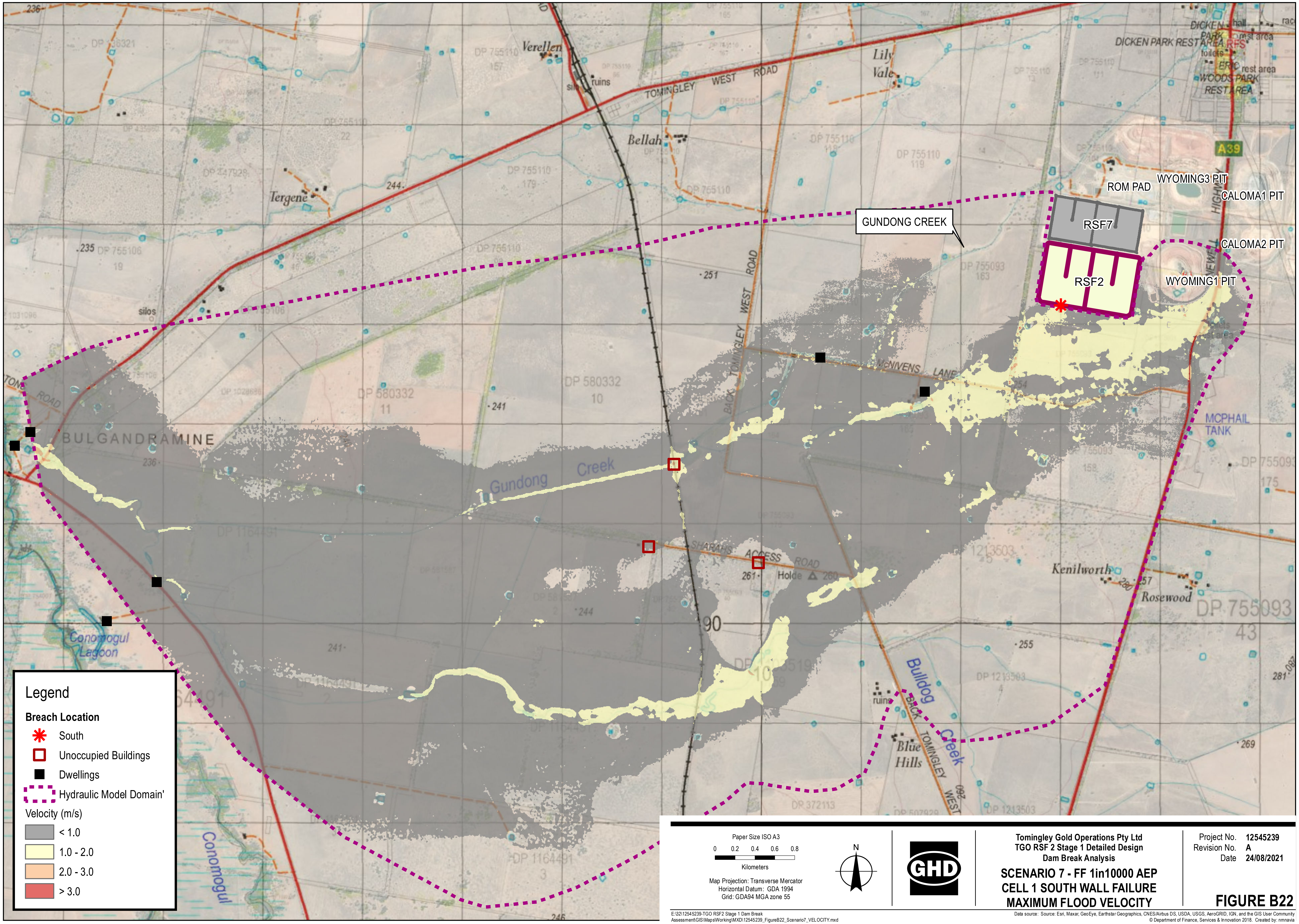
SCENARIO 6 - FF 1in100 AEP
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B21

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB21_Scenario6_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:32

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 7 - FF 1in10000 AEP
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B22

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB22_Scenario7_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:34

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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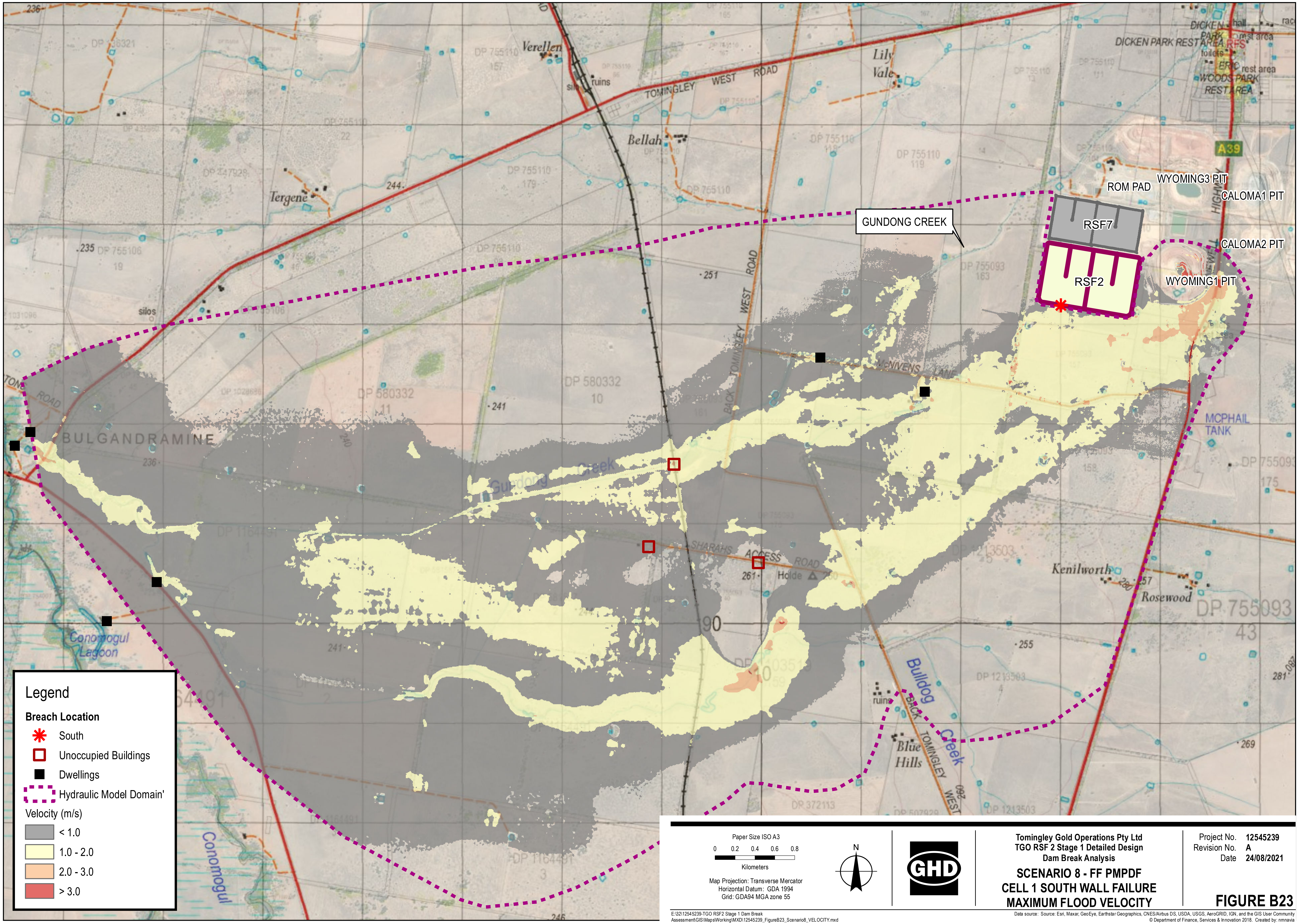

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 8 - FF PMPDF
CELL 1 SOUTH WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B23

E:\32\12545239-TGO RSF2 Stage 1 Dam Break Assessment\GIS\Maps\Working\MXD\12545239_FigureB23_Scenario8_VELOCITY.mxd
Print date: 24 Aug 2021 - 17:34

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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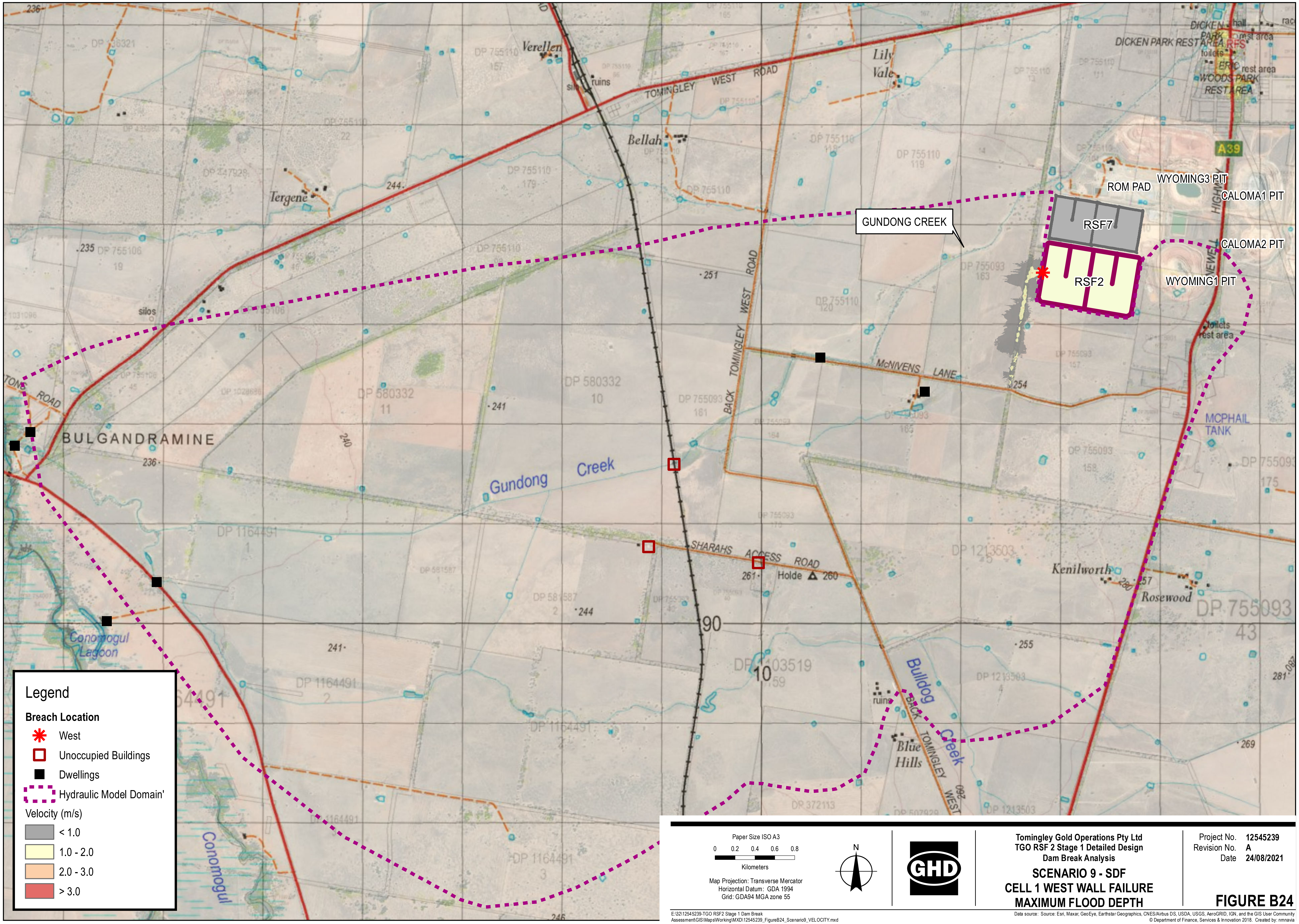

Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

GHD

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 9 - SDF
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD DEPTH

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B24

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Print date: 24 Aug 2021 - 17:35

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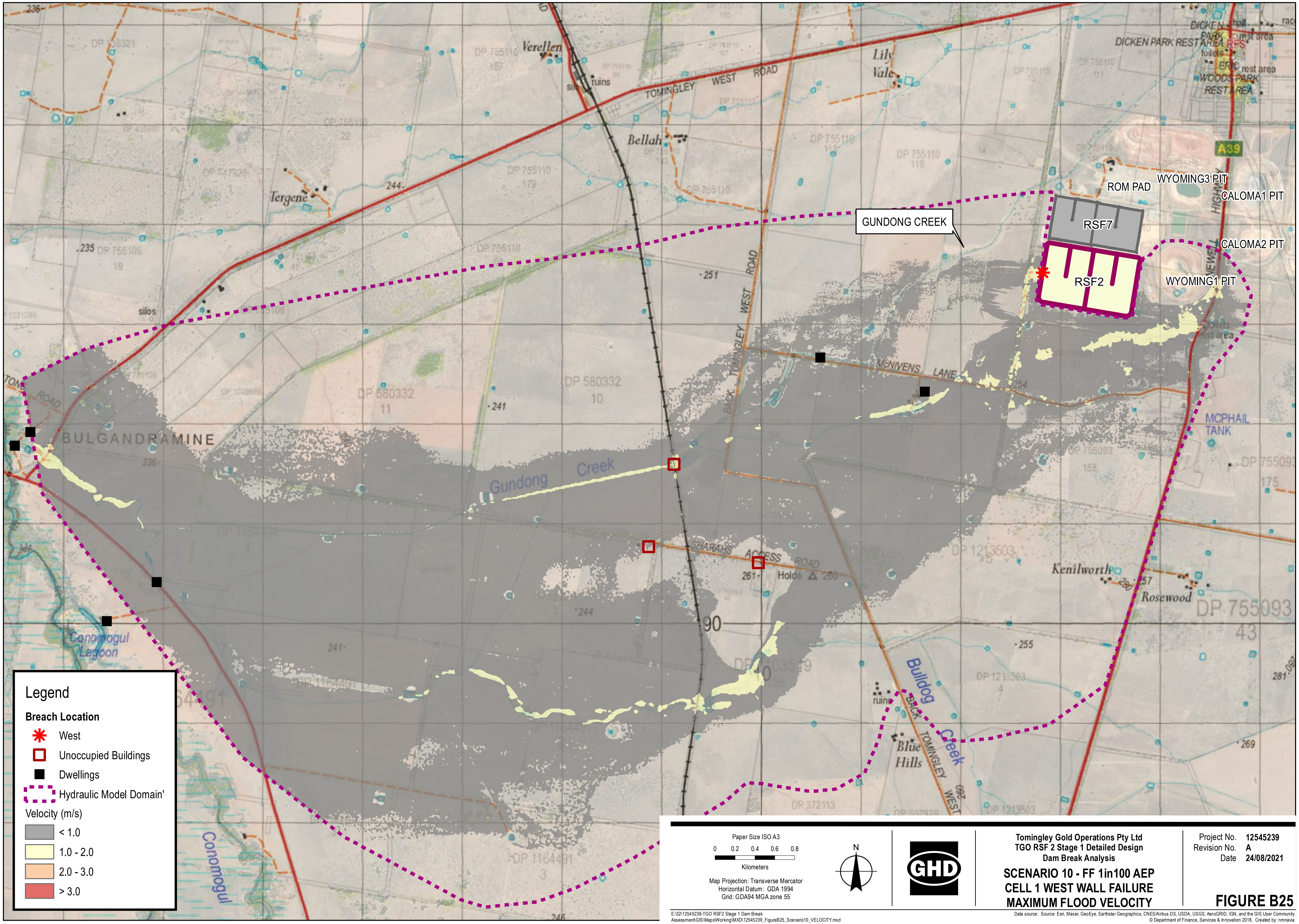

Paper Size ISO A3
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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 10 - FF 1in100 AEP
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B25

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Print date: 24 Aug 2021 - 17:36

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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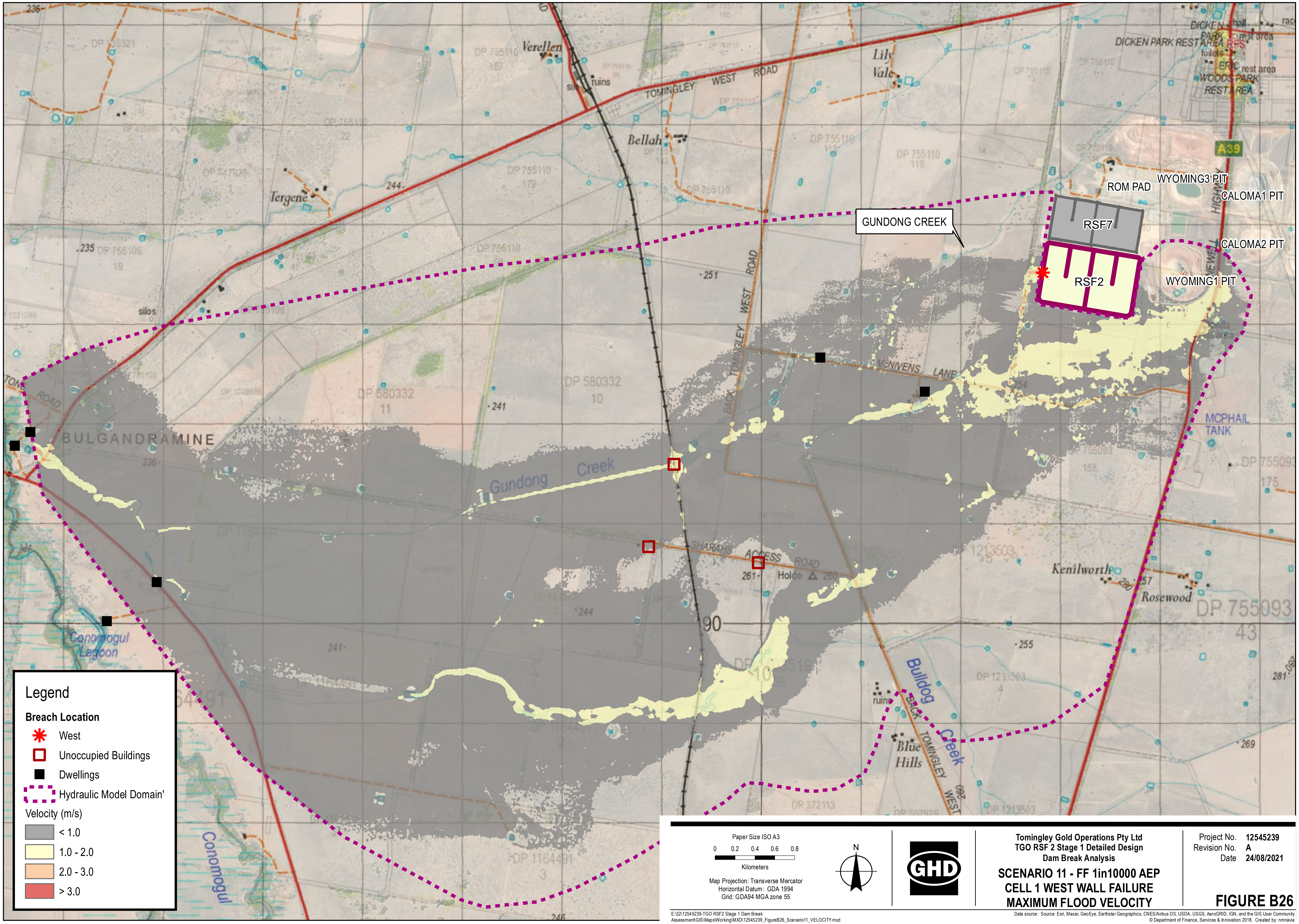

Paper Size ISO A3

0 0.2 0.4 0.6 0.8

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 11 - FF 1in10000 AEP
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No.	**12545239**
Revision No.	**A**
Date	**24/08/2021**

FIGURE B26

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Print date: 24 Aug 2021 - 17:37

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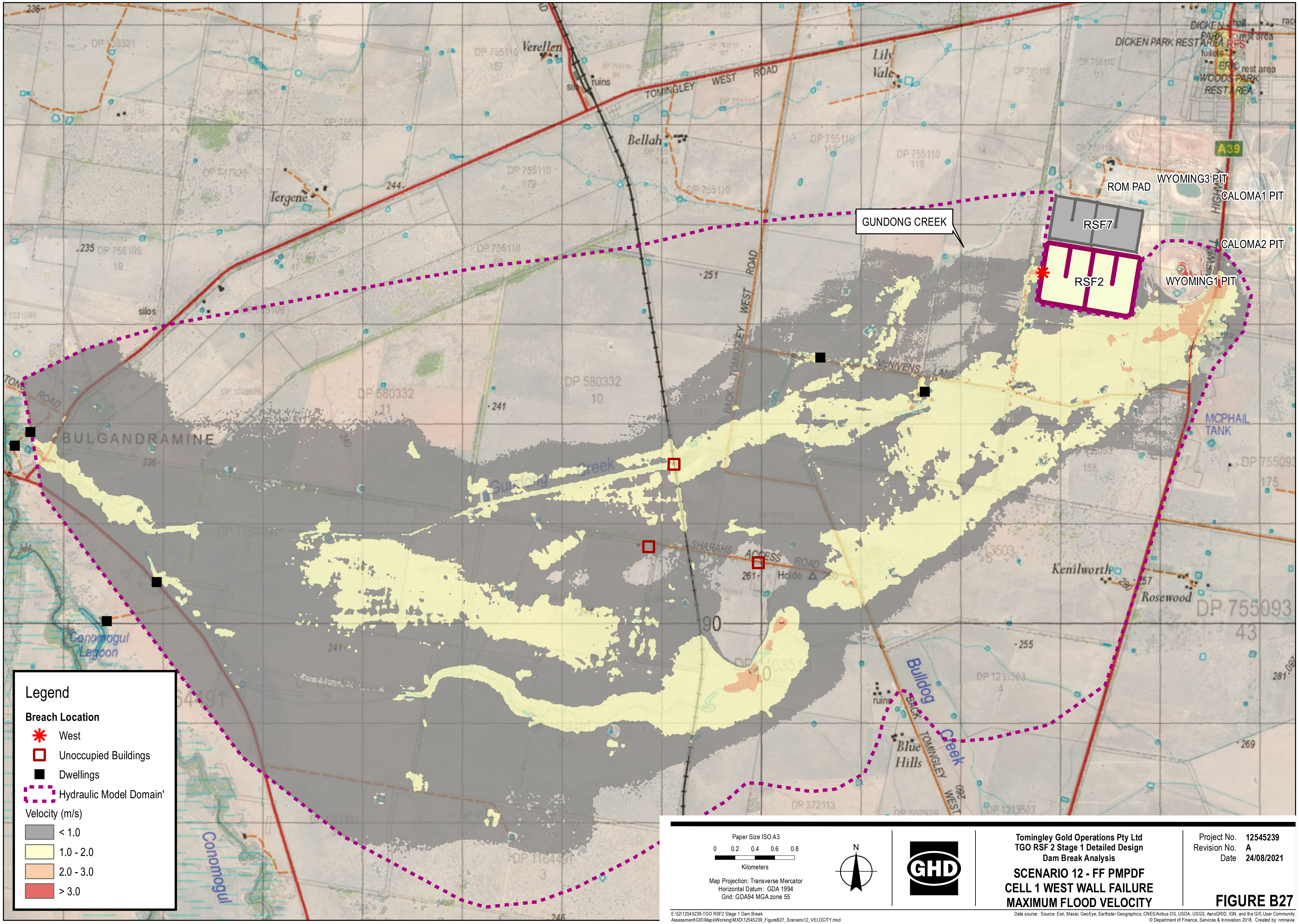

Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 MGA zone 55

N

Tomingley Gold Operations Pty Ltd
TGO RSF 2 Stage 1 Detailed Design
Dam Break Analysis

SCENARIO 12 - FF PMPDF
CELL 1 WEST WALL FAILURE
MAXIMUM FLOOD VELOCITY

Project No. **12545239**
Revision No. **A**
Date **24/08/2021**

FIGURE B27

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Print date: 24 Aug 2021 - 17:37

Data source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created by: nmnavia

CONSEQUENCE CATEGORY ASSESSMENT

Sunny Day Failure Scenario

Client Name	TGO		
Dam Name	RSF2		
Dam ID. No. (If existing dam)			
Stream Name			
Dam Height (Metres)	6	**Crest RL**	**270.0 m**
Estimated Capacity at FSL (Megalitres)			
Location	Tomingley		

Damage and Loss	**Estimate**	**Severity Level** Minor	 Medium	 Major	 Catastrophic
TOTAL INFRASTRUCTURE COSTS (costs are indicative only)					
Residential	<10M	YES	.	.	.
Commercial	$10M - $100M	.	YES	.	.
Community Infrastructure	<10M	YES	.	.	.
Dam replacement or repair cost	$10M - $100M	.	YES	.	.
TOTAL INFRASTRUCTURE COSTS severity level			**MEDIUM**		
IMPACT ON DAM OWNER'S BUSINESS					
Importance to the business	Restrictions needed during peak days and peak hour	.	YES	.	.
Effect on services provided by the owner	Reduced services are possible with reasonable restrictions	.	YES	.	.
Effect on continuing credibility	Extreme discontent	.	.	YES	.
Community reaction and political implications	Extreme discontent	.	.	YES	.
Impact on financial viability	Able to absorb in 1 financial year	YES	.	.	.
Value of water in storage (assessed by the owner in relation to the business)	Can be absored in one financial year	YES	.	.	.
IMPACT ON DAM OWNER'S BUSINESS damage and loss severity level			**MAJOR**		
HEALTH and SOCIAL IMPACTS					
Public health	<100 people affected	YES	.	.	.
Loss of service to the community	<100 people affected	YES	.	.	.
Cost of emergency management	<1,000 person days	YES	.	.	.
Dislocation of people	<100 person months	YES	.	.	.
Dislocation of businesses	<20 business months	YES	.	.	.
Employment affected	<100 jobs lost	YES	.	.	.
Loss of heritage	Local facility	YES	.	.	.
Loss of recreational facility	Local facility	YES	.	.	.
HEALTH and SOCIAL IMPACTS damage and loss severity level			**MINOR**		
NATURAL ENVIRONMENT					
Area of Impact	<1km2	YES	.	.	.
Duration of Impact	<1 (wet) year	YES	.	.	.
Stock and Fauna	Discharge from dambreak would contaminate water supplies used by stock and fauna. Health impacts not expected.	.	YES	.	.
Ecosystems	Discharge from dambreak would have short term impacts on ecosystems with natural recovery expected after 1 wet season. Remediation possible.	.	YES	.	.
Rare and endangered fauna and flora	Species exist but minimal damage expected. Recovery within one year.	YES	.	.	.
NATURAL ENVIRONMENT damage and loss severity level			**MEDIUM**		

HIGHEST DAMAGE AND LOSS SEVERITY LEVEL	**MAJOR**

Population at Risk (PAR) PAR includes all those persons who would be directly exposed to flood waters within the dam break affected zone if they took no action to evacuate.	**<1** **CONSEQUENCE CATEGORY =**	**SIGNIFICANT**

Completed and Reviewed By	Tom Ridgway
Date	14/09/2021

CONSEQUENCE CATEGORY ASSESSMENT

Environmental Release Scenario

Client Name	TGO	
Dam Name	RSF2	
Dam ID. No. (If existing dam)		
Stream Name		
Dam Height (Metres)	6	**Crest RL** 270.0 m
Estimated Capacity at FSL (Megalitres)		
Location	Tomingley	

Damage and Loss	**Estimate**	**Severity Level**			
		Minor	Medium	Major	Catastrophic
TOTAL INFRASTRUCTURE COSTS (costs are indicative only)					
Residential	<10M	YES	.	.	.
Commercial	$10M - $100M	.	YES	.	.
Community Infrastructure	<10M	YES	.	.	.
Dam replacement or repair cost	$10M - $100M	.	YES	.	.
TOTAL INFRASTRUCTURE COSTS severity level		**MEDIUM**			
IMPACT ON DAM OWNER'S BUSINESS					
Importance to the business	Restrictions needed during peak days and peak hour	.	YES	.	.
Effect on services provided by the owner	Reduced services are possible with reasonable restrictions	.	YES	.	.
Effect on continuing credibility	Severe widespread reaction	.	YES	.	.
Community reaction and political implications	Severe widespread reaction	.	YES	.	.
Impact on financial viability	Able to absorb in 1 financial year	YES	.	.	.
Value of water in storage (assessed by the owner in relation to the business)	Can be absored in one financial year	YES	.	.	.
IMPACT ON DAM OWNER'S BUSINESS damage and loss severity level		**MEDIUM**			
HEALTH and SOCIAL IMPACTS					
Public health	<100 people affected	YES	.	.	.
Loss of service to the community	<100 people affected	YES	.	.	.
Cost of emergency management	<1,000 person days	YES	.	.	.
Dislocation of people	<100 person months	YES	.	.	.
Dislocation of businesses	<20 business months	YES	.	.	.
Employment affected	<100 jobs lost	YES	.	.	.
Loss of heritage	Local facility	YES	.	.	.
Loss of recreational facility	Local facility	YES	.	.	.
HEALTH and SOCIAL IMPACTS damage and loss severity level		**MINOR**			
NATURAL ENVIRONMENT					
Area of Impact	<1km2	YES	.	.	.
Duration of Impact	<1 (wet) year	YES	.	.	.
Stock and Fauna	Discharge from dambreak would contaminate water supplies used by stock and fauna. Health impacts not expected.	.	YES	.	.
Ecosystems	Discharge from dambreak would have short term impacts on ecosystems with natural recovery expected after 1 wet season. Remediation possible.	.	YES	.	.
Rare and endangered fauna and flora	Species exist but minimal damage expected. Recovery within one year.	YES	.	.	.
NATURAL ENVIRONMENT damage and loss severity level		**MEDIUM**			

HIGHEST DAMAGE AND LOSS SEVERITY LEVEL	**MEDIUM**

Population at Risk (PAR) PAR includes all those persons who would be directly exposed to flood waters within the dam break affected zone if they took no action to evacuate.	**<1** **CONSEQUENCE CATEGORY =**	**LOW**

Completed and Reviewed By	Tom Ridgway
Date	14/09/2021

Appendix C

RSF2 Geotechnical Investigation Report

Tomingley Gold Operations Pty Ltd

TGO RSF 2 Geotechnical investigation

Geotechnical Factual Report

October 2021

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Appendices

1. Introduction

1.1 Background

TGO are preparing a project modification for the development of a proposed satellite pit south of the existing mine to extend the production by 10 Mt, for nominally 7 years at a production rate of 1.5 Mtpa, which is increased from the existing 1 Mtpa.

GHD have previously undertaken an options study for TGO, utilising a multi-criteria assessment to identify the preferred site for the new Residue Storage Facility (RSF) (refer GHD report – TGO Residue Storage Facility 2 Site Options Study Report, dated December 2019). The study determined the preferred site for the new RSF to be located immediately to the south of the existing storage facility.

GHD has also undertaken a concept design for the new RSF which is comprises of a turkeys nest arrangement and utilises the southern wall of the existing embankment to optimise earthwork requirements, and assist in developing a stable landform arrangement and allow for a single closure landform at the end of mine life.

1.2 Purpose of this report

The purpose of this report is to provide factual results from the geotechnical investigation, facilitate the preliminary design of the proposed second RSF.

1.3 Scope of works

The scope of the geotechnical investigation referenced in the report comprised:

- A desktop review of publicly available information and previous geotechnical investigations nearby the proposed site.
- A programme of geotechnical fieldwork, consisting of test pit investigation and borehole investigation, with associated insitu and laboratory testing.
- Preparation of a factual geotechnical report (this report) to summarise the findings of the investigation

Additional to the geotechnical scope of works, a series of hydrogeological work items were original proposed to be undertaken in conjunction with the geotechnical scope, including;

- Installation of 6 No groundwater monitoring bores on conclusion of the drilling investigation and subsequent slug testing following development of the wells.
- Preparation of a hydrogeological assessment section within the geotechnical report (this report) to summarise any relevant hydrogeological observations, comparison to existing information, bore construction details and reporting on the initial baseline groundwater chemistry results.

The hydrogeological scope items were not completed due to cadastral ownership issues at the time of the site works and therefore delayed to a later time.

1.4 Limitations

This report has been prepared by GHD for Tomingley Gold Operations Pty Ltd and may only be used and relied on by Tomingley Gold Operations Pty Ltd for the purpose agreed between GHD and the Tomingley Gold Operations Pty Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Tomingley Gold Operations Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Desktop Review

2.1 General

A desktop study was undertaken to ascertain the anticipated geological conditions and potential geohazards at the site. The study entailed a review of published data available in the public domain (e.g. NSW geological maps and Google Earth imagery), site specific assessments by other consultants, and a GHD previous investigation undertaken in close proximity to the proposed site.

2.2 Geological setting

Geological Survey of NSW (GSNSW) statewide seamless geology on MinView indicates that the site is located on the Junee-Narromine volcanic belt, part of the Palaeozoic Lachlan Orogen composition of sedimentary, volcanic and intrusive rock formations of early Cambrian to early Devonian age. The Ordo-Silurian sequences that comprise the Wyoming/Caloma deposits are tight to isoclinal folding, strong axial planar cleavage with green schist metamorphic assemblages (GHD 2020a).

The area is dominated by alluvial sequences of clays, sands and gravel of Quaternary to Tertiary age, up to 50 m thick. The alluvial material dissipates to the south and north with basement outcropping. There is a well-developed weathering profile which can extend to 70 m below ground level (The Impax Group 2011).

An extract of the geology map is provided in Appendix B.

2.3 Hydrogeological Setting

There are three distinct groundwater systems within the vicinity of TGO’s mining leases, as identified by The Impax Group (2011), and discussed in GHD (2020a):

- Shallow alluvium – discrete, shallow alluvium (less than 10 to 20 m deep) dissects the plains surrounding the mine site along creek flow paths. These aquifers are likely to be recharged from rainfall infiltration. Groundwater within these systems is of relatively good quality, however yields are relatively low and dependent on rainfall.
- Deep alluvium – up to 100 m deep and located approximately 10 km to the northwest and west of TGO. Groundwater yields are expected to be low and of poor quality. These systems may have some interaction with underlying bedrock however are likely to be primarily recharged from rainfall.
- Fractured rock – the area surrounding TGO is typically underlain by shale, siltstone and chert with several fractured rock aquifers in the vicinity of the mine. Groundwater yields range from 0-3 L/s, generally less than 1.5 L/s, and water quality is poor with high salinity.

2.4 Previous investigations

A database search of existing subsurface information within or in close proximity to the proposed RSF site was conducted.

Mining One (2009) carried out a geotechnical investigation for the feasibility study of the Residue Storage Facility. The investigation comprised excavation of 25 No test pits to maximum 2.6 m depth within the footprint of the RSF, and cored borehole drilling to a maximum 15 m below ground level within the footprint of the Wyoming One Open Cut.

Based on the findings of the Mining One report, Cooper and Associates (2009) prepared a design for the existing RSF. The design entailed a 42 ha facility, comprising embankment with

6 m wide crest, downstream face slope angle of 1V:3H and upstream face slope angle of 1V:1.5H and 3 m wide by 2 m deep keyway.

Three recent boreholes (GHD 2020b) were found with the findings summarised in Table 2-1. The location of these boreholes are shown on the site plan presented in Appendix A.

Table 2-1 Summary of subsurface conditions at RSF1

Hole ID	Depth Encountered (min to max m)	Material Description
GBH01	0.0 to 7.5	Silty/sandy CLAY, medium to high plasticity, firm to hard, dark red/brown to grey
	Overlying	
	7.5 to 10.5	Clayey/gravelly SAND, coarse grained, grey blotched red-orange
	Overlying	
	10.5+	CLAY trace/some gravel, grey blotched orange-brown/dark red, medium plasticity, hard (residual soil)
GBH02	0.0 to 2.0	CLAY/SILT, medium to high plasticity, red spotted orange, hard
	Overlying	
	2.0 to 2.8	Clayey SAND with gravel, spotted grey, orange streaked brown, dense
	Overlying	
	2.8 to 14.0	Sandy/gravelly CLAY, medium plasticity, grey blotched orange, spotted red and white-orange
	Overlying	
	14.0+	CLAY, medium plasticity, blotch red and grey spotted black to dark red, blotched dark orange
GBH03	0.0 to 6.0	Silty/Sandy CLAY, low to medium plasticity, very stiff to hard, red and white, grey and brown
	Overlying	
	6.0 to 6.5	SAND with clay and gravel, dense, red spotted, red-grey
	Overlying	
	6.5 to 8.9	Gravelly/sandy CLAY, medium plasticity, grey spotted red to grey blotch red-brown
	Overlying	
	8.9 to 11.0	CLAY/SILT, medium plasticity, pale brown
	Overlying	
	11.0+	SILTSTONE/MUDSTONE, pale yellow/green, vertical laminations

3. Field Investigations

3.1 General

An intrusive geotechnical ground investigation was carried out between 17 November and 5 December 2020, comprising the following activities:

- Mechanical excavation of 20 No test pits (TP01 to TP20) in vicinity of the proposed reservoir storage area.
- Drilling of 10 No geotechnical boreholes (BH01 to BH10) within the alignment of the proposed embankment foundation to a target depth of 20 m

The location of test pits and boreholes are shown in Appendix A.

Fieldwork was carried out under full time supervision of an experienced engineer/geologist from GHD and in accordance with AS 1726-2017 (Geotechnical Site Investigations) and standard GHD procedures.

Visual and tactile logging of recovered samples was undertaken in accordance with the GHD soil and rock logging procedures.

The locations and elevations for each test location was surveyed by TGO mine surveyors and provided to GHD following completion of the works. The relevant data is provided on the respective geotechnical log sheets.

3.2 Test Pits

Test pits were excavated to a maximum depth of 4.0 m below ground level, using a 21.5 tonne excavator provided and operated by TGO contractors.

On completion of test pit logging and sampling, the test pits were backfilled with the excavated material and tamped with the base of the excavator bucket.

Descriptive logs indicating the observed soil profile in each pit and test pit photographs are presented in Appendix C and are preceded by explanatory notes summarising general nomenclature and symbols used.

A summary of the test pits locations is included in Table 3-1.

Table 3-1 Test Pit Summary

Test Pit ID	Coordinates (MGA 94, Zone 55)		Depth Excavated (m)	Termination Reason
	Easting (m)	Northing (m)		
TP01	613678.8	6393170	3.2	Effective refusal
TP02	613703.7	6393315	3.5	Limit of Hole
TP03	613505.9	6393348	3.5	Target Depth
TP04	613534.7	6393509	2.1	Effective refusal
TP05	613554	6393622	2.0	Effective refusal
TP06	613299.9	6393550	3.7	Limit of Hole
TP07	613318.8	6393661	2.0	Effective refusal
TP08	613085.4	6393690	3.1	Limit of Hole

Test Pit ID	Coordinates (MGA 94, Zone 55)		Depth Excavated (m)	Termination Reason
	Easting (m)	Northing (m)		
TP09	612879.5	6393721	2.4	Limit of Hole
TP10	612870.5	6393621	3.0	Effective refusal
TP11	613067.7	6393588	3.2	Effective refusal
TP12	613276.8	6393385	4.0	Limit of Hole
TP13	613043.5	6393417	3.5	Effective refusal
TP14	613252.2	6393237	4.0	Target Depth
TP15	613482.5	6393207	2.8	Effective refusal
TP16	613730.6	6393476	3.7	Effective refusal
TP17	613757.1	6393589	3.3	Effective refusal
TP18	613015.1	6393279	3.2	Effective refusal
TP19	612819.5	6393320	3.0	End of Hole, rock encountered
TP20	612839.7	6393455	3.5	End of hole, rock encountered

3.1 Boreholes

The boreholes were drilled using a track mounted drill rig own and operated by Numac Drilling Services Australia Pty Ltd. The boreholes were advanced using sonic drilling techniques from ground surface to achieve a maximum depth of 20 m below ground level.

The boreholes were grouted to ground surface on extraction of drilling rods.

The geotechnical logs and core tray photos are presented in Appendix C, and are preceded by explanatory notes summarising general nomenclature and symbols used.

A summary of the boreholes is presented in Table 3-2.

Table 3-2 Borehole Summary

BH ID	Coordinates (MGA 94, Zone 55)		Collar RL (mAHD) (survey data)	Depth (mbgL)
	Easting (m)	Northing (m)		
BH01	613566.3	6393074	264.7	20
BH02	613269.7	6393126	263.8	20
BH03	612974.4	6393189	263.4	20
BH04	612790.1	6393360	263.8	20
BH05	612841.4	6393664	264.6	20
BH06	612974.4	6393714	265.1	20
BH07	613320.9	6393651	265.4	20
BH08	613552.7	6393609	265.9	20
BH09	613785.6	6393577	266.8	20

BH ID	Coordinates (MGA 94, Zone 55)		Collar RL (mAHD) (survey data)	Depth (mbgL)
	Easting (m)	Northing (m)		
BH10	613739.8	6393286	265.5	20

3.2 In-situ Testing

3.2.1 Pocket Penetrometer

Pocket penetrometer testing was undertaken on the ends of undisturbed (U63) samples obtained from the boreholes, and at regular depth intervals in the walls of the test pits to assess the in-situ consistency of the shallow soils and aid in identification of any potentially soft or low strength zones.

The results of pocket penetrometer testing are presented on the associated test pit and borehole logs in Appendix C.

3.2.2 Dynamic Cone Penetration (DCP)

DCP testing was undertaken at select locations to assist in determining the density of the near surface material. The results of the DCP tests are presented on the test pit logs in Appendix C.

3.2.3 Standard Penetration Tests (SPT)

Standard Penetration Tests (SPT) were undertaken within the boreholes at approximately 1.5 m intervals (where appropriate) to assess the consistency of the soils and to recover disturbed samples. The uncorrected results of the SPTs are plotted on Figure 3-1 and presented on the associated borehole logs in Appendix C.

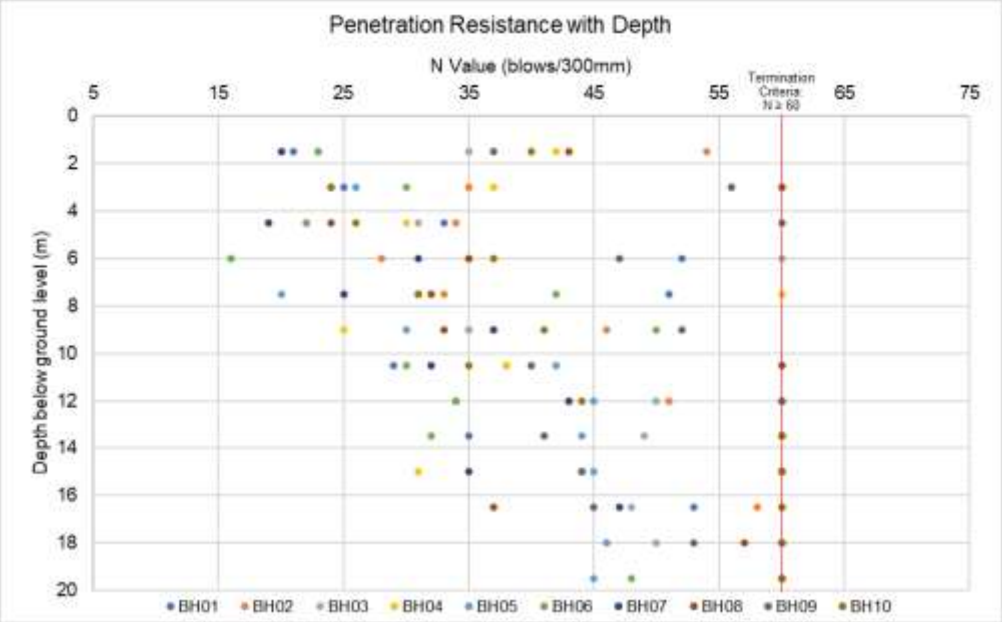


Figure 3-1 Relationship between SPT N value and depth

4. Site Conditions

4.1 Surface Conditions

The proposed RSF2 is located on farmland immediately south of the existing RSF. The vegetation at the site comprises paddocks of knee-high grass and weed-like vegetation. A small farm dam (approx. 0.35 Ha) is located within the south east corner of the proposed RSF. A smaller dam (0.3 Ha) is situated south of the downstream toe in the south west corner.

The RSF area generally had a gentle slope (average of 0.2°) from north east towards the south west.

4.2 Subsurface Conditions

The subsurface conditions encountered within the test pits and boreholes generally comprised topsoil overlying alluvial (sandy) clays with varying proportions of gravels. The material types are summarised in the sections below.

Detailed descriptions of the subsurface materials and conditions encountered during the investigations are provided in the geotechnical test pit and borehole logs, presented in Appendix C and should be referred to for detail at each test location. Photographs of test pits and core trays are included after the corresponding log.

4.2.1 Topsoil

The topsoil encountered across the site typically comprised low plasticity, sandy clay with rootlets. The colour of the topsoil varied between brown and orange brown and with a field moisture condition less than the plastic limit (i.e. dry)

4.2.2 Alluvial

The alluvial material encountered to 20 m depth comprised very stiff to hard, sandy clay/clay with varying proportions of gravels. The clay was typically of low to medium plasticity with a field moisture condition generally equal to, or less than, the plastic limit (i.e. dry to moist).

The alluvial clays were observed to vary in colour between (pale to dark) brown and orange, and grey.

4.3 Groundwater

Groundwater was encountered in BH01, BH04 and BH08 at 7.5 m (RL 257.2 m), 8.0 m (RL 255.8 m) and 7.5 m (RL 258.4 m) below ground level respectively.

5. Laboratory testing

5.1 General

Laboratory testing was undertaken on samples collected from the test sites to confirm field logging and assess material properties.

The following tests were undertaken according to the relevant Australian Standard test methods:

- Particle Size Distribution, including Hydrometer
- Atterberg Limits
- Field Moisture Content
- Bulk Density
- Emerson Class (dispersion)
- Standard Compaction Tests (98% MDD)
- Constant Head Permeability (Triaxial Cell)
- X-ray Computed Tomography (XCT) scan
- Single Stage Triaxial Consolidated Undrained (CU) Strength Tests with Pore Pressure Measurement
- One dimensional consolidation (Oedometer) tests

Testing was conducted in the NATA accredited Fugro AG Laboratory in Perth, and GHD's NATA accredited facility in Sydney.

5.2 Characteristic Tests

Tabulated summaries of the respective soil laboratory test results are presented in Table 5-1 to Table 5-4. Charts plotting all particle size distribution and Atterberg Limit results are presented in Figure 5-1 and Figure 5-2, respectively. The relationships between field moisture content and Atterberg Limits for samples are presented in Figure 5-3.

The laboratory test certificates related to the tests summarised in Table 5-1 to Table 5-4 is included in Appendix D.

Table 5-1 Soil Classification Testing

<table>
<tr><th rowspan="2">Test ID</th><th rowspan="2">Depth (m)</th><th rowspan="2">Soil Description</th><th rowspan="2">MC (%)</th><th colspan="2">Plasticity (%)</th><th rowspan="2">LS (%)</th><th colspan="5">Particle Size Distribution (%)</th><th rowspan="2">Emerson Class</th></tr>
<tr><th>LL</th><th>PI</th><th colspan="2">Clay</th><th>Silt</th><th>Sand</th><th>Gravel</th></tr>
<tr><td>TP01</td><td>1.0 - 2.0</td><td>Sandy CLAY, trace gravel</td><td>10.0</td><td>31</td><td>17</td><td>–</td><td colspan="2">59</td><td colspan="2">37</td><td>4</td><td>2</td></tr>
<tr><td>TP03</td><td>2.0 - 3.0</td><td>CLAY with sand, trace gravel</td><td>16.9</td><td>50</td><td>34</td><td>–</td><td>32</td><td>56</td><td colspan="2">11</td><td>1</td><td>2</td></tr>
<tr><td>TP04</td><td>1.0 - 2.0</td><td>CLAY with sand, trace gravel</td><td>13.9</td><td>56</td><td>38</td><td>–</td><td>30</td><td>33</td><td colspan="2">28</td><td>9</td><td>2</td></tr>
<tr><td>TP07</td><td>1.0 - 2.0</td><td>CLAY with sand, trace gravel</td><td>17.7</td><td>48</td><td>30</td><td>–</td><td colspan="2">69</td><td colspan="2">23</td><td>8</td><td>2</td></tr>
<tr><td>TP10</td><td>0.0 - 1.0</td><td>Sandy CLAY, trace gravel</td><td>11.5</td><td>29</td><td>15</td><td>–</td><td>28</td><td>40</td><td colspan="2">31</td><td>1</td><td>2</td></tr>
<tr><td>TP11</td><td>1.0 - 2.0</td><td>Sandy CLAY</td><td>17.4</td><td>56</td><td>40</td><td>–</td><td colspan="2">35</td><td>27</td><td>36</td><td>2</td><td>2</td></tr>
<tr><td>TP11</td><td>2.0 - 3.0</td><td>Sandy CLAY with gravel</td><td>–</td><td>–</td><td>–</td><td>–</td><td colspan="3">41</td><td>46</td><td>13</td><td>–</td></tr>
<tr><td>TP12</td><td>3.0 - 4.0</td><td>Sandy CLAY</td><td>14.1</td><td>31</td><td>17</td><td>–</td><td colspan="3">64</td><td>36</td><td>0</td><td>2</td></tr>
<tr><td>TP14</td><td>1.0 - 2.0</td><td>Sandy CLAY, trace gravel</td><td>14.1</td><td>44</td><td>29</td><td>–</td><td colspan="3">44</td><td>54</td><td>2</td><td>2</td></tr>
<tr><td>TP17</td><td>1.0 - 2.0</td><td>Sandy CLAY, trace gravel</td><td>14.4</td><td>50</td><td>34</td><td>–</td><td colspan="3">66</td><td>29</td><td>5</td><td>2</td></tr>
<tr><td>TP18</td><td>1.0 - 2.0</td><td>CLAY with sand, trace gravel</td><td>14.7</td><td>54</td><td>37</td><td>–</td><td colspan="2">35</td><td>35</td><td>27</td><td>3</td><td>2</td></tr>
<tr><td>TP19</td><td>1.0 - 2.0</td><td>Sandy CLAY, trace gravel</td><td>8.1</td><td>41</td><td>27</td><td>–</td><td colspan="3">39</td><td>54</td><td>7</td><td>–</td></tr>
<tr><td>BH01</td><td>1.5 and 3.0*</td><td>Sandy CLAY trace gravel</td><td>–</td><td>–</td><td>–</td><td>–</td><td colspan="3">95</td><td>35</td><td>5</td><td>–</td></tr>
<tr><td>BH01</td><td>3.7 - 3.89</td><td>CLAY with sand</td><td>22.7</td><td>48</td><td>29</td><td>9.0</td><td colspan="2">17</td><td>68</td><td>15</td><td>–</td><td>–</td></tr>
<tr><td>BH01</td><td>9.0 and 13.5*</td><td>CLAY, trace sand & gravel</td><td>–</td><td>–</td><td>–</td><td>–</td><td colspan="3">86</td><td>12</td><td>2</td><td>–</td></tr>
<tr><td>BH01</td><td>9.68 - 9.84</td><td>CLAY with sand</td><td>17.0</td><td>54</td><td>48</td><td>10</td><td colspan="2">31</td><td>48</td><td>19</td><td>2</td><td></td></tr>
<tr><td>BH02</td><td>1.5 and 3.0*</td><td>CLAY with sand, trace gravel</td><td>–</td><td>–</td><td>–</td><td>–</td><td colspan="3">77</td><td>22</td><td>1</td><td>–</td></tr>
</table>

Test ID	Depth (m)	Soil Description	MC (%)	Plasticity (%)		LS (%)	Particle Size Distribution (%)				Emerson Class
				LL	PI		Clay	Silt	Sand	Gravel	
BH02	6.0, 7.5 and 9.0*	CLAY with sand, trace gravel	–	–	–	–	81		17	2	–
BH03	5.8, 9.0 and 11.8*	Sandy CLAY, trace gravel	–	–	–	–	40	26	30	4	–
BH03	15.0, 18.0 and 19.5*	CLAY with sand, trace gravel	–	–	–	–	45	38	14	3	–
BH04	6.0, 9.0 and 15*	CLAY trace sand	–	–	–	–	86		13	1	–
BH05	3.0 and 4.5*	CLAY with sand, trace gravel	–	–	–	–	71		27	2	–
BH05	5.06 - 5.22	CLAY with sand	19.1	34	19	6	20	65	15	–	–
BH05	7.5, 10.0 and 16.5*	Sandy CLAY, trace gravel	–	–	–	–	67		32	1	–
BH06	1.5 and 3.0*	CLAY with sand, trace gravel	–	–	–	–	70		27	3	–
BH06	6.65 - 6.84	Sandy CLAY	12.2	28	13	6	13	42	44	–	–
BH06	10.7, 12.0 and 13.5*	CLAY with sand, trace gravel	–	–	–	–	83		16	1	–
BH07	3.52 - 3.71	CLAY with sand	17.5	44	27	10	26	48	26	–	–
BH07	4.5 and 6.0*	CLAY trace sand	–	–	–	–	91		9	0	–
BH07	13.5, 16.5 and 19.5*	CLAY with sand, trace gravel	–	–	–	–	34	29	29	–	–
BH08	1.5 and 3.0*	Clayey SAND with gravel	–	–	–	–	31		50	19	–

Test ID	Depth (m)	Soil Description	MC (%)	Plasticity (%)		LS (%)	Particle Size Distribution (%)				Emerson Class
				LL	PI		Clay	Silt	Sand	Gravel	
BH08	5.16 - 5.35	CLAY trace sand	20.1	43	26	11.5	30	59	11	–	–
BH08	7.5 - 7.95	Sandy CLAY trace gravel	–	–	–	–	62		35	3	–
BH09	1.5, 3.0, 4.5 and 6.0*	Sandy CLAY trace gravel	–	–	–	–	44		46	10	–
BH09	15.0,18.0 and 19.5*	CLAY with sand, trace gravel	–	–	–	–	78		20	2	–
BH10	1.5, 3.0, 6.0 and 9.0*	Sandy CLAY trace gravel	–	–	–	–	41		46	13	–
BH10	13.5,15.0 and 18.0*	CLAY trace sand and gravel	–	–	–	–	88		11	1	–

*Note: MC = Moisture Content; LL = Liquid Limit; PI = Plasticity Index; LS = Linear Shrinkage, * Multiple depths indicate blended samples*

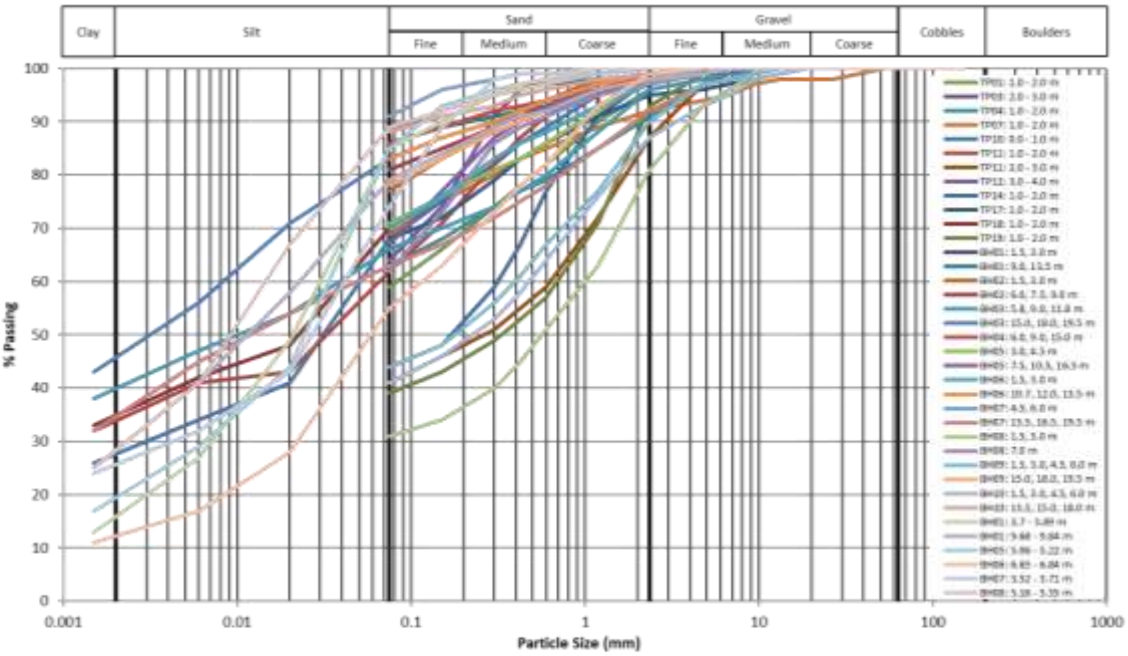


Figure 5-1 Particle Size Distribution Plot

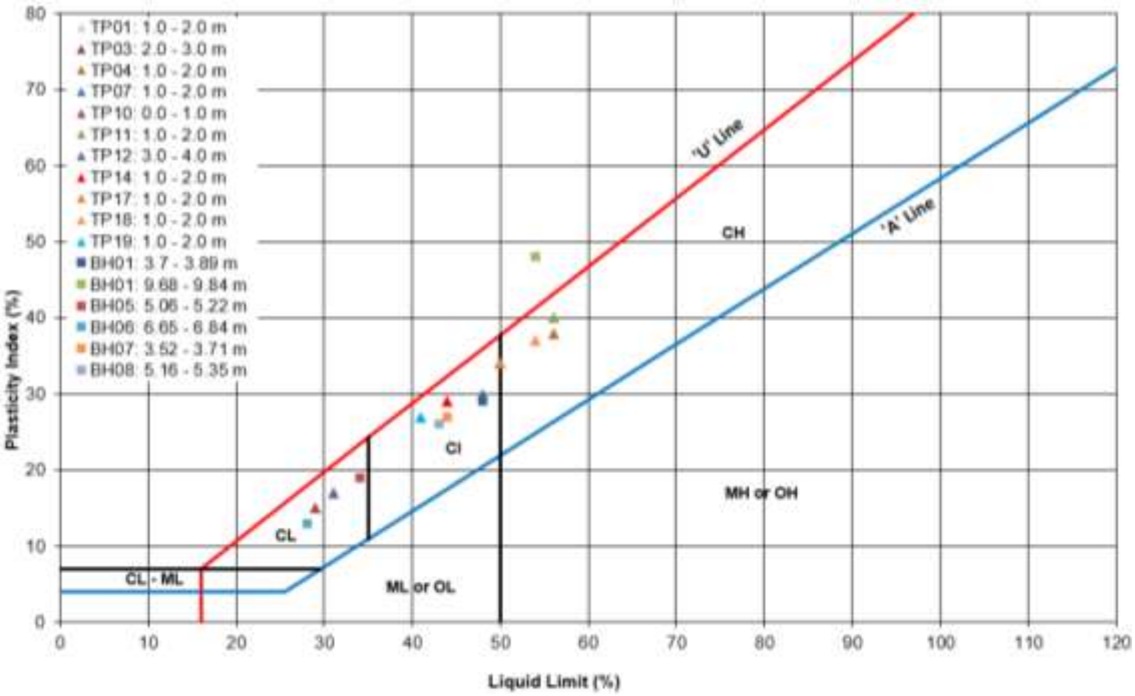


Figure 5-2 Atterberg Limits Plot

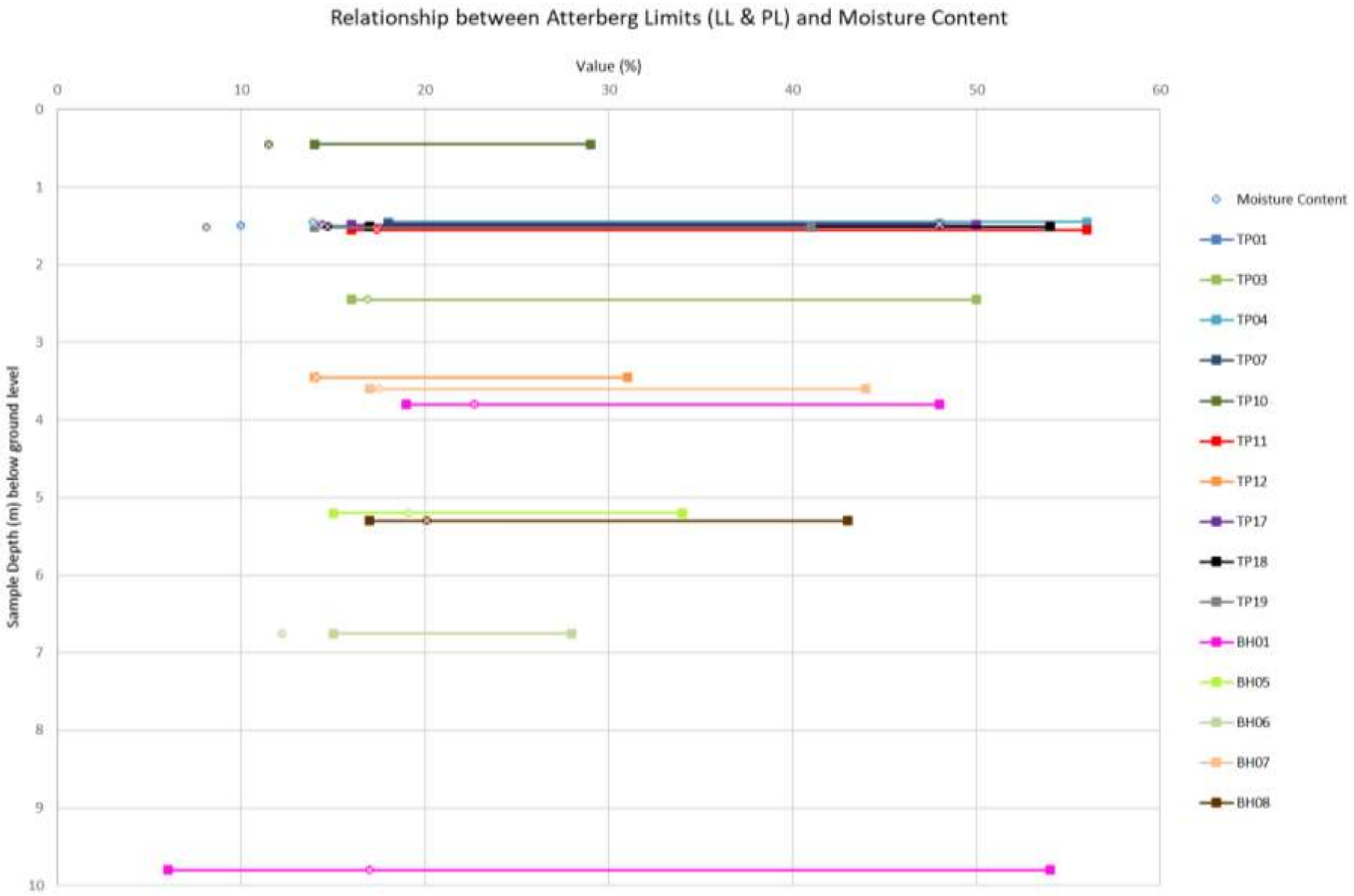


Figure 5-3 Field moisture content relative to Atterberg Limits with depth

Table 5-2 Standard Compaction Results

Test ID	Depth (m)	Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	Field Moisture Content (%)
TP01	1.0 - 2.0	1.84	14.5	10.0
TP03	2.0 - 3.0	1.66	20.0	16.9
TP04	1.0 - 2.0	1.70	18.0	13.9
TP07	1.0 - 2.0	1.70	21.0	17.7
TP10	0.0 - 1.0	1.81	15.0	11.5
TP11	1.0 - 2.0	1.65	20.0	17.4
TP12	3.0 - 4.0	1.77	16.5	14.1
TP14	1.0 - 2.0	1.79	16.0	14.1
TP17	1.0 - 2.0	1.67	18.0	14.4
TP18	1.0 - 2.0	1.62	18.5	14.7

Table 5-3 Material Density

Test ID	Depth (m)	Soil Particle Density (g/cm^3)	Bulk Density (t/m^3)	Dry Density (t/m^3)	Field Moisture Content (%)
TP01	1.0 - 2.0	2.53	2.038	1.852	10.0
TP03	2.0 - 3.0	2.55	1.962	1.679	16.9
TP04	1.0 - 2.0	2.50	2.075	1.822	13.9
TP07	1.0 - 2.0	2.48	1.829	1.554	17.7
TP10	0.0 - 1.0	2.46	1.892	1.697	11.5
TP12	3.0 - 4.0	2.50	1.936	1.697	14.1
TP14	1.0 - 2.0	2.61	2.051	1.798	14.1
TP18	1.0 - 2.0	2.50	1.932	1.685	14.7
BH01	3.51 - 3.7	2.68	–	1.72	19.7
BH01	3.7 - 3.89	2.70	–	1.62	22.7
BH01	9.68 - 9.87	2.75	–	1.82	17.0
BH05	5.03 - 5.22	2.71	–	1.71	19.1
BH06	6.65 - 6.84	2.68	–	1.86	12.2
BH07	3.52 - 3.71	2.70	–	1.71	17.5
BH08	5.16 - 5.35	2.71	–	1.40	20.1

Table 5-4 Laboratory Permeability Testing

Test ID	Depth (m)	Description	Coefficient of permeability, k (m/sec)
TP03	2.0 – 3.0	CLAY trace sand	2×10^{-10}
TP10	0.0 – 1.0	Sandy CLAY, trace gravel	2×10^{-10}
TP11	1.0 – 2.0	Sandy CLAY	4×10^{-11}
TP18	1.0 – 2.0	Sandy CLAY, trace gravel	1×10^{-10}

5.3 Oedometer Tests

Consolidation testing was undertaken on four undisturbed samples. The results of the tests are summarised in Figure 5-4 and available test certificates are included in Appendix D.

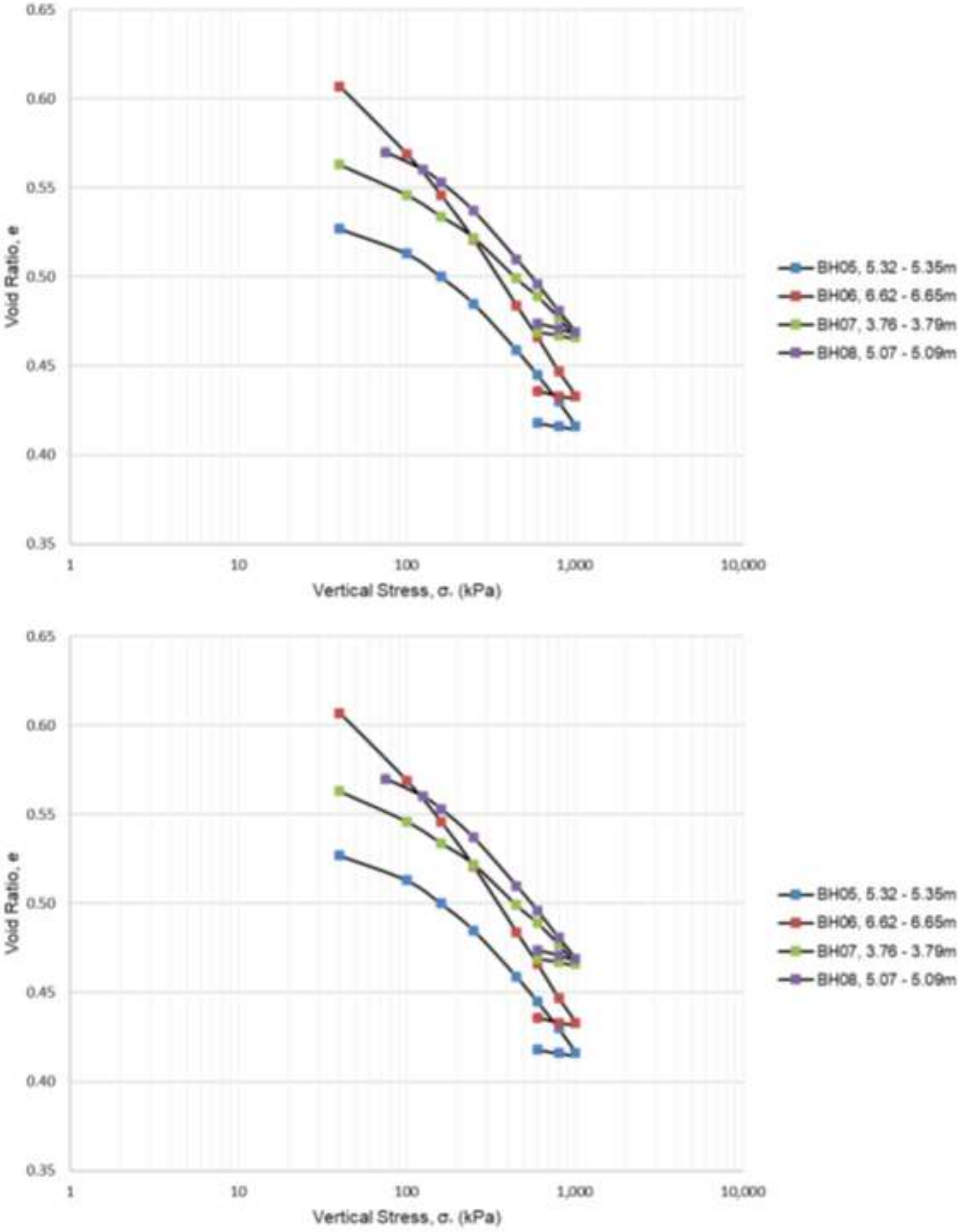


Figure 5-4 Consolidation test compressibility curves

5.4 Triaxial Tests

Four multi-stage and three single stage isotropically consolidated triaxial (CIU) tests with measurement of pore water pressure, have been completed on undisturbed samples. Samples were tested with the consideration of the future consolidation pressure. Available test certificates are included in Appendix D and test results are summarised in Table 5-5.

Table 5-5 Triaxial Test Results

Sample Locations	Consolidation Pressure, po′ (kPa)	Maximum Stress Ratio (M=q/p')	Effective Peak Friction Angle, ϕ (°)	Peak Undrained Shear Strength, S_u (kPa)	Shear Strength Ratio, s_u/po'
BH01 9.68 - 9.84 m	130	1.61	39.40	126	0.97
	330	1.24	30.92	234	0.71
	530	1.09	27.47	318	0.6
BH05 5.06 - 5.22 m	120	1.39	34.35	102	0.85
	300	1.21	30.23	180	0.6
	480	1.15	28.85	269	0.56
BH06 6.65 - 6.84 m	120	1.51	37.10	119	0.99
	300	1.38	34.12	240	0.8
	480	1.33	32.98	379	0.79
BH08 5.16 - 5.35 m	120	1.66	40.55	134	1.12
	300	1.33	32.98	228	0.76
	480	1.18	29.54	302	0.63
BH01 3.51 - 3.70 m	100	1.5	36.87	119	1.19
BH01 3.70 - 3.89 m	200	1.39	34.35	160	0.8
BH07 3.52 - 3.71 m	400	1.23	30.69	240	0.6

6. Information about this report

The report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

Test hole logging

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Reference should be made to the relevant sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

Groundwater

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeability (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

Interpretation of results

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data. Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

Change in conditions

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GHD for appropriate assessment and comment.

Geotechnical verification

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system or to conduct monitoring as a result of this natural variability. Allowance for verification by geotechnical personnel accordingly should be recognised and programmed during construction.

Foundations

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

7. References

ANCOLD 2019, *Guidelines on Tailings Dams, Planning, Design, Construction Operation and Closure*

Australian Standard, AS 1726-2017. *Geotechnical site investigations*. Standards Australia

Australian Standard, AS 1289 – *Method of testing soils for engineering purposes.* Standards Australia

Cooper and Associates, 2009 *Tomingley Gold Project Residue Management Design Report*

GHD 2020a, *Tomingley Gold Operations Pty Ltd Processing Plant 2020 Groundwater Review*

GHD 2020b, *TGO RSF Stage 6 Raise Detailed Design Geotechnical Investigation Factual Report*

Mining One 2009, *Tomingley Gold Project Feasibility Study Factual Geotechnical Report for Residue Storage Facility*

The Impax Group 2011, *Tomingley Gold Project Groundwater Assessment,* prepared for R.W Corkery & Co Pty Ltd on behalf of Alkane Resources Ltd

Appendices

Appendix A – Site Plan

0 50 100 150m

SCALE 1:5000 AT ORIGINAL SIZE

N

LEGEND:

◐	BOREHOLE
▣	TEST PIT
◑	EXISTING BOREHOLE

GHD

TOMINGLEY GOLD OPERATIONS
RSF 2 GEOTECHNICAL INVESTIGATION

TEST LOCATIONS

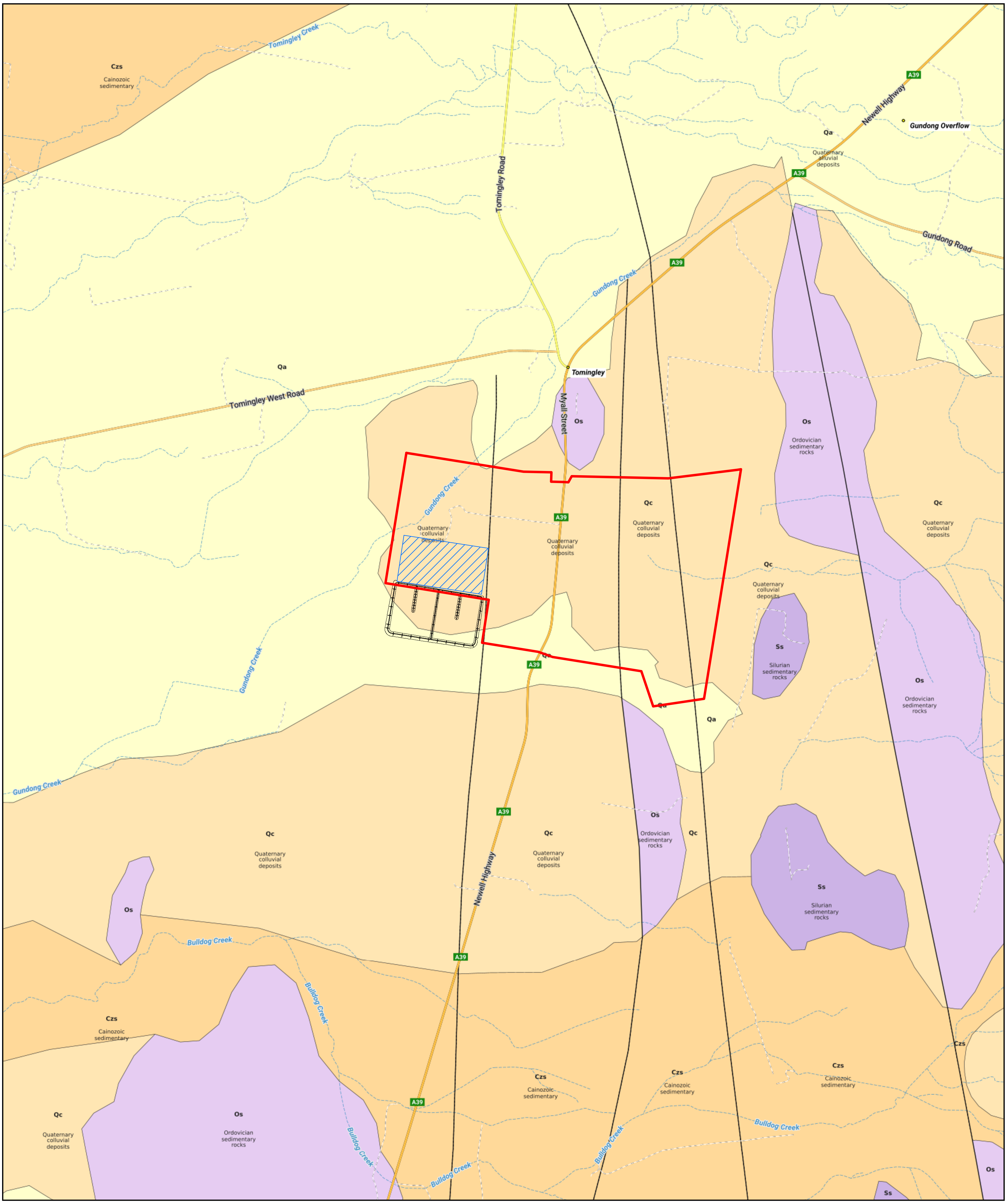
Job Number	12538404
Revision	A
Date	MAR 2021

Appendix A

2 Salamanca Square Hobart TAS 7000 Australia **T** 61 3 6210 0600 **F** 61 3 6210 0601 **E** hbamail@ghd.com **W** www.ghd.com

Plot Date: 22 March 2021 - 2:13 PM Plotted by: Victoria Jenkins Cad File No: G:\32\12538404\CADD\Drawings\12517944-FIG01.dwg

Appendix B – Geology Plan



LEGEND

— Existing TGO Lease Boundary

▨ Existing RSF

☐ Proposed RSF 2

1:40,000 @ A3

0 250 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Tomingley Gold Operations Pty Ltd
RSF2 Geotechnical Investigation

Geological Map Extract

Job Number	12538404
Revision	A
Date	22 Mar 2021

Appendix B

G:\32\12517944\GIS\Maps\Deliverables\12517944_Geology_20200720.mxd

2 Salamanca Square, Hobart Tasmania 7000 Australia **T** 61 3 6210 0600 **E** hbamail@ghd.com **W** www.ghd.com

Data source: Maps SIX NSW, Basemap Image, 2020. GHD, Borehole and Test Pit Locations, 2020; Porposed Tailings Dam, 2020. Created by:npolmear

Appendix C – Geotechnical Logs and Photographs

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH01

SHEET 1 OF 2

Position : 613566.3 E, 6393074.4 N GDA94
Surface RL : 264.7m
Inclination\Bearing : -90 \ 000
Processed : CP
Contractor : Numac
Rig Type : Sonic Geoprobe
Checked : TAS
Date Started : 24 Nov 20
Date Completed : 24 Nov 20
Logged by : SG
Date : 22 Mar 21

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic							Sandy CLAY, orange brown, low to medium plasticity, organics, fine to medium grained sand (Alluvial)	CI	D	F			
					264.0									
1						1.0								1
					263.0			Sandy CLAY, trace gravel, medium plasticity, orange brown, fine to coarse grained sand, w ~ PL (Alluvial)	CI	D-M	St	PP SPT	1.5m: PP = 400 kPa (UCS) 1.5-1.95m: SPT = 5,11,10 N = 21	
2						2.0		pale brown to brown			St- VSt	U75	U75-01 @ 1.95 - 2.35 m R: 350 / 400 mm	2
												PP	2.35m: PP >600 kPa (UCS)	
					262.0							PP	2.50m: PP = 450 kPa (UCS)	
3						3.0						PP SPT	3.0m: PP = 300 kPa (UCS) 3.0-3.45m: SPT = 9,11,14 N = 25	3
					261.0							U75	U75-02 @ 3.5 - 3.9 m R: 400/400 mm	
4						4.0		pale orange brown mottled pale grey			VSt	PP	3.9m: PP >600 kPa (UCS)	4
								CLAY with sand, trace gravel, orange brown, low plasticity, fine to medium grained, angular to sub angular gravels, polymictic, w ~ PL (Alluvial)	CL	D-M	H			
					260.0							SPT	4.5-4.95m: SPT = 12,14,19 N = 33	
5						5.0		CLAY with sand and gravel, grey and orange mottled, low plasticity, sand and gravel is fine to coarse grained, angular to sub angular polymictic gravels up to 40 mm, no grading observed, w ~ PL (Alluvial)	CL	D-M	H	PP	5.0 m: PP >600 kPa (UCS)	5
					259.0									
6						6.0						PP SPT	6.0 m: PP > 600 kPa (UCS) 6.0-6.45 m: SPT =15,22,30 N = 52	6
					258.0			CLAY, medium brown mottled grey and orange, w < PL (Alluvial)	CH	D-M	H	PP	6.5 m: PP >600 kPa (UCS)	
7						7.0						PP	7.0 m: PP >600 kPa (UCS)	7
				∇ 24/11/2020										
					257.0			Sandy CLAY, brown, high plasticity, fine to coarse grained, grey and orange mottled, w > PL (Alluvial)	CH	W	H	SPT	7.5-7.95 m: SPT = 9,20,31 N = 51	
8						8.0		CLAY with sand, trace gravels and cobbles, brown, high plasticity, fine to coarse grained angular to sub angular gravels, polymictic, cobbles to 70 mm, w ~ PL (Alluvial)	CH	M	H	PP	8.0 m: PP > 600 kPa (UCS)	8
					256.0									
9						9.0						PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 7,16,19 N =- 35	9
					255.0							U75	U75-03 9.5 - 9.9 m R: 400/400 mm	
10						10.0		CLAY, trace sand and gravel, pale grey, medium to high plasticity, fine to coarse grained sand, fine grained gravel, w ~ PL (Alluvial)	CH	M	VSt	PP	9.9 m: PP > 600 kPa (UCS)	10
					254.0							PP SPT	10.5 m: PP > 600 kPa (UCS) 10.5-10.95 m: SPT = 7,11,18 N = 29	
11						11.0								11

See standard sheets for details of abbreviations & basis of descriptions

GHD Pty Ltd
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CLIENTS | PEOPLE | PERFORMANCE

Job No.
12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH01

SHEET 2 OF 2

Position : 613566.3 E, 6393074.4 N GDA94
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Logged by : SG
Date : 22 Mar 21

SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
11.0	Sonic								M	VSt		11.0 m: PP > 600 kPa (UCS)
					253.0							
12						12.0					SPT	12.0 m: PP > 600 kPa (UCS) 12.0-12.45 m: SPT = 10,15,19 N = 34
					252.0						U75	U75-04 12.6 - 12.9 m R: 250/300 mm
13						13.0					PP	12.9 m: PP > 600 kPa (UCS)
											PP	13.25 m: PP = 500 kPa (UCS)
					251.0						PP SPT	13.5 m: PP = 400 kPa (UCS) 13.5-13.95 m: SPT = 11,16,18 N = 34
14						14.0	CLAY with sand, trace gravels and cobbles, orange brown, high plasticity, fine to coarse grained gravels dominantly quartz, angular to sub angular cobbles up to 40 mm, no grading observed, polymictic, grey mottled, w ~ PL (Alluvial)	CH	M	H	PP	14.0 m: PP > 600 kPa (UCS)
					250.0						PP	14.5 m: PP > 600 kPa (UCS)
15						15.0					SPT	15.0-15.45 m: SPT = 21,31,30*/135mm
					249.0							
16						16.0						
					248.0						SPT	16.5-16.95 m: SPT = 15,24,29 N = 53
17						17.0						
					247.0							
18						18.0	18.0 m becomes very brittle/friable				SPT	18.0-18.45 m: SPT = 18,30,30*/140mm
					246.0							
19						19.0						
					245.0							
20						20.0	END OF HOLE at 20.0 m, required depth					
					244.0							
21						21.0						
					243.0							
22						22.0						

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH02

SHEET 1 OF 2

Position : 613269.7 E, 6393126.1 N GDA94
Surface RL : 263.8m
Inclination\Bearing : -90 \ 000
Processed : CP
Contractor : Numac
Rig Type : Sonic
Checked : TAS
Date Started : 26 Nov 20
Date Completed : 26 Nov 20
Logged by : SG
Date : 22 Mar 21

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Graphic Log	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results	SCALE (m)
								TOPSOIL: CLAY with sand, brown to orange brown, medium plasticity, fine to medium grained sand, organics, grass, rootlets, w < PL	CI	D	F			
					263.0			CLAY with Sand, trace gravel, brown, medium plasticity, fine to medium grained sand, fine grained gravel w < PL (Alluvial)	CI	D	H			
1						1.0		thin interbedded sandy layers at 1.0 m and 1.5 m				PP	1.0 m: PP > 600 kPa (UCS)	1
												PP SPT	1.4 m: PP > 600 kPa (UCS) 1.5-1.95 m: SPT = 18,25,29 N = 54	
					262.0									
2						2.0		CLAY with Sand, trace Gravels and Cobbles, brown grey, medium plasticity, fine to medium grained sand, sub rounded to sub angular gravels and cobbles, no grading, cobbles to 30 mm, polymictic, orange mottling, w ~ PL (Alluvial)	CI	M	H		2.0 m: PP > 600 kPa (UCS)	2
					261.0									
3						3.0						SPT	3.0-3.45 m: SPT = 10,16,19 N = 35	3
								CLAY with Sand, brown to orange brown, medium plasticity, sand is fine grained, w ~ PL (Alluvial)	CI	M	H	PP	3.6 m: PP > 600 kPa (UCS)	
					260.0									
4						4.0								4
								Sandy CLAY, orange brown, medium plasticity, fine to medium grained sand, w ~ PL (Alluvial)	CI	M	H	SPT	4.5-4.95 m: SPT = 14,16,18 N = 34	
					259.0									
5						5.0		Sandy CLAY with Gravels, orange brown, medium plasticity, fine to medium grained sand, fine to coarse grained angular to sub angular gravels, no apparent grading, grey mottled, w ~ PL (Alluvial)	CI	M	VSt-H	U75	U75-01 5.0 - 5.3 m R: 300/300	5
												PP	5.3 m: PP = 450 kPa (UCS)	
	Sonic											PP	5.6 m: PP = 450 kPa (UCS)	
					258.0									
6						6.0						PP SPT	6.0 m: PP = 500 kPa (UCS) 6.0-6.45 m: SPT = 7,11,17 N = 28	6
					257.0									
7						7.0						PP	7.0 m: PP = 550 kPa (UCS)	7
												PP SPT	7.5 m: PP = 600 kPa (UCS) 7.5-7.95 m: SPT = 8,13,20 N = 33	
					256.0									
8						8.0						PP	8.0 m: PP = 600 kPa (UCS)	8
												PP	8.5 m: PP > 600 kPa (UCS)	
					255.0									
9						9.0						SPT	9.0-9.45 m: SPT = 10,20,26 N = 46	9
												PP	9.5 m: PP = 550 kPa (UCS)	
					254.0									
10						10.0							10.0 m: PP > 600 kPa (UCS)	10
												PP SPT	10.4 m: PP > 600 kPa (UCS) 10.4-10.85 m: SPT = 6,16,22 N = 38	
					253.0									
11						11.0								11

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH02

SHEET 2 OF 2

Position : 613269.7 E, 6393126.1 N GDA94 **Surface RL :** 263.8m **Inclination\Bearing :** -90 \ 000 **Processed :** CP
Contractor : Numac **Rig Type :** Sonic **Checked :** TAS
Date Started : 26 Nov 20 **Date Completed :** 26 Nov 20 **Logged by :** SG **Date :** 22 Mar 21

DRILLING		MATERIAL					ADDITIONAL DATA
Method	Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
Sonic	11.0			M	VSt-H		
	12.0	CLAY with sand, pale yellow brown, high plasticity, fine grained sand, brittle, w < PL (Alluvial)	CH	D	H	SPT	12.0 - 12.45 m: SPT = 11,23,28 N = 51
	13.5					SPT	13.5-13.95 m: SPT = 8,25,30*/110mm
	15.0					SPT	15.0-15.45 m: SPT = 16,27,30*/110mm
	16.5					SPT	16.5-16.95 m: SPT = 15,27,31 N = 58
	18.0					SPT	18.0-18.45 m: SPT = 18,17,30*/95mm
	19.5					SPT	19.5-19.95 m: SPT = 22, 27, 30*115mm
	20.0	END OF HOLE @ 20.0 m, required depth					

SCALE (m)	RL (m)	Depth (m)
	252.0	
12		12.0
	251.0	
13		13.0
	250.0	
14		14.0
	249.0	
15		15.0
	248.0	
16		16.0
	247.0	
17		17.0
	246.0	
18		18.0
	245.0	
19		19.0
	244.0	
20		20.0
	243.0	
21		21.0
	242.0	
22		22.0

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Job No.
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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH03

SHEET 1 OF 2

Position : 612974.4 E, 6393178.2 N GDA94 | **Surface RL :** 263.4m | **Inclination\Bearing :** -90 \ 000 | **Processed :** CP
Contractor : Numac | **Rig Type :** Sonic | **Checked :** TAS
Date Started : 26 Nov 20 | **Date Completed :** 27 Nov 20 | **Logged by :** SG | **Date :** 22 Mar 21

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic							TOPSOIL: CLAY with sand, rootlets, orange brown, medium plasticity, fine grained, w < PL	CI	D	F			
					263.0									
								CLAY with sand, pale orange brown mottled yellow, medium plasticity, fine grained, brittle, w < PL (Alluvial)	CI	D	H			
1						1.0		1.0 m: colour chage to pale beige yellow						1
					262.0									
												SPT	1.5-1.95 m: SPT = 12,17,18 N = 35	
2						2.0						U75	U75-01 2.0 - 2.4 m R: 180/200 mm	2
					261.0									
3						3.0		Sandy CLAY with Gravel, low plasticity, fine to coarse grained sand, fine to medium grained angular to sub angular gravel, no grading, polymictic, w ~ PL (Alluvial)	CL	M	H	SPT	3.0-3.45 m: SPT = 28, 30*/110mm	3
					260.0									
4						4.0								4
					259.0									
												SPT	4.5-4.95 m: SPT = 6,12,19 N = 31	
5						5.0						U75	U75-02 4.95 - 5.4 m R: refusal	5
					258.0									
								Sandy CLAY, trace gravel, orange brown mottled grey, medium plasticity, sand is fine to coarse grained, gravel is fine grained, brittle, w < PL (Alluvial)	CI	D	H			
												PP SPT	5.8 m: PP = 500 kPa (UCS) 5.8-6.25 m: SPT = 25, 30, 30*/130mm	
6						6.0								6
					257.0									
7						7.0		Sandy CLAY with Gravel, low plasticity, fine to coarse grained sand, fine to medium grained angular to sub angular gravel, no grading, polymictic, w ~ PL (Alluvial)	CL	M	H			7
												PP	7.25 m: PP = 200 kPa (UCS)	
					256.0									
												SPT	7.5-7.95 m: SPT = 22,29,30*/130mm	
8						8.0		Sandy CLAY, trace gravel, pale brown, medium to high plasticity, sand is fine to coarse grained, gravel is fine grained, brittle, w < PL (Alluvial)	CI-CH	M	H	PP	8.0 m: PP > 600 kPa (UCS)	8
					255.0									
9						9.0						PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 7,15,20 N = 35	9
					254.0									
10						10.0								10
					253.0									
												SPT	10.5-10.95 m: SPT = 14,23,30*/130mm	
11						11.0								11

See standard sheets for details of abbreviations & basis of descriptions

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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH03

SHEET 2 OF 2

Position : 612974.4 E, 6393178.2 N GDA94	**Surface RL : 263.4m**	**Inclination\Bearing : -90 \ 000**	**Processed : CP**
Contractor : Numac	**Rig Type : Sonic**		**Checked : TAS**
Date Started : 26 Nov 20	**Date Completed : 27 Nov 20**	**Logged by : SG**	**Date : 22 Mar 21**

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	*RL (m)*	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic									M	H	PP	11.0 m: PP > 600 kPa (UCS)	
					252.0									
												PP	11.5 m: PP > 600 kPa (UCS)	
												SPT	11.8-12.25 m: SPT = 12,20,30 N = 50	
12						12.0								12
					251.0									
13						13.0								13
					250.0									
												PP SPT	13.5-13.95 m: SPT = 11,22,27 N = 49	
14						14.0		CLAY with sand, trace gravel, red brown, high plasticity, fine to coarse grained sand, fine grained gravel, w ~ PL (Alluvial)	CH	M	H			14
					249.0									
15						15.0						SPT	15.0 m: PP > 600 kPa (UCS) 15.0-15.45 m: SPT = 13, 25, 30*/135mm	15
					248.0									
												PP	15.5 m: PP > 600 kPa (UCS)	
16						16.0						PP	16.0 m: PP > 600 kPa (UCS)	16
					247.0									
												SPT	16.5-16.95 m: SPT = 13,20,28 N = 48	
17						17.0						PP	17.0 m: PP > 600 kPa (UCS)	17
					246.0									
18						18.0						PP SPT	18.0 m: PP > 600 kPa (UCS) 18.0-18.45 m: SPT = 12,24,26 N = 50	18
					245.0									
19						19.0								19
					244.0									
												SPT	19.5-19.95 m: SPT = 13,19,30*/130mm	
20						20.0		END OF HOLE @ 20 m, required depth						20
					243.0									
21						21.0								21
					242.0									
22						22.0								22

See standard sheets for details of abbreviations & basis of descriptions

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH04

SHEET 1 OF 2

Position : 612790.1 E, 6393360.1 N GDA94	**Surface RL :** 263.8m	**Inclination\Bearing :** -90 \ 000	**Processed :** CP
Contractor : Numac	**Rig Type :** Sonic		**Checked :** TAS
Date Started : 27 Nov 20	**Date Completed :** 27 Nov 20	**Logged by :** SG	**Date :** 22 Mar 21

DRILLING					MATERIAL									ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests		**Comments/Observations** Insitu test results	SCALE (m)
	Sonic							CLAY, orange brown, medium plasticity, organics, grass, rootlets, w < PL (Alluvial)	CI	D	F				
					263.0										
1						1.0									1
								CLAY with sand, trace gravel, beige brown, high plasticity, fine to coarse grained sand, fine grained sub angular to angular gravel, polymictic, no grading, w < PL (Alluvial)	CH	D	H	SPT		1.5-1.95 m: SPT = 14,21,21 N = 42	
					262.0										
2						2.0									2
								CLAY, pale beige, high plasticity, pale orange mottling, brittle, w <= PL (Alluvial)	CH	D-M	H				
												PP		2.6 m: PP > 600 kPa (UCS)	
					261.0										
3						3.0						SPT		3.0-3.45 m: SPT = 15,17,20 N = 37	3
												PP		3.5 m: PP > 600 kPa (UCS)	
					260.0										
4						4.0						PP		4.0 m: PP > 600 kPa (UCS)	4
												PP SPT		4.5 m: PP > 600 kPa (UCS) 4.5-4.95 m: SPT = 7,14,16 N = 30	
					259.0										
5						5.0		CLAY trace sand, occasional gravel, orange brown, medium to coarse grained sand, fine to coarse grained sub angular to angular gravel, no grading, polymictic, black and beige mottling, w ~ PL (Alluvial)	CI	M	H				5
					258.0										
6						6.0						SPT		6.0-6.45 m: SPT = 10,21,14 N = 35	6
					257.0										
7						7.0									7
												SPT		7.5-7.95 m: SPT = 25,30*/135mm	
				27/11/2020	256.0										
8				▽		8.0						PP		8.0 m: PP = 300 kPa (UCS)	8
					255.0										
9						9.0						PP SPT		9.0 m: PP = 500 kPa (UCS) 9.0-9.45 m: SPT = 7,9,16 N = 25	9
												U75 PP		U75-01 9.5 - 9.7 m R: 200/200 mm 9.7 m: PP = 400 kPa (UCS)	
					254.0										
10						10.0									10
												SPT		10.5-10.95 m: SPT = 11,18,20 N = 38	
					253.0										
11						11.0									11

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH04

SHEET 2 OF 2

Position : 612790.1 E, 6393360.1 N GDA94 **Surface RL :** 263.8m **Inclination\Bearing :** -90 \ 000 **Processed :** CP
Contractor : Numac **Rig Type :** Sonic **Checked :** TAS
Date Started : 27 Nov 20 **Date Completed :** 27 Nov 20 **Logged by :** SG **Date :** 22 Mar 21

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	*RL (m)*	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic									M	H			
					252.0									
12						12.0						SPT	12.0-12.45 m: SPT = 8,15,28 N = 43	12
					251.0									
13						13.0								13
												SPT	13.5-13.95 m: SPT = 11, 20, 30*/140mm	
					250.0									
14						14.0								14
					249.0									
15						15.0						SPT	15.0-15.45 m: SPT = 12,21,30 N = 31	15
					248.0									
16						16.0								16
												SPT		
					247.0									
17						17.0								17
					246.0									
18						18.0						SPT		18
					245.0									
19						19.0								19
												SPT		
					244.0									
20						20.0		END OF HOLE at 20.0 m, required depth						20
					243.0									
21						21.0								21
					242.0									
22						22.0								22

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH05

SHEET 1 OF 2

Position : 612841.4 E, 6393663.9 N GDA94
Surface RL : 264.6m
Inclination\Bearing : -90 \ 000
Processed : CP

Contractor : Numac
Rig Type : Sonic
Checked : TAS

Date Started : 28 Nov 20
Date Completed : 28 Nov 20
Logged by : SG
Date : 22 Mar 21

DRILLING | **MATERIAL** | **ADDITIONAL DATA**

Method: Sonic

Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
0.0	Sandy CLAY with Gravel, orange brown, medium plasticity, fine to medium grained sub angular to angular, no grading, polymictic, w < PL (Alluvial)	CI	D	St		
1.5					SPT	1.5-1.95 m: SPT = 10,8,15 N = 23
1.8	CLAY with sand, trace gravel, pale yellow beige brown, orange brown mottled, high plasticity, fine to coarse grained sand, gravel is fine grained, w ~ PL (Alluvial)	CH	M	VSt		
3.0	3.0 m: pale orange brown with pale beige mottling				SPT	3.0-3.45 m: SPT = 9,11,15 N = 26
4.0					PP	4.0 m: PP = 500 kPa (UCS)
4.5					SPT	4.5-4.95 m: SPT = 11,13,9 N = 22
5.0					U75	U75-01 5.0 - 5.4 m R: 400/400
5.4					PP	5.4 m: PP = 500 kPa (UCS)
5.6					PP	5.6 m: PP = 300 kPa (UCS)
6.0	Sandy CLAY, trace gravel, orange brown, grey and beige mottling, medium plasticity, fine to medium grained sand, fine to coarse grained sub angular to angular gravel, no grading, polymictic, w ~ PL (Alluvial)	CI	M	VSt	PP SPT	6.0 m: PP = 300 kPa (UCS) 6.0-6.45 m: SPT = 5,8,8 N = 16
6.5					U75	U75-02 6.5 - 6.9 m R: 400/400
6.9					PP	6.9 m: PP = 300 kPa (UCS)
7.5					PP SPT	7.5 m: PP = 250 kPa (UCS) 7.5-7.95 m: SPT = 6,10,10 N = 20
8.0					PP	8.0 m: PP = 300 kPa (UCS)
9.0	9.0 m: mottling becomes more prevalent, orange brown, pale grey and yellow			VSt	PP SPT	9.0 m: PP = 300 kPa (UCS) 9.0-9.45 m: SPT = 4,12,18 N = 30
10.0					PP	10.0 m: PP > 600 kPa (UCS)
10.5	10.5 m: colour change to pale grey with beige mottling			H	PP SPT	10.5 m: PP > 600 kPa (UCS) 10.5-10.95 m: SPT = 10,19,23 N = 42

RL (m): 264.0, 263.0, 262.0, 261.0, 260.0, 259.0, 258.0, 257.0, 256.0, 255.0, 254.0

SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH05

SHEET 2 OF 2

Position : 612841.4 E, 6393663.9 N GDA94 **Surface RL :** 264.6m **Inclination\Bearing :** -90 \ 000 **Processed :** CP
Contractor : Numac **Rig Type :** Sonic **Checked :** TAS
Date Started : 28 Nov 20 **Date Completed :** 28 Nov 20 **Logged by :** SG **Date :** 22 Mar 21

SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
11	Sonic				253.0				M	VSt		
12					252.0	12.0					SPT	12.0-12.45 m: SPT = 9,19,26 N = 45
13					251.0	13.0					SPT	13.5-13.95 m: SPT = 14,19,25 N = 44
14					250.0	14.0						
15					249.0	15.0	15.0 m: colour change to orange brown with pale grey mottling			H	SPT	15.0-15.45 m: SPT = 8,19,26 N = 45
16					248.0	16.0					SPT	16.5-16.95 m: SPT = 18,25,30*/135mm
17					247.0	17.0						
18					246.0	18.0					SPT	18.0-18.45 m: SPT = 15,21,25 N = 46
19					245.0	19.0					SPT	19.5-19.95 m: SPT = 8,19,26 N = 45
20					244.0	20.0	END OF HOLE at 20.0 m, required depth					
21					243.0	21.0						
22						22.0						

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
12538404

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH06

SHEET 1 OF 2

Position : 612974.4 E, 6393714.3 N GDA94
Surface RL : 265.1m
Inclination\Bearing : -90 \ 000
Processed : CP

Contractor : Numac
Rig Type : Sonic
Checked : TAS

Date Started : 29 Nov 20
Date Completed : 29 Nov 20
Logged by : SG
Date : 22 Mar 21

Method: Sonic

Depth (m)	RL (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
0.0	265.0	Sandy CLAY, trace gravel, orange brown, medium plasticity, fine to coarse grained angular to sub angular gravels, no grading, polymictic, w < PL (Alluvial)	CI	D	St		
1.0	264.0	CLAY with sand, trace gravel, beige brown with orange, medium plasticity, fine to medium grained sand, fine to coarse grained angular to sub angular gravels, no grading, polymictic, w < PL (Alluvial)	CI	D	VSt		
1.5						SPT	1.5-1.95 m: SPT = 9,11,12 N = 23
2.0	263.0					U75	U75-01 2.0 - 2.3 m R: 300/300 mm
3.0	262.0	3.0 m: slight colour change to pale orange beige				SPT	3.0-3.45 m: SPT = 10,14,16 N = 30
4.0	261.0	Sandy CLAY, beige brown, high plasticity, fine to medium grained sand, w ~ PL (Alluvial)	CH	M	VSt		
4.5						SPT	4.5-4.95 m: SPT = 7,10,12 N = 22
5.0	260.0						
6.0	259.0					PP SPT	6.0 m: PP = 100 kPa (UCS) 6.0-6.45 m: SPT = 5,7,9 N = 16
6.5						U75	U75-02 6.5 - 6.9 m R: 400/400 mm
7.0	258.0					PP	7.0 m: PP = 500 kPa (UCS)
7.5		Sandy Gravelly CLAY, orange brown, low plasticity, fine to coarse grained sand, fine to medium grained angular to sub angular gravel, no grading, polymictic, w ~ PL (Alluvial)	CL	M	H	SPT	7.5-7.95 m: SPT = 18,20,22 N = 42
8.0	257.0					PP	8.0 m: PP > 600 kPa (UCS)
9.0	256.0	CLAY with sand, trace gravel, beige brown, medium to high plasticity, sand is fine to coarse grained, gravel is fine grained, w ~ PL (Alluvial)	CI-CH	M	H	PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 20,23,27 N = 50
9.5						PP	9.5 m: PP > 600 kPa (UCS)
10.0	255.0					PP	10.0 m: PP > 600 kPa (UCS)
10.7						SPT	10.7-11.15 m: SPT = 9,13,17 N = 30
11.0							

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Job No. **12538404**

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH06

SHEET 2 OF 2

Position : 612974.4 E, 6393714.3 N GDA94	**Surface RL : 265.1m**	**Inclination\Bearing : -90 \ 000**	**Processed : CP**
Contractor : Numac	**Rig Type : Sonic**		**Checked : TAS**
Date Started : 29 Nov 20	**Date Completed : 29 Nov 20**	**Logged by : SG**	**Date : 22 Mar 21**

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	*RL (m)*	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic				254.0					M	H	PP	11.2 m: PP > 600 kPa (UCS)	
12					253.0	12.0						SPT	12.0-12.45 m: SPT = 9,14,20 N = 34	12
13					252.0	13.0						PP	13.1 m: PP = 200 kPa (UCS)	13
												PP SPT	13.5 m: PP = 300 kPa (UCS) 13.5-13.95 m: SPT = 16,17,25 N = 32	
14					251.0	14.0								14
								CLAY with sand, orange brown mottled grey, medium plasticity, sand is fine grained, w <= PL (Alluvial)	CI	D-M	H			
15					250.0	15.0						PP SPT	15.0 m: PP > 600 kPa (UCS) 15.0-15.45 m: SPT = 12,19,25 N = 44	15
16					249.0	16.0						PP	16.0 m: PP > 600 kPa (UCS)	16
												SPT	16.5-16.95 m: SPT = 14,28,30*/120mm	
17					248.0	17.0						PP	17.0 m: PP > 600 kPa (UCS)	17
18					247.0	18.0						SPT	18-18.45 m: SPT = 17,27,30*/130mm	18
19					246.0	19.0								19
												SPT	19.5-19.95 m: SPT = 11,18,30 N = 48	
20					245.0	20.0		END OF HOLE at 20.0 m, required depth						20
21					244.0	21.0								21
22						22.0								22

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH07

SHEET 1 OF 2

Position : 613320.9 E, 6393650.8 N GDA94	**Surface RL : 265.4m**	**Inclination\Bearing : -90 \ 000**	**Processed : CP**
Contractor : Numac	**Rig Type : Sonic**		**Checked : TAS**
Date Started : 30 Nov 20	**Date Completed : 2 Dec 20**	**Logged by : IG**	**Date : 22 Mar 21**

DRILLING — SCALE (m), Method, Hole Support, Run, Water

MATERIAL — RL (m), Depth (m), Graphic Log, Description, Group Symbol, Moisture Condition, Consistency / Relative Density, Samples & Tests

ADDITIONAL DATA — Comments/Observations, SCALE (m)

Method: Sonic

SCALE (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

RL (m): 265.0, 264.0, 263.0, 262.0, 261.0, 260.0, 259.0, 258.0, 257.0, 256.0, 255.0

Depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0

Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
CLAY with sand, orange brown, medium plasticity, some black mottling, sand is fine grained, w < PL (Alluvial)	CI	D	F		
Gravelly Sandy CLAY, pale beige brown, low plasticity, coarse grained sand, fine to coarse grained angular to sub angular gravel, no obvious grading, polymictic, w < PL (Alluvial)	CL	D	H	SPT	1.5-1.95 m: SPT = 13,20,26 N = 46
CLAY with sand, pale beige brown, medium plasticity, fine to medium grained sand, grey and orange brown mottling, w ~ PL (Alluvial)	CI	M	VSt	PP SPT	PP @ 3.0 m 200 kPa 3.0-3.45 m: SPT = 8,10,10 N = 20
				U75	U75-01 3.5 - 3.9 m R: 400/400
				PP PP	PP @ 3.9 m 425 kPa PP @ 4.0 m 200 kPa
				SPT	4.5 - 4.95 m: SPT = 7,11,13 N = 24
				PP	5.5 m: PP = 300 kPa (UCS)
				SPT	6.0-6.45 m: SPT = 5,9,10 N = 19
Sandy CLAY, trace gravel, pale brown, low plasticity, medium to coarse grained sand, fine to coarse grained angular to sub angular gravel, w ~ PL (Alluvial)	CL	M	VSt		
7.5 m: becoming mottled with pale grey				PP SPT	7.5 m: PP = 150 kPa (UCS) 7.5-7.95 m: SPT = 11,14,17 N = 31
				PP	8.0 m: PP = 350 kPa (UCS)
				SPT	9.0-9.45 m: SPT = 8,12,13 N = 25
				SPT	10.5-10.95 m: SPT = 14,15,22 N = 37

SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH07

SHEET 2 OF 2

Position : 613320.9 E, 6393650.8 N GDA94	**Surface RL :** 265.4m	**Inclination\Bearing :** -90 \ 000	**Processed :** CP
Contractor : Numac	**Rig Type :** Sonic		**Checked :** TAS
Date Started : 30 Nov 20	**Date Completed :** 2 Dec 20	**Logged by :** IG	**Date :** 22 Mar 21

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	Sonic				254.0			CLAY with sand, trace gravel, orange brown, medium to high plasticity, sand is fine to coarse grained, gravel is fine grained, w < PL (Alluvial)	CI-CH	D	VSt-H			
12					253.0	12.0		12.0 m: some grey mottling				PP SPT	12.0m: PP > 600 kPa (UCS) 12.0-12.45 m: SPT = 15,15,17 N = 32	12
13					252.0	13.0						SPT	13.5-13.95 m: SPT = 13,13,30 N = 43	13
14					251.0	14.0								14
15					250.0	15.0						PP SPT	15.0 m: PP > 600 kPa 15.0-15.45 m: SPT = 11,21,30*/120mm	15
16					249.0	16.0						PP SPT	16.5 m: PP = 400 kPa (UCS) 16.5-16.95 m: SPT = 16,15,20 N = 35	16
17					248.0	17.0								17
18					247.0	18.0						PP SPT	18.0 m: PP > 600 kPa (UCS) 18.0-18.45 m: SPT = 17,20,27 N = 47	18
19					246.0	19.0						PP SPT	19m: PP > 600 kPa (UCS) 19.5-19.95 m: SPT = 29,30,30*/100mm	19
20					245.0	20.0		END OF HOLE at 20.0 m, at required depth						20
21					244.0	21.0								21
22						22.0								22

See standard sheets for details of abbreviations & basis of descriptions

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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

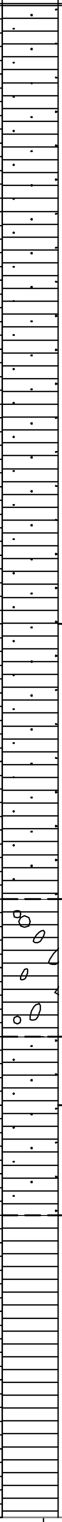
LOCATION No. BH08

SHEET 1 OF 2

Position : 613552.7 E, 6393608.7 N GDA94 | **Surface RL :** 265.9m | **Inclination\Bearing :** -90 \ 000 | **Processed :** CP

Contractor : Numac | **Rig Type :** Sonic | **Checked :** TAS

Date Started : 2 Dec 20 | **Date Completed :** 3 Dec 20 | **Logged by :** IG | **Date :** 22 Mar 21



DRILLING					MATERIAL							ADDITIONAL DATA
SCALE (m)	Method	Hole Support	Run	Water	RL (m)	Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
	Sonic						Sandy CLAY, with gravel, orange brown, low plasticity, fine to coarse sand, angular to sub angular gravel, some small roots, w < PL (Alluvial)	CL	D	F		
							0.5 m: becoming pale orange					
					265.0							
1						1.0	1.0 m: becoming grey			H		
											SPT	1.5-1.95 m: SPT = 16,22,21 N = 43
					264.0							
2						2.0						
					263.0							
3						3.0					SPT	3.0-3.45 m: SPT = 18,30*/85mm
					262.0							
4						4.0						
							CLAY trace sand, orange brown some grey mottling, medium plasticity, sand is fine grained, w ~ PL (Alluvial)	CI	M	VSt	PP SPT	4.5 m: PP = 350 kPa (UCS) 4.5-4.95 m: SPT = 6,11,13 N = 24
					261.0							
5						5.0					U75	U75-01 5.0 - 5.4 m R: 400/400
					260.0							
6						6.0					PP SPT	6.0 m: PP > 600 kPa (UCS) 6.0-6.45 m: SPT = 12,18,17 N = 35
							Gravelly CLAY, orange brown, medium plasticity, angular to sub angular gravel, w ~ PL (Alluvial)	CI	M	H	PP	6.5 m: PP = 450 kPa (UCS)
				3/11/2020	259.0							
7						7.0						
				∇								
							Sandy CLAY, trace gravel, pale brown, medium plasticity, fine to medium grained sand, gravel is fine grained w > PL (Alluvial)	CI	W	H	PP SPT	7.5 m: PP = 500 kPa (UCS) 7.5-7.95 m: SPT = 6,12,20 N = 32
					258.0							
8						8.0	Sandy CLAY with gravel, brown, medium plasticity, angular to sub angular gravel, some cobbles (larger gravels), w ~ PL (Alluvial)	CI	M	VSt-H	PP	8.0 m: PP = 200 kPa (UCS)
					257.0							
9						9.0	CLAY with sand, orange brown, low to medium plasticity, sand is fine grained, w ~ PL (Alluvial)	CI	M	H		
											PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 8,13,20 N = 33
					256.0							
10						10.0						
											SPT	10.5-10.95 m: SPT = 10,21,30*/115mm
					255.0							
11						11.0						

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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH08

SHEET 2 OF 2

Position : 613552.7 E, 6393608.7 N GDA94	**Surface RL : 265.9m**	**Inclination\Bearing : -90 \ 000**	**Processed : CP**
Contractor : Numac	**Rig Type : Sonic**		**Checked : TAS**
Date Started : 2 Dec 20	**Date Completed : 3 Dec 20**	**Logged by : IG**	**Date : 22 Mar 21**

DRILLING					MATERIAL								ADDITIONAL DATA	
SCALE (m)	Method	Hole Support	Run	Water	*RL (m)*	Depth (m)	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
										M	H			
								11.5 m: dark orange brown colour						
12					*254.0*	12.0						PP SPT	12.0 m: PP > 600 kPa (UCS) 12.0-12.45 m: SPT = 27,30*/95mm	12
								12.8 m: orange brown colour						
13					*253.0*	13.0								13
												SPT	13.5-13.95 m: SPT = 16,24,30*/125mm	
14					*252.0*	14.0								14
15					*251.0*	15.0						PP SPT	15.0 m: PP > 600 kPa (UCS) 15.0-15.45 m: SPT = 14,25,30*/125mm	15
	Sonic													
16					*250.0*	16.0								16
												SPT	16.5-16.95 m: SPT = 11,12,25 N = 37	
17					*249.0*	17.0								17
18					*248.0*	18.0						SPT	18.0-18.45 m: SPT = 17,27,30 N = 57	18
19					*247.0*	19.0						PP SPT	19.0 m: PP > 600 kPa (UCS) 19.0-19.45 m: SPT = 20,30*/10mm	19
20					*246.0*	20.0		END OF HOLE at 20.0 m, required depth						20
21					*245.0*	21.0								21
22					*244.0*	22.0								22

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Job No.
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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH09

SHEET 1 OF 2

Position : 613785.6 E, 6393577.4 N GDA94
Surface RL : 266.8m
Inclination\Bearing : -90 \ 000
Processed : CP
Contractor : Numac
Rig Type : Sonic
Checked : TAS
Date Started : 3 Dec 20
Date Completed : 4 Dec 20
Logged by : IG
Date : 22 Mar 21

DRILLING	MATERIAL					ADDITIONAL DATA	
Method	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results	
Sonic	CLAY with sand, dark orange brown, medium plasticity, sand is fine grained, w < PL	CI	D	Fb			
	Gravelly CLAY, dark brown, medium plasticity, angular to sub angular gravel, w <= PL (Alluvial)	CI	D-M	H	PP	0.5 m: PP > 600 kPa (UCS)	
	Sandy CLAY trace gravel, pale brown, medium plasticity, medium to coarse grained sand, angular to sub angular gravels, w <= PL (Alluvial)	CI	D-M				
					SPT	1.5-1.95 m: SPT = 15,17,20 N = 37	
					PP	2.4 m: PP > 600 kPa (UCS)	
					SPT	3.0-3.45 m: SPT = 18,27,28 N = 56	
	4.5 m: grey colour, increasing sand and gravel, lower plasticity, w ~ PL		M		PP SPT	4.4 m: PP = 500 kPa (UCS) 4.5-4.95 m: SPT = 18,30*/15mm	
	Sandy Gravelly CLAY, pale brown, medium plasticity, medium to coarse grained sand, angular to sub angular gravel, w ~ PL (Alluvial)	CI	M				
					PP	5.2 m: PP > 600 kPa (UCS)	
	6.0 m: orange brown colour				PP SPT	6.0 m: PP > 600 kPa (UCS) 6.0-6.45 m: SPT = 12,19,28 N= 47	
					PP SPT	7.5 m: PP > 600 kPa (UCS) 7.5-7.95 m: SPT = 6,14,17 N = 31	
	Sandy CLAY, orange brown, medium plasticity, fine to medium grained sand, w ~ PL (Alluvial)	CI	M				
	CLAY, orange brown, medium plasticity (Alluvial)	CI	M		PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 22,22,30 N = 52	
					SPT	10.5-10.95 m: SPT = 9,17,23 N = 40	

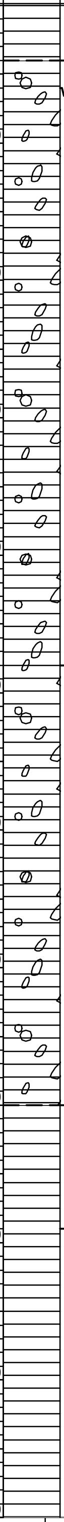
SCALE (m): 1 2 3 4 5 6 7 8 9 10 11

Hole Support, Run, Water

RL (m): 266.0 265.0 264.0 263.0 262.0 261.0 260.0 259.0 258.0 257.0 256.0

Depth (m): 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0

Graphic Log



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SOIL LOG SHEET

Client : Tomingley Gold Operations		**LOCATION No. BH09**
Project : Geotechnical Investigation		
Location : Tomingley, NSW		**SHEET 2 OF 2**
Position : 613785.6 E, 6393577.4 N GDA94	**Surface RL : 266.8m**	**Inclination\Bearing : -90 \ 000**
Contractor : Numac	**Rig Type : Sonic**	
Date Started : 3 Dec 20	**Date Completed : 4 Dec 20**	**Logged by : IG**

Processed : CP
Checked : TAS
Date : 22 Mar 21

Method	RL (m)	Depth (m)	Description	Group Symbol	Moisture Condition	Samples & Tests	Comments/Observations (Insitu test results)
Sonic					M		
	255.0	12.0	12.0 m: some grey mottling			PP SPT	12.0 m: PP > 600 kPa (UCS) 12.0-12.45 m: SPT = 9,25,30*/20mm
	253.0	13.5				PP SPT	13.5 m: PP > 600 kPa (UCS) 13.5-13.95 m: SPT = 12,14,27 N = 41
	252.0	15.0	Gravelly Sandy CLAY, dark orange brown, medium plasticity, sand is fine to coarse grained, gravel is fine grained, angular to sub angular gravel, w ~ PL (Alluvial)	CI	M	SPT	15.0-15.45 m: SPT = 19,19,25 N = 44
	250.0	16.5	Sandy CLAY, dark orange brown, medium plasticity, medium to coarse grained sand, rare gravels, w ~ PL (Alluvial)	CI	M	SPT	16.5-16.95 m: SPT = 10,20,25 N = 45
	249.0	18.0				SPT	18.0-18.45 m: SPT = 16,27,26 N = 53
	247.0	19.5				SPT	19.5-19.95 m: SPT = 15,30*/10mm
		20.0	END OF HOLE at 20.0 m, required depth				

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH10

SHEET 1 OF 2

Position : 613739.8 E, 6393286.2 N GDA94 **Surface RL :** 265.5m **Inclination\Bearing :** -90 \ 000 **Processed :** CP
Contractor : Numac **Rig Type :** Sonic **Checked :** TAS
Date Started : 4 Dec 20 **Date Completed :** 4 Dec 20 **Logged by :** IG **Date :** 22 Mar 21

DRILLING	MATERIAL				ADDITIONAL DATA	
Method	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
Sonic	Gravelly Sandy CLAY, orange brown, medium plasticity, sand is fine to coarse grained, rare angular to sub angular gravels, w < PL	CI	D-M	F		
	CLAY with sand, dark orange brown, medium plasticity, rare gravels, w < PL (Alluvial)	CI	D-M	F		
	Sandy CLAY, trace gravel, grey, medium plasticity, medium to coarse grained sand, fine grained gravel, w < PL (Alluvial)	CI	D-M	H	SPT	1.5-1.95 m: SPT = 15,20,20 N = 40
	Sandy CLAY with gravel, orange brown, medium plasticity, medium to coarse grained sand, angular to sub angular gravels, w ~ PL (Alluvial)	CI	M	VSt	PP SPT	3.0 m: PP > 600 kPa (UCS) 3.0-3.45 m: SPT = 8,9,15 N = 24
					SPT	4.5-4.95 m: SPT = 11,10,16 N = 26
						5.5 m: PP = 350 kPa (UCS)
					PP SPT	6.0 m: PP > 600 kPa (UCS) 6.0-6.45 m: SPT = 12,15,22 N = 37
	Sandy CLAY, orange brown, medium plasticity, medium grained sand, w ~ PL (Alluvial)	CI	M	H		
	7.0 m: some grey mottling					
	7.5 m: dark orange brown				PP SPT	7.5 m: PP > 600 kPa (UCS) 7.5-7.95 m: SPT = 9,15,16 N = 31
					PP SPT	9.0 m: PP > 600 kPa (UCS) 9.0-9.45 m: SPT = 10,22,19 N = 41
	CLAY, orange brown, medium plasticity, w ~ PL (Alluvial)	CI	M	H	SPT	10.5-10.95 m: SPT = 6,12,23 N = 35

SCALE (m): 1 2 3 4 5 6 7 8 9 10 11

RL (m): 265.0 264.0 263.0 262.0 261.0 260.0 259.0 258.0 257.0 256.0 255.0

Depth (m): 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0

Hole Support / Run / Water / Graphic Log

See standard sheets for details of abbreviations & basis of descriptions

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SOIL LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. BH10

SHEET 2 OF 2

Position : 613739.8 E, 6393286.2 N GDA94	**Surface RL : 265.5m**	**Inclination\Bearing : -90 \ 000**	**Processed : CP**
Contractor : Numac	**Rig Type : Sonic**		**Checked : TAS**
Date Started : 4 Dec 20	**Date Completed : 4 Dec 20**	**Logged by : IG**	**Date : 22 Mar 21**

SCALE (m)	Method	RL (m)	Depth (m)	Description Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations Insitu test results
11	Sonic					M	H		
12			12.0					SPT	12.0-12,45 m: SPT = 9,18,26 N = 44
		253.0		Sandy CLAY, pale orange brown, medium plasticity, medium to coarse grained sand, w < PL (Alluvial)	CI	D	H		
13		252.0	13.0	CLAY, trace sand and gravel, pale orange brown, medium plasticity, medium to coarse grained sand and fine grained gravels, w < PL (Alluvial)	CI	D	H	SPT	13.5-13.95 m: SPT = 19,30*/30mm
15			15.0					SPT	15.0-15.45 m: SPT = 14,30*/20mm
16			16.0					SPT	16.5-16.95 m: SPT = 14,28,30*/40mm
18			18.0					SPT	18.0-18.45 m: SPT = 20,30*/70mm
19			19.0					SPT	19.5-19.95 m: SPT = 16,30*/10mm
20			20.0	END OF HOLE at 20.0 m, required depth					

RL (m) scale: 254.0, 253.0, 252.0, 251.0, 250.0, 249.0, 248.0, 247.0, 246.0, 245.0, 244.0
Depth (m) scale: 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0, 21.0, 22.0

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP01

SHEET 1 OF 1

Position : 613678.8 E, 6393170.0 N GDA94
Surface RL : 265.5m
Pit Width : 1.5
Processed : TAS
Contractor : TGO
Machine : Doosan DX 225LC
Pit Length : 3.5
Checked : TAS
Date : 17 Nov 20
Logged by : SG
Date : 22 Mar 21

EXCA		MATERIAL						ADDITIONAL DATA		
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	F	DCP	DCP (blows/100mm): 7,11,15,15,15,18,32	
		0.60 264.91		Sandy CLAY, low plasticity, orange brown, w < PL (Alluvial)	CL	D	H			
								BS	BS (0.5 - 1.0m)	
1								PP	1.0m: PP > 600 kPa (UCS)	1
								BS	BS (1.0 - 2.0m)	
2		2.00 263.51		Sandy CLAY with Gravel, low plasticity, brown, gravel is fine to coarse grained, subround to subangular, polymictic, w < PL (Alluvial)	CL	D	H	PP	2.0m: PP > 600 kPa (UCS)	2
	GNE							BS	nodules of white weathered rock (feldspar, plagioclase), brittle, 20cm diam BS (2.0 - 3.0m)	
3										3
		3.20 262.31		Effective refusal with 0.6m wide, toothed bucket						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP02

SHEET 1 OF 1

Position : 613703.7 E, 6393315.0 N GDA94	**Surface RL : 265.7m**	**Pit Width : 1.3**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3.5**	**Checked : TAS**
Date : 17 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	GNE			TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP BS PP	DCP (blows/100mm): 3,3,14,14,9,8,9,9,9,12,14,16,14,27 BS (0.0 - 0.5m) 0.5m: PP > 600 kPa	
1		1.00 264.67		CLAY with sand, trace gravel, low plasticity, brown, gravel is fine to coarse grained, subround to subangular, w < PL (Alluvial)	CL	D	H	PP BS	1.1m: PP > 600 kPa 1.5m: white inclusions possible weathered rock? feldspar plagioclase, brittle, <20 cm diam BS (1.0 - 2.0m)	1
2										2
3		3.00 262.67		Sandy CLAY, medium plasticity, pale grey with occasional orange mottles, w <= PL (Alluvial)	CI	D-M	H	PP BS	3.0m: PP > 600 kPa BS (3.0 - 3.5m)	3
		3.50 262.17		Limit of hole						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP03

SHEET 1 OF 1

Position : 613505.9 E, 6393348.0 N GDA94	**Surface RL : 265.1m**	**Pit Width : 1.3**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 2.1**	**Checked : TAS**
Date : 17 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP PP BS	DCP (blows/100mm): 5,7,10,12,14,16,15,12,11,11,11,13,10,10,10 BS (0.0 - 0.5m)	
		0.50 264.57		CLAY, medium plasticity, orange brown, w < PL, reduced rootlets (Alluvial)	CI	D	H	PP	0.5m: PP > 600 kPa (UCS)	
1								PP	1.0m: PP > 600 kPa (UCS)	1
								BS	BS (1.0 - 2.0m)	
2		2.00 263.07		CLAY with sand, medium plasticity, pale brown-yellow, w < PL (Alluvial)	CI	D	H			2
	GNE							BS	BS (2.0 - 3.0m)	
3										3
		3.50 261.57								
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP04

SHEET 1 OF 1

Position : 613534.7 E, 6393509.0 N GDA94	**Surface RL : 265.8m**	**Pit Width : 1.5**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 2**	**Checked : TAS**
Date : 17 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP	DCP (blows/100mm): 3,3,4,15,26	
								PP	0.2m: PP > 600 kPa (UCS)	
		0.50 265.34		CLAY with sand, trace gravel, high plasticity, orange brown, gravel is fine to medium grained (Alluvial)	CH	D	H	BS PP	0.5m: PP > 600 kPa (UCS) BS (0.0-1.0m)	
1								PP	1.0m: PP > 600 kPa (UCS)	1
								BS	BS (1.0 - 2.0m)	
		1.80 264.04		with gravel, fine grained, subround to subangular, black mottled orange brown (Alluvial)	CH	D	H			
2										2
	GNE	2.10 263.74		Effective refusal with 0.6m wide, toothed bucket						
3										3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP05

SHEET 1 OF 1

Position : 613554.0 E, 6393622.0 N GDA94	**Surface RL : 266.0m**	**Pit Width : 1.3**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3.7**	**Checked : TAS**
Date : 17 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		**MATERIAL**							**ADDITIONAL DATA**	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, brown, w < PL	CL	D	H	DCP BS PP	DCP (blows/100mm): 4,17,18,25 BS (0.0 - 0.5m) 0.3m: PP > 600 kPa (UCS)	
		0.50 265.45		Sandy CLAY with gravel, high plasticity, orange mottled brown, gravel is fine grained, subround to subangular, w < PL (Alluvial)	CH	D	H	PP	0.5m: PP > 600 kPa (UCS)	
1								PP	1.0m: PP > 600 kPa (UCS)	1
								PP	1.3m: PP > 600 kPa	
								PP	1.9m: PP > 600 kPa	
2		2.00 263.95		Effective refusal						2
	GNE									
3										3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP06

SHEET 1 OF 1

Position : 613299.9 E, 6393550.0 N GDA94
Surface RL : 265.2m
Pit Width : 1.5
Processed : TAS
Contractor : TGO
Machine : Doosan DX 225LC
Pit Length : 2
Checked : TAS
Date : 17 Nov 20
Logged by : SG
Date : 22 Mar 21

Depth / (RL) metres	Water	Description (Soil Name (USC Symbol), Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure)	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	Comments/Observations (Insitu test results)
	GNE	TOPSOIL: Sandy Clay, low plasticity, orange brown to medium brown, w < PL	CL	D	VSt	DCP SV PP PP	DCP (blows/100mm): 7,7,9,9,23,20,22,25 0.1m: SV = 145/30 kPa 0.3m: PP > 600 kPa (UCS) 0.5m: PP > 600 kPa (UCS)
0.60 264.64		CLAY with sand, trace gravel, medium plasticity, brown mottled black and orange, gravel is fine to coarse grained, subround to subangular (Alluvial)	CI	D	H	PP PP PP	1.0m: PP > 600 kPa (UCS) 2.5m: PP > 600 kPa (UCS) 3.0m: PP > 600 kPa (UCS)
3.70 261.54		Limit of hole				PP	3.7m: PP > 600 kPa (UCS)

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP07

SHEET 1 OF 1

Position : 613318.8 E, 6393661.0 N GDA94	**Surface RL : 265.6m**	**Pit Width : 1.4**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3.1**	**Checked : TAS**
Date : 18 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
1				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	St	DCP SV PP PP BS PP SV	DCP (blows/100mm): 5,3,8,20,20,21,24,21,20,17,15,18,13,18,18,34,24,18,17,19,18,22, 0.1m: SV = 70/8 kPa 0.2m: PP > 600 kPa 0.5m: PP > 600 kPa BS (0.5 - 1.0m) 1.0m: PP > 600 kPa 1.0m: SV unable to penetrate	1
		1.50 264.11		CLAY with sand, trace gravel, medium plasticity orange brown occasional black mottles, gravel is fine to coarse grained, subround to subangular (Alluvial)	CI	D	H	BS	BS (1.0 - 2.0m)	
2 3 4 5	GNE	2.00 263.61		Effective refusal with 0.6m wide, toothed bucket						2 3 4 5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP08

SHEET 1 OF 1

Position : 613085.4 E, 6393690.0 N GDA94	**Surface RL : 265.4m**	**Pit Width : 1.4**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 2.4**	**Checked : TAS**
Date : 18 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	St	DCP SV PP	DCP (blows/100mm): 9,12,9,9,11,13,16,16,15,17,32 0.1m: SV = 68/24 kPa 0.2m: PP > 300 kPa	
								PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
		0.70 264.72		CLAY with sand, trace gravel, medium plasticity, brown occasionally black and orange mottled, gravel is coarse grained, subround to sub angular (Alluvial)	CI	D	H			
1								PP	1.0m: PP > 600 kPa	1
2		2.00 263.42		CLAY with sand and gravel, medium plasticity, fine to coarse grained sand, pale brown (Alluvial)	CI	D	D	PP	2.0m: PP > 600 kPa	2
	GNE							BS	BS (2.0 - 3.0m)	
3		3.10 262.32		Limit of hole						3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP09

SHEET 1 OF 1

Position : 612879.5 E, 6393721.0 N GDA94	**Surface RL : 264.9m**	**Pit Width : 1.4**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3**	**Checked : TAS**
Date : 18 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL						ADDITIONAL DATA		
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay, low plasticity, orange brown, w < PL	CL	D	St	DCP SV PP	DCP (blows/100mm): 7,7,10,25 0.1m: SV = 65/15 kPa 0.2m: PP > 600 kPa	
		0.50 264.44		Sandy CLAY with gravel, medium plasticity, brown with orange and black staining, gravel is medium to coarse grained, subround to subangular (Alluvial)	CI	D	H	PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
1								PP	1.0m: PP > 600 kPa	1
								BS	BS (1.0 - 2.0m)	
2										2
	GNE	2.40 262.54		Limit of hole						
3										3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP10

SHEET 1 OF 1

Position : 612870.5 E, 6393621.0 N GDA94
Surface RL : 264.6m
Pit Width : 1.3
Processed : TAS
Contractor : TGO
Machine : Doosan DX 225LC
Pit Length : 3.2
Checked : TAS
Date : 18 Nov 20
Logged by : SG
Date : 22 Mar 21

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
			▨	TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP SV PP	DCP (blows/100mm): 4,7,15,20,27 0.1m: SV = 95/10 kPa 0.2m: PP > 600 kPa	
		0.50 264.07	☰	Sandy CLAY, trace gravel, low plasticity, orange brown, w < PL (Alluvial)	CL	D	H	PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
1								PP	1.0m: PP > 600 kPa	1
		1.50 263.07	☰	Sandy CLAY, trace gravel, medium plasticity, yellow brown with black and orange mottled, trace Fe, gravel is medium to coarse grained, subround to subangular (Alluvial)	CI	D	H	BS	BS (1.5 - 2.0)	
2								PP	2.0m: PP > 600 kPa	2
	GNE									
3		3.00 261.57		Effective refusal with 0.6m wide, toothed bucket						3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP11

SHEET 1 OF 1

Position : 613067.7 E, 6393588.0 N GDA94	**Surface RL :** 264.9m	**Pit Width :** 1.4	**Processed :** TAS
Contractor : TGO	**Machine :** Doosan DX 225LC	**Pit Length :** 4	**Checked :** TAS
Date : 18 Nov 20		**Logged by :** SG	**Date :** 22 Mar 21

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H		DCP (blows/100mm): 3,6,13,19,18,17,15,13,11,14,14,13,13,13,12	
								PP	0.2m: PP > 600 kPa	
		0.60 264.27						PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
				Sandy CLAY, trace organics, high plasticity, orange brown, sand is fine to coarse grained, w < PL (Alluvial)	CH	D	H			
1								PP	1.0m: PP > 600 kPa	1
								BS	BS (1.0 - 2.0m)	
2		2.00 262.87								2
				Sandy CLAY with gravel, high plasticity, grey-brown with orange and black staining, sand is fine to coarse grained, gravel is fine grained, sub-rounded, w < PL (Alluvial)	CH	D	VD			
	GNE							BS	BS (2.0 - 3.2m)	
3										3
		3.20 261.67		Effective refusal with 0.6m wide, toothed bucket						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP12

SHEET 1 OF 1

Position : 613276.8 E, 6393385.0 N GDA94	**Surface RL : 265.0m**	**Pit Width : 1.3**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3.5**	**Checked : TAS**
Date : 18 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay, with rootlets, low plasticity, orange brown, w < PL	CL	D	VSt	DCP SV PP	DCP (blows/100mm): 4,7,19,16,17,15,14,11,12,13,14,14,12,14,12 0.1m: SV = 78/20 kPa 0.2m: PP = 300 kPa	
		0.60 264.43						PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
				CLAY with sand, low to medium plasticity, trace organics, orange brown, w < PL (Alluvial)	CL-CI	D	H			
1								PP	1.0m: PP > 600 kPa	1
								BS	BS (1.0 - 2.0m)	
2								PP	2.0m: PP > 600 kPa	2
	GNE	2.50 262.53		Sandy CLAY, low plasticity, orange yellow brown, sand is fine to coarse grained, w < PL (Alluvial)	CL	D	H			
3										3
								BS	BS (3.0 - 4.0m)	
4		4.00 261.03		Limit of hole						4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP13

SHEET 1 OF 1

Position : 613043.5 E, 6393417.0 N GDA94
Surface RL : 264.1m
Pit Width : 1.4
Processed : TAS
Contractor : TGO
Machine : Doosan DX 225LC
Pit Length : 4
Checked : TAS
Date : 19 Nov 20
Logged by : SG
Date : 22 Mar 21

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay, low plasticity, orange brown, w < PL	CL	D	VSt	DCP	DCP (blows/100mm): 4,4,8,9,29 0.1m: SV = 120/20 kPa	
								PP	0.3m: PP = 300 kPa (UCS)	
								PP BS	0.5m: PP = 300 kPa (UCS) BS (0.0 - 1.0m)	
		0.60 263.50		Sandy CLAY, trace organics, medium plasticity, yellow brown, sand is fine to medium grained, w < PL (Alluvial)	CI	D	H			
1								PP	1.0m: PP > 600 kPa	1
2		2.00 262.10		Sandy CLAY with gravel, medium plasticity, pale yellow brown, sand is fine to coarse grained, gravel is fine grained, well rounded to subangular, polymictic, w < PL (Alluvial)	CI	D	H			2
	GNE							BS	BS (2.0 - 3.0m)	
3										3
		3.50 260.60		Effective refusal of 0.6m wide, toothed bucket						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client :	**Tomingley Gold Operations**	
Project :	**Geotechnical Investigation**	
Location :	**Tomingley, NSW**	

LOCATION No. TP14

SHEET 1 OF 1

Position :	**613252.2 E, 6393237.0 N GDA94**	**Surface RL : 264.4m**	**Pit Width : 1.3**	**Processed : TAS**
Contractor :	**TGO**	**Machine : Doosan DX 225LC**	**Pit Length : 2.8**	**Checked : TAS**
Date :	**19 Nov 20**		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		**MATERIAL**							**ADDITIONAL DATA**	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
		0.60 263.80	▨	TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP SV PP PP BS	DCP (blows/100mm): 4,7,14,16,18,13,10,10,12,10,12,11,13,12,12 0.1m: SV = 185/45 kPa 0.3m: PP > 600 kPa (UCS) 0.5m: PP > 600 kPa (UCS) BS (0.0 - 1.0m)	
1 2 3	GNE	4.00 260.40	▤	Sandy CLAY, trace gravel, black mottled orange brown, medium plasticity, sand is fine to coarse grained, gravel is fine grained, well rounded to subangular, w < PL (Alluvial)	CI	D	H	PP BS BS	clasts consist of quartz, feldspar, k-feldspar 1.0m: PP > 600 kPa (UCS) BS (1.0 - 2.0m) BS (2.0 - 2.5m) change to trenching bucket	1 2 3
4 5										4 5

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TESTPIT/EXCAVATION LOG SHEET

Client :	**Tomingley Gold Operations**	**LOCATION No. TP15**
Project :	**Geotechnical Investigation**	
Location :	**Tomingley, NSW**	**SHEET 1 OF 1**

Position : 613482.5 E, 6393207.0 N GDA94	**Surface RL : 264.6m**		**Pit Width : 0.8**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**		**Pit Length : 3.7**	**Checked : TAS**
Date : 19 Nov 20			**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
			▩	TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP SV PP	DCP (blows/100mm): 12,16,26,26,26 0.1m: SV = 148/16 kPa 0.3m: PP > 600 kPa	
1 2	GNE	0.50 264.15	▤	Sandy CLAY, trace gravel, low to medium plasticity, orange brown, sand is fine to coarse grained, w < PL (Alluvial)	CL - CI	D	H	PP BS PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m) BS (1.0 - 2.0m)	1 2
3 4 5		2.80 261.85		Effective refusal with 0.6m wide, toothed bucket						3 4 5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP16

SHEET 1 OF 1

Position : 613730.6 E, 6393476.0 N GDA94	**Surface RL : 266.2m**		**Pit Width : 0.8**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**		**Pit Length : 3.3**	**Checked : TAS**
Date : 19 Nov 20			**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: clay with sand and rootlets, brown, sand is fine to medium grained, w < PL	CI	D	H	DCP	DCP (blows/100mm): 6,8,13,13,17,17,18,13,14,15,16,13,13,14,13	
								PP	0.3m: PP > 600 kPa	
								PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
		0.60 265.60		Sandy CLAY with gravel, medium plasticity, brown, sand is fine to coarse grained, gravel is fine grained, subrounded to subangular, w < PL (Alluvial)	CI	D	H			
1								PP	1.0m: PP > 600 kPa 1.0m: white inclusions of possible weathered feldspar, plagioclase, < 20cm diam	1
								BS	BS (1.0 - 2.0m)	
2										2
	GNE							BS	BS (2.0 - 3.0m)	
3										3
		3.70 262.50		Effective refusal with 0.6m wide, toothed bucket						
4										4
5										5

See standard sheets for details of abbreviations & basis of descriptions

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TESTPIT/EXCAVATION LOG SHEET

Client :	**Tomingley Gold Operations**	**LOCATION No. TP17**
Project :	**Geotechnical Investigation**	
Location :	**Tomingley, NSW**	**SHEET 1 OF 1**

Position : 613745.1 E, 6393589.0 N GDA94	**Surface RL : 266.7m**	**Pit Width : 0.8**	**Processed : TAS**
Contractor : TGO	**Machine : Doosan DX 225LC**	**Pit Length : 3.2**	**Checked : TAS**
Date : 19 Nov 20		**Logged by : SG**	**Date : 22 Mar 21**

EXCA		**MATERIAL**							**ADDITIONAL DATA**	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
	GNE			TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP	DCP (blows/100mm): 9,6,10,12,16,15,17,13,13,12,9,9,20,18,19	
								PP	0.3m: PP > 600 kPa	
								PP BS	0.5m: PP > 600 kPa BS (0.0 - 1.0m)	
		0.60 266.13		Sandy CLAY, trace gravel, medium plasticity, orange brown, sand is fine to coarse grained, w < PL (Alluvial)	CI	D	H			
1		1.00 265.73		Sandy CLAY, trace gravel, medium plasticity, black mottled yellow brown, sand is fine to medium grained, gravel is fine grained, w < PL (Alluvial)	CI	D	H		1.0m: PP > 600 kPa	1
								BS	BS (1.0 - 2.0m)	
2										2
								BS	BS (2.0 - 3.0m)	
3										3
		3.30 263.43		Effective refusal with 0.6m wide, toothed bucket						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP18

SHEET 1 OF 1

Position : 613015.1 E, 6393279.0 N GDA94
Surface RL : 263.9m
Pit Width : 0.8
Processed : TAS
Contractor : TGO
Machine : Doosan DX 225LC
Pit Length : 3
Checked : TAS
Date : 19 Nov 20
Logged by : SG
Date : 22 Mar 21

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				TOPSOIL: Sandy Clay with rootlets, low plasticity, orange brown, w < PL	CL	D	H	DCP	DCP (blows/100mm): 5,12,20,26	
								PP	0.3m: PP = 550 kPa	
								PP BS	0.5m: PP = 550 kPa BS (0.0 - 1.0m)	
		0.80 263.08		CLAY with sand, trace gravel, high plasticity, orange brown, sand is fine to coarse grained, gravel is fine grained, w < PL (Alluvial)	CH	D	H			
1								PP	1.0m: PP > 600 kPa	1
								BS	BS (1.0 - 2.0m)	
2		2.00 261.88		Sandy CLAY with gravel, high plasticity, yellow orange brown, sand is fine to coarse grained, gravel is fine grained, subround to subangular, w < PL (Alluvial)	CH	D	H			2
	GNE							BS	BS (2.0 - 3.0m)	
3										3
		3.20 260.68		Effective refusal with 0.6m wide, toothed bucket						
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP19

SHEET 1 OF 1

Position : 612839.7 E, 6393455.0 N GDA94	**Surface RL : 264.1m**		**Pit Width : 0.8**	**Processed : CP**
Contractor : TGO	**Machine : Doosan DX 225LC**		**Pit Length : 3**	**Checked : TAS**
Date : 19 Nov 20			**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
		0.60 263.45		Topsoil: Sandy CLAY with rootlets/organics, low to medium plasticity, orange yellow brown, sand is fine to coarse grained, w < PL	CL	W<PL	F	DCP SV PP BS PP	DCP (blows/100mm): 5,5,10,14,14,19,25 SV 113/55 kPa, small blade PP 550 kPa PP 600 kPa	
1		2.00 262.05		Sandy CLAY, trace gravel, medium plasticity, pale grey brown, black and orange mottled, sand is fine to coarse grained, gravel is fine grained, well rounded to sub angular gravel, no obvious grading, polymictic (Alluvial)	CI	W<PL	F	SV PP BS	SV refused, small blade PP > 600 kPa	1
2	GNE	3.00 261.05		Sandy CLAY with gravel, medium plasticity, pale yellow orange brown, fine to medium grained well rounded to sub angular gravels, no obvious grading, cemented by clay, w < PL (Alluvial)	CI	D	F-St	BS		2
3				END OF HOLE at 3.0 m, effective refusal						3
4										4
5										5

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TESTPIT/EXCAVATION LOG SHEET

Client : Tomingley Gold Operations
Project : Geotechnical Investigation
Location : Tomingley, NSW

LOCATION No. TP20

SHEET 1 OF 1

Position : 612819.5 E, 6393320.0 N GDA94	**Surface RL : 263.7m**		**Pit Width : 0.8**	**Processed : CP**
Contractor : TGO	**Machine : Doosan DX 225LC**		**Pit Length : 3.5**	**Checked : TAS**
Date : 19 Nov 20			**Logged by : SG**	**Date : 22 Mar 21**

EXCA		MATERIAL							ADDITIONAL DATA	
Scale (m)	Water	Depth / (RL) metres	Graphic Log	**Description** Soil Name (USC Symbol) Other Minor Components, Plasticity or Particle Characteristics, Colour, Moisture Condition, Consistency, Structure	Group Symbol	Moisture Condition	Consistency / Relative Density	Samples & Tests	**Comments/Observations** Insitu test results	SCALE (m)
				Topsoil: Sandy Clay with rootlets, orange brown, low plasticity, fine to medium grained sand, w < PL	CL	D	F	DCP SV	DCP (blows/100mm): 3,4,7,9,18,26 SV 90/22 kPa, small blade	
								PP	PP >600 kPa	
				From 0.5 m: more compacted, decreased proportion of organics				BS PP	PP >600 kPa	
1		1.00 262.70		Sandy CLAY, pale orange yellow brown, medium plasticity, fine to medium grained sand, w < PL (Alluvial)	CI	D	F-St	SV PP	SV refusal, small blade PP 600 kPa	1
								BS		
2		2.00 261.70		Sandy CLAY with Gravel, medium plasticity, yellow brown, fine to medium grained sand, fine to coarse grained well rounded to sub angular gravel, no grading, polymictic, w < PL (Alluvial)	CI	D	F		Possible extremely weathered granite clasts with quartz, feldspar and plagioclase?	2
	GNE							BS		
3										3
								BS		
		3.50 260.20		END OF HOLE at 3.5 m, effective refusal						
4										4
5										5

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Job No.
12538404

GHD Pty Ltd
2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH01	Tomingley Gold Operations (TGO)

Project: TGO RSF 2

Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH02

This drawing should be read in conjunction with report number 12538404

Client
Tomingley Gold Operations (TGO)

Project
TGO RSF 2
Geotechnical Investigation

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH03	Tomingley Gold Operations (TGO)

Project

TGO RSF 2

Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH04	Tomingley Gold Operations (TGO)
					Project TGO RSF 2 Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd
2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH05	Tomingley Gold Operations (TGO)
					Project TGO RSF 2 Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd
2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number	
TS	18/01/2021	12538404	A4

This drawing should be read in conjunction with report number 12538404

Title
Core Photo
Geotechnical Investigation
BH06

Client
Tomingley Gold Operations (TGO)

Project
TGO RSF 2
Geotechnical Investigation

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH07	Tomingley Gold Operations (TGO)
					Project TGO RSF 2 Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH08	Tomingley Gold Operations (TGO)
					Project TGO RSF 2 Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd
2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH09	Tomingley Gold Operations (TGO)
					Project TGO RSF 2 Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

GHD Pty Ltd

2 Salamance Square Hobart TAS 7000

Drawn	Date	Job Number		Title	Client
TS	18/01/2021	12538404	A4	Core Photo Geotechnical Investigation BH10	Tomingley Gold Operations (TGO)

Project

TGO RSF 2

Geotechnical Investigation

This drawing should be read in conjunction with report number 12538404

Appendix D – Laboratory Testing

Natural Moisture / Density Report

Report No: ***SYD2100076***

Client :	Tomingley Gold Operations
Project :	RSF 2 GI
Location :	Tomingley, NSW
TEST METHOD :	AS1289.2.1.1

Job No :	12538404
Borehole No :	See below
Depth :	See below
Sample No :	See below
Client ID :	See below

BH/Test Pit ID	Depth (m)	FMC (%)	Bulk Density (t/m³)	Dry Density (t/m³)	GHD Sample No
TP01	1.0-2.0	10.0	2.038	1.852	SYD21-0001-01
TP03	2.0-3.0	16.9	1.962	1.679	SYD21-0001-02
TP04	1.0-2.0	13.9	2.075	1.822	SYD21-0001-03
TP07	1.0-2.0	17.7	1.829	1.554	SYD21-0001-04
TP10	0.0-1.0	11.5	1.892	1.697	SYD21-0001-05
TP12	3.0-4.0	14.1	1.936	1.697	SYD21-0001-08
TP14	1.0-2.0	14.1	2.051	1.798	SYD21-0001-09
TP18	1.0-2.0	14.7	1.932	1.685	SYD21-0001-11

Comments :

Bulk density performed on soil lumps

Tested By:	DW
Date Tested:	15/01/2021
Checked By:	GV
Approved Signatory :	D. Brooke
Date :	19/01/2021

GHD
5/43 Herbert St Artarmon, NSW 2065
Telephone: (02) 9462 4860 Fax: (02) 9462 4710
GEOTECHNICAL TESTING SERVICES

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Laboratory Accreditation Number: 679

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Tel: (02) 9462 4860
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Material Test Report

Report No: SYD2100001
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-01
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP01
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY ; grey/brown trace gravel

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.0	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	31	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	17	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.53	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.57	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.53	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.84**	
Standard OMC (%)		**14.5**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		79	
LL Method		AS 1289.3.1.1	
Date Tested		8/01/2021	

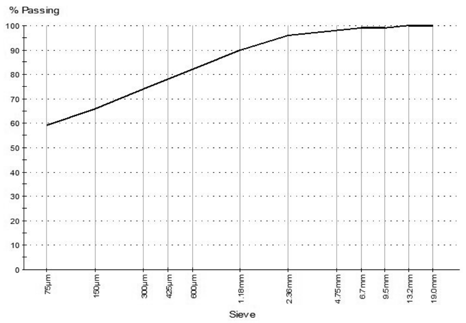
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	100	
9.5mm	99	
6.7mm	99	
4.75mm	98	
2.36mm	96	
1.18mm	90	
600µm	82	
425µm	78	
300µm	74	
150µm	66	
75µm	59	

Chart



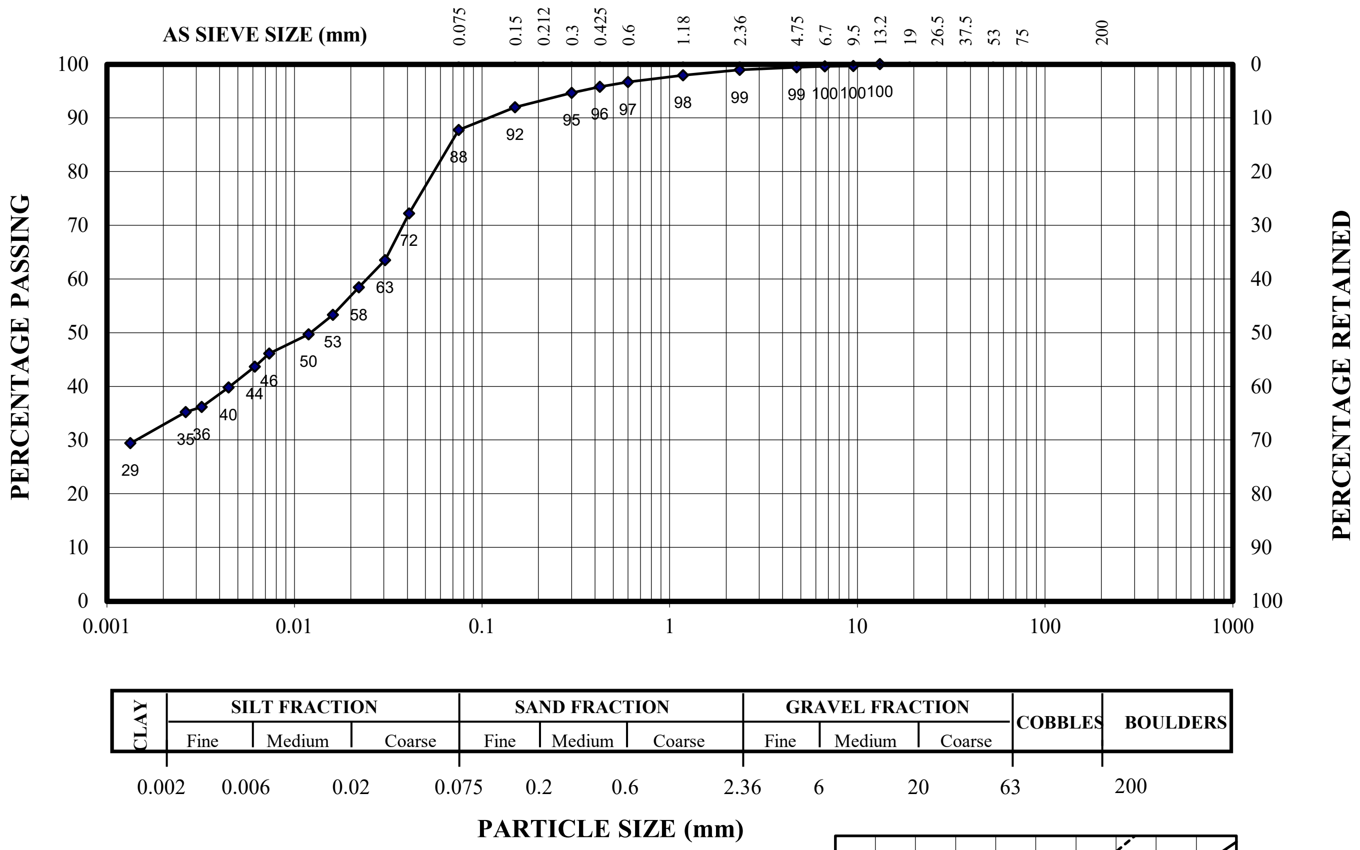
Comments

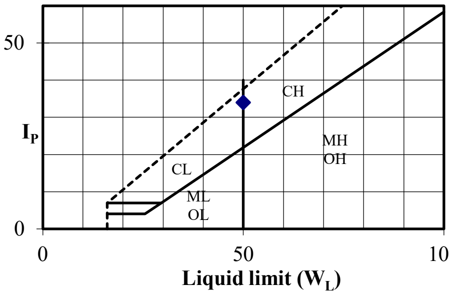
N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	TP03
Depth (m):	2.0 - 3.0
Sample No:	SYD21-0001-02

Client:	Tomingley Gold Operations	**Client Sample No.:**	n/a
Project:	RSF 2 GI	**Sample History:**	Sampled by GHD
Location:	Tomingley, NSW		





TEST METHODS

Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1 AS1289.3.5.1

GRADING

$C_u = D_{60} / D_{10} =$ not determinable

$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.55 (measured)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL: CH

SOIL NAME: CLAY; grey/brown trace sand

INDEX PROPERTIES (%)

Liquid Limit =	50	Plastic Limit =	16
Plasticity Index =	34	Linear Shrinkage % =	Not determined

Atterberg Limits (History/Preparation) Dry/Oven dry

Liquid Limit (type of test) Four point

Linear Shrinkage (mould size)

REMARKS:

Tested by:	DW
Date tested:	06.01.21
Checked by:	GV
Date checked:	18/01/2021

GHD Pty Ltd
Unit 5, 43 Herbert St, Artarmon NSW, 2064
Tel: (02) 9462 4700 Fax: (02) 9462 4710

Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100002.1**

Ref: Document F9.1.16 issue 1.2

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100002
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-02
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP03
Depth (m)	2.0 - 3.0
Soil Description	CLAY; grey/brown trace sand

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	16.9	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	50	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	34	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.55	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.57	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.57	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		CLAY trace sand	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.66**	
Standard OMC (%)		**20.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		175	
LL Method		AS 1289.3.1.1	

Comments

N/A

Sydney Laboratory
Unit 5/43 Herbert St
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Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100002
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-02
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP03
Depth (m)	2.0 - 3.0
Soil Description	CLAY; grey/brown trace sand

Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	
Coef of Permeability (m/s)	AS 1289.6.7.3	2 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		75.7	
Diameter (mm)		64.3	
Length/Diameter Ratio		1.18	
Laboratory Moisture Ratio (%)		100.5	
Laboratory Density Ratio (%)		97.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.5	
Moisture Content (%)		24.9	
Date Tested		8/01/2021	

Comments

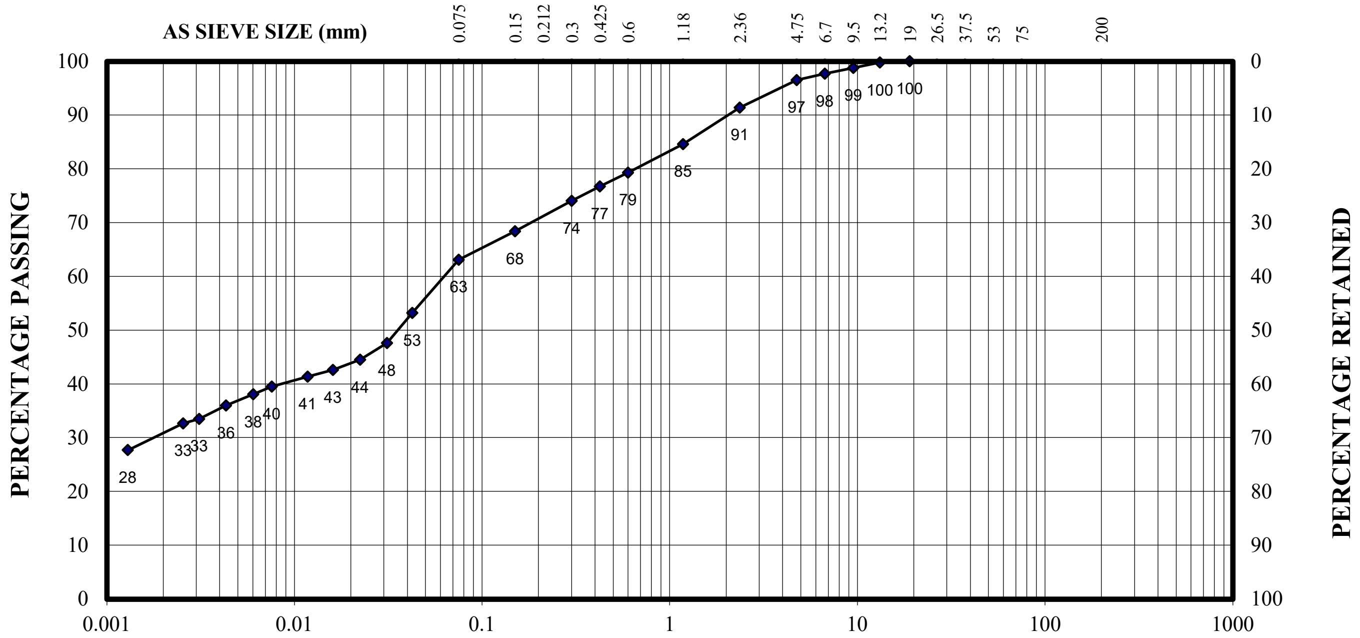
N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	TP04
Depth (m):	1.0 - 2.0
Sample No:	SYD21-0001-03

Client: Tomingley Gold Operations
Project: RSF 2 GI
Location: Tomingley, NSW

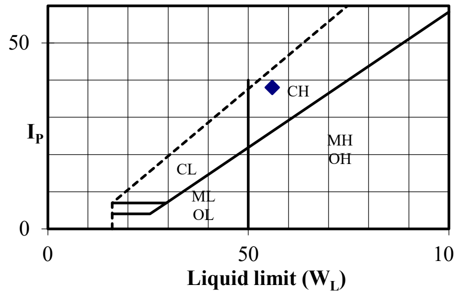
Client Sample No.: n/a
Sample History: Sampled by GHD



CLAY	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

0.002 0.006 0.02 0.075 0.2 0.6 2.36 6 20 63 200

PARTICLE SIZE (mm)



TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.61 (measured)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL: CH

SOIL NAME: Sandy CLAY; red/grey brown trace gravel

INDEX PROPERTIES (%)
Liquid Limit = 56 Plastic Limit = 18
Plasticity Index = 38 Linear Shrinkage % = Not determined

Atterberg Limits (History/Preparation) Dry/Oven dry
Liquid Limit (type of test) Four point
Linear Shrinkage (mould size)

REMARKS:

Tested by: DW
Date tested: 06.01.21
Checked by: GV
Date checked: 18/01/2021

GHD Pty Ltd
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Tel: (02) 9462 4700 Fax: (02) 9462 4710

Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100003**

Ref: Document F9.1.16 issue 1.2

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Artarmon NSW 2064
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Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100003
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-03
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP04
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; red/grey brown trace gravel

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.9	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	56	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	38	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.61	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.50	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.50	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.70**	
Standard OMC (%)		**18.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		169	
LL Method		AS 1289.3.1.1	

Comments

N/A

Sydney Laboratory
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Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100004
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-04
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP07
Depth (m)	1.0 - 2.0
Soil Description	CLAY with sand ; brown trace gravel

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	17.7	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	48	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	30	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.48	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.29	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.46	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		CLAY with sand	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.70**	
Standard OMC (%)		**21.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		2	
Curing Time (h)		97	
LL Method		AS 1289.3.1.1	
Date Tested		7/01/2021	

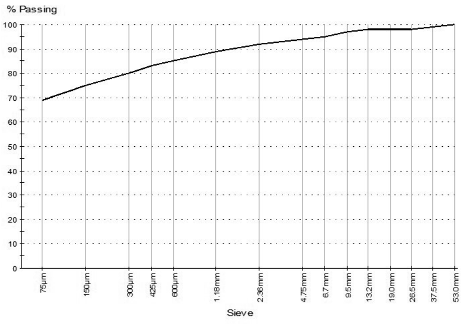
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
53.0mm	100	
37.5mm	99	
26.5mm	98	
19.0mm	98	
13.2mm	98	
9.5mm	97	
6.7mm	95	
4.75mm	94	
2.36mm	92	
1.18mm	89	
600µm	85	
425µm	83	
300µm	80	
150µm	75	
75µm	69	

Chart



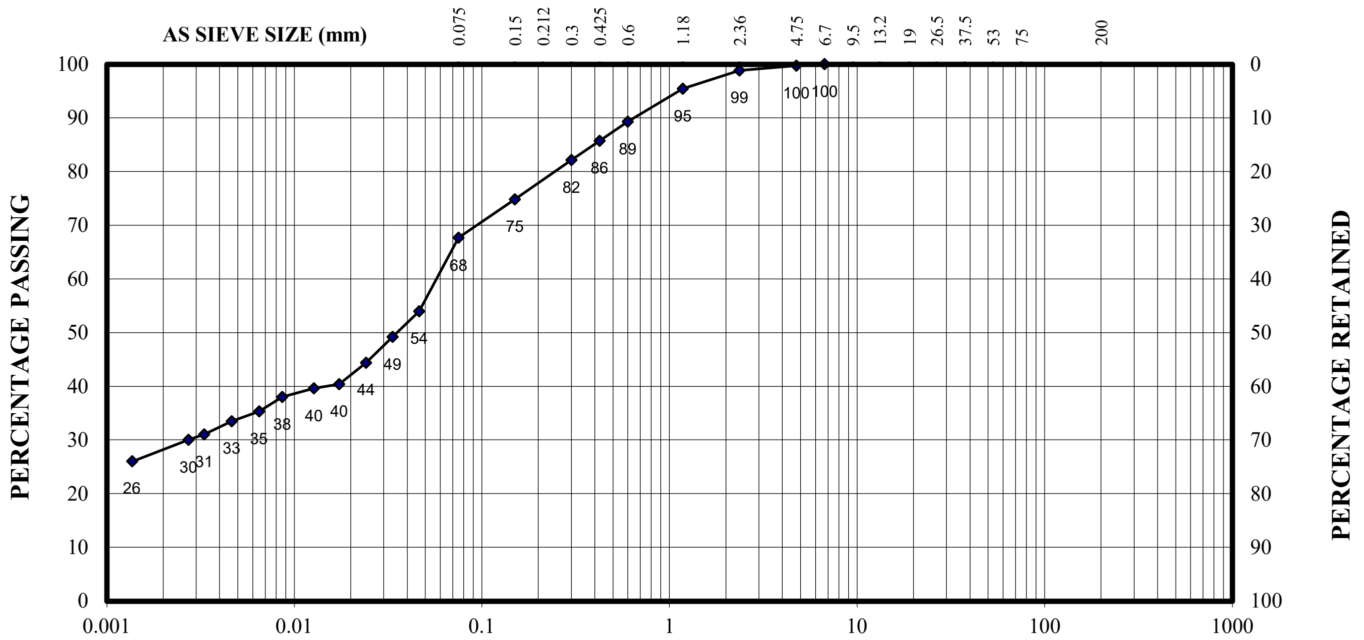
Comments

N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	TP10
Depth (m):	0.0 - 1.0
Sample No:	SYD21-0001-05

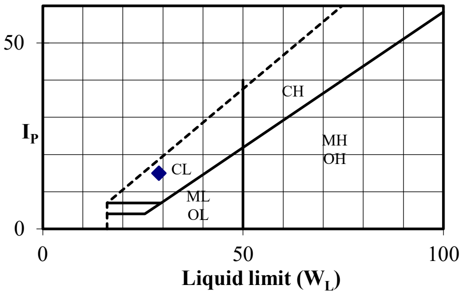
Client:	Tomingley Gold Operations	**Client Sample No.:**	n/a
Project:	RSF 2 GI	**Sample History:**	Sampled by GHD
Location:	Tomingley, NSW		



CLAY	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

0.002 0.006 0.02 0.075 0.2 0.6 2.36 6 20 63 200

PARTICLE SIZE (mm)



TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.55 (measured)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL: CL

SOIL NAME: Sandy CLAY; red/brown trace gravel

INDEX PROPERTIES (%)

Liquid Limit =	29	Plastic Limit =	14
Plasticity Index =	15	Linear Shrinkage % =	Not determined

Atterberg Limits (History/Preparation) Dry/Oven dry

Liquid Limit (type of test) Four point

Linear Shrinkage (mould size)

REMARKS:

Tested by:	DW
Date tested:	06.01.21
Checked by:	GV
Date checked:	18/01/2021

GHD Pty Ltd
Unit 5, 43 Herbert St, Artarmon NSW, 2064
Tel: (02) 9462 4700 Fax: (02) 9462 4710

Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100005.1**

Ref: Document F9.1.16 issue 1.2

Sydney Laboratory
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Artarmon NSW 2064
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web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
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Material Test Report

Report No: SYD2100005
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-05
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP10
Depth (m)	0.0 - 1.0
Soil Description	Sandy CLAY; red/brown trace gravel

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.5	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	15	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.55	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.46	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.46	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.81**	
Standard OMC (%)		**15.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		79	
LL Method		AS 1289.3.1.1	

Comments

N/A

Sydney Laboratory
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Material Test Report

Report No: SYD2100005
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-05
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP10
Depth (m)	0.0 - 1.0
Soil Description	Sandy CLAY; red/brown trace gravel

Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	
Coef of Permeability (m/s)	AS 1289.6.7.3	2 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		74.4	
Diameter (mm)		63.5	
Length/Diameter Ratio		1.17	
Laboratory Moisture Ratio (%)		101.0	
Laboratory Density Ratio (%)		98.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		17.9	
Date Tested		8/01/2021	

Comments

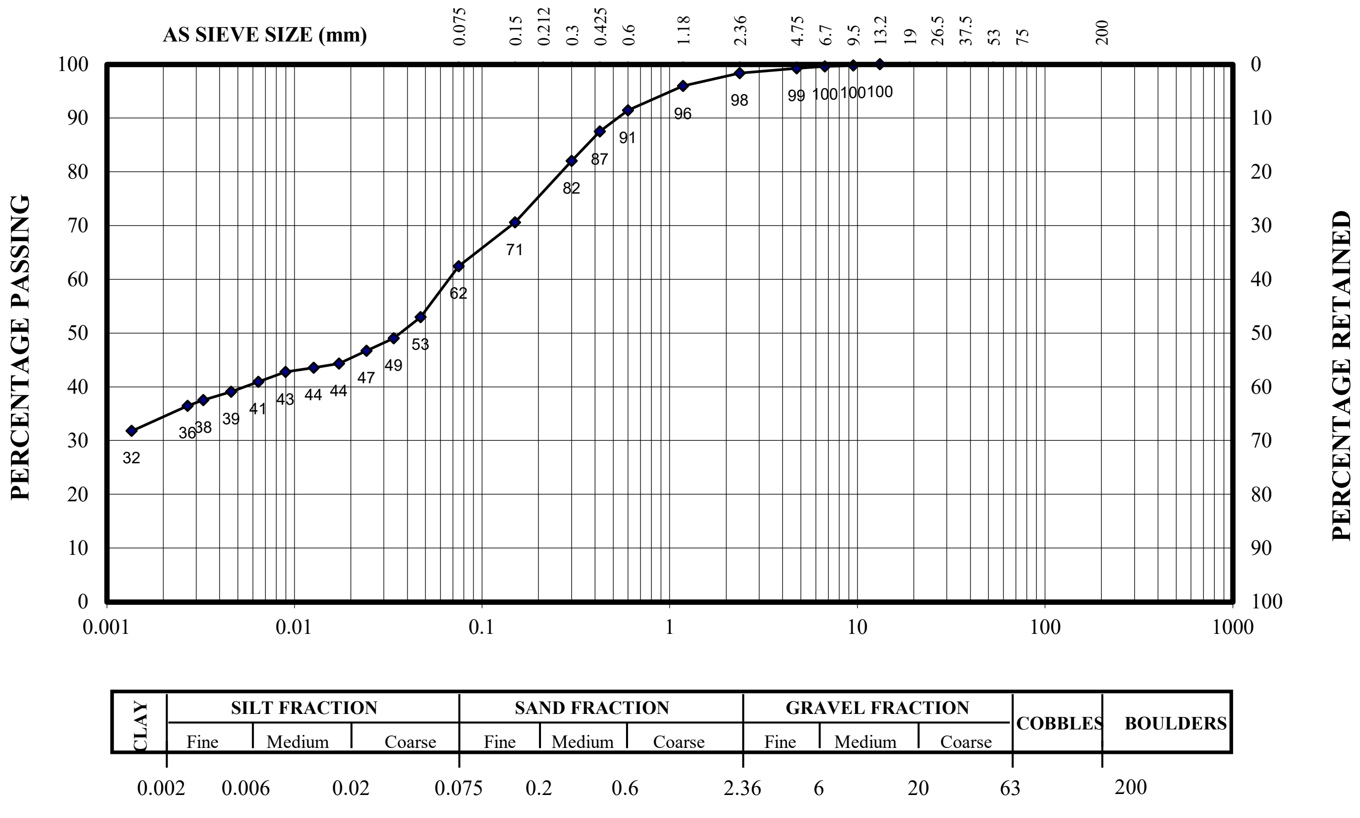
N/A

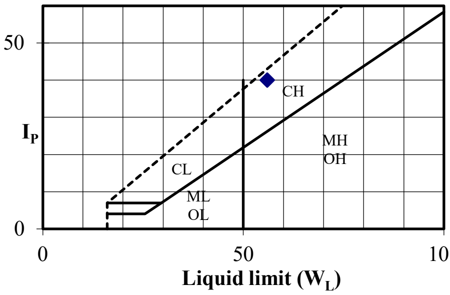
SOIL CLASSIFICATION REPORT

Trial Hole: TP11
Depth (m): 1.0 - 2.0
Sample No: SYD21-0001-06

Client: Tomingley Gold Operations
Project: RSF 2 GI
Location: Tomingley, NSW

Client Sample No.: n/a
Sample History: Sampled by GHD





TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.5 (measured)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL: CH

SOIL NAME: Sandy CLAY; brown trace gravel

REMARKS:

INDEX PROPERTIES (%)
Liquid Limit = 56
Plasticity Index = 40
Plastic Limit = 16
Linear Shrinkage % = Not determined

Atterberg Limits (History/Preparation) Dry/Oven dry
Liquid Limit (type of test) Four point
Linear Shrinkage (mould size)

Tested by: DW
Date tested: 06.01.21
Checked by: GV
Date checked: 18/01/2021

GHD Pty Ltd
Unit 5, 43 Herbert St, Artarmon NSW, 2064
Tel: (02) 9462 4700 Fax: (02) 9462 4710

Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No. 12538404
REPORT No. SYD2100006.1

Ref: Document F9.1.16 issue 1.2

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100006
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-06
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP11
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	17.4	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	56	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	40	
Avg Particle Density - passing 2.36mm (g/cm^3)	AS 1289.3.5.1	2.50	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm^3)		2.41	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm^3)		2.41	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m^3)	AS 1289.5.1.1 - 2017	**1.65**	
Standard OMC (%)		**20.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		169	
LL Method		AS 1289.3.1.1	

Comments

N/A

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Material Test Report

Report No: SYD2100006
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

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Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-06
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP11
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; brown

Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	
Coef of Permeability (m/s)	AS 1289.6.7.3	4 E-11	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		74.2	
Diameter (mm)		63.5	
Length/Diameter Ratio		1.17	
Laboratory Moisture Ratio (%)		100.0	
Laboratory Density Ratio (%)		98.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.5	
Moisture Content (%)		23.8	
Date Tested		8/01/2021	

Comments

N/A

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Material Test Report

Report No: SYD2100007
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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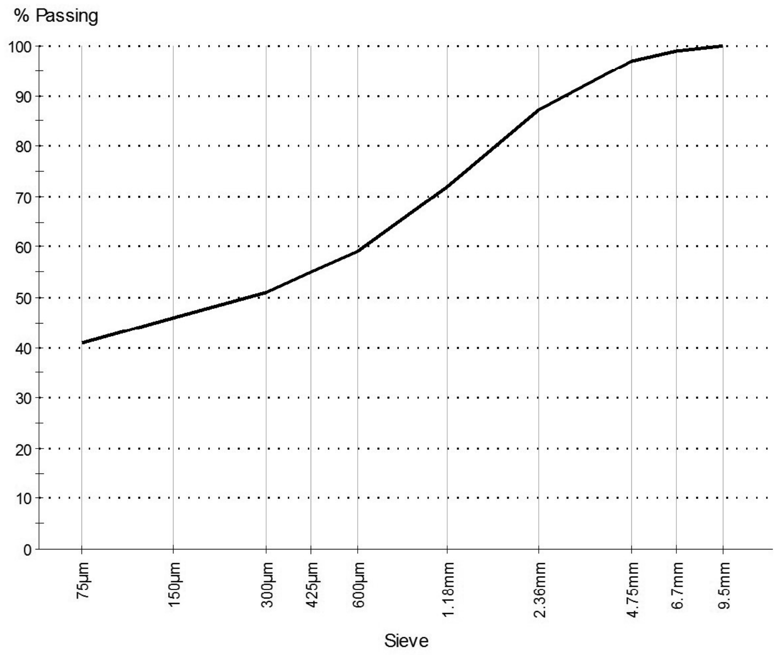
Sample Details

GHD Sample No	SYD21-0001-07
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP11
Depth (m)	2.0 - 3.0
Soil Description	Sandy CLAY; red/grey brown with gravel

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	99	
4.75mm	97	
2.36mm	87	
1.18mm	72	
600µm	59	
425µm	55	
300µm	51	
150µm	46	
75µm	41	

Comments

N/A

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Material Test Report

Report No: SYD2100008
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-08
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP12
Depth (m)	3.0 - 4.0
Soil Description	Sandy CLAY; grey/brown

Other Test Results

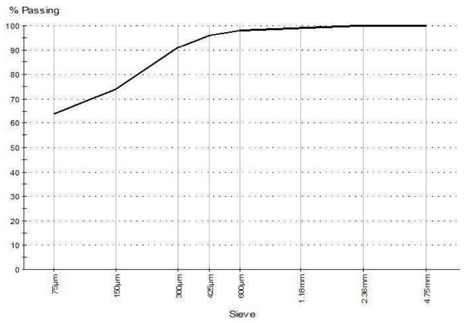
Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.1	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	31	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	17	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.50	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)			
Temperature - retained 2.36mm (°C)			
Soil Particle Density (g/cm³)		2.50	
Date Tested		18/01/2021	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.77**	
Standard OMC (%)		**16.5**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		79	
LL Method		AS 1289.3.1.1	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	5/01/2021
Note:	Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	99	
600µm	98	
425µm	96	
300µm	91	
150µm	74	
75µm	64	

Chart



Comments

N/A

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Material Test Report

Report No: SYD2100008
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-08
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP12
Depth (m)	3.0 - 4.0
Soil Description	Sandy CLAY; grey/brown

Other Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	
Coef of Permeability (m/s)	AS 1289.6.7.3	2 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		74.8	
Diameter (mm)		63.5	
Length/Diameter Ratio		1.18	
Laboratory Moisture Ratio (%)		101.0	
Laboratory Density Ratio (%)		97.5	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		19.6	
Date Tested		8/01/2021	

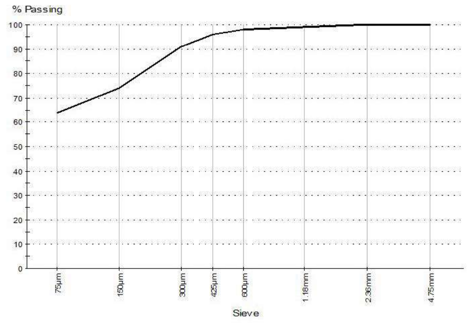
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	99	
600µm	98	
425µm	96	
300µm	91	
150µm	74	
75µm	64	

Chart



Comments

N/A

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Material Test Report

Report No: SYD2100009
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-09
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP14
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; red/grey brown trace gravel

Other Test Results

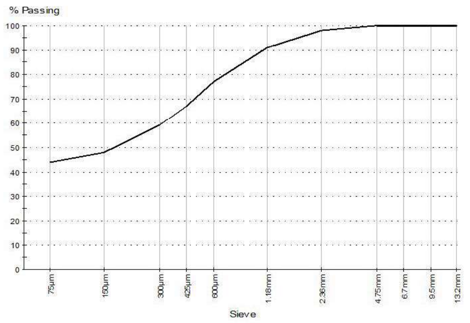
Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.1	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	44	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	29	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.61	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.47	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.61	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.79**	
Standard OMC (%)		**16.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		79	
LL Method		AS 1289.3.1.1	
Date Tested		8/01/2021	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	5/01/2021
Note:	Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	98	
1.18mm	91	
600µm	77	
425µm	67	
300µm	59	
150µm	48	
75µm	44	

Chart



Comments

N/A

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Material Test Report

Report No: SYD2100010
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

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NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-10
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP17
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; grey/brown trace gravel

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.4	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	50	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	34	
Date Tested		18/01/2021	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.62	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.42	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.61	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.67**	
Standard OMC (%)		**18.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		97	
LL Method		AS 1289.3.1.1	

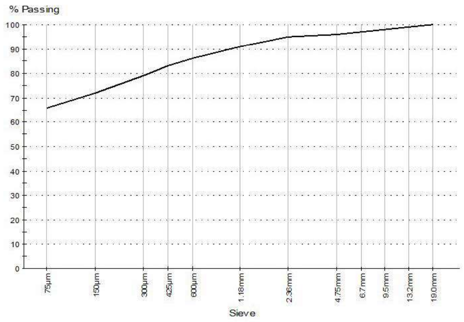
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	99	
9.5mm	98	
6.7mm	97	
4.75mm	96	
2.36mm	95	
1.18mm	91	
600µm	86	
425µm	83	
300µm	79	
150µm	72	
75µm	66	

Chart



Comments

N/A

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Material Test Report

Report No: SYD2100010
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

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NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-10
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP17
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; grey/brown trace gravel

Other Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	

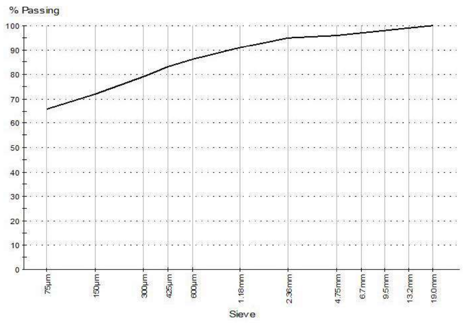
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	99	
9.5mm	98	
6.7mm	97	
4.75mm	96	
2.36mm	95	
1.18mm	91	
600µm	86	
425µm	83	
300µm	79	
150µm	72	
75µm	66	

Chart



Comments

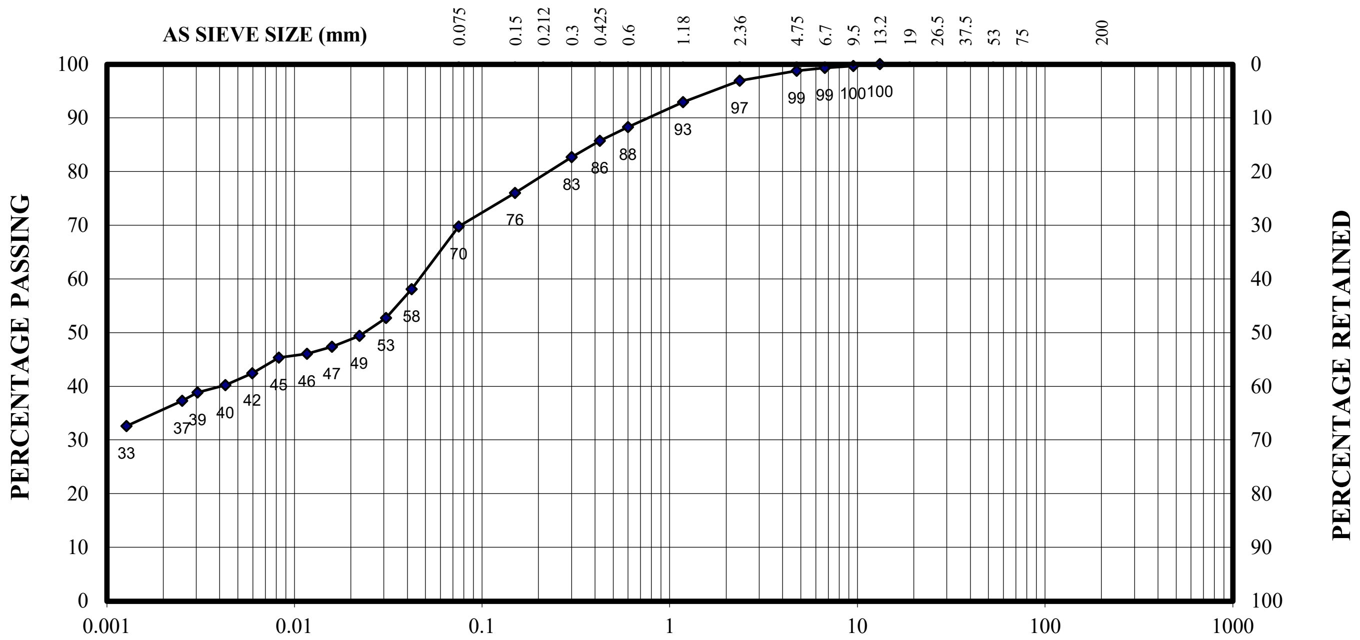
N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	TP18
Depth (m):	1.0 - 2.0
Sample No:	SYD21-0001-11

Client: Tomingley Gold Operations
Project: RSF 2 GI
Location: Tomingley, NSW

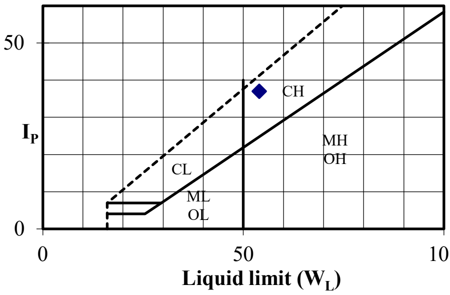
Client Sample No.: n/a
Sample History: Sampled by GHD



CLAY	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

0.002 0.006 0.02 0.075 0.2 0.6 2.36 6 20 63 200

PARTICLE SIZE (mm)



TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.62 (measured)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL: CH

SOIL NAME: Sandy CLAY; red/grey brown trace gravel

INDEX PROPERTIES (%)
Liquid Limit = 54 Plastic Limit = 17
Plasticity Index = 37 Linear Shrinkage % = Not determined

Atterberg Limits (History/Preparation) Dry/Oven dry
Liquid Limit (type of test) Four point
Linear Shrinkage (mould size)

REMARKS:

Tested by: DW
Date tested: 06.01.21
Checked by: GV
Date checked: 18/01/2021

GHD Pty Ltd
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Approved Signatory:

J.G.Vukovic 19/01/2021

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Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100011.1**

Ref: Document F9.1.16 issue 1.2

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Material Test Report

Report No: SYD2100011
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-11
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP18
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; red/grey brown trace gravel

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.7	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	54	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	37	
Avg Particle Density - passing 2.36mm (g/cm³)	AS 1289.3.5.1	2.62	
Temperature - passing 2.36mm (°C)		26	
Avg Particle Density - retained 2.36mm (g/cm³)		2.50	
Temperature - retained 2.36mm (°C)		26	
Soil Particle Density (g/cm³)		2.50	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Sandy CLAY	
Type of Water		Distilled	
Temperature of Water (°C)		23	
Date Tested		13/01/2021	
Standard MDD (t/m³)	AS 1289.5.1.1 - 2017	**1.62**	
Standard OMC (%)		**18.5**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		169	
LL Method		AS 1289.3.1.1	

Comments

N/A

Sydney Laboratory
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Material Test Report

Report No: SYD2100011
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-11
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP18
Depth (m)	1.0 - 2.0
Soil Description	Sandy CLAY; red/grey brown trace gravel

Test Results

Description	Method	Result	Limits
Date Tested		7/01/2021	
Coef of Permeability (m/s)	AS 1289.6.7.3	1 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		74.3	
Diameter (mm)		63.8	
Length/Diameter Ratio		1.16	
Laboratory Moisture Ratio (%)		101.0	
Laboratory Density Ratio (%)		98.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (kg)		0.0	
Pressure Applied (kPa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		0.0	
Moisture Content (%)		25.0	
Date Tested		8/01/2021	

Comments

N/A

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Material Test Report

Report No: SYD2100012
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 19/01/2021

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Sample Details

GHD Sample No	SYD21-0001-12
Date Sampled	18/11/2020
Sampled By	Sampled by GHD
BH / TP No.	TP19
Depth (m)	1.0 - 2.0
Soil Description	sandy CLAY; grey/brown trace gravel

Other Test Results

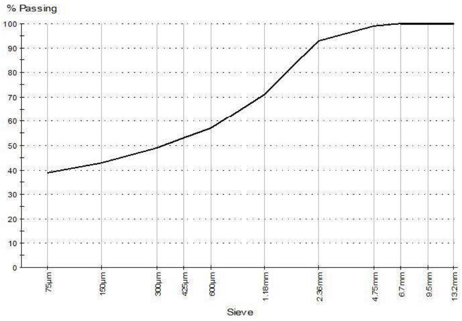
Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	8.1	
Date Tested		4/01/2021	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)			
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	41	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	27	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	5/01/2021
Note:	Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	100	
6.7mm	100	
4.75mm	99	
2.36mm	93	
1.18mm	71	
600µm	57	
425µm	53	
300µm	49	
150µm	43	
75µm	39	

Chart



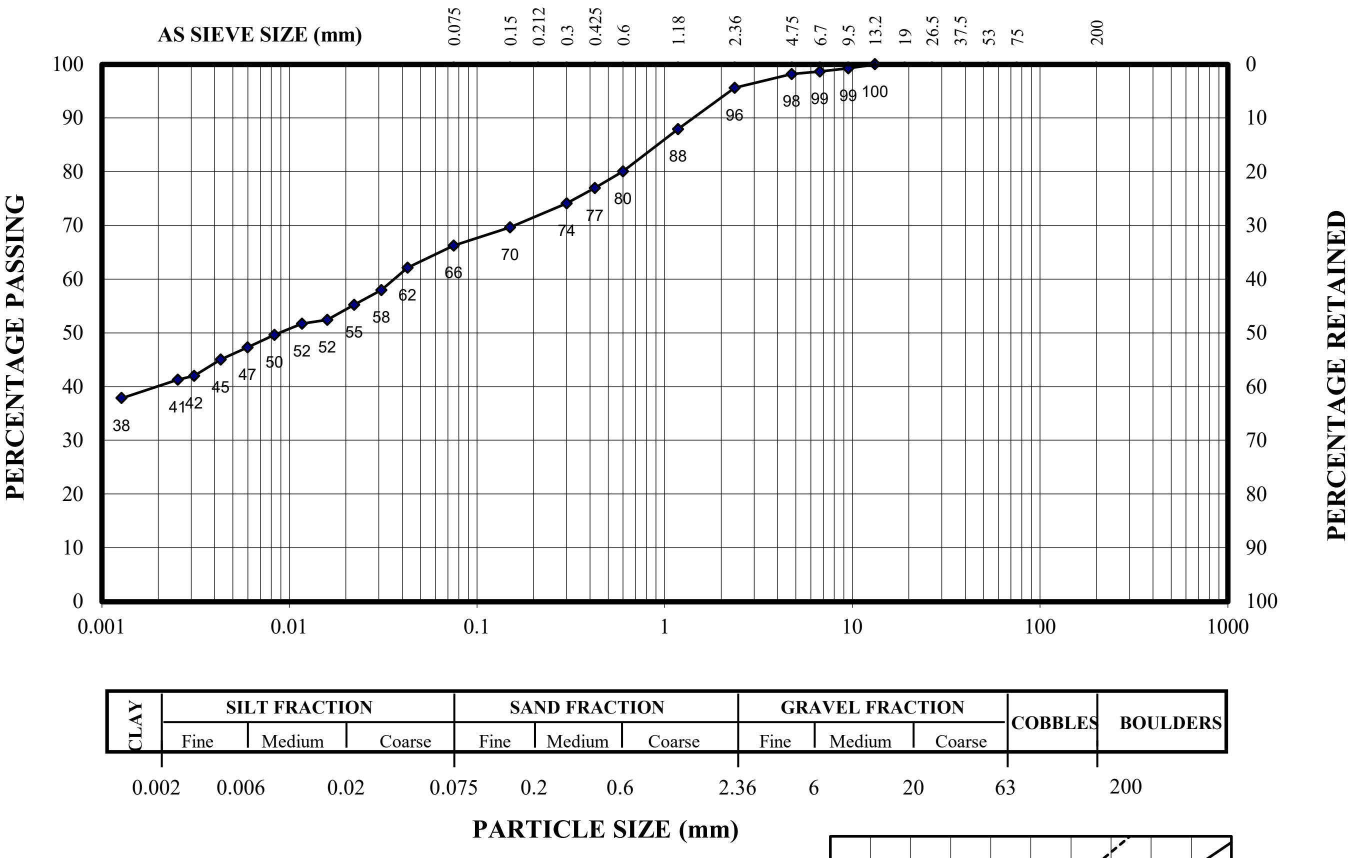
Comments

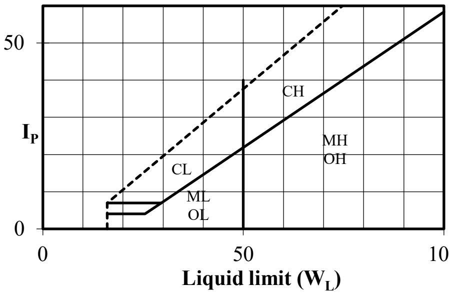
N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	BH03
Depth (m):	5.8 / 9.0 / 11.8
Sample No:	SYD21-0002-05

Client:	Tomingley Gold Operations	**Client Sample No.:**	n/a
Project:	RSF 2 GI	**Sample History:**	Sampled by GHD
Location:	Tomingley, NSW		





TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.55 (assumed)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL:

INDEX PROPERTIES (%)

Liquid Limit =	N/A	Plastic Limit =	N/A
Plasticity Index =	N/A	Linear Shrinkage % =	Not determined

Atterberg Limits (History/Preparation)

Liquid Limit (type of test)

Linear Shrinkage (mould size)

SOIL NAME: Sandy CLAY; red/grey brown trace gravel

REMARKS: Cobined sample BH03 (5.8-6.25m, 9.0-9.45m and 11.8-12.25m)

Tested by:	DW
Date tested:	06.01.21
Checked by:	GV
Date checked:	18/01/2021

GHD Pty Ltd
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Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100018**

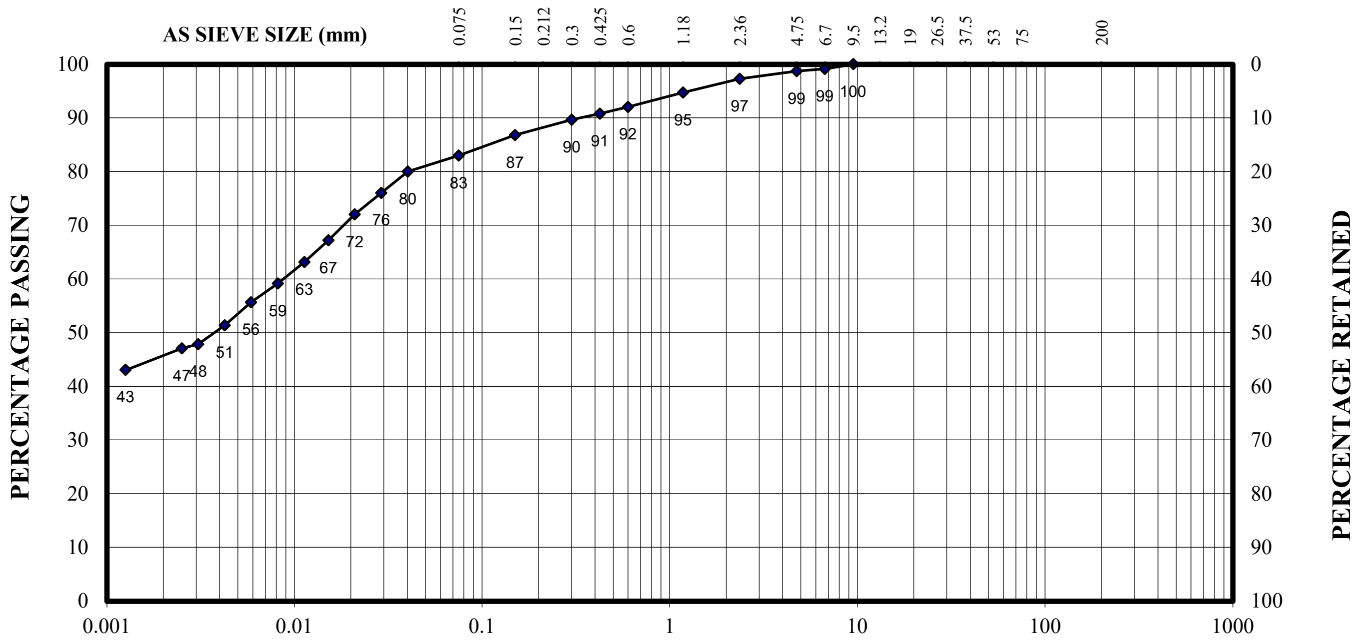
Ref: Document F9.1.16 issue 1.2

SOIL CLASSIFICATION REPORT

Trial Hole: BH03
Depth (m): 15.0 / 18.0 / 19.5
Sample No: SYD21-0002-06

Client: Tomingley Gold Operations
Project: RSF 2 GI
Location: Tomingley, NSW

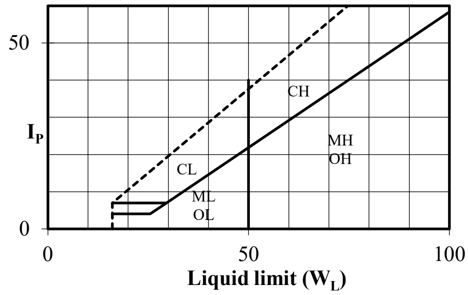
Client Sample No.: n/a
Sample History: Sampled by GHD



CLAY	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

0.002 0.006 0.02 0.075 0.2 0.6 2.36 6 20 63 200

PARTICLE SIZE (mm)



TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.6 (assumed)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL:

SOIL NAME: CLAY with sand; red/grey brown trace gracel

INDEX PROPERTIES (%)
Liquid Limit = N/A
Plasticity Index = N/A
Plastic Limit = N/A
Linear Shrinkage % = Not determined

Atterberg Limits (History/Preparation)

Liquid Limit (type of test)

Linear Shrinkage (mould size)

REMARKS: Combined sample BH03 (15.0-15.95m, 18.0-18.95m and 19.5-19.95m)

Tested by: DW
Date tested: 06.01.21
Checked by: GV
Date checked: 18/01/2021

GHD Pty Ltd
Unit 5, 43 Herbert St, Artarmon NSW, 2064
Tel: (02) 9462 4700 Fax: (02) 9462 4710

Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100019**

Ref: Document F9.1.16 issue 1.2

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Material Test Report

Report No: SYD2100020
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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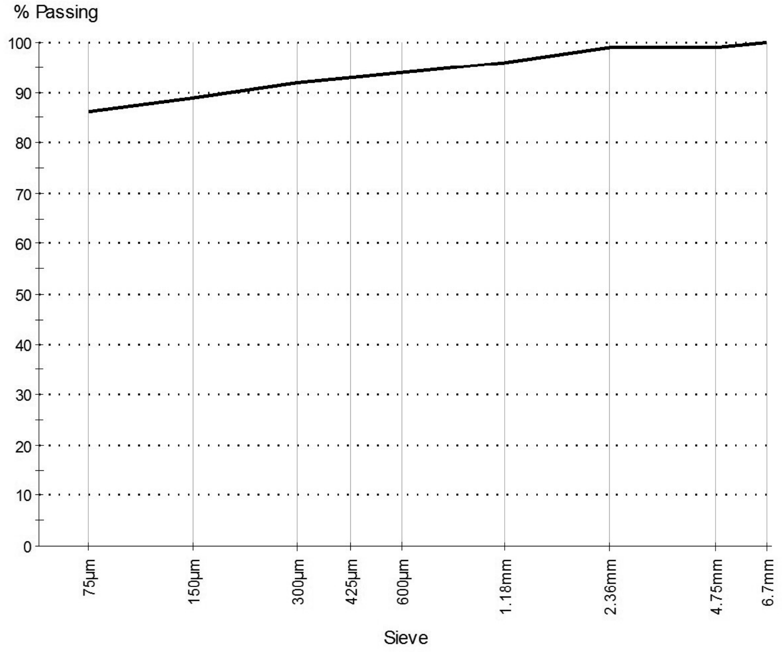
Sample Details

GHD Sample No	SYD21-0002-07
Date Sampled	27/11/2020
Sampled By	Sampled by GHD
BH / TP No.	BH04
Depth (m)	6-6.45 / 9-9.45 / 15-15.4
Soil Description	CLAY: trace sand, brown red mottled grey/brown

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	99	
2.36mm	99	
1.18mm	96	
600µm	94	
425µm	93	
300µm	92	
150µm	89	
75µm	86	

Comments

N/A

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Material Test Report

Report No: SYD2100021
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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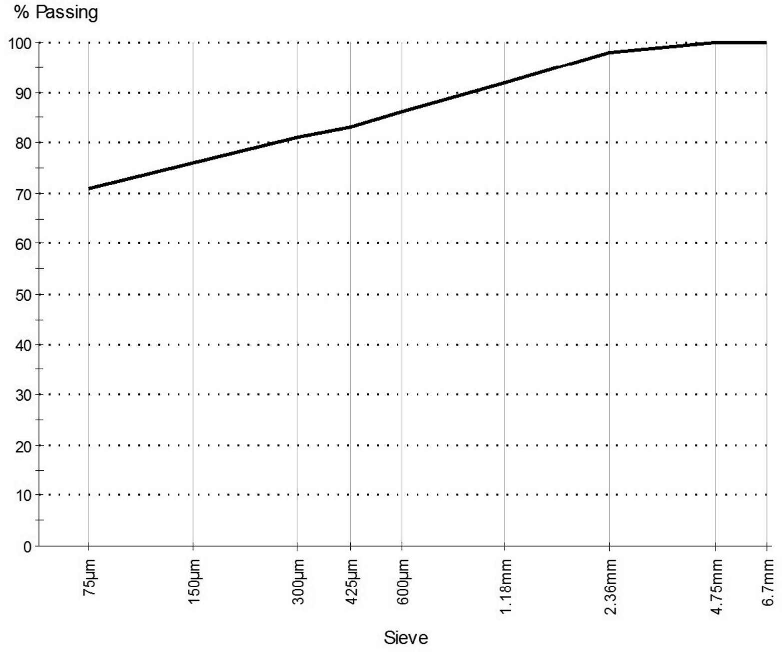
Sample Details

GHD Sample No	SYD21-0002-08
Date Sampled	28/11/2020
Sampled By	Sampled by GHD
BH / TP No.	BH05
Depth (m)	3.0 - 3.45 / 4.5 - 4.95
Soil Description	CLAY: with sand, trace gravel, brown/red/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	98	
1.18mm	92	
600µm	86	
425µm	83	
300µm	81	
150µm	76	
75µm	71	

Comments

N/A

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Material Test Report

Report No: SYD2100022
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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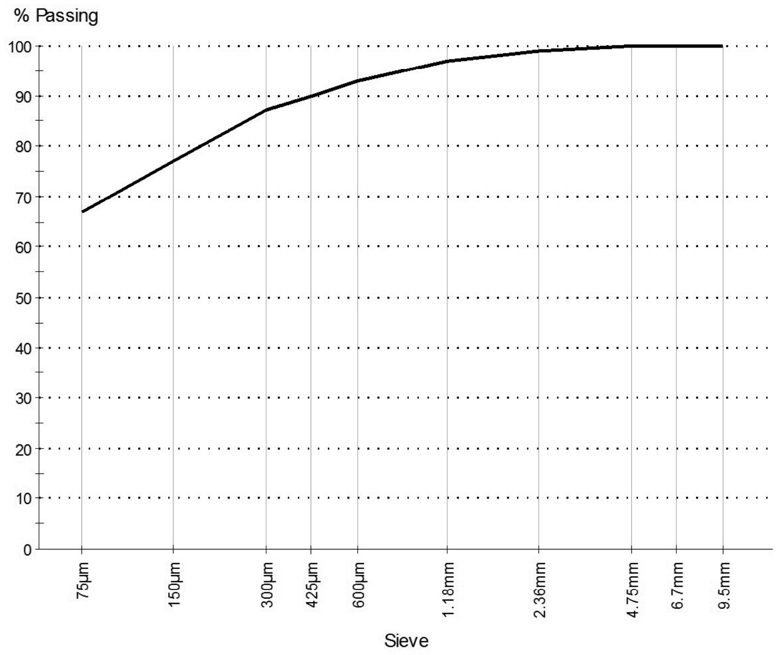
Sample Details

GHD Sample No	SYD21-0002-09
Date Sampled	28/11/2020
Sampled By	Sampled by GHD
BH / TP No.	BH05
Depth (m)	7.5, 10.5 & 16.5
Soil Description	Sandy CLAY: trace gravel, brown/red/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	97	
600µm	93	
425µm	90	
300µm	87	
150µm	77	
75µm	67	

Comments

Combined sample BH05 (7.50-7.95m, 10.5-10.95m and 16.5-16.95m)

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Material Test Report

Report No: SYD2100023
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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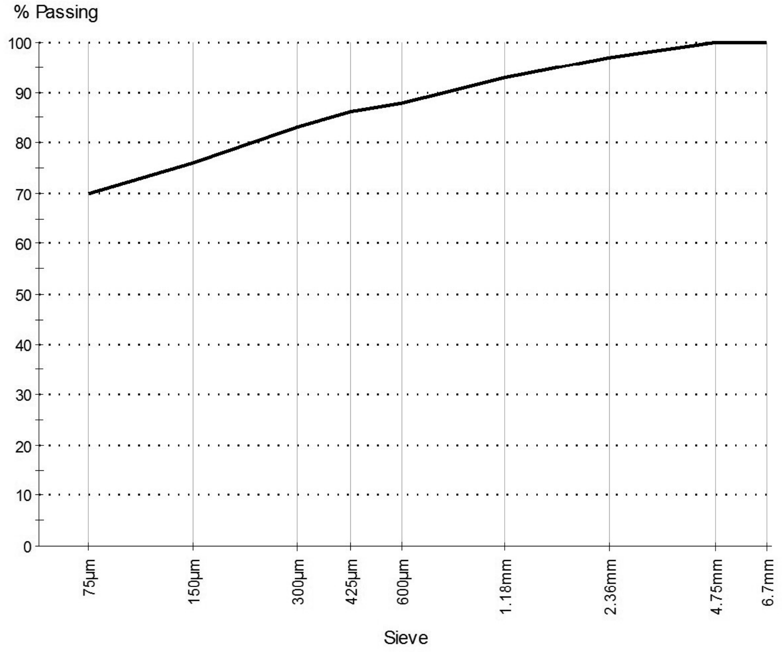
Sample Details

GHD Sample No	SYD21-0002-10
Date Sampled	29/11/2020
Sampled By	Sampled by GHD
BH / TP No.	BH06
Depth (m)	1.5 - 1.95 / 3.0 - 3.45
Soil Description	CLAY: with sand, trace gravel, pale grey/brown

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	97	
1.18mm	93	
600µm	88	
425µm	86	
300µm	83	
150µm	76	
75µm	70	

Comments

N/A

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Material Test Report

Report No: SYD2100024
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

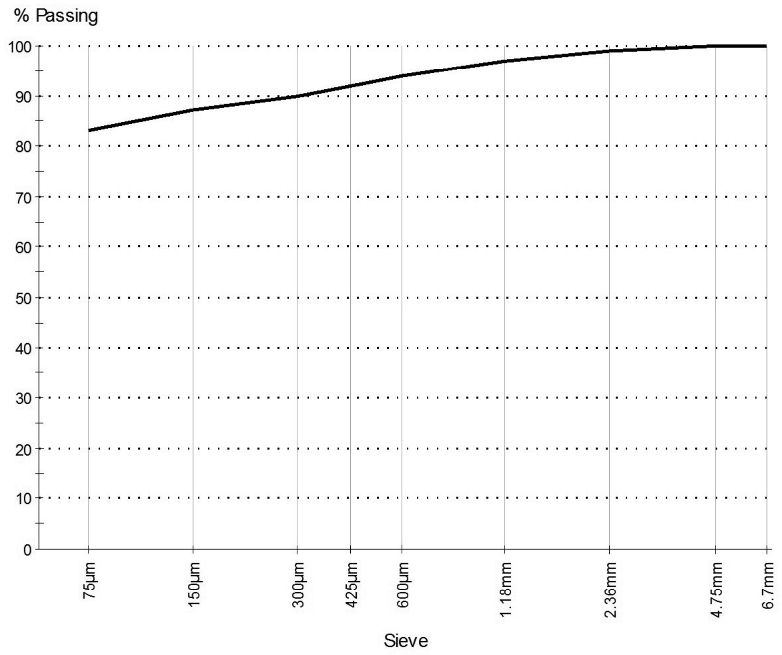
Sample Details

GHD Sample No	SYD21-0002-11
Date Sampled	29/11/2020
Sampled By	Sampled by GHD
BH / TP No.	BH06
Depth (m)	10.7, 12.0 & 13.5
Soil Description	CLAY: with sand, trace gravel, pale grey/brown

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	97	
600µm	94	
425µm	92	
300µm	90	
150µm	87	
75µm	83	

Comments

Comined sample BH06 (10.7-11.15m, 12.0-12.45m and 13.5-13.95m)

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Material Test Report

Report No: SYD2100025
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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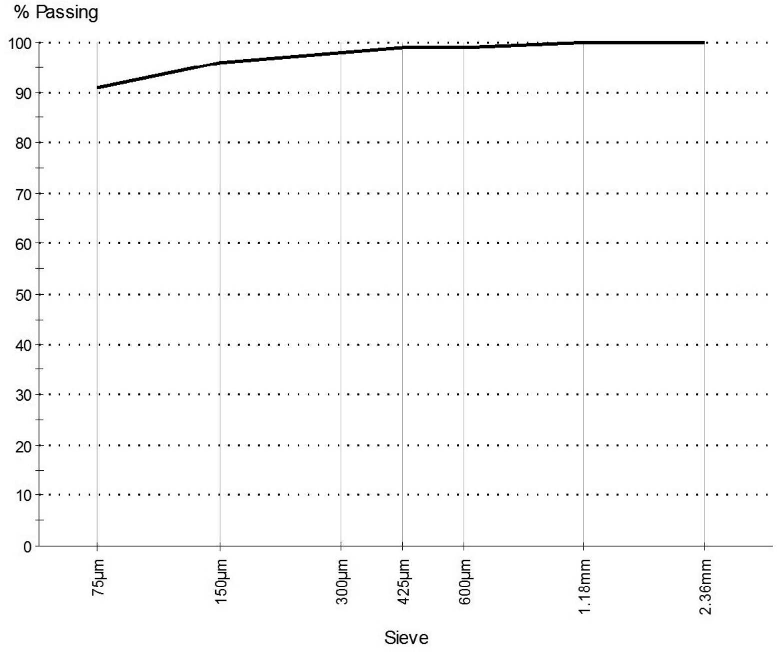
Sample Details

GHD Sample No	SYD21-0002-12
Date Sampled	02/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH07
Depth (m)	4.5 - 4.95 / 6.0 - 6.45
Soil Description	CLAY: trace sand, grey mottled brown/red

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	99	
425µm	99	
300µm	98	
150µm	96	
75µm	91	

Comments

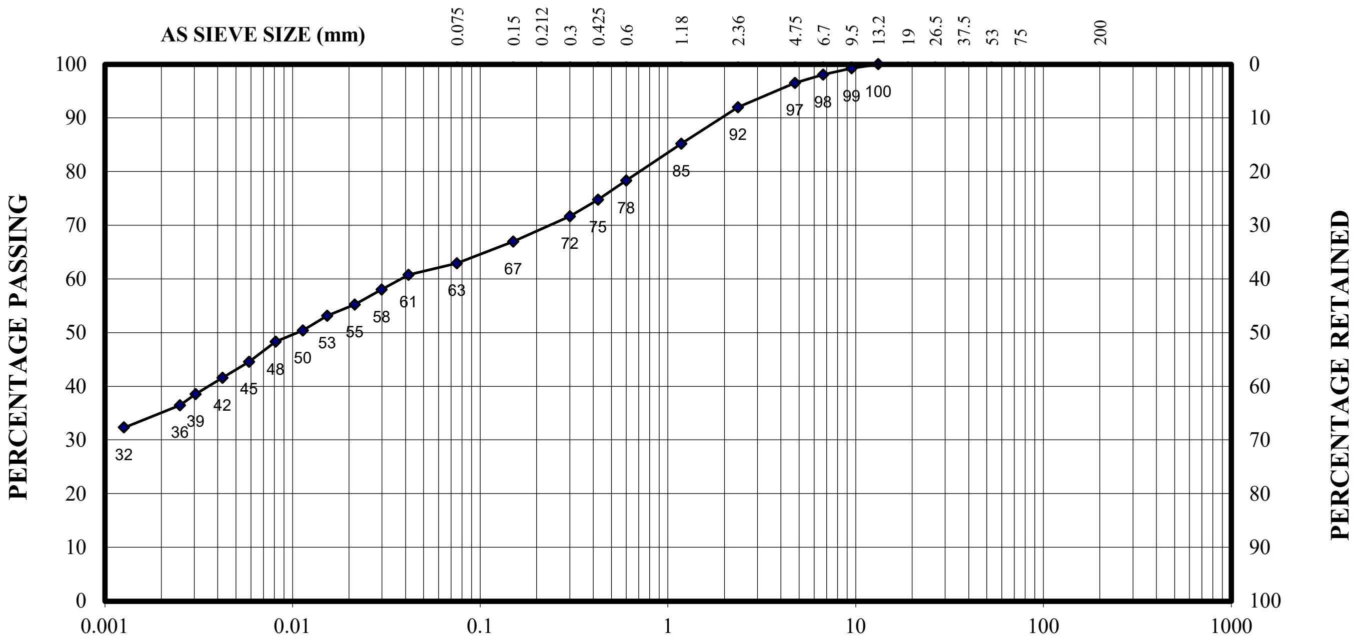
N/A

SOIL CLASSIFICATION REPORT

Trial Hole:	BH07
Depth (m):	13.5 / 16.5 / 19.5
Sample No:	SYD21-0003-01

Client: Tomingley Gold Operations
Project: RSF 2 GI
Location: Tomingley, NSW

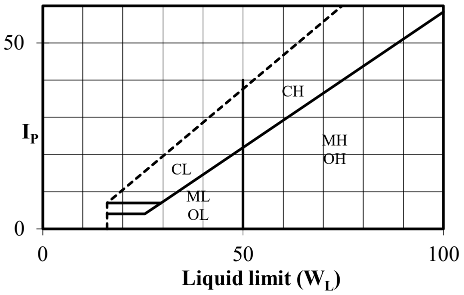
Client Sample No.: n/a
Sample History: Sampled by GHD



CLAY	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse		

0.002 0.006 0.02 0.075 0.2 0.6 2.36 6 20 63 200

PARTICLE SIZE (mm)



TEST METHODS
Particle size AS1289.3.6.3

OTHER TESTS AS1289.2.1.1 AS1289.3.1.1
AS1289.3.5.1

GRADING
$C_u = D_{60} / D_{10} =$ not determinable
$C_c = D_{30}^2 / (D_{10} \times D_{60}) =$ not determinable

PARTICLE DENSITY 2.66 (assumed)

PRE-TREATMENT HYDROMETER N/A

TEST CONDITION Washed sieve with dispersing agent

GROUP SYMBOL:

SOIL NAME: Sandy CLAY; grey/brown red trace gravel

INDEX PROPERTIES (%)

Liquid Limit =	N/A	Plastic Limit =	N/A
Plasticity Index =	N/A	Linear Shrinkage % =	Not determined

Atterberg Limits (History/Preparation)

Liquid Limit (type of test)

Linear Shrinkage (mould size)

REMARKS: Combined sample BH07 (13.5-13.95m, 16.5-16.95m and 19.5-19.95m)

Tested by:	DW
Date tested:	06.01.21
Checked by:	GV
Date checked:	18/01/2021

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Approved Signatory:

J.G.Vukovic 19/01/2021

Accredited for compliance with ISO/IEC 17025 - Testing

Laboratory Accreditation Number - 679

JOB No.	**12538404**
REPORT No.	**SYD2100026**

Ref: Document F9.1.16 issue 1.2

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Material Test Report

Report No: SYD2100027
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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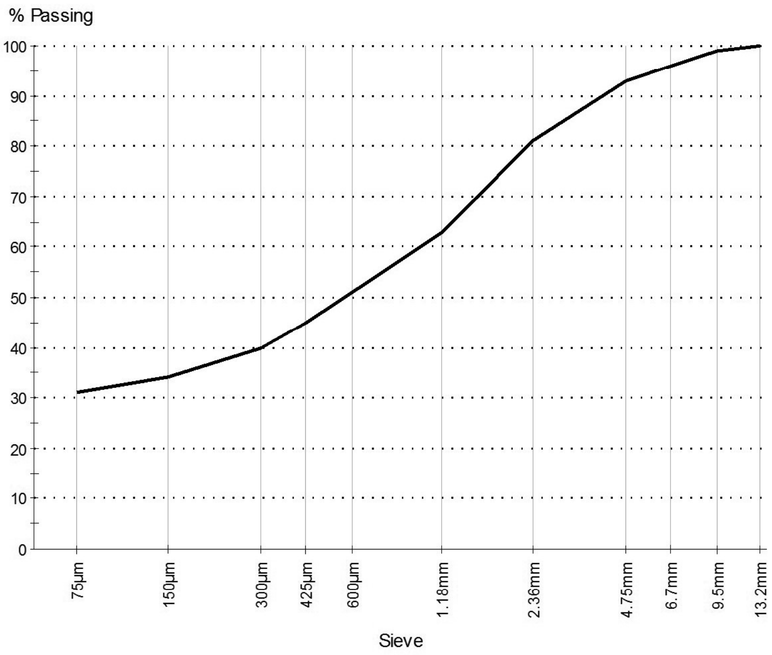
Sample Details

GHD Sample No	SYD21-0003-02
Date Sampled	03/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH08
Depth (m)	1.5 - 1.95 / 3.0 - 3.45
Soil Description	Clayey SAND: with gravel, brown/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	99	
6.7mm	96	
4.75mm	93	
2.36mm	81	
1.18mm	63	
600µm	51	
425µm	45	
300µm	40	
150µm	34	
75µm	31	

Comments

N/A

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web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
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Material Test Report

Report No: SYD2100028
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

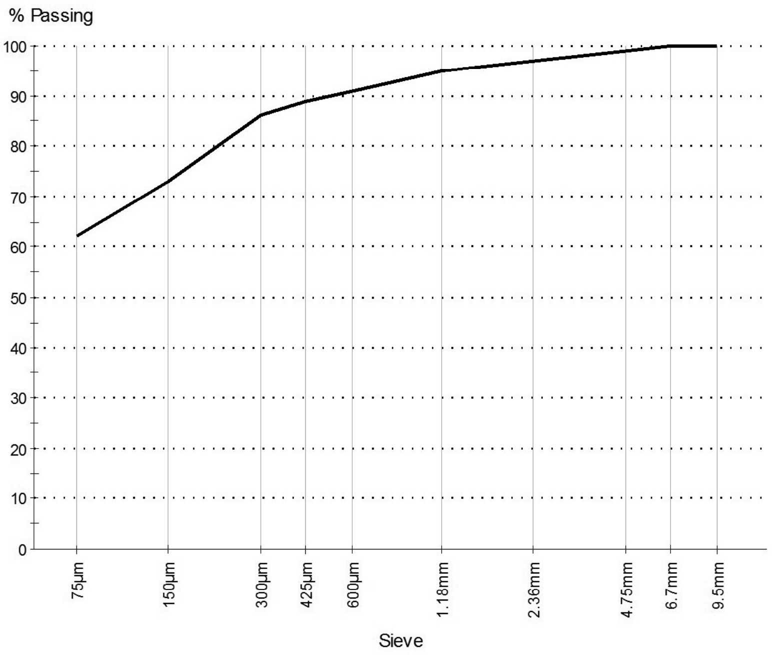
Sample Details

GHD Sample No	SYD21-0003-03
Date Sampled	03/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH08
Depth (m)	7.5 - 7.95
Soil Description	Sandy CLAY: trace gravel, red brown/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	99	
2.36mm	97	
1.18mm	95	
600µm	91	
425µm	89	
300µm	86	
150µm	73	
75µm	62	

Comments

N/A

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Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100029
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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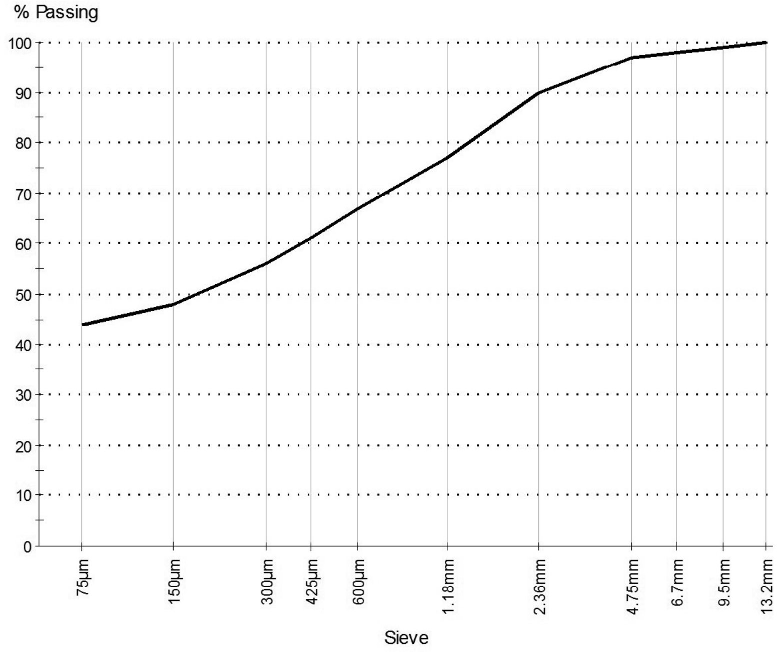
Sample Details

GHD Sample No	SYD21-0003-04
Date Sampled	04/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH09
Depth (m)	1.5, 3.0, 4.5 & 6.0
Soil Description	Sandy CLAY: trace gravel, brown/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	99	
6.7mm	98	
4.75mm	97	
2.36mm	90	
1.18mm	77	
600µm	67	
425µm	61	
300µm	56	
150µm	48	
75µm	44	

Comments

Combined sample BH09 (1.5-1.95, 3.0-3.95, 4.5-4.95 and 6.0-6.45m)

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100030
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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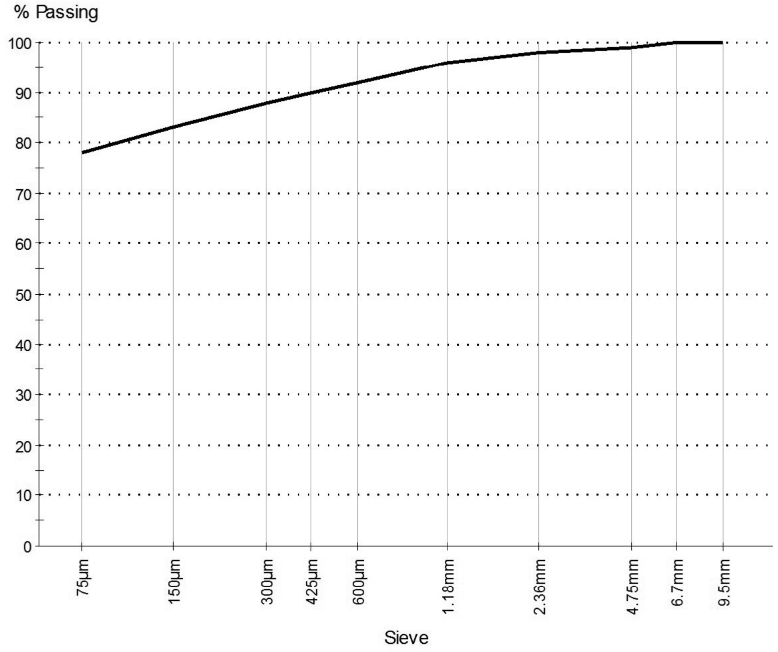
Sample Details

GHD Sample No	SYD21-0003-05
Date Sampled	04/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH09
Depth (m)	15.0, 18.0 & 19.5
Soil Description	CLAY: with sand, trace gravel, brown/grey/red

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	99	
2.36mm	98	
1.18mm	96	
600µm	92	
425µm	90	
300µm	88	
150µm	83	
75µm	78	

Comments

Combined sample BH09 (15.0-15.95, 18.0-18.95 and 19.5-19.95m)

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100031
Issue No: 1

Client:	Tomingley Gold Operations Pty Ltd RSF 2 GI Tomingley NSW
Project:	12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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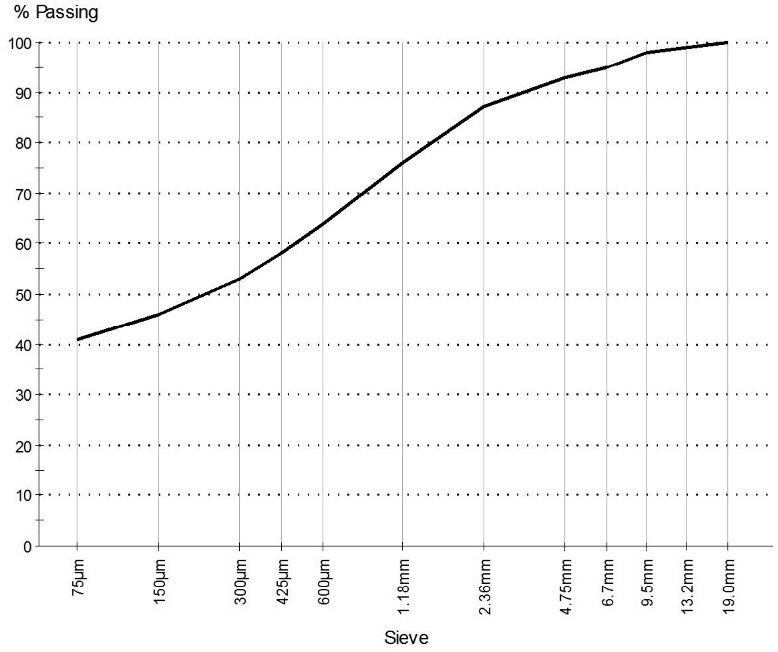
Sample Details

GHD Sample No	SYD21-0003-06
Date Sampled	04/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH10
Depth (m)	1.5, 3.0, 6.0 & 9.0
Soil Description	Sandy CLAY: trace gravel, brown/red/grey

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	99	
9.5mm	98	
6.7mm	95	
4.75mm	93	
2.36mm	87	
1.18mm	76	
600µm	64	
425µm	58	
300µm	53	
150µm	46	
75µm	41	

Comments

Combined sample BH10 (1.5-1.95, 3.0-3.45, 6.0-6.45 and 9.0-9.45m)

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
email: artarmon@ghd.com.au
web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
Fax:(02) 9462 4710

Material Test Report

Report No: SYD2100032
Issue No: 1

Client: Tomingley Gold Operations Pty Ltd
RSF 2 GI
Tomingley NSW

Project: 12538404

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accreditation No: 679

Approved Signatory: Jure G Vukovic

Date of Issue: 18/01/2021

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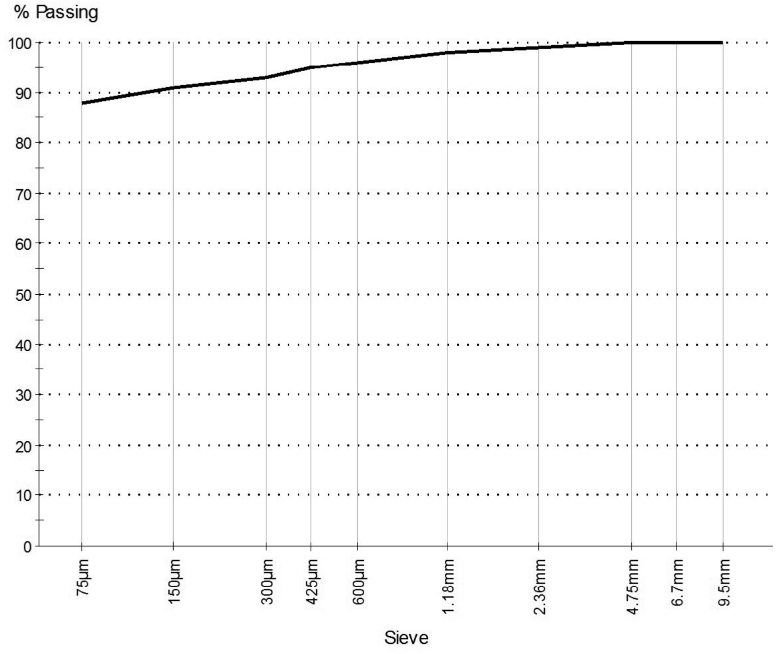
Sample Details

GHD Sample No	SYD21-0003-07
Date Sampled	04/12/2020
Sampled By	Sampled by GHD
BH / TP No.	BH10
Depth (m)	13.5, 15.0 & 18.0
Soil Description	CLAY: trace sand & gravel (silt); pale brown/pale grey/red

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution



Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 5/01/2021

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	98	
600µm	96	
425µm	95	
300µm	93	
150µm	91	
75µm	88	

Comments

Combined sample BH10 (13.5-13.45, 15.0-15.45 and 18.0-18.45m)

TEST CERTIFICATE

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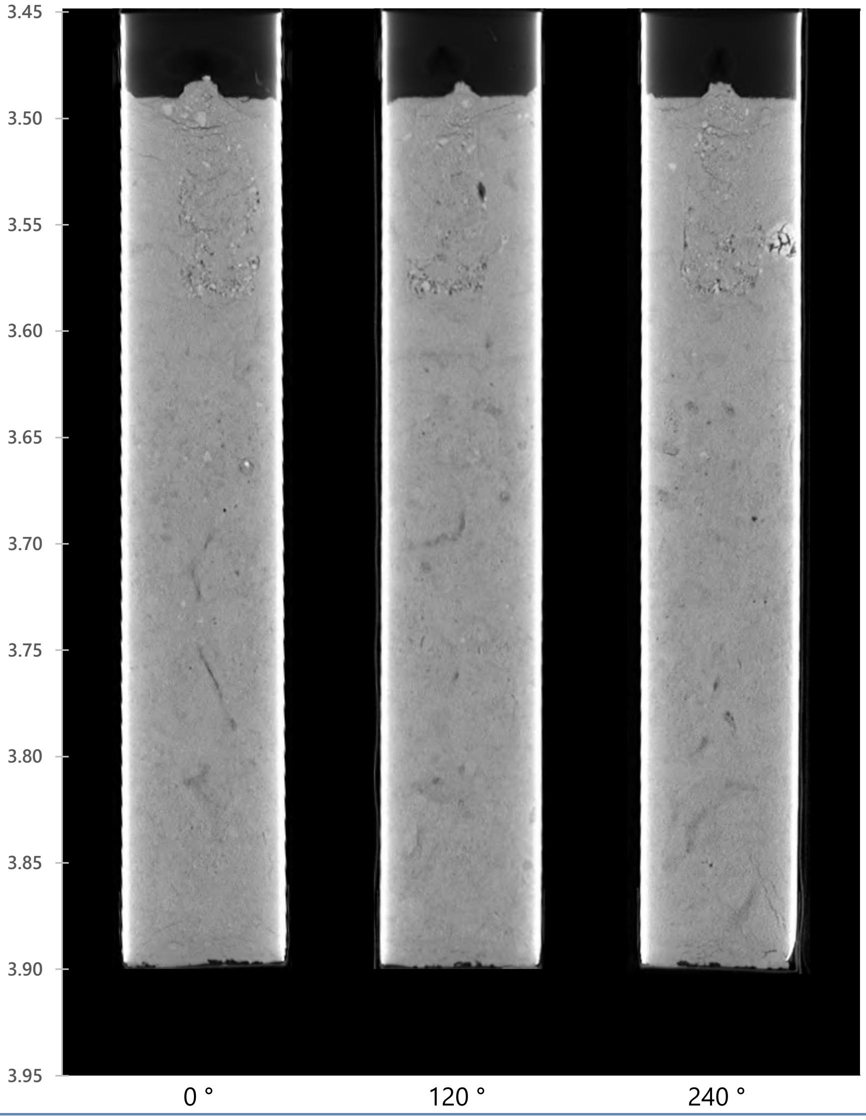
Imaging Performed By: Capital Radiology, Claremont, WA, 6010

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-001
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Tube Length [m]:	0.45	**Depth:**	3.50 m to 3.90 m



Comments:

Figure A - 1

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

Cert. No.:	LAB184106_2021-001-001_XCT_XCT01(00)	**Approved Signatory:**
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		R. Calvert

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

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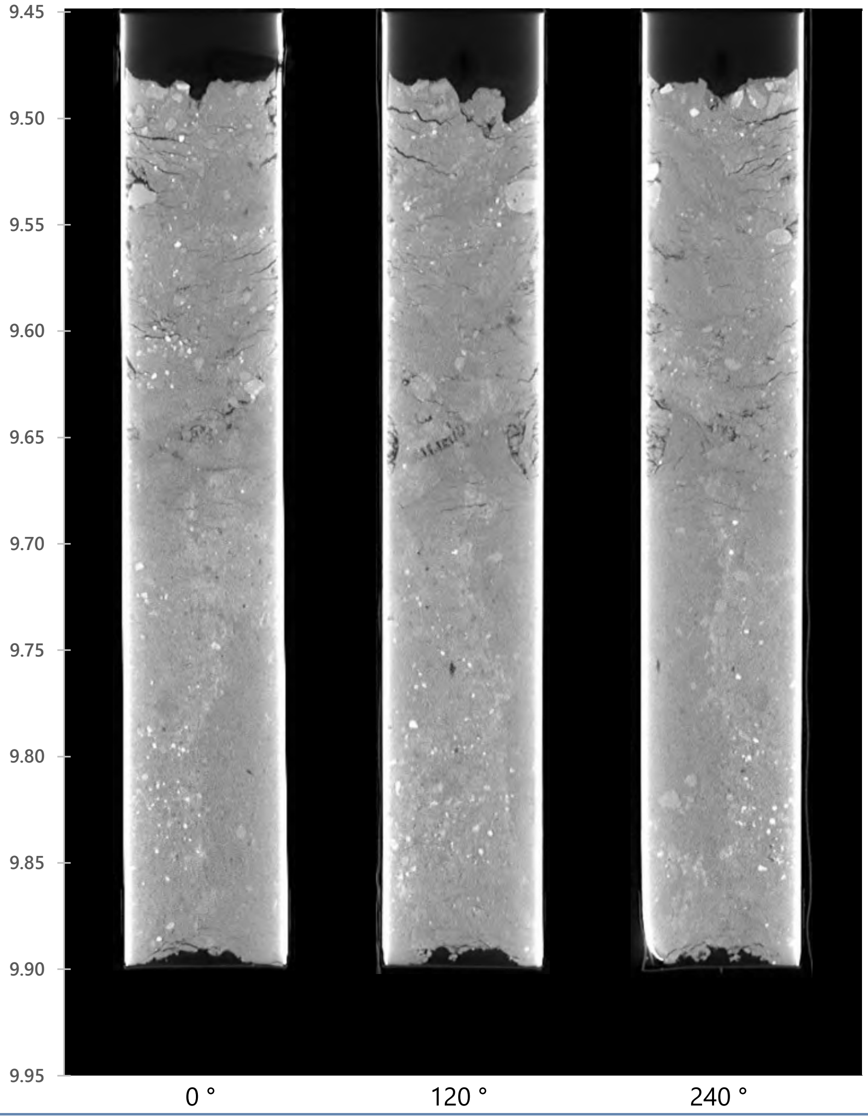
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-002
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_03
Tube Length [m]:	0.45	**Depth:**	9.50 m to 9.90 m



Comments:

Figure A - 2

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Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-003
		Borehole ID:	BH02
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Tube Length [m]:	0.45	**Depth:**	5.00 m to 5.30 m

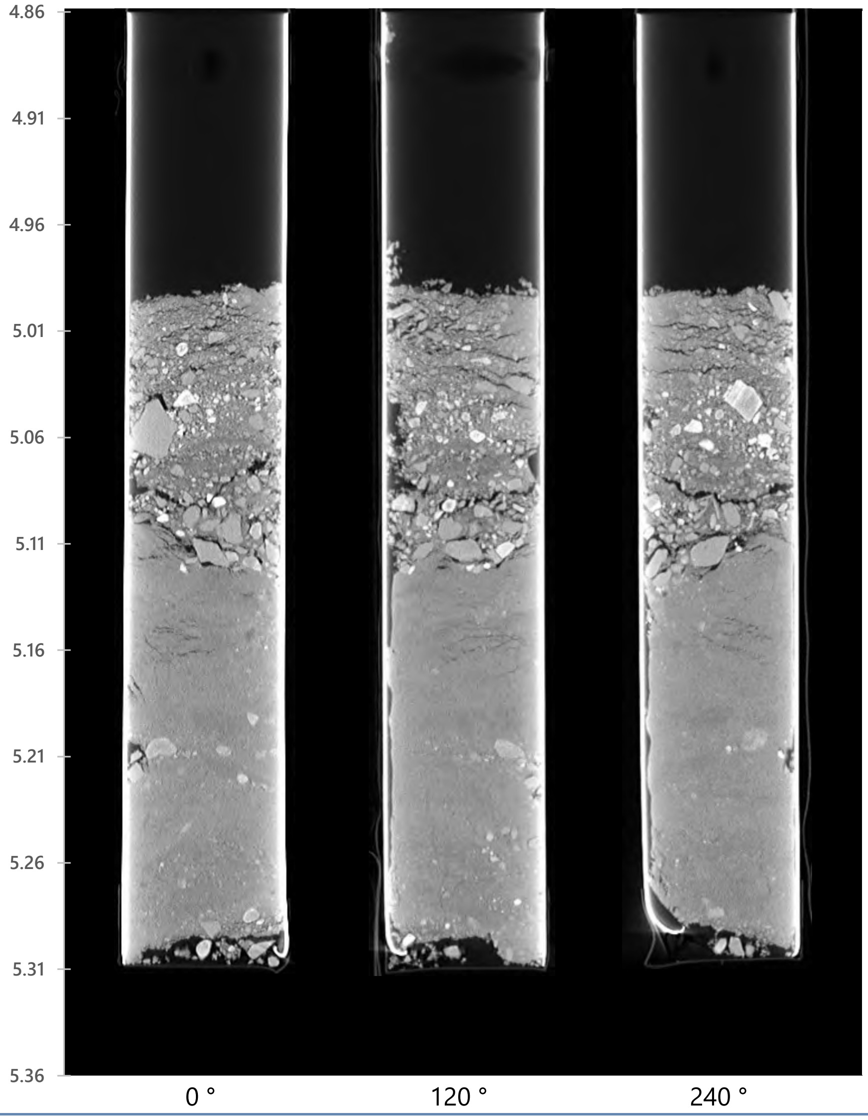

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Figure A - 3

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

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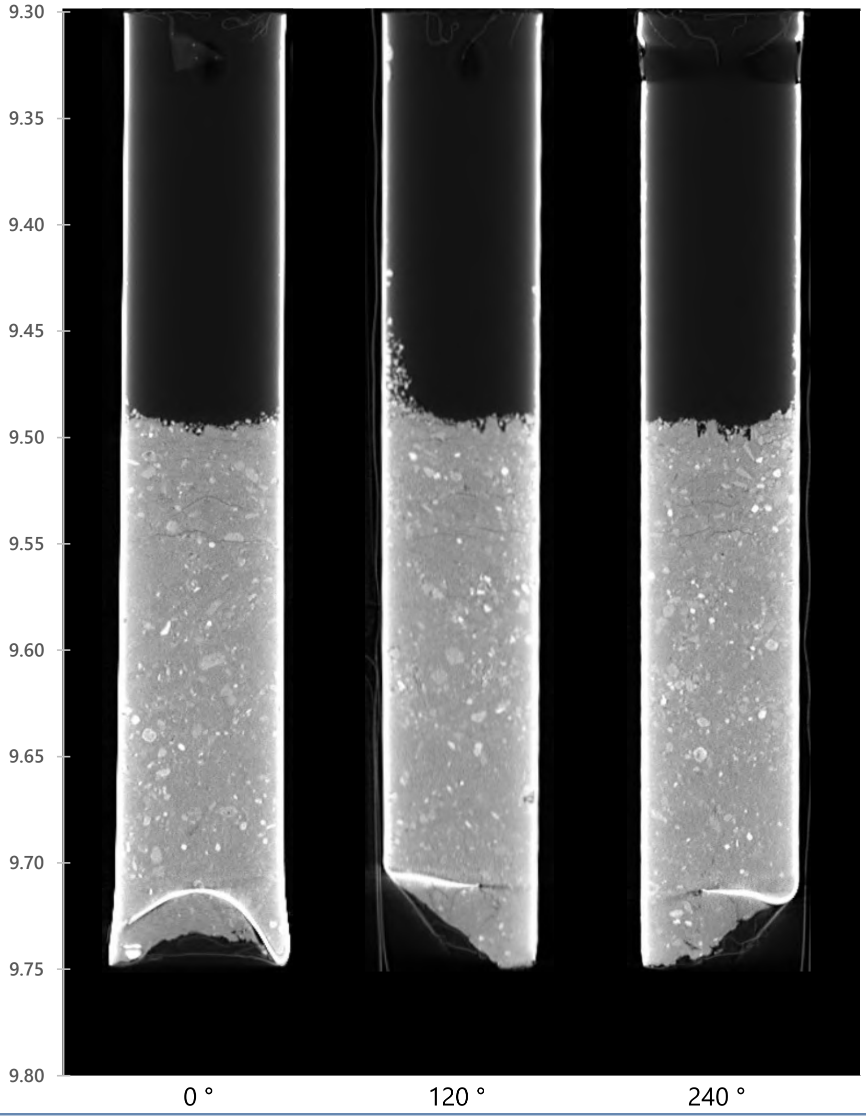
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-004
		Borehole ID:	BH04
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Tube Length [m]:	0.45	**Depth:**	9.50 m to 9.70 m



Comments:

Figure A - 4

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

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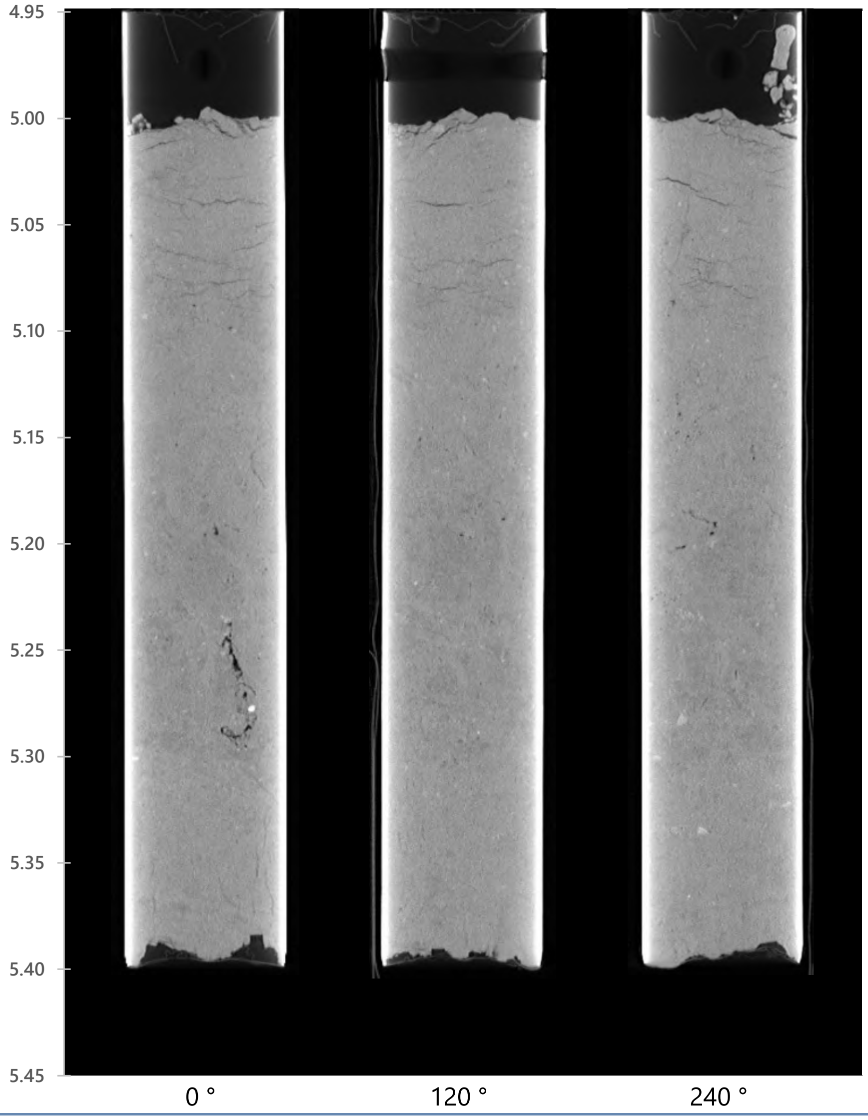
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-005
		Borehole ID:	BH05
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Tube Length [m]:	0.45	**Depth:**	5.00 m to 5.40 m



Comments:

Figure A - 5

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

Cert. No.:	LAB184106_2021-001-005_XCT_XCT01(00)	**Approved Signatory:**
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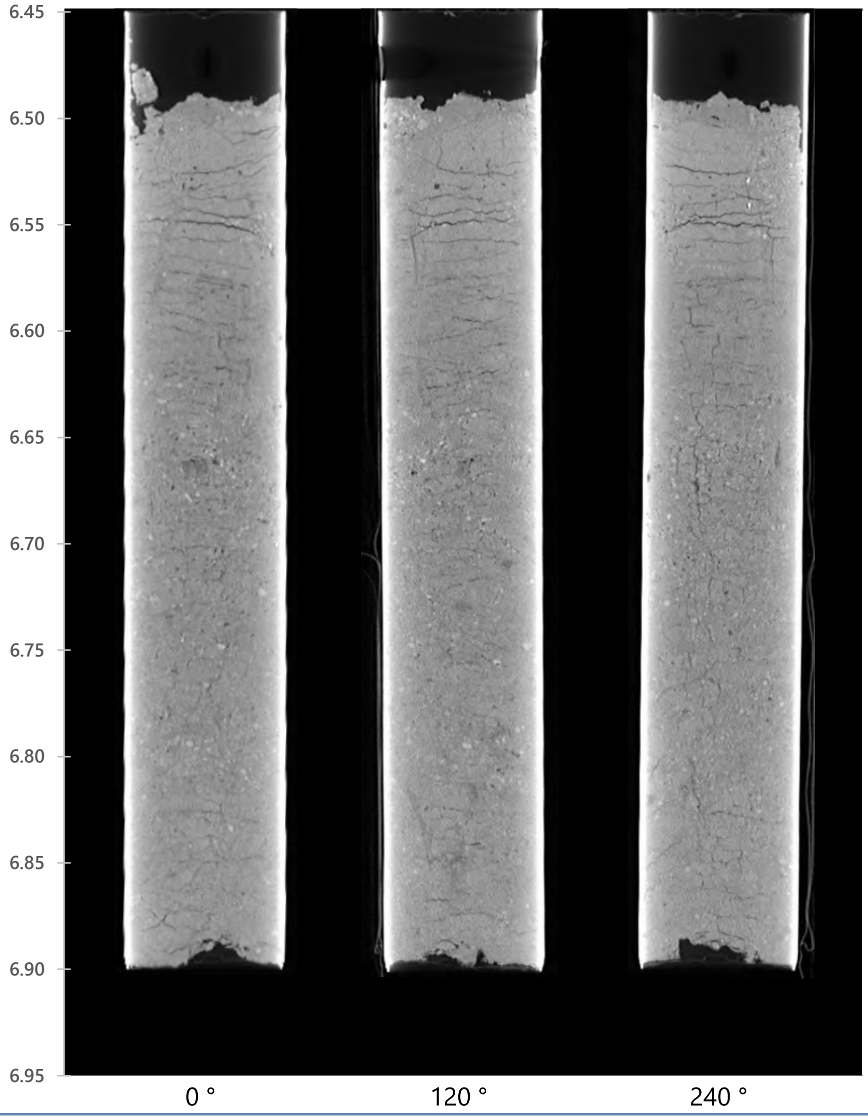
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-006
		Borehole ID:	BH06
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Tube Length [m]:	0.45	**Depth:**	6.50 m to 6.90 m



Comments:

Figure A - 6

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

Cert. No.:	LAB184106_2021-001-006_XCT_XCT01(00)	**Approved Signatory:**
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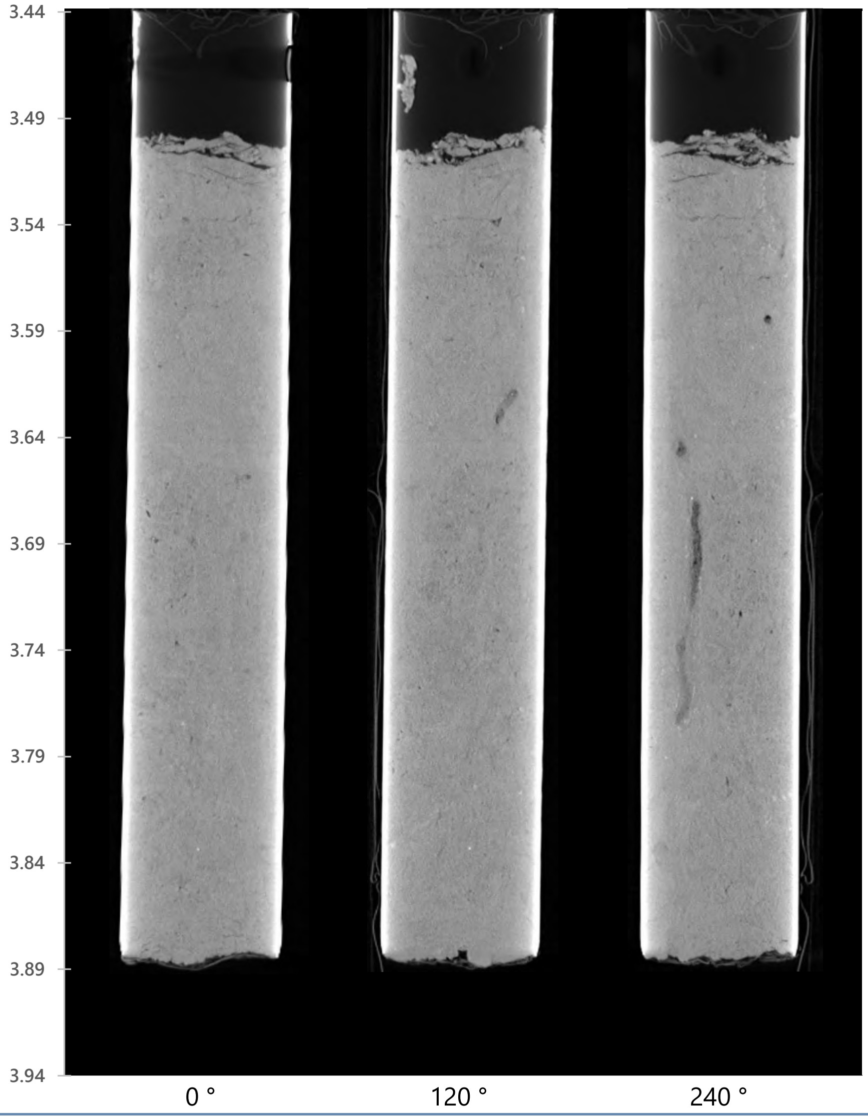
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-007
		Borehole ID:	BH07
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Tube Length [m]:	0.45	**Depth:**	3.50 m to 3.90 m



Comments:

Figure A - 7

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

Cert. No.:	LAB184106_2021-001-007_XCT_XCT01(00)	**Approved Signatory:**
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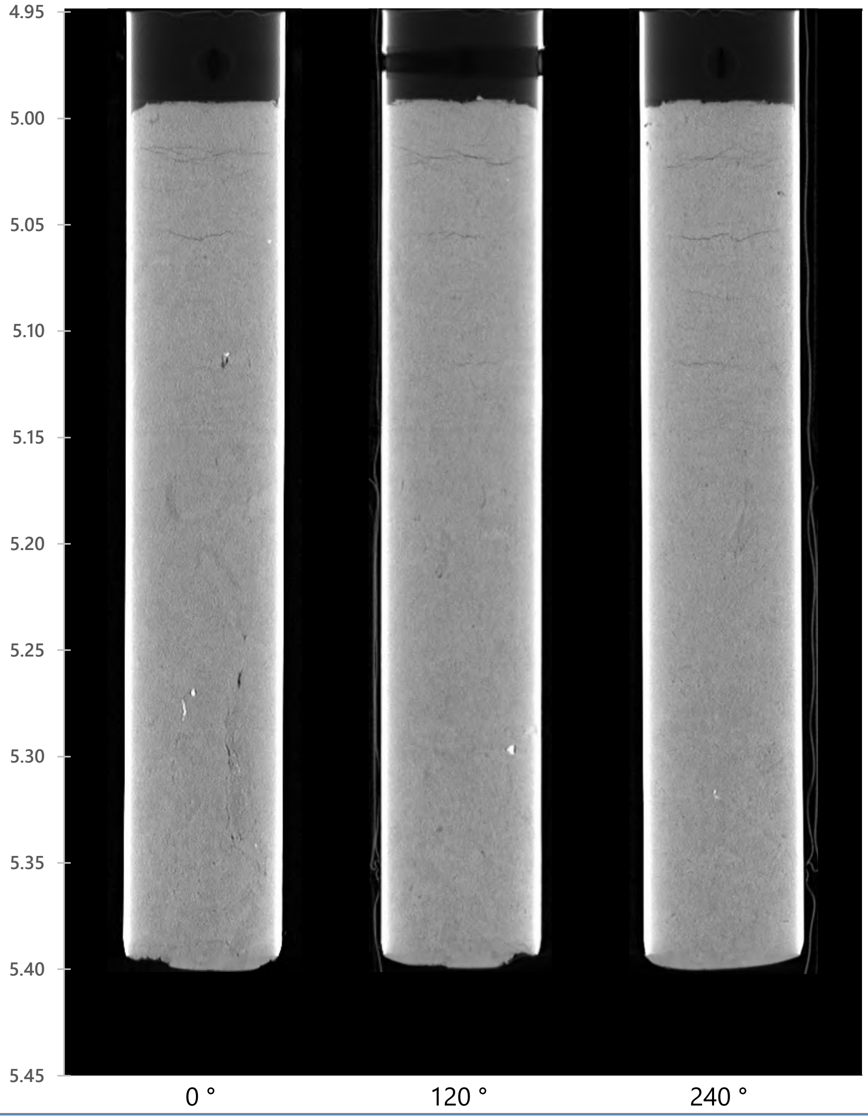
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-008
		Borehole ID:	BH08
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Tube Length [m]:	0.45	**Depth:**	5.00 m to 5.40 m



Comments:

Figure A - 8

Imaged by: Capital Radiology **Date Imaged:** 13/01/2021 **Reviewed by** RC **Date Reported:** 14/01/2021

Cert. No.:	LAB184106_2021-001-008_XCT_XCT01(00)	**Approved Signatory:**
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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

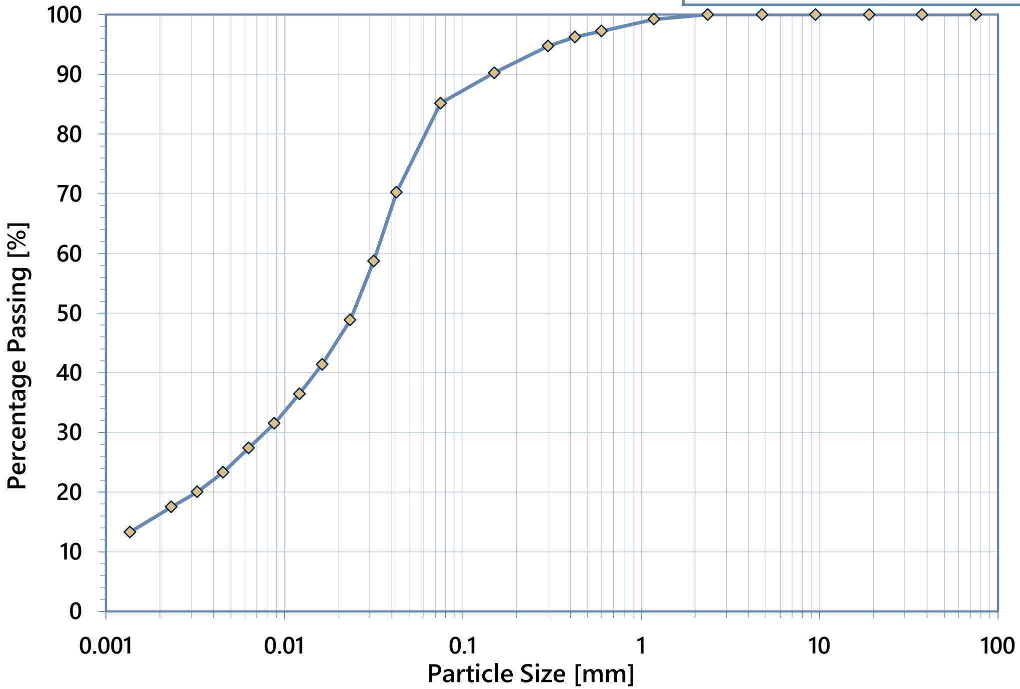
Test Method: AS1289.3.6.1 & AS1289.3.6.3

Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-011
Borehole ID: BH01
Project Location: Tomingley, NSW
Sample No.: U75_02
Method of Sample Preparation: As received post-triaxial testing
Depth: 3.70 m to 3.89 m
Sample Description: Brownish yellow/grey CLAY with sand

Particle Density Used [g/cm^3]: 2.70



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	99	0.0425	70	0.0063	27
37.5	100	0.600	97	0.0316	59	0.0045	23
19.0	100	0.425	96	0.0233	49	0.0032	20
9.50	100	0.300	95	0.0163	41	0.0023	17
4.75	100	0.150	90	0.0121	36	0.0014	13
2.36	100	0.075	85	0.0088	32		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 1

Tested by: SL **Date tested:** 15/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-011_PSD_CL03(00)

Approved Signatory:

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TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

Test Method: AS1289.3.6.1 & AS1289.3.6.3

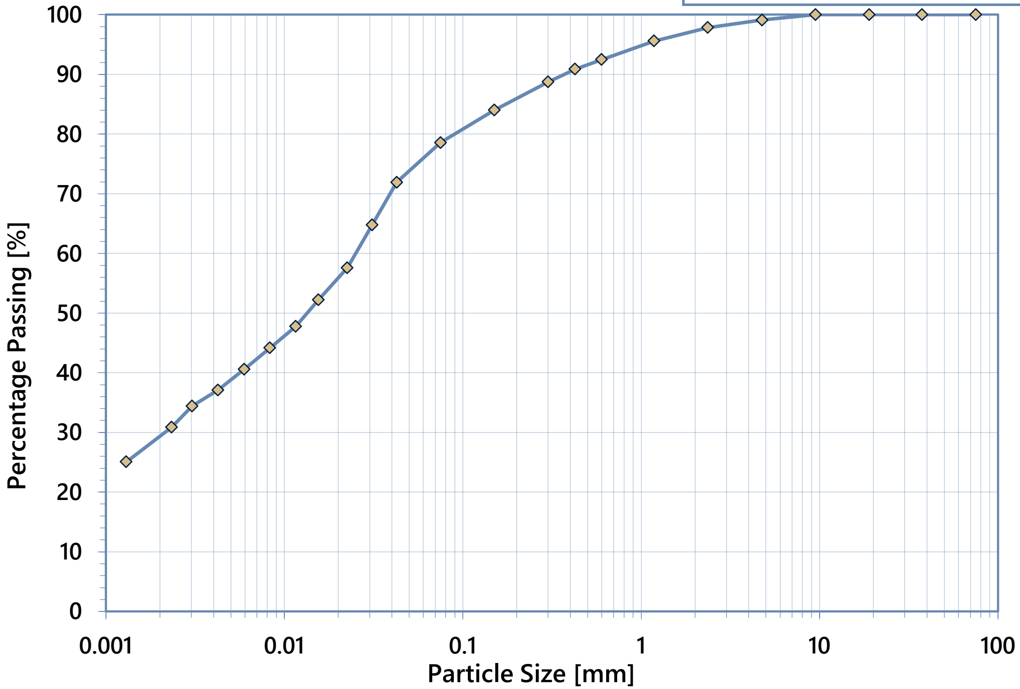
Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW
Method of Sample Preparation: As received post-triaxial testing
Sample Description: Light brownish grey CLAY with sand

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: 2021-001-015
Borehole ID: BH01
Sample No.: U75_03
Depth: 9.68 m to 9.84 m

Particle Density Used [g/cm^3]: 2.75



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	96	0.0426	72	0.0059	41
37.5	100	0.600	92	0.0310	65	0.0043	37
19.0	100	0.425	91	0.0225	58	0.0030	34
9.50	100	0.300	89	0.0155	52	0.0023	31
4.75	99	0.150	84	0.0115	48	0.0013	25
2.36	98	0.075	79	0.0083	44		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 2

Tested by: SL/ARC **Date tested:** 08/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-015_PSD_CL03(00)

Approved Signatory:

R. Calvert

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TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

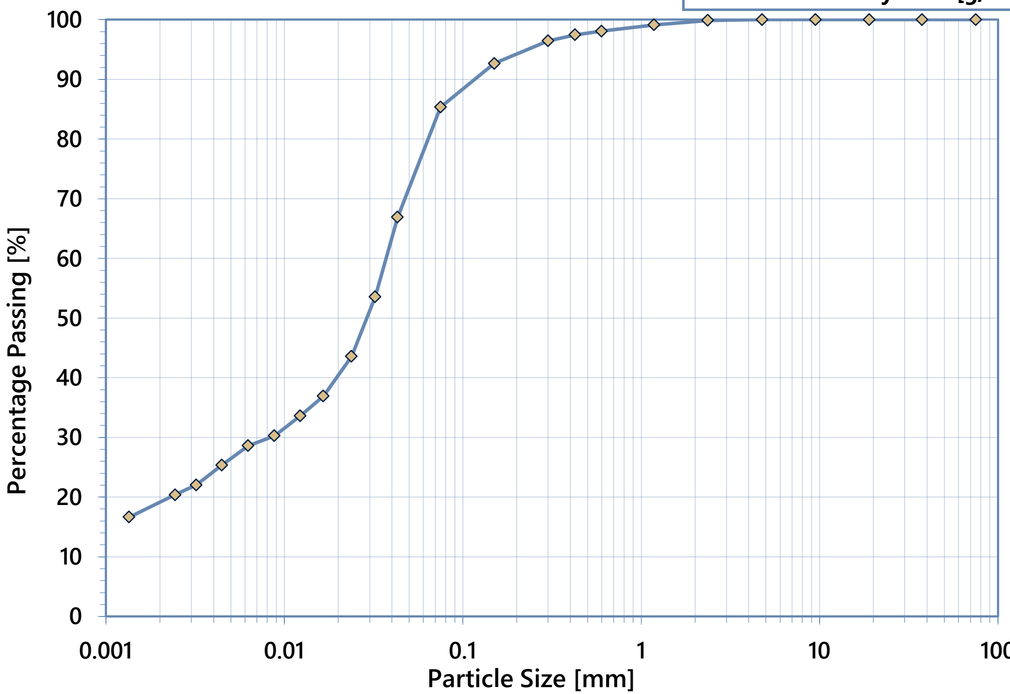
Test Method: AS1289.3.6.1 & AS1289.3.6.3

Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-019
Borehole ID: BH05
Project Location: Tomingley, NSW
Sample No.: U75_01
Method of Sample Preparation: As received post-triaxial testing
Depth: 5.06 m to 5.22 m
Sample Description: Brownish yellow/yellow/grey CLAY with sand

Particle Density Used [g/cm^3]: 2.71



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	99	0.0431	67	0.0062	29
37.5	100	0.600	98	0.0322	54	0.0045	25
19.0	100	0.425	97	0.0237	44	0.0032	22
9.50	100	0.300	96	0.0165	37	0.0024	20
4.75	100	0.150	93	0.0122	34	0.0013	17
2.36	100	0.075	85	0.0088	30		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 3

Tested by: SL **Date tested:** 08/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-019_PSD_CL03(00)

Approved Signatory:

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R. Calvert

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

Test Method: AS1289.3.6.1 & AS1289.3.6.3

Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd

Client Address: 2 Salamanca Square, Hobart, Tasmania 7000

Job No.: LAB184106

IPO No.: 2021-001

Project Name: TGO RSF 2 Geotechnical Investigation

Lab Sample ID: 2021-001-025

Borehole ID: BH06

Project Location: Tomingley, NSW

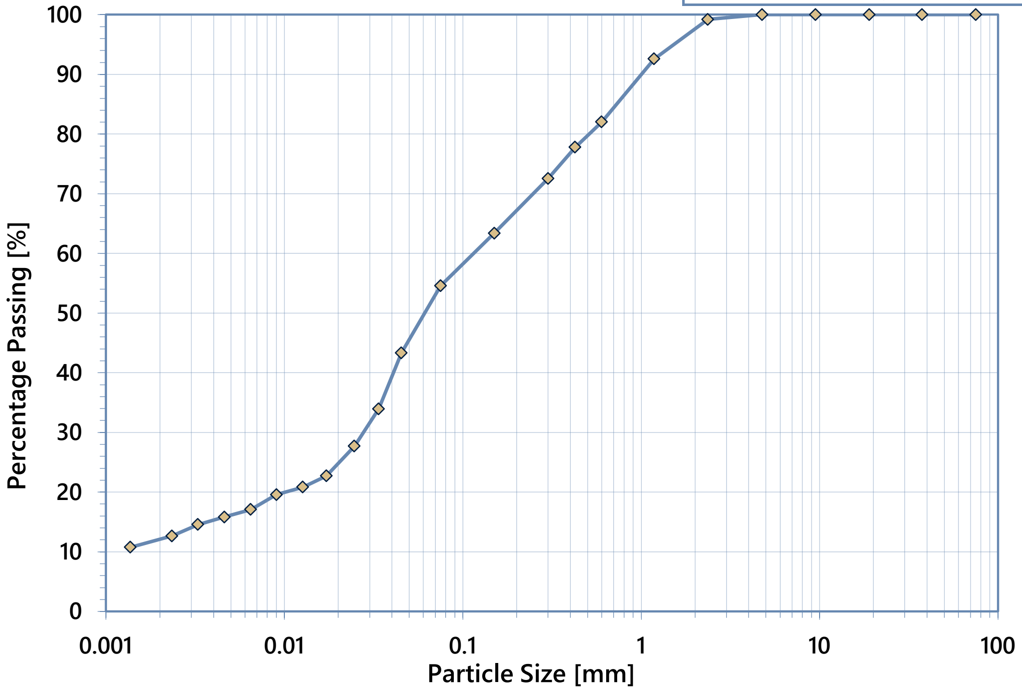
Sample No.: U75_02

Method of Sample Preparation: As received post-triaxial testing

Depth: 6.65 m to 6.84 m

Sample Description: Brownish yellow sandy CLAY

Particle Density Used [g/cm^3]: 2.68



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	93	0.0453	43	0.0065	17
37.5	100	0.600	82	0.0337	34	0.0046	16
19.0	100	0.425	78	0.0246	28	0.0033	15
9.50	100	0.300	73	0.0172	23	0.0023	13
4.75	100	0.150	63	0.0127	21	0.0014	11
2.36	99	0.075	55	0.0090	20		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 4

Tested by: SL **Date tested:** 15/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-025_PSD_CL03(00)

Approved Signatory:

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TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

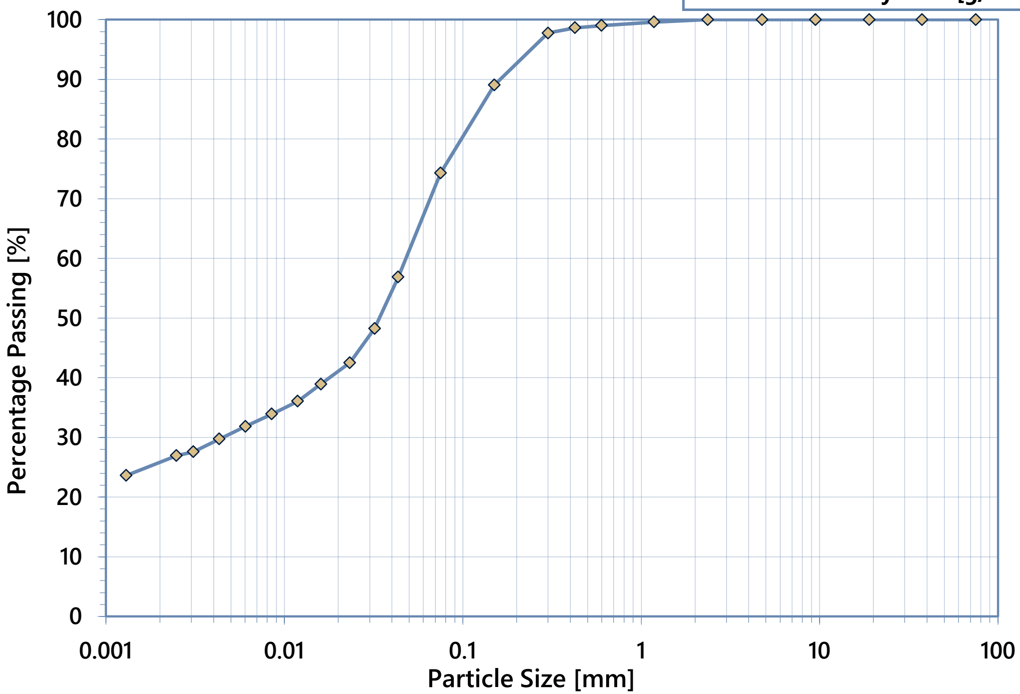
Test Method: AS1289.3.6.1 & AS1289.3.6.3

Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-029
Borehole ID: BH07
Project Location: Tomingley, NSW
Sample No.: U75_01
Method of Sample Preparation: As received post-triaxial testing
Depth: 3.52 m to 3.71 m
Sample Description: Brownish yellow/grey CLAY with sand

Particle Density Used [g/cm^3]: 2.70



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	100	0.0434	57	0.0060	32
37.5	100	0.600	99	0.0320	48	0.0043	30
19.0	100	0.425	99	0.0233	43	0.0031	28
9.50	100	0.300	98	0.0160	39	0.0025	27
4.75	100	0.150	89	0.0119	36	0.0013	24
2.36	100	0.075	74	0.0085	34		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 5

Tested by: SL/ARC **Date tested:** 22/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-029_PSD_CL03(00)

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TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

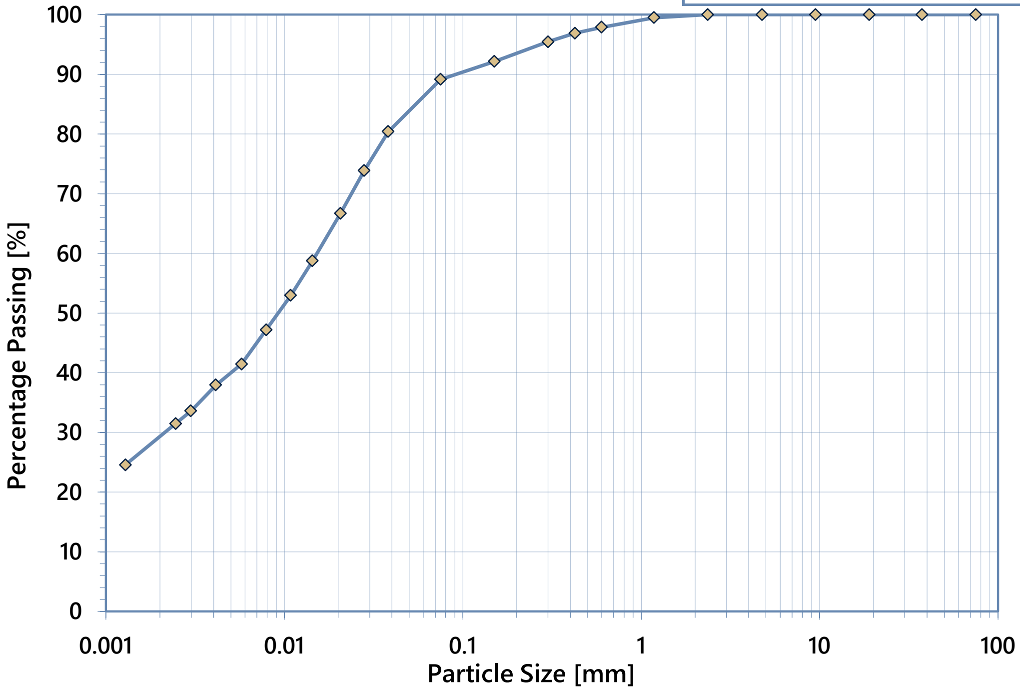
Test Method: AS1289.3.6.1 & AS1289.3.6.3

Sieving and Hydrometer Analysis

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-035
Borehole ID: BH08
Project Location: Tomingley, NSW
Sample No.: U75_01
Method of Sample Preparation: As received post-triaxial testing
Depth: 5.16 m to 5.35 m
Sample Description: Brownish yellow/grey CLAY trace sand

Particle Density Used [g/cm^3]: 2.71



Sieve Analysis				Hydrometer Analysis			
Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing	Particle Size [mm]	% passing
75.0	100	1.18	100	0.0382	80	0.0057	41
37.5	100	0.600	98	0.0280	74	0.0041	38
19.0	100	0.425	97	0.0206	67	0.0030	34
9.50	100	0.300	95	0.0144	59	0.0025	31
4.75	100	0.150	92	0.0108	53	0.0013	25
2.36	100	0.075	89	0.0079	47		

Comments: Hydrometer used: g/L, Sample dispered by mechanical stirring

Figure B.1 - 6

Tested by: SL/ARC **Date tested:** 19/02/2021 **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-035_PSD_CL03(00)

Approved Signatory:

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TEST CERTIFICATE

ATTERBERG LIMITS TEST

Test Method: AS1289.3.9.1, AS1289.3.2.1, AS1289.3.3.2 & AS1289.3.4.1

Cone Penetrometer Method

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: Refer to Table
Borehole ID: Refer to Table
Sample No.: Refer to Table
Depth: Refer to Table

Lab Sample ID	2021-001-012	2021-001-016	2021-001-020	2021-001-026	2021-001-030
Borehole ID	BH01	BH01	BH05	BH06	BH07
Sample No.	U75_02	U75_03	U75_01	U75_02	U75_01
Depth From [m]	3.70	9.68	5.03	6.65	3.52
Depth To [m]	3.89	9.87	5.22	6.84	3.71
Sample Description	Brownish yellow/grey CLAY with sand	Light brownish grey CLAY with sand	Brownish yellow/yellow/grey CLAY with sand	Brownish yellow sandy CLAY	Brownish yellow/grey CLAY with sand
Date Tested	24/02/2021	22/02/2021	23/02/2021	23/02/2021	25/02/2021
Cone Liquid Limit, w_{CL} [%]	48	54	34	28	44
Plastic Limit, w_P [%]	19	6	15	15	17
Cone Plasticity Index, I_{CP} [%]	29	48	19	13	27
Linear Shrinkage, *LS*	9.0	10.0	6.0	6.0	10.0
Mode	Curling and Cracking	Curling and Cracking	Flat with Cracking	Curling	Curling
Length of Mould [mm]	250	250	250	250	250
Type of Water Used	Potable	Potable	Potable	Potable	Potable

Comments: N.P. = Non-plastic, N.O. = Not Obtainable, N.D. = Not Determined
Method of preparation : Dry sieved, History of sample : Oven dried at 50°c
Sample 2021-001-016 was observed to contain air bubbles (gas) during testing

Figure B.2 - 1

Tested by: SL **Date tested:** Refer to Table **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-012 to 030_ATT_CL04(00)

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Approved Signatory:

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TEST CERTIFICATE

ATTERBERG LIMITS TEST

Test Method: AS1289.3.9.1, AS1289.3.2.1, AS1289.3.3.2 & AS1289.3.4.1

Cone Penetrometer Method

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: Refer to Table
Borehole ID: Refer to Table
Sample No.: Refer to Table
Depth: Refer to Table

Lab Sample ID	2021-001-036				
Borehole ID	BH08				
Sample No.	U75_01				
Depth From [m]	5.16				
Depth To [m]	5.35				
Sample Description	Brownish yellow/grey CLAY trace sand				
Date Tested	25/02/2021				
Cone Liquid Limit, w_{CL} [%]	43				
Plastic Limit, w_P [%]	17				
Cone Plasticity Index, I_{CP} [%]	26				
Linear Shrinkage, *LS*	11.5				
Mode	Curling and Cracking				
Length of Mould [mm]	250				
Type of Water Used	Potable				

Comments: N.P. = Non-plastic, N.O. = Not Obtainable, N.D. = Not Determined

Method of preparation : Dry sieved, History of sample : Oven dried at 50°c

Figure B.2 - 2

Tested by: SL **Date tested:** Refer to Table **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-036_ATT_CL04(00)

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TEST CERTIFICATE

SOIL PARTICLE DENSITY OF FRACTION PASSING THE 2.36 mm SIEVE

Test Method: AS1289.3.5.1

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: Refer to Table
Borehole ID: Refer to Table
Sample No.: Refer to Table
Depth: Refer to Table

Borehole ID	Sample No.	Lab Sample ID	Date Tested	Depth [m]		Soil Particle Density, ρ_f	Temperature of Test
				From	To	[g/cm^3]	[°C]
BH01	U75_02	2021-001-009	09/02/2021	3.51	3.70	2.68	24.1
BH01	U75_02	2021-001-013	18/02/2021	3.70	3.89	2.70	24.1
BH01	U75_03	2021-001-017	09/02/2021	9.68	9.87	2.75	24.1
BH05	U75_01	2021-001-021	09/02/2021	5.03	5.22	2.71	24.1
BH06	U75_02	2021-001-027	18/02/2021	6.65	6.84	2.68	24.1
BH07	U75_01	2021-001-031	22/02/2021	3.52	3.71	2.70	24.1
BH08	U75_01	2021-001-037	18/02/2021	5.16	5.35	2.71	24.1

Comments: Samples 2021-001-031 and 2021-001-037 were observed to swell significantly in the bottle following the addition of water and were also observed to produce bubbles (gas) whilst in the density bottle following testing.

Figure B.3 - 1

Tested by: SL/ARC **Date tested:** Refer to Table **Reviewed by** RC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-009 to 037_SG_CL06(00)

Approved Signatory:

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TEST CERTIFICATE

1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW
Sample Description: Mottled brown/grey silty clay trace sand

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: 2021-001-023
Borehole ID: BH05
Sample No.: -
Depth: 5.32 m to 5.35 m

Test Details:	
Test ID:	TGO-OED01
Soil Particle Density [t/m^3]:	2.71

Sample Details:	Initial	Final
Sample Diameter [mm]:	60.00	60.00
Sample Height [mm]:	22.14	21.54
Dry Density [t/m^3]:	1.73	1.79
Moisture Content [%]:	17.3 *	18.8

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage		σ_v	e	c_v	m_v	k
		kPa		m^2/year	m^2/kN	m/sec
Loading	1	40	0.527	-	4.9E-04	-
	2	100	0.513	34.0	1.6E-04	1.7E-09
	3	160	0.500	28.2	1.4E-04	1.3E-09
	4	250	0.485	27.7	1.1E-04	9.5E-10
	5	450	0.459	24.7	8.8E-05	6.8E-10
	6	600	0.445	20.5	6.1E-05	3.9E-10
	7	800	0.430	10.2	5.4E-05	1.7E-10
	8	1000	0.416	8.1	4.8E-05	1.2E-10
Unloading	9	800	0.416	-	-	-
	10	600	0.418	-	-	-

Comments:

Figure C1 Page 1

Tested by: BB **Date tested:** 02/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-023_CONS_OED01(00)

Approved Signatory:

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TEST CERTIFICATE

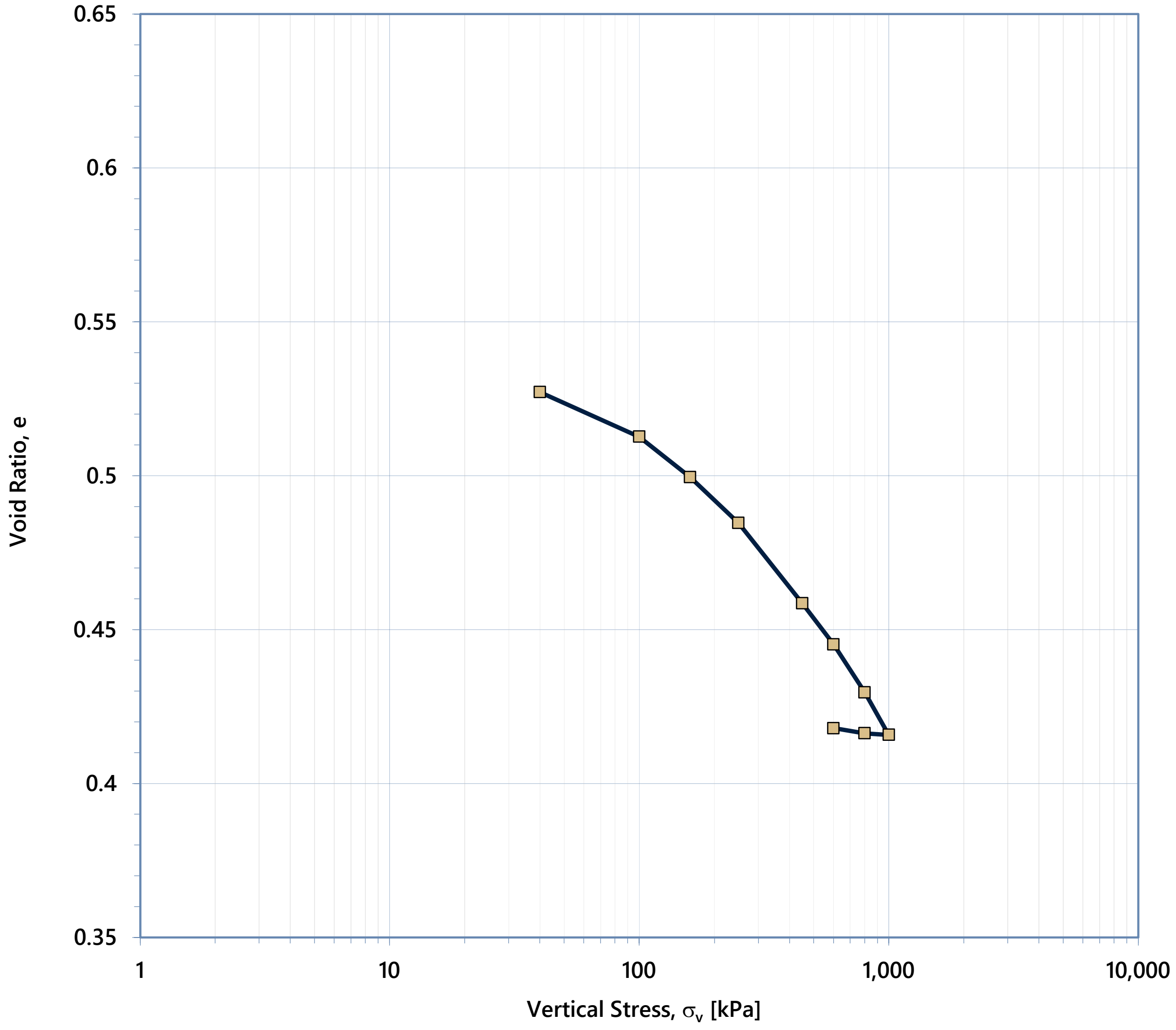
1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-023
		Borehole ID:	BH05
Project Location:	Tomingley, NSW	**Sample No.:**	-
Sample Description:	Mottled brown/grey silty clay trace sand	**Depth:**	5.32 m to 5.35 m



Comments:

Figure C1 Page 2

Tested by:	BB	**Date tested:**	02/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.: LAB184106_2021-001-023_CONS_OED01(00)

Approved Signatory:

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TEST CERTIFICATE

1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Job No.: LAB184106
IPO No.: 2021-001

Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-024
Borehole ID: BH06

Project Location: Tomingley, NSW
Sample No.: -

Sample Description: Greyish brown sandy clay
Depth: 6.62 m to 6.65 m

Test Details:	
Test ID:	TGO-OED02
Soil Particle Density [t/m^3]:	2.68

Sample Details:	Initial	Final
Sample Diameter [mm]:	60.00	60.00
Sample Height [mm]:	22.25	20.11
Dry Density [t/m^3]:	1.60	1.80
Moisture Content [%]:	14.9 *	16.6

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage		σ_v	e	c_v	m_v	k
		kPa		m^2/year	m^2/kN	m/sec
Loading	1	40	0.607	-	6.6E-04	-
	2	100	0.569	118.2	3.9E-04	1.4E-08
	3	160	0.546	93.0	2.5E-04	7.2E-09
	4	250	0.521	95.5	1.8E-04	5.3E-09
	5	450	0.484	56.6	1.2E-04	2.1E-09
	6	600	0.466	56.2	8.1E-05	1.4E-09
	7	800	0.447	63.2	6.4E-05	1.3E-09
	8	1000	0.433	60.3	5.0E-05	9.4E-10
Unloading	9	800	0.433	-	-	-
	10	600	0.436	-	-	-

Comments:

Figure C2 Page 1

Tested by: BB **Date tested:** 02/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-024_CONS_OED01(00)

Approved Signatory:

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TEST CERTIFICATE

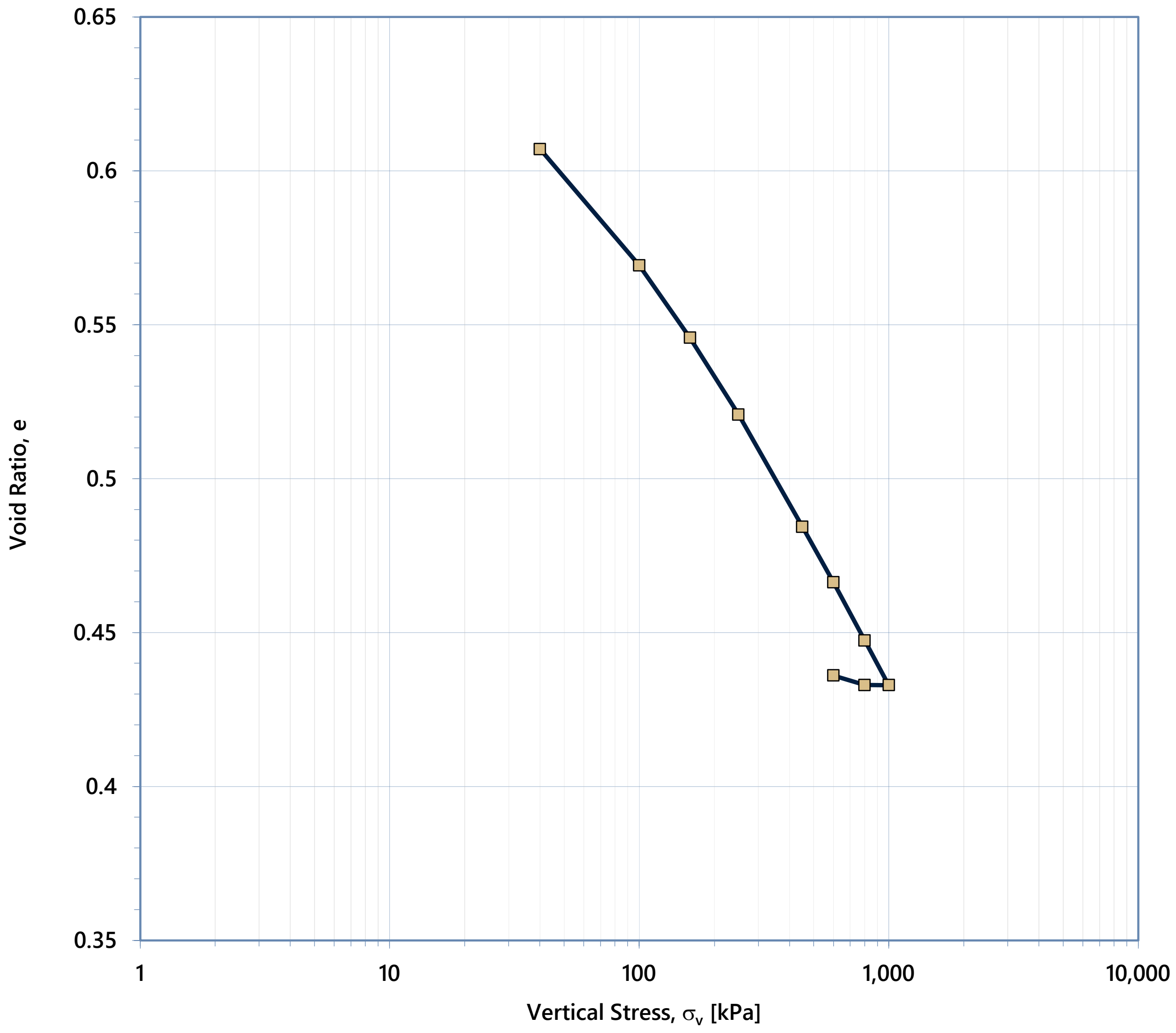
1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:** **Borehole ID:**	2021-001-024 BH06
Project Location:	Tomingley, NSW	**Sample No.:**	-
Sample Description:	Greyish brown sandy clay	**Depth:**	6.62 m to 6.65 m



Comments:

Figure C2 Page 2

Tested by:	BB	**Date tested:**	02/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.: LAB184106_2021-001-024_CONS_OED01(00)

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TEST CERTIFICATE

1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-033
		Borehole ID:	BH07
Project Location:	Tomingley, NSW	**Sample No.:**	-
Sample Description:	Mottled brown/grey/yellow silty clay with sand	**Depth:**	3.76 m to 3.79 m

Test Details:	
Test ID:	TGO-OED03
Soil Particle Density [t/m^3]:	2.70

Sample Details:	Initial	Final
Sample Diameter [mm]:	60.00	60.00
Sample Height [mm]:	22.29	21.72
Dry Density [t/m^3]:	1.71	1.74
Moisture Content [%]:	16.0 *	18.6

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage		σ_v	e	c_v	m_v	k
		kPa		m^2/year	m^2/kN	m/sec
Loading	1	40	0.563	-	5.2E-04	-
	2	100	0.546	239.8	1.8E-04	1.3E-08
	3	160	0.534	154.6	1.3E-04	6.1E-09
	4	250	0.522	126.8	9.2E-05	3.6E-09
	5	450	0.499	114.5	7.3E-05	2.6E-09
	6	600	0.489	45.3	4.5E-05	6.4E-10
	7	800	0.477	23.3	4.2E-05	3.0E-10
	8	1000	0.466	12.5	3.5E-05	1.3E-10
Unloading	9	800	0.467	-	-	-
	10	600	0.469	-	-	-

Comments:

Figure C3 Page 1

Tested by: BB **Date tested:** 04/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-033_CONS_OED01(00)

Approved Signatory:

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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

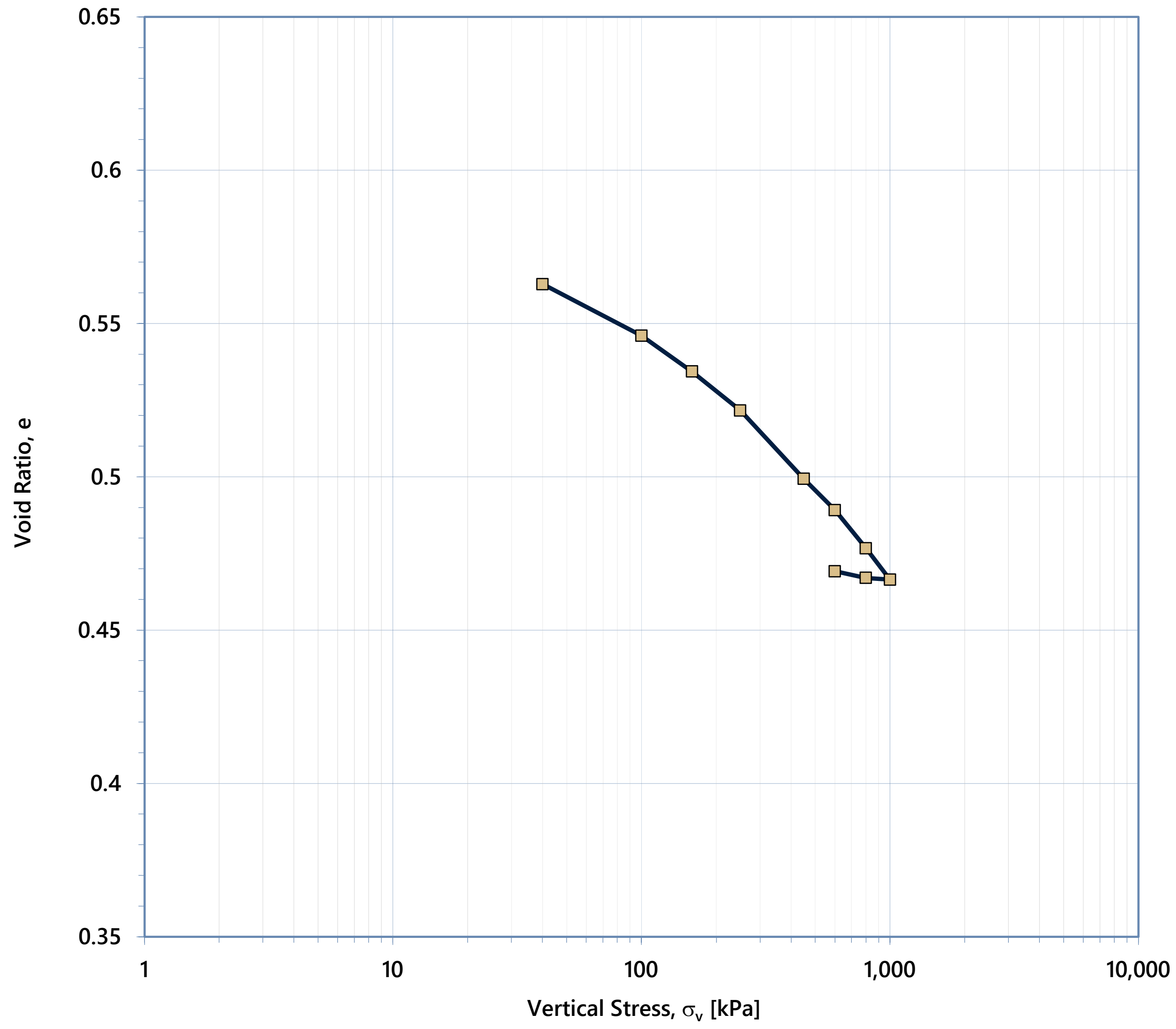
1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-033
		Borehole ID:	BH07
Project Location:	Tomingley, NSW	**Sample No.:**	-
Sample Description:	Mottled brown/grey/yellow silty clay with sand	**Depth:**	3.76 m to 3.79 m



Comments:

Figure C3 Page 2

Tested by:	BB	**Date tested:**	04/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-033_CONS_OED01(00)	**Approved Signatory:**
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TEST CERTIFICATE

1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW
Sample Description: Mottled brown/grey/yellow silty clay

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: 2021-001-034
Borehole ID: BH08
Sample No.: -
Depth: 5.07 m to 5.09 m

Test Details:	
Test ID:	TGO-OED04
Soil Particle Density [t/m^3]:	2.71

Sample Details:	Initial	Final
Sample Diameter [mm]:	70.00	70.00
Sample Height [mm]:	20.18	19.51
Dry Density [t/m^3]:	1.66	1.77
Moisture Content [%]:	21.0 *	22.6

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage		σ_v	e	c_v	m_v	k
		kPa		m^2/year	m^2/kN	m/sec
Loading	1	75	0.570	-	1.5E-04	-
	2	125	0.560	46.3	1.3E-04	1.8E-09
	3	160	0.553	54.3	1.3E-04	2.2E-09
	4	250	0.537	32.8	1.2E-04	1.2E-09
	5	450	0.510	35.6	8.6E-05	9.5E-10
	6	600	0.496	28.6	6.2E-05	5.5E-10
	7	800	0.481	18.9	5.0E-05	2.9E-10
	8	1000	0.469	15.9	4.1E-05	2.0E-10
Unloading	9	800	0.471	-	-	-
	10	600	0.474	-	-	-

Comments:

Figure C4 Page 1

Tested by: BB **Date tested:** 17/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-034_CONS_OED01(00)

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Approved Signatory:
T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

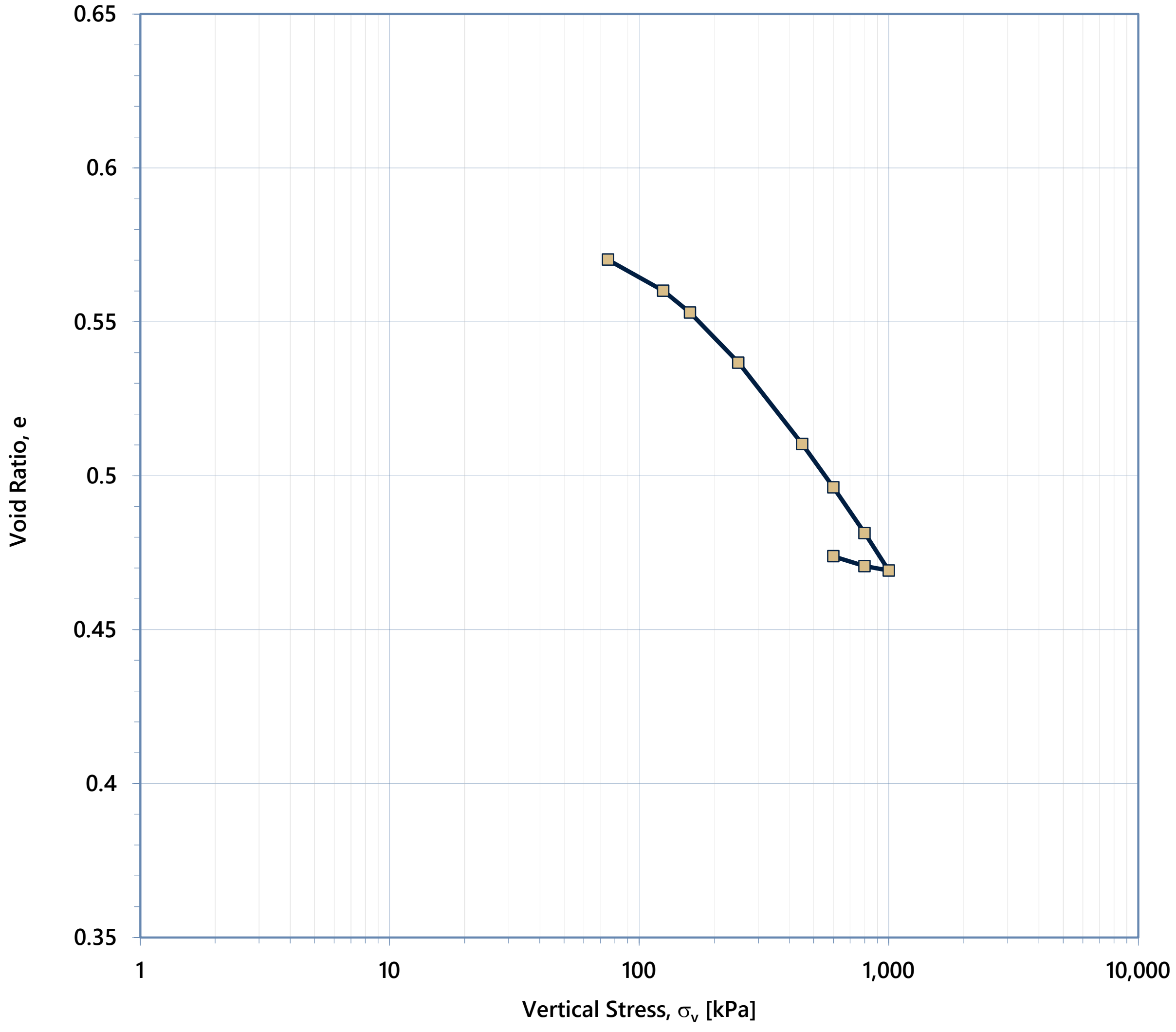
1-DIMENSIONAL CONSOLIDATION TEST

Test Method: AS 1289.6.6.1

Incremental Loading Oedometer

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-034
		Borehole ID:	BH08
Project Location:	Tomingley, NSW	**Sample No.:**	-
Sample Description:	Mottled brown/grey/yellow silty clay	**Depth:**	5.07 m to 5.09 m



Comments:

Figure C4 Page 2

Tested by:	BB	**Date tested:**	17/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-034_CONS_OED01(00)	**Approved Signatory:**
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	T. Chang

TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

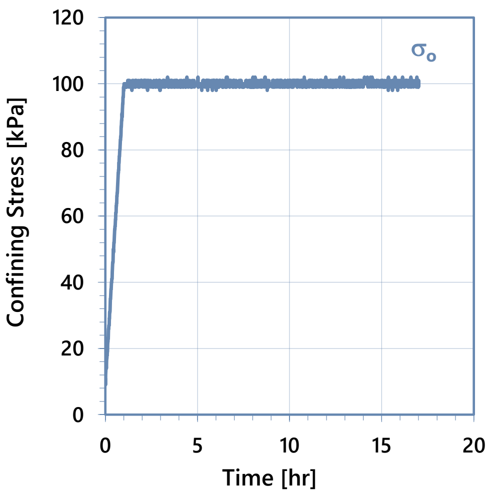
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-010
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY	**Depth:**	3.51 m to 3.70 m

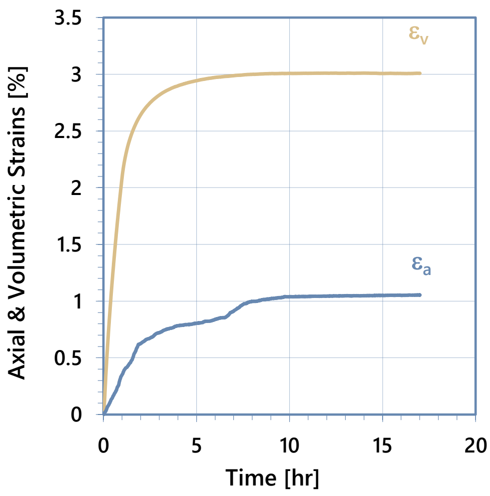
Test Details:	
Test ID:	TGO-TX01
Confining Stress [kPa]:	σ_o
	100
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.10	82.19
Sample Height [mm]:	149.81	111.82
Dry Density [t/m^3]:	1.71	1.76
Moisture Content [%]:	19.7*	22.5

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation





Comments:

Figure D1 Page 1

Tested by:	GO/SRJ	**Date tested:**	05/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-010_TXL_TX01(00)	**Approved Signatory:**
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

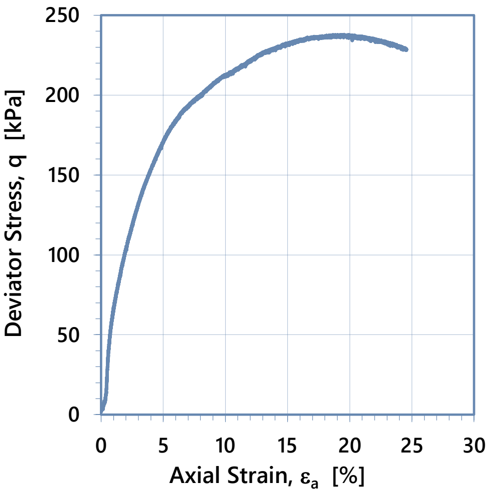
Test Method: AGLab Test Procedure FAM-17864

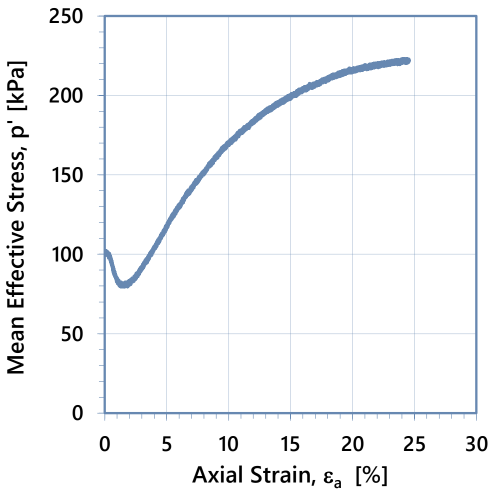
Undrained Triaxial Compression

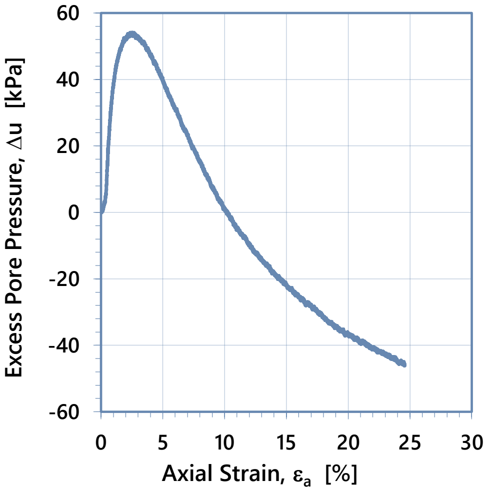
Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

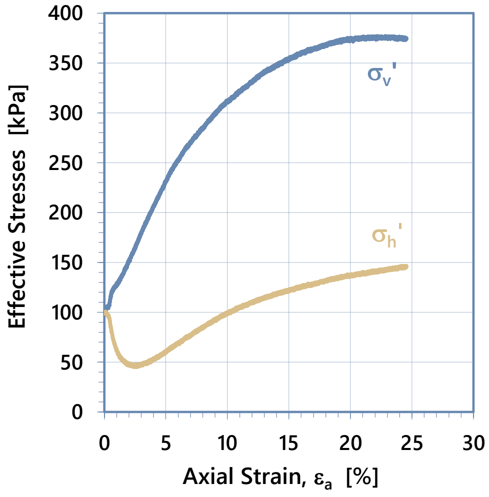
Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-010
Borehole ID: BH01
Project Location: Tomingley, NSW
Sample No.: U75_02
Sample Description: Brownish yellow/grey CLAY
Depth: 3.51 m to 3.70 m

Stage 2: Loading









Comments:

Figure D1 Page 2

Tested by: GO/SRJ **Date tested:** 05/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-010_TXL_TX01(00)

Approved Signatory:

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

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TEST CERTIFICATE

MONOTONIC TRIAXIAL

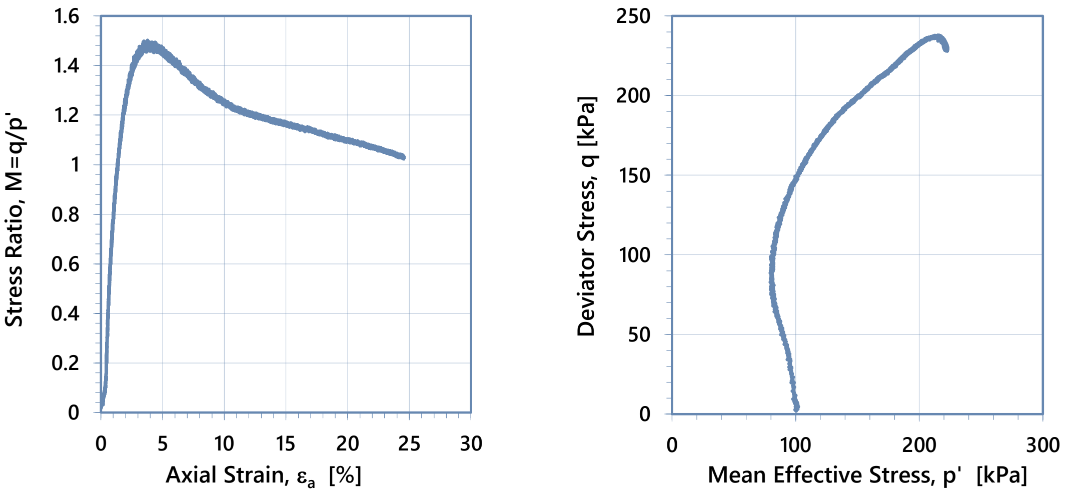
Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-010
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY	**Depth:**	3.51 m to 3.70 m

Stage 2: Loading [continued]



Comments:

Figure D1 Page 3

Tested by:	GO/SRJ	**Date tested:**	05/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-010_TXL_TX01(00)	**Approved Signatory:**
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TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-010
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY	**Depth:**	3.51 m to 3.70 m

Sample Photographs:

Sample at the end of shearing

Sample after the test

Comments:

Figure D1 Page 4

Tested by: GO/SRJ **Date tested:** 05/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-010_TXL_TX01(00)	**Approved Signatory:**
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TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

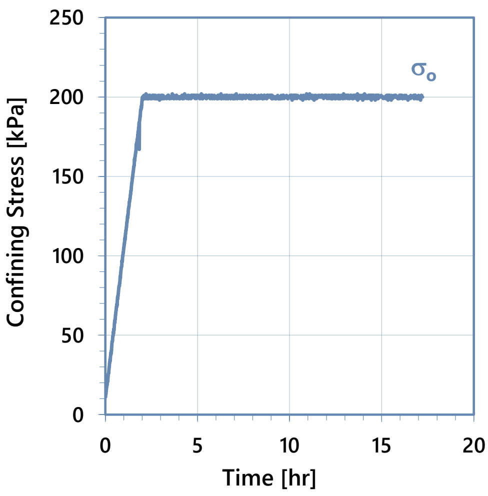
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-014
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY with sand	**Depth:**	3.70 m to 3.89 m

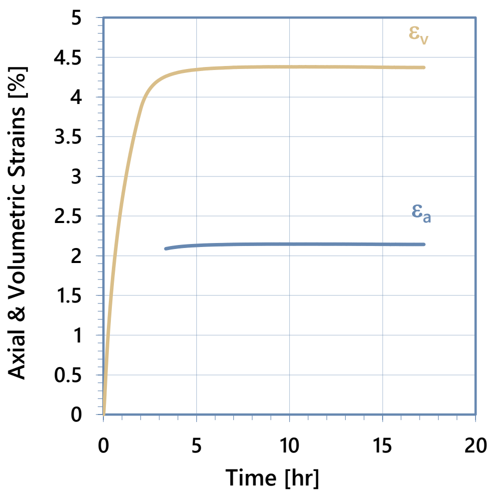
Test Details:	
Test ID:	TGO-TX02
Confining Stresss [kPa]:	σ_o
	200
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.10	79.85
Sample Height [mm]:	149.81	116.81
Dry Density [t/m^3]:	1.62	1.71
Moisture Content [%]:	22.7*	23.0

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation





Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D2 Page 1

Tested by: GO/SRJ **Date tested:** 13/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-014_TXL_TX01(00)	**Approved Signatory:**
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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd

Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000

Job No.: LAB184106

IPO No.: 2021-001

Project Name: TGO RSF 2 Geotechnical Investigation

Lab Sample ID: 2021-001-014

Borehole ID: BH01

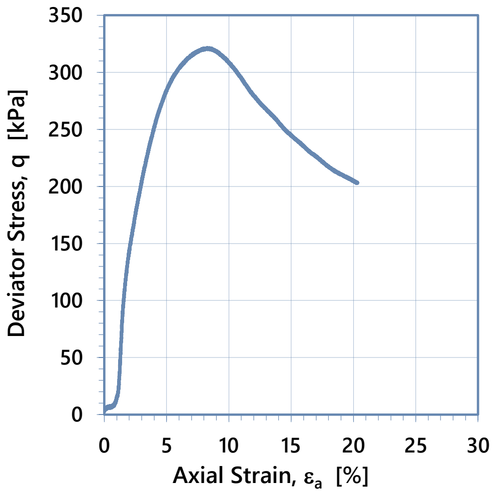
Project Location: Tomingley, NSW

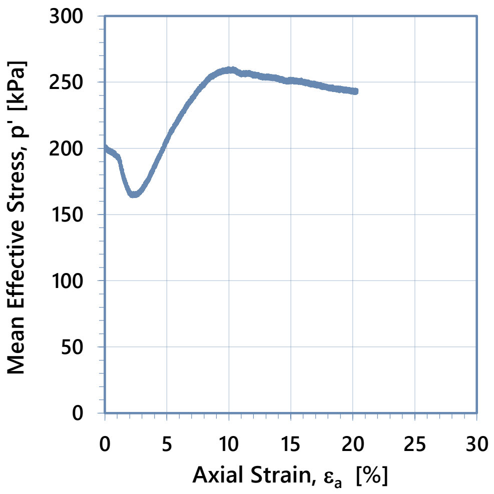
Sample No.: U75_02

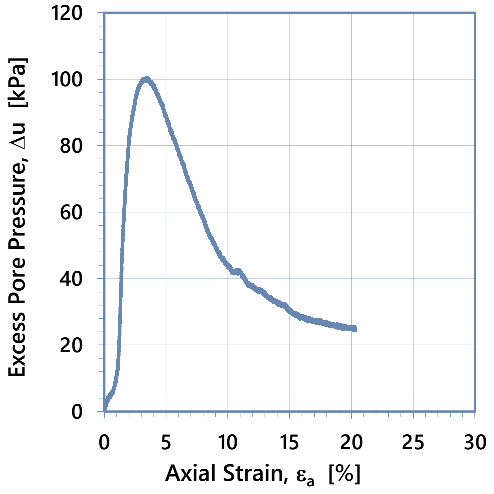
Sample Description: Brownish yellow/grey CLAY with sand

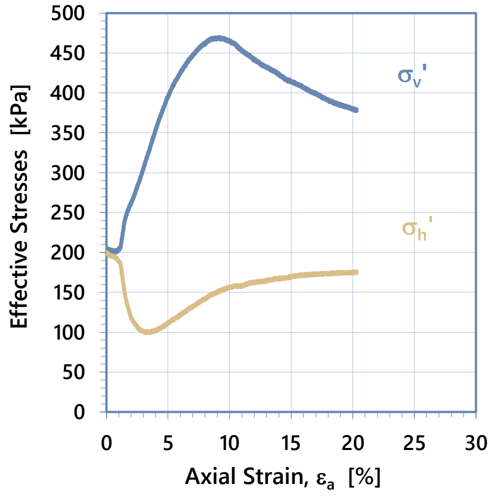
Depth: 3.70 m to 3.89 m

Stage 2: Loading









Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D2 Page 2

Tested by: GO/SRJ **Date tested:** 13/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-014_TXL_TX01(00)

Approved Signatory:

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

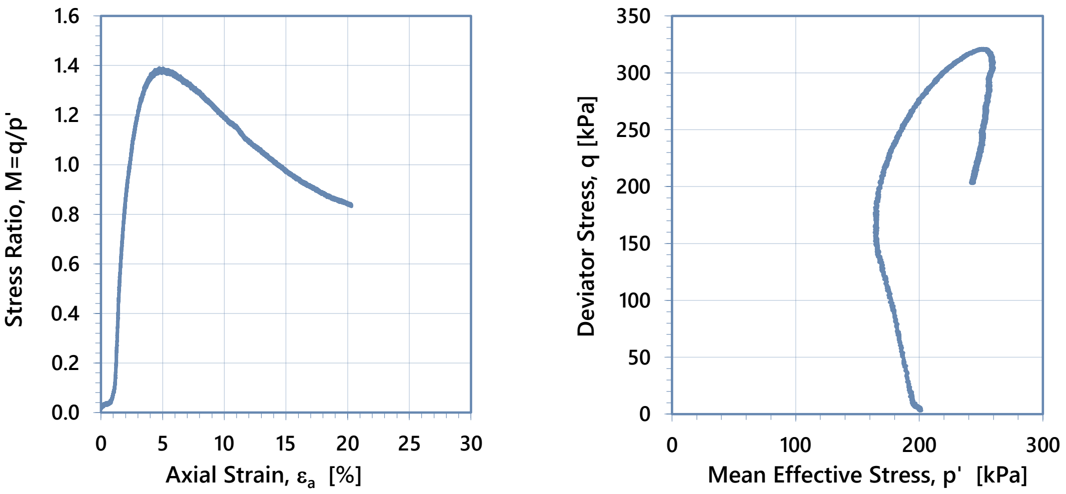
Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-014
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY with sand	**Depth:**	3.70 m to 3.89 m

Stage 2: Loading [continued]



Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D2 Page 3

Tested by:	GO/SRJ	**Date tested:**	13/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-014_TXL_TX01(00)	**Approved Signatory:**
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

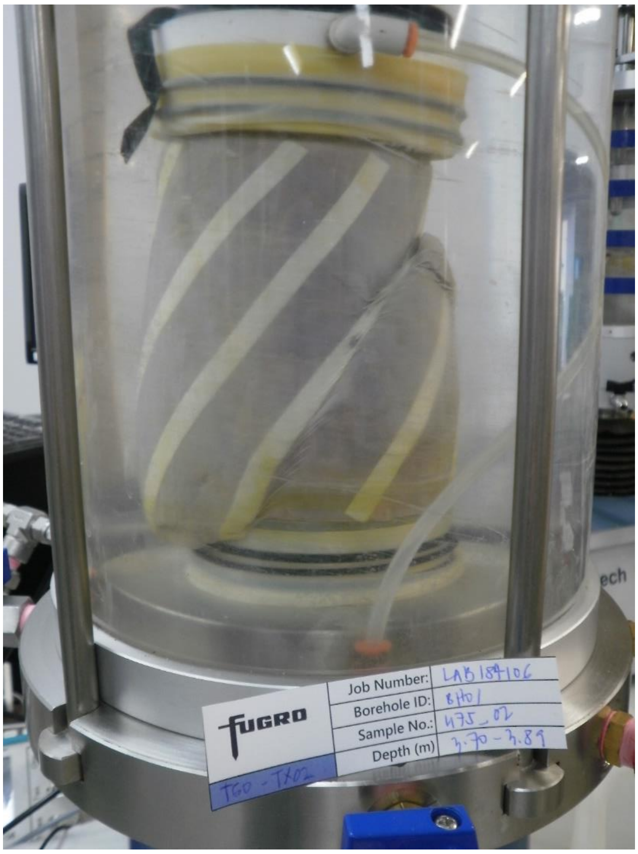
Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:** **Borehole ID:**	2021-001-014 BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow/grey CLAY with sand	**Depth:**	3.70 m to 3.89 m

Sample Photographs:



Sample at the end of shearing

Sample after the test

Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D2 Page 4

Tested by: GO/SRJ **Date tested:** 13/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-014_TXL_TX01(00)

Approved Signatory:

T. Chang

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

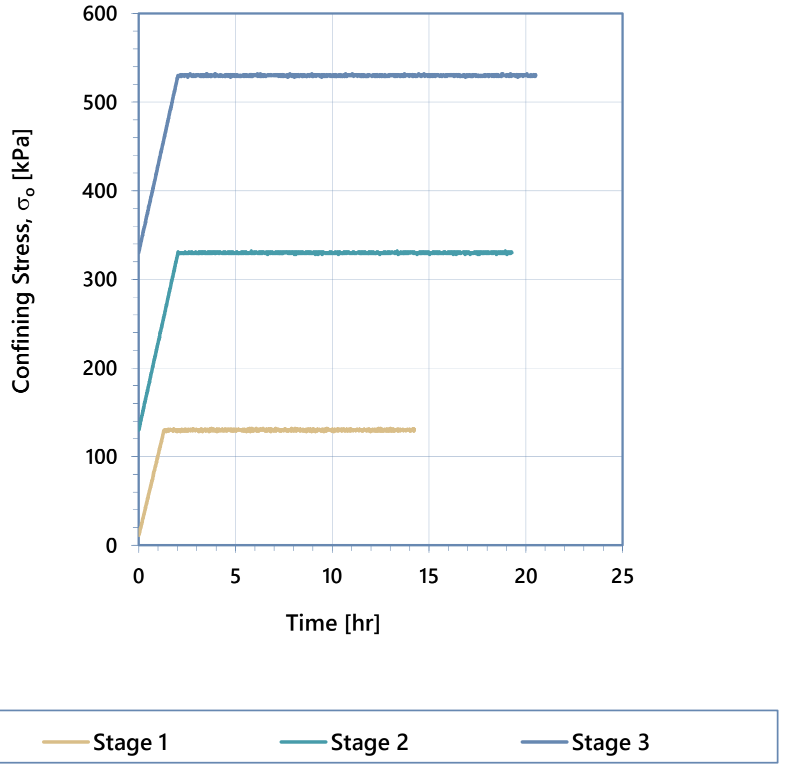
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-018
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_03
Sample Description:	Light brownish grey CLAY with sand	**Depth:**	9.68 m to 9.84 m

Test Details:	
Test ID:	TGO-TX03
Confining Stress [kPa]:	σ_o 130, 330 & 530
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.1	79.7
Sample Height [mm]:	149.8	116.5
Dry Density [t/m^3]:	1.82	1.91
Moisture Content [%]:	17.0*	17.5

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation



Comments:

Figure D3 Page 1

Tested by: GO/SRJ **Date tested:** 01/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-018_TXL_TX04(00)	**Approved Signatory:**
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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

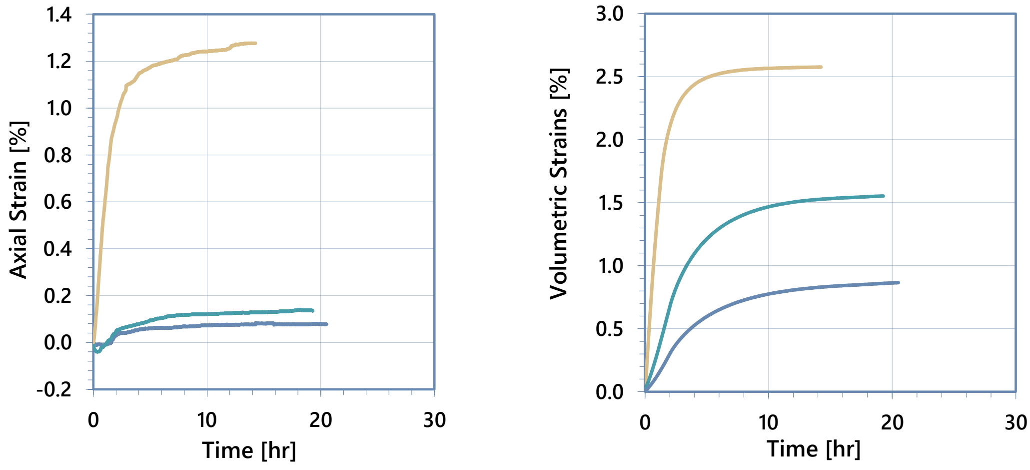
Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

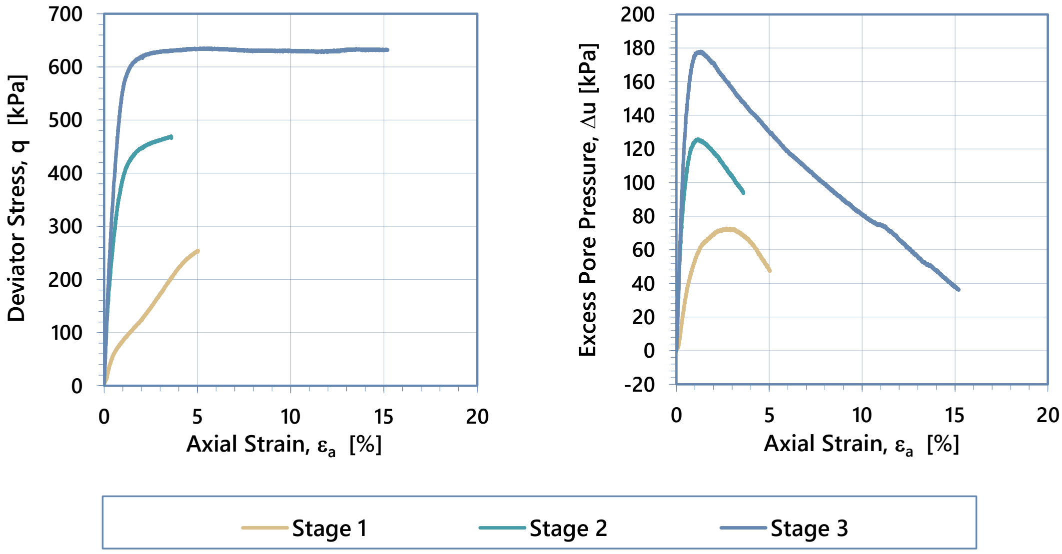
Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW
Sample Description: Light brownish grey CLAY with sand

Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: 2021-001-018
Borehole ID: BH01
Sample No.: U75_03
Depth: 9.68 m to 9.84 m

Stage 1: Consolidation [Continued]



Stage 2: Loading



Comments:

Figure D3 Page 2

Tested by: GO/SRJ **Date tested:** 01/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-018_TXL_TX04(00)

Approved Signatory:

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T. Chang

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

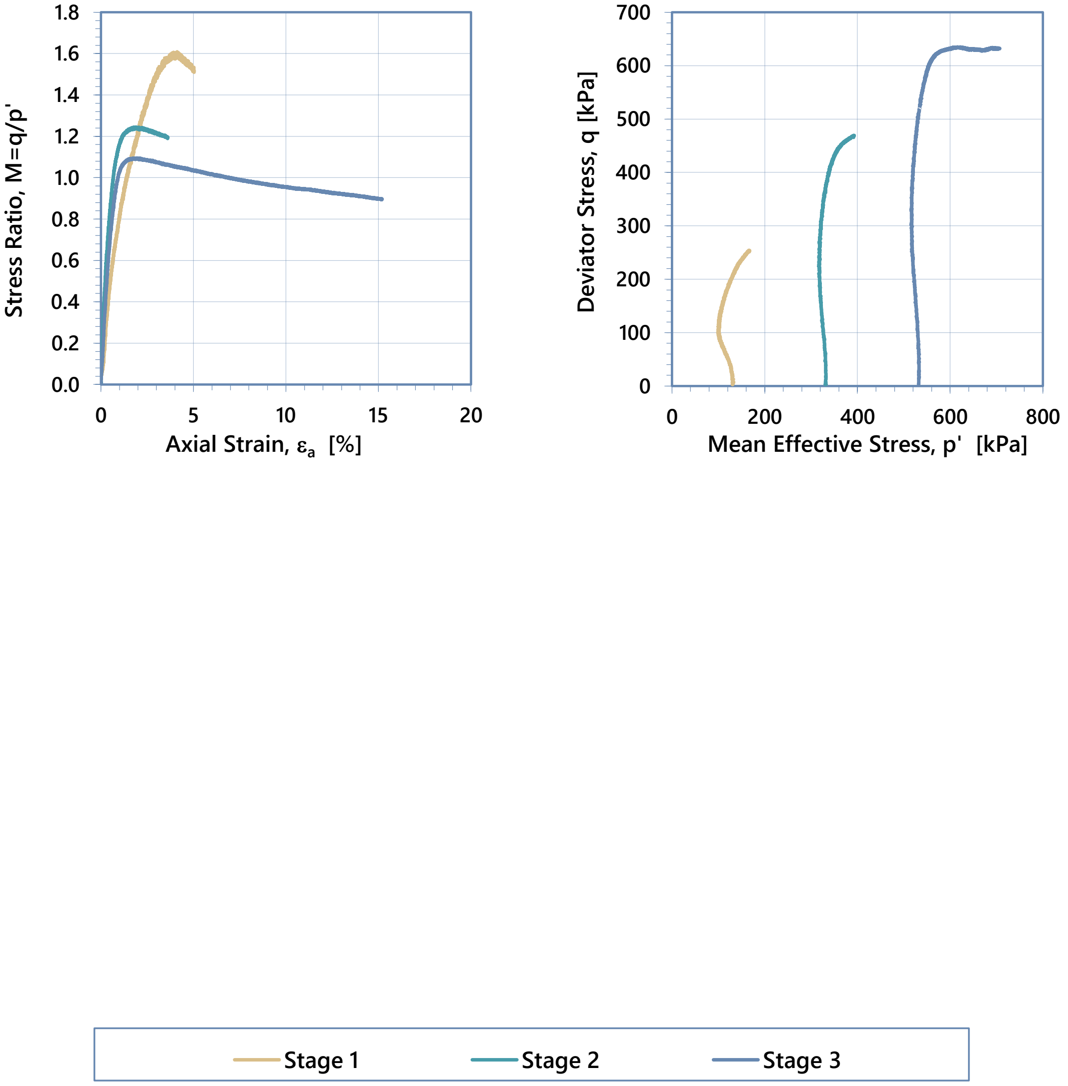
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-018
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_03
Sample Description:	Light brownish grey CLAY with sand	**Depth:**	9.68 m to 9.84 m

Stage 2: Loading [continued]



Comments:

Figure D3 Page 3

Tested by:	GO/SRJ	**Date tested:**	01/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.: LAB184106_2021-001-018_TXL_TX04(00)

Approved Signatory:

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

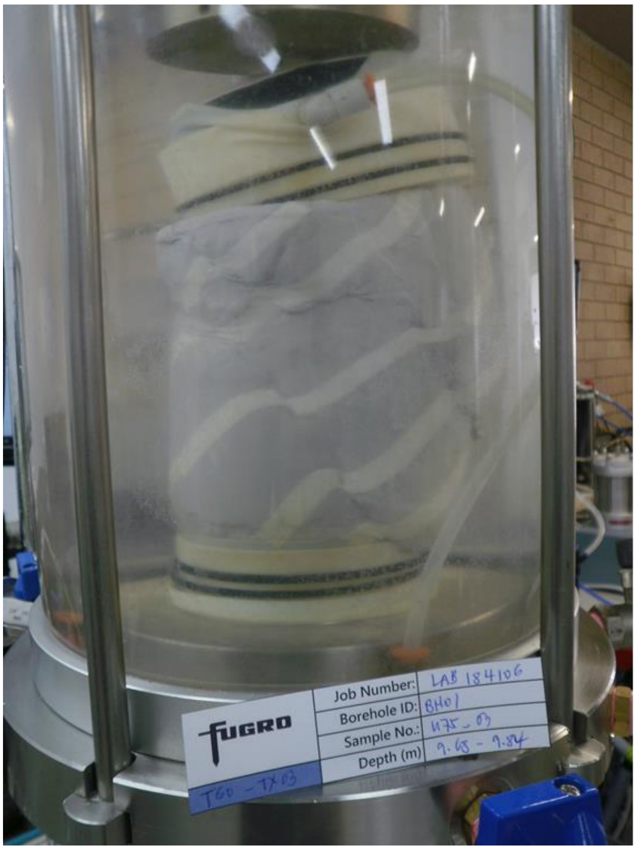
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-018
		Borehole ID:	BH01
Project Location:	Tomingley, NSW	**Sample No.:**	U75_03
Sample Description:	Light brownish grey CLAY with sand	**Depth:**	9.68 m to 9.84 m

Sample Photographs:



Sample at the end of shearing

Sample after test

Comments:

Figure D3 Page 4

Tested by:	GO/SRJ	**Date tested:**	01/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-018_TXL_TX04(00)	**Approved Signatory:**
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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

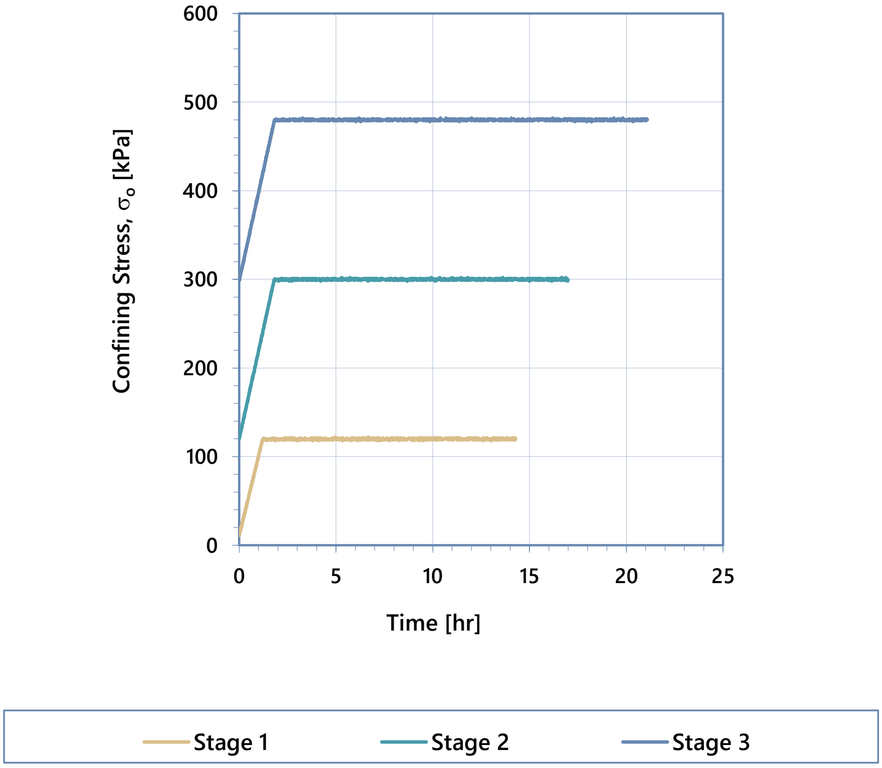
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-022
		Borehole ID:	BH05
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/yellow/grey CLAY with sand	**Depth:**	5.06 m to 5.22 m

Test Details:	
Test ID:	TGO-TX04
Confining Stress [kPa]:	σ_o 120, 300 & 480
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.1	78.8
Sample Height [mm]:	146.8	114.8
Dry Density [t/m^3]:	1.71	1.83
Moisture Content [%]:	19.1*	19.0

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation



Comments:

Figure D4 Page 1

Tested by:	GO/SRJ	**Date tested:**	05/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-022_TXL_TX04(00)	**Approved Signatory:**
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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

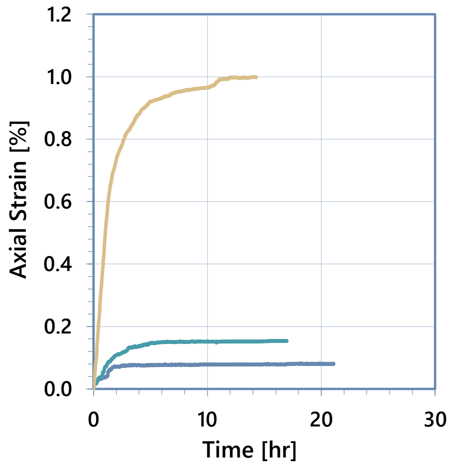
Test Method: AGLab Test Procedure FAM-17864

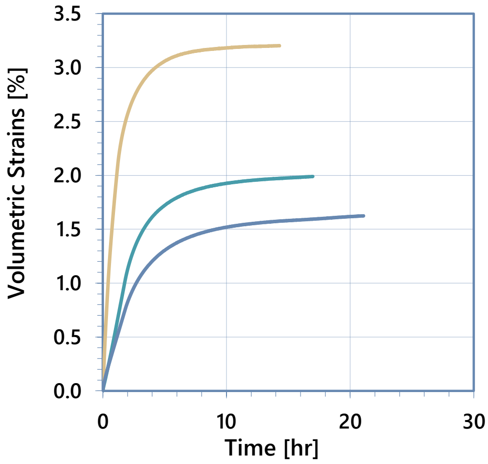
Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

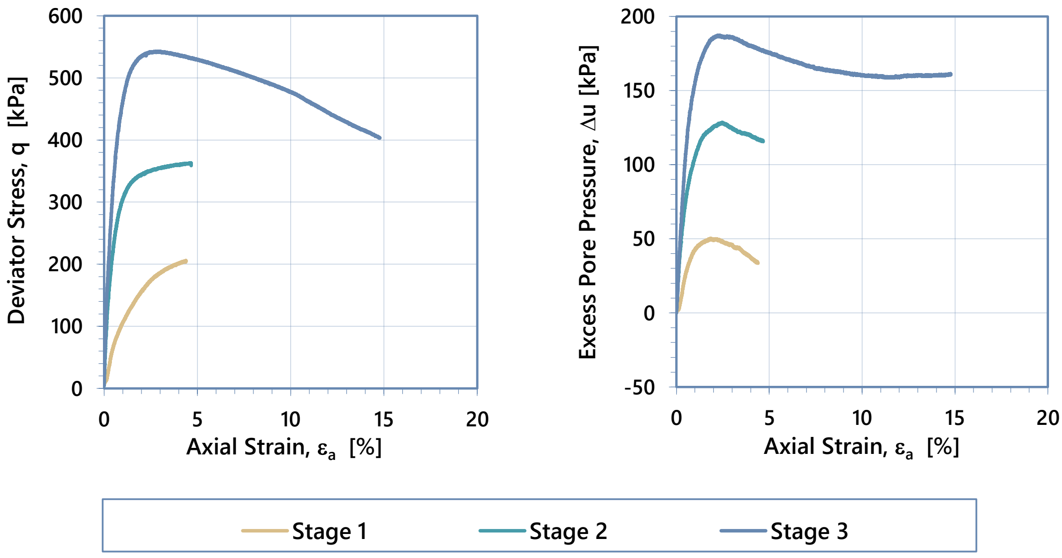
Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-022
Borehole ID: BH05
Project Location: Tomingley, NSW
Sample No.: U75_01
Sample Description: Brownish yellow/yellow/grey CLAY with sand
Depth: 5.06 m to 5.22 m

Stage 1: Consolidation [Continued]





Stage 2: Loading



Comments:

Figure D4 Page 2

Tested by: GO/SRJ **Date tested:** 05/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-022_TXL_TX04(00)

Approved Signatory:

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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

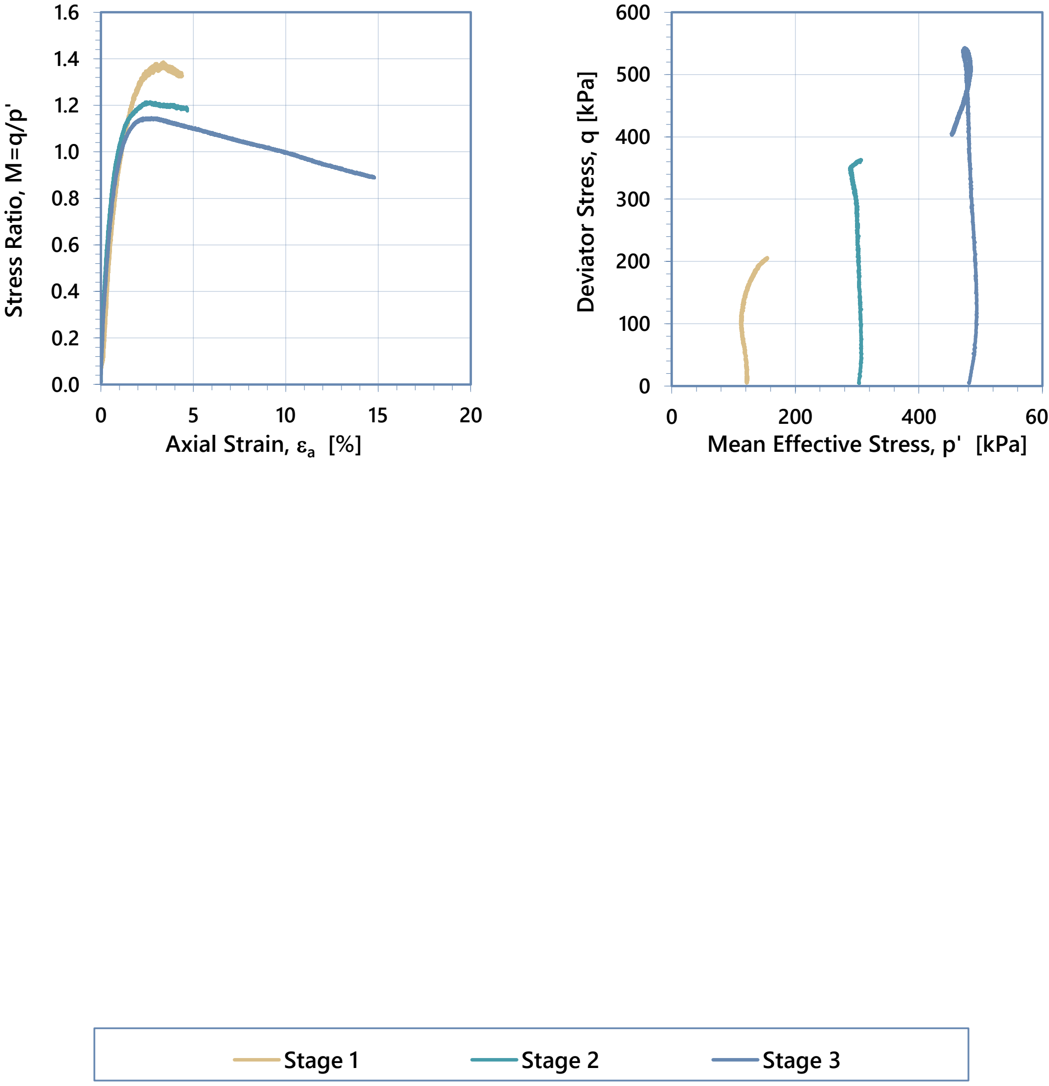
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-022
Borehole ID: BH05
Project Location: Tomingley, NSW
Sample No.: U75_01
Sample Description: Brownish yellow/yellow/grey CLAY with sand
Depth: 5.06 m to 5.22 m

Stage 2: Loading [continued]



Comments:

Figure D4 Page 3

Tested by: GO/SRJ **Date tested:** 05/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-022_TXL_TX04(00)

Approved Signatory:

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T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-022
		Borehole ID:	BH05
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/yellow/grey CLAY with sand	**Depth:**	5.06 m to 5.22 m

Sample Photographs:

Sample at the end of shearing

Sample after test

Comments:

Figure D4 Page 4

Tested by: GO/SRJ **Date tested:** 05/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-022_TXL_TX04(00)	**Approved Signatory:**
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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

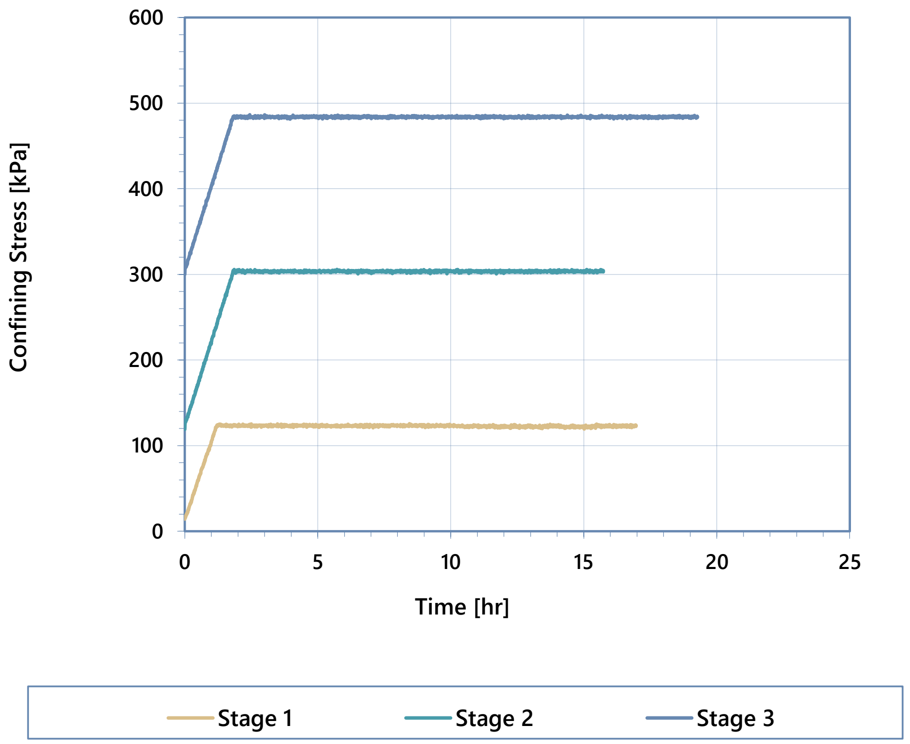
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-028
		Borehole ID:	BH06
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow sandy CLAY	**Depth:**	6.65 m to 6.84 m

Test Details:	
Test ID:	TGO-TX05
Confining Stress [kPa]:	σ_o 120, 300 & 480
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.1	79.4
Sample Height [mm]:	146.8	113.6
Dry Density [t/m^3]:	1.86	1.95
Moisture Content [%]:	12.2*	14.4

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation



Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D5 Page 1

Tested by:	GO/SRJ	**Date tested:**	08/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-028_TXL_TX04(00)	**Approved Signatory:**
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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

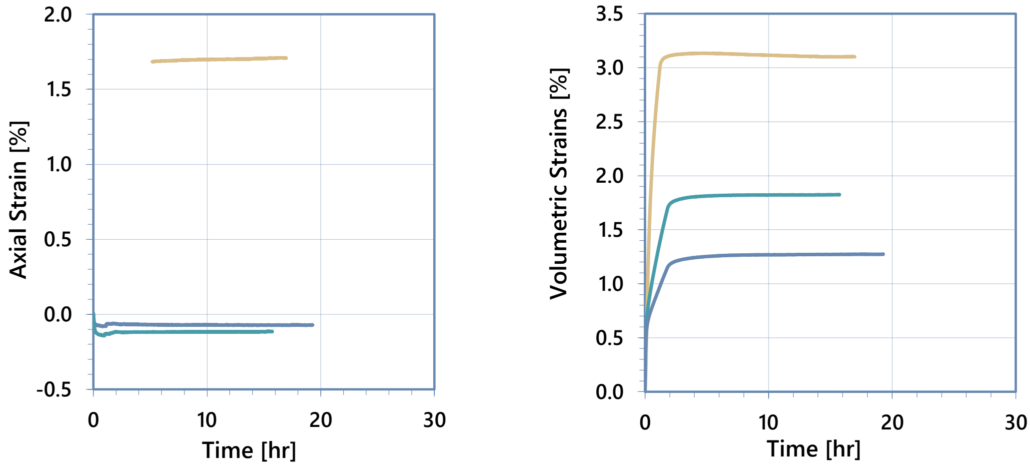
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

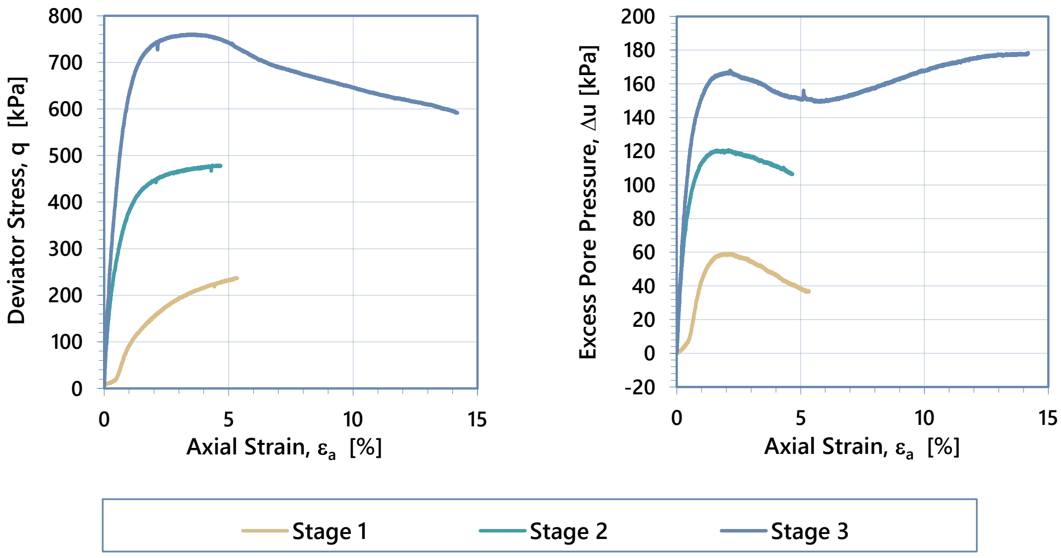
Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-028
Borehole ID: BH06
Project Location: Tomingley, NSW
Sample No.: U75_02
Sample Description: Brownish yellow sandy CLAY
Depth: 6.65 m to 6.84 m

Stage 1: Consolidation [Continued]



Stage 2: Loading



Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D5 Page 2

Tested by: GO/SRJ **Date tested:** 08/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-028_TXL_TX04(00)

Approved Signatory:

T. Chang

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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

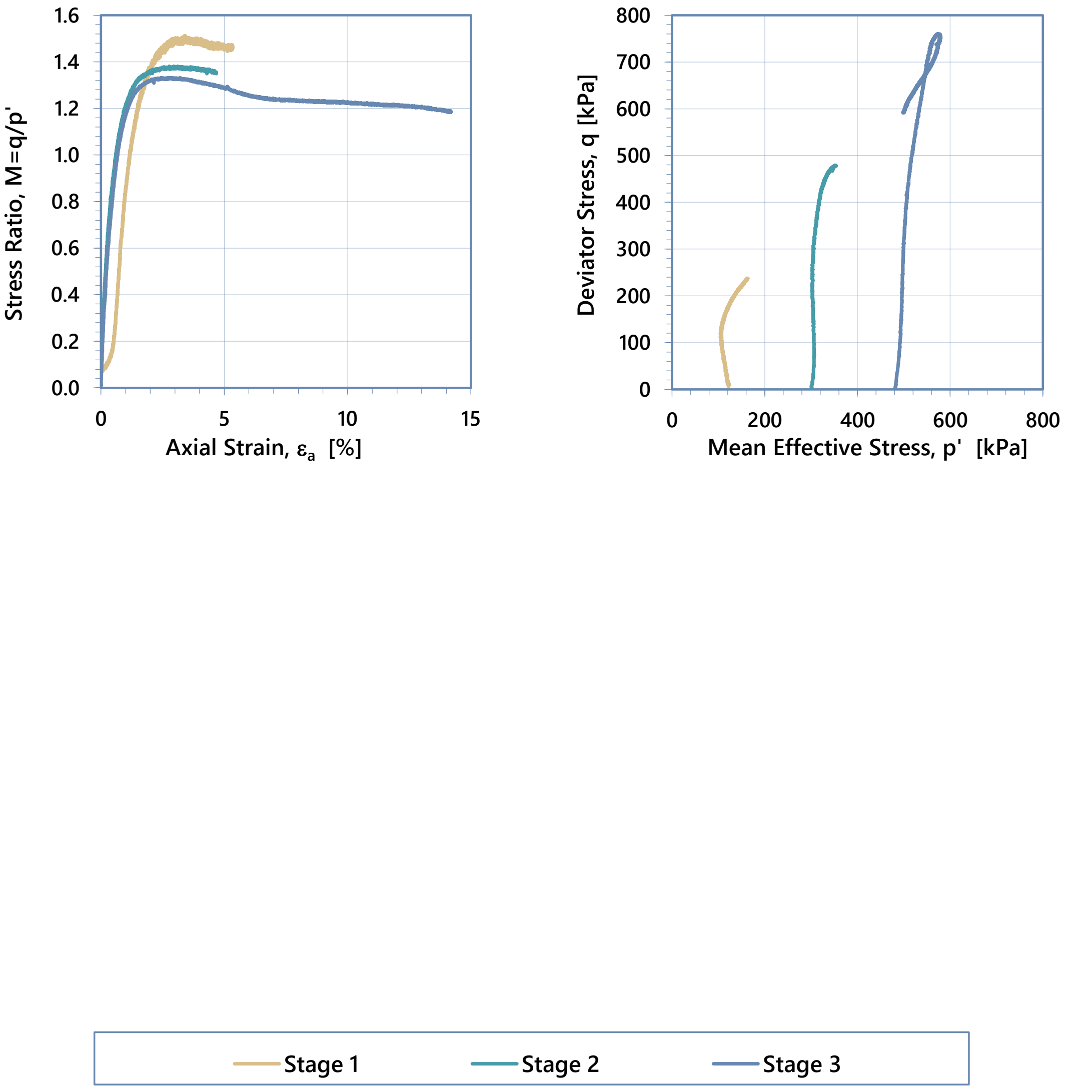
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-028
		Borehole ID:	BH06
Project Location:	Tomingley, NSW	**Sample No.:**	U75_02
Sample Description:	Brownish yellow sandy CLAY	**Depth:**	6.65 m to 6.84 m

Stage 2: Loading [continued]



Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D5 Page 3

Tested by: GO/SRJ **Date tested:** 08/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-028_TXL_TX04(00)	**Approved Signatory:**
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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001

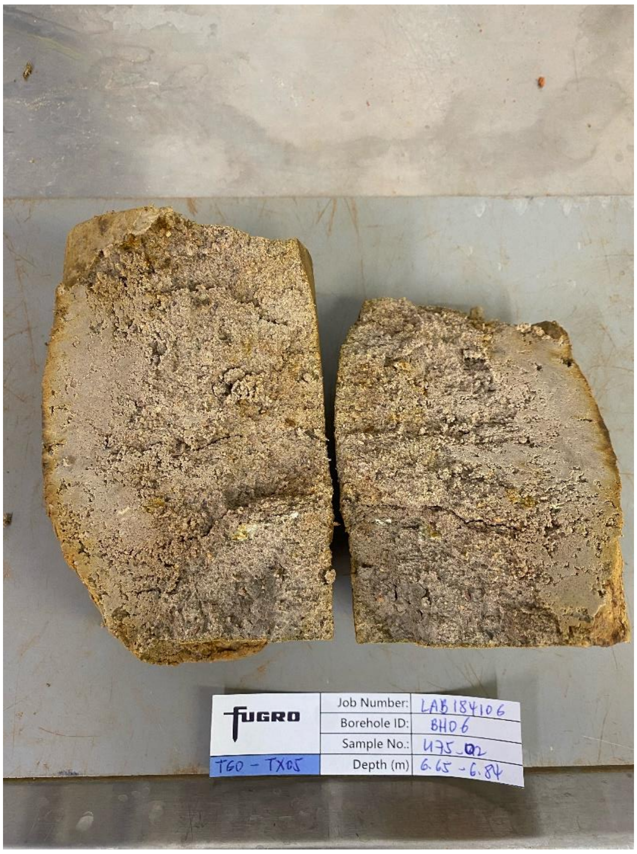
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-028
Borehole ID: BH06

Project Location: Tomingley, NSW
Sample No.: U75_02

Sample Description: Brownish yellow sandy CLAY
Depth: 6.65 m to 6.84 m

Sample Photographs:

Sample at the end of shearing



Sample after test

Comments: Initial axial strain result during consolidation is not available due to data loss.

Figure D5 Page 4

Tested by: GO/SRJ **Date tested:** 08/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-028_TXL_TX04(00)

Approved Signatory:

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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

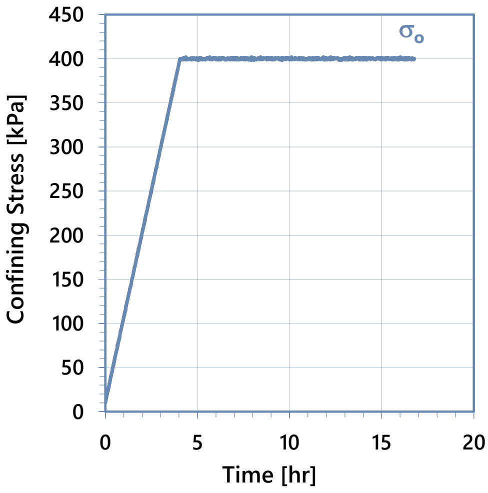
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-032
		Borehole ID:	BH07
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/grey CLAY with sand	**Depth:**	3.52 m to 3.71 m

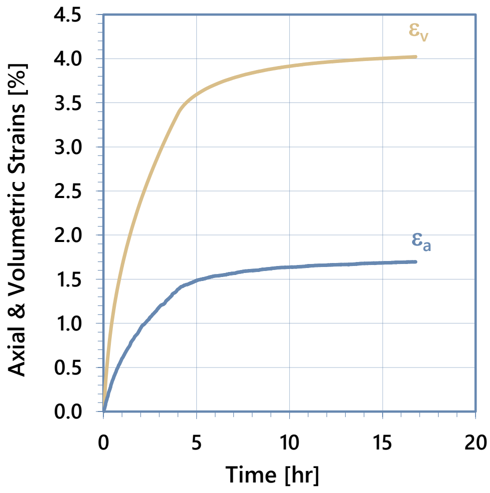
Test Details:	
Test ID:	TGO-TX06
Confining Stress [kPa]:	σ_o
	400
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.10	81.04
Sample Height [mm]:	149.81	113.82
Dry Density [t/m^3]:	1.76	1.83
Moisture Content [%]:	17.5*	18.9

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation





Comments:

Figure D6 Page 1

Tested by:	GO/SRJ	**Date tested:**	19/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-032_TXL_TX01(00)	**Approved Signatory:**
	THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL	T. Chang

Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

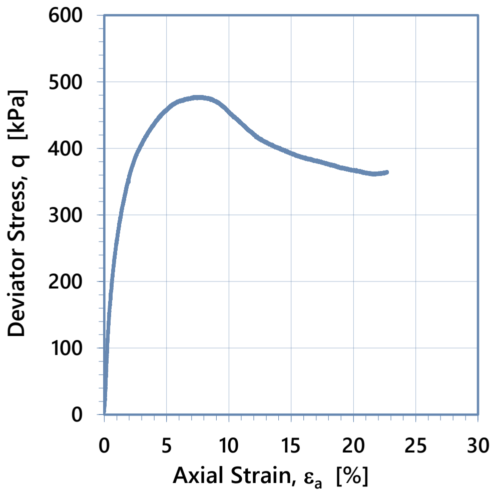
Undrained Triaxial Compression

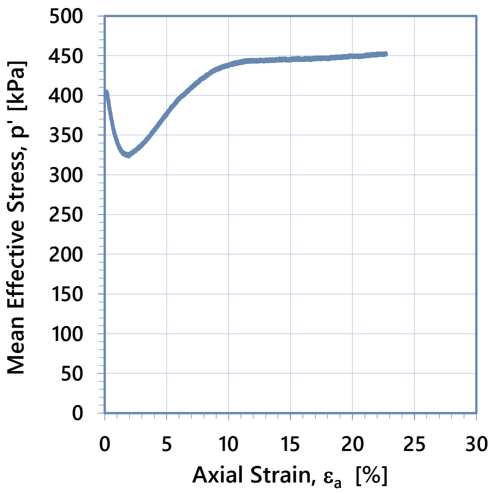
Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

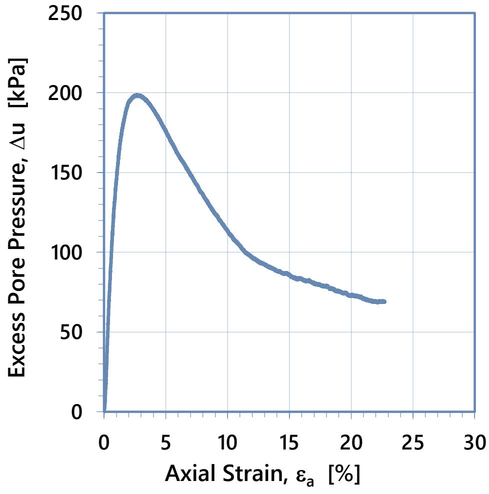
Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Project Name: TGO RSF 2 Geotechnical Investigation
Project Location: Tomingley, NSW
Sample Description: Brownish yellow/grey CLAY with sand

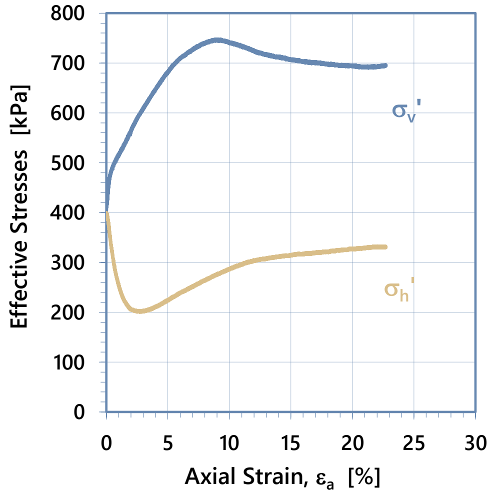
Job No.: LAB184106
IPO No.: 2021-001
Lab Sample ID: 2021-001-032
Borehole ID: BH07
Sample No.: U75_01
Depth: 3.52 m to 3.71 m

Stage 2: Loading









Comments:

Figure D6 Page 2

Tested by: GO/SRJ **Date tested:** 19/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-032_TXL_TX01(00)

Approved Signatory:

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TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

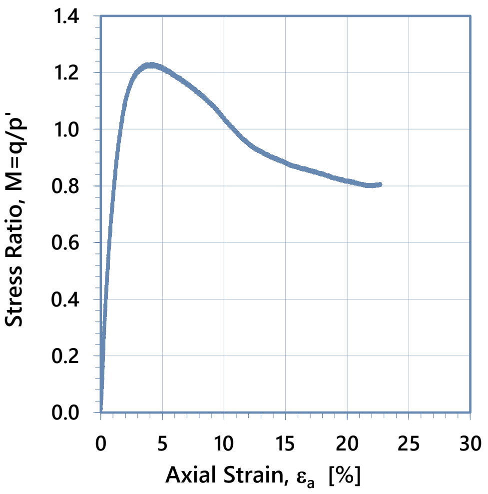
Undrained Triaxial Compression

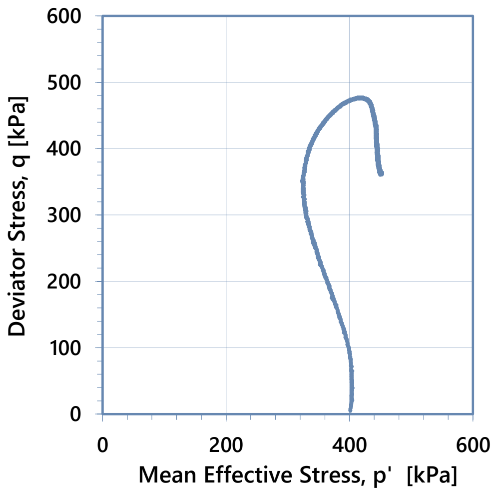
Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001

Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-032
Borehole ID: BH07
Project Location: Tomingley, NSW
Sample No.: U75_01
Sample Description: Brownish yellow/grey CLAY with sand
Depth: 3.52 m to 3.71 m

Stage 2: Loading [continued]





Comments:

Figure D6 Page 3

Tested by: GO/SRJ **Date tested:** 19/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-032_TXL_TX01(00)

Approved Signatory:

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TEST CERTIFICATE

MONOTONIC TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-032
		Borehole ID:	BH07
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/grey CLAY with sand	**Depth:**	3.52 m to 3.71 m

Sample Photographs:

Sample at the end of shearing

Sample after the test

Comments:

Figure D6 Page 4

Tested by:	GO/SRJ	**Date tested:**	19/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.:	LAB184106_2021-001-032_TXL_TX01(00)	**Approved Signatory:**
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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

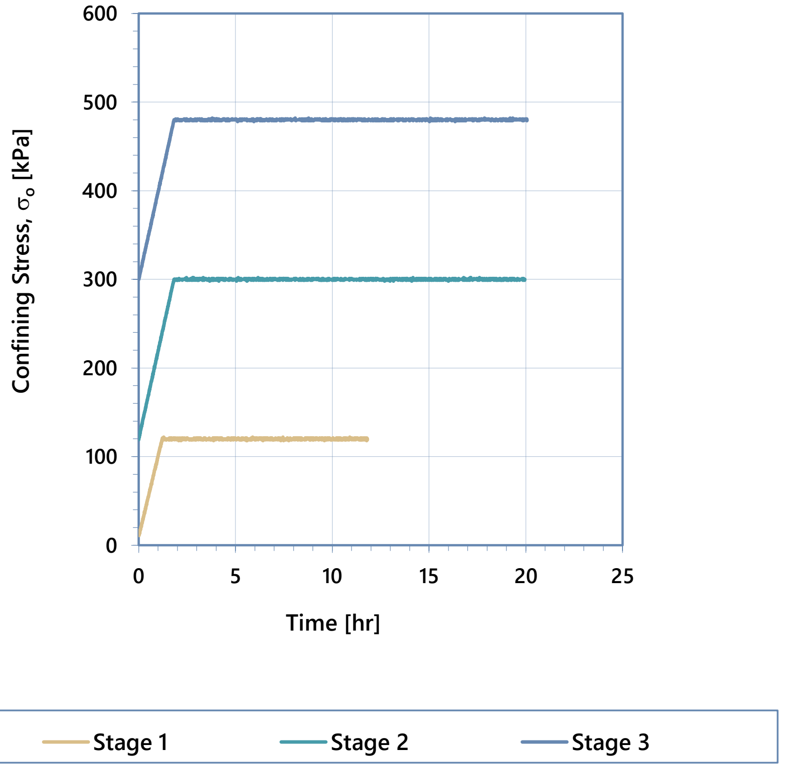
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-038
		Borehole ID:	BH08
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/grey CLAY trace sand	**Depth:**	5.16 m to 5.35 m

Test Details:	
Test ID:	TGO-TX07
Confining Stress [kPa]:	σ_o 120, 300 & 480
Loading rate [%/hr]:	1

Sample Details:	Initial	Final
Sample Diameter [mm]:	72.1	78.8
Sample Height [mm]:	179.8	144.2
Dry Density [t/m^3]:	1.40	1.47
Moisture Content [%]:	20.1*	21.2

Note: * Moisture content calculated using trimmings; may not be equal to moisture content of whole sample.

Stage 1: Consolidation



Comments:

Figure D7 Page 1

Tested by: GO/SRJ **Date tested:** 15/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.:	LAB184106_2021-001-038_TXL_TX04(00)	**Approved Signatory:**
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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

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TEST CERTIFICATE

MULTISTAGE TRIAXIAL

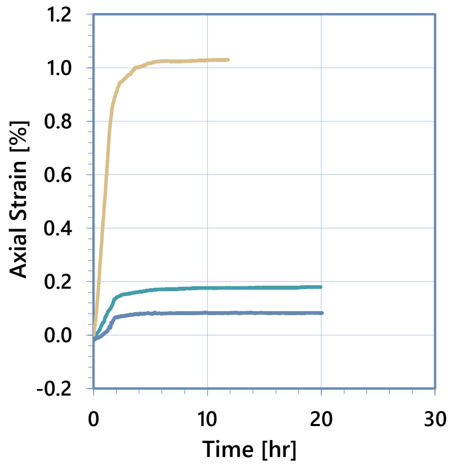
Test Method: AGLab Test Procedure FAM-17864

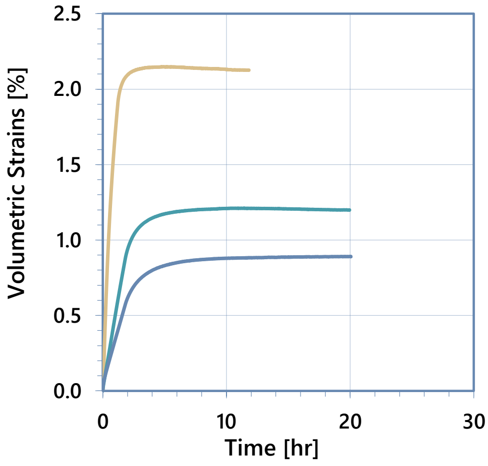
Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

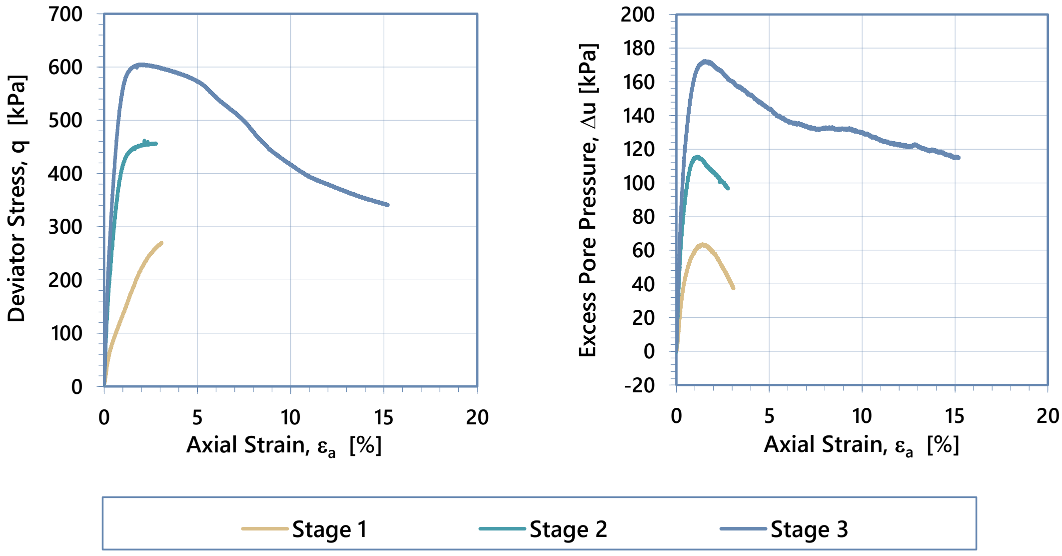
Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-038
		Borehole ID:	BH08
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/grey CLAY trace sand	**Depth:**	5.16 m to 5.35 m

Stage 1: Consolidation [Continued]





Stage 2: Loading



Comments:

Figure D7 Page 2

Tested by:	GO/SRJ	**Date tested:**	15/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.: LAB184106_2021-001-038_TXL_TX04(00)

Approved Signatory:

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T. Chang

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

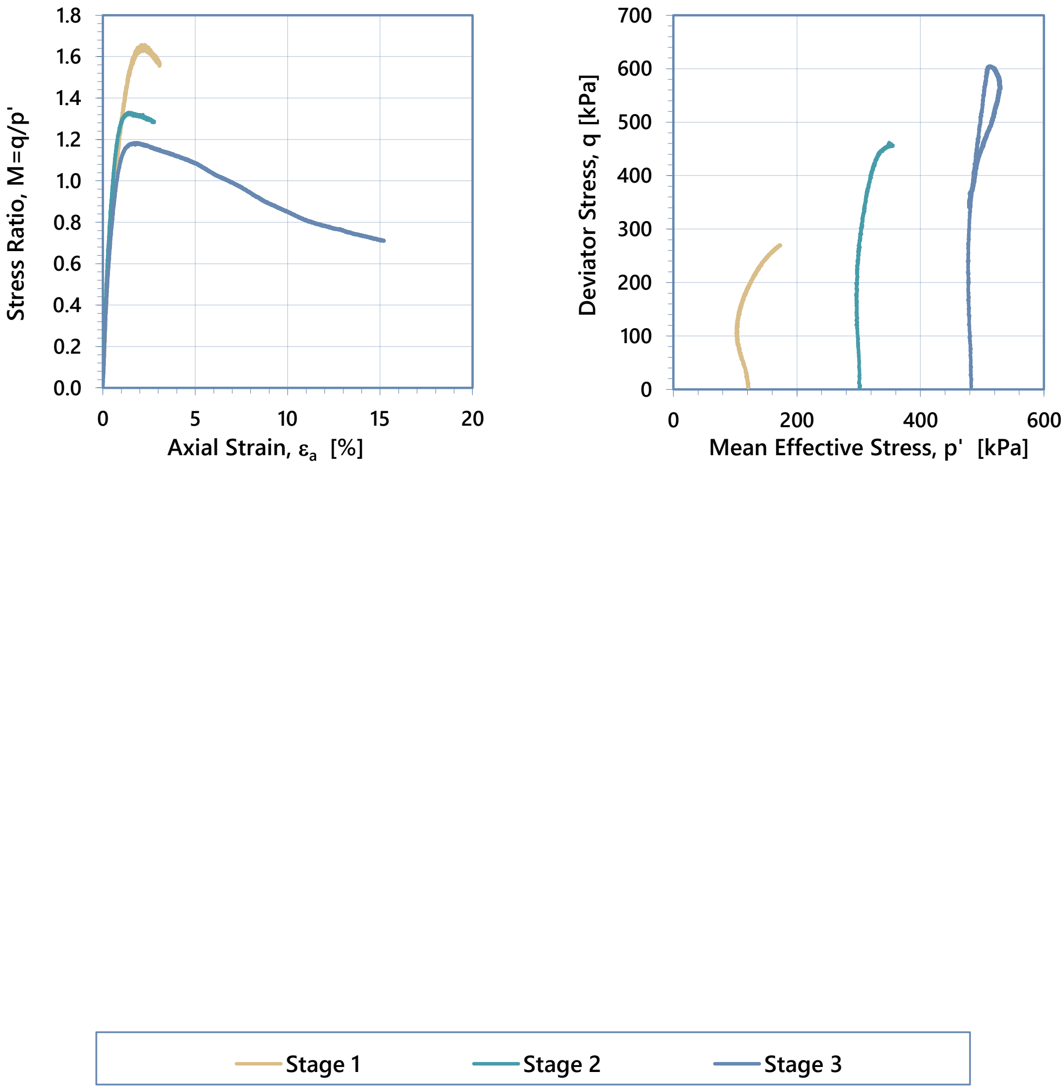
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client:	GHD Pty Ltd	**Job No.:**	LAB184106
Client Address:	2 Salamanca Square, Hobart, Tasmania, 7000	**IPO No.:**	2021-001
Project Name:	TGO RSF 2 Geotechnical Investigation	**Lab Sample ID:**	2021-001-038
		Borehole ID:	BH08
Project Location:	Tomingley, NSW	**Sample No.:**	U75_01
Sample Description:	Brownish yellow/grey CLAY trace sand	**Depth:**	5.16 m to 5.35 m

Stage 2: Loading [continued]



Comments:

Figure D7 Page 3

Tested by:	GO/SRJ	**Date tested:**	15/02/2021	**Reviewed by:**	TC	**Date Reported:**	10/03/2021

Cert. No.: LAB184106_2021-001-038_TXL_TX04(00)

Approved Signatory:

T. Chang

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Phone: +61 8 9218 2000 **E-mail:** FugroAGLab@fugro.com **Web:** www.fugro.com

TEST CERTIFICATE

MULTISTAGE TRIAXIAL

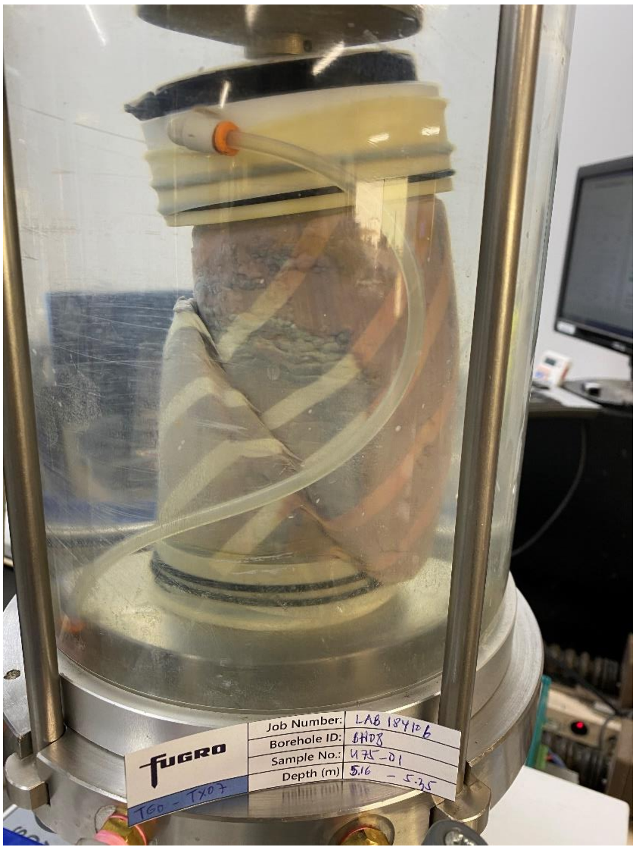
Test Method: AGLab Test Procedure FAM-17864

Multistage Undrained Triaxial Compression

Fugro Australia Marine Pty Ltd
Advanced Geotechnical Laboratory
Unit 2, 10 Carbon Court
Osborne Park, WA, 6017
Australia

Client: GHD Pty Ltd
Client Address: 2 Salamanca Square, Hobart, Tasmania, 7000
Job No.: LAB184106
IPO No.: 2021-001
Project Name: TGO RSF 2 Geotechnical Investigation
Lab Sample ID: 2021-001-038
Borehole ID: BH08
Project Location: Tomingley, NSW
Sample No.: U75_01
Sample Description: Brownish yellow/grey CLAY trace sand
Depth: 5.16 m to 5.35 m

Sample Photographs:



Sample at the end of shearing

Sample after test

Comments:

Figure D7 Page 4

Tested by: GO/SRJ **Date tested:** 15/02/2021 **Reviewed by:** TC **Date Reported:** 10/03/2021

Cert. No.: LAB184106_2021-001-038_TXL_TX04(00)

Approved Signatory:

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

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12538404-57773-9/https://projectsportal.ghd.com/sites/pp16_01/tgorsf2geotechnicali/ProjectDocs/12538404-REP-A_TGO RSF2 Geotech Factual.docx

Document Status

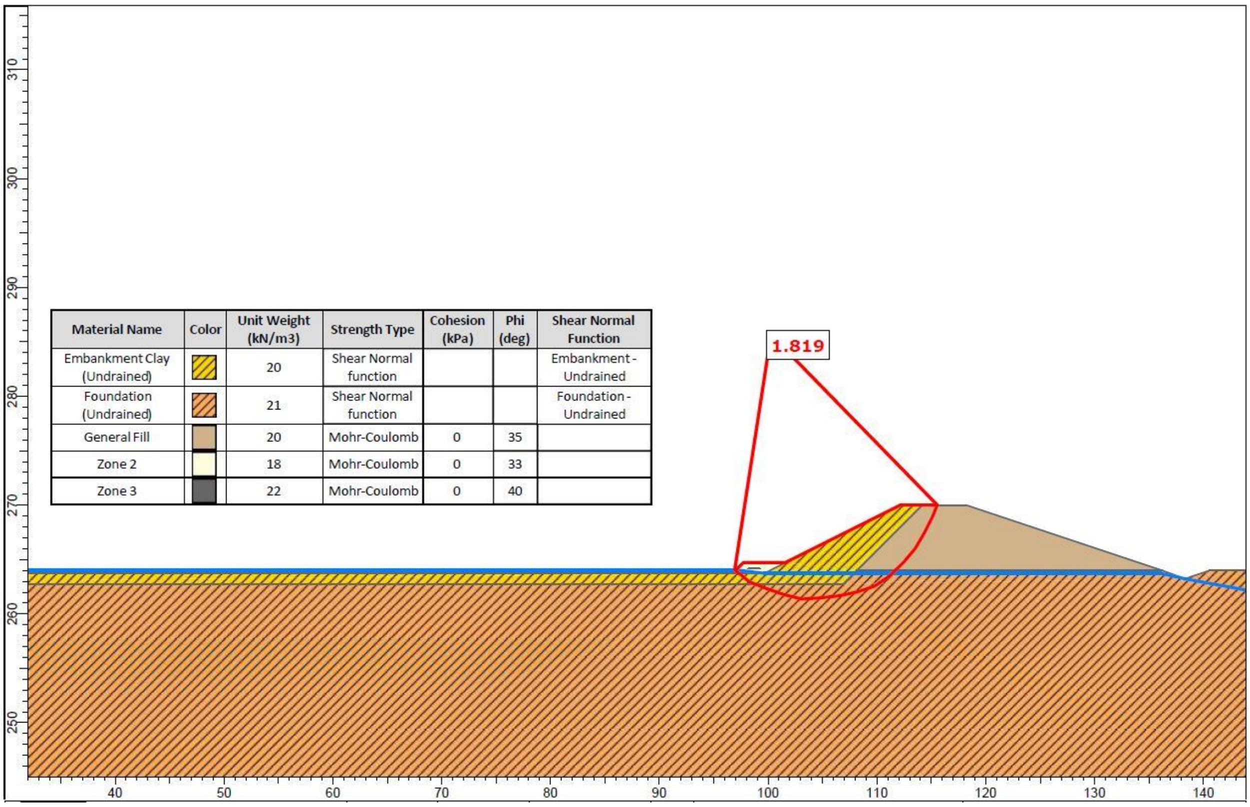
Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	T.Swinoga J.Chan	J.De La Rosa	* J.De La Rosa	R. Longey	* R. Longey	14/09/2021

Appendix D

RSF2 Slope Stability Analysis

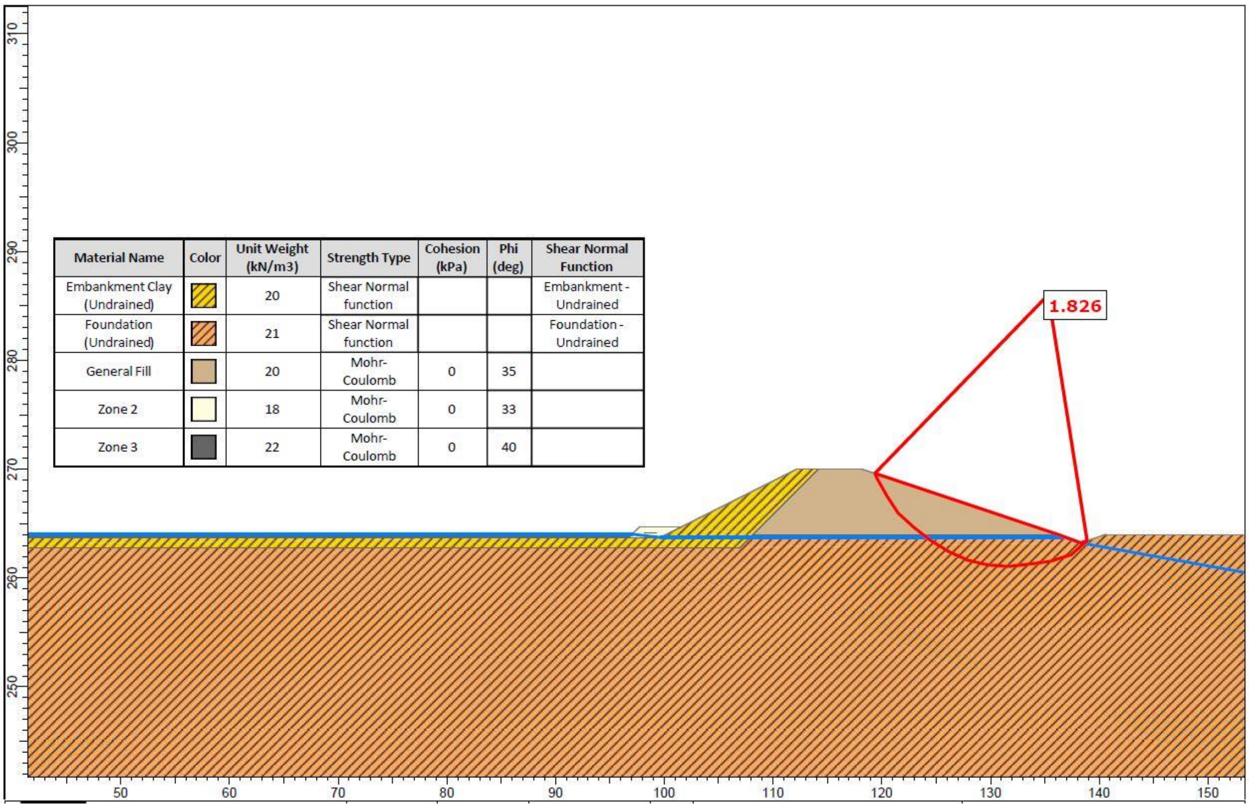
Perimeter Embankment

Stage 1



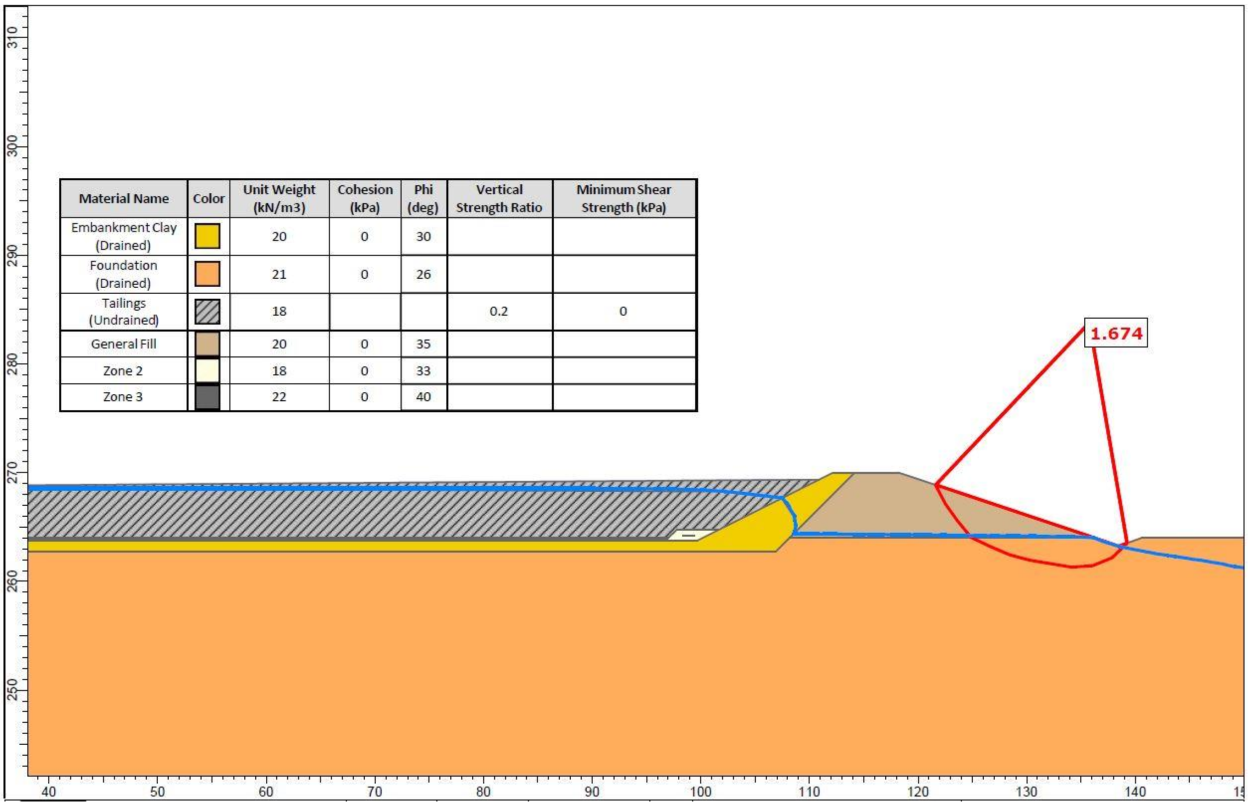
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained
Foundation (Undrained)	▨	21	Shear Normal function			Foundation - Undrained
General Fill	■	20	Mohr-Coulomb	0	35	
Zone 2	□	18	Mohr-Coulomb	0	33	
Zone 3	■	22	Mohr-Coulomb	0	40	

Perimeter Embankment Stage 1, Short Term Loading Case Upstream



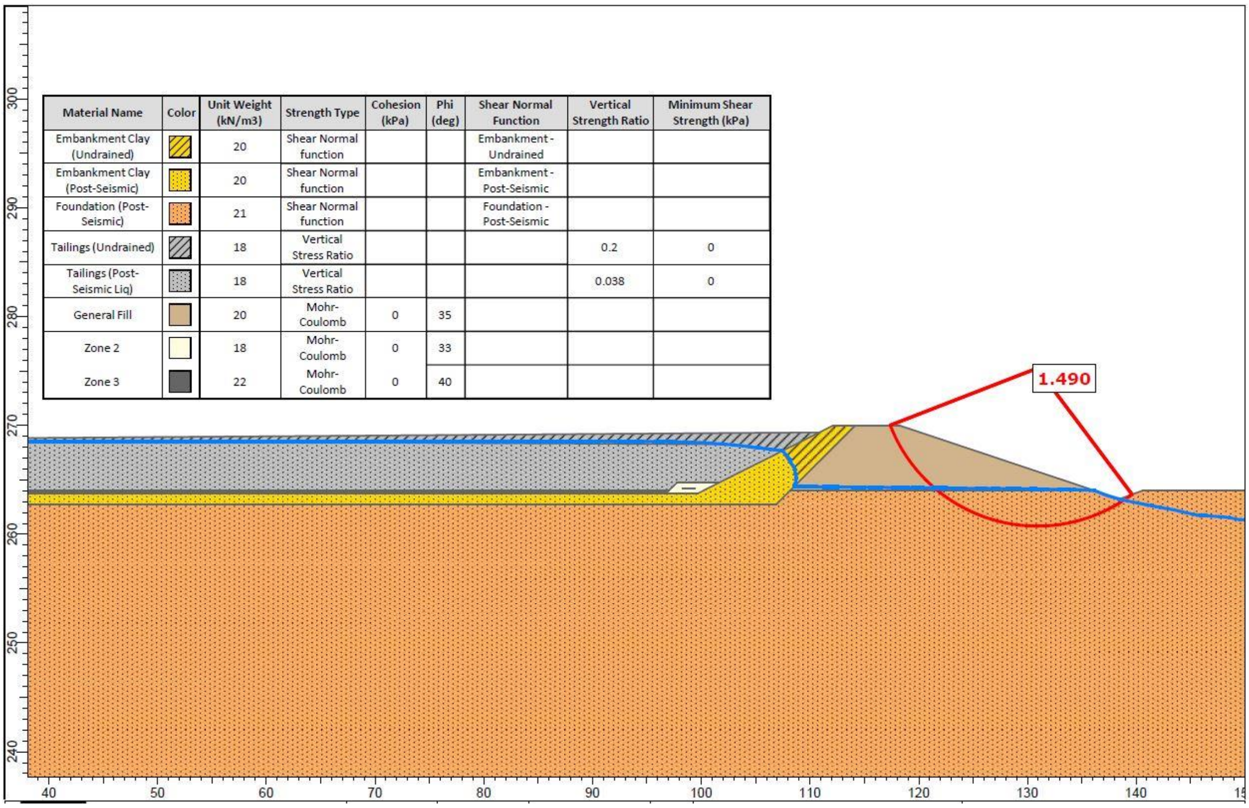
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained
Foundation (Undrained)	▨	21	Shear Normal function			Foundation - Undrained
General Fill	■	20	Mohr-Coulomb	0	35	
Zone 2	□	18	Mohr-Coulomb	0	33	
Zone 3	■	22	Mohr-Coulomb	0	40	

Perimeter Embankment Stage 1, Short Term Loading Case Downstream



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	🟨	20	0	30		
Foundation (Drained)	🟧	21	0	26		
Tailings (Undrained)	▨	18			0.2	0
General Fill	🟫	20	0	35		
Zone 2	□	18	0	33		
Zone 3	⬛	22	0	40		

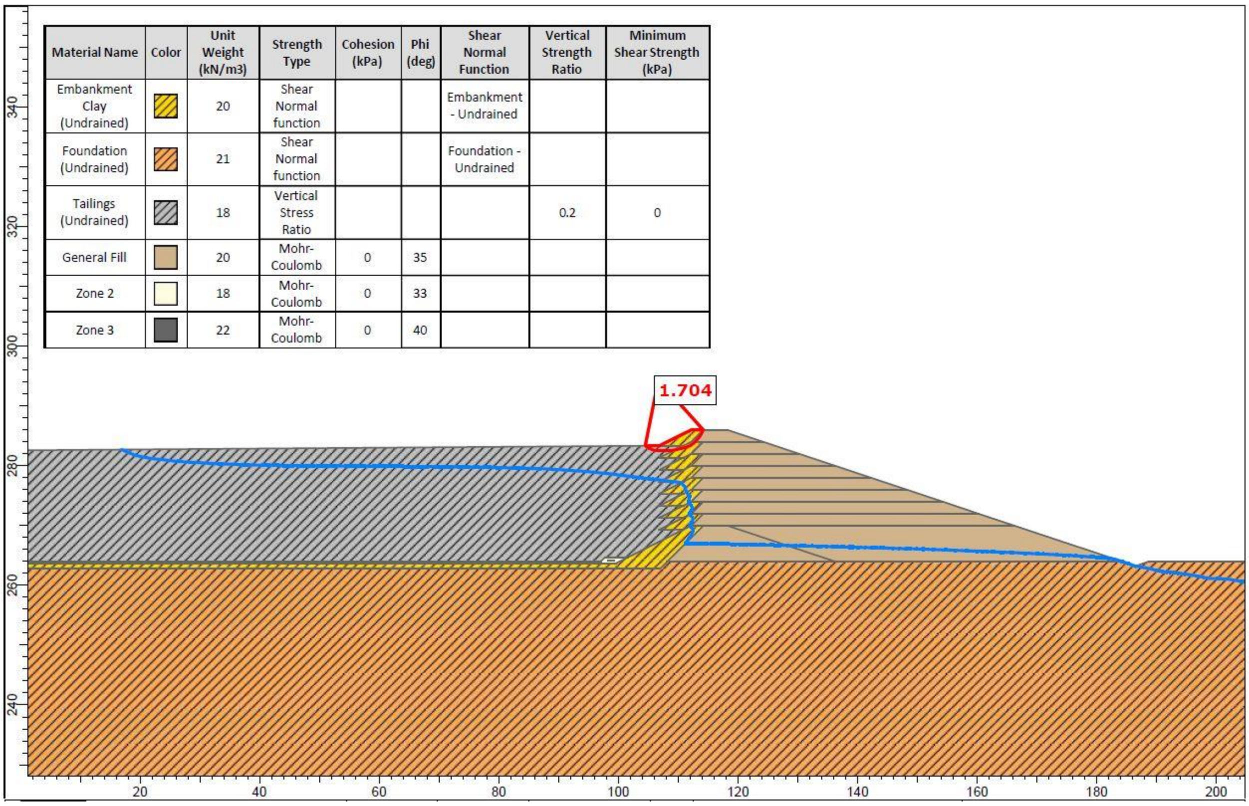
Perimeter Embankment Stage 1, Long Term Loading Case



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained		
Embankment Clay (Post-Seismic)	▒	20	Shear Normal function			Embankment - Post-Seismic		
Foundation (Post-Seismic)	▒	21	Shear Normal function			Foundation - Post-Seismic		
Tailings (Undrained)	▨	18	Vertical Stress Ratio				0.2	0
Tailings (Post-Seismic Liq)	▒	18	Vertical Stress Ratio				0.038	0
General Fill	🟫	20	Mohr-Coulomb	0	35			
Zone 2	□	18	Mohr-Coulomb	0	33			
Zone 3	⬛	22	Mohr-Coulomb	0	40			

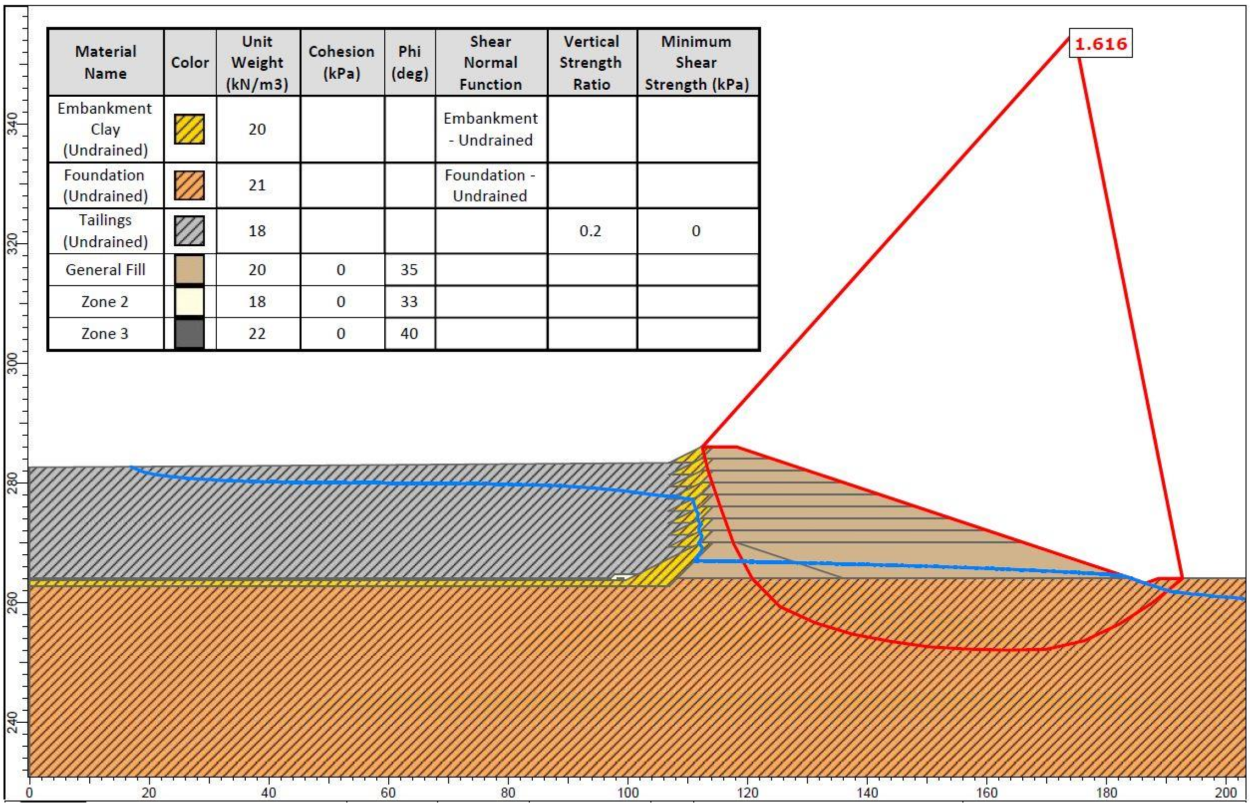
Perimeter Embankment Stage 1, Post Seismic Loading Case

Stage 9



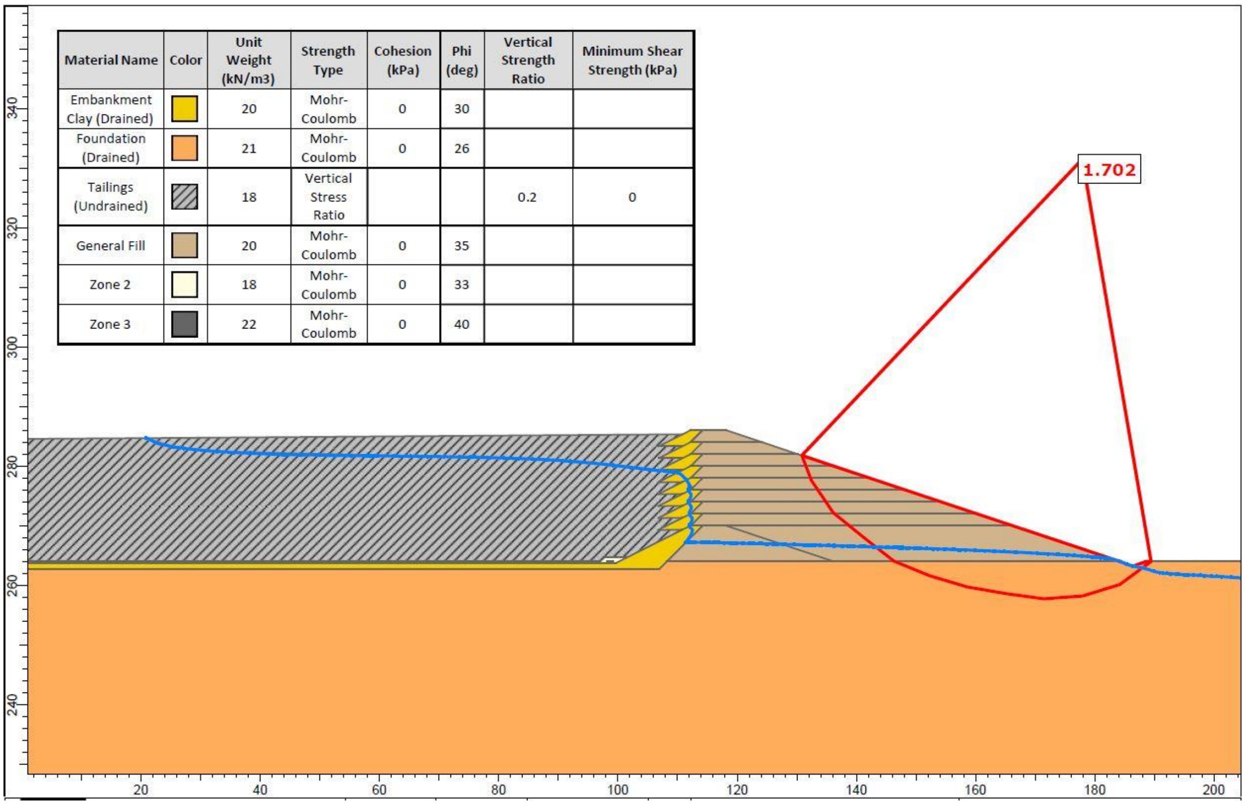
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained		
Foundation (Undrained)	▨	21	Shear Normal function			Foundation - Undrained		
Tailings (Undrained)	▨	18	Vertical Stress Ratio				0.2	0
General Fill	■	20	Mohr-Coulomb	0	35			
Zone 2	□	18	Mohr-Coulomb	0	33			
Zone 3	■	22	Mohr-Coulomb	0	40			

Perimeter Embankment Stage 9, Short Term Loading Case Upstream



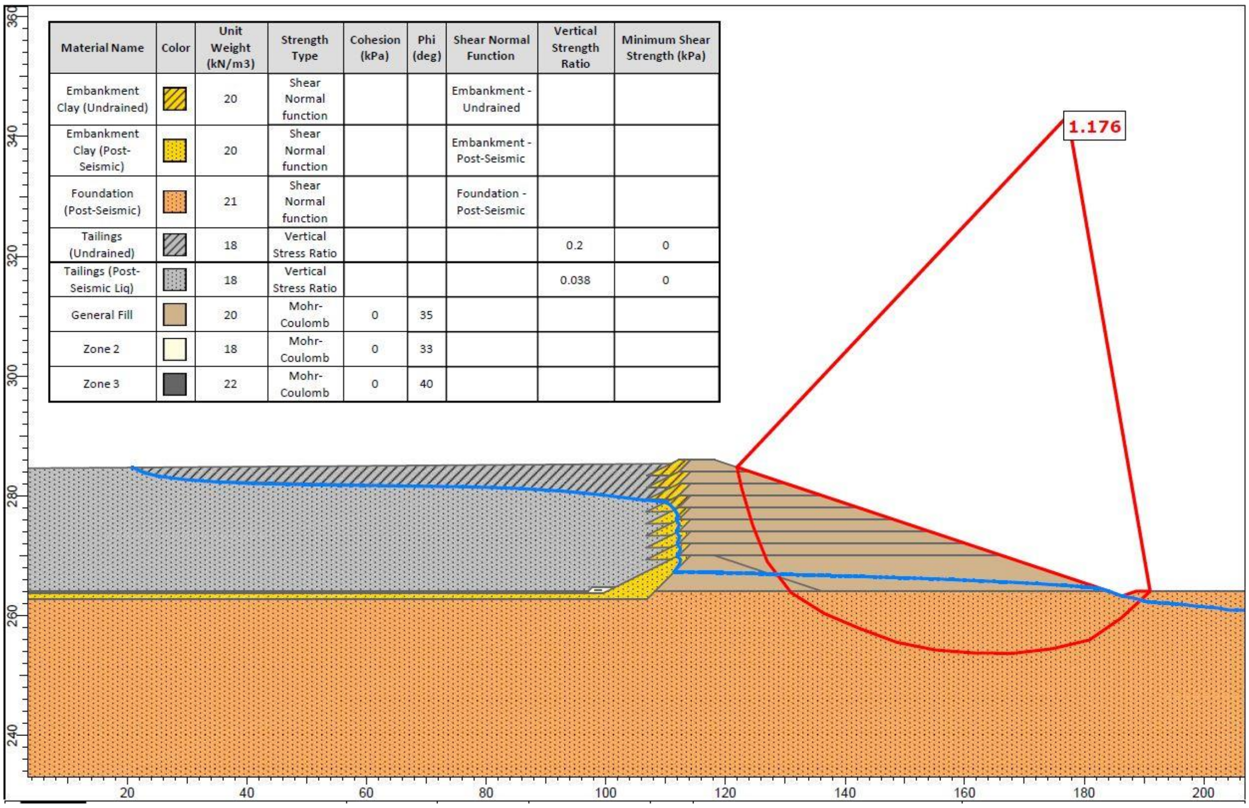
Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20			Embankment - Undrained		
Foundation (Undrained)	▨	21			Foundation - Undrained		
Tailings (Undrained)	▨	18				0.2	0
General Fill	■	20	0	35			
Zone 2	□	18	0	33			
Zone 3	■	22	0	40			

Perimeter Embankment Stage 9, Short Term Loading Case Downstream



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	🟨	20	Mohr-Coulomb	0	30		
Foundation (Drained)	🟧	21	Mohr-Coulomb	0	26		
Tailings (Undrained)	▨	18	Vertical Stress Ratio			0.2	0
General Fill	🟫	20	Mohr-Coulomb	0	35		
Zone 2	⬜	18	Mohr-Coulomb	0	33		
Zone 3	⬛	22	Mohr-Coulomb	0	40		

Perimeter Embankment Stage 9, Long Term Loading Case

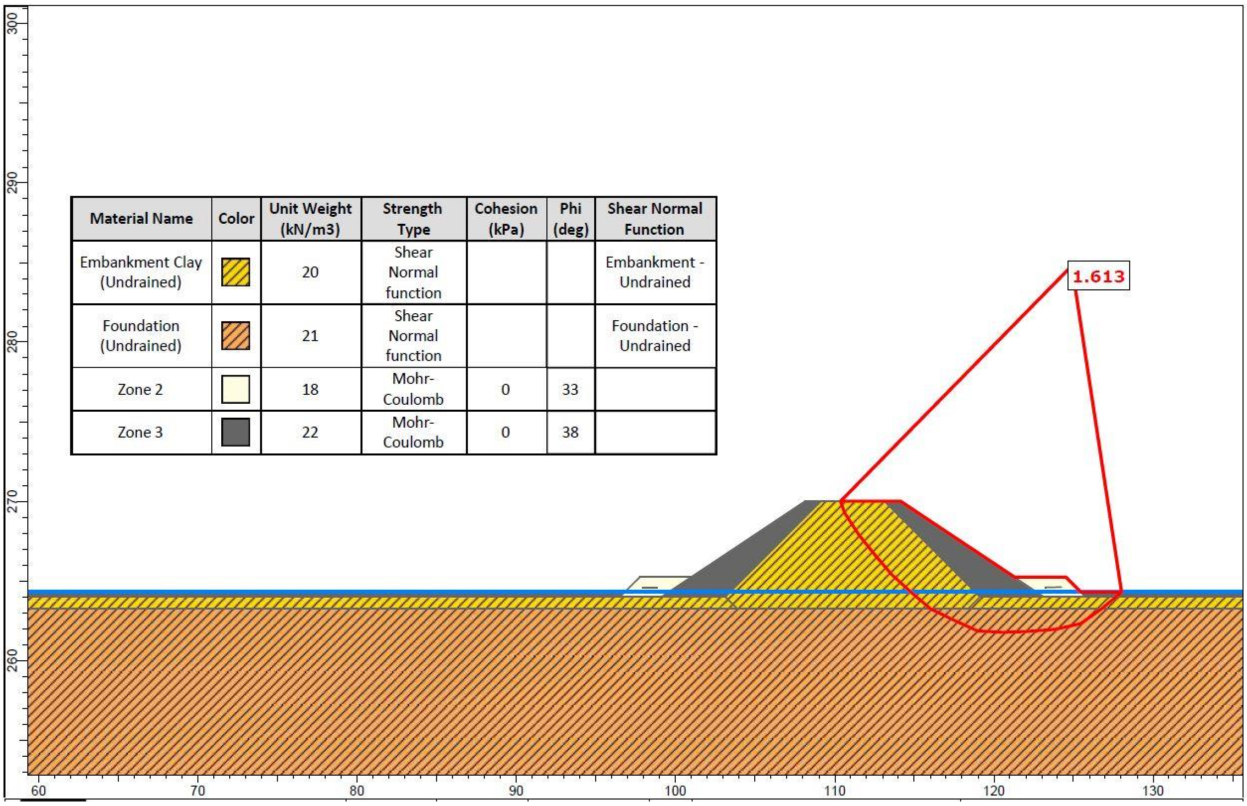


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained		
Embankment Clay (Post-Seismic)	░	20	Shear Normal function			Embankment - Post-Seismic		
Foundation (Post-Seismic)	░	21	Shear Normal function			Foundation - Post-Seismic		
Tailings (Undrained)	▨	18	Vertical Stress Ratio				0.2	0
Tailings (Post-Seismic Liq)	░	18	Vertical Stress Ratio				0.038	0
General Fill	🟫	20	Mohr-Coulomb	0	35			
Zone 2	⬜	18	Mohr-Coulomb	0	33			
Zone 3	⬛	22	Mohr-Coulomb	0	40			

Perimeter Embankment Stage 9, Post Seismic Loading Case

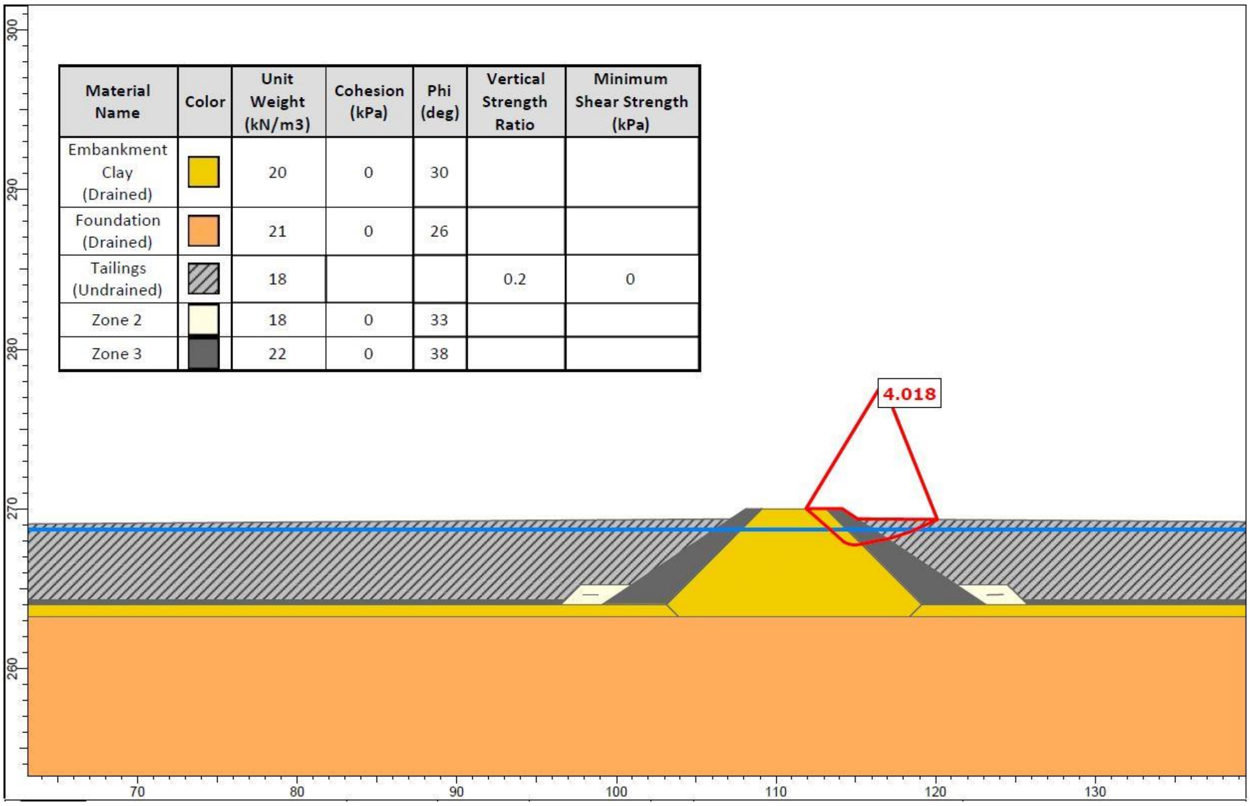
Common Wall

Stage 1



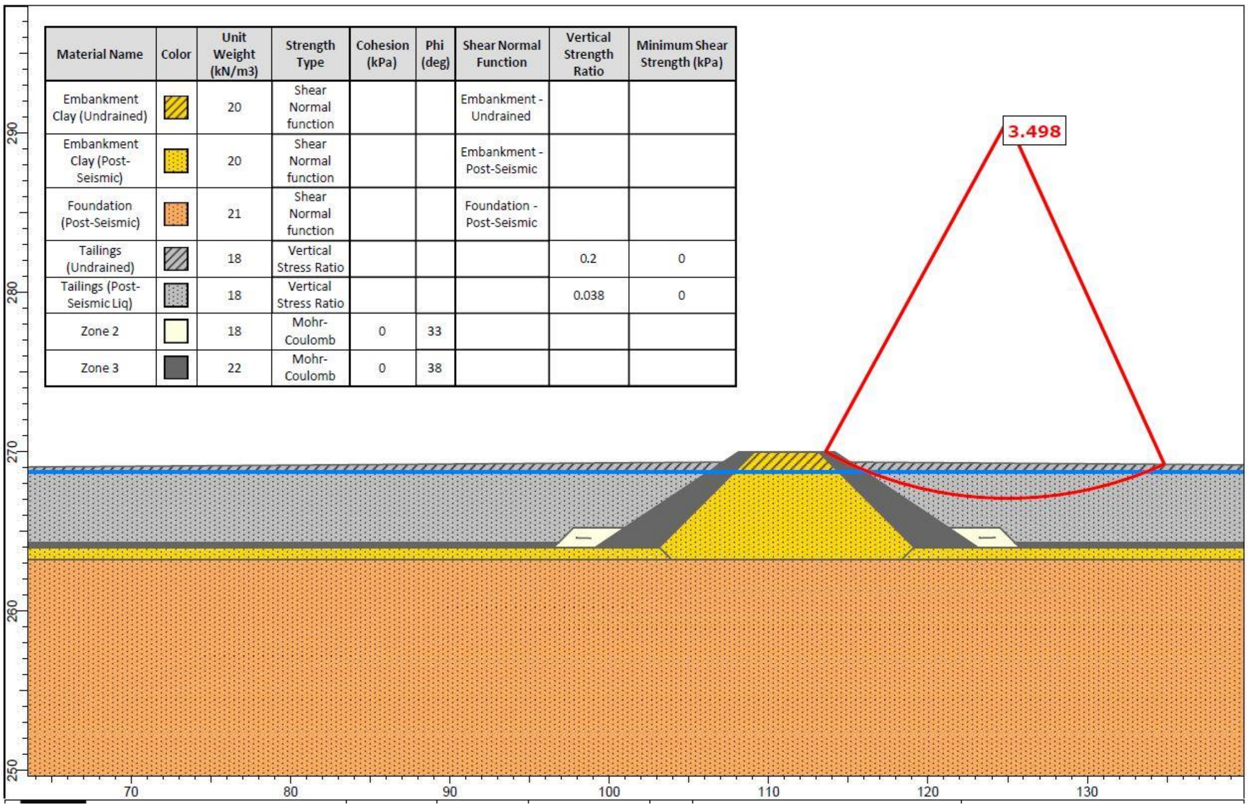
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained
Foundation (Undrained)	▨	21	Shear Normal function			Foundation - Undrained
Zone 2	□	18	Mohr-Coulomb	0	33	
Zone 3	■	22	Mohr-Coulomb	0	38	

Common Wall Stage 1, Short Term Loading Case



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	■	20	0	30		
Foundation (Drained)	■	21	0	26		
Tailings (Undrained)	▨	18			0.2	0
Zone 2	□	18	0	33		
Zone 3	■	22	0	38		

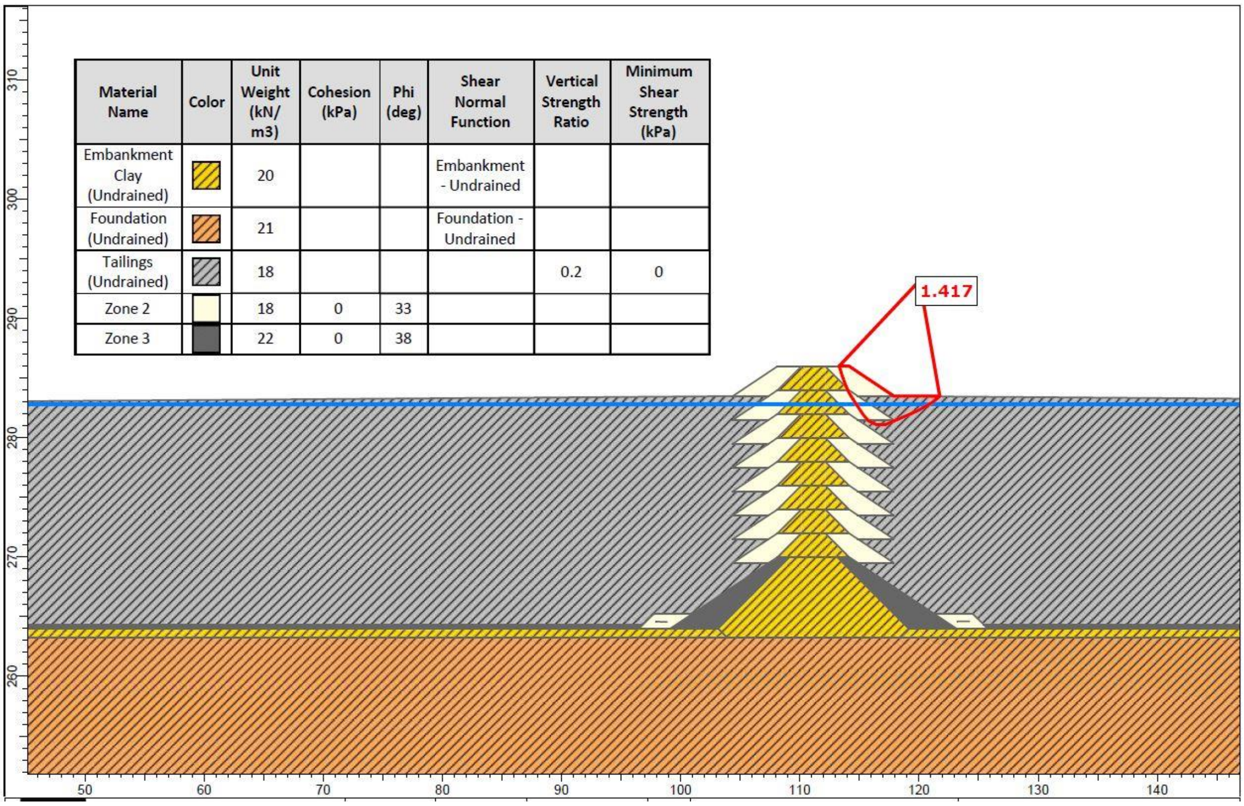
Common Wall Stage 1, Long Term Loading Case



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained		
Embankment Clay (Post-Seismic)	▒	20	Shear Normal function			Embankment - Post-Seismic		
Foundation (Post-Seismic)	▒	21	Shear Normal function			Foundation - Post-Seismic		
Tailings (Undrained)	▨	18	Vertical Stress Ratio				0.2	0
Tailings (Post-Seismic Liq)	▒	18	Vertical Stress Ratio				0.038	0
Zone 2	□	18	Mohr-Coulomb	0	33			
Zone 3	■	22	Mohr-Coulomb	0	38			

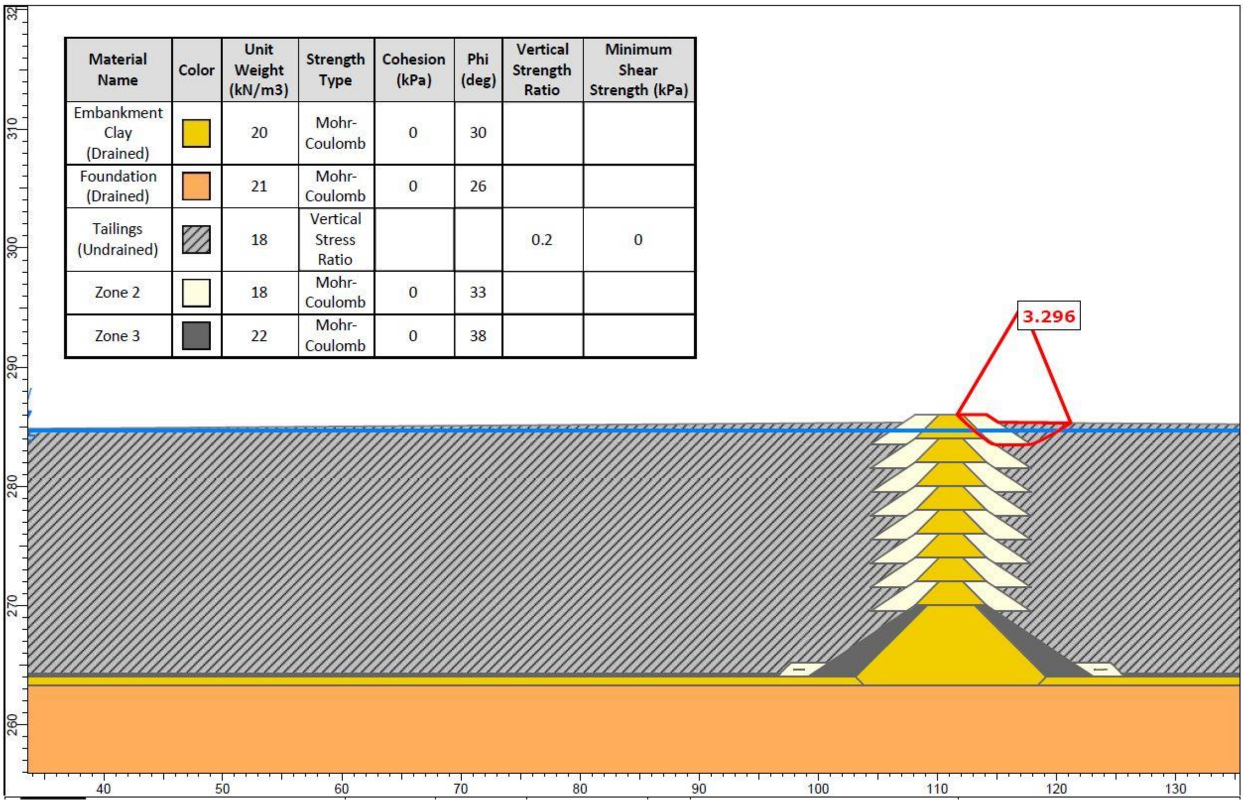
Common Wall Stage 1, Post Seismic Loading Case

Stage 9



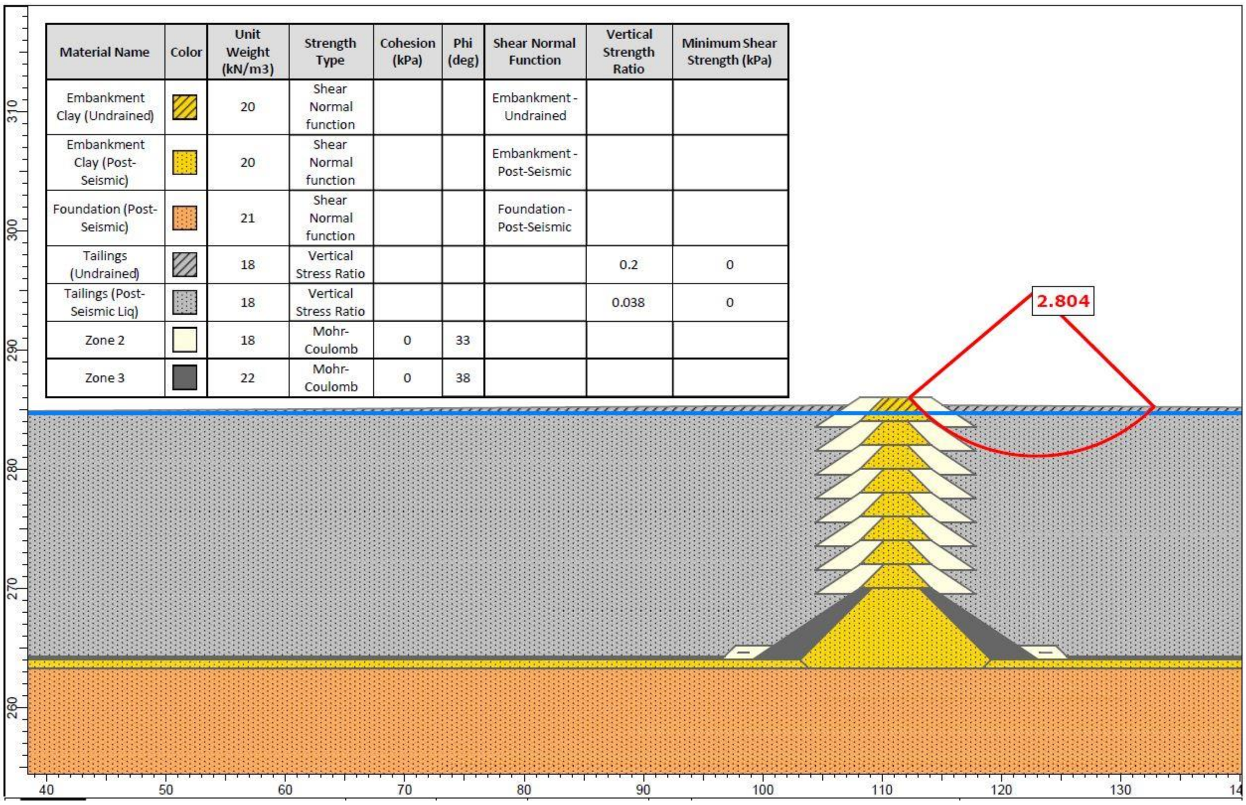
Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20			Embankment - Undrained		
Foundation (Undrained)	▨	21			Foundation - Undrained		
Tailings (Undrained)	▨	18				0.2	0
Zone 2	□	18	0	33			
Zone 3	■	22	0	38			

Common Wall Stage 9, Short Term Loading Case



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Drained)	🟨	20	Mohr-Coulomb	0	30		
Foundation (Drained)	🟧	21	Mohr-Coulomb	0	26		
Tailings (Undrained)	▨	18	Vertical Stress Ratio			0.2	0
Zone 2	□	18	Mohr-Coulomb	0	33		
Zone 3	■	22	Mohr-Coulomb	0	38		

Common Wall Stage 9, Long Term Loading Case



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Shear Normal Function	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Embankment Clay (Undrained)	▨	20	Shear Normal function			Embankment - Undrained		
Embankment Clay (Post-Seismic)	🟨	20	Shear Normal function			Embankment - Post-Seismic		
Foundation (Post-Seismic)	🟧	21	Shear Normal function			Foundation - Post-Seismic		
Tailings (Undrained)	▨	18	Vertical Stress Ratio				0.2	0
Tailings (Post-Seismic Liq)	▩	18	Vertical Stress Ratio				0.038	0
Zone 2	□	18	Mohr-Coulomb	0	33			
Zone 3	■	22	Mohr-Coulomb	0	38			

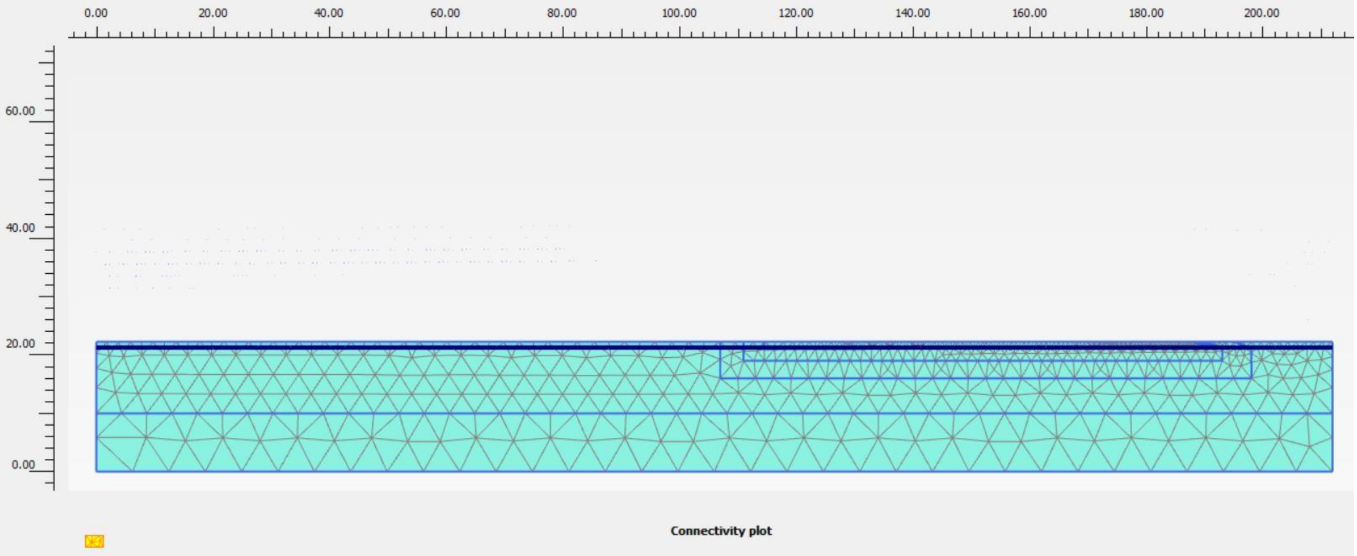
Common Wall Stage 9, Post Seismic Loading Case

Appendix E

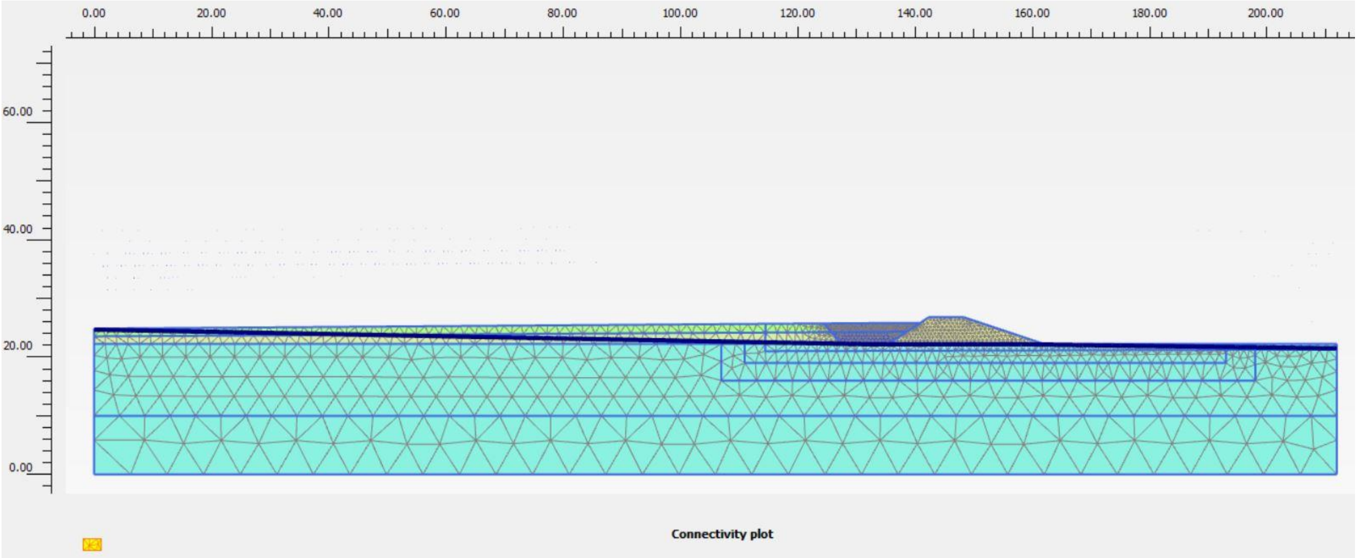
RSF2 Finite Element Modelling

Construction Stages

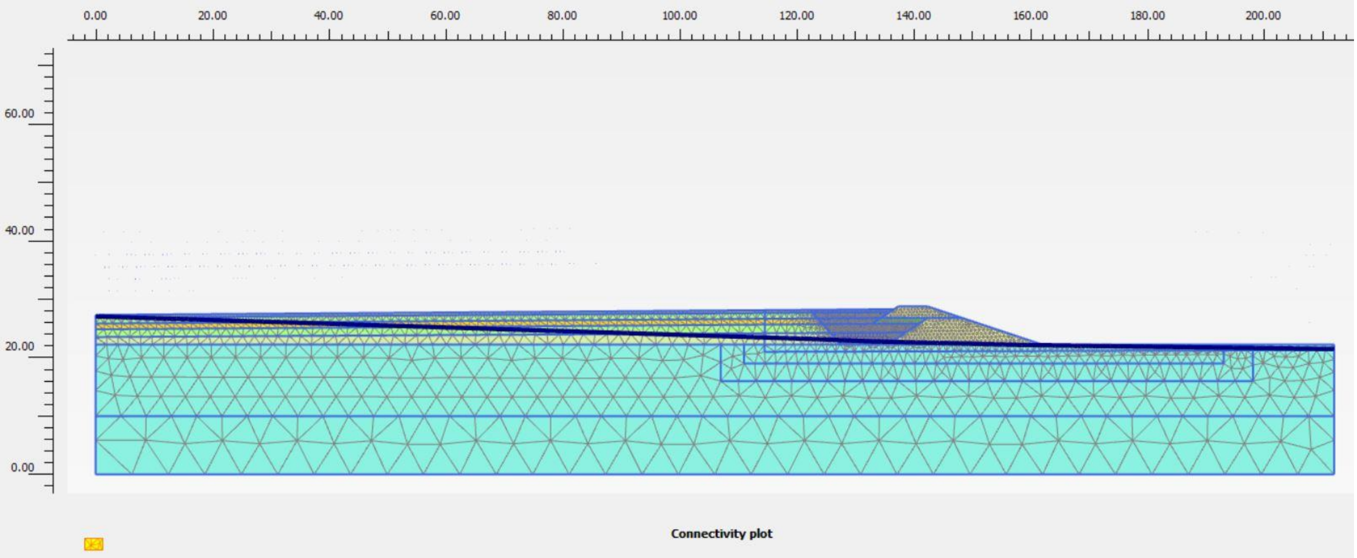
RSF 1



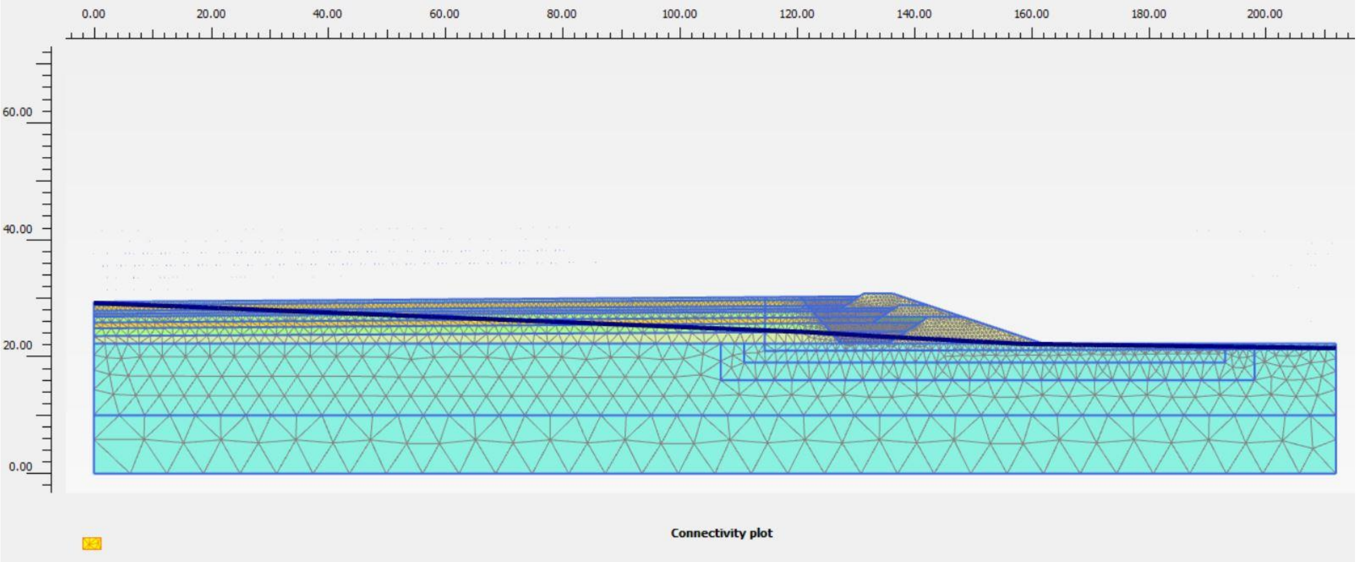
Stage 1: Setting up initial stress stage of in-situ field prior to the construction of the Starter Dam (See Figure 0.3).



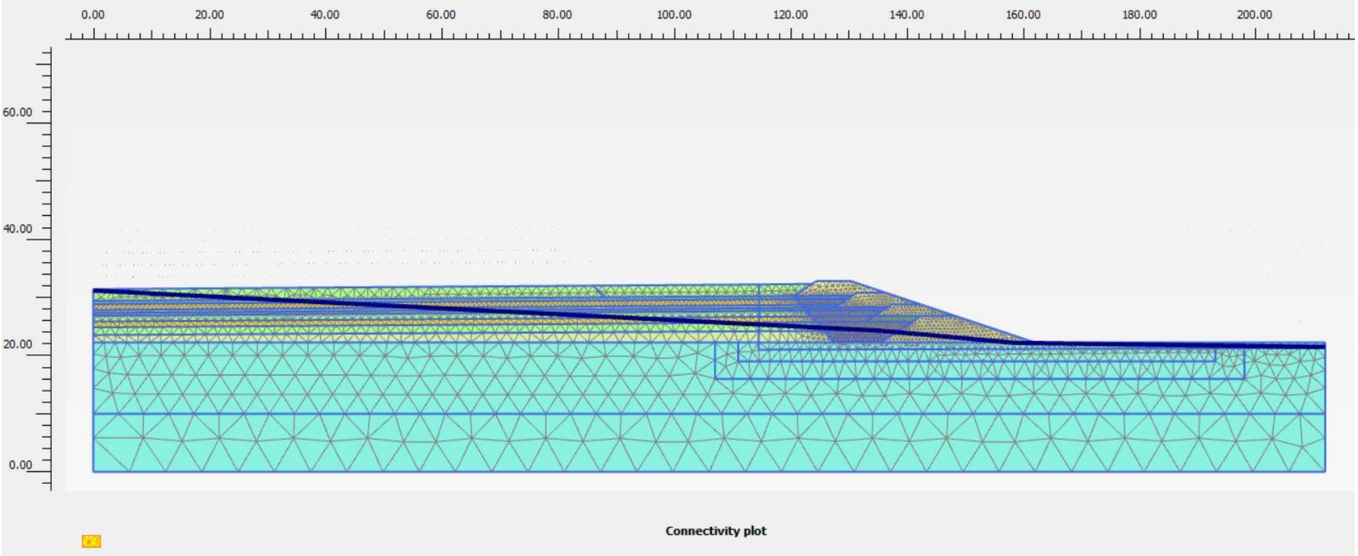
Stage 2: Construction of the Starter Dam. Tailings deposition to RL 269.85 m



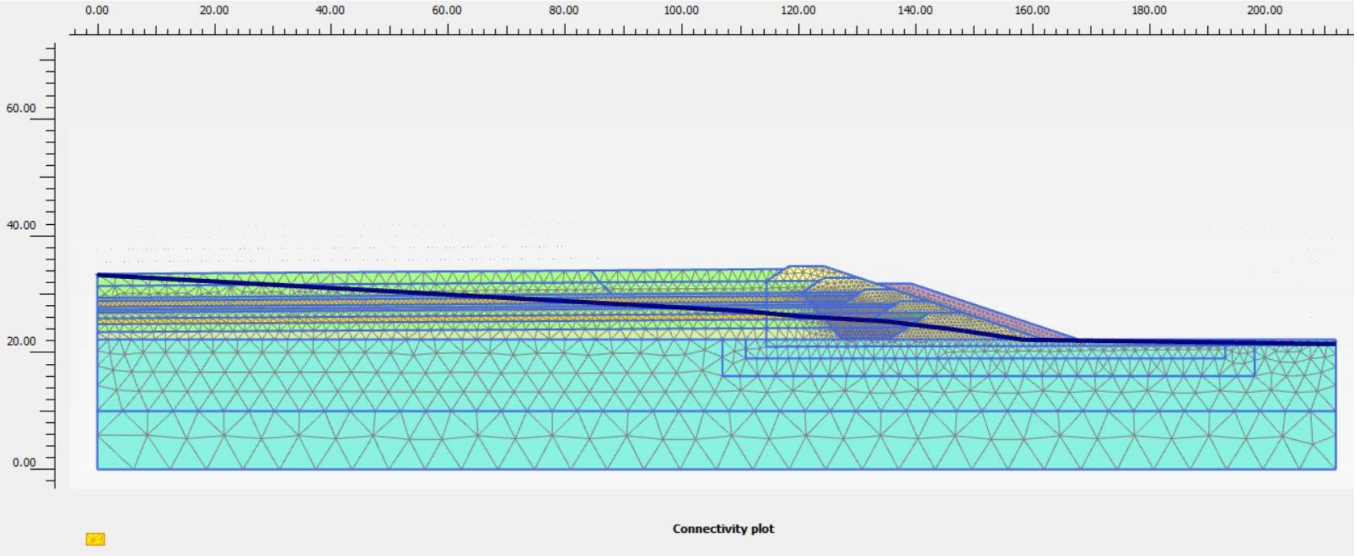
Stage 3: Construction of embankment raise 2. Tailings deposition to RL 271.85 m.



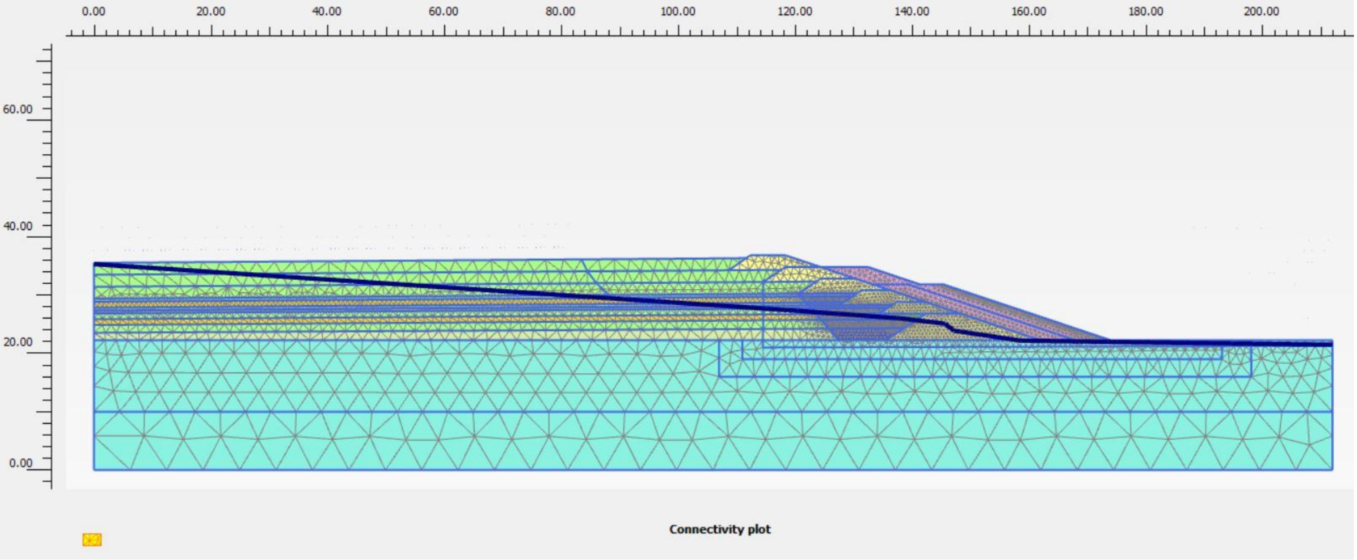
Stage 4: Construction of embankment raise 3. Tailings deposition to RL 273.85 m



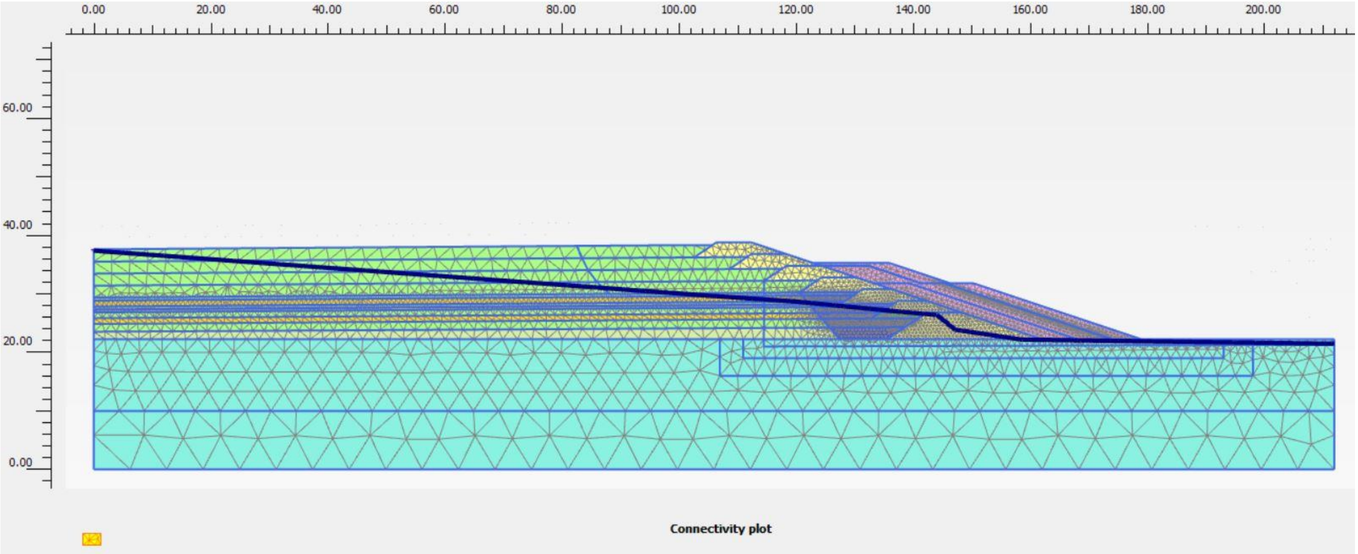
Stage 5:Construction of embankment raise 4. Tailings deposition to RL 275.85 m



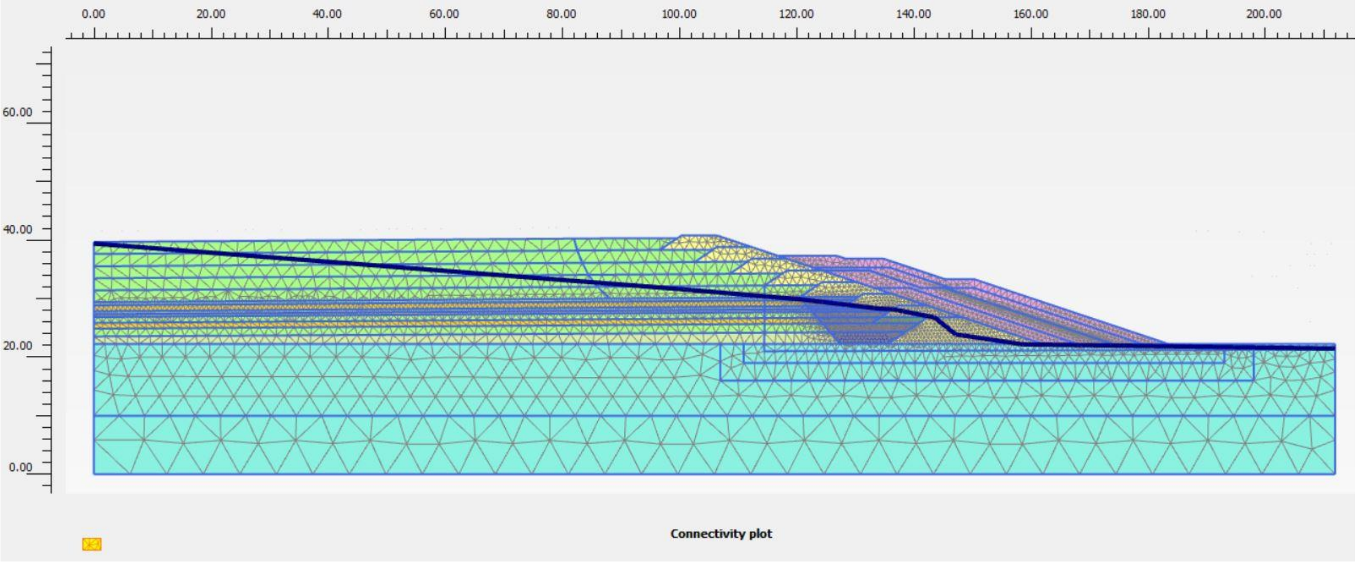
Stage 6: Construction of embankment raise 5 and buttress 1. Tailings deposition to RL 277.85 m



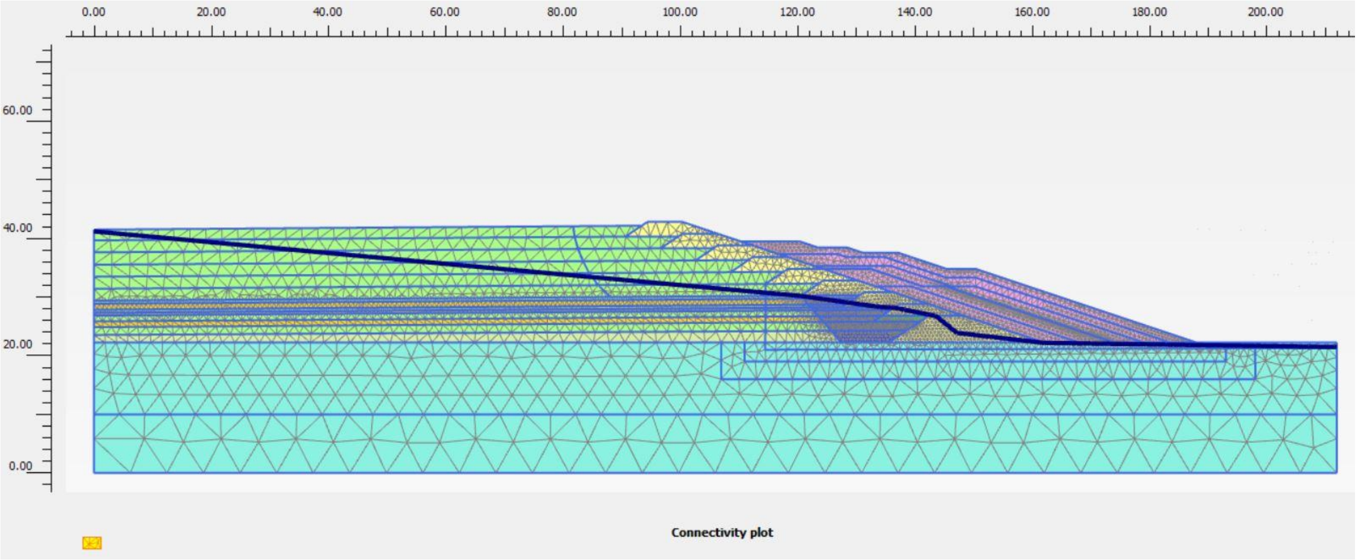
Stage 7: Construction of embankment raise 6 and buttress 2. Tailings deposition to RL 279.85 m



Stage 8: Construction of embankment raise 7 and buttress 3. Tailings deposition to RL 281.85 m

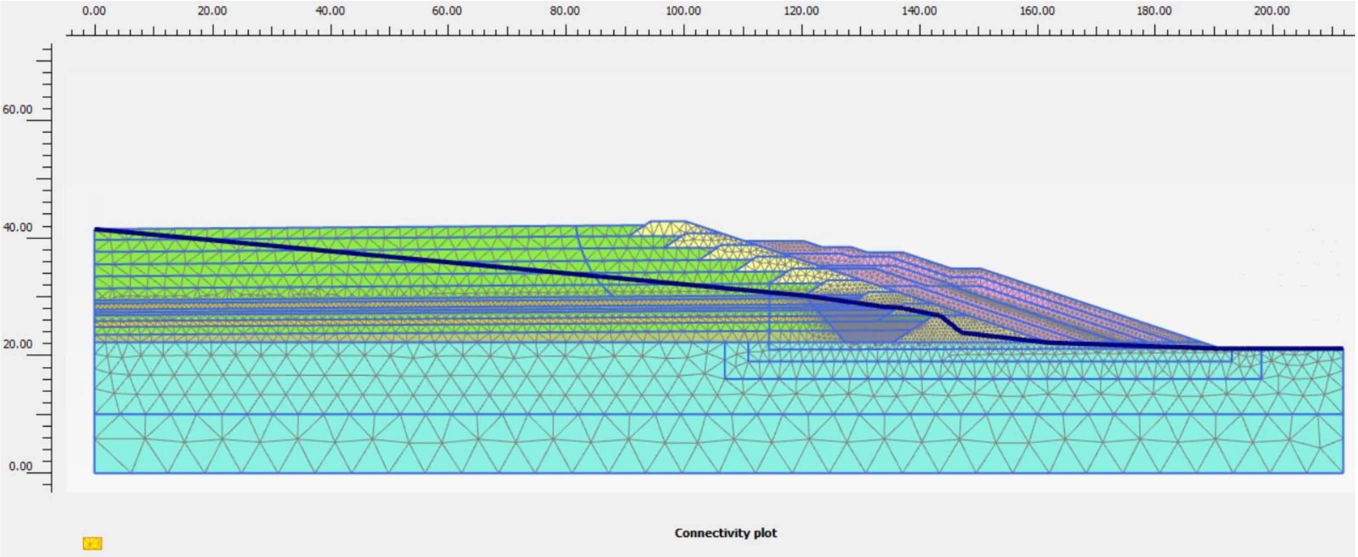


Stage 9: Construction of embankment raise 8 and buttress 4. Tailings deposition to RL 283.85 m

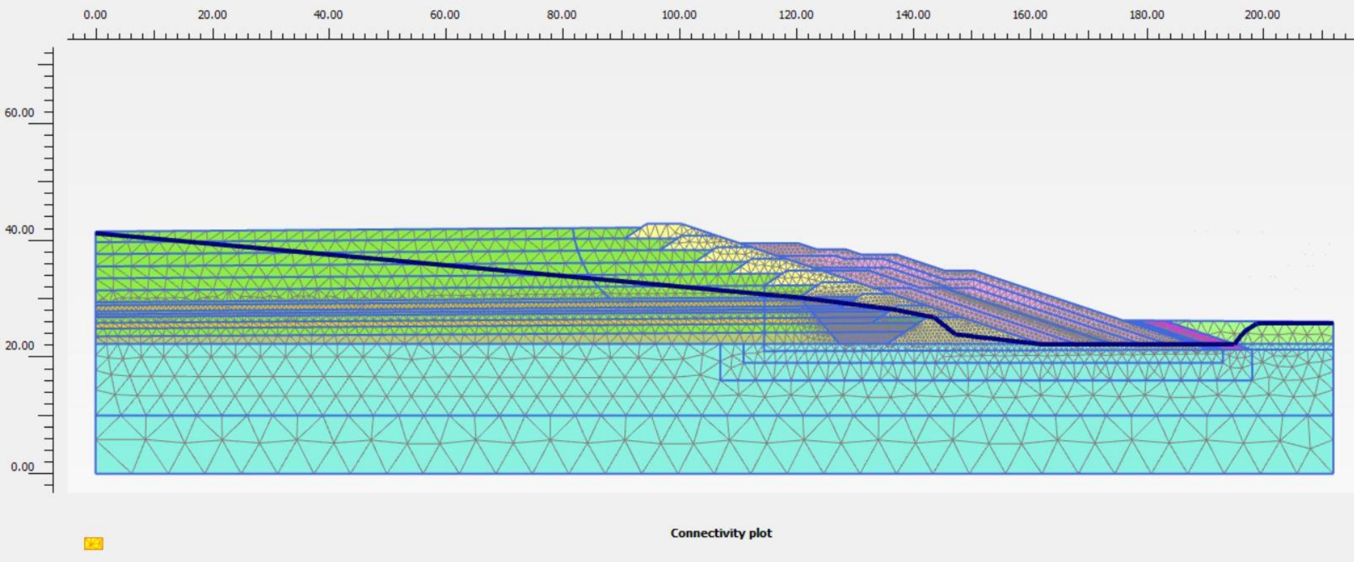


Stage 10: Construction of embankment raise 9 and buttress 5. Tailings deposition to RL 285.85 m

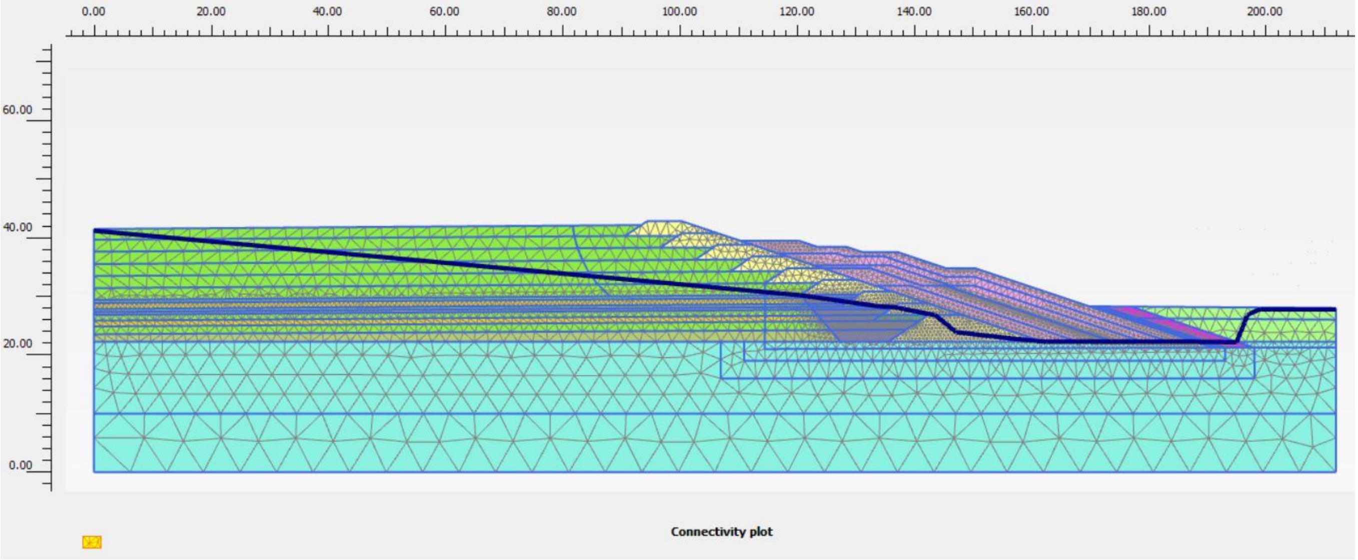
RSF 2



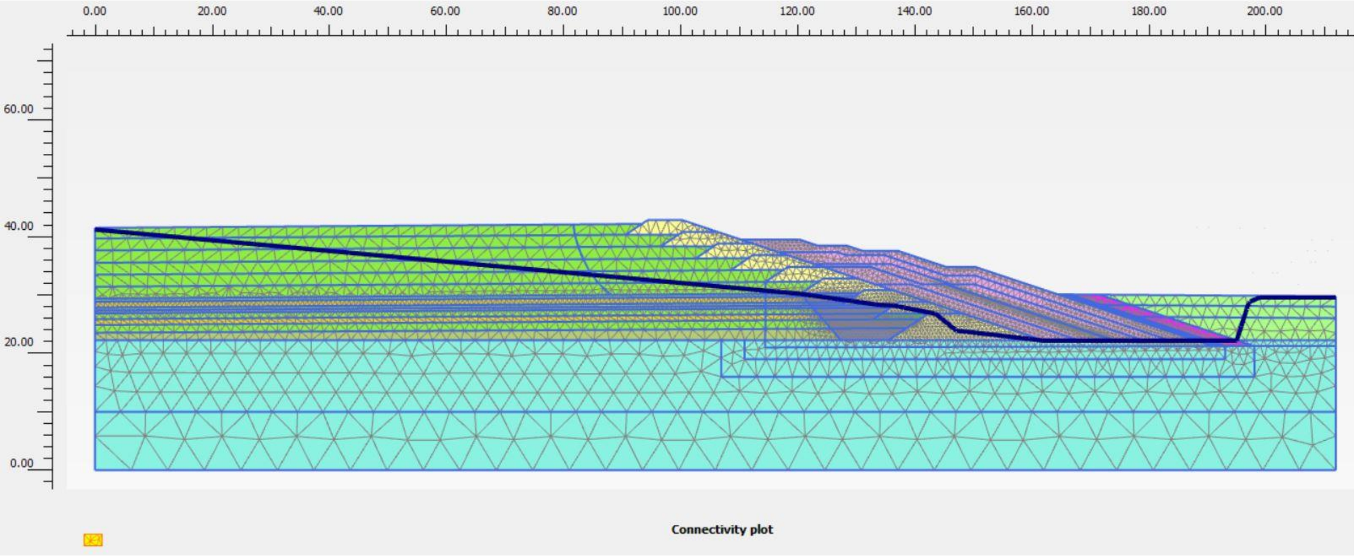
Stage 11: Blanket excavation at the RSF1 downstream toe. Consolidation phase of 10 days. Blanket construction.



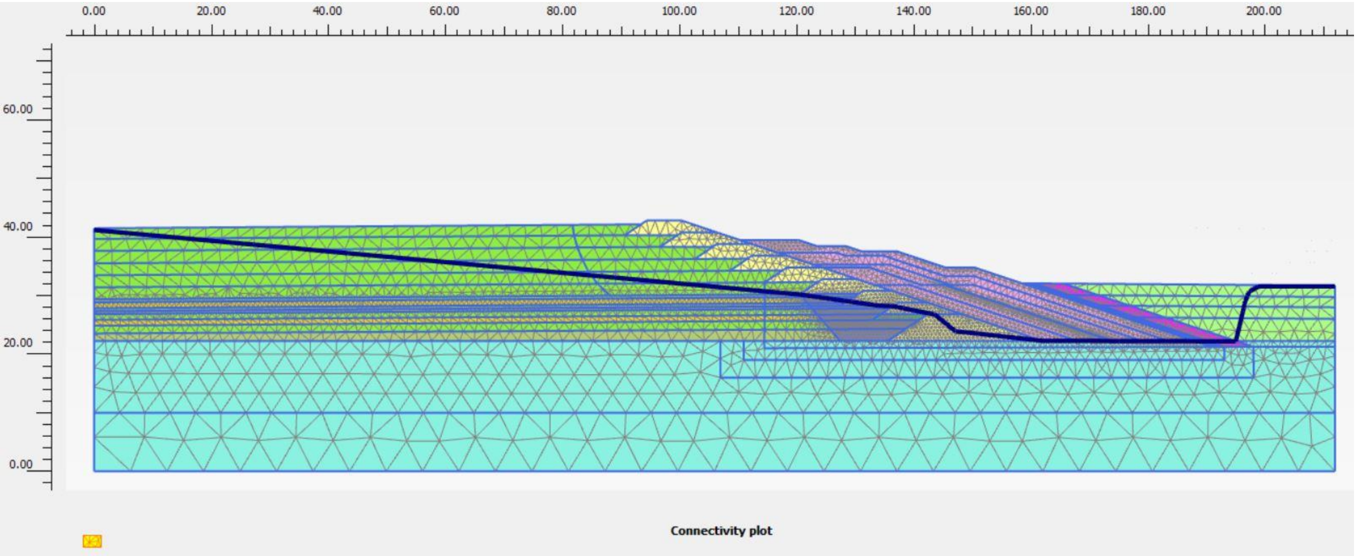
Stage 12: Drainage system construction. Tailings deposition to RL 269.85 m (RSF2 Starter Dam). Consolidation phase of 100 days.



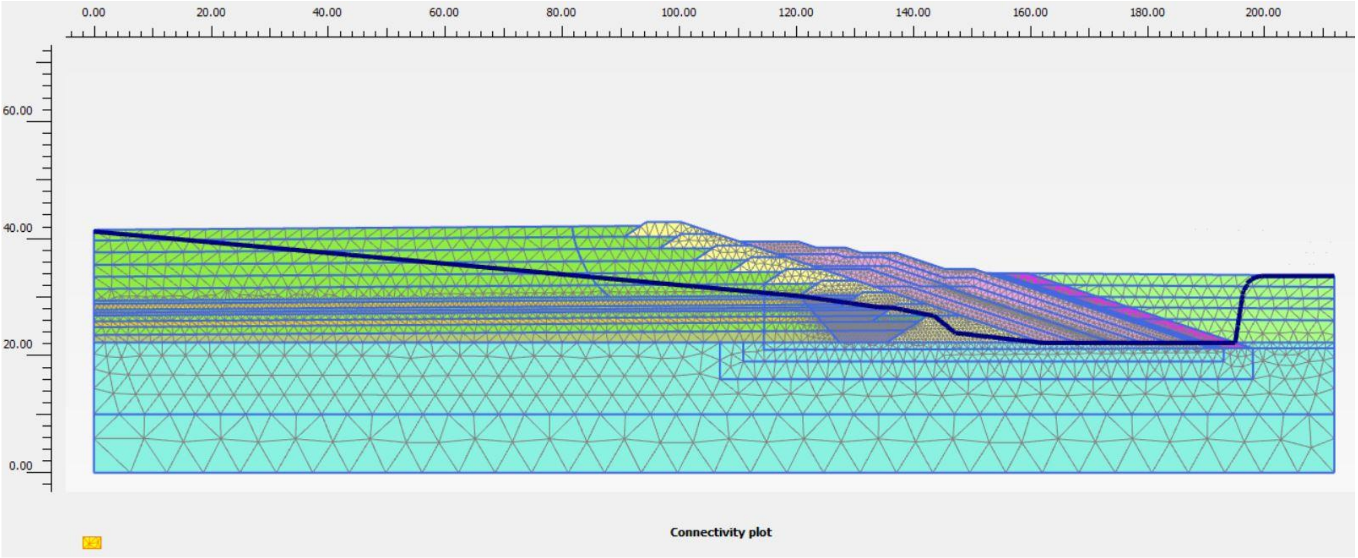
Stage 13: Drainage system construction. Tailings deposition to RL 271.85 m (RSF2 embankment raise 2). Consolidation phase of 100 days



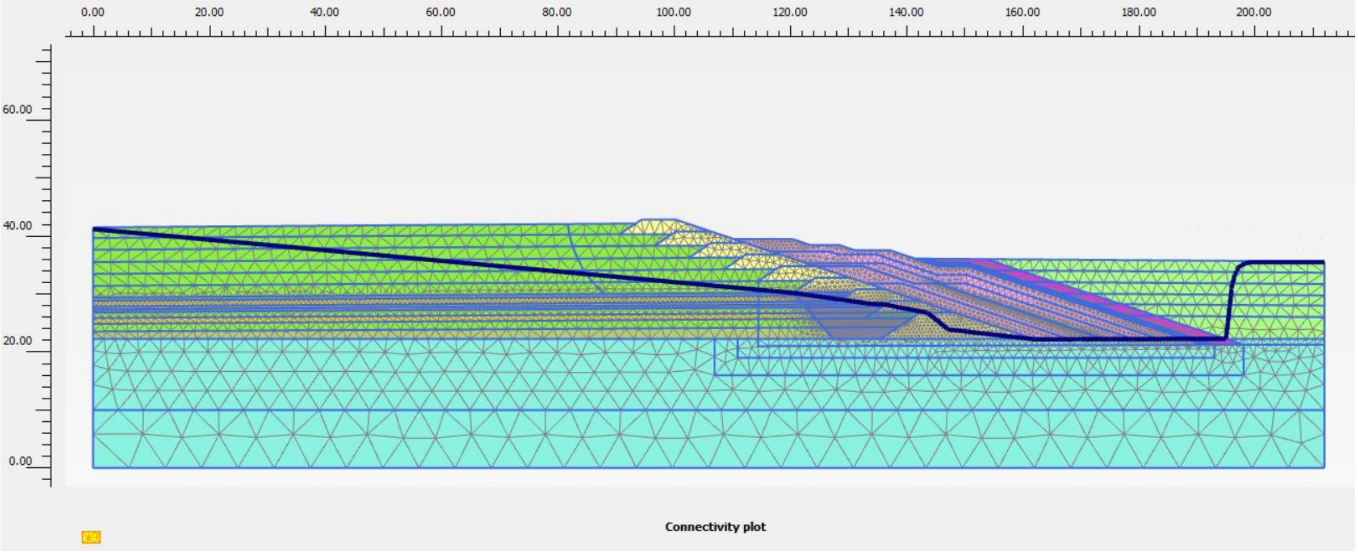
Stage 14: Drainage system construction. Tailings deposition to RL 273.85 m (RSF2 embankment raise 3). Consolidation phase of 100 days



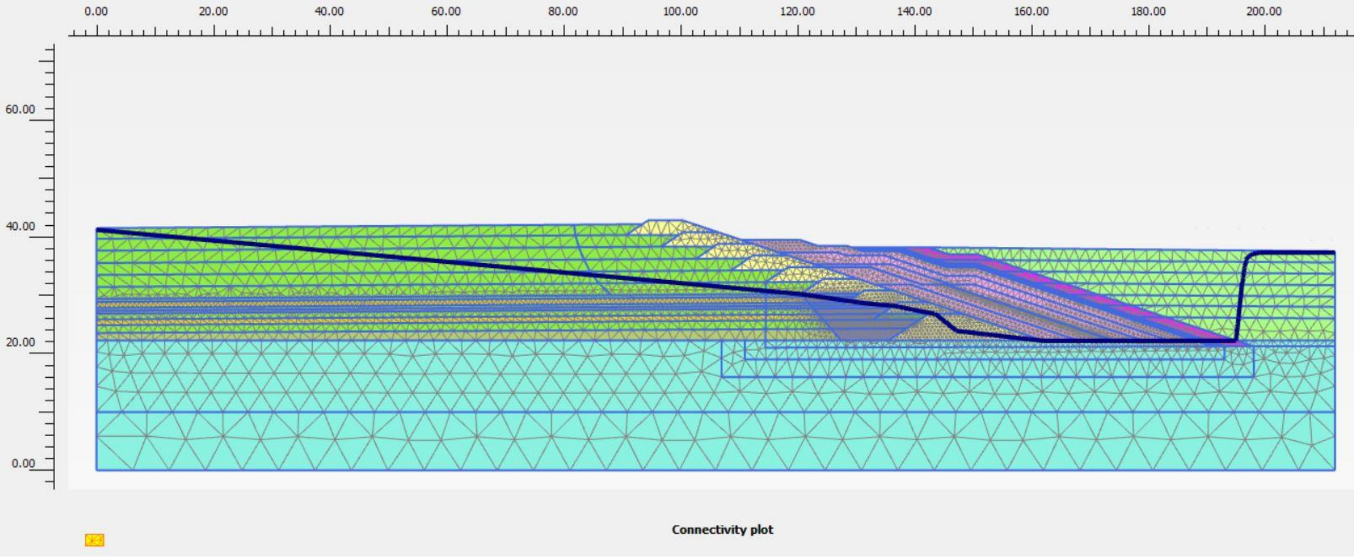
Stage 15: Drainage system construction. Tailings deposition to RL 275.85 m (RSF2 embankment raise 4). Consolidation phase of 100 days



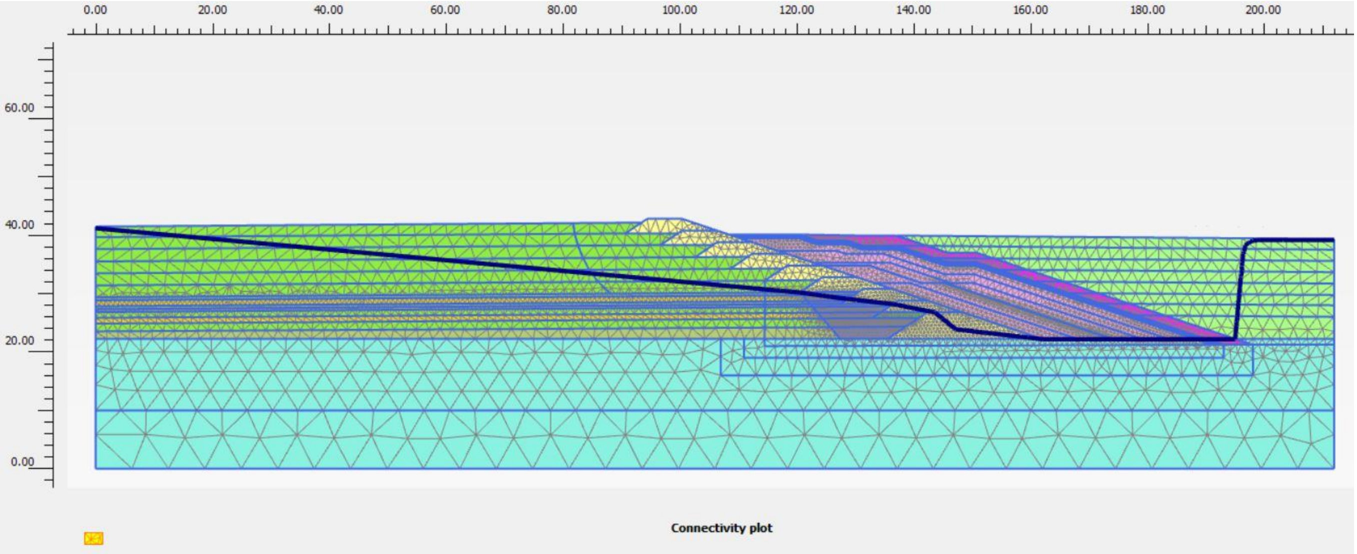
Stage 16: Tailings deposition to RL 277.85 m (RSF2 embankment raise 5). Consolidation phase of 100 days



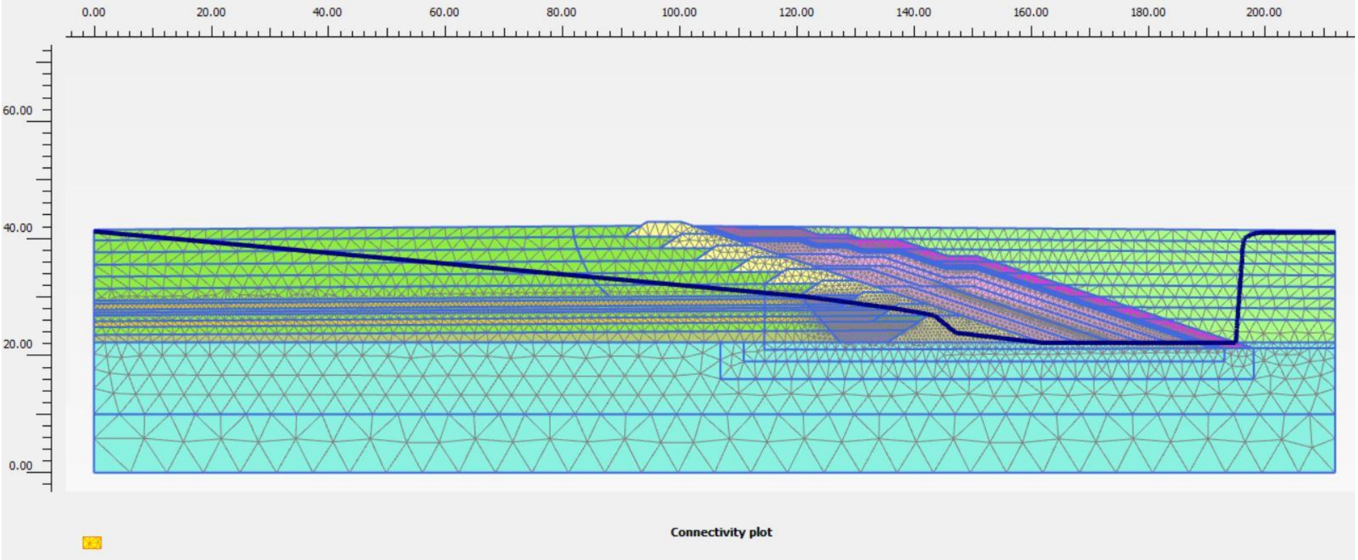
Stage 17: Tailings deposition to RL 279.85 m (RSF2 embankment raise 6). Consolidation phase of 100 days.



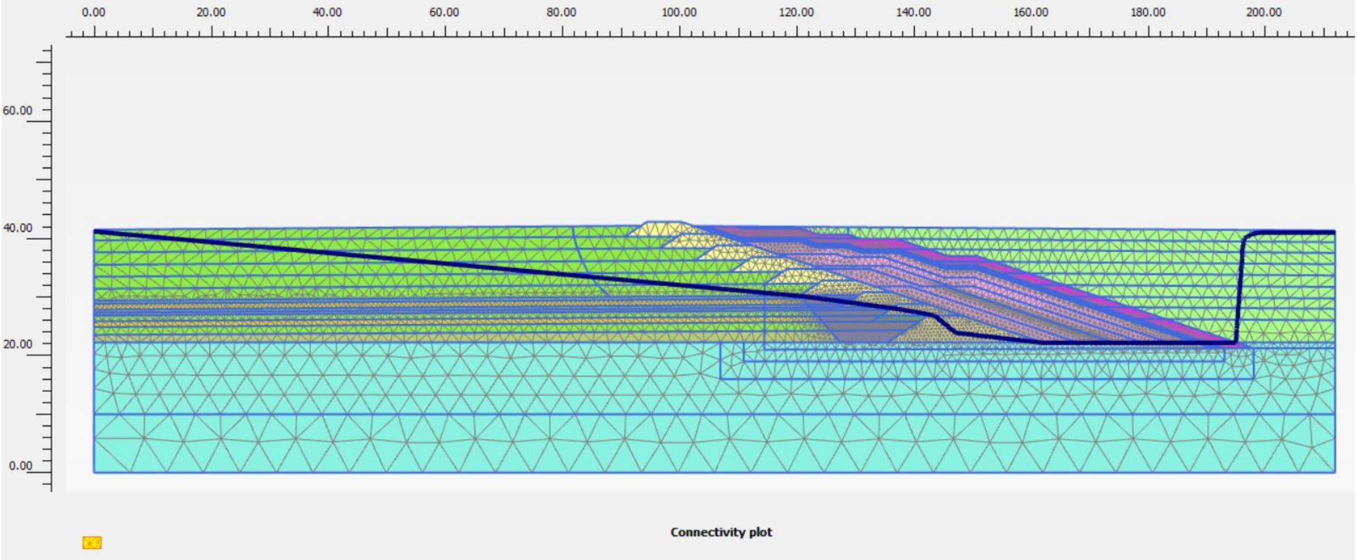
Stage 18: Tailings deposition to RL 279.85 m (RSF2 embankment raise 7). Consolidation phase of 300 days.



Stage 19: Tailings deposition to RL 279.85 m (RSF2 embankment raise 8). Consolidation phase of 300 days



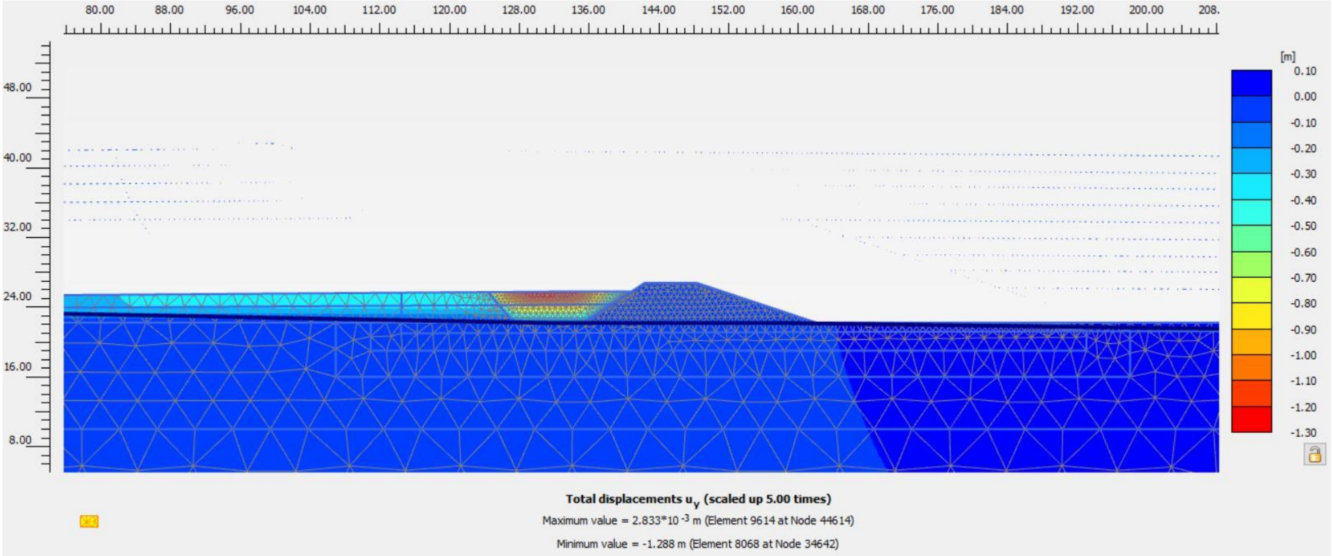
Stage 20: Tailings deposition to RL 279.85 m (RSF2 embankment raise 9). Consolidation phase of 300 days



Stage 21: Long term consolidation phase until tailings pore pressure is less than 10kPa. This condition is reached after 3,584 days

Vertical Displacement

RSF 1

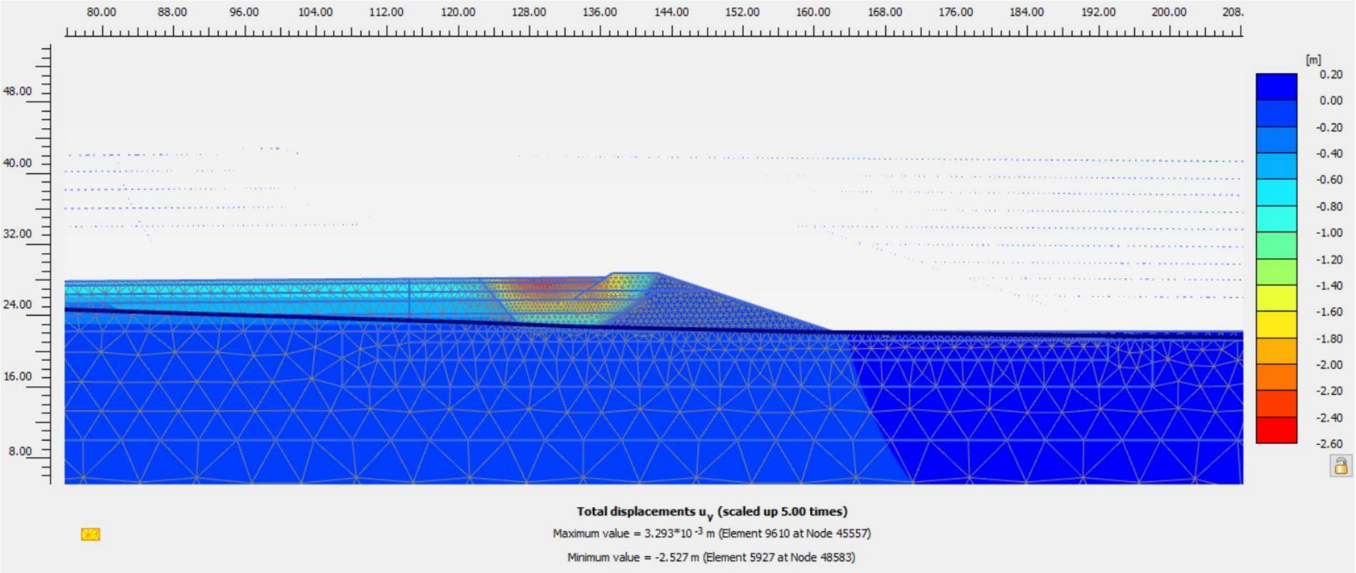


Total displacements u_y (scaled up 5.00 times)

Maximum value = $2.833*10^{-3}$ m (Element 9614 at Node 44614)

Minimum value = -1.288 m (Element 8068 at Node 34642)

Vertical Displacements Stage 2, Construction of the Starter Dam. Tailings deposition to RL 269.85 m

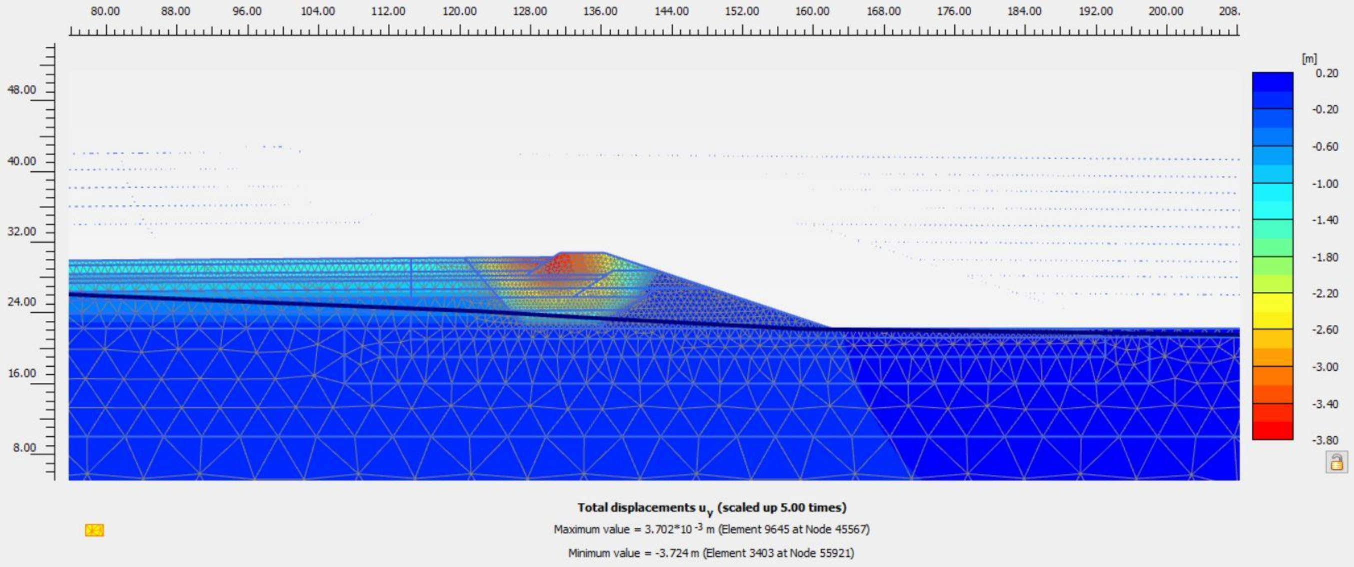


Total displacements u_y (scaled up 5.00 times)

Maximum value = $3.293*10^{-3}$ m (Element 9610 at Node 45557)

Minimum value = -2.527 m (Element 5927 at Node 48583)

Vertical Displacements Stage 3, Construction of embankment raise 2. Tailings deposition to RL 271.85 m.

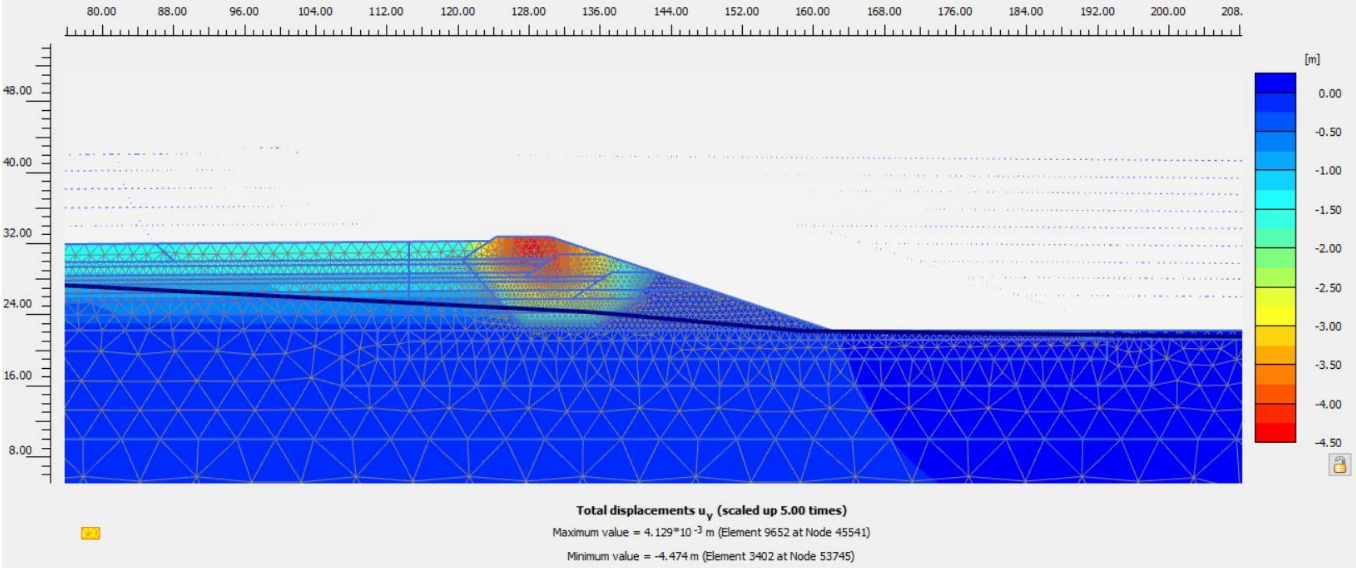


Total displacements u_y (scaled up 5.00 times)

Maximum value = $3.702*10^{-3}$ m (Element 9645 at Node 45567)

Minimum value = -3.724 m (Element 3403 at Node 55921)

Vertical Displacements Stage 4, Construction of embankment raise 3. Tailings deposition to RL 273.85 m

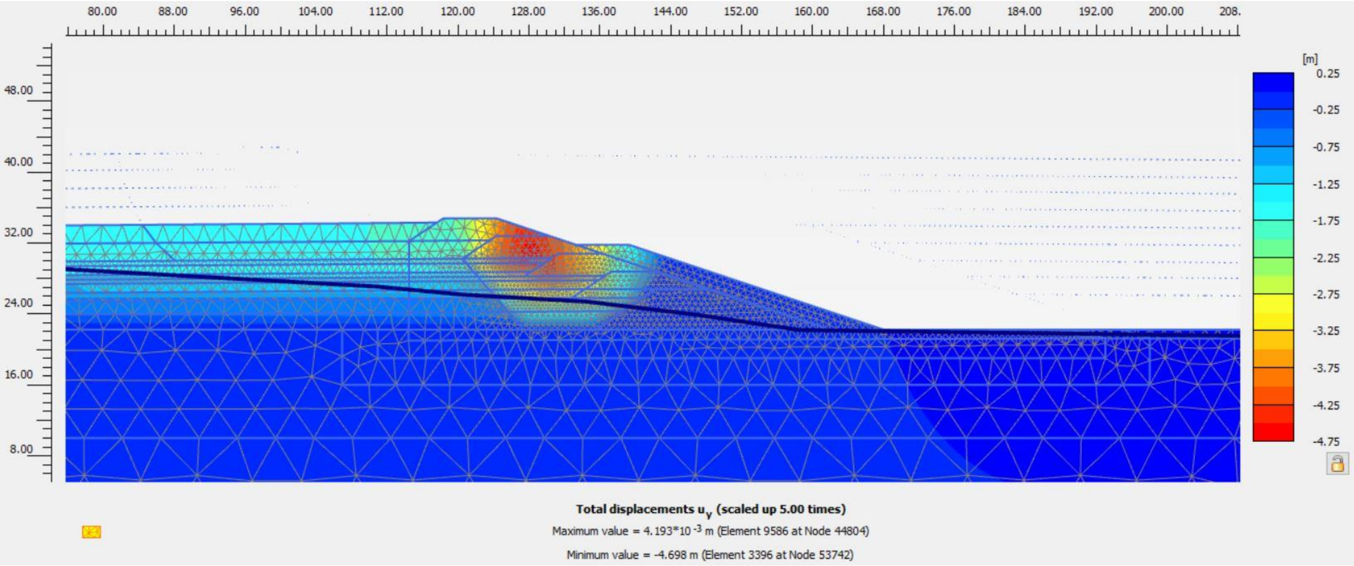


Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.129*10^{-3}$ m (Element 9652 at Node 45541)

Minimum value = -4.474 m (Element 3402 at Node 53745)

Vertical Displacements Stage 5, Construction of embankment raise 4. Tailings deposition to RL 275.85 m

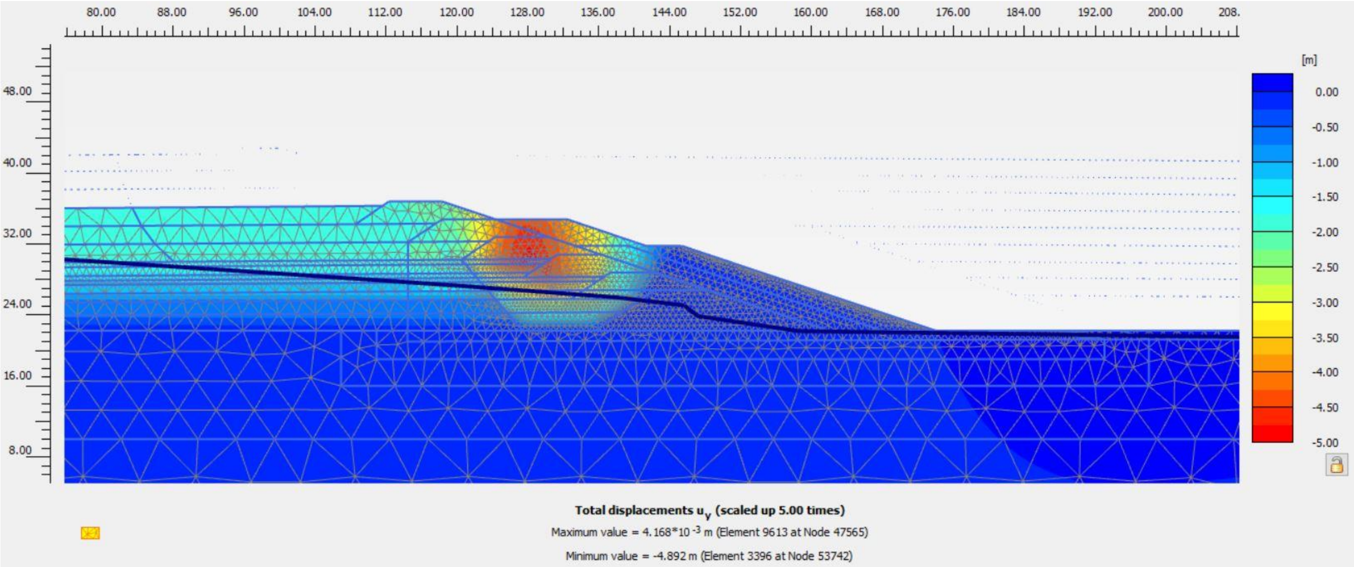


Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.193*10^{-3}$ m (Element 9586 at Node 44804)

Minimum value = -4.698 m (Element 3396 at Node 53742)

Vertical Displacements Stage 6, Construction of embankment raise 5 and buttress 1. Tailings deposition to RL 277.85 m

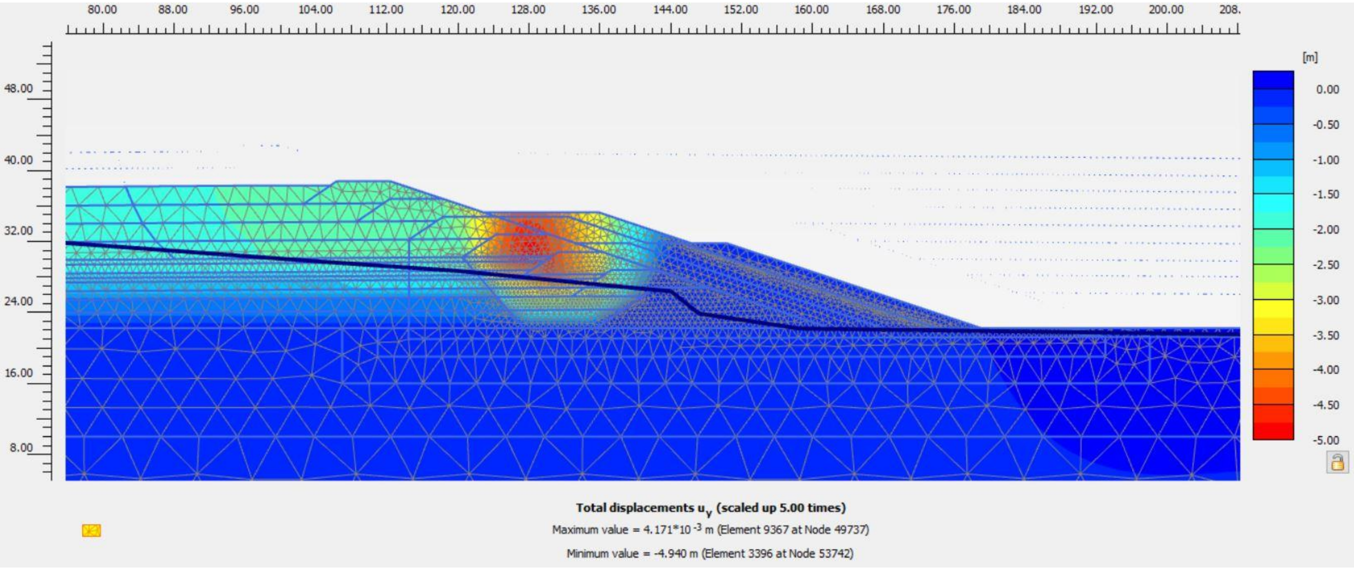


Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.168*10^{-3}$ m (Element 9613 at Node 47565)

Minimum value = -4.892 m (Element 3396 at Node 53742)

Vertical Displacements Stage 7, Construction of embankment raise 6 and buttress 2. Tailings deposition to RL 279.85 m

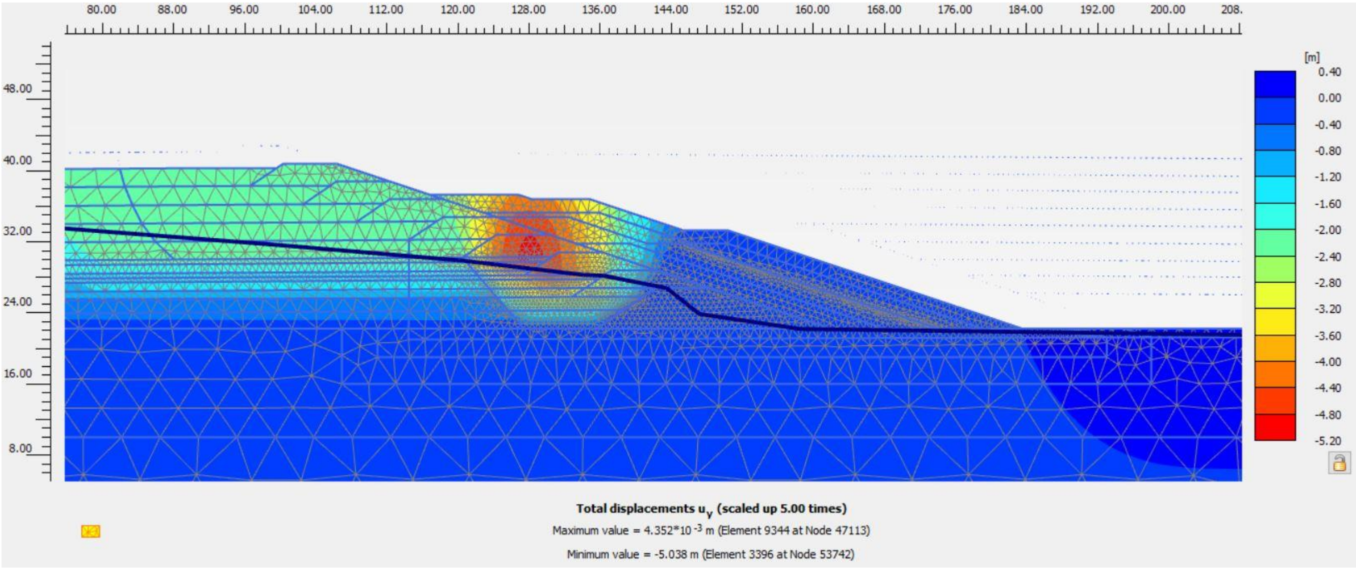


Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.171*10^{-3}$ m (Element 9367 at Node 49737)

Minimum value = -4.940 m (Element 3396 at Node 53742)

Vertical Displacements Stage 8, Construction of embankment raise 7 and buttress 3. Tailings deposition to RL 281.85 m

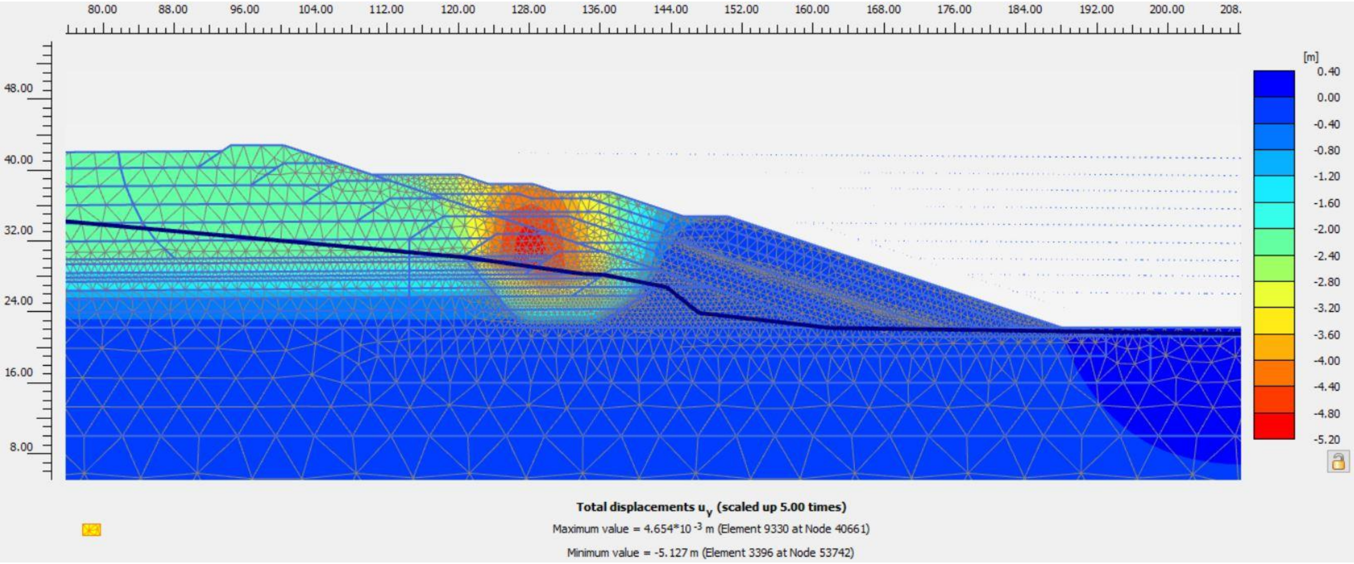


Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.352*10^{-3}$ m (Element 9344 at Node 47113)

Minimum value = -5.038 m (Element 3396 at Node 53742)

Vertical Displacements Stage 9, Construction of embankment raise 8 and buttress 4. Tailings deposition to RL 283.85 m



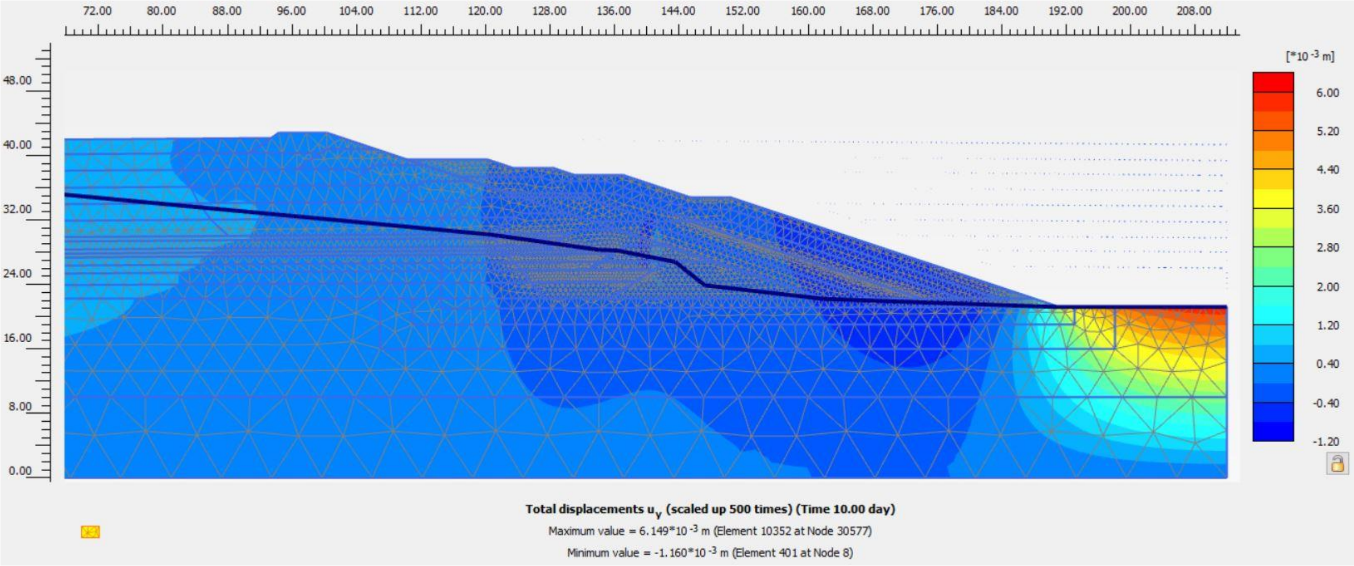
Total displacements u_y (scaled up 5.00 times)

Maximum value = $4.654*10^{-3}$ m (Element 9330 at Node 40661)

Minimum value = -5.127 m (Element 3396 at Node 53742)

Vertical Displacements Stage 10, Construction of embankment raise 9 and buttress 5. Tailings deposition to RL 285.85 m

RSF 2

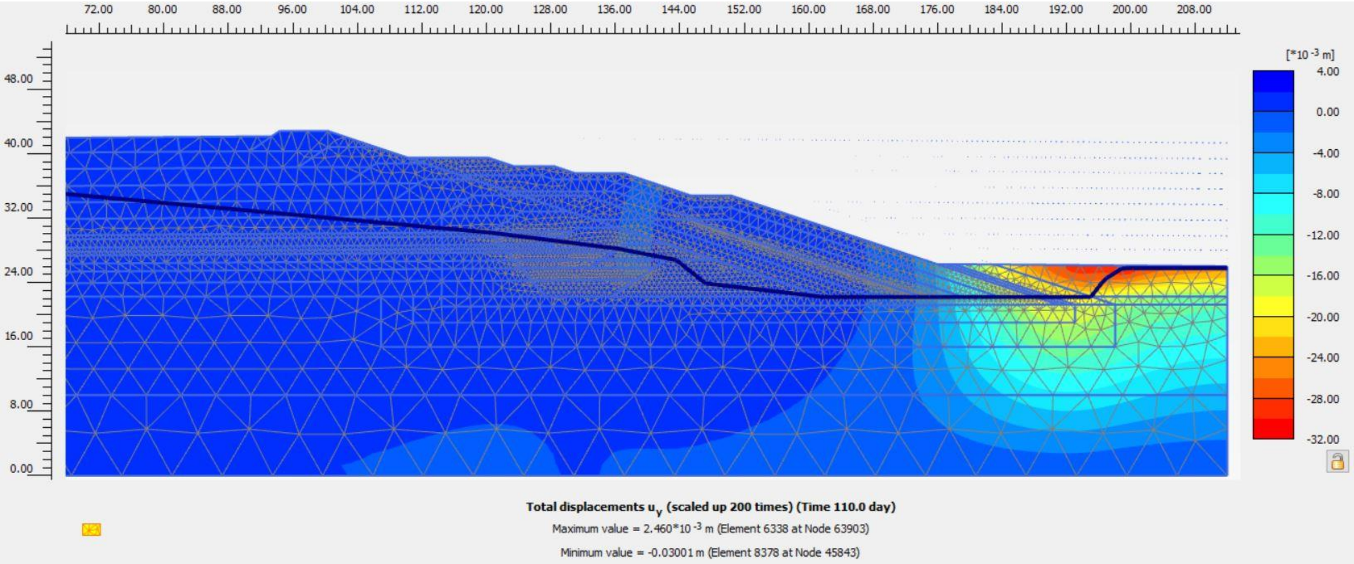


Total displacements u_y (scaled up 500 times) (Time 10.00 day)

Maximum value = 6.149*10^{-3} m (Element 10352 at Node 30577)

Minimum value = -1.160*10^{-3} m (Element 401 at Node 8)

Vertical Displacements Stage 11, Blanket excavation at the RSF1 downstream toe. Consolidation phase of 10 days. Blanket construction.

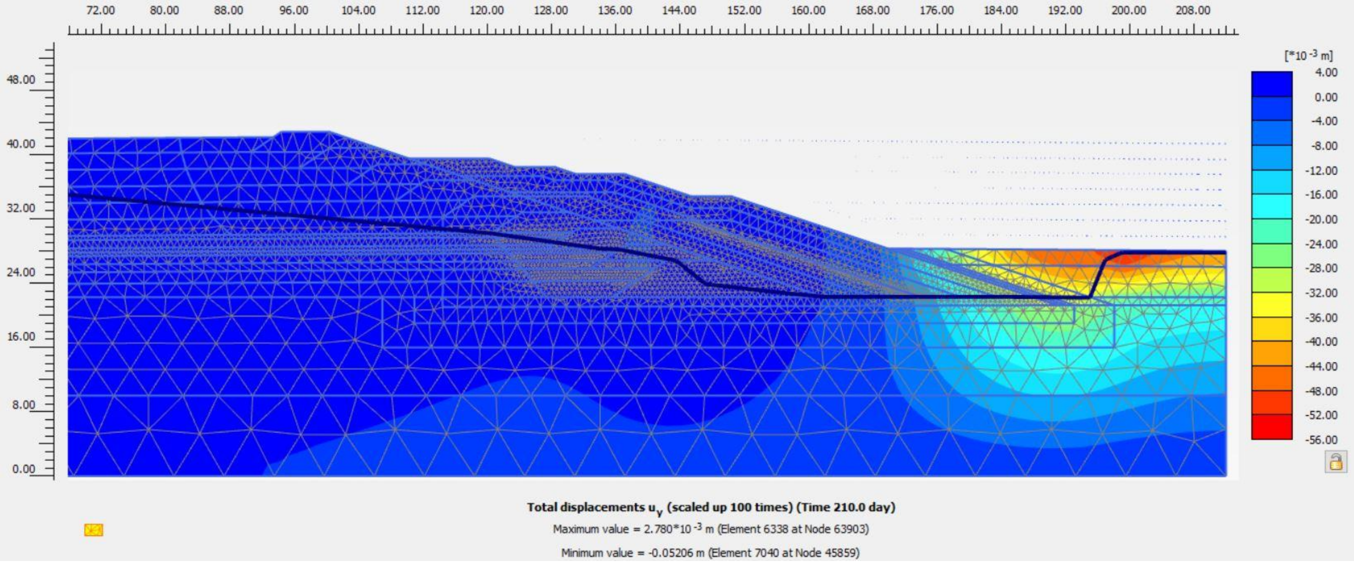


Total displacements u_y (scaled up 200 times) (Time 110.0 day)

Maximum value = 2.460*10^{-3} m (Element 6338 at Node 63903)

Minimum value = -0.03001 m (Element 8378 at Node 45843)

Vertical Displacements Stage 12, Drainage system construction. Tailings deposition to RL 269.85 m (RSF2 Starter Dam). Consolidation phase of 100 days.

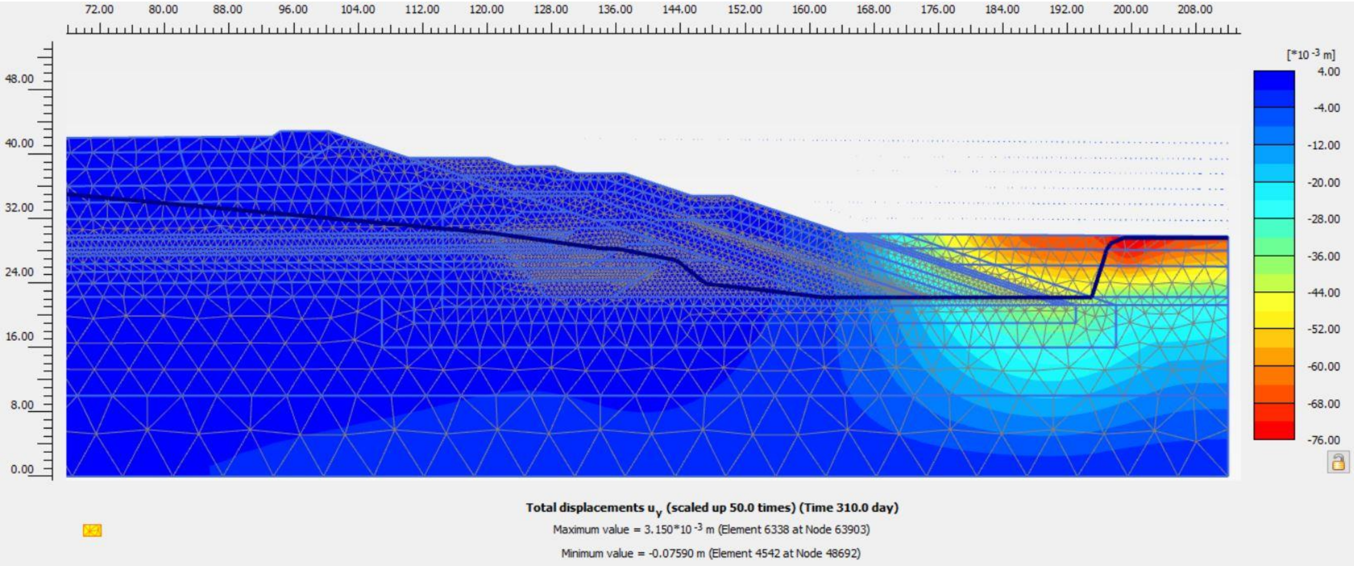


Total displacements u_y (scaled up 100 times) (Time 210.0 day)

Maximum value = $2.780*10^{-3}$ m (Element 6338 at Node 63903)

Minimum value = -0.05206 m (Element 7040 at Node 45859)

Vertical Displacements Stage 13, Drainage system construction. Tailings deposition to RL 271.85 m (RSF2 embankment raise 2). Consolidation phase of 100 days

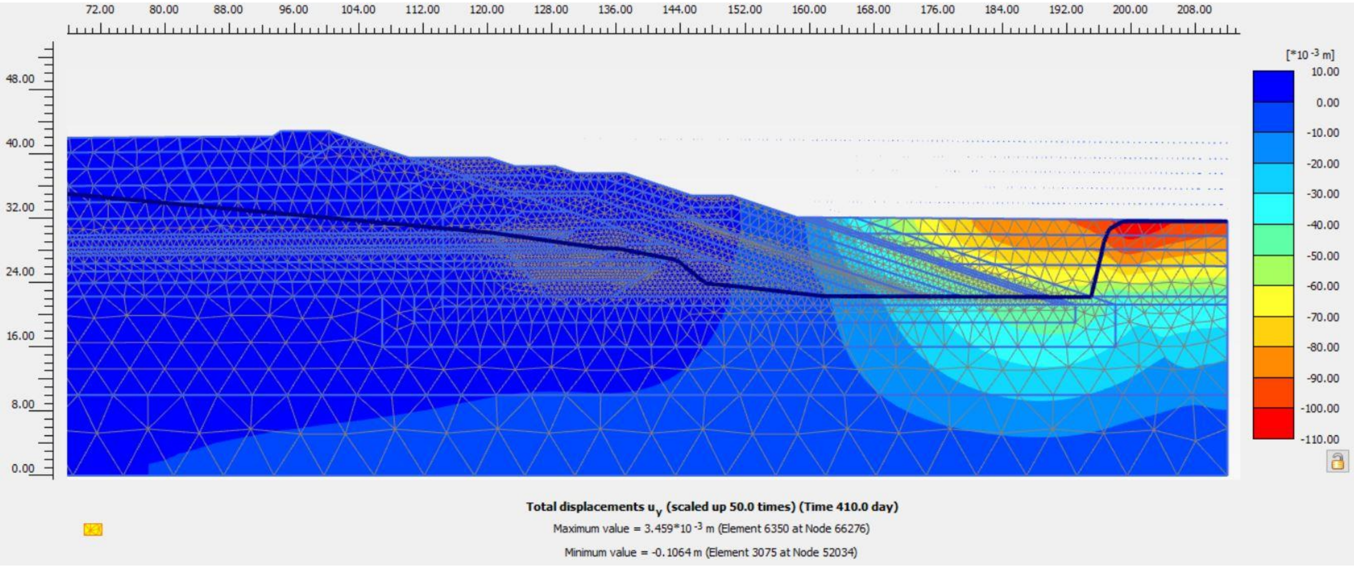


Total displacements u_y (scaled up 50.0 times) (Time 310.0 day)

Maximum value = $3.150*10^{-3}$ m (Element 6338 at Node 63903)

Minimum value = -0.07590 m (Element 4542 at Node 48692)

Vertical Displacements Stage 14, Drainage system construction. Tailings deposition to RL 273.85 m (RSF2 embankment raise 3). Consolidation phase of 100 days

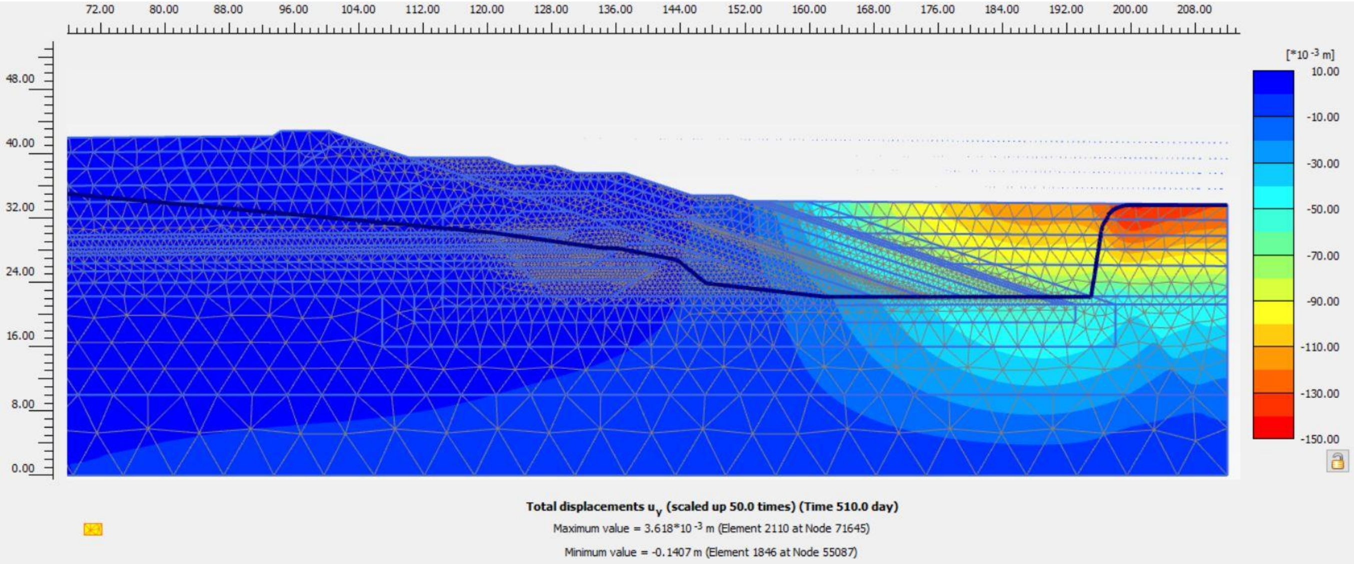


Total displacements u_y (scaled up 50.0 times) (Time 410.0 day)

Maximum value = $3.459*10^{-3}$ m (Element 6350 at Node 66276)

Minimum value = -0.1064 m (Element 3075 at Node 52034)

Vertical Displacements Stage 15, Drainage system construction. Tailings deposition to RL 275.85 m (RSF2 embankment raise 4). Consolidation phase of 100 days

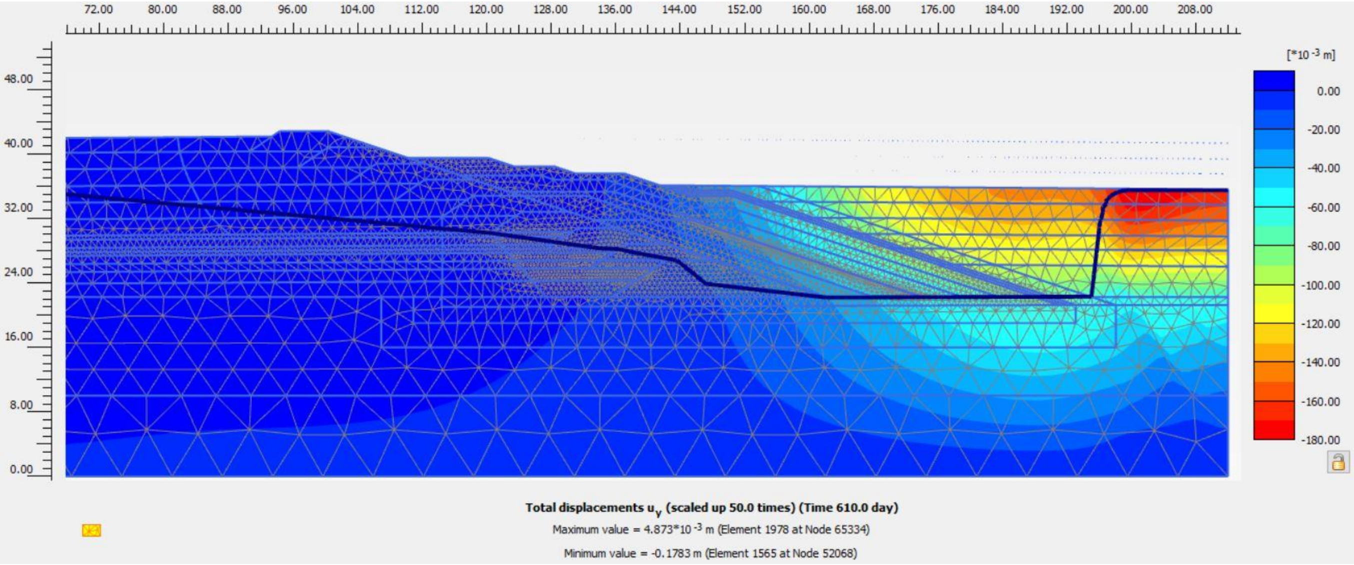


Total displacements u_y (scaled up 50.0 times) (Time 510.0 day)

Maximum value = $3.618*10^{-3}$ m (Element 2110 at Node 71645)

Minimum value = -0.1407 m (Element 1846 at Node 55087)

Vertical Displacements Stage 16, Tailings deposition to RL 277.85 m (RSF2 embankment raise 5). Consolidation phase of 100 days

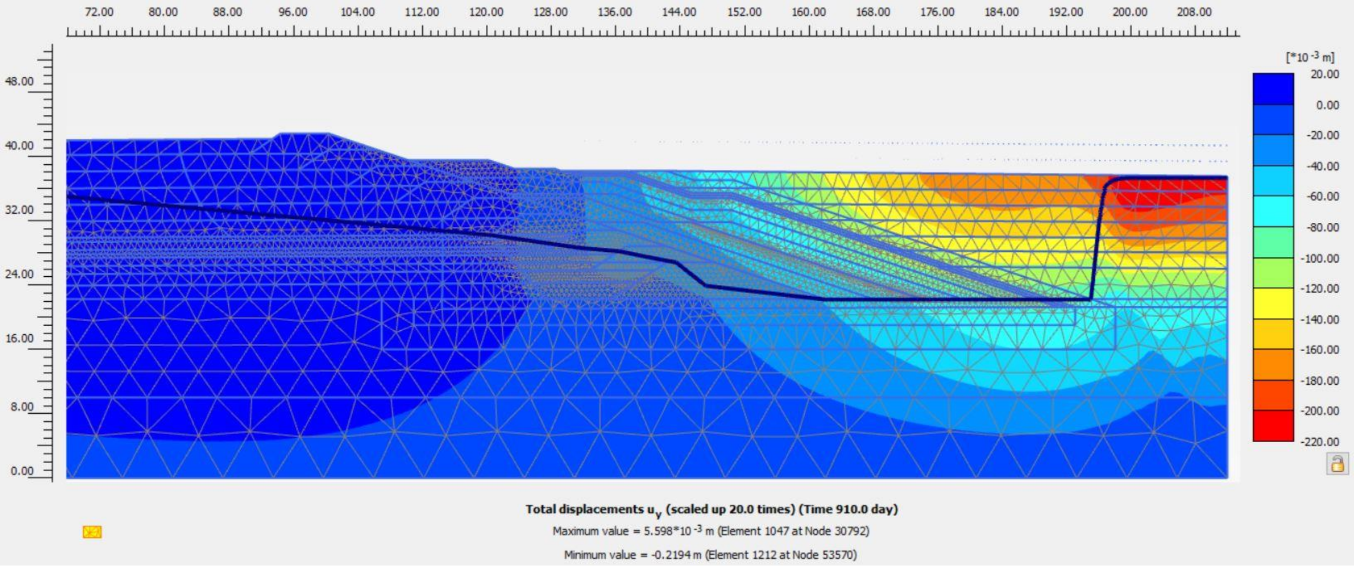


Total displacements u_y (scaled up 50.0 times) (Time 610.0 day)

Maximum value = $4.873*10^{-3}$ m (Element 1978 at Node 65334)

Minimum value = -0.1783 m (Element 1565 at Node 52068)

Vertical Displacements Stage 17, Tailings deposition to RL 279.85 m (RSF2 embankment raise 6). Consolidation phase of 100 days.

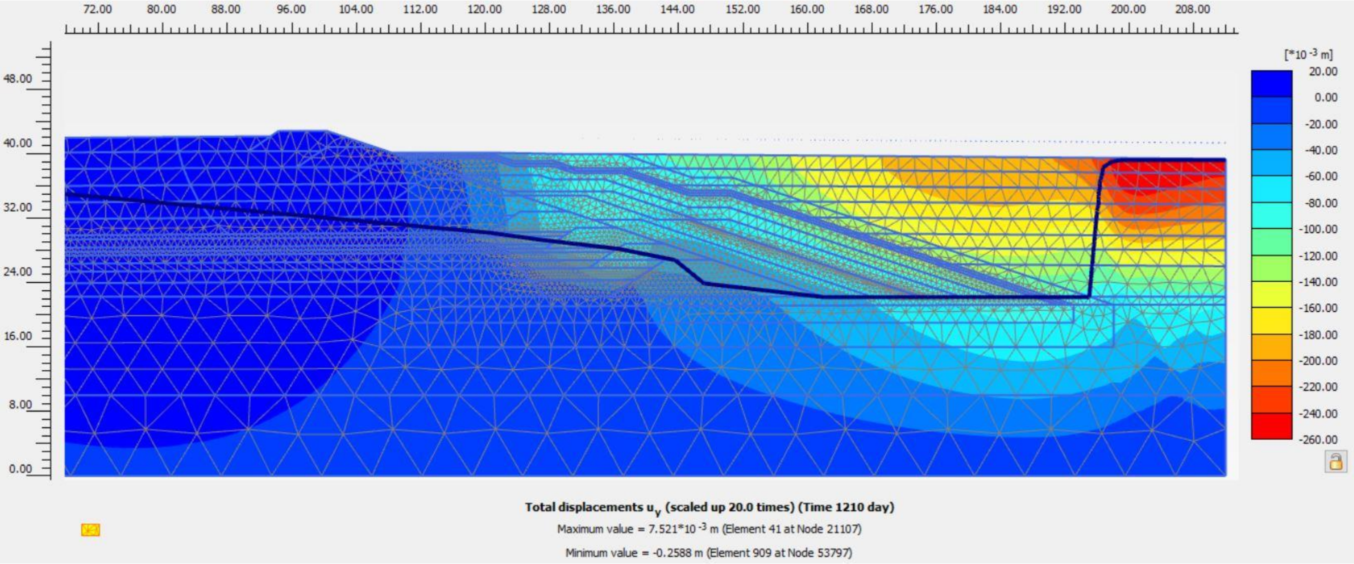


Total displacements u_y (scaled up 20.0 times) (Time 910.0 day)

Maximum value = $5.598*10^{-3}$ m (Element 1047 at Node 30792)

Minimum value = -0.2194 m (Element 1212 at Node 53570)

Vertical Displacements Stage 18, Tailings deposition to RL 279.85 m (RSF2 embankment raise 7). Consolidation phase of 300 days.

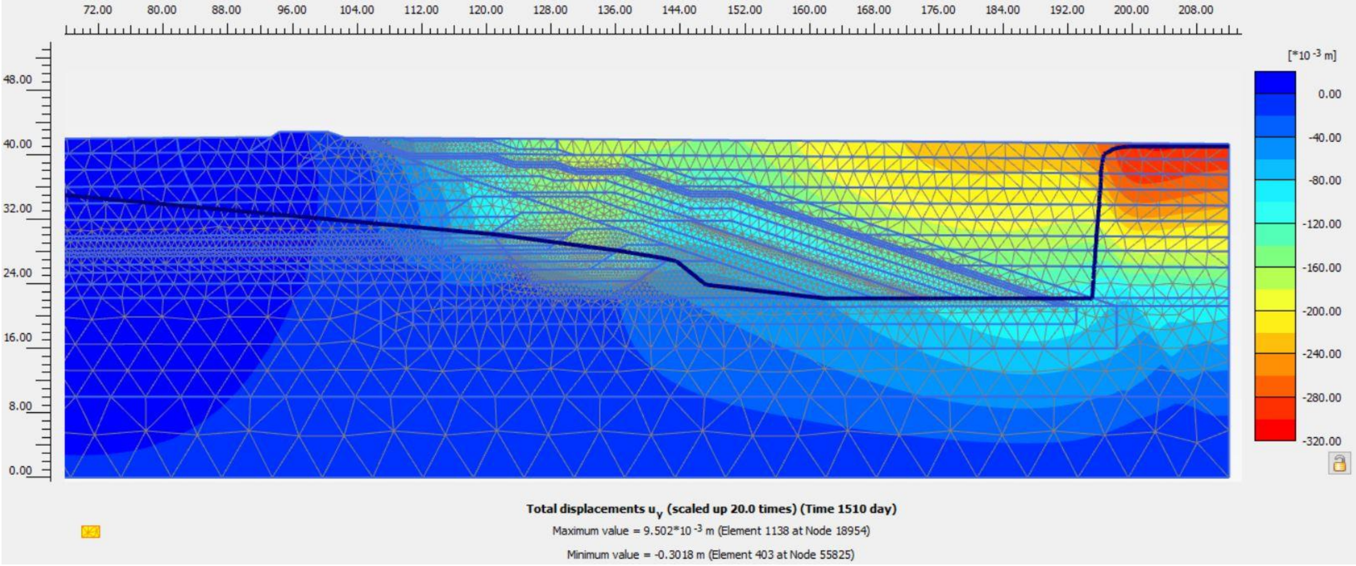


Total displacements u_y (scaled up 20.0 times) (Time 1210 day)

Maximum value = $7.521*10^{-3}$ m (Element 41 at Node 21107)

Minimum value = -0.2588 m (Element 909 at Node 53797)

Vertical Displacements Stage 19, Tailings deposition to RL 279.85 m (RSF2 embankment raise 8). Consolidation phase of 300 days

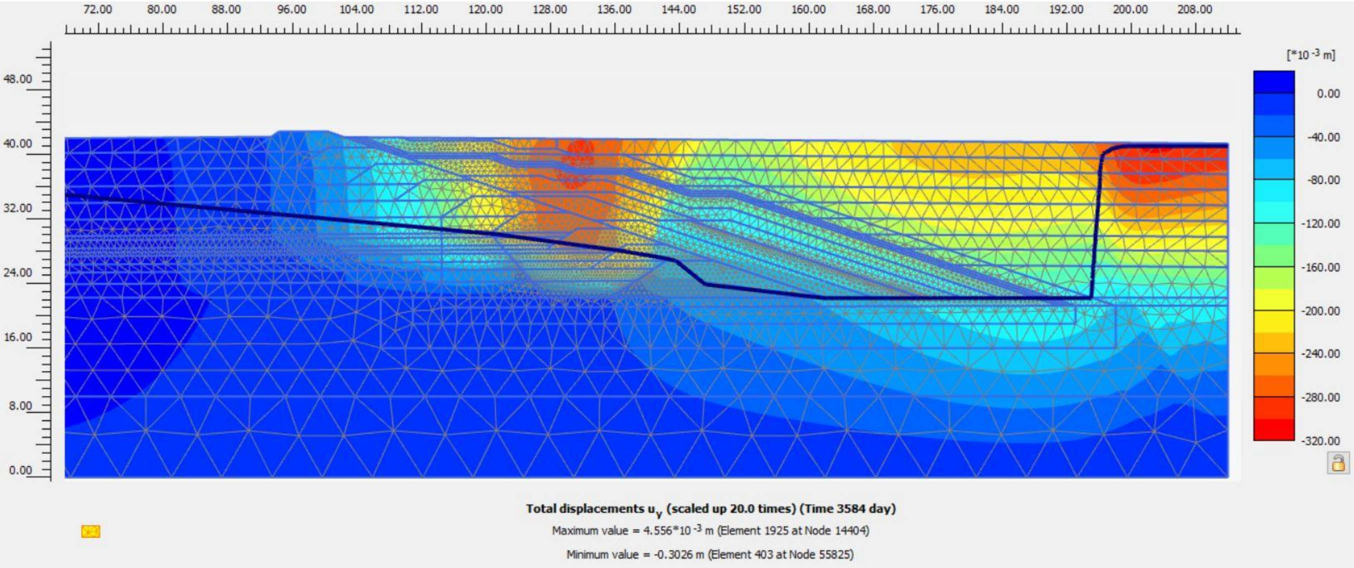


Total displacements u_y (scaled up 20.0 times) (Time 1510 day)

Maximum value = $9.502*10^{-3}$ m (Element 1138 at Node 18954)

Minimum value = -0.3018 m (Element 403 at Node 55825)

Vertical Displacements Stage 20, Tailings deposition to RL 279.85 m (RSF2 embankment raise 9). Consolidation phase of 300 days



Total displacements u_y (scaled up 20.0 times) (Time 3584 day)

Maximum value = $4.556*10^{-3}$ m (Element 1925 at Node 14404)

Minimum value = -0.3026 m (Element 403 at Node 55825)

Vertical Displacements Stage 21, Long term consolidation phase until tailings pore pressure is less than 10kPa. This condition is reached after 3,584 days

Appendix F

Safety in Design Risk Assessment

Risk Assessment

Notes: *Designs with significant quantities of dangerous goods may require detailed risk assessments under Dangerous Goods or Major Hazard legislation
* Most industrial processes will require an industry specific assessment, e.g. HAZOP and/or Quantitative Risk Assessment for facilities that have chemical or high-pressure processes under Dangerous Goods or Major Hazard legislation.

Design Life Cycle:	Investigation and Design	Setup, Construction and Commissioning	Operation	Maintenance	Closure	Date Prepared: 14/09/2021	**Revision No:**	Rev A
Job Name:	RSF 2 Stage 1 Raise Detailed Design & Construction Services		**Job No:**	12545239	**Client:**	Tomingley Gold Mine Pty Ltd (TGO)		
People involved in Risk Assessment:			Rob Longey, Tom Ridgway, Gonzalo Suazo, Nicolas De La Maza					

Design Ref	**Design Life Cycle Stage**	**Hazards** What could cause injury or ill health, damage to property or damage to the environment	**Risk** What could go wrong and what might happen as a result	**Existing Control Measures**	**Initial Risk Rating**			**Potential Control Measures** (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	**Residual Risk Rating**			**Person Responsible**
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
	Investigation and Design	**Inaccurate assumptions relating to hydraulic properties of the embankment, foundations and tailings, seepage behaviour and phreatic surface**	Inadequate embankment stability or dam failure as a result of higher than anticipated phreatic surface.	RSF will be constructed using sandy clay or clayey sand materials sourced from the foundation excavation. The embankment is Stage 1 and is constructed entirely on natural foundations. Tailings beach is designed to keep the decant away from the from the embankment to maintain a minimum phreatic surface through the embankment. The decant pond should be maintained as low as possible using the submersible pump. OMS of the RSF2 will be prepared prior to construction detailing minimum operating requirements. Piezometers to be installed over the storage liner to monitor pore pressure/ phreatic surface through RSF.	**E**	**2**	**Significant**	- Monitor piezometers to observe the phreatic surface in the dam and visual inspection to enable early detection of unusual dam behaviour. - Ongoing review of design assumptions using "observational approach" during detailed design of the embankment including provision for additional stabilisation or drainage if required to maintain acceptable embankment stability.	**E**	**1**	**Moderate**	TGO
	Investigation and Design	**Dam Failure Consequence Category (DFCC) and Dam Spill Consequence Category (DSCC) are different compared to the RSF1 due to the location of critical infrastructure.**	Incorrect design assumptions	A detailed dam break assessment has been undertaken for the consequence category assessment. Design criteria has been based on the results of the consequence category assessment.	**C**	**3**	**Moderate**	- Downstream development and expansions of the mining infrastructure into the identified inundation zones are to be reviewed as to their necessity as these are expected to increase the consequences of failure.	**C**	**1**	***Low***	TGO
	Investigation and Design	**Inaccurate assumptions relating to foundation, tailings and embankment material strength properties and loading conditions**	Embankment failure as a result of incorrect design assumptions relating to loading conditions or material properties relating to foundation conditions (i.e. low strength foundation zone, liquefaction potential).	Material properties have been reviewed based on the geotechnical investigations on the existing RSF tailings and the RSF2 foundations. Loading conditions assessed in accordance with ANCOLD Guidelines on Tailings Dams (2019) and Guidelines for Design of Dams and Appurtenant Structures for Earthquake (2019) as appropriate for RSF design including post-seismic case using post-liquefied strength for tailings and 15% strength reduction for clay and foundation under the phreatic surface. Lower bound post liquefaction parameters adopted.	**E**	**2**	**Significant**	- Undertake CPT tests through the initial tailings prior to future raises to verify tailings strength. - Monitor piezometer readings to confirm that phreatic surface is within or below design.	**E**	**1**	**Moderate**	TGO
	Setup, Construction and Commissioning	**TGO plans to construct Stage 1 in January 2022 but approval/form is yet to be submitted leading to time delays in construction**	Design/approval/construction delay could result in delay of production and financial implications	Stage 8 Raise will be under construction prior to this allowing for sufficient storage in RSF1 should construction be delayed.	**D**	**2**	**Moderate**	- Report to be submitted asap. - Reduce production if required. - Ongoing review of project schedule. - Proactive management to ensure tasks are completed on time. - Time construction to maximise production during summer weather to minimise contractor delays. - Initiate RSF1 Stage 9 if necessary to achieve additional storage. - Stage RSF2 construction to allow for deposition in Cell 1 while Cell 2 is finishing construction.	**C**	**2**	***Low***	TGO

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Design Ref	**Design Life Cycle Stage**	**Hazards** What could cause injury or ill health, damage to property or damage to the environment	**Risk** What could go wrong and what might happen as a result	**Existing Control Measures**	**Initial Risk Rating**			**Potential Control Measures** (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	**Residual Risk Rating**			**Person Responsible**
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
	Setup, Construction and Commissioning	**Insufficient availability of suitable embankment construction materials**	Insufficient construction materials to enable successful construction of embankment works results in compromised embankment quality, changes in design or increased cost.	Design and material specification has been developed to enable use of as wide a range of material as possible. Material to be sourced form the RSF2 footprint and if necessary from the same borrow area (WRE1) as previous RSF1 raises.	**C**	**2**	**Low**	- Future RSF2 raise construction to be a consideration in mine planning. - Future RSF2 raises to use waste rock on the downstream shell.	**C**	**1**	***Low***	TGO
	Setup, Construction and Commissioning	**Borrow materials properties differ from those anticipated (do not meet permeability requirements)**	Higher permeability may cause seepage reporting to the external environment	Materials are to be borrowed from the storage area as per the geotechnical investigations, which are expected to have suitable properties based on geotechnical investigations. Testing / compaction regime outlined in specification to accommodate permeability requirements. Tailings against embankment reduces the risk of seepage, sufficient beach freeboard maintained.	**C**	**2**	**Low**	- Additional testing and review of borrow materials for each construction raise.	**C**	**1**	***Low***	TGO
	Setup, Construction and Commissioning	**Instability of excavations for the embankment and borrow areas**	Slope failure of excavation results in harm to staff and/or damage to plant and equipment.	Minimum batter slopes for excavations provided in Technical Specification.	**C**	**2**	**Low**	- Visual assessment of the stability of batter slopes in borrow, ensure a safety distance to the slopes.	**C**	**1**	***Low***	TGO
	Setup, Construction and Commissioning	**Wetter or drier than anticipated conditions**	RSF embankment more difficult / expensive to place or cannot be placed, results in production delay/stoppage.	Reviewed seasonal rainfall variation. Contractor experience from previous raises.	**D**	**3**	**Significant**	- Specification can potentially be relaxed to allow material wet of optimum following additional testing to prove required strength and permeability requirements met. - Contractor to have water cart to condition material and borrow areas.	**C**	**2**	***Low***	TGO
	Setup, Construction and Commissioning	**Limited availability of materials eg pipes, valves and fittings**	Delay to completion of cell.	Indicative construction schedule has been established. Early supplier involvement is recommended to confirm local supply.	**B**	**2**	**Negligible**	- Appropriate measures should be in place in the contracts and or site spares should damage occur	**B**	**1**	***Negligible***	TGO
	Operation	**Rising piezometric pressures**	Instability of the RSF as a result of rising phreatic surface.	Vibrating wire piezometers to be installed over the clay liner to monitor pore pressures within the embankments.	**D**	**2**	**Moderate**	- Monitoring of the piezometers after the construction to verify pore pressures and adequate factor of safety. - Undertake regular routine and intermediate surveillance inspections during operation to keep decant pond as low as practicable.	**D**	**1**	**Moderate**	TGO
	Operation	**Poor tailings management practices**	Target tailings densities are not achieved resulting in RSF filling quicker than anticipated. Reduced freeboard and flood storage leading to increased risk of uncontrolled spill.	Tailings management addressed as part of design documentation. Regular reviews of tailings management during routine operator and periodic engineering inspections. Ongoing review of design flood storage allowance.	**C**	**3**	**Moderate**	- Install Instrumentation (i.e. piezometers, movement monitoring, tailings beach indicators) to enable monitoring. - Undertake tailings reconciliation to check tailings settled density and review filling schedule and design flood storage allowance. - Undertake regular routine and intermediate surveillance inspections during operation to keep decant pond as low as practicable.	**C**	**2**	***Low***	TGO

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People involved in Risk Assessment:			Rob Longey, Tom Ridgway, Gonzalo Suazo, Nicolas De La Maza					

Design Ref	**Design Life Cycle Stage**	**Hazards** What could cause injury or ill health, damage to property or damage to the environment	**Risk** What could go wrong and what might happen as a result	**Existing Control Measures**	**Initial Risk Rating**			**Potential Control Measures** (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	**Residual Risk Rating**			**Person Responsible**
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
	Operation	**RSF fills quicker than anticipated**	Production is greater than anticipated or tailings density is less than anticipated. Raise schedule must be bought forward. Production must be slowed or halted.	Design based on TGO supplied production and forecasts.	**C**	**2**	**Low**	- Monitor RSF fill rate during operation. Tailings survey and density reconciliation.	**C**	**1**	***Low***	TGO
	Operation	**High decant pond level**	Potential for piping failure of RSF embankment due to increased hydraulic gradients. Reduced flood storage, increase risk of overtopping.	RSD can store 150ML of water. RSF constructed on natural foundation improving stability.	**D**	**2**	**Moderate**	- Undertake regular routine and intermediate surveillance inspections during operation to keep decant pond as low as practicable. - Regular reviews of piezometer data to validate assumptions made in determining phreatic surface in stability models. - Beach markers to check pond extents comply with design	**D**	**1**	**Moderate**	TGO
	Operation	**Decant pump failure**	Unable to supply water to Processing Plant. Production must be slowed /halted. Large decant pond reducing flood storage, increase risk of overtopping.	RSF has the capacity to store 568ML (in both Cell 1 and Cell 2) of water up to embankment crest without overtopping the spillway. Water can be sourced from open pits or water dams on site. Can use decant pump from alternate cell if required.	**B**	**3**	**Low**	- Undertake regular routine inspection to ensure decant pond is kept as low as practicable. - Operate additional pumps to drawdown pond as soon as possible post large storm event. - Regular servicing of pumps. - Consider backup options for pump and power supply	**B**	**2**	***Negligible***	TGO
	Operation	**Severe Earthquake**	Foundation liquefaction or cyclic softening. Loss of strength of embankment material. Deformation or failure of embankment leads to loss of tailings/decant water.	Embankment materials to be compacted to design specification hence loss of strength is not expected above phreatic surface. Embankment has been designed based on worst loading case which is the post-seismic case using post seismic liquefaction strength under SEE 1:10,000 AEP with PGA of 0.18g.	**D**	**1**	**Moderate**		**D**	**1**	**Moderate**	TGO
	Operation	**Extreme flood event**	Overtopping of embankment, resulting in uncontrolled release of water and tailings causing significant environmental damage and economic losses.	RSF has been designed to store PMP rainfall event within the RSF, emergency spillway capable of passing 1:1,000 AEP rainfall event to be constructed in Cell 1 to route flow safely. External excess water storage of 150ML at RSD.	**E**	**2**	**Significant**	- Undertake regular routine inspection to ensure decant pond is kept as low as practicable. - OMS & DSEP regularly reviewed and updated if required.	**E**	**1**	**Moderate**	TGO
	Operation	**Tailings delivery and decant pipelines**	Failure of tailings delivery pipeline or decant pipeline results in erosion of embankment /contamination of site requiring remedial works	Tails pipe bunds. Natural foundation soils are low permeability to minimise leakage to ground. Routine shift inspection. Flow meter alarms.	**C**	**2**	**Low**	-	**C**	**2**	***Low***	TGO
	Operation	**Vehicle driving on dam crest /along tailings pipelines**	Vehicle drives off crest road into RSF storage/ down downstream batter harming personnel or vehicle. Vehicle damages the tailings pipelines.	Safety bund on downstream side of crest road and ramps. Suitable crest width designed for LV access. Tailings pipe on upstream side acts as partial deflector upstream batter.	**D**	**3**	**Significant**	- Speed / warning signage on approach to RSF crests. - Temporary windrows using in construction, pending contractor methodology.	**D**	**2**	**Moderate**	TGO
	Operation	**Poor operational management**	Dam safety issues are not observed leading to unsafe conditions	Instrumentation has been installed for monitoring purposes. Daily monitoring by appropriately trained staff. OMS & DSEP regularly reviewed and updated if required. Annual inspections undertaken by consultant dams' engineer	**C**	**2**	**Low**	-	**C**	**2**	***Low***	TGO
	Operation	**Dam failure, or emergency situation**	Inability to adequately respond to avoid risk to personnel or environment due to dam failure flood / release of tailings	Appropriate design to mitigate risk of failure. OMS and DSEP updated annually. Personnel responsible for monitoring/surveillance have been trained in RSF Surveillance.	**E**	**2**	**Significant**	- New RSF operators to undertake RSF Training Course. - Dam break inundation mapping to be updated to account for RSF / downstream topography changes / mill changes. - Run RSF Emergency Scenario simulation to test DSEP and train those responsible to act in case of emergency.	**E**	**1**	**Moderate**	TGO

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Job Name:	RSF 2 Stage 1 Raise Detailed Design & Construction Services		**Job No:**	12545239	**Client:**		Tomingley Gold Mine Pty Ltd (TGO)					
People involved in Risk Assessment:			Rob Longey, Tom Ridgway, Gonzalo Suazo, Nicolas De La Maza									
Design Ref	**Design Life Cycle Stage**	**Hazards** What could cause injury or ill health, damage to property or damage to the environment	**Risk** What could go wrong and what might happen as a result	**Existing Control Measures**	**Initial Risk Rating**			**Potential Control Measures** (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	**Residual Risk Rating**			**Person Responsible**
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating	
	Closure	**Mine Closure plan not able to be executed**	RSF capping not feasible or higher cost than expected	GHD concept developed as part of detailed design of Stage 1 of RSF2.	**C**	**3**	**Moderate**	- RSF2 Closure Plan to be prepared prior to the construction of RSF2 Stage 1 outlining the preliminary closure plan for the two RSF's outlining rehabilitation requirements and future investigation and trial requirements.	**C**	**2**	***Low***	TGO

Appendix G

RSF2 Technical Specification

RSF2 Stage 1

Technical Specification

Tomingley Gold Operations Pty Ltd

19 January 2022

→ **The Power of Commitment**

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	2	K Mosey (TGO)	T.Ridgway	TRidgway	R.Longey	RLongey	19/01/2022

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Table index

1. Embankment Construction

1.1 Material Sourcing Requirements

The material requirements for each zone shall be as set out below, unless otherwise determined by the Principal.

Zone 1:	Low to high plasticity sandy clay (CH), or clayey sand (SC) sourced from excavation of the RSF2 footprint.
General Fill:	Highly to extremely weathered rock sourced from excavation of the RSF2 footprint with additional material from the Waste Rock Emplacement 1 (WRE1)
Zone 2:	Fine to coarse grained sand.
Zone 3 / Rip-Rap:	Rockfill. Slightly weathered to fresh rock sourced from fresh mine waste.

1.2 Tolerances

The dam embankment shall generally be constructed to the lines, grades and dimensions as shown on the drawings and derived from the set-out information. However, at any time prior to, or during construction, the Principal may vary the division lines between portions of the dam embankment and also the position of the outside faces of the dam embankment.

The upstream and downstream faces of the dam embankment shall, when completed, present an appearance of uniform texture and shall be generally planar.

The following tolerances limitations in the embankment shall be adhered to.

Table 1 Embankment Tolerances

Item	Towards axis of dam	Away from axis of dam
Crest	0 mm	+ 250 mm
Downstream slope	0 mm	+ 500 mm
Upstream slope	0 mm	+ 500 mm
Division between core and filter zone	0 mm	400 mm
Width of Filter Zones	- 0 mm to + 400 mm	
Width of Rip Rap / Zone 3	- 0 mm to + 200 mm perpendicular to slope	
Tolerance on Vertical Thickness		
	Minus	Plus
Compacted layer thickness	50 mm	50 mm
Zone 2	0 mm	200 mm
Transition Zone	0 mm	200 mm
Top of core and crest elevation	0 mm	150 mm

1.3 Geochemical management of borrow materials

The Principal has made provision for geochemical testing of borrow materials. All borrow materials and excavated material shall be tested for Net Acid Production Potential (NAPP) and Net Acid Generation (NAG) at a frequency of 1 set of tests per 10,000 m^3 of material, and results provided by the Principal. Only materials designated as non-acid forming shall be permitted for use in the dam embankment. The Contractor must make notification to the Geotechnical Engineer at quantity intervals during excavation for testing.

2. Material Definition & Requirements

2.1 Zone 1 Requirements

2.1.1 Required Properties

Zone 1 shall conform to the following soil classifications unless otherwise approved by the Principal (in accordance with AS 1726 - 2017 Geotechnical Site Investigations):

– low to high plasticity sandy CLAY or clayey SAND (with other elements whilst conforming to the table below)

The Zone 1 materials, for the construction of the embankments, shall be naturally occurring, predominantly clayey materials free of organic and other unsuitable materials. The materials shall be well graded and have a low permeability when compacted.

Table 2 Required properties of Zone 1 after compaction

Property	Requirement
Maximum thickness of layer after compaction	150 mm
Size of largest particle	Not greater than 75 mm
Minimum % by weight passing 0.075 mm AS 1152 sieve	30
Minimum Plasticity Index (AS 1289.3.3.1)	10
Minimum plasticity product (PI x % by weight passing 0.075mm)	300
Maximum Plasticity Index (AS 1289.3.3.1)	60

2.1.2 Moisture Content and Conditioning

Moisture conditioning shall occur in the borrow area where practical to bring the materials within the specified moisture content range. After placement within the embankment, only minor moisture adjustment is anticipated to maintain the moisture content within specification. A proposed methodology for moisture conditioning shall be submitted for approval with the borrow material approvals **Hold Point**.

The material in each layer of zone 1 material shall have a uniform moisture content, during and after compaction, with ***moisture content OMC between plus 1% (Dry) and minus 3% (Wet)*** (OMC = Optimum Moisture Content, Standard Compaction AS 1289). There is no maximum moisture content specified and the clay will be accepted provided the material has been compacted to the specified density. Material that fails to meet the above requirements will require corrective measures to achieve a uniform moisture content within specification or removal from the embankment.

2.1.3 Placement and Compaction Requirements

All clay material required for the core of the embankment shall be obtained from the sources designated as borrow areas or from other excavations approved by the Principal.

Each layer of Zone 1 material shall be compacted with vibrating pad foot rollers or tamping foot compactors until the field density determined in accordance with AS 1289.5.8.1 (Nuclear Densometer) meets the criterion that the **Hilf density ratio (RHD) is in excess of 98%** when tested in accordance with AS 1289.5.7.1 **using standard compactive effort** in accordance with AS 1289.5.1.1.

The Contractor’s operations in handling and spreading Zone 1 material on the embankment shall result in an acceptable gradation of the materials when compacted in the fill. Should stones, cobbles or rock fragments be found in otherwise approved Zone 1 materials, the maximum dimension of the stone, cobble or rock fragment after compaction would be expected not to exceed 150 mm. Cobbles exceeding 150 mm are expected to be removed by the Contractor either at the Site of the excavation or after being transported to the dam embankment but before the materials in Zone 1 are compacted. The Contractor will be required to develop a methodology for removal of cobbles, which may include the following removal techniques:

- Use of a Grizzly Bucket during borrow excavations to screen out stones, cobbles, and rock fragments;
- Selective borrowing as determined suitable on site; and
- Supervision during placement to remove cobbles prior to compaction.

Materials shall be placed in such a manner that the distribution and gradation of the materials throughout Zone 1 shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material within the zone.

Maximum layer thickness shall be and not more than 150 mm in thickness after compaction unless adequate compaction using thicker layers can be demonstrated with a roller trial to the satisfaction of the Principal.

The surfaces of any layer of Zone 1 shall be suitably textured to the Principals satisfaction to ensure bonding of the subsequent layer. Surfaces of Zone 1 which are ruptured or uneven after compaction shall be repaired and re-levelled before placing the next layer of material.

2.1.4 Foundation Placement

Within 0.5 metre measured normally to the embankment abutments and foundation, the Zone 1 material shall be from the selected finer, more plastic material in the sources for Zone 1 material. The material shall be deposited in horizontal layers not more than 150 mm in thickness when compacted. The material shall be compacted by approved heavy pneumatic tyred equipment or other means in such a manner that it is forced into all the irregularities of the abutment and foundation surfaces.

2.2 General Fill

General Fill material shall be sourced from highly to completely weathered rock from necessary excavations for the RSF2 impoundment and / or external borrow areas. It is envisaged that this material will typically behave as a fine-grained cohesive soil, with gravel and some larger cobbles of less weathered rock. The largest rock size will be that which can be adequately incorporated in a lift, usually two thirds of the lift height.

Where General Fill material has greater than 80% of particles passing the 37.5 mm sieve, it shall be compacted to ***95% of standard maximum dry density*** at a moisture content ***OMC between plus 1% (Dry) and minus 3% (Wet).*** Maximum lift height after compaction shall be 300 mm.

Where General Fill material has less than 80% of particles passing the 37.5 mm sieve, the compaction requirements shall be determined by test rolling in accordance with Clause **Error! Reference source not found.**. Maximum lift height after compaction shall be 300 mm unless it can be demonstrated that adequate compaction is achieved with larger lifts.

General Fill material shall be selectively placed to ensure that more finely graded material is placed adjacent to the core and the larger materials are directed toward the outer edges of the embankment to give a gentle transition across the width of the zone. In no case will zones of rock be allowed adjacent to the Zone 1 core.

Compaction equipment shall be that most suitable for compaction of the material as directed by the Principal.

2.3 Zone 2

Durability of source rock for crushed Zone 2 coarse drainage sand material shall be tested in a manner similar to that described in AS 1141 and shall be rejected if the loss in the Los Angeles abrasion test exceeds 40 per cent by weight at 500 revolutions or if the portion retained on a 0.300 mm AS sieve, when subjected to 5 cycles of the sodium sulphate test for soundness, in accordance with AS 1141, shows a weighted loss of more than 10 per cent by mass.

The filters shall be placed to the lines and grades shown on the Drawings. The placement method shall consider the need to avoid contamination with the core or downstream zone materials, and ensuring the minimum thickness is obtained. The placement method shall be subject to approval after a filter placement trial to be carried out in the presence of the Principal (**HOLD POINT**).

The specified width of the vertical filter shall be the minimum thickness, where subsequent lifts are offset, the minimum thickness is the dimension of the overlap between lifts.

At the time of placement the filter materials shall be damp or moist but shall not contain excessive free water. A smooth drum vibratory roller or tamping plate shall be used for compacting the material in a manner approved by the Principal. Any contamination of the filter materials (such as roots, organics) shall be immediately removed.

If, during or after placement, any filter material has become contaminated by earthfill, filter or other objectionable material from the passage of construction machinery, or from surface run-off, or by any other means, the contaminated material shall be entirely removed from the dam embankment.

Blending of filter material on the dam embankment in order to produce the required grading will not be permitted.

A sample of Zone 2 material shall be collected from the placed filter zone for grain size analysis in accordance with Section 2.6. Compaction testing of the vertical filter shall be carried out on early placed materials to confirm the placement method is acceptable, the target density ratio shall be within the range of 60% to 80%. The Principal may also direct DCP testing of the filter zone to confirm uniform density throughout the lift height.

The methodology of sampling and testing shall be outlined in the *Contractor's Quality Plan* according to the requirements above.. The Zone 2 material grading specifications shall comply with Appendix A and will be supplied by the Principal.

2.4 Zone 3 / Rip Rap Requirements

Rip Rap shall be obtained from fresh mine waste rock complying with the Fresh to Slightly Weathered rock (F, SW) classification (in accordance with AS 1726 - 1993 Geotechnical Site Investigations) provided by the Principal.

Rip rap will generally comprise of well graded, angular and high to extremely high strength rock for durability. Unless otherwise approved, the rip rap size shall comply with the drawings and shall be well graded from the minimum to maximum rock size. Rip Rap material will be provided by the Principal to the specifications defined in this report..

Riprap for locations as described in the drawings shall have a particle size as shown on the drawings. Where only a D_{50} size is shown, the riprap shall be graded such that D_{100} is approximately 1.5 times D_{50}.

2.5 Filter rock

Filter rock provided by the Principal will be placed around the decant tower. The filter rock will consist of clean, fresh aggregate, with an average particle size of 60-150 mm. Suitability of this material shall be as directed by the Principal. Compaction will be taken with care to avoid damage to pipework and geofabric.

Filter rock may consist of run of mine material (if an appropriate material is produced) or alternatively be imported from an off-site quarry.

2.6 Embankment Construction Quality Control

2.6.1 Testing Requirements

The Principal shall engage a laboratory registered with the National Association of Testing Authorities for the particular tests specified to undertake the testing of embankment materials for the project. The testing capacity of the laboratory shall be sufficient to enable testing of all materials from the source to the fill in accordance with the Contractor's construction programme.

Test procedures and minimum testing frequency shall be in accordance with Table 3 and the requirements of this specification. Notwithstanding these minimum test requirements, the Principal may make additional tests as considered necessary to control the quality of the materials.

The results of all moisture and compaction control testing shall be reviewed and approved by the Contractor following appropriate Quality Assurance processes before work on the next layer of the embankment material can commence (**WITNESS POINT**).

The Principal may request additional random tests on the embankment to verify that quality assurance requirements are carried out adequately and consistently.

2.6.2 Lot Selection

A lot is defined as an area of work which is essentially homogeneous in: material type, moisture condition, rolling effort and compaction technique and which is to be used for the assessment of the density ratio. Where a production unit does not satisfy the definition of a lot it shall be divided into smaller units, each of which shall conform with the definition.

Maximum lot sizes are defined as follows:

Zone 1 – Maximum lot size shall comprise the lesser of:

- 2,000 m^2 of material placed
- 500 m^3 of material placed
- One day’s production
- 2 lifts.

Zone 3 – Maximum lot size shall comprise the lesser of:

- 3,000 m^2 of material placed
- 2,000 m^3 of material placed
- One day’s production
- 2 lifts.

Table 3 Quality Control Testing Schedule

Zone	Process	Test Procedure for Quality Compliance	Minimum Testing Frequency
Zone 1	Particle Size Distribution with Hydrometer	AS 1289.3.6.3	1 test per 5,000 m^3
	Plasticity Index	AS 1289.3.3.1	1 test per 5,000 m^3
	Liquid Limit	AS 1289.3.1.1	1 test per 5,000 m^3
	Field wet density	AS 1289.5.3.1, 1289.5.3.2 or 1289.5.3.5	Every 300 mm, 1 test every 1,000 m^3
	Field moisture content	AS 1289.2.1.1	Every 300 mm, 1 test every 1,000 m^3
	Moisture variation	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1	Every 300 mm, 1 test every 1,000 m^3
	Hilf Density Ratio	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1 and field wet density in accordance with AS 1289.5.8.1	Every 300 mm, 1 test every 1,000 m^3
	Emerson Class Testing	AS 1289.3.8.1 using Process Water & Fresh Water	1 test per 5,000 m^3
	Triaxial Testing	AS 1289.6.4.2	1 test per 10,000 m^3
	Permeability	AS 1289.6.7.1	1 test per 5,000 m^3
General Earth-fill	Particle Size Distribution	AS 1289.3.6.3	1 test per 10,000 m^3
	Plasticity Index	AS 1289.3.3.1	1 test per 10,000 m^3
	Liquid Limit	AS 1289.3.1.1	1 test per 10,000 m^3
	Field wet density	AS 1289.5.3.1, 1289.5.3.2 or 1289.5.3.5	1 test every 5,000 m^3

Zone	Process	Test Procedure for Quality Compliance	Minimum Testing Frequency
	Field moisture content	AS 1289.2.1.1	1 test every 5,000 m^3
	Moisture variation	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1	1 test every 5,000 m^3
	Hilf Density Ratio	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1 and field wet density in accordance with AS 1289.5.8.1	1 test every 5,000 m^3
	Emerson Class Testing	AS 1289.3.8.1 using Process Water & Fresh Water	1 test per 10,000 m^3
	Triaxial Testing	AS 1289.6.4.2	1 test per 20,000 m^3
	Permeability	AS 1289.6.7.1	1 test per 10,000 m^3
Engineered Fill	Hilf Density Ratio or Equivalent Compaction	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1 and field wet density in accordance with AS 1289.5.8.1	Every 300 mm, 1 test every 1,000 m^3
	Particle Size Distribution	AS 1289.3.6.3	1 test per 2,000 m^3
	Triaxial Testing	AS 1289.6.4.2	1 test per 5,000 m^3
Tests to be carried out from stockpile at quarry or commercial supplier:			
Filter Zone 2	Particle Size Distribution (wet sieve method)	AS 1289.3.6.1 Note maximum 3% fines at supplier	3 tests prior to approval then 1 test per 500 m^3
	Los Angeles Abrasion	AS 1141	1 tests prior to approval
	Sodium Sulphate Test	AS 1141	1 tests prior to approval
	Organic Content	AS 1141.34	1 tests prior to approval
	Tests to be carried out on samples taken after placement:		
	Particle Size Distribution (wet sieve method)	AS 1289.3.6.1	1 test per 250 m^3
	Density Index	AS 1289.5.6.1	2-3 tests as directed by the Principal

2.6.3 Testing Results

All NATA certified test results will be supplied to the Contractor in a timely manner, whereas the Contractor will manifest these into a control report.

In addition to satisfying the specific requirements detailed in other parts of this specification, the report shall include;

– Location of all tests in terms of chainage, transverse location, elevation RL and easting and northing of the test.
– Individual test values of moisture content (both nuclear and oven check) and dry density at each test location.
– Reference density for each test location
– Hilf density index and moisture variation.

2.6.4 Acceptance Criteria

All lots shall be compacted to a dry density ratio or density index equal to or greater than the specified value and moisture content within the specified range. In the event that a test result for a lot is below the specified value, remedial work shall be conducted over the whole lot.

REMEDIAL WORK: Any unsatisfactory filling is to be made good and may include removal or reworking of subsequently placed or overlying material which conforms with the Specification requirements.

Typical remedial action required for unacceptable fill placement will include but may not be limited to the following:

Table 4 Remedial actions for compacted fill

Category	Hilf Density Ratio Result	Moisture Result	Remedial Action 1
A	Fail by less than 1%	Pass	Re-compact (number of passes to be specified by the Principal)
B	Fail by 1% or more	Pass	Rip, re-compact and re-test
C	Pass	Fail, but no more than 2.0% dry of OMC	Rip, re-water, re-compact and re-test
D	Fail	Fail	Remove fill, replace, compact and re-test

Note: [1] Should the Principal deem the depth of insufficiently compacted material to be greater than can be effectively compacted from the surface, material shall be removed to a depth at which compaction is satisfactory and replaced and compacted in layers.

2.6.5 Further Potential Actions

The primary strategy will be to utilise borrow materials that can be moisture conditioned to meet the compaction specification, and not be placed “over-wet”.

If, however, there are repeated occurrences of moisture content above the specification limits, and remedial works to address the repeated failures become overly cumbersome and restrict construction progress, additional supporting strategies may be required. The Contractor will be required to demonstrate that all other practical strategies to source and treat materials to be compacted within specification have been exhausted.

In this event, the Design Engineer will review the circumstances and conditions and present a course of action for the Contractor and the Principal to review and agree. This may include insitu testing (such as shear vane) to confirm achievement of the minimum undrained shear strengths adopted in the stability analyses, and a programme for monitoring the piezometers during construction (including trigger limits).

2.6.6 Control Charts

The Contractor shall maintain and keep up to date charts on site as defined below:

- A longitudinal section (schematic) of the works identifying the precise location and extent of all lots tested, the lot identification, the dates of all compaction tests and the date at which compliance was achieved.
- A control chart presenting all test results (including re-tests), pertinent test details and confirmation of compliance with the acceptance criteria.
- For every nuclear meter used on site, control charts of daily standard counts (for applicable channels) and secondary block checks shall be made available to the Principal for inspection when required.

2.6.7 Reduction in Testing Frequency

Where the Contractor can demonstrate consistent conformance with the Specification requirements for a given test or group of tests, to the satisfaction of the Principal, then the Contractor may apply to the Principal to reduce the testing frequency to no less than half that defined in the Specification for the relevant test or group of tests.

A minimum of four (4) consecutive lots or batches of work tested in accordance with the Specification shall be taken to assess consistency.

If, when the testing frequency has been reduced, a subsequent test by the Principal shows a departure from the consistent conformance, then the Contractor shall return to full testing frequency as defined in the Specification. The Principal shall likewise return to a full testing frequency if the materials, methods of work or conditions of application alter.

Notwithstanding the provision for reduced frequency of testing, the Principal may elect to test a particular lot.

2.7 Geotextile

The Principal shall supply and the Contractor will install a layer of geotextile filter fabric (labelled interchangeably as geotextile or geofabric in the Drawings) at the locations shown on the Drawings or as directed.

Geotextile shall be suitable and durable for the intended application as satisfactorily demonstrated by similar and prior applications. Geotextile shall be non-woven 100% polyester or polypropylene (with the exception of inhibitors and/or carbon black added for UV resistance). Polypropylene materials shall be UV stabilised. The geotextile filament shall be rot proof, chemically stable and shall have low water absorbency. They shall resist delamination and maintain their relative position.

All geotextile material shall be free of flaws that may have an adverse effect on the physical and mechanical properties of the geotextile.

All geotextile material shall comply with AS 3706 and have the properties listed in the table below when tested in accordance with AS 3706.

Table 5 *Geotextile required properties*

Pore Size	AS 3706.1	90 micron
Pore Size	AS 3706.1	90 micron
Mean wide strip tensile strength	AS 3706.2	20 kN/m in both machine and cross-machine direction
Mean trapezoidal tear strength	AS 3706.3	500 N in both machine and cross-machine direction
Geotextile Strength Rating G(1)	Austroads	2,800
Permittivity	AS 3706.9	1.0 per second

(1) $G = (L \text{ X } H_{50})^{0.5}$

Where L = CBR Burst Strength (AS 3706.4)

H_{50} = Puncture Resistance by Drop Cone (AS 3706.5)

A proprietary product and grade of geotextile is shown on the Drawings. If, where an alternative is provided by the Principal it shall meet or exceed the grab tear strength, permittivity and be less than or equal to the apparent opening size of the specified product and the following requirements.

Prior to delivery, all individual roll manufacturer certifications required by the Specification shall be received and approved by the Principal. Delivery of any unapproved roll shall not be allowed and unapproved rolls shall be transported off-site.

Each delivery shall be subjected to a visual inspection prior to being allowed into the permanent Works stocks. For each delivery a quality control certificate shall be provided. The product name shall clearly be identified on each roll. Quality control certificates shall be retained by the Principal for future management of independent quality assurance testing.

After delivery of geotextile to site, the Contractor shall ensure that all geotextile surfaces are kept clean and undamaged and stored away from direct sunlight until covered. Any damaged or improperly stored geotextile materials shall be replaced by the Contractor at the Contractor's expense.

Geotextile shall be laid evenly with no kinks or folds. Geotextile shall be placed such that adjacent lengths of fabric overlap on longitudinal and transverse joints by a width not less than 500 mm. Joints shall be overlapped such that the upslope geotextile is lapped over the downslope geotextile. Geotextile placed on slopes of 1V:5H or steeper shall be laid upslope/downslope.

Any tear or puncture in the fabric caused by the Contractor's operations shall be repaired by the Contractor at its expense by patching using geotextile patches fastened over the tear or puncture. Patches shall overlap the tear or puncture by a minimum of 500 mm in all directions.

3. Concrete

3.1 Scope

The work specified under this Section includes the supply, mixing, placing, compacting and finishing of concrete to the lines, levels and dimensions shown on the Drawings, and it represents the minimum requirements with regard to concrete durability.

3.2 Standards

3.2.1 General

All concrete work shall conform to the requirements of the latest editions, including amendments, of the following Australian Standards, unless varied otherwise by this Specification.

3.2.2 Concrete Generally

AS 1478-1	Chemical Admixtures for Concrete, Mortar and Grout
AS 3582	Supplementary Cementitious Materials for use with Portland and Blended Cement.
AS 3600	Concrete Structures
AS 3972	Portland and Blended Cements
AS 3850	Prefabricated Concrete Elements Code

3.2.3 Sampling and Testing

AS 1012	Methods of Testing Concrete
AS 1141	Methods for Sampling and Testing Aggregates
AS 3583	Methods of Tests for Supplementary Cementitious Materials for use with Portland Cement

3.2.4 Concrete Supply and Placing

AS 1379	The Specification and Manufacture of Concrete
AS 2349	Methods of Sampling Portland and Blended Cements
AS 2350	Methods of Testing Portland and Blended Cements
AS 2758	Aggregates and Rock Engineering Purposes

3.2.5 Formwork

AS 3610	Formwork for Concrete

3.3 Materials

3.3.1 General

All concrete shall be dense and well graded.

All materials used in the manufacture of concrete shall, as a minimum, conform to the requirements of this Specification, and shall be subject to approval by the Principal before concreting is commenced. Details of the proposed materials and concrete mix proportions shall be submitted to the Principal at least 28 days prior to their intended use.

3.3.2 Portland Cement

All cement used in the Works shall be Portland Cement of Australian manufacture and shall comply with AS 3972. The type of cement shall be ASCE Specification Type GP General Purpose Portland Cement unless otherwise designated. The maximum alkali content of the cement (measured as Na2O equivalent) shall be 0.6% by weight.

Cement shall not be more than six months old when used in the Works and any cement that has become lumpy or partially set prior to mixing will be condemned and shall be removed from the site immediately.

All bagged cement shall be supplied in unopened and undamaged bags, bearing the Manufacturer's brand and date of manufacture.

3.3.3 Aggregate

Fine aggregate shall consist of clean natural sand.

Coarse aggregate shall consist of crushed stone or gravels composed of clean, sound, hard and durable particles free from dust, clay, organic materials or other deleterious substances. Unless otherwise noted on the Drawings or in this Specification, the maximum size of coarse aggregate to be used in each class of concrete shall be 20 mm.

All fine and coarse aggregates shall comply with the requirements of AS 2758.1 and shall be tested in accordance with AS 1141 Section 38.

All aggregates shall be tested by the Contractor for alkaline reactivity in particular and the results submitted to the Principal. Aggregates with high alkaline reactivity will be rejected altogether.

3.3.4 Water

Clean water of potable quality shall be used in all concrete mixes and shall be free from oil and injurious amounts of alkalis, salts, organic materials or other deleterious substances harmful to concrete or reinforcement.

3.4 Quality and Mix

3.4.1 Quality of Concrete

Concrete shall be specified by required properties as defined in AS 3600. The properties required for each element of the Works are as shown on the Drawings and herein.

The total cementitious content shall be between 320 and 360 kg/m^3 of concrete where the concrete grade is N32 or higher.

The concrete to be used shall attain a characteristic compressive strength at 28 days as indicated on the Drawings.

The maximum water / cementitious material ratio for all concrete shall be 0.5 by mass. Liquid additives shall be included in the water volume for the purpose of this calculation.

The consistency of concrete shall be determined by a slump test. Concrete shall be of such consistency that it can be readily placed and compacted without segregation of the materials and without excess water collecting on the surface. Slump measured is to be no greater than 80 mm within the tolerances given in AS 1379 clause 5.2.3, unless a superplasticiser, approved by the Principal, is used.

The Contractor shall note that the strength requirements are a minimum and that other criteria may control the approved mix.

3.4.2 Concrete Mix Design

The Contractor shall be responsible for the design and production of all concrete used in the Works. The use of ready-mixed concrete shall in no way lessen or remove this responsibility.

Not less than 2 weeks prior to the commencement of concreting operations, the Contractor shall submit details of the mix design for each specified class of concrete for the approval of the Principal. The submission shall include the following information:

- Class of Concrete;
- Supplier of Concrete (if ready mixed);
- Proportion (by weight) of various materials comprising the mix (including any proposed admixtures);
- Certificates of Compliance for various materials used in the mix;
- Target Strength;
- Target Slump;
- Degree of quality control over the mix;
- Method of Placing.

The Contractor shall state the proposed degree of control when details of the proposed mix design are submitted. If during the course of the work this degree of control is not maintained (as evidenced by either the batching and mixing and placing methods employed, or by the strength of test cylinders taken on the work), the Principal may withdraw approval, pending either redesign of the mix, or establishment of improved quality control, or revision to the method of placing. Where a new mix design is prepared, testing of the new mix shall be carried out entirely at the Contractor's expense.

Approval of the Concrete Mix Design shall be a **HOLD POINT**.

3.5 Grades of Concrete

The following table presents the required concrete grades for various structures.

Table 6 Concrete Grades

Structure	Required Grade (MPa)
Spillway Control Structure	N32
Outlet Tower Concrete	N32
Survey Monuments and Points	N25

3.6 Testing

3.6.1 Sampling and Testing

All concrete with strength grade equal to or greater than 32 MPa.

The Contractor shall take samples from separate batches of concrete selected at random during the placing operation. Each specimen cylinder shall be identified with the batch or as directed by the Principal. The minimum rate of sampling shall be as follows:

- Slump testing on at least the first two trucks where concrete testing is to be carried out
- 4 cylinders from each lot of 25 cubic metres (or part thereof);
- For each set of specimen cylinders one shall be tested at 7 days and two at 28 days or as directed by the Principal;
- At least one specimen shall be tested at 3 days to obtain an indication of the strength development rate on major pours, as directed by the Principal.

Specimen cylinders taken from the batches shall be cured in accordance with AS 1012, except that they shall be stored at the site of the Works under moist conditions, sheltered from the influence of sun and wind and protected from extremes of temperature.

The compressive strength of a batch of concrete shall be determined as the mean 28-day strength of the specimen cylinders cast from that batch.

All concrete shall be supplied by a quality assured supplier who shall provide test certificates to confirm that the concrete complies with maximum drying shrinkage and density requirements.

All test results shall be submitted to the Principal, and in particular, notification of any failures on the test specimens shall immediately be given to the Principal.

Should the Contractor seek to vary any requirement of this Specification and should the Principal's approval be subject to additional sampling and testing at other than 28 days, the cost of such additional sampling and testing shall be borne entirely by the Contractor.

The Contractor shall keep on the site, a log book in which is recorded the following information:

- Specimen cylinder number or identifying mark;
- Date of sampling and name of operator;
- Slump of batch from which sample is taken;
- Portion of structure represented by the sample;
- Test results.

This logbook shall be available for inspection by the Principal at all times.

Batch Certificates

All concrete supplied shall at arrival on site be provided with batch plant certificates for the respective batches. Batch certificates shall contain all information about the concrete supplied as required by AS 1379.

3.6.2 Acceptance of Testing

Where the concrete already placed is classed as defective and liable to rejection, the criteria for rejection shall be as set out in AS 3600.

Should any concrete be liable to rejection, the Contractor may submit specimens cut from the completed work for testing. The number, form and dimensions of the specimens, and the location from which they are cut shall be subject to the approval of the Principal. The Contractor shall arrange for an approved Testing Authority to carry out the required tests and submit the results directly to the Principal, with a copy to the Contractor.

The Principal will then consider the test results and other information, and may, with absolute discretion, determine whether the strength of the specimens cut from the work and adjusted for the age of the specimens, is to be taken as the actual strength of the concrete for acceptance purposes. The entire cost of cutting specimens from the completed work, testing and restoration shall be borne by the Contractor.

Nothing in the foregoing shall in any way relieve the Contractor of any contractual responsibilities, and the Principal shall be indemnified against any damage from the quality of the concrete being below that specified.

Concrete classed as defective and rejected by the Principal shall be removed from the Works and, together with any other work subsequently erected thereon, shall be replaced, at the Contractor's entire expense, with concrete complying with the Specification.

3.7 Formwork and Falsework

3.7.1 Formwork

Formwork shall be designed and constructed in accordance with AS 3610 and AS 3600. All forms shall be built surface smooth and mortar tight and have sufficient rigidity to prevent distortion due to the pressure of fresh concrete and other construction loads. Particular care shall be taken in the preparation of the joint around piles penetrating the soffit.

It should be noted that welding of formwork or its supports to exposed parts of permanent piles will not be permitted.

Forms for plane exposed surfaces shall consist of plastic-coated plywood, waterproof plywood, timber forms lined with tempered hard board or close-fitting unwarped metal forms. Joints in the form sheeting for plane exposed concrete surfaces shall be either vertical or horizontal unless otherwise specified.

Forms for surfaces not exposed to general view may consist of standard timber or metal panels.

Timber forms shall be constructed and maintained in such a manner as to prevent warping and opening of joints due to shrinkage of the timber. The timber shall be free of any defects which will affect the structure.

Unless otherwise shown on the Drawings all corners shall be provided with 20 mm x 20 mm chamfers or fillets.

All forms shall be set and maintained to line and level such that the finished concrete will conform to the proper levels, dimensions and contours, as shown on the Drawings, within the tolerances specified.

All forms shall be cleaned and coated with the lightest practical coating of release agent prior to erection. The Contractor shall ensure that reinforcing steel and construction joints are not contaminated with release agent.

Pockets formed in the concrete for subsequent casting of anchor bolts, or the like shall be carefully constructed to allow for the full reinforcement to project through the forms.

Metal form-ties shall be of an approved type. If the form-ties are cast in, they shall be of a type which permits removal of the end fittings to a depth at least 50 mm below the finished surface of the concrete. Ordinary wire ties shall not be used.

Form-ties shall be located in a uniform symmetrical pattern relative to the finished surface. The cavities left when the end fittings of embedded ties are removed shall be as small as possible and shall be filled with an approved epoxy cement mortar at the earliest possible time. The surface of such filled cavities shall be left smooth and uniform in colour.

When forms are re used, their original shape, strength, rigidity, mortar tightness and surface smoothness shall be maintained. Forms which, in the opinion of the Principal, become unsatisfactory in any respect shall not be used.

The Contractor shall check the formwork prior to placing the concrete. All dimensions, particularly those affecting the construction of subsequent portions of the Works, shall be carefully checked.

All formwork shall be subject to inspection and approval by the Principal or a nominated representative, and shall not be used until approval has been given. Notwithstanding any inspection or approval given by the Principal, the responsibility for the structural sufficiency of the whole of the formwork shall remain entirely with the Contractor.

Should any formwork be displaced during concreting, or within the periods specified for the retention of formwork, the concrete shall be removed between such limits as the Principal may determine, construction joints shall be formed, and the section of work reconstructed, after the formwork has been strengthened and adjusted.

3.7.2 Falsework

The design and erection of falsework, the method of founding or supporting the falsework, and the time, order and manner of its release shall all be the responsibility of the Contractor, but will be subject to the approval of the Principal before commencement of construction. The Contractor shall supply the Principal with detailed drawings of such falsework at least four (4) weeks prior to the commencement of erection.

It should be noted that welding of falsework or its supports will not be permitted to exposed parts of permanent piles.

All falsework shall include adequate bracing to prevent movement of piles or formwork during concreting.

The provisions of such drawings and their approval by the Principal shall in no way relieve the Contractor of any responsibility for the satisfactory performance of the falsework.

Subject to the Principal's approval, falsework may be supported on completed sections of the Works provided that the construction loads subsequently applied do not result in over stressing or instability within the sections, and that due allowance is made for any deflection of the sections.

If any structural strengthening or modification of such sections of the Works is necessary as a condition for approval of their use as support structures, the cost of such strengthening or modification shall be borne entirely by the Contractor.

The Principal's approval of the use of completed sections of the Works as support structures for falsework, shall in no way relieve the Contractor of any responsibility for the cost of restoration or repair of any damage occasioned by or resulting from such use.

3.7.3 Finishes

Formwork shall be in accordance with the AS 3610 Class 2. Aluminium alloy sheeting shall not be used as formwork.

The number of re uses, and the conditions of faces and edges of forms, shall be consistent with the formwork surface class specified. Forms shall not be disturbed until the concrete in contact with them has hardened sufficiently to withstand such action without damage.

3.7.4 Stripping

Forms shall be so designed and constructed that they may be removed without injuring the concrete surfaces and without excessive jarring or hammering.

Forms and falsework beneath the soffit of self-supporting concrete elements shall not be removed until a minimum of 75% of the Characteristic Compressive Strength at 28 days has been achieved and in accordance with AS 3610 Table 4.2, unless noted otherwise. Special care shall be exercised when removing formwork from the vicinity of piles to ensure that the protective treatment is not damaged.

Precast reinforced and prestressed concrete elements shall not be lifted before a minimum of 75% of the Characteristic Compressive Strength at 28 days has been achieved, or any larger limit as specified on the Drawings, and approval must be obtained from the Principal before commencement of lifting.

3.8 Ready Mix Concrete

The Contractor shall submit the name of the proposed Supplier to the Principal at least four (4) weeks prior to the commencement of concreting operations.

Only those Suppliers approved by the Principal will be allowed to supply ready mixed concrete. The Principal shall reserve the right to withdraw approval of any Supplier at any time.

The production and delivery of ready mixed concrete shall be in accordance with the requirements of AS 1379 except as otherwise specified hereunder.

Mixing speeds shall range from 12 - 20 rpm and agitating speeds shall range from 2 - 3 rpm.

Notwithstanding any requirement to the contrary contained in AS 1379, the sampling, testing and acceptance of ready-mixed concrete shall conform to the requirements of this Specification.

Ready-mixed concrete shall be delivered to the site in trucks of the revolving drum type and the use of non-agitating equipment for this purpose will not be permitted.

The quantity of concrete delivered in any truck shall not exceed the rated capacity of its agitator drum. The timing of deliveries shall be such as to ensure an essentially continuous placing operation.

3.9 Placing

3.9.1 General

Before commencing placement of concrete in any section of the Works, the formwork shall be checked for accuracy and tightness and all joints shall be effectively stopped.

No concrete shall be placed in the Works until the formwork and reinforcing steel have been inspected and approved by the Principal and any foreign material has been completely removed from the forms and reinforcing.

Concrete shall be liable to rejection if the slump is in excess of the maximum slump specified.

Except for underwater concrete, all concrete shall be placed under dry conditions.

Concreting operation shall be carried out in a continuous manner between approved construction joints. Should a delay occur which allows the concrete in the forms to take its initial set as determined by the Principal, a construction joint shall be formed as specified elsewhere herein and fresh concrete shall not be placed against the concrete already in the forms at that time.

Chutes, if used, shall be arranged in a manner which avoids segregation of the concrete. Apart from an initial flushing immediately prior to commencement of concreting, the use of water in chutes to assist movement of concrete will not be permitted.

Buckets shall be capable of discharging portions of their load at a time in a controlled manner.

Concrete shall not generally be dropped from a height exceeding 2 m, nor shall it be placed in any other manner which results in segregation or loss of concrete and damage to formwork and reinforcement.

If placing operations necessitate a drop of more than 2 m, the concrete shall be placed using a method approved by the Principal.

Fresh concrete shall be deposited within the forms as near as possible to its final location. Excessive use of vibrators and tamping rods to move the concrete along the forms will not be permitted.

Formwork shall not be disturbed or adjusted during the concreting operation, and shall remain undisturbed up to the minimum removal time specified.

No strain shall be placed on any projecting reinforcing steel for a period of at least 24 hours following completion of concreting.

The full thickness of all structural members shall be concreted in the one operation, unless approved otherwise by the Principal.

If a cessation of work becomes unavoidable, a construction joint shall be formed as specified elsewhere herein, at the point of stopping. When work is resumed, the treatment of the concrete at the cold joints shall be as specified under Section 3.9.5. "Construction Joints".

3.9.2 Pumping

Approval to use concrete pumps to place concrete may be given by the Principal, subject to the Contractor submitting full details of the type and capacity of the pumps, pipework, and procedures to be adopted, and satisfactory evidence that any modifications to the concrete proportions and consistency to suit pumping procedures shall comply with the provisions and intent of this Specification.

The pump shall have a variable speed control and shall be capable of pumping concrete containing 20 mm aggregate through delivery lines not less than 75mm diameter.

Delivery lines shall be of an approved metallic type. Under no circumstance shall aluminium alloy pipes or fittings be used nor shall concrete be permitted to come into contact with aluminium during its manufacture, transport or placing.

Where delivery lines are exposed to the direct sunlight, they shall be protected by covering with bags, wet hessian or other approved means.

Direct, efficient communication shall be maintained at all times between the pump operator and the concrete placing crew.

During delays in delivery of concrete to the pump, concrete in the lines shall be pumped at approximately 10 minute intervals (5 minutes where the ambient temperature is greater than 32°C) to ensure that the concrete is "live". For piston type pumps at least two strokes of the piston shall be made at each pumping interval. In the event of any delay or breakdown in the equipment not exceeding 20 minutes, during which time concrete cannot be placed, the concrete already in place shall have the "wet edges" maintained in an approved manner.

If the delay exceeds twenty minutes, an emergency construction joint shall be formed where directed, the concrete completed to it, and all concrete in the pipeline discarded.

Should the atmospheric (shade) temperature on the site not exceed 18°C, the concrete in the receiving hopper and lines may be placed in the work on the resumption of pumping, when approved by the Principal.

Should the temperature exceed 30°C, the receiving hopper and lines shall be cleaned out and the concrete contained therein discarded.

Where the temperature lies between 18°C and 30°C, the using or discarding of the concrete shall be determined by the Principal.

In any case where initial setting of the concrete has begun in the hopper or discharge lines, the concrete shall be discarded.

3.9.3 Placing in Hot Weather

The Contractor shall take all practical precautions to maintain the concrete at a temperature not exceeding 32°C. Such precautions shall be taken to avoid premature stiffening of the fresh mix, reduce water absorption and evaporation loss, and prevent shrinkage, settlement, and pre setting cracks.

Such precautions shall be taken if the ambient air temperature at the time of placing is likely to be greater than 32 °C and may include:

General	(a)	All concreting shall be placed during the early morning and commencement of work shall be timed to ensure completion of concreting before 10.00 am to the satisfaction and approval of the Principal.
At the mixer	(a)	Using crushed ice in the mixing water.
	(b)	Liquid nitrogen cooling of the mix.
	(c)	Shading and watering aggregate stockpiles.
	(d)	Insulating containers and delivery lines.
	(e)	Any combination of the above methods.
At the site	(a)	Cooling formwork by dampening with water sprays.
	(b)	Shading work areas.
	(c)	Erecting wind breaks.
	(d)	Minimising the time for placing and finishing

No concrete shall be placed with temperature greater than 32°C at the time of placing in the forms.

Unless a concrete mix with a retarder has been approved, concrete shall be placed and compacted within the time limits specified below.

Table 7 Maximum Elapsed Time from Time of Charging Mixture

Concrete Temperature	Ready-mixed (min)	Site-mixed (min)
Less than 24C	120	60
24C - 27C	90	45
25C - 30C	45	30
30C - 32C	30	20
Over 32C	Not acceptable	Not acceptable

After placing and compacting, the concrete shall be covered with an impervious membrane or hessian kept wet until cured to the satisfaction of the Principal.

The Contractor's proposed hot weather placing techniques shall be subject to the Principal's approval, and full details shall be submitted to the Principal at least 28 days before the first concrete pour at a time when hot weather could be expected.

3.9.4 Cold Weather Concreting

In cold weather the temperature of freshly mixed concrete shall be maintained within the limits shown below. "Outdoor" air temperature is air temperature at time of mixing, or predicted or likely air temperature during the next 48 hours. Before and while placing concrete maintain the temperature of formwork and reinforcement at more than 5°C. Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of concrete. Do not allow frozen materials to enter the mixer. Keep forms, materials, equipment in contact with concrete free of frost and ice. Heat concrete materials (other than cement) to the minimum temperature necessary to ensure temperature of placed concrete is within the limits specified. Maximum water temperature: 60°C when placed in the mixer.

Outdoor Air Temperature	Temperature of Concrete	
	Minimum	Maximum
>5oC	10 °C	32 °C
<5oC	18 °C	32 °C

3.9.5 Construction Joints

A construction joint is defined as the junction between two successive concreting operations in an element, intended to act structurally.

Generally, construction joints shall be located away from the mid span of the slab and not within 1000mm of any supports, openings or inserts in the deck. Pile caps, and similar sections shall be cast in one operation without construction joints.

Whenever the work of placing concrete is delayed so that the initial set has taken place as determined by the Principal, the point of stopping shall be deemed a construction joint and formed accordingly. The initial set shall be deemed to occur if a standard vibrator will not penetrate the surface under its own weight, and will not re work the concrete mix once penetration has been achieved.

Where such a point of stopping occurs at a location considered unsuitable by the Principal, the Contractor shall remove such concrete already placed as will enable a satisfactory construction joint to be formed where directed by the Principal.

Before depositing new concrete on or against concrete which has hardened, the forms shall be re tightened. The surface of the hardened concrete shall be roughened in a manner that will expose sound concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance and saturated with potable quality water.

Immediately before the next pour, the joint surface shall be saturated with potable quality water.

3.10 Compaction and Curing

3.10.1 Compaction

Concrete shall be thoroughly compacted during and immediately after depositing. Concrete other than no-fines concrete shall be compacted with high frequency internal vibrators in the manner described below. Hand compaction in lieu of mechanical vibration will be allowed only as an emergency measure when approved by the Principal.

The vibration shall be internal except for the use of form vibrators.

Vibrators shall be of an approved type, capable of transmitting vibration to the concrete at frequencies of not less than 12,000 impulses per minute at an intensity to visibly affect a zero slump concrete at a radius of 300mm.

For concrete of 28 day strengths of 20MPa or less, the vibrators shall be capable of transmitting vibration to the concrete at frequencies of not less than 8,000 impulses per minute at such an intensity to visibly affect a 25mm slump concrete at a radius of 300mm.

The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed. The minimum number of vibrators to be provided will depend on the rate of placing concrete but in no case shall be less than 1 vibrator for each 5 m^3 of concrete or part thereof placed per hour, with a minimum of 2 vibrators.

At least one vibrator in working order shall be held in reserve at all times.

A vibrator shall be inserted into the concrete at successive positions not more than 500mm apart and vibration shall continue at each position until air bubbles cease to emerge. It shall then be withdrawn slowly.

Vibrators shall be inserted so as to thoroughly compact the concrete around the reinforcement and embedded fixtures into the corners and angles of the forms. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. Where more than one layer is being placed in a continuous operation the vibrator shall be inserted through the layer into the layer below.

The vibrators shall be inserted into and withdrawn from the concrete slowly. The vibration shall be of sufficient duration to thoroughly compact the concrete, but shall not be continued so as to cause segregation.

Vibration shall not be applied, directly to or through the reinforcement, or to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

3.10.2 Form Vibrators

The provision of this section shall also apply to precast members except that if approved by the Principal, the Manufacturer's method of vibration may be used. For precast slab units, internal vibration shall be used in conjunction with external mould vibration.

Except where authorised by the Principal and in thin web sections, concrete shall be placed in horizontal layers not more than 300mm thick. Each layer shall be placed and compacted before the preceding layer has taken its initial set.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon exposed reinforcing steel and the surfaces of the forms shall be removed.

3.10.3 Protection and Curing

The Contractor shall ensure that all concrete is properly and adequately cured. The Principal shall approve the curing methods before any concrete is placed. The Contractor shall modify or change the curing procedures as directed by the Principal at any time during the work of the Contract, if the Principal is not satisfied that the concrete is properly cured.

Initial curing of exposed concrete surfaces shall be commenced as soon as the surface of the concrete has hardened sufficiently and shall continue for not less than 72 hours. The concrete surface shall be kept continuously moist, preferably by ponding, but where this method is considered impractical, an absorbent cover that is kept continuously wet shall be used.

Final curing shall commence immediately following the initial curing period and shall continue for not less than seven days or such longer period as the Principal may direct. During this period the curing shall be carried out either by continuing the method used during the initial curing period or by the following method, subject to the provisions of the hot weather placement in Clause 3.9.3.

a) Waterproof Sheeting Covers

The Concrete shall be covered with an approved waterproof sheeting maintained in close contact with the surface of the concrete.

The edges of the sheeting shall be taped or shall overlap by at least 200mm, and the whole sheeting shall be securely held in position. Any damage to, or displacement of the sheeting during building operations, shall immediately be made good, and should the concrete surface show signs of drying out during the final curing period, the sheeting shall be temporarily removed, the surface of the concrete wetted, and the sheeting replaced as before.

b) Membrane Curing Compound (note that not permitted under hot weather conditions)

Proprietary membrane curing compounds shall be to the specific approval of the Principal and shall be applied in accordance with the Manufacturer's instructions and recommended rate, half to be applied back and forth in one direction, and the remainder at right angles. The compound shall be thoroughly mixed before application. It shall provide a continuous flexible coating without visible breaks or pinholes which remains unbroken for not less than the curing period after application.

Curing compounds shall not be used on surfaces which are to receive other finishes or further concrete.

The curing compound shall be either a wax emulsion or chlorinated rubber based composition containing a fugitive white pigment. The Contractor shall submit the name, type and Manufacturer of the proposed compound for the approval of the Principal, at least two (2) weeks prior to commencing concrete operations.

Steel forms exposed to direct sunlight, and all wood forms in contact with the concrete during the final curing period, shall be kept wet. If forms are removed during the curing period, one of the previously described curing methods shall be employed and continued for the remainder of the period.

The Contractor shall ensure that a uniform colour is achieved on adjacent surfaces by applying uniform curing methods, the details of which must be submitted for the approval of the Principal at least 28 days before concreting commences.

3.10.4 Concrete Cracking

The Contractor shall treat all cracks at his expense as directed by the Principal using the method described as follows:

- Cracks of width between 0.2 and 1.0 mm shall be sealed using an approved low viscosity epoxy.
- Cracks of width greater than 1.0 mm shall be grooved out, cleaned and sealed with a special modified bentonite/cement grout.
- Cracks which have developed along construction joints shall be sealed over their full depths with a low viscosity epoxy, except that where cracking of width greater than 1.0 mm occurs in these joints, they shall be grooved out and sealed with an approved polyurethane sealant in addition to sealing with a low viscosity epoxy.

Polyurethane sealants and low viscosity epoxies shall be used in accordance with the manufacturer’s written instructions and allowance made for the time to complete full cure.

Where a low viscosity epoxy is used, the surface of the concrete in the vicinity of the construction joints and cracks shall be wire brushed, dried and all dust removed by air blasting or other approved methods before application of the epoxy.

Where grooving out followed by sealing is required, the grooves shall be cut 10 mm wide x 10 mm deep, by means of a suitable cutting disc over the construction joint or located crack. Such grooves shall be wire brushed and kept clean, dried and blown free of dust immediately before application of either the grout, epoxy or sealant primer, whichever is applicable.

3.11 Surface Finish

The finish of formed concrete surfaces shall be in accordance with and as defined in AS3610, except that surface tolerances shall be in accordance with the Specification. Unless shown otherwise on the Drawings, surfaces which will remain permanently exposed shall be formed using Class 2 formwork and surfaces which will be permanently concealed shall be formed using Class 3 formwork

Unformed surfaces shall be of finish Class U1.

3.12 Tolerances and Building-In

3.12.1 Dimensional Tolerances

Where tolerances are not stated in the Specification or the Drawings for any individual structure or feature thereof, they shall not be greater than the deviations listed below.

These tolerances shall be applied to the completed work, and forms shall be set and maintained so as to ensure the completed work is within the tolerance limits. Should a specified tolerance be exceeded, the work shall be liable to rejection or remedy at the Principal's discretion, and the nature of remedial work shall be at the Principal's discretion. The cost of any remedial work shall be borne entirely by the Contractor.

3.12.2 Pre-Cast Concrete

Item	Tolerance Requirements
Size of members of thickness of slab	+2 mm - 0 mm
Cover of concrete over reinforcement	+2 mm - 1 mm
Departures from plane in exposed surfaces.	

Gradual Sudden	-2 mm in 3 m -1 mm in 3 m
Departure from line on exposed edges	-2 mm in 3 m
Departure from Contract dimension where other tolerances do not apply.	0 – 20 m 2 mm over 20 m 5 mm

3.12.3 Cast Insitu Concrete

Item	Tolerance Requirements
Size of members of thickness of slab	-0 mm +6 mm
Cover of concrete over reinforcement	+6 mm -0 mm
Departures from plane in exposed surfaces. Gradual Sudden	 -6 mm in 3 m -3 mm in 3 m
Departure from line on exposed edges	-3 mm in 3 m
Departure from Contract dimension where other tolerances do not apply.	0 – 20 m 5 mm over 20 m 10 mm

Where in the opinion of the Principal the application of the above tolerances would adversely affect the serviceability of the structure, the tolerances may be amended at the Principal's discretion. Where appearance or serviceability of the structure will not be impaired (e.g., in concrete to be subsequently buried below ground level), the Principal may relax the tolerances above.

3.13 Handling of Pre-Cast Units

Precast concrete shall only be used where shown on the drawings or approved by the Principal.

All precast units shall be lifted only by double slinging from twin lifting devices or a suitable spreader bar and single hoist from attachments near each end. No other lifting points shall be permitted without the prior approval of the Principal.

Precast units shall be lifted by both ends simultaneously during general transportation, but this may be altered to a single vertical lift from the top during installation.

All precast units shall be stacked by placing soft timber packing under both end lifting points, whether during transportation or when stockpiled for subsequent use. Under no circumstances shall any other means of stacking be adopted.

Units may be placed on top of each other, spaced by timbers at support points mentioned above, provided that the net bearing stress so produced on the lowermost unit is less than 7MPa, and provided furthermore that the Principal is satisfied as to the suitability of the foundation material and the stability of the stacked units.

During erection, units shall be handled by slinging from lifting points only, and all movements shall be gradual and procedures used shall be such as to minimise shock loading. Precast units shall always be handled with care to avoid damage.

All damaged precast units (cracked or spalled) are to be set aside for inspection by the Principal repair or recasting to be undertaken at the Principals discretion.

3.14 Grout, Mortars and Other Components

3.14.1 Materials in Sand/Cement Mortars and Grouts

Cement and water shall be as specified in this document.

Sand shall consist of sharp, coarse, clean siliceous sand, free from dust, clay, organic matter or other deleterious substances.

Grading and fineness shall be such that the mortar produced from the sand shall be impervious to moisture.

The sand, cement and water shall be mixed in the preparation specified in the relevant clauses of this Specification. They shall be efficiently mixed and no segregation shall be allowed. The water cement ratio for the grout or mortar shall be the minimum required to allow placement as specified herein.

3.14.2 Miscellaneous Compounds

Where proprietary sealants, epoxy compounds, bond breaking compounds, glues and grouts are used, details shall be supplied for the approval of the Principal prior to use. Such items shall always be applied strictly in accordance with the Manufacturer's Specification.

3.15 Pre-Cast Workshop Drawings

Prior to the proposed commencement of fabrication of precast portions of the Works, the Contractor shall submit Workshop Drawings for the approval of the Principal. Approval by the Principal shall not relieve the Contractor of any responsibility in regard to the proper execution of the Work under this Contract.

4. Reinforcement

4.1 General

4.1.1 Responsibilities

Requirement: Provide concrete reinforcement, as documented.

4.1.2 Standards

Reinforced concrete construction: To AS 3600.

Reinforcement production: To AS4671

4.1.3 Tolerances

Fabrication and fixing: To AS 3600 clause 17.2.

Reinforcement position: To AS 3600 clause 17.5.3.

4.1.4 Submissions

Submit the following:

- Certification: Valid ACRS certification of compliance with AS 4671 for manufacturers, processors, suppliers and mill, product tags and supporting documentation for all reinforcement to be included.
- General: Details of any proposed changes to documented reinforcement.
- Damaged galvanizing: Details of proposed repair to AS/NZS 4680 Section 8.
- Mechanical bar splices: Details and test certificates for each size and type of bar to be spliced.
- Provision for concrete placement: Details of spacing or cover to reinforcement that does not conform to AS 3600.
- Splicing: Details of any proposed changes to documented requirements.
- Welding: Details of any proposed welding of reinforcement.

4.1.4.1 Materials

Reinforcement strength and ductility: Submit type-test reports to verify conformance to AS 3600 Table 3.2.1 for each reinforcement type.

The reinforcement must have unique marks to identify the supplier and these must correspond to the ACRS certification provided with the reinforcement.

4.1.5 Inspection

Inspection: Give notice so that inspection may be made of the following:

- Cores and embedment’s fixed in place.
- Reinforcement fixed in place, with formwork completed.
- Inspection of reinforcement shall constitute a **HOLD POINT**.

4.2 Products

Steel reinforcement

Standard: To AS/NZS 4671.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Bars are to be supplied to site pre-bent to required shapes, reinforcement cages to be prefabricated off site as far as practicable. Bend diameters are to be to AS3600, do not bend after galvanising or application of other coating.

4.2.1.1 Tie wire

General: Annealed steel 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

4.3 Execution

4.3.1.1 Dowels

Fixing: If a dowel has an unpainted half, embed in the concrete placed first.

Tolerances:

Alignment: 1:150.

Location: ± half the diameter of the dowel.

Grade: 250 N.

4.3.1.2 Cover

Concrete cover shall be minimum:

Generally - 30 mm cover

Cast against the ground – 45 mm

4.3.1.3 Supports

Proprietary concrete, metal or plastic supports: To AS/NZS 2425 and as follows:

Able to withstand construction and traffic loads.

With a protective coating if they are ferrous metal, located within the concrete cover zone, or are used with galvanized or zinc-coated reinforcement.

Spacing:

Bars: ≤ 60 diameters.

Mesh: ≤ 800 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

4.3.1.4 Projecting Reinforcement

Protection: If starter or other bars extend beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is cast into later work.

4.3.1.5 Tying

General: Secure the reinforcement against displacement at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of formwork or unformed faces to prevent the ties projecting into the concrete cover. Ensure all bars are restrained before stopping work to prevent bars rolling underfoot

Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.

Bundled bars: Tie bundled bars in closest possible contact. Provide tie wire at least 2.5 mm diameter and spaced not more than 24 times the diameter of the smallest bar in the bundle.

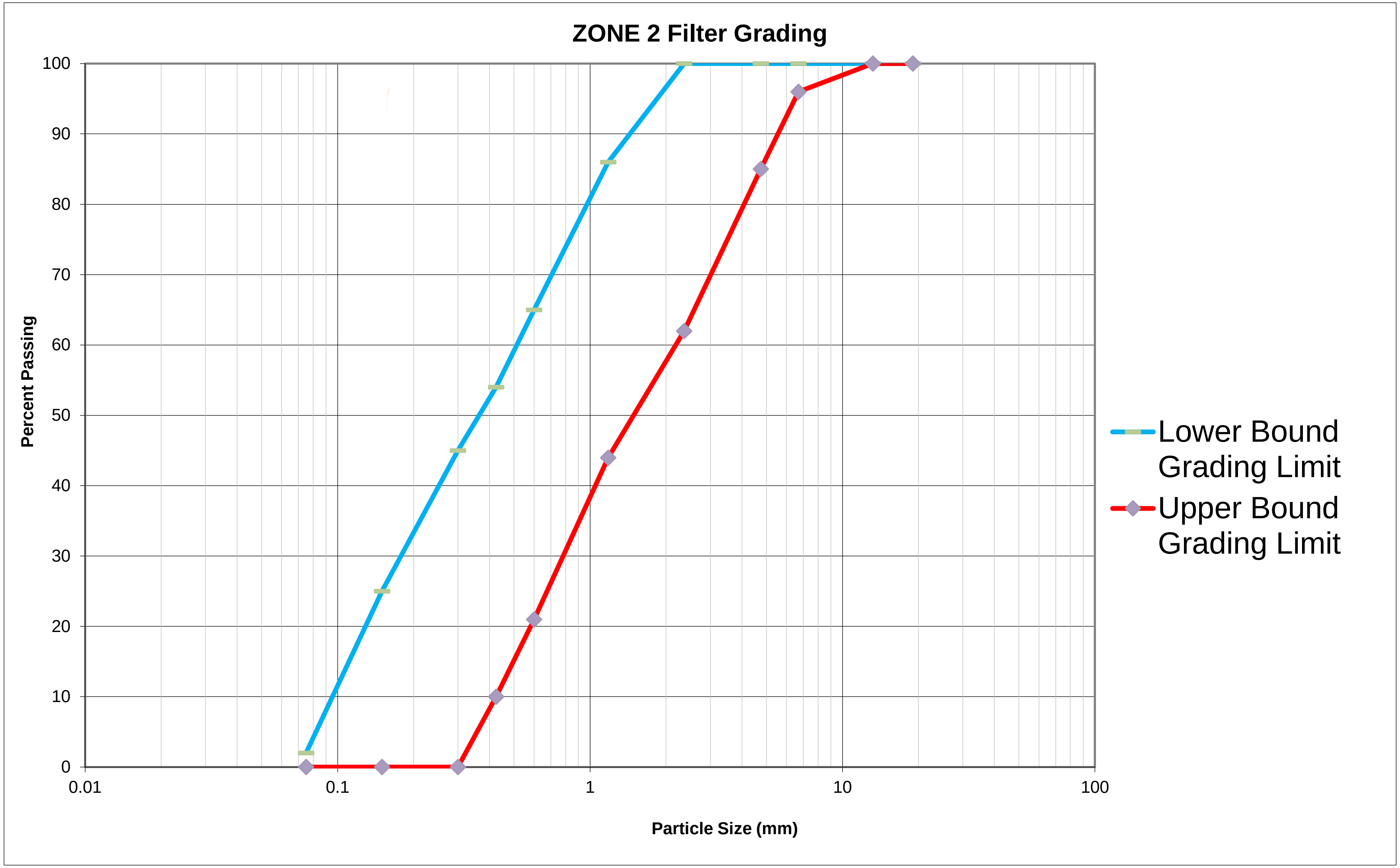
Columns: Secure longitudinal column reinforcement to all ties at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections.

Appendices

Appendix A

Zone 2 Filter Grading Requirements


ZONE 2 Filter Grading
Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
Particle Size (mm)
Lower Bound Grading Limit
Upper Bound Grading Limit

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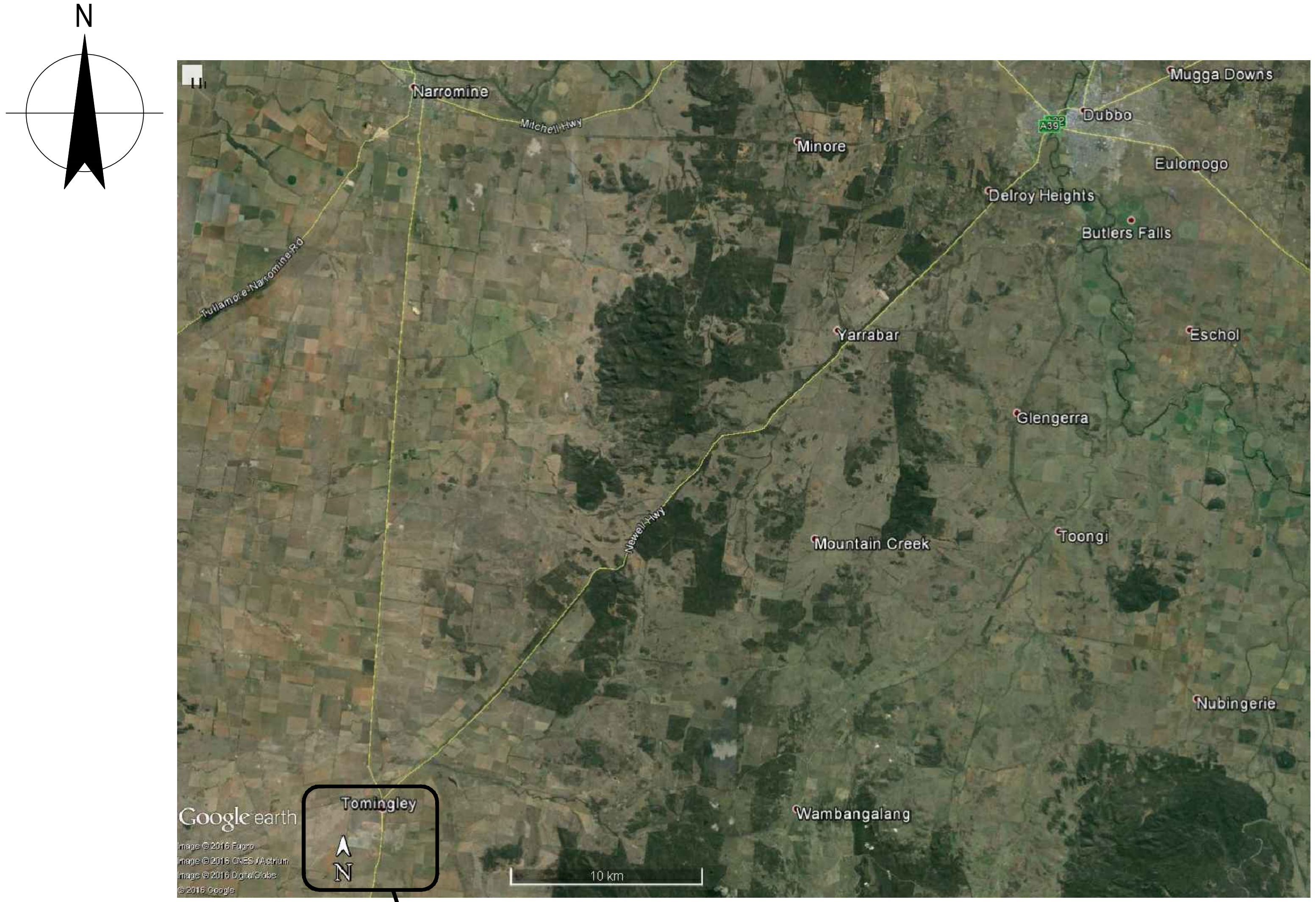
TOMINGLEY GOLD MINE
RSF 2 STAGE 1 DETAILED DESIGN
12545239



LOCALITY PLAN
NOT TO SCALE

SITE LOCATION

DRAWING LIST

DRG No.	DRAWING TITLE
12545239-C001	COVER SHEET AND DRAWING LIST
12545239-C002	GENERAL ARRANGEMENT PLAN
12545239-C003	GEOTECHNICAL INVESTIGATION PLAN
12545239-C004	TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 1 OF 4
12545239-C005	TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 2 OF 4
12545239-C006	TYPICAL SECTIONS - SHEET 3 OF 4
12545239-C007	TYPICAL SECTIONS - SHEET 4 OF 4
12545239-C008	MATERIALS SPECIFICATION
12545239-C009	TYPICAL SPILLWAY SECTION AND DETAIL
12545239-C010	INSTRUMENTATION PLAN
12545239-C011	GPS INSTRUMENTATION TYPICAL SECTIONS
12545239-C012	GNSS GPS UNIT DETAILS
12545239-C013	SURVEY REFERENCE APRIL TAG MOUNT
12545239-C014	STAND ALONE APRIL TAG MOUNT DETAILS
12545239-C015	LONGITUDINAL SECTIONS - SHEET 1 OF 5
12545239-C016	LONGITUDINAL SECTIONS - SHEET 2 OF 5
12545239-C017	LONGITUDINAL SECTIONS - SHEET 3 OF 5
12545239-C018	LONGITUDINAL SECTIONS - SHEET 4 OF 5
12545239-C019	LONGITUDINAL SECTIONS - SHEET 5 OF 5
12545239-C020	ULTIMATE TYPICAL SECTIONS
12545239-C021	CONCEPTUAL CLOSURE PLAN
12545239-C022	CONCEPTUAL CLOSURE SECTION AND DETAILS

Rev	Description	Checked	Approved	Date
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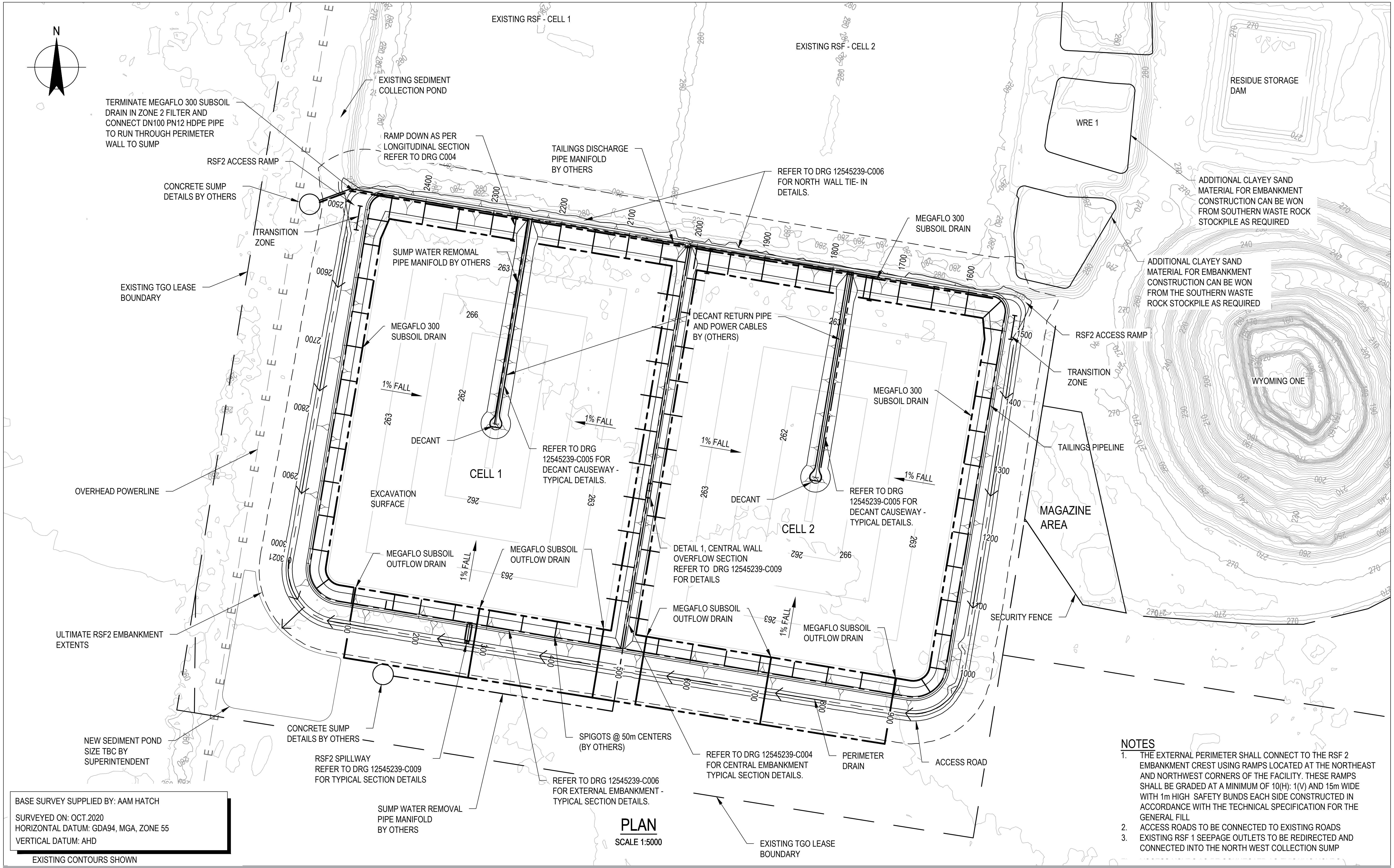
Drawing Title COVER SHEET AND DRAWING LIST
Size A3
Drawing No. 12545239-C001
Rev 0

Plot Date: 17 December 2021 - 2:01 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C001.dwg



PLAN
SCALE 1:5000

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

NOTES

1. THE EXTERNAL PERIMETER SHALL CONNECT TO THE RSF 2 EMBANKMENT CREST USING RAMPS LOCATED AT THE NORTHEAST AND NORTHWEST CORNERS OF THE FACILITY. THESE RAMPS SHALL BE GRADED AT A MINIMUM OF 10(H): 1(V) AND 15m WIDE WITH 1m HIGH SAFETY BUNDS EACH SIDE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION FOR THE GENERAL FILL
2. ACCESS ROADS TO BE CONNECTED TO EXISTING ROADS
3. EXISTING RSF 1 SEEPAGE OUTLETS TO BE REDIRECTED AND CONNECTED INTO THE NORTH WEST COLLECTION SUMP

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Designer T. RIDGWAY Design Check R. LONGEY

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Drawing Title GENERAL ARRANGEMENT PLAN

Size A3
Drawing No. 12545239-C002
Rev 0

GEOTECHNICAL INVESTIGATION PLAN

SCALE 1:5000

TEST PIT SETOUT POINTS

POINT	EASTING	NORTHING
TP01	613678.800	6393170.000
TP02	613703.700	6393315.000
TP03	613505.900	6393348.000
TP04	613534.700	6393509.000
TP05	613554.000	6393622.000
TP6	613299.900	6393550.000
TP07	613318.800	6393661.000
TP08	613085.400	6393690.000
TP09	612879.500	6393721.000
TP10	612870.500	6393621.000
TP11	613067.700	6393588.000
TP12	613276.800	6393385.000
TP13	613043.500	6393417.000
TP14	613252.200	6393237.000
TP15	613482.500	6393207.000
TP16	613730.600	6393476.000
TP17	613757.100	6393589.000
TP18	613015.100	6393279.000
TP19	612819.500	6393320.000
TP20	612839.700	6393455.000

BOREHOLE SETOUT POINTS

POINT	EASTING	NORTHING
BH01	613566.300	6393074.000
BH02	613269.700	6393126.000
BH03	612974.400	6393189.000
BH04	612790.100	6393360.000
BH05	612841.400	6393664.000
BH06	612974.400	6393714.000
BH07	613320.900	6393651.000
BH08	613552.700	6393609.000
BH09	613785.600	6393577.000
BH10	613739.800	6393286.000

LEGEND:

⊕	BOREHOLE
▣	TEST PIT

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Project RSF 2 DETAILED DESIGN
Status
Status Code
Drawing Title GEOTECHNICAL INVESTIGATION PLAN
Size A3
Drawing No. 12545239-C003
Rev 0

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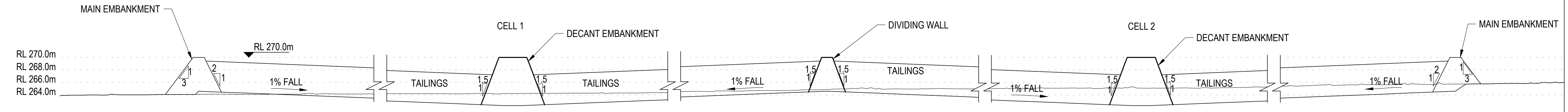


LONGITUDINAL SECTION - STAGE 1 DAM

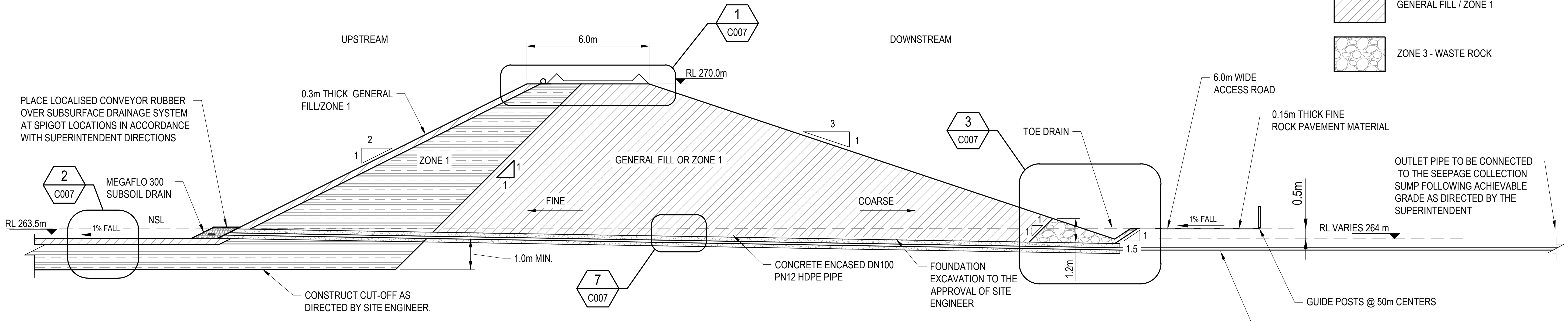
SCALE 1:2000 H/1:500 V

LEGEND:

▤ ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK

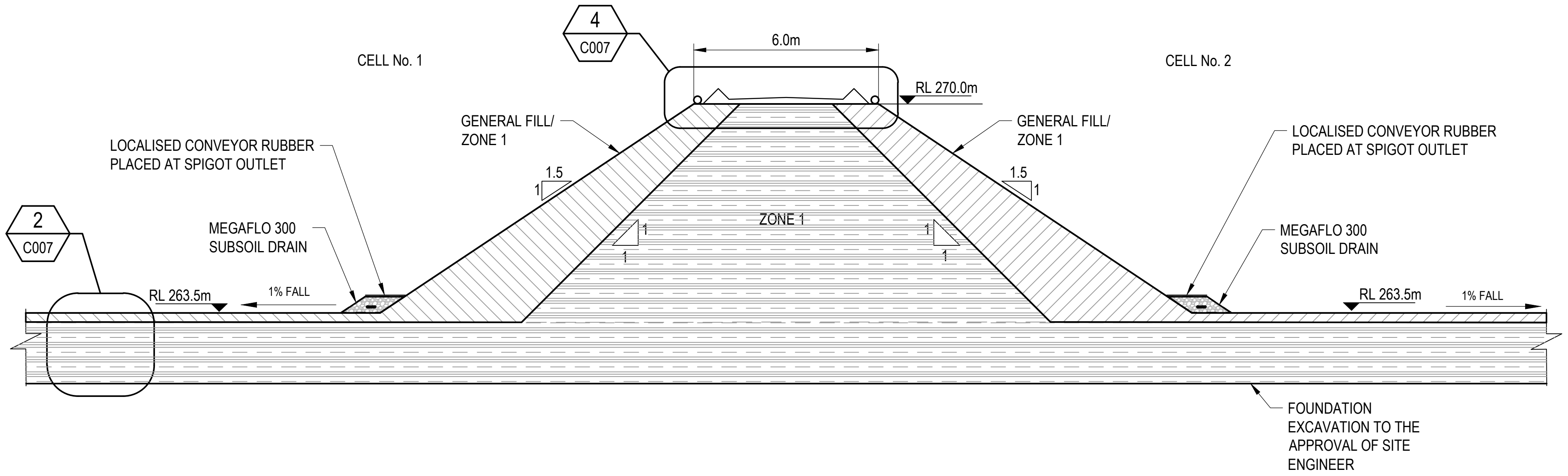
▨ GENERAL FILL / ZONE 1

▩ ZONE 3 - WASTE ROCK



TYPICAL SECTION - EXTERNAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200



TYPICAL SECTION - CENTRAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200

NOTES
1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
2. PROVIDE MINIMUM 0.5 OVERLAPS ON GEOFABRIC EDGES AND JOINTS

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Designer T. RIDGWAY Design Check R. LONGEY

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

VERTICAL SCALE 1:500 AT ORIGINAL SIZE 0 5 10 15m
HORIZONTAL SCALE 1:2000 AT ORIGINAL SIZE 0 20 40 60m

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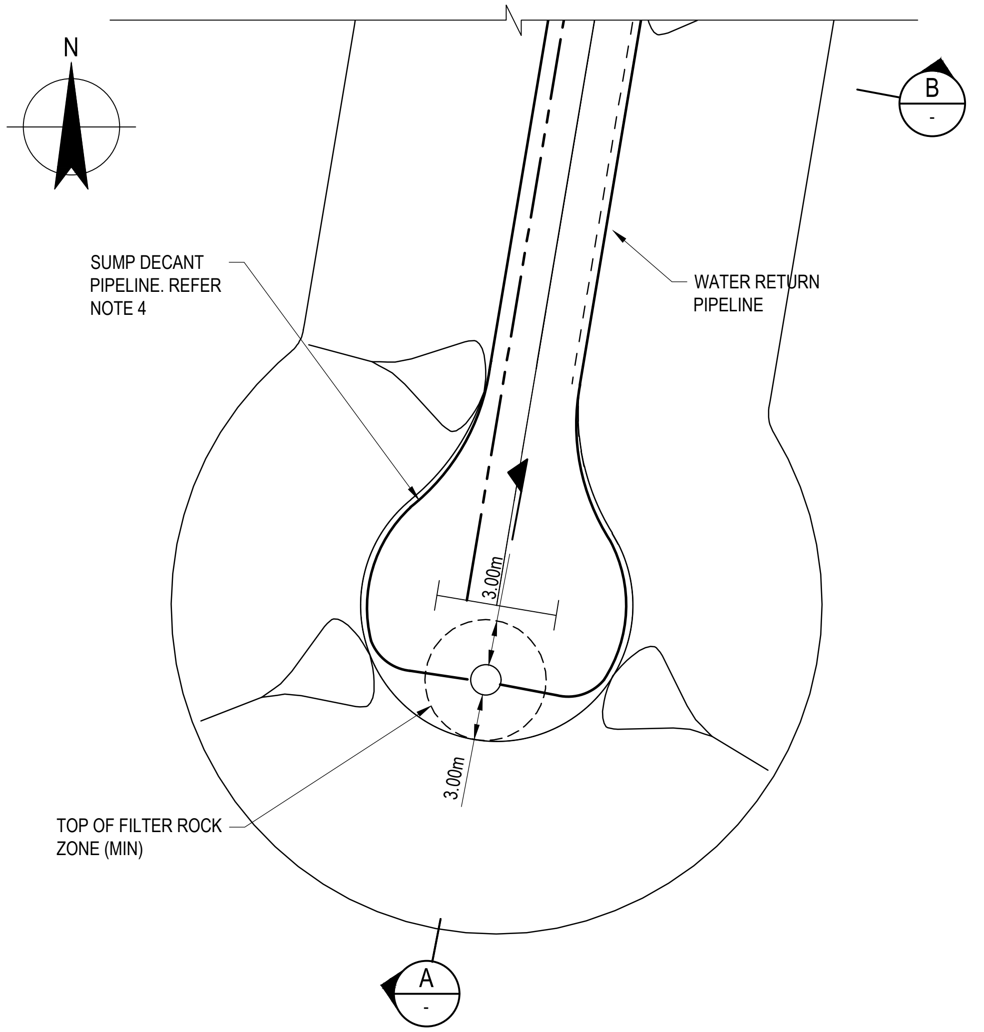
Status
Status Code

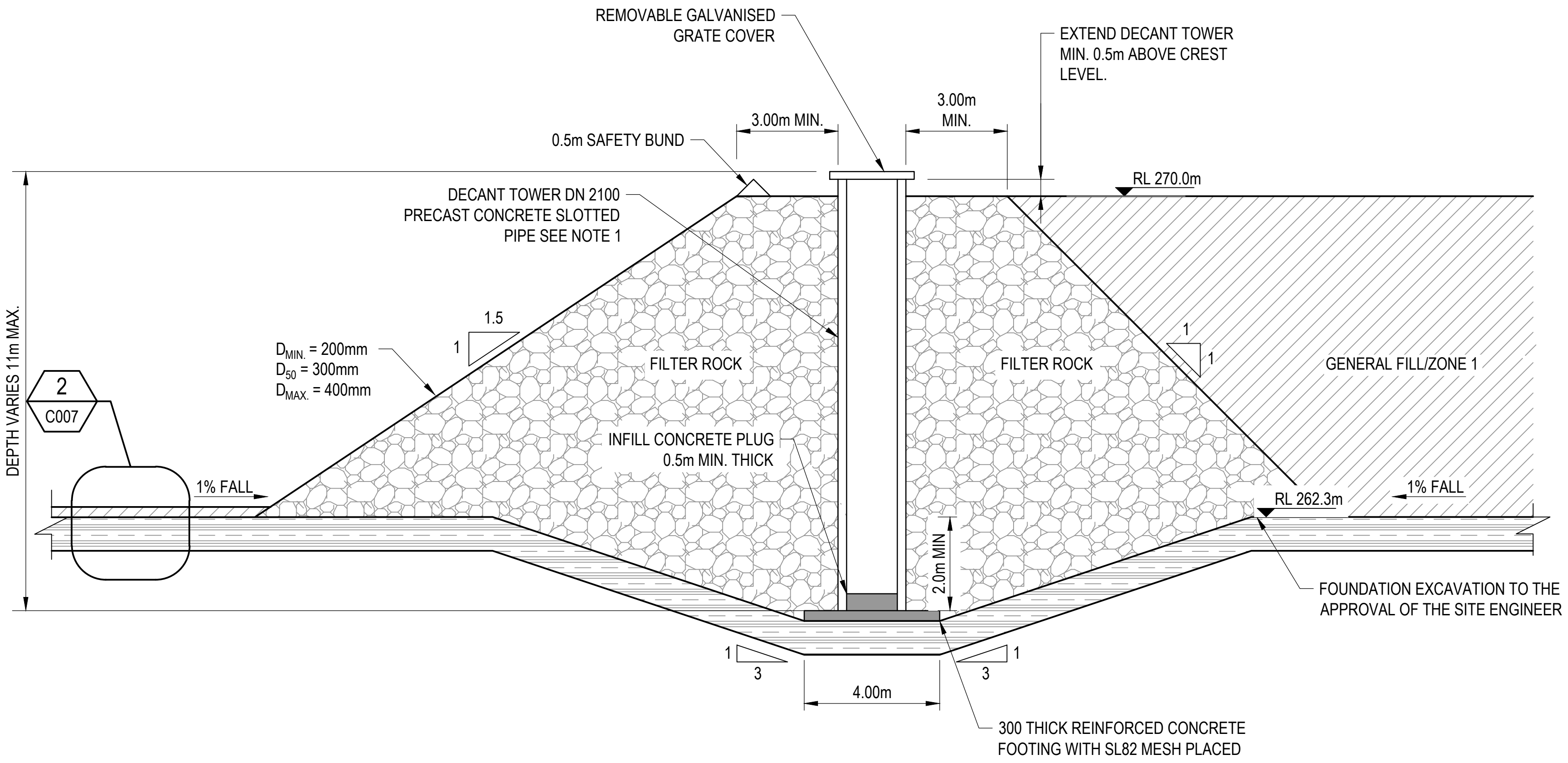
Drawing Title TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 1 OF 4
Size A3
Drawing No. 12545239-C004
Rev 0

Plot Date: 17 December 2021 - 1:09 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C004.dwg



DECANT TOWER PLAN

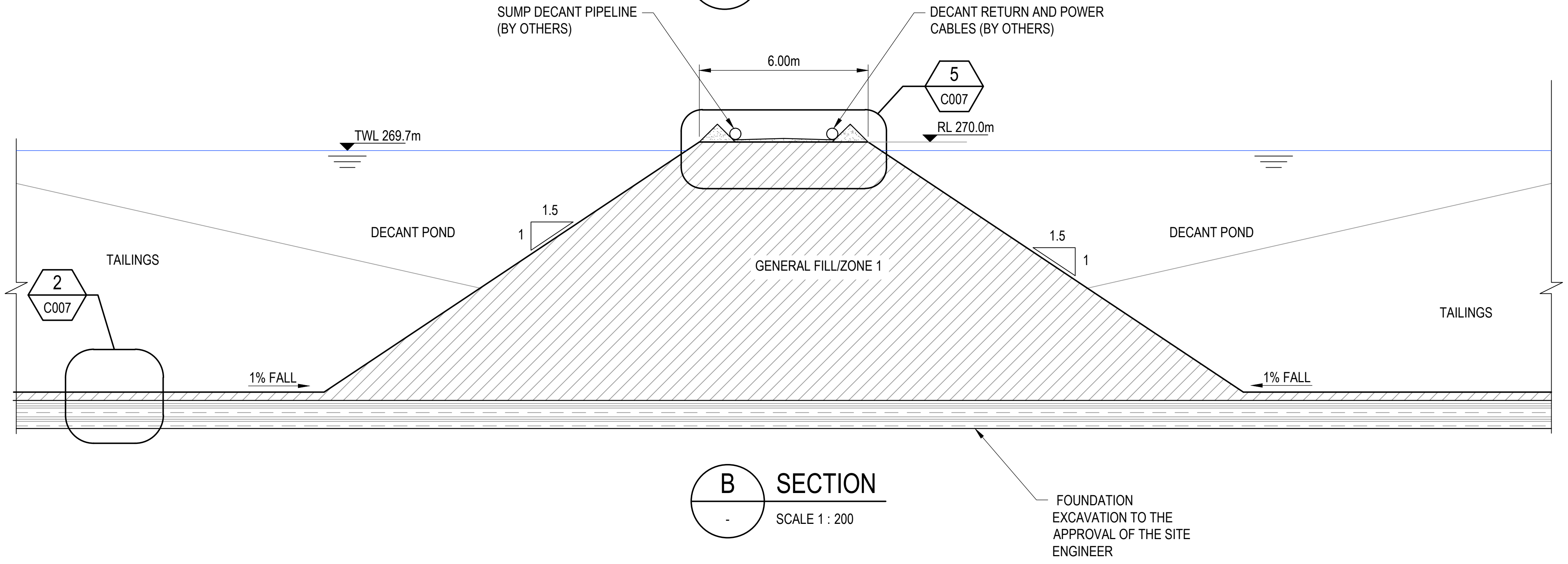
SCALE 1 : 500



A SECTION

-

SCALE 1 : 200



B SECTION

-

SCALE 1 : 200

LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
░	ZONE 3 - WASTE ROCK

NOTES

1. PRECAST CONCRETE DECANT UNITS (OR APPROVED EQUIVALENT). DN 2100, 600 HIGH CLASS 8 UNITS. EACH UNIT TO HAVE 40 SLOTS WITH SLOT DIMENSIONS OF 200 x 70mm
2. MINIMUM OPERATIONAL PUMP CAPACITY TO ACHIEVE 22L/s
3. ADDITIONAL EMERGENCY PUMP CAPACITY TO BE MAINTAINED BY THE MINE TO ACHIEVE 50ML/Day
4. SUMP DECANT PIPELINE IS FOR CELL 2 DECANT WALL ONLY

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0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

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Status
Status Code

Drawing Title TYPICAL EMBANKMENT SECTIONS AND DETAILS - SHEET 2 OF 4

Size A3

Drawing No. 12545239-C005
Rev 0

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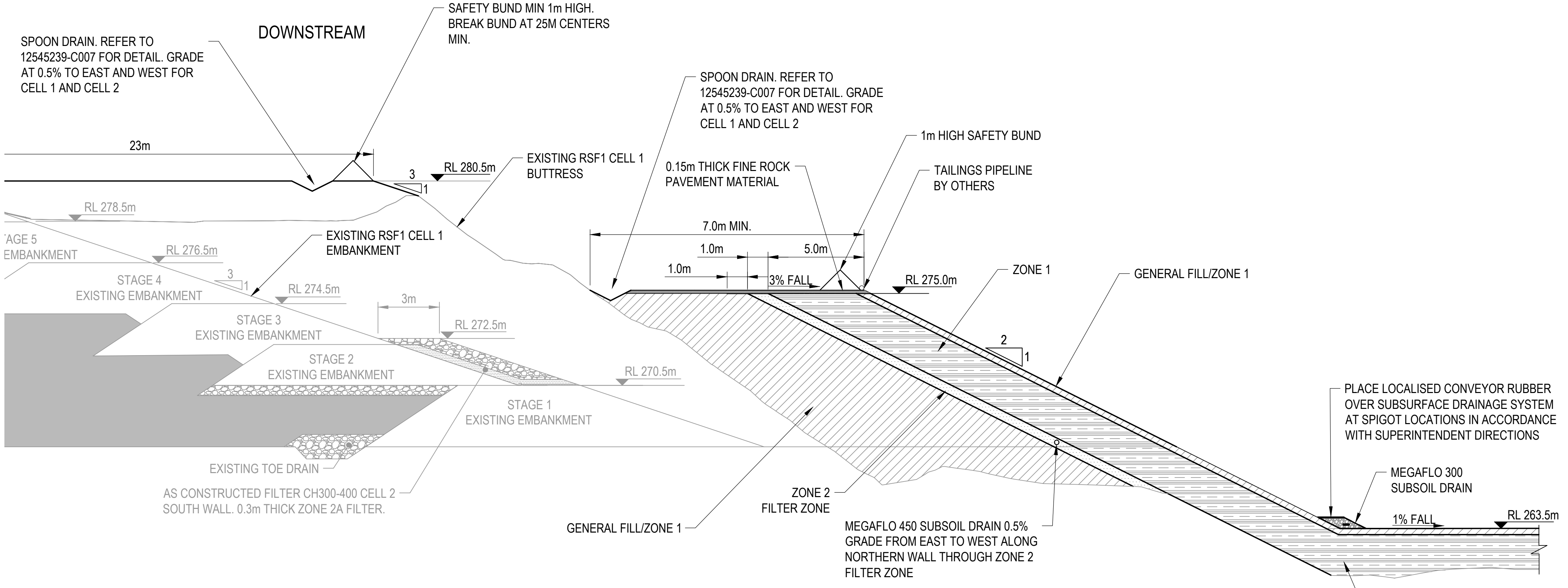
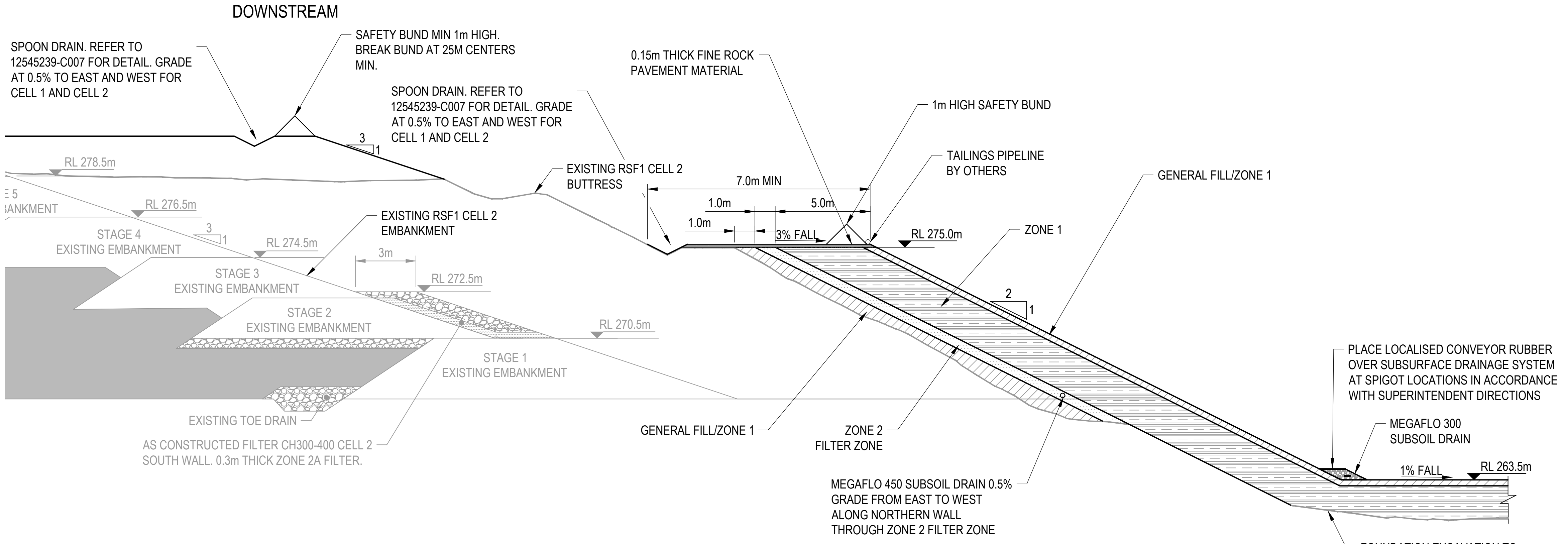


EMBANKMENT RAISE - CELL 1 NORTHERN WALL

SCALE 1:250



EMBANKMENT RAISE - CELL 2 NORTHERN WALL

SCALE 1:250

LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▦	ZONE 3 - WASTE ROCK
░	ZONE 2 FILTER ZONE

NOTES
1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
3. EXISTING RSF 1 SEEPAGE OUTLETS TO BE REDIRECTED AND CONNECTED INTO THE NORTH WEST COLLECTION SUMP

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Designer T. RIDGWAY   Design Check R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

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Project RSF 2 EMBANKMENT DETAILED DESIGN
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Drawing Title TYPICAL SECTIONS SHEET 3 OF 4
Size A3
Drawing No. 12545239-C006
Rev 0

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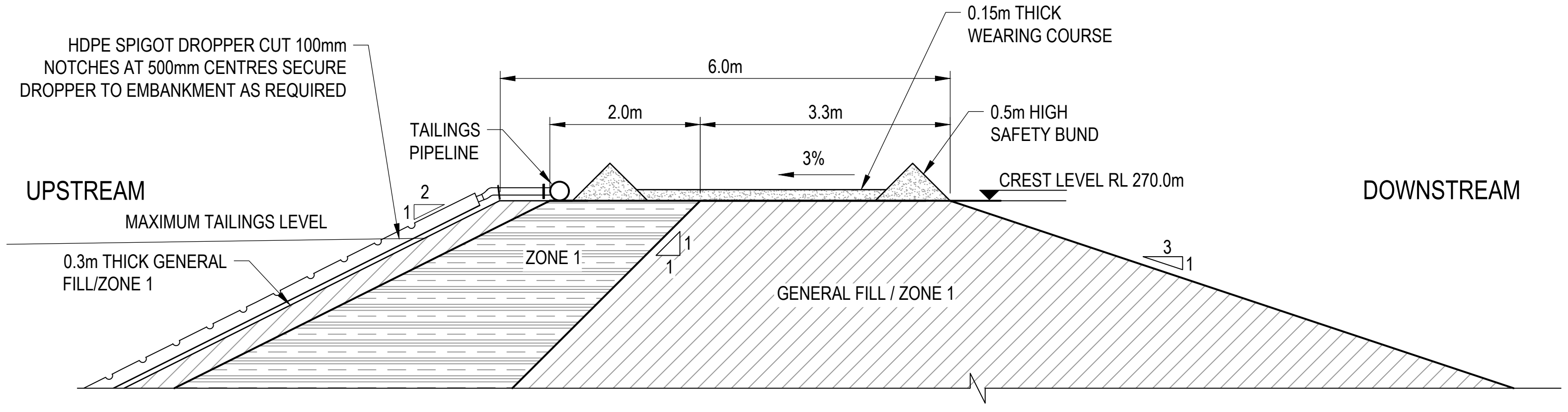
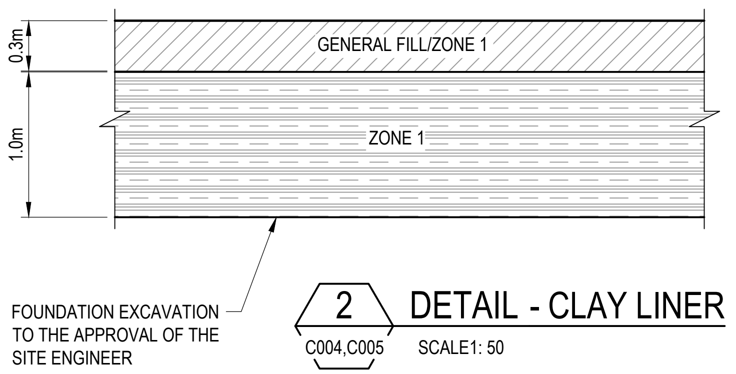


1 DETAIL - EXTERNAL EMBANKMENT

C004 SCALE 1 : 100



2 DETAIL - CLAY LINER

C004,C005 SCALE1: 50

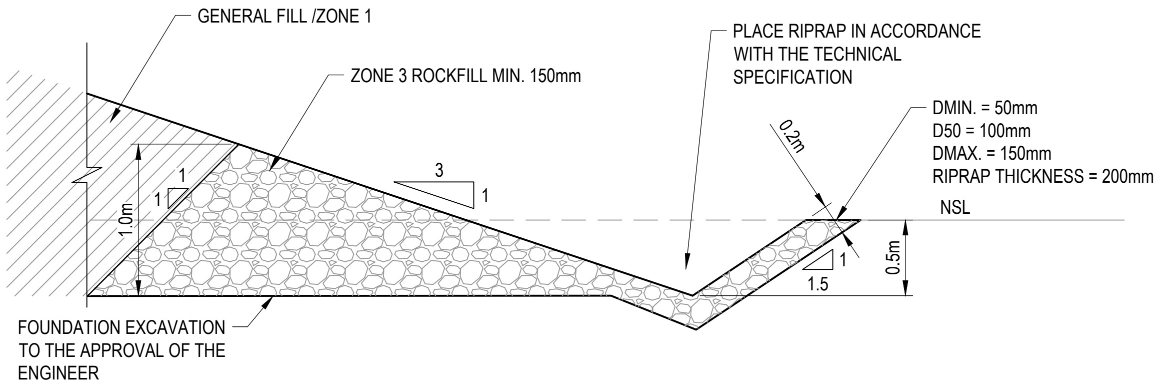
LEGEND:

▤ ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK

▨ GENERAL FILL / ZONE 1

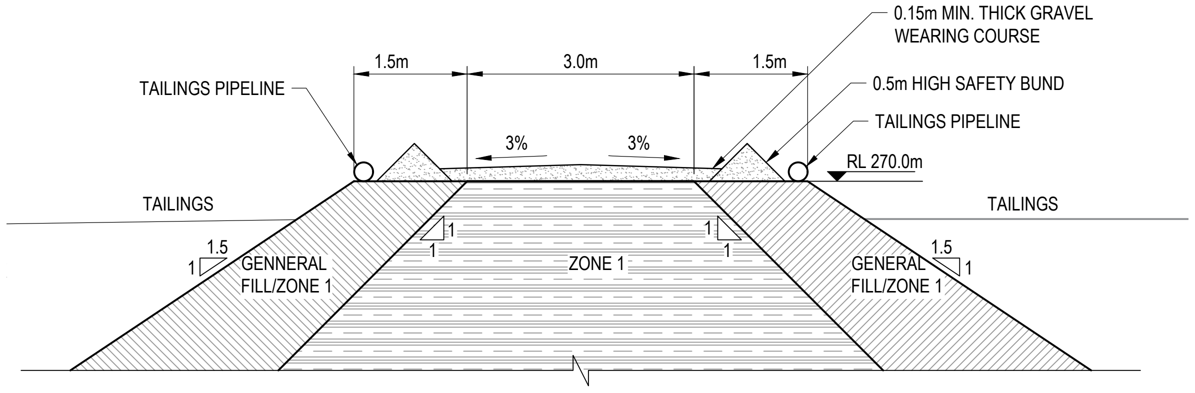
NOTES

1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION AND ASSESSED BY A QUALIFIED GEOTECHNICAL ENGINEER
2. ALL EARTHWORK MATERIALS SHALL BE IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS
3. THE EXTERNAL PERIMETER SHALL CONNECT TO THE RSF 2 EMBANKMENT CREST USING RAMPS LOCATED AT THE NORTHEAST AND NORTHWEST CORNERS OF THE FACILITY. THESE RAMPS SHALL BE GRADED AT A MINIMUM OF 10(H): 1(V) AND 15m WIDE WITH 1m HIGH SAFETY BUNDS EACH SIDE CONSTRUCTED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION FOR THE GENERAL FILL
4. CENTRAL WALL DECANT TO BE GRADED AT 3% FROM CELL 2 TO CELL 1



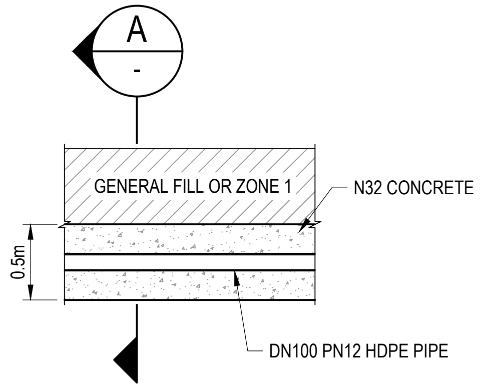
3 DETAIL -TOE DRAIN (HDPE PIPE NOT SHOWN)

C004,C011,C020 SCALE1: 50



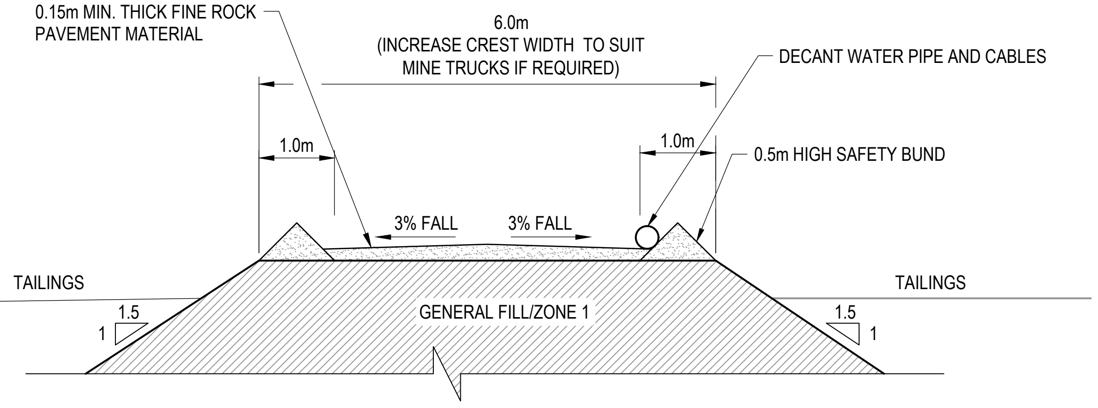
4 DETAIL - CENTRAL EMBANKMENT

C004 SCALE 1 : 100



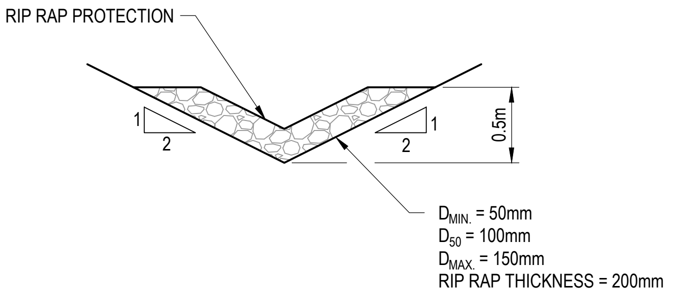
7 DETAIL - UNDER DRAINAGE OUTLET PIPE CONCRETE ENCASEMENT

C004,C009,C011 SCALE1: 50



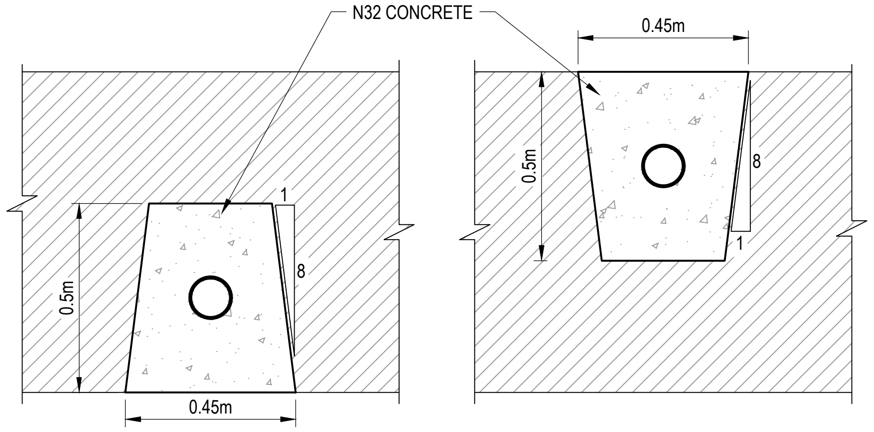
5 DETAIL - DECANT EMBANKMENT

C005 SCALE 1 : 100



6 DETAIL - SPOON DRAIN TYPICAL DETAIL

C006,C011 SCALE1: 50



A SECTION - ABOVE GROUND CONCRETING -BELOW GROUND CONCRETING

- SCALE 1 :20

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Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 0.2 0.4 0.6m
SCALE 1:20 AT ORIGINAL SIZE

0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

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Drawing Title TYPICAL SECTIONS SHEET 4 OF 4
Size A3
Drawing No. 12545239-C007
Rev 0

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TABLE 1 - MATERIAL CONSTRUCTION REQUIREMENTS

MATERIAL	DESCRIPTION	CONSTRUCTION REQUIREMENTS
ZONE 1	EXTREMELY WEATHERED SANDY CLAY OR CLAYEY SAND MATERIAL WON FROM THE FOUNDATION EXCAVATIONS, MEETING SPECIFICATIONS SETOUT IN TABLE 2.	• SPREAD IN LAYERS 150mm THICK AFTER COMPACTION. • COMPACT WITH MINIMUM 6 PASSES OF A 10 TONNE VIBRATING PAD FOOT ROLLER TO NO LESS THAN 98% MAX. DRY DENSITY (MDD). • SANDY CLAY TO BE PLACED BETWEEN 1% DRY & 3% WET OF OPTIMUM MOISTURE CONTENT (OMC)
ZONE 1/GENERAL FILL	EXTREMELY WEATHERED SANDY CLAY OR CLAYEY SAND TO GRAVELLY CLAY MATERIAL WON FROM THE FOUNDATION EXCAVATIONS, MEETING SPECIFICATIONS SET OUT IN TABLE 2.	• SPREAD IN LAYERS 300mm THICK AFTER COMPACTION • COMPACT WITH MINIMUM 6 PASSES OF A 10 TONNE VIBRATING PAD FOOT ROLLER NO LESS THAN 95% MAX. DRY DENSITY (MDD). • SANDY CLAY TO BE PLACED BETWEEN 1% DRY AND 3% WET OF OPTIMUM MOISTURE CONTENT (OMC)
ZONE 2	SAND MATERIAL SOURCED FROM CRUSHED ROCK IN ACCORDANCE WITH THE MATERIAL SPECIFICATIONS SET OUT IN SECTION 6.3 OF THE TECHNICAL SPECIFICATION.	• FILTER SAND TO BE PLACED IN ACCORDANCE WITH THE SPECIFICATION SET OUT IN SECTION 6.3 OF THE TECHNICAL SPECIFICATION.

TABLE 2 - GHD SPECIFICATION

REQUIRED PROPERTIES OF ZONE 1 FILL AFTER COMPACTION

MINIMUM % BY WEIGHT PASSING 0.075mm AS 1152 SIEVE	30
MINIMUM % BY WEIGHT PASSING 0.3mm AS 1152 SIEVE	70
MINIMUM % BY WEIGHT PASSING 1.18mm AS 1152 SIEVE	80
MINIMUM PLASTICITY INDEX (%) (AS 1289.3.3.1)	15
LAYER THICKNESS	150mm
PERMEABILITY	K < 1 X 10^(-9) m's (SATURATED)

REQUIRED PROPERTIES OF GENERAL FILL AFTER COMPACTION

MINIMUM % BY WEIGHT PASSING 0.075mm AS 1152 SIEVE	20 (REFER NOTE 2)
MINIMUM % BY WEIGHT PASSING 0.3mm AS 1152 SIEVE	40
MINIMUM % BY WEIGHT PASSING 1.18mm AS 1152 SIEVE	60
LAYER THICKNESS	300mm
PERMEABILITY	K < 1 X 10^(-7) m/s (SATURATED). (REFER NOTE 2).

NOTE 2: IF MATERIALS MEET THE REQUIRED PERMEABILITY SPECIFICATION THEN THIS CAN SUPERCEDE THE REQUIRED GRADING SPECIFICATION.

TABLE 3 - FOUNDATION PREPARATION

MATERIAL	REQUIREMENTS
STORAGE FOUNDATION	STORAGE FOUNDATION TO BE PREPARED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATION

TABLE 4 - MATERIAL TESTING REQUIREMENTS FOR SANDY CLAY/ CLAYEY SAND

TEST DETAILS	MINIMUM TEST FREQUENCY/ VOLUME PLACE (m^3)
FIELD DENSITY & HILF COMPACTION OR STANDARD COMPACTION	EVERY 300mm AND 1,000m^3/5,000m^3)
ATTERBERG LIMITS	1,000m^3/5,000m^3
PARTICLE SIZE DISTRIBUTION	1,000m^3/5,000m^3
EMERSON CLASS TESTING - PROCESS WATER	5,000m^3/10,000m^3
EMERSON CLASS TESTING - FRESH WATER	5,000m^3/10,000m^3
TRIAXIAL	10,000m^3/20,000m^3
PERMEABILITY	5,000m^3/10,000m^3
EMBANKMENT FOUNDATION TESTING REQUIREMENTS	
PUSH TUBE SAMPLING AND TRIAXIAL TESTING	1 EVERY 500m

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Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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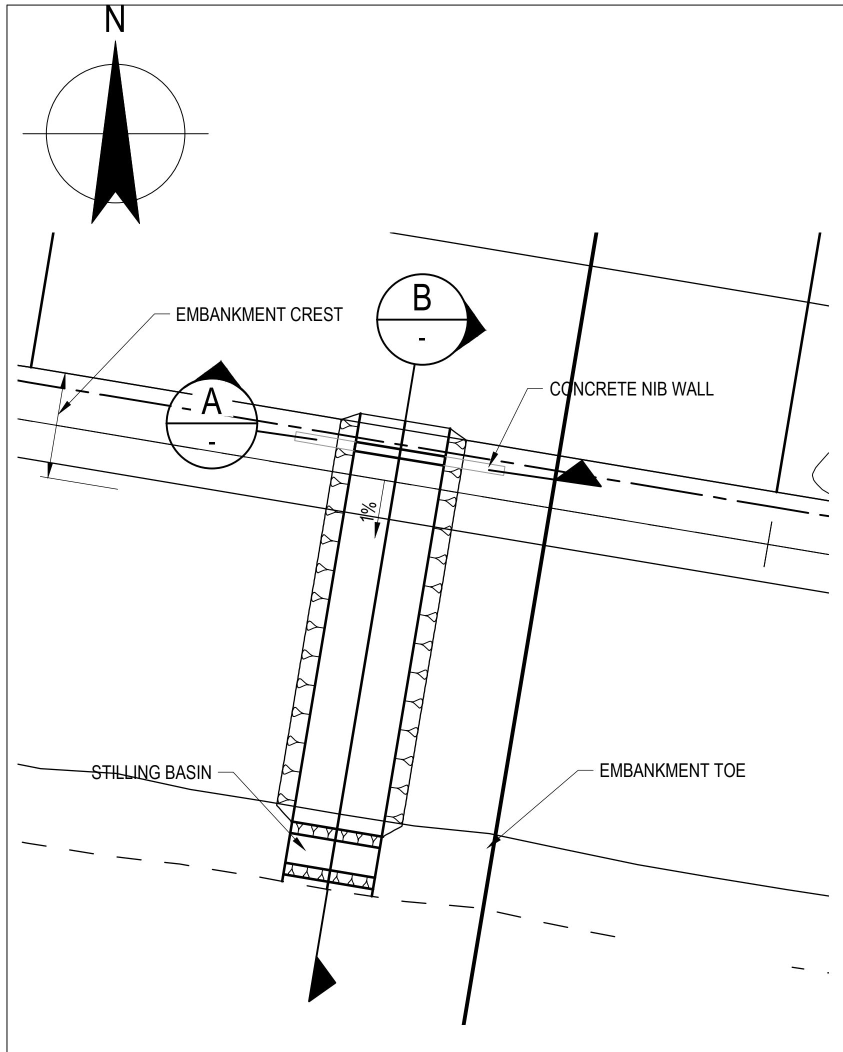
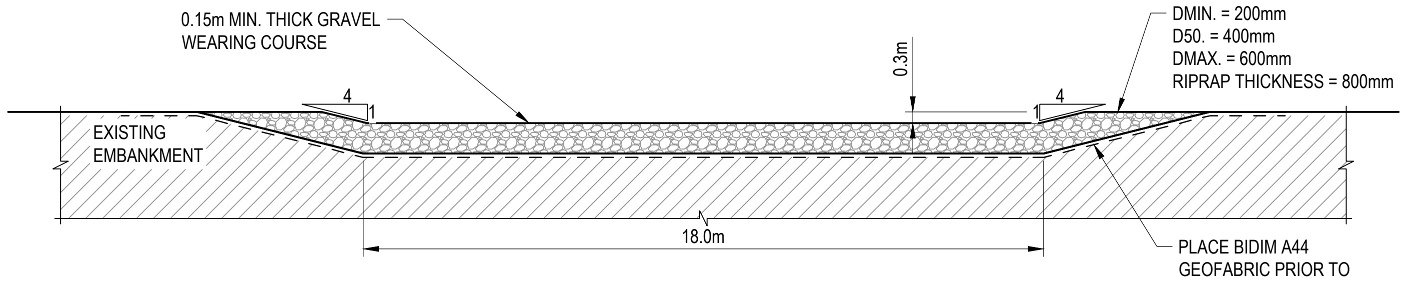
Drawing Title MATERIALS SPECIFICATION
Size A3
Drawing No. 12545239-C008
Rev 0

Plot Date: 17 December 2021 - 1:20 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C008.dwg



CELL 1 SPILLWAY PLAN

SCALE 1:500



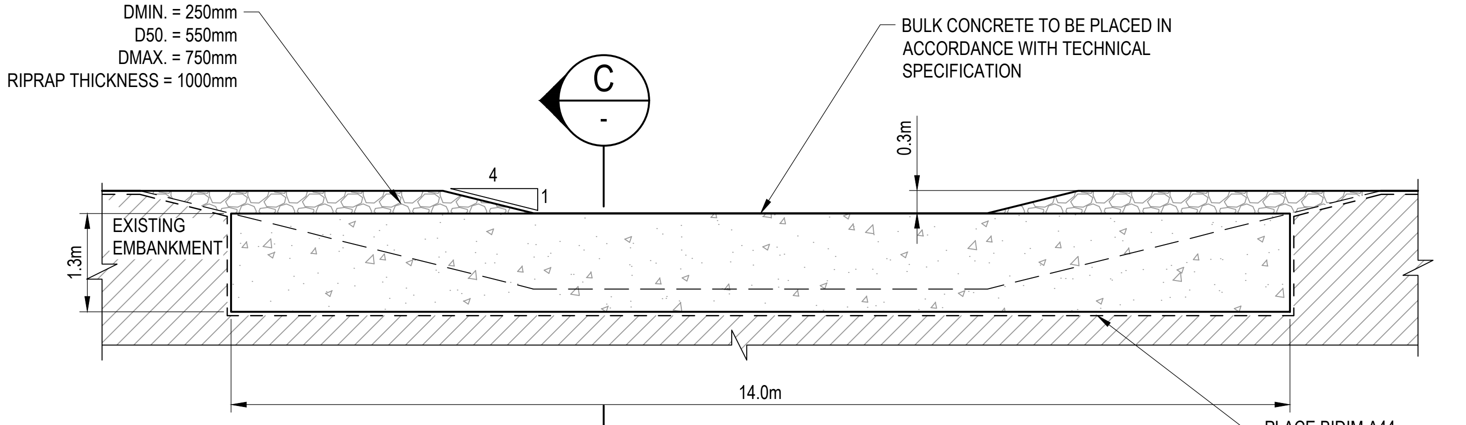
1 DETAIL - CENTRAL WALL OVERFLOW

C002

SCALE 1 : 200

LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▦	ZONE 3 - WASTE ROCK



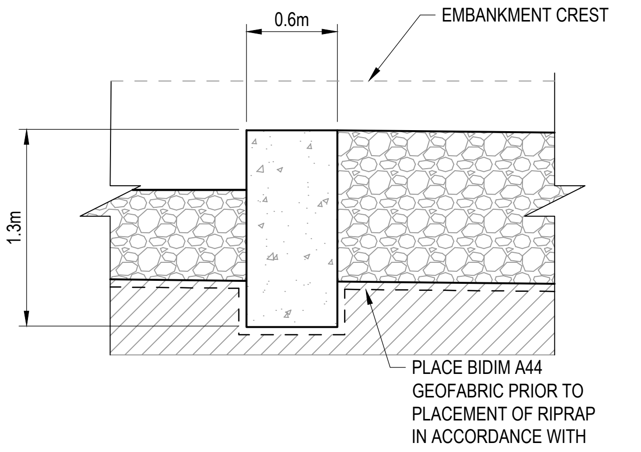
CONCRETE NIB WALL SECTION

SCALE 1:100

A SECTION

-

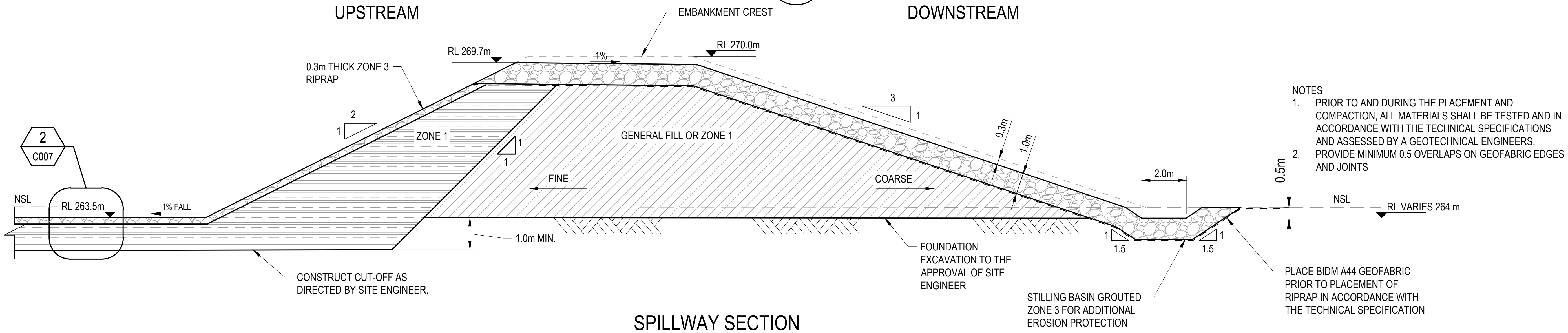
SCALE 1 :100



C SECTION

-

SCALE 1 :50



NOTES
1. PRIOR TO AND DURING THE PLACEMENT AND COMPACTION, ALL MATERIALS SHALL BE TESTED AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND ASSESSED BY A GEOTECHNICAL ENGINEERS.
2. PROVIDE MINIMUM 0.5 OVERLAPS ON GEOFABRIC EDGES AND JOINTS

SPILLWAY SECTION

SCALE 1:200

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

0 5 10 15m
SCALE 1:500 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

0 0.5 1.0 1.5m
SCALE 1:50 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN

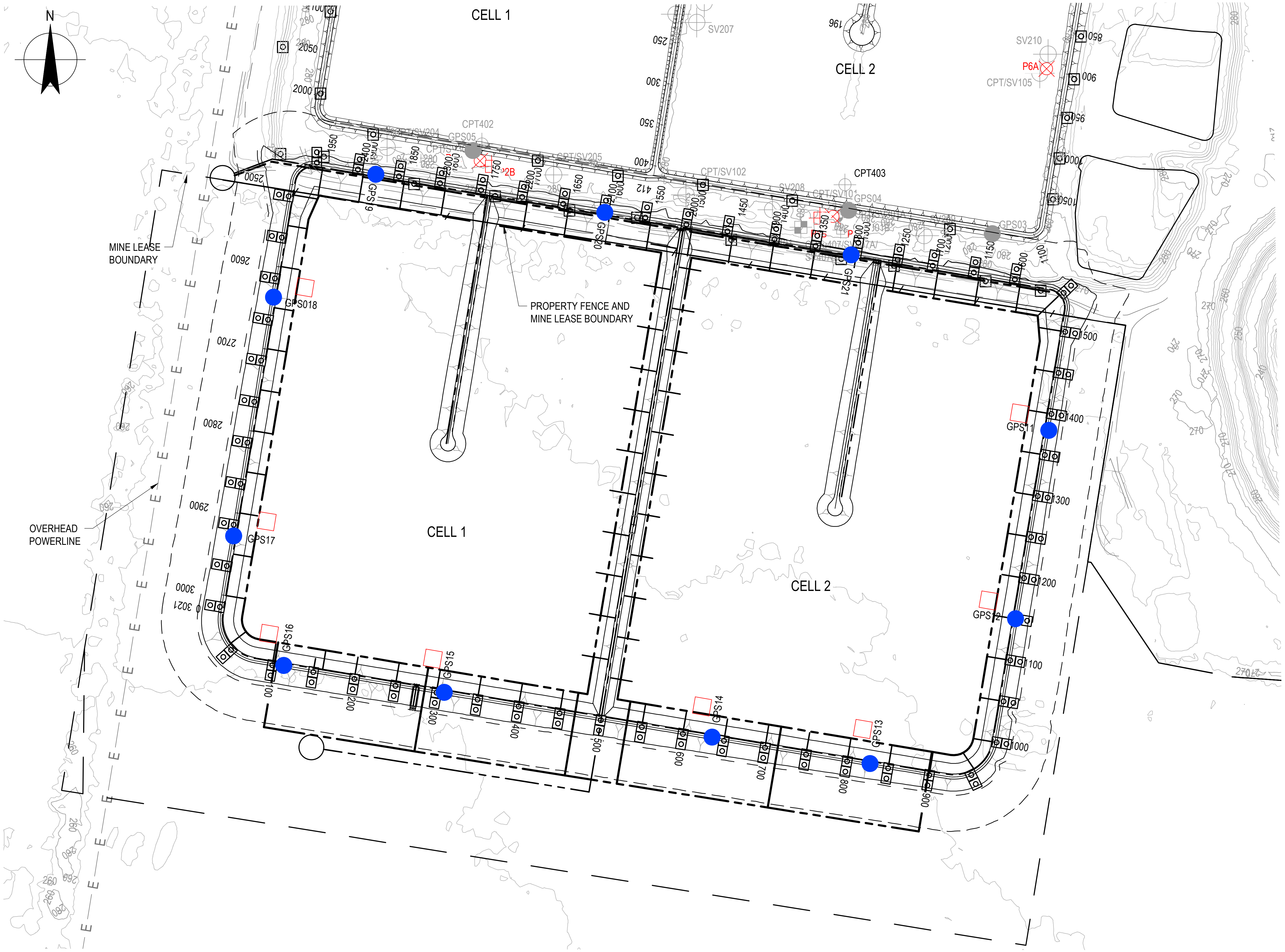
Status
Status Code

Drawing Title TYPICAL SPILLWAY SECTION AND DETAIL

Size A3

Drawing No. 12545239-C009
Rev 0

Plot Date: 17 December 2021 - 1:22 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C009.dwg



PROPOSED GPS SURVEY LOCATIONS		
POINT	EASTING	NORTHING
GPS11	613772.756	6393495.126
GPS12	613733.223	6393268.255
GPS13	613558.114	6393094.898
GPS14	613368.352	6393126.634
GPS15	613046.595	6393180.445
GPS16	612853.942	6393212.664
GPS17	612793.650	6393368.276
GPS018	612841.610	6393655.048
GPS19	612964.450	6393802.685
GPS20	613239.498	6393756.948
GPS21	613535.455	6393705.913

LEGEND:

—	VIBRATING WIRE PIEZOMETER CABLE
⊠	SET A PIEZOMETERS - PUSH IN FROM STAGE 4 CREST
⊕	SET B PIEZOMETERS - PUSH IN FROM BUTTRESS
⊡	APRILTAG LOCATION
● GPSXX	GPS SURVEY MONUMENT - NEW
● GPSXX	GPS SURVEY MONUMENT - EXISTING
☐	VIBRATING WIRE PIEZOMETER

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

INSTRUMENTATION PLAN

SCALE 1:5000

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project TGO RSF STAGE 8 RAISE RL284.5m

Status

Status Code

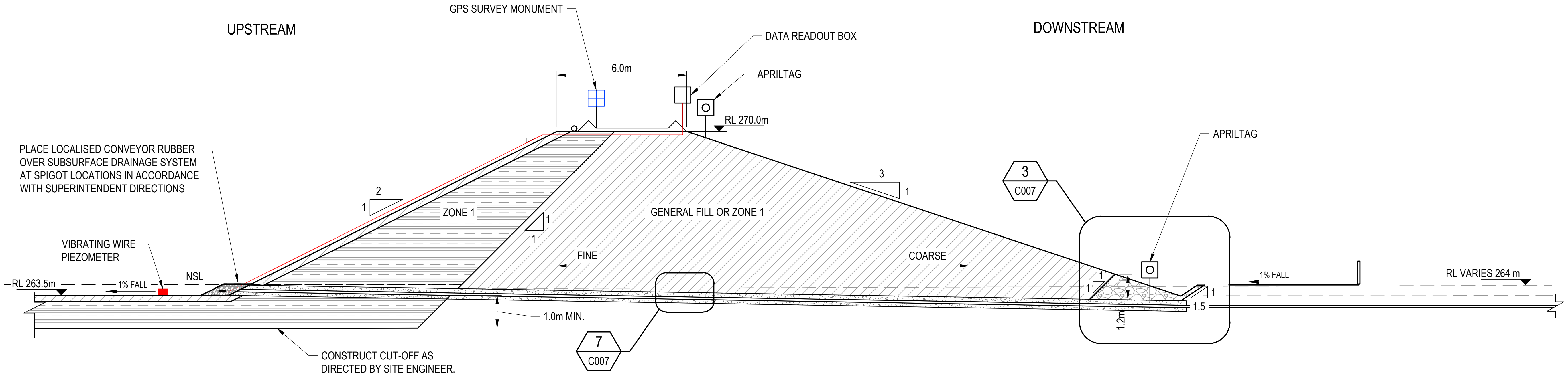
Drawing Title INSTRUMENTATION PLAN

Size A3

Drawing No. 12545239-C010

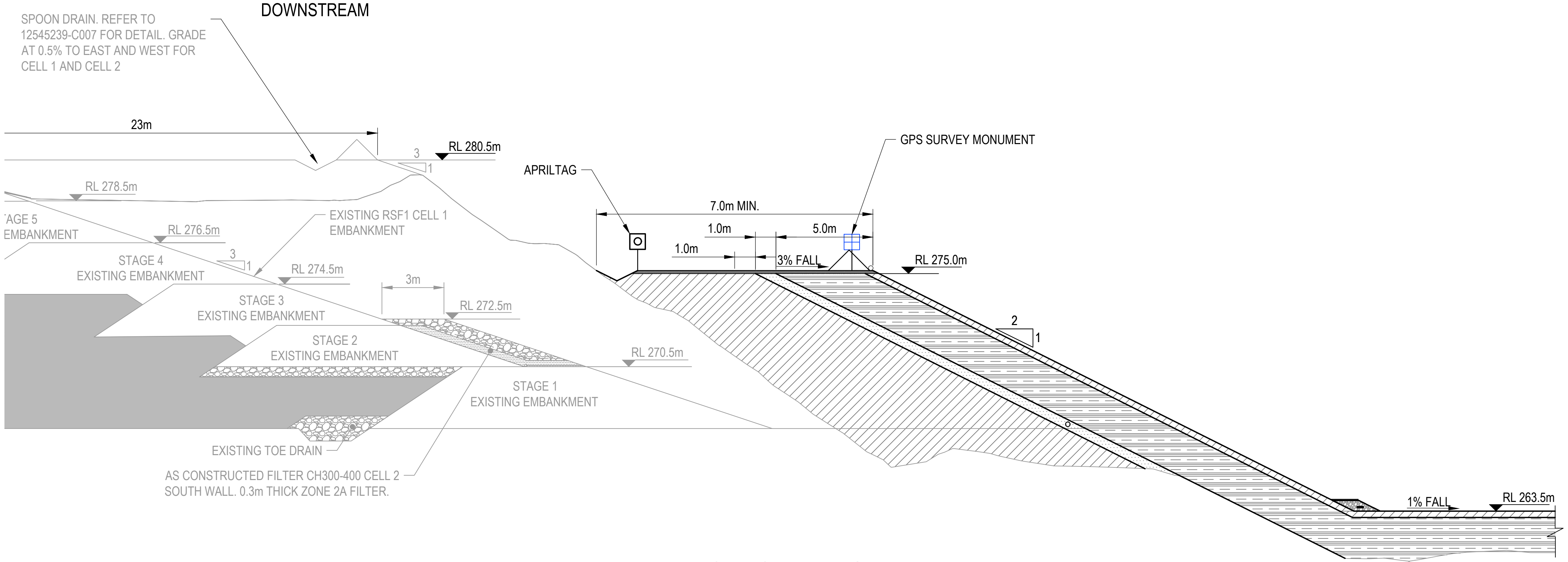
Rev 0

Plot Date: 17 December 2021 - 1:33 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C010.dwg



TYPICAL SECTION - EXTERNAL EMBANKMENT - STAGE 1 DAM

SCALE 1:200



EMBANKMENT RAISE - CELL 1 NORTHERN WALL

SCALE 1:250

LEGEND:

🟥	VIBRATING WIRE PIEZOMETER CABLE
☐	DATA READOUT BOX
⊞	GPS SURVEY MONUMENT
⊡	APRILTAG

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Project No.

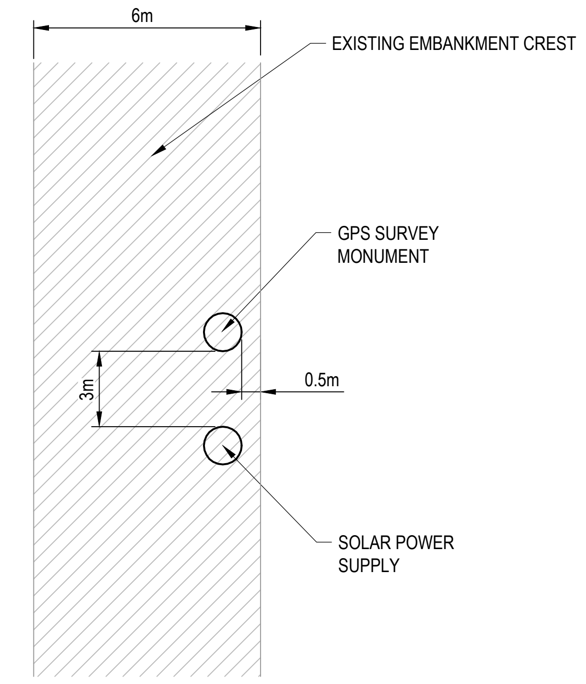
Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project TGO RSF STAGE 8 RAISE RL284.5m
Status
Status Code

Drawing Title GPS INSTRUMENTATION TYPICAL SECTIONS

Size A3

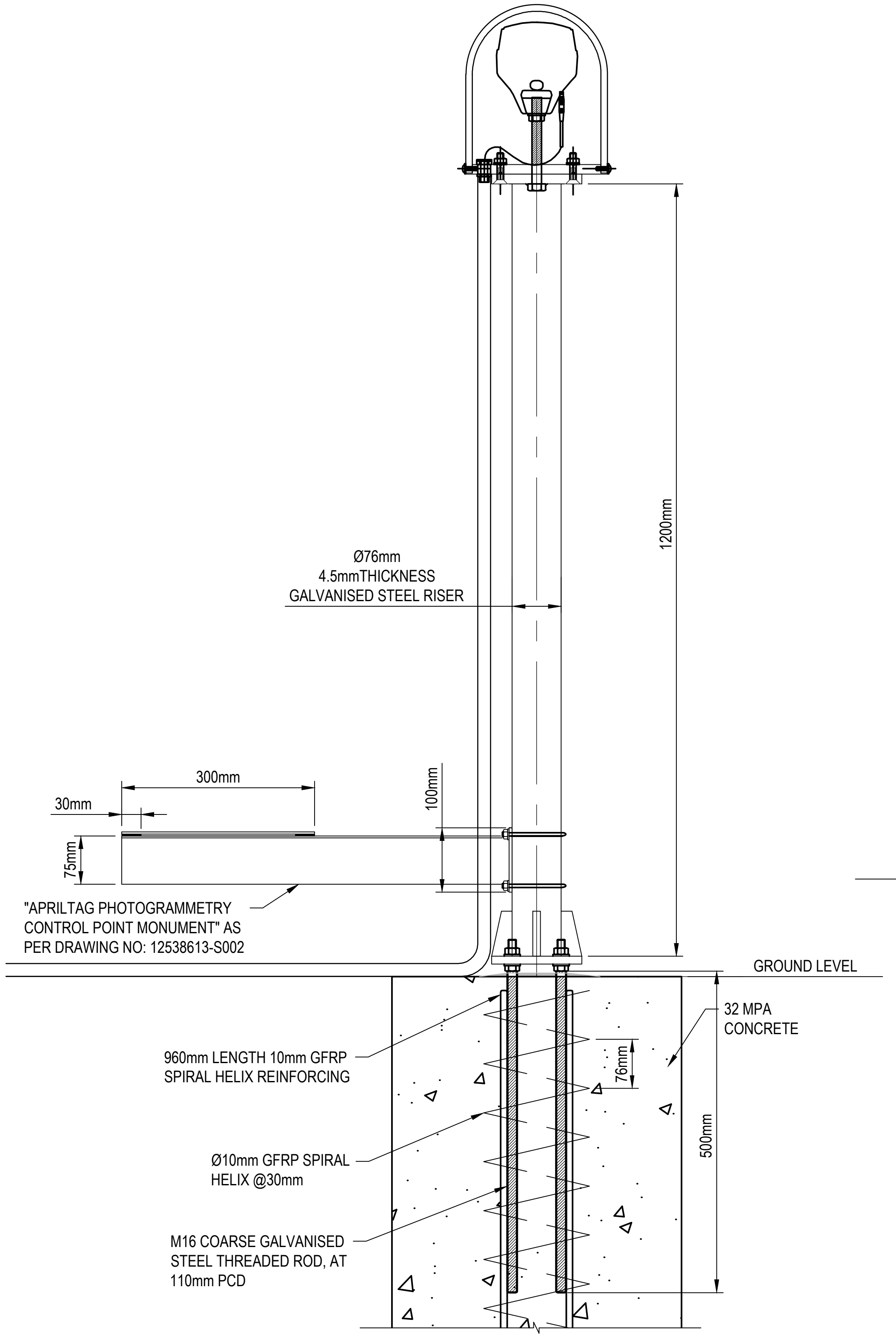
Drawing No. 12545239-C011
Rev 0

Plot Date: 17 December 2021 - 1:36 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C011.dwg



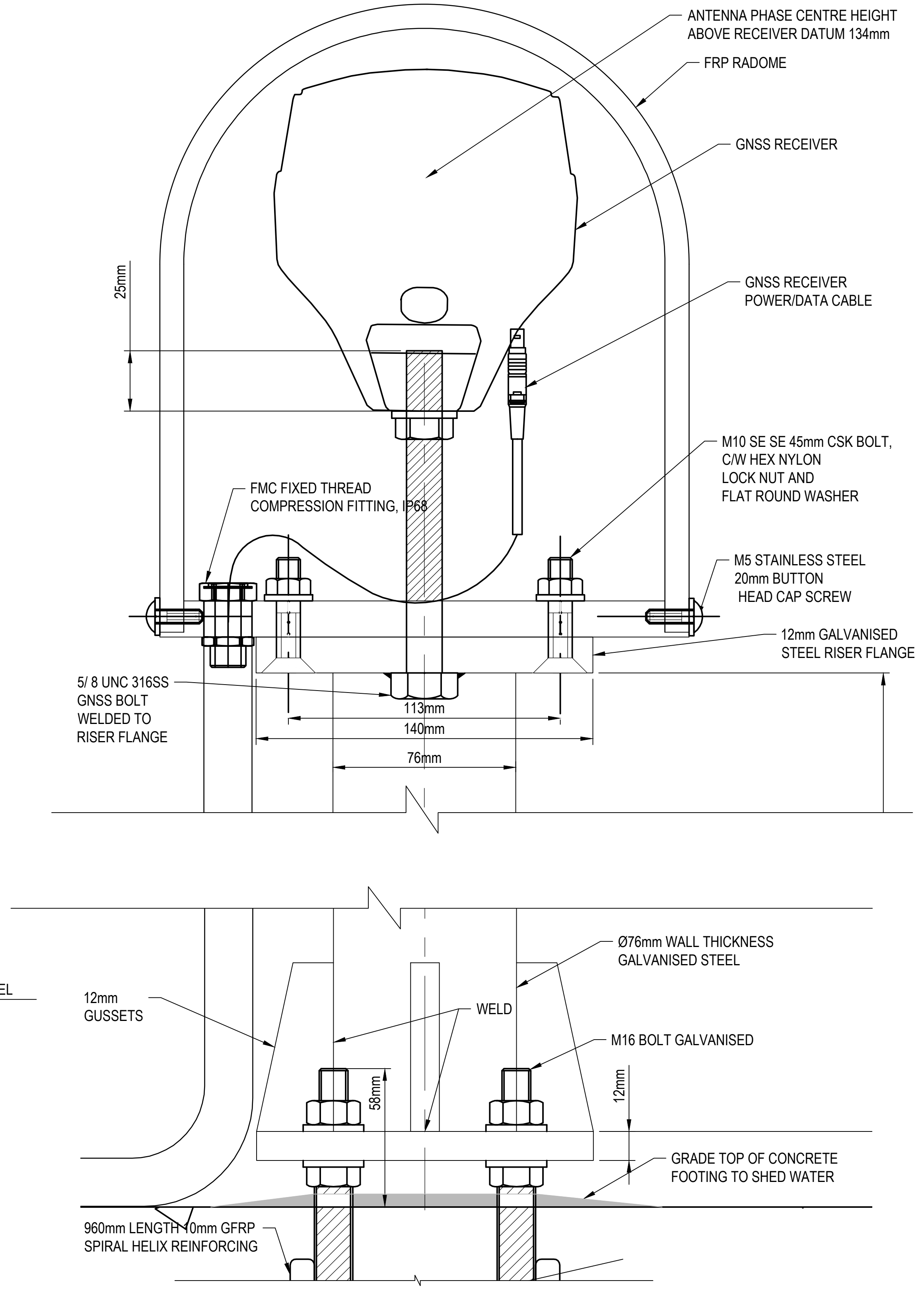
GPS LOCATION PLAN

SCALE 1:200



GNSS UNIT

SCALE 1:10



GNSS UNIT DETAILED SECTION

SCALE 1:2.5

0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021
Rev	Description	Checked	Approved	Date

Author P. BURBURY Drafting Check C. LONG

Designer T. RIDGWAY Design Check R. LONGEY

0 25 50 75mm
SCALE 1:2.5 AT ORIGINAL SIZE

0 100 200 300mm
SCALE 1:10 AT ORIGINAL SIZE

0 2 4 6m
SCALE 1:200 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title GNSS GPS UNIT DETAILS

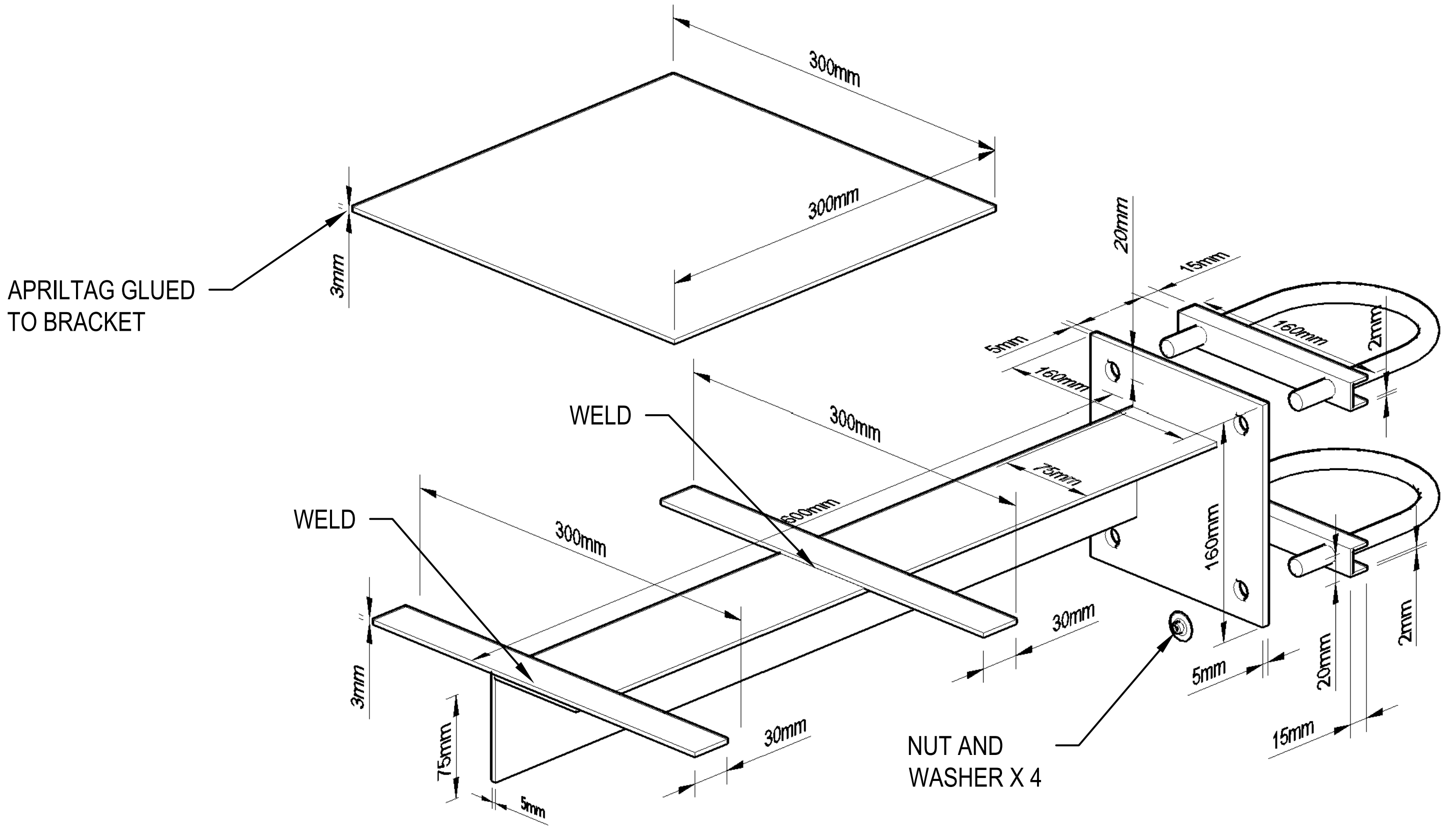
Size A3

Drawing No. 12545239-C012

Rev 0

Plot Date: 17 December 2021 - 1:26 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C012.dwg



SURVEY REFERENCE APRIL TAG MOUNT

SCALE 1:5

0 0.05 0.10 0.15m
SCALE 1:5 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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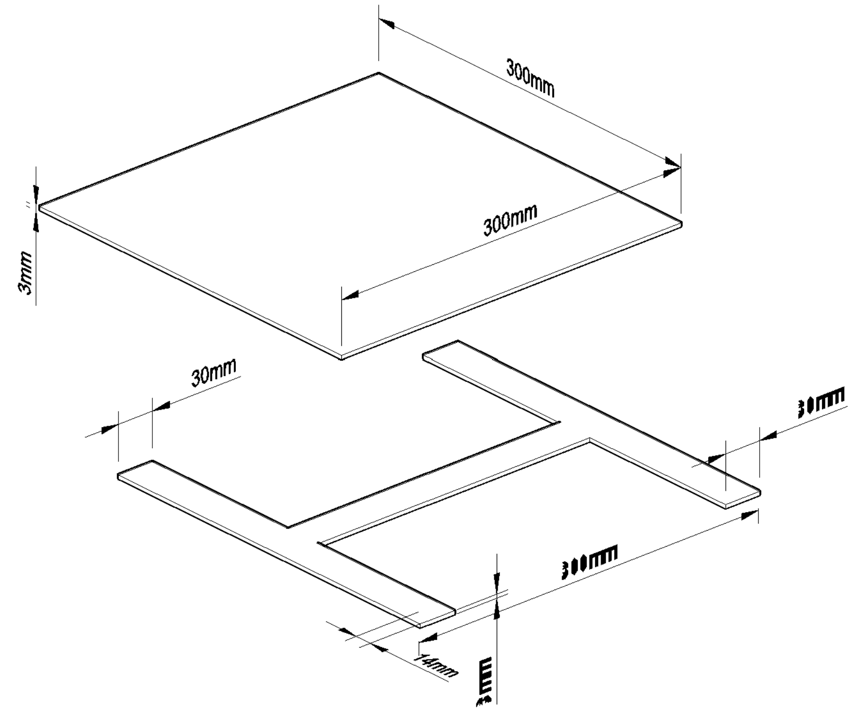
Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

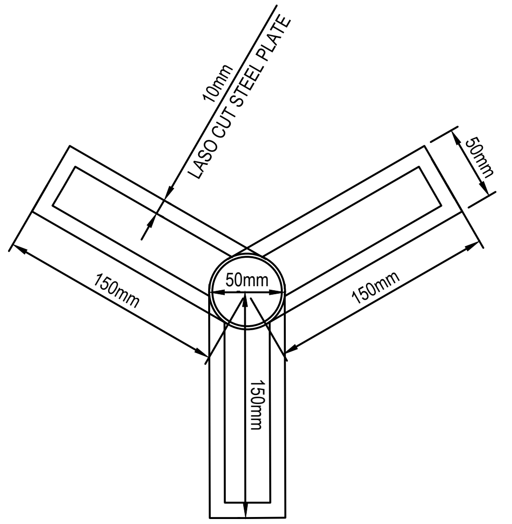
Drawing Title SURVEY REFERENCE APRIL TAG MOUNT
Size A3
Drawing No. 12545239-C013
Rev 0

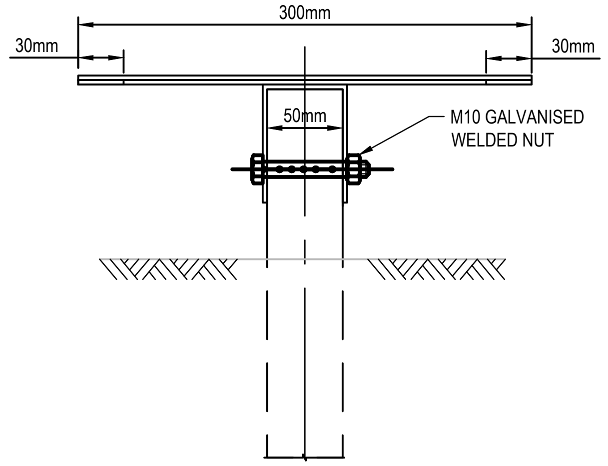
Plot Date: 17 December 2021 - 1:29 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C013.dwg

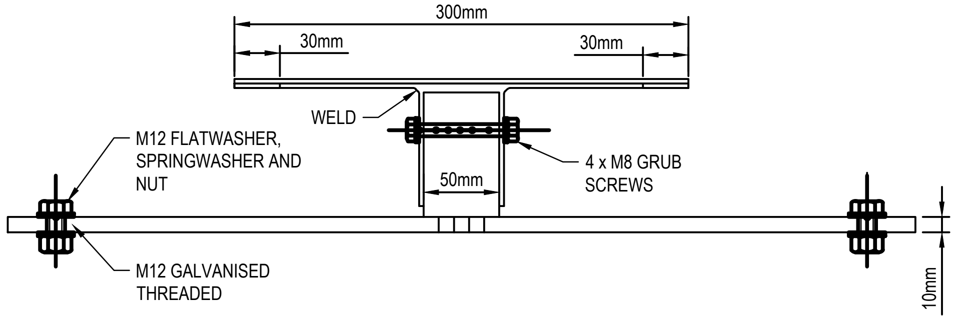


STANDALONE APRIL TAG UNDERSIDE SUPPORT BRACKET

SCALE 1:5







STANDALONE APRIL TAG ROCK MOUNT TO BE INSTALLED ON TFS BUTTRESS TOE

SCALE 1:5

STANDALONG APRIL TAG MOUNT TO BE INSTALLED ON TFS CREST

SCALE 1:5

0 0.05 0.10 0.15m
SCALE 1:5 AT ORIGINAL SIZE

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

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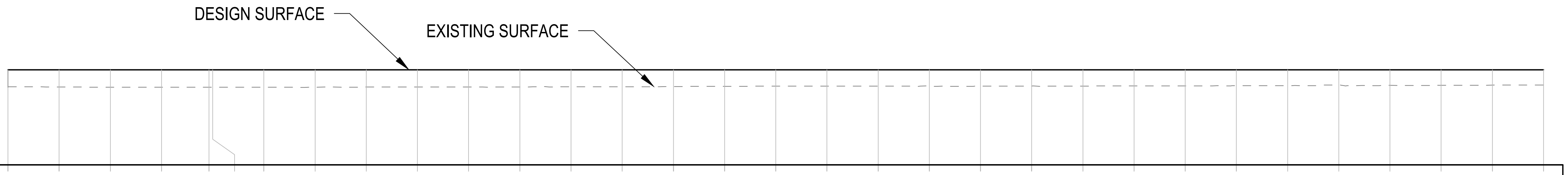
Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title STAND ALONE APRIL
TAG MOUNT DETAILS

Size **A3**
Drawing No. 12545239-C014
Rev 0

Plot Date: 17 December 2021 - 1:31 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C014.dwg



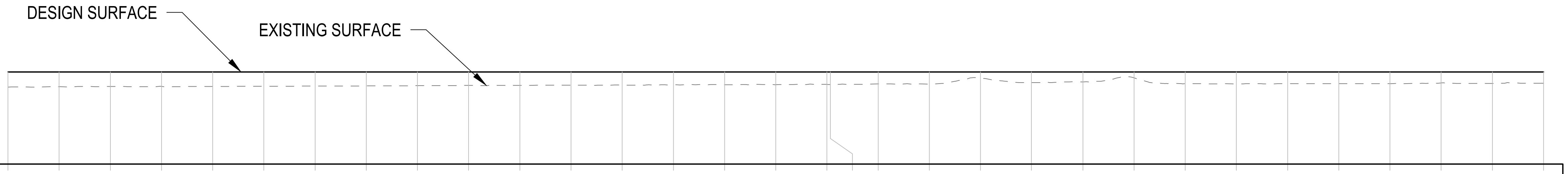
DATUM RL. 233.00

LEVEL DIFFERENCE CUT - / FILL +	6.60	6.70	6.78	6.77	6.79	6.79	6.77	6.80	6.75	6.73	6.73	6.72	6.64	6.64	6.54	6.44
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	263.40	263.30	263.22	263.23	263.21	263.21	263.23	263.20	263.25	263.27	263.27	263.28	263.36	263.36	263.46	263.56
CHAINAGE	0.00	20.00	40.00	60.00	78.54	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00

LEVEL DIFFERENCE CUT - / FILL +	6.38	6.40	6.38	6.44	6.33	6.33	6.34	6.28	6.28	6.23	6.19	5.85	6.04	6.00	5.98	5.92
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	263.62	263.60	263.62	263.56	263.67	263.67	263.66	263.72	263.72	263.77	263.81	264.15	263.96	264.00	264.02	264.08
CHAINAGE	300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (0 - 600)

SCALE 1:2000



DATUM RL. 234.00

LEVEL DIFFERENCE CUT - / FILL +	5.92	5.82	5.74	5.69	5.69	5.63	5.56	5.49	5.39	5.29	5.27	5.21	5.18	5.05	5.02	4.98
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
	264.08	264.18	264.26	264.31	264.31	264.37	264.44	264.51	264.61	264.71	264.73	264.79	264.82	264.95	264.98	265.02
CHAINAGE	600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00

LEVEL DIFFERENCE CUT - / FILL +	4.90	4.90	4.72	4.75	2.46	4.20	3.91	2.35	4.64	4.67	4.64	4.60	4.63	4.33	4.49	4.40
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
	265.10	265.10	265.28	265.25	267.54	265.80	266.09	267.65	265.36	265.33	265.36	265.40	265.37	265.67	265.51	265.60
CHAINAGE	920.00	921.31	940.00	960.00	980.00	999.85	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00	1160.00	1180.00	1200.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (600 - 1200)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 1 0F 5

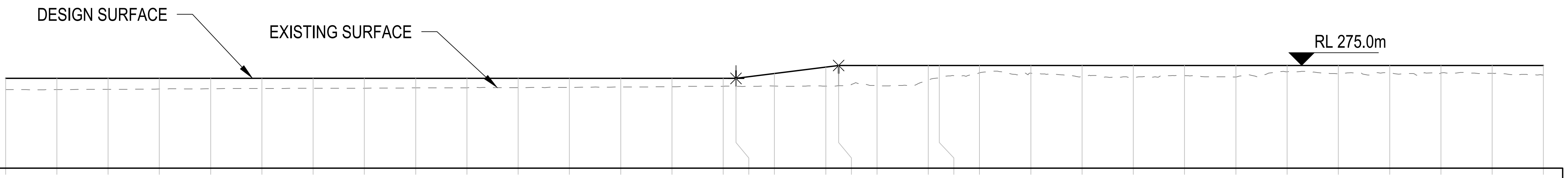
Size A3

Drawing No. 12545239 - C015

Rev 0

Plot Date: 17 December 2021 - 1:42 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C015.dwg



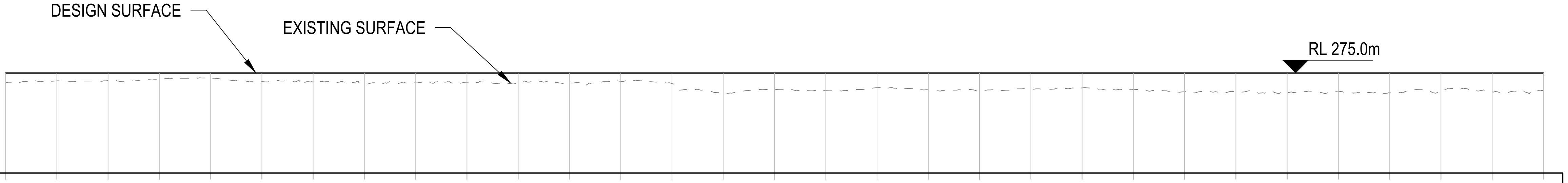
DATUM RL. 235.00

LEVEL DIFFERENCE CUT - / FILL +	4.40	4.36	4.29	4.13	4.02	3.94	3.86	3.82	3.69	3.64	3.57	3.48	3.37	3.24
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	265.60	265.64	265.71	265.87	265.98	266.06	266.14	266.18	266.31	266.36	266.43	266.52	266.63	266.76
CHAINAGE	1200.00	1220.00	1240.00	1260.00	1280.00	1300.00	1320.00	1340.00	1360.00	1380.00	1400.00	1420.00	1440.00	1460.00

LEVEL DIFFERENCE CUT - / FILL +	3.07	3.12	4.86	7.35	7.88	7.80	5.56	4.72	2.86	2.93	4.36	4.57	3.88	4.43	2.38	3.11	2.97	2.90	2.98	3.70
DESIGN SURFACE LEVEL	270.000	270.000	271.875	274.375	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000
EXISTING SURFACE LEVEL	266.93	266.88	267.02	267.03	267.12	267.20	269.44	270.28	272.14	272.07	270.64	270.43	271.12	270.57	272.62	271.89	272.03	272.10	272.02	271.30
CHAINAGE	1480.00	1485.00	1500.00	1520.00	1525.00	1540.00	1560.00	1564.29	1580.00	1600.00	1620.00	1640.00	1660.00	1680.00	1700.00	1720.00	1740.00	1760.00	1780.00	1800.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (1200 - 1800)

SCALE 1:2000



DATUM RL. 236.00

LEVEL DIFFERENCE CUT - / FILL +	3.70	3.10	2.90	2.53	2.03	3.28	3.50	4.14	3.57	3.85	3.85	3.96	3.23	4.09
DESIGN SURFACE LEVEL	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000
EXISTING SURFACE LEVEL	271.30	271.90	272.10	272.47	272.97	271.72	271.50	270.86	271.43	271.15	271.15	271.04	271.77	270.91
CHAINAGE	1800.00	1820.00	1840.00	1860.00	1880.00	1900.00	1920.00	1940.00	1960.00	1980.00	2000.00	2020.00	2040.00	2060.00

LEVEL DIFFERENCE CUT - / FILL +	7.78	6.37	6.90	5.75	6.58	6.82	6.32	5.81	6.43	7.31	7.39	7.87	7.32	7.46	6.70	7.40	6.75
DESIGN SURFACE LEVEL	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000	275.000
EXISTING SURFACE LEVEL	267.22	268.63	268.10	269.25	268.42	268.18	268.68	269.19	268.57	267.69	267.61	267.13	267.68	267.54	268.30	267.60	268.25
CHAINAGE	2080.00	2100.00	2120.00	2140.00	2160.00	2180.00	2200.00	2220.00	2240.00	2260.00	2280.00	2300.00	2320.00	2340.00	2360.00	2380.00	2400.00

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (1800 - 2400)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

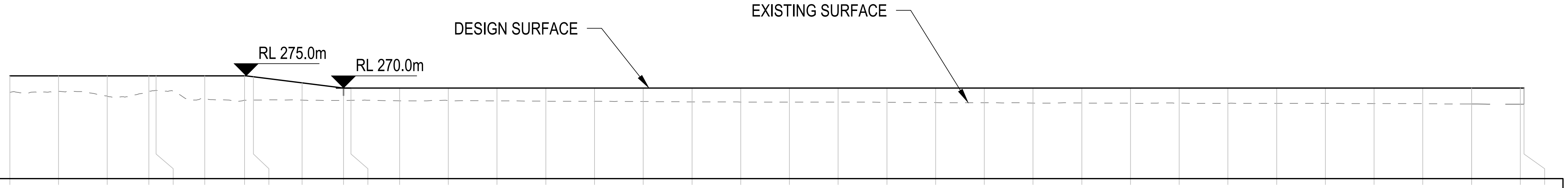
Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 2 0F 5

Size A3

Drawing No. 12545239 - C016
Rev 0

Plot Date: 17 December 2021 - 1:46 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C016.dwg



DATUM RL. 233.00

LEVEL DIFFERENCE CUT - / FILL +	6.75	6.31	8.32	6.28	5.89	8.97	9.98	9.52	7.03	5.04	5.00	5.17	5.09	5.21	5.35	5.41	5.46	5.60
DESIGN SURFACE LEVEL	275.000	275.000	275.000	275.000	275.000	275.000	275.000	274.625	272.125	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	268.25	268.69	266.68	268.72	269.11	266.03	265.02	265.11	265.09	264.96	265.00	264.83	264.91	264.79	264.65	264.59	264.54	264.40
CHAINAGE	2400.00	2420.00	2440.00	2457.06	2460.00	2480.00	2496.33	2500.00	2520.00	2537.00	2540.00	2560.00	2580.00	2600.00	2620.00	2640.00	2660.00	2680.00

LEVEL DIFFERENCE CUT - / FILL +	5.68	5.72	5.72	5.79	5.92	5.99	6.08	6.09	6.15	6.12	6.18	6.20	6.24	6.28	6.34	6.50	6.59	6.60
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.32	264.28	264.28	264.21	264.08	264.01	263.92	263.91	263.85	263.88	263.82	263.80	263.76	263.72	263.66	263.50	263.41	263.40
CHAINAGE	2700.00	2720.00	2740.00	2760.00	2780.00	2800.00	2820.00	2840.00	2860.00	2880.00	2900.00	2920.00	2940.00	2960.00	2980.00	3000.00	3020.00	3021.49

EXTERNAL EMBANKMENT - LONGITUDINAL SECTION (2400 - 3021)

SCALE 1:2000

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS
PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title LONGITUDINAL SECTIONS
SHEET 3 0F 5

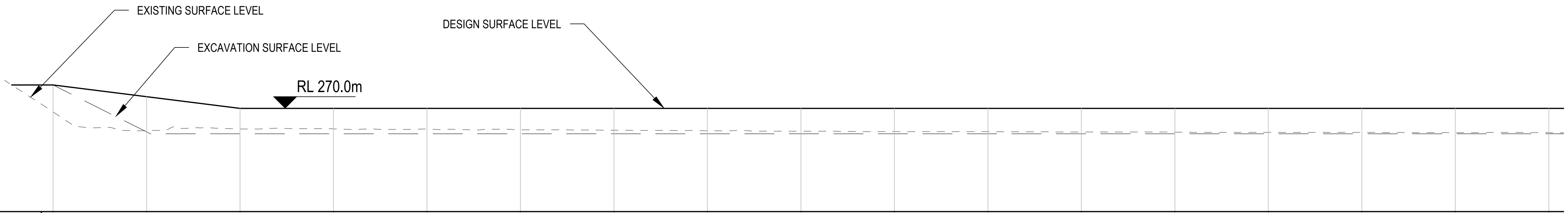
Size A3

Drawing No. 12545239 - C017

Rev 0

Plot Date: 17 December 2021 - 1:59 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C017.dwg



DATUM RL. 248.00

EXCAVATION SURFACE LEVEL	275.00	265.00	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60
LEVEL DIFFERENCE CUT - / FILL +	5.70	7.22	4.37	4.35	4.39	4.56	4.64	4.75	4.84	4.94	4.95	5.01	5.05	5.10	5.11	5.14	5.17
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	269.30	265.28	265.63	265.65	265.61	265.44	265.36	265.25	265.16	265.06	265.05	264.99	264.95	264.90	264.89	264.86	264.83
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	320.00

DIVIDING WALL EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000

DATUM RL. 248.00

EXCAVATION SURFACE LEVEL	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	264.60	270.00
LEVEL DIFFERENCE CUT - / FILL +	5.10	5.11	5.13	5.20	5.28	5.36	5.49	5.41	5.63	5.73	5.84	6.00	6.13	6.17
DESIGN SURFACE LEVEL	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	264.90	264.89	264.87	264.80	264.72	264.64	264.51	264.59	264.37	264.27	264.16	264.00	263.87	263.83
CHAINAGE	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	593.17

DIVIDING WALL EMBANKMENT - LONGITUDINAL SECTION (CONTINUED)

SCALE 1:1000

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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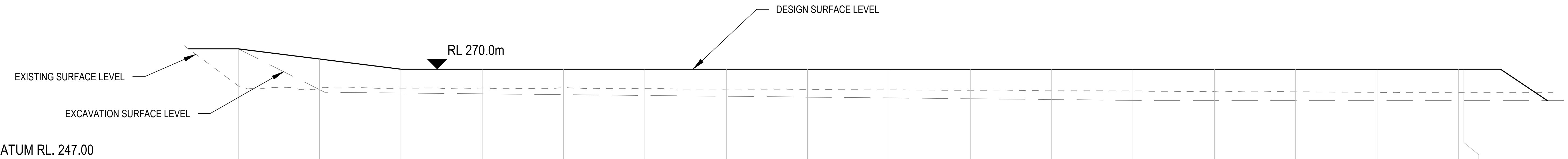
Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title LONGITUDINAL SECTIONS SHEET 4 OF 5
Size A3
Drawing No. 12545239 - C018
Rev 0

Plot Date: 17 December 2021 - 1:48 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C018.dwg

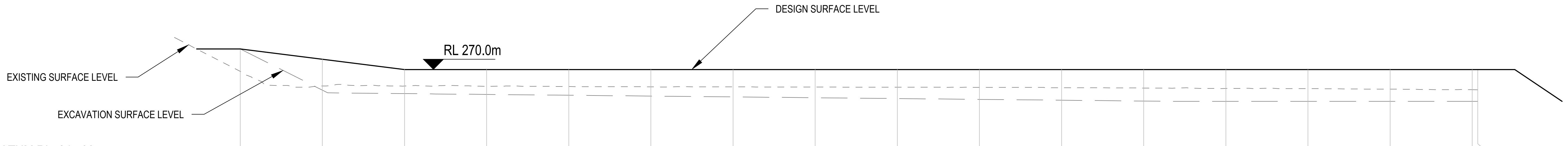


DATUM RL. 247.00

EXCAVATION SURFACE LEVEL	275.00	265.00	264.17	263.97	263.77	263.57	263.37	263.17	262.97	262.77	262.57	262.37	262.30	262.30	262.30	262.30	262.30
LEVEL DIFFERENCE CUT - / FILL +	9.35	6.91	4.65	4.61	4.52	4.78	4.88	4.96	5.07	5.16	5.27	5.32	5.43	5.53	5.69	5.75	5.75
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	265.65	265.59	265.35	265.39	265.48	265.22	265.12	265.04	264.93	264.84	264.73	264.68	264.57	264.47	264.31	264.25	264.25
CHAINAGE	-0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	301.33

CELL 1 DECANT EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000



DATUM RL. 247.00

EXCAVATION SURFACE LEVEL	275.00	265.00	264.17	263.97	263.77	263.57	263.37	263.17	262.97	262.77	262.57	262.37	262.30	262.30	262.30	262.30	262.30
LEVEL DIFFERENCE CUT - / FILL +	5.35	6.48	4.00	4.05	4.12	4.20	4.21	4.24	4.28	4.31	4.41	4.47	4.59	4.62	4.74	4.88	4.89
DESIGN SURFACE LEVEL	275.000	272.500	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000	270.000
EXISTING SURFACE LEVEL	269.65	266.02	266.00	265.95	265.88	265.80	265.79	265.76	265.72	265.69	265.59	265.53	265.41	265.38	265.26	265.12	265.11
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	301.33

CELL 2 DECANT EMBANKMENT - LONGITUDINAL SECTION

SCALE 1:1000

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY Drafting Check C. LONG
Designer T. RIDGWAY Design Check R. LONGEY

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

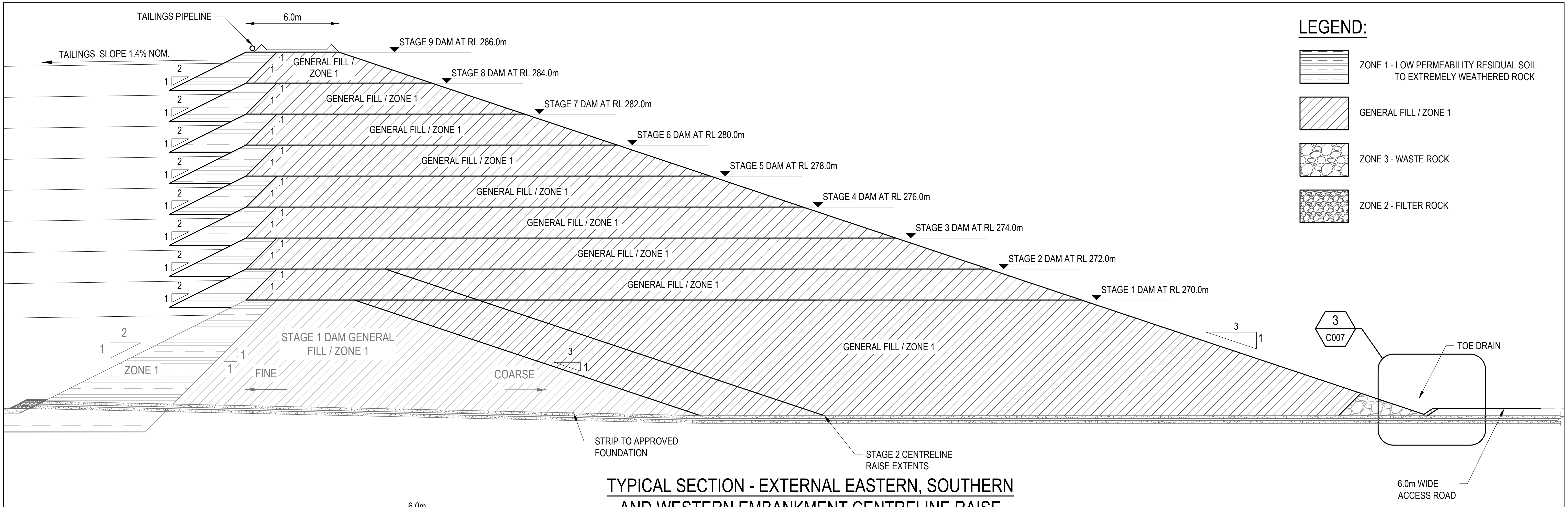
Drawing Title LONGITUDINAL SECTIONS SHEET 5 0F 5

Size A3

Drawing No. 12545239 - C019

Rev 0

Plot Date: 17 December 2021 - 1:49 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C019.dwg

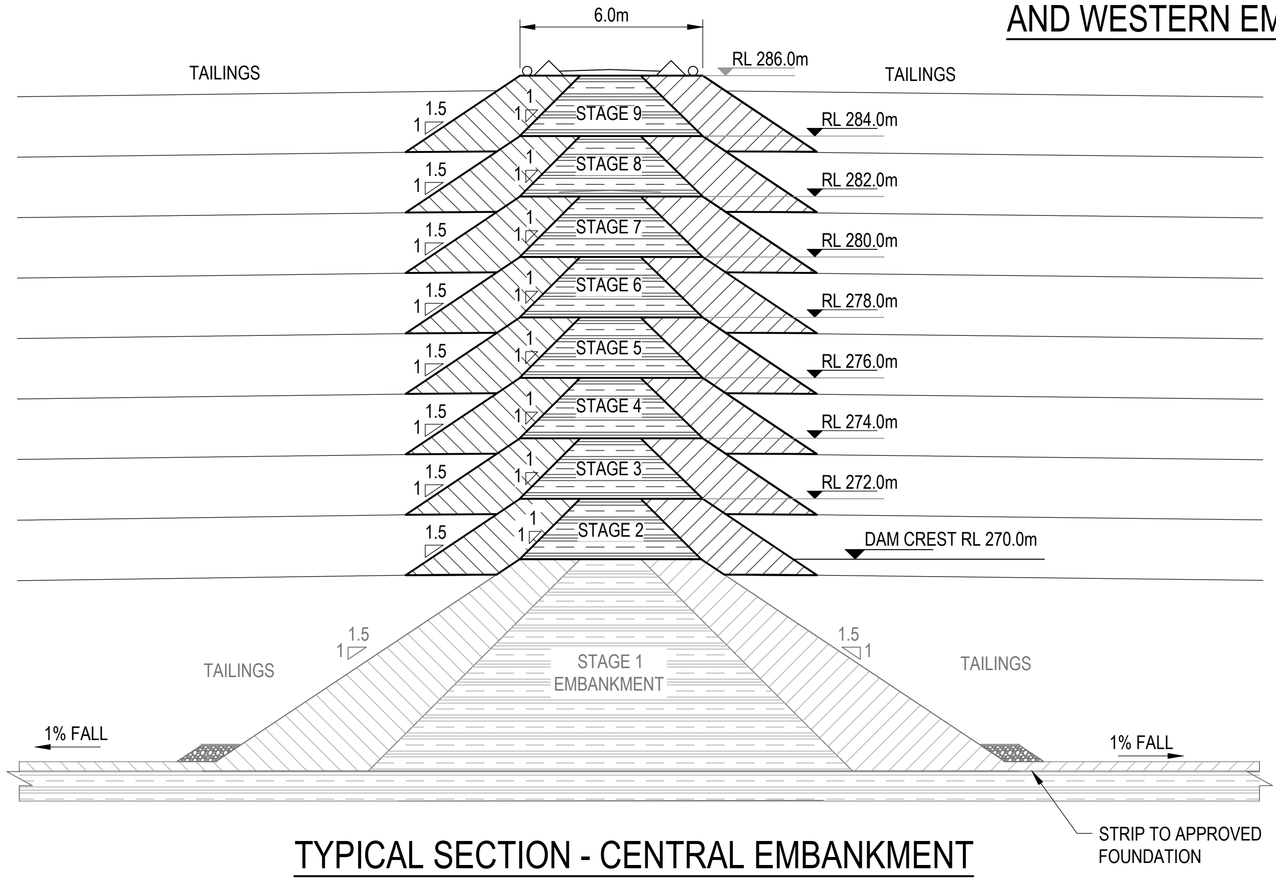


LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▩	ZONE 3 - WASTE ROCK
▩	ZONE 2 - FILTER ROCK

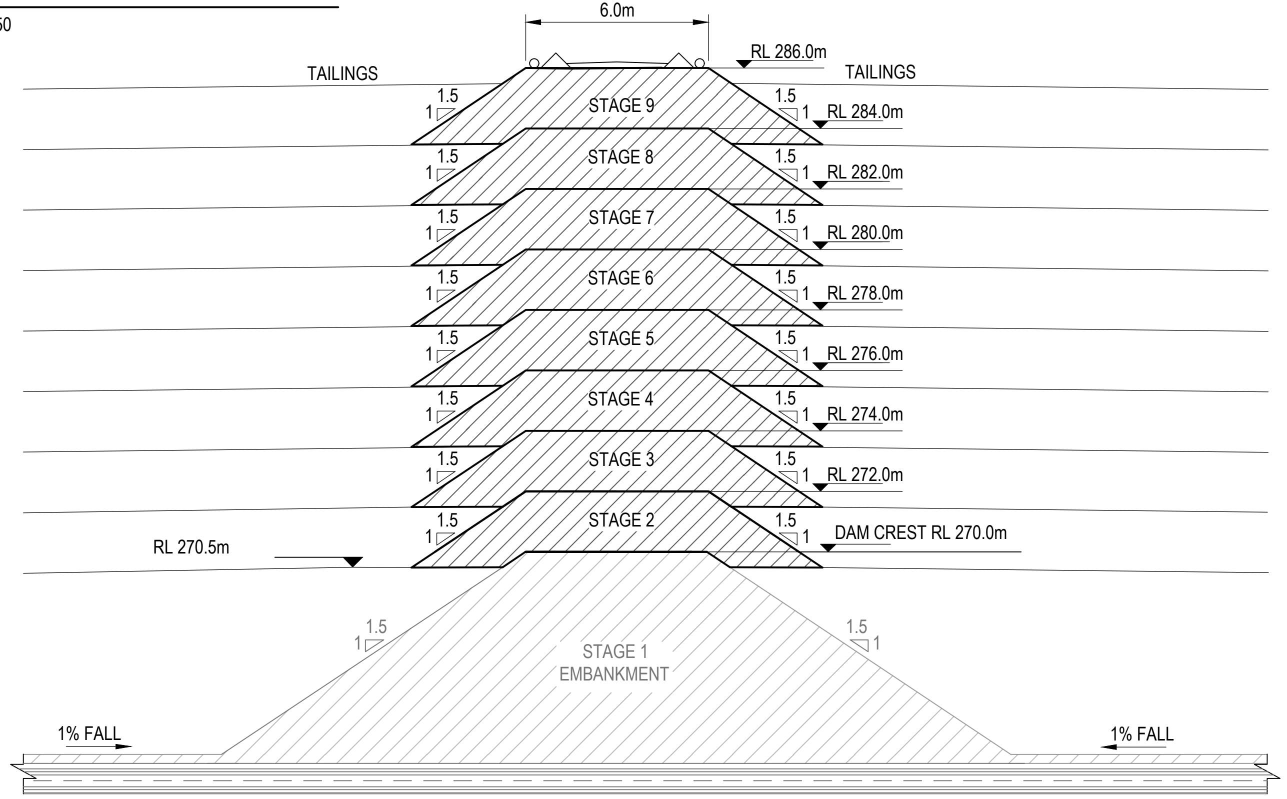
TYPICAL SECTION - EXTERNAL EASTERN, SOUTHERN AND WESTERN EMBANKMENT CENTRELINE RAISE

SCALE 1:250



TYPICAL SECTION - CENTRAL EMBANKMENT

SCALE 1:250



TYPICAL SECTION - DECANT CAUSEWAYS

SCALE 1:250

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 2.5 5.0 7.5m
SCALE 1:250 AT ORIGINAL SIZE

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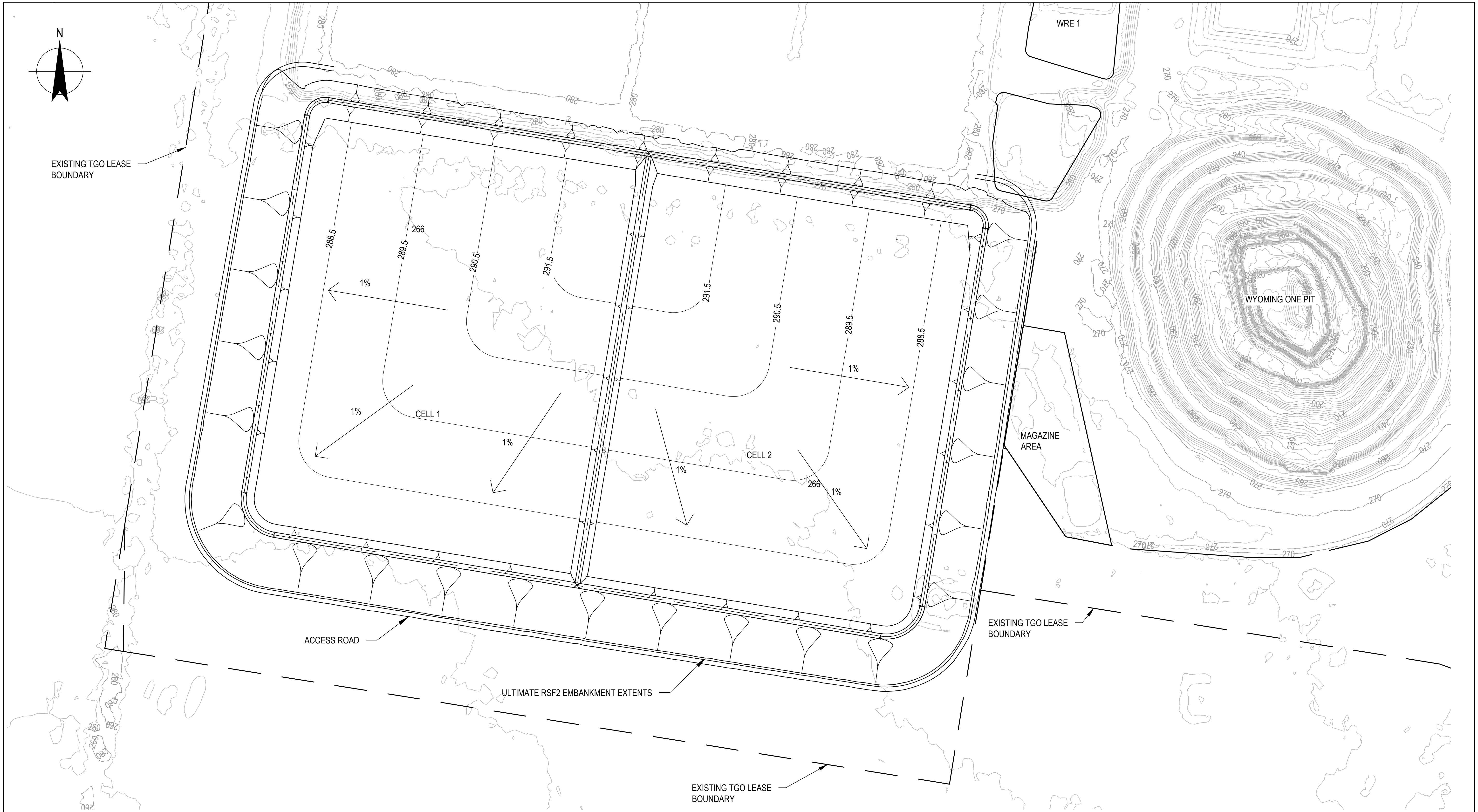
Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 EMBANKMENT DETAILED DESIGN
Status
Status Code

Drawing Title ULTIMATE TYPICAL SECTIONS
Size A3
Drawing No. 12545239 - C020
Rev 0

Plot Date: 17 December 2021 - 1:51 PM Plotted by: Melvin Agomuoh
File Name: G:\32\12545239\CADD\Drawings\12545239-C020.dwg



CLOSURE PLAN

SCALE 1:5000

BASE SURVEY SUPPLIED BY: AAM HATCH

SURVEYED ON: OCT.2020
HORIZONTAL DATUM: GDA94, MGA, ZONE 55
VERTICAL DATUM: AHD

EXISTING CONTOURS SHOWN

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG
Designer T. RIDGWAY **Design Check** R. LONGEY

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD
Project RSF 2 DETAILED DESIGN
Status
Status Code

Drawing Title CONCEPTUAL CLOSURE PLAN
Size A3
Drawing No. 12545239-C021
Rev 0

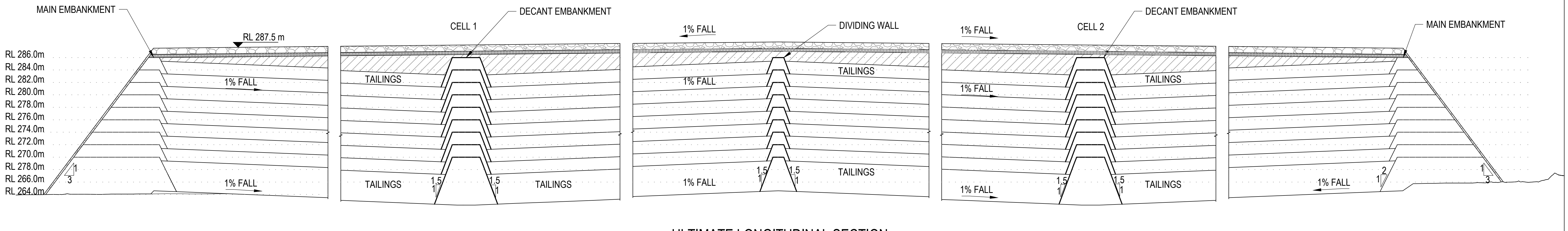
Plot Date: 17 December 2021 - 1:53 PM Plotted by: Melvin Agomuoh File Name: G:\32\12545239\CADD\Drawings\12545239-C021.dwg

NOTES

1. DECANT WATER TO BE REMOVED FROM RSF USING EXISTING DECANT INFRASTRUCTURE
2. PRIOR TO THE PLACEMENT OF THE CLOSURE MATERIAL, THE TAILINGS ARE TO BE TRACK ROLLED FOR CONSOLIDATION
3. WASTE ROCK AND GENERAL FILL IS TO BE USED TO INFILL THE DECANT POND AREA PRIOR TO CAPPING THE RSF LANDFORM
4. ALL CONTAMINATED TAILINGS INFRASTRUCTURE SUCH AS THE TAILINGS DEPOSITION PIPELINE IS TO BE DISPOSED IN AN APPROVED LOCATION
5. THE DECANT TOWER IS TO BE INFILLED WITH BULK CONCRETE FOLLOWING THE DECANT POND WATER REMOVAL AND PRIOR TO THE CAPPING OF THE FACILITY
6. ADDITIONAL WASTE ROCK IS T BE PLACED ON THE DOWNSTREAM FACE OF THE PERIMETER EMBANKMENT FOR EROSION PROTECTION IF REQUIRED
7. THE CAPPING SURFACE AND DOWNSTREAM FACE OF THE EMBANKMENT IS TO BE REHABILITATED USING LOCALLY AVAILABLE NATIVE GRASSES

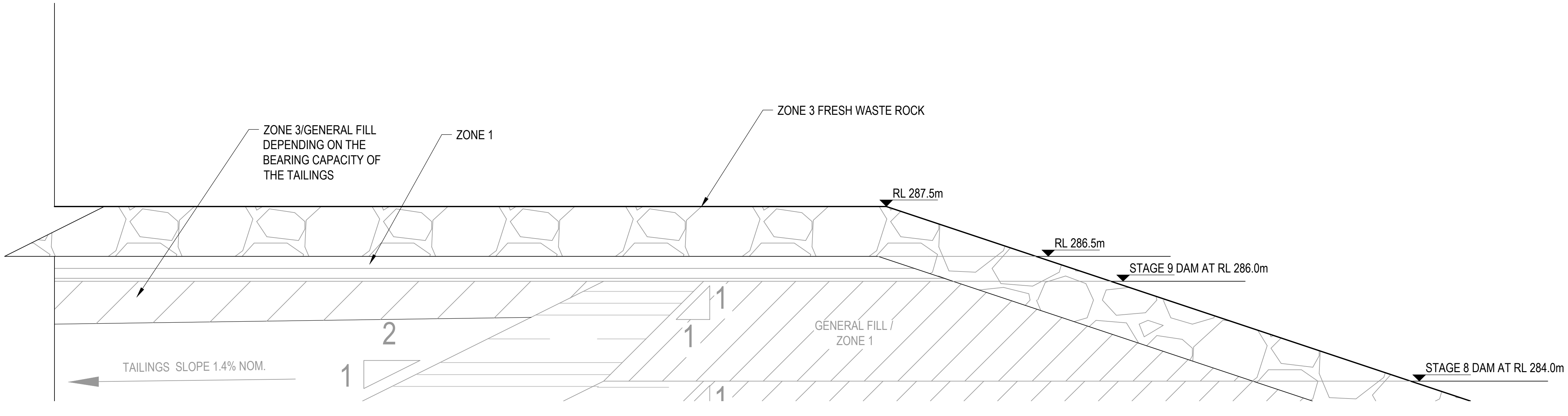
LEGEND:

▤	ZONE 1 - LOW PERMEABILITY RESIDUAL SOIL TO EXTREMELY WEATHERED ROCK
▨	GENERAL FILL / ZONE 1
▩	ZONE 3 - WASTE ROCK



ULTIMATE LONGITUDINAL SECTION

SCALE 1:2000 H/1:500 V



CLOSURE DETAIL

SCALE 1:100

Rev	Description	Checked	Approved	Date
0	ISSUED FOR CONSTRUCTION	MR*	RL*	17/12/2021

Author P. BURBURY **Drafting Check** C. LONG

Designer T. RIDGWAY **Design Check** R. LONGEY

0 25 50 75m
SCALE 1:2500 AT ORIGINAL SIZE

0 1 2 3m
SCALE 1:100 AT ORIGINAL SIZE

VERTICAL SCALE 1:500 AT ORIGINAL SIZE 0 5 10 15m

HORIZONTAL SCALE 1:2000 AT ORIGINAL SIZE 0 20 40 60m

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Project No.

Client TOMINGLEY GOLD OPERATIONS PTY LTD

Project RSF 2 DETAILED DESIGN

Status

Status Code

Drawing Title CONCEPTUAL CLOSURE SECTION AND DETAILS

Size **A3**

Drawing No. 12545239-C022

Rev 0

Plot Date: 17 December 2021 - 1:55 PM Plotted by: Melvin Agomuoh

File Name: G:\32\12545239\CADD\Drawings\12545239-C022.dwg