

EGL Ref: 9702

**MATAKANUI GOLD LIMITED
BENDIGO-OPHIR GOLD PROJECT
SHEPHERDS TAILINGS STORAGE FACILITY
TECHNICAL REPORT**

Prepared for:

08 August 2025

Matakanui Gold Limited

EXECUTIVE SUMMARY

This technical report presents the proposed design, construction, operation, maintenance and surveillance of the proposed Shepherds TSF. Shepherds TSF will be formed by a 108 m high downstream constructed earth and rockfill embankment dam with a proposed crest at 690 mRL. The TSF will be constructed in the upper reaches of the Shepherds Creek valley and proposed final crest height will lie approximately 200 m below adjacent ridge lines (approximately 900 mRL). Design analyses undertaken confirm that the TSF design meets the design and performance criteria in the NZDSG. As the embankment is developed it will be buttressed downstream by the Shepherd ELF. This ELF provides a large buttress to the TSF embankment such that there is no credible long-term failure mode that could result in breach and release of tailings.

The resource consent conditions will refer to the Tailings Management Plan. It is recommended that between the consent conditions and the Tailings Management Plan the following items are required:

1. The approved Tailings Management Plan is in place and complied with.
2. Substantive changes to the Tailings Management Plan require approval by the Regional Council.
3. The TSF is designed by a professional with experience in High PIC tailings storage facilities and the design is approved by a Chartered Professional Engineer. This is required under the building consent process.
4. The TSF is designed in general accordance with the NZDSG. Typically applied as an alternate solution as means of complying with the Building Act.
5. The design is peer reviewed. This is required under the building consent process.
6. A building consent is required for construction of the TSF. Requirement of the Building Act.
7. Construction is managed by personnel or a contractor experienced in the construction of a High PIC dams. Recommendation of the NZDSG.
8. A dam safety assurance programme is in place requiring assessment and review of PIC, routine surveillance, IDSRs, CDSRs, OMS, EAP, and maintenance of dam safety critical infrastructure. Required under the Building (Dam Safety) Regulations.
9. TSF rehabilitation and closure is planned for and regularly reviewed as the site is developed.

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**MATAKANUI GOLD LIMITED
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TAILINGS STORAGE FACILITY
TECHNICAL REPORT**

1.0 INTRODUCTION

Engineering Geology Limited (EGL) has been engaged by Matakanui Gold Limited (MGL) to provide geotechnical engineering assessment and design services for the Bendigo-Ophir Gold Project (BOGP). MGL are proposing to establish the BOGP, which comprises a new gold mine, ancillary facilities, and environmental mitigation measures within the Bendigo and Ardour Stations in the Dunstan Mountains of Central Otago. The project site is located approximately 20 km north of Cromwell. The site location is shown on Figure 1.

The BOGP involves mining the identified gold deposits at Rise and Shine ("RAS"), Come in Time ("CIT"), Srek ("SRX") and Srek East ("SRE"). Both open pit and underground mining methods will be utilised within the project site to access the gold deposits. Infrastructure to support the project will be constructed in the lower Shepherds Creek Valley. The proposed site layout is shown on Figure 2.

The new Shepherds Tailings Storage Facility (Shepherds TSF) is proposed to provide the tailings storage for ore processed from the mine. Design for the construction of the TSF will be undertaken in accordance with the recommendations and guidelines of the New Zealand Society on Large Dams (NZSOLD) 'New Zealand Dam Safety Guidelines' (NZDSG - Ref. 2). The TSF is to be designed as a High Potential Impact Classification (PIC) dam.

2.0 PURPOSE

This technical report has been prepared to support an application for resource consent. It provides recommendations for design, construction and operation of the proposed Shepherds TSF. The design in this report is for the assessment of environmental effects as required under the Resource Management Act 1991 and Fast Track Approvals Act 2024. Detailed design will be undertaken under a Building Consent process which includes peer review.

3.0 LOCATION AND PROJECT DESCRIPTION

3.1. Location

The project site is located approximately 20 km northeast of Cromwell. The RAS and CIT gold deposit is located within a ridge between Shepherds Creek to the northeast and Rise and Shine Creek to southwest. The SRX gold deposit is located on the southern slopes of RAS Valley.

The general location of the proposed site is shown in Figure 1.

3.2. Shepherds TSF

Shepherds TSF is to be formed using an embankment dam within the Shepherds Creek valley. The layout of the Shepherds TSF is shown in Figures 3 and 4.

The impoundment will be created between the embankment and the valley head to the southeast. The Shepherds TSF embankment will be constructed primarily from the overburden material that is excavated as part of the process of obtaining ore from the RAS-Pit. The proposed final crest height for the embankment is 690 mRL (NZVD 2016), forming a 108m high embankment above the existing ground at the downstream toe (582 mRL). As the embankment is developed it will be buttressed downstream by the Shepherd Engineered Landform. A long section along the stream bed and cross section across the valley are shown on Figure 05.

4.0 SITE SETTING

4.1. Topography

The Shepherds Creek and RAS Creek catchments start from a divide at approximately 900-1000 mRL in the southeast and water flows to the northwest. The creeks flow over schist rock within the valleys and onto gravel terraces in the northwest. Shepherds Creek is approximately 150 m lower than Rise and Shine Creek. The ridge between the creeks is approximately 60 to 190 m above the floor of Rise and Shine Creek, and 200 to 350 m above the floor of Shepherds Creek.

Shepherds Creek is a tributary to the Lindis River, which flows to the Clutha River. RAS Creek flows into Clearwater Creek, and then Bendigo Creek which is a tributary of the Clutha River. Under normal flows Shepherds Creek and Bendigo Creek have no wet connection with the Lindis River with the surface water infiltrating the gravels. Both creeks have surface water takes which reduce flows across and into the gravels.

Shepherds TSF will be located within Shepherds Creek, upstream of where the Jeans Creek tributary flows into Shepherds Creek. The distance from the stream head to the valley entrance is approximately 8 km and the streambed has an average slope of approximately 5.5 % (3.15 °).

4.2. Site Climate and Rainfall Estimates

The site is in Central Otago in the lower South Island of New Zealand, at approximately 450 to 1000 m above sea level. New Zealand lies in the mid-latitude zone of westerly winds, in the path of a succession of anticyclones, which move eastwards (Ref. 3). The presence of the Southern Alps extending the length of the South Island and to the west of the site has a major effect on the climate of Central Otago region, producing distinct contrasts from west to east across the South Island. Mean annual rainfall in the South Island ranges from over 8000 mm in the Southern Alps to the west to as little as 300 mm in parts of Central Otago (Ref. 3). The study area is approximately the most inland area of New Zealand and has a far more continental tendency than other parts of the country (Ref. 4).

Site monitoring demonstrates an increase in rainfall depth with elevation from the gravel terraces up into the Dunstan Mountains that are located southeast of the site. The mean annual rainfall at the site is estimated to be approximately 450 mm on the gravel terraces and approximately 550 mm in the upper catchment (Ref. 4). Heavy rainfall can occur, particularly when weather conditions cause rain bearing fronts to stall over the region.

The New Zealand High Intensity Rainfall Database (HIRDS, Ref. 5) provides estimates of rainfall depths and intensities for different average recurrence intervals (ARI) or annual exceedance probabilities (AEP). Tables 1 and 2 summarise the historical estimates for rainfall depth and intensity respectively. Historical estimates are considered suitable for design cases up to 2030. Estimates for climate change are available for the period 2031 to 2050 from HIRDS (Ref. 5).

The Probable Maximum Precipitation (PMP) has been assessed for the site. It represents the greatest depth of precipitation that is meteorologically possible at a specific location, for a given duration, under the most extreme combination of atmospheric conditions considered reasonably possible. For the Otago region, the PMP estimation is based on the methodology developed by Thompson and Tomlinson (Ref. 6)

This approach incorporates regional climatic influences such as the rain-shadow effect of the Southern Alps, the predominantly westerly airflow, and the limited moisture availability characteristic of the inland Otago environment. As such, PMP values in the area are generally lower than those in the West Coast or alpine regions. Unlike rainfall with a defined average recurrence interval, PMP is not probabilistic. It represents an upper bound intended to account for the worst-case meteorological scenario. The 72-hour duration PMP rainfall depth for the site has been estimated at 748 mm.

Evapotranspiration rates are high, averaging around 2.3 mm/day (Ref. 7), which often results in evaporation exceeding precipitation, particularly outside the winter months.

Temperatures at the site typically range from -5°C in winter to +35°C in summer (Ref. 8). Snow can occur at the site in winter months. Icy road conditions can be expected at times. Site roads and earthworks surfaces will require clearing of snow and ice at times.

5.0 GEOTECHNICAL INVESTIGATIONS

Geotechnical investigations have been undertaken at the direction of EGL, with onsite supervision and borehole logging undertaken by MGL geologists. The results of the investigation are presented in the site Geotechnical Factual report (Ref. 9).

Investigations comprised field mapping and the drilling of three rotary cored boreholes (MTD394, MTD396, MTD399), and the excavation of seven test pits (MTP033 to MTP039). The locations of the geotechnical investigations are presented in plan on Figure 18 and in section on Figures 20, and 21.

5.1. Field Testing

Permeability testing was undertaken in the boreholes using falling head and packer testing methods. Typically, the packer testing used a single packer as the boreholes were advanced. The purpose of the testing was to determine the permeability of the Torlesse Textural Zone III (TZ3) and Textural Zone IV (TZ4) Schist and associated fault or shear zones.

A total of eight packer tests and fourteen falling head tests were completed in the rotary cored boreholes.

5.2. Laboratory Testing

No laboratory testing was completed on the samples obtained from the ground investigations undertaken in close proximity to the TSF embankment. Laboratory testing will be undertaken as part of detailed design.

5.3. Groundwater monitoring

Nine vibrating wire piezometers (VWP) have been installed within the three rotary cored boreholes located in the vicinity of the proposed embankment. All VWPs were installed as fully grouted (cement-bentonite grout) piezometers. The tip depth of the VWPs and readings post investigation are shown in Figures 20 and 21.

6.0 GEOLOGY

6.1. Regional Geological Setting

The following geological description of the strata that is inferred to underlie the BOGP is based on a review of the currently available site-specific investigation results and the 1:250,000 scale geological map and associated report “Geology of the Wakatipu Area” published by the Geological and Nuclear Science (GNS) that was compiled by Turnbull et al (Ref. 10). The relevant excerpt from the GNS geological map is presented as Figure 17.

The Upper Clutha regional topography is dominated by mountains and glacially carved valleys. The site is within the Dunstan Mountains, with the valleys shaped to the north by glaciation while near the site, the valleys appear to be formed by river erosion.

According to the 1:250,000 scale Geological and Nuclear Science Qmap 19 “Wakatipu” (See Figure 17) the area is underlain by Otago Schist, along the boundary of two textural units recognised within the schist, TZ3 and TZ4.

The protolith for the schist is sedimentary mudstones and sandstones, deposited in the Permian to Triassic, 300 Mya to 200 Mya. Metamorphism occurred in the Cretaceous between 140 Mya and 75 Mya, undergoing greenschist facies pressures and temperatures, with the TZ3 experiencing lower pressure and temperature than TZ4.

Orogenic gold mineralisation occurred in the schist during metamorphism in the axis of a fold creating the RAS Shear Zone. The boundary of TZ3 and TZ4 is along the Thomson Gorge Fault (TGF), a non-active reverse fault dipping to the north-east at approximately 25°, with an estimated offset of approximately 8 km.

Movement along the TGF occurred in the Late Cretaceous, ending by approximately 82 Mya. The TGF is part of a large fold system across the southern end of the Dunstan Mountains, with the Cromwell Gorge Faults matching the TGF at the Southern arm of the fold.

The Otago region has experienced a series of faulting relating to oblique compression associated with the Australian – Pacific tectonic plate boundary and Alpine Fault starting approximately 25 Mya. Compression associated with the tectonic plate boundary has formed the Pisa Range, Dunstan Mountain Range and Rock and Pillar Range in the region. Recent glaciation has occurred in the area, with a series of glacial advances and retreats leaving tills and moraines along the Clutha Valley at the north of the site. The site is located at the historic junction of the Lindis and Wanaka glaciers. The lower site is shown as having been glaciated during the last maximum glaciation approximately 650 kya.

Gold was found on the site in 1862, with gold prospecting occurring until 1913, restarting in 1935-1942. Sluicing took place in the RAS Creek during 1864-1899. Mining in RAS shear zone was undertaken in the years 1872 to 1890, and 1932 to 1939.

6.2. Local Geological Setting

Bedrock on site is Otago Schist, consisting of TZ3 and TZ4, separated by the TGF. The TGF is generally a consistent plane, which runs along RAS Creek from Thomsons Saddle to the point where the stream cuts westward to join Clearwater Creek. There the TGF continues northwest and joins Shepherds Creek which follows the TGF until the end of the valley.

Fault activity on the TGF is dated to 82 ± 3 Mya, at the end of the metamorphism of the schist. In surface, the TGF outcrops as clay rich zone. In core recovered from the rotary cored borehole investigation, the TGF is observed as a cataclastic clay gouge, with blocks of schist up to 50 mm diameter present within the gouge.

The schist encountered onsite outcrops in many locations. MGL geologists have measured the dip and dip direction of joints, foliation and shear zones on outcrops (Figure 18). Fault shears and folds have been mapped and interpreted as structural features by MGL geologists within the TZ3.

Landslide features have been identified on the site within the TZ3 schist (see Figure 19). Movement is controlled by structural elements within the underlying bedrock. Many are large block slide type features that are ancient landslides, and present as displaced masses without debris fields.

6.3. Geological Units

Descriptions of geological deposits encountered onsite are provided below.

6.3.1. Topsoil

A veneer of topsoil covers much of the site. The topsoil is an organic rich silty soil that tends to be thicker closer to the base of the valley. On the valley slopes, the topsoil comprises an organic stained loess deposit.

6.3.2. Alluvial Deposits and Fans (Q1a & Q1af)

Undifferentiated, typically unconsolidated, variable weathered gravels with interbeds of sands, silts and clays. This unit is generally encountered in the valley floor. These materials comprise clays, silts, sands and gravels derived from parent materials upstream of the deposition location.

Organic-rich clays, with infrequent lenses of variable material from other sources may be encountered where low energy environments existed (swamps), e.g. in the RAS Creek.

6.3.3. Loess

These deposits are not mapped on geological maps of the area but are described in the associated report as “*too thin, diffuse and complex to be shown on a map*”. Locally, on the lower flatter valley slopes the loess may have been deposited as a thin ‘blanket deposit’ with a depth of 1 to 3 m thick while on steeper slopes it has been remobilised and forms a thin loess / colluvium slope wash unit containing material from the underlying rock.

Loess was not encountered in the investigations (test pits and boreholes). However, outcrops show up to approximately 3 m thick deposits in some areas.

6.3.4. Holocene Landslide Deposits (Q1l)

The Holocene landslide deposits range from shattered rock to clay and boulder breccias but are predominantly silt and gravel. They are typically loose and unsorted, derived from weathering and erosion of the schist. They are typically deposited at the base of slopes or on the lower slopes of the river valleys. Holocene landslide deposits may be described in some references as colluvium and slope wash deposits.

6.3.5. Undifferentiated Quaternary landslide deposits (uQl)

Undifferentiated quaternary landslide deposits are older than the Holocene landslide deposits but have a similar composition. In some locations they may have been overlain by more recent Holocene landslide deposits. The indicative extent of the

landslides which have been identified to date are shown on the Figure 19. The landslides shown in Figure 19 are a combination of Holocene and Quaternary landslide deposits (i.e., they are not differentiated).

6.3.6. Schist

Otago schist is the basement bedrock within the study area. It has been divided into the following zones:

Torlesse TZ3 Schist (*Rakaia Terrane, Whakatipu Group*) (Yt3): Permian to Triassic era undifferentiated pelitic and psammitic schist and greenschist sequences. This unit may be locally weathered to a silty gravel.

Torlesse TZ4 Schist (*Rakaia Terrane, Whakatipu Group*) (Yt4): Permian to Triassic era undifferentiated pelitic and psammitic schist and greenschist sequences. This unit may be variable segregated, veined and foliated.

Thomson Gorge Fault (TGF) Gouge: This deposit was not noted on the geological map. It typically comprises a band of material 2 to 10 m thick derived from movement on the TGF. In general, this material comprises clays with some angular gravel. The fault gouge forms a 'marker bed' separating the TZ3 and TZ4 schist within the project area.

The TZ4 schist is a higher metamorphic grade and is stronger and more resistant to weathering and erosion than TZ3 schist. Foliation in TZ4 is generally consistent, dipping northwest at around 20 degrees. Slopes in the TZ4 are roughly parallel to the foliation, and steeper than foliation where the foliation dips into the slope. TZ3 schist is a lower metamorphic grade, is weaker and more erodible than TZ4 schist. Foliation planes in TZ3 vary greatly with folds and angular contacts between different planes. Slopes in TZ3 have variable slope angles, typically relating to the changes in foliation and the presence of structures antithetic to foliation.

Weathering of the schist is generally thin, but variable, with the depth of the weathering profile increasing along defects and in more micaceous layers. The same weathering processes are at work in both the TZ3 and the TZ4. The weathering profile is deeper in the TZ3 than TZ4, due to a weaker starting condition and more defects present. TZ3 weathered material is practically the same as TZ4 weathered material and consists of clays from weathered micas with more competent schist blocks from less micaceous zones of the original rock. Weathered material eventually forms a slope wash of clays and blocks of intact schist.

7.0 GROUND AND SURFACE WATER CONDITIONS

7.1. Surface Water

Surface water discharges from the Shepherds TSF area will be to Shepherds Creek. Shepherds Creek is a tributary of the Lindis River. There is no wet connection between Shepherds Creek and the Lindis River.

Flow gauge measurements of Shepherds Creek within the Shepherds Creek valley indicate average base flow rates of approximately 17 l/s. The flow is derived from a

catchment of approximately 12.0 km². The base flow is fed all year by springs on the slopes middle to upper catchment. The creek bed is formed on alluvial gravels over schist in the valley and over gravels across the terraces. High rainfall events notably increase the flow. Daily Mean Flows up to 0.14 m³/s (140 l/s) have been recorded over an approximately 2-year period. These measured flows are notably less than flows predicted from runoff type analysis for flood conditions. The 1 in 2 years, 1 in 10 years, and 1 in 100 years peak flood flows are estimated to be 18 m³/s, 28 m³/s and 61 m³/s at the valley outlet from schist rock onto the terrace gravels. Estimates use the simplified rational method (Ref. 11).

Review of historical aerial photographs and visual inspection onsite indicates that the water course between the outlet of the Shepherds Valley and the Lindis River is ephemeral, typically dry. The water course has been modified by agricultural activities and the construction of water storage ponds and pivot irrigation. A downstream irrigation scheme takes much of the base flow from Shepherds Creek before the valley outlet onto the gravel terraces. Beyond the valley outlet any remaining base flow infiltrates into alluvial and till and outwash gravel terraces. Under normal rainfall conditions, no surface water reaches the Lindis River. Water flowing from the Shepherds Creek catchment is likely to only reach the Lindis River under very high rainfall events, and anecdotally, according to the Ardgour Station owner, has never occurred in the past 40 years.

7.2. Ground water

Groundwater flow within the schist occurs through defects in the rock mass, with flow rate dependent on the aperture, infill, and geometry of the defects. Piezometric readings indicate a groundwater level that is elevated in the ridges and draining towards the valley floor. The readings from piezometers in the valley floor indicate artesian pressures below the proposed site of the Shepherds TSF, which indicate upward flow into the base of the Shepherds Creek valley floor.

Groundwater is also transmitted through the alluvial and colluvium deposits within the valley floor and was found in some of the test pits.

The proposed TSF will affect the ground water levels in the area where tailings are impounded. It is expected that there will be a rise in the groundwater at lower elevations on the valley sides. Underdrains will minimise this effect.

7.3. Conceptual Site Model

The Conceptual Site Model (CSM) for Shepherds TSF is based on the following site characteristics:

- A single, fractured rock (TZ3 schist) aquifer system, draining to the valley floor and northwest along Shepherds Creek. The ridge crests form effective lateral no-flow boundaries. Many kilometres downstream, the TZ3 rock system connects to the groundwater system within the alluvial and glacial outwash gravels and tills located in the Lindis river valley. Flows from the TSF will be low in the context of the larger system.
- The foliation planes in the TZ3 vary greatly with folds and angular contacts between different planes. The foliation planes beneath the Shepherds TSF are assumed to dip

to the northwest. Additional fault structures will create additional barriers or pathways for groundwater flow.

- The TZ3 schist is characterised by decreasing frequency and openness of fractures with depth. The fracture system provides the hydraulic conductivity and storage. Intact schist has a very low hydraulic conductivity and water storage.
- The schist has been weathered along the fracture system in the near surface (<20 m) zone. The weathering has resulted in infilling of the fracture system with micaceous clay, giving an overall lower permeability.
- There are surficial soils and completely weathered schist that forms a veneer (0-3 m thick). This layer typically inhibits the rate of recharge to the regional system. It will also inhibit any seepage from the tailings into the fractured rock aquifer.
- A thin mantle of loess and slope colluvium overlies landslide breccias and discontinuous alluvial fans. Landslide blocks exist and may introduce higher or lower permeability zones. The surficial soils and landslide block will contain perched water tables and may be the cause of some of the observed springs in the valley sides.

The above CSM forms the basis for the hydrology and hydrogeological assessments in this report.

8.0 IN-SITU ROCK, WASTE ROCK AND TAILINGS CHARACTERISTICS

The foundation for the Shepherds TSF will be stripped of surficial soils to expose the underlying TZ3 schist. The TSF embankment will be largely constructed from weathered TZ3 schist with the potential for minor amounts of weathered TZ4 schist. The properties of the foundation and fill materials, and the tailings adopted for preliminary design are summarised below.

8.1 In-Situ Rock

Three sets of shear strength parameters have been adopted for the in-situ rock. The shear strengths proposed are based on EGL's experience and testing of similar materials at the Macraes Gold Mine in New Zealand and the ground investigation completed at the Shepherds TSF. They are as follows:

1. Rock shallower than 40m below original ground level (accounts for weathering in TZ3 schist):

Effective cohesion	$c' = 50 \text{ kPa}$
Effective friction angle	$\phi' = 40 \text{ degrees}$

2. Rock greater than 40m below original ground level (less weathered TZ3 schist):

Effective cohesion	$c' = 150 \text{ kPa}$
Effective friction angle	$\phi' = 45 \text{ degrees}$

3. Rock shear strength along foliations and minor shears/faults within TZ3 schist:

Effective cohesion	$c' = 47 \text{ kPa}$
Effective friction angle	$\phi' = 23 \text{ degrees}$

These strength parameters will be further reviewed in detailed design, under the building consent process.

8.2. Waste Rock

The shear strength functions for Zones A1, B, B1 and C are summarised and plotted in Table 3. They show that at low effective stress (less than about 100 kPa) the equivalent effective friction angle is about 45 degrees with zero cohesion. The friction angle reduces with increasing effective stress. The shear strength functions proposed are based on EGL's experience and testing of similar rockfill materials at the Macraes Gold Mine in New Zealand.

Zones A1, B, and B1

Density (γ)	$\gamma = 22.5 \text{ kN/m}^3$
Shear strength (τ)	$\tau = 2.43 \sigma_v'^{0.83}$

where σ_v' is the effective vertical overburden pressure (in kPa).

Zone C, and General Rockfill in the Shepherds ELF

Density (γ)	$\gamma = 21.5 \text{ kN/m}^3$
Shear strength (τ)	$\tau = 1.29 \sigma_v'^{0.91}$

where σ_v' is the effective vertical overburden pressure (in kPa).

8.3. Tailings

8.3.1. General

The tailings are the residue that remains following the extraction of gold from the ore. The ore rock is passed through crushers and mills to break and grind it down to a fine size prior to gold being extracted. The resulting residue is generally a non-plastic silty sand.

The tailings will be discharged sub-aerially via spigots from the embankment. This promotes segregation of the tailings and the formation of a more permeable beach adjacent to the embankment. Generally, the coarse tailings will be deposited on the beach with the finer tailings carried further from the embankment. However, experience from the Macraes Gold Mine indicate that there are occasional thin lenses of finer tailings, generally less than 100 mm thick that are deposited adjacent to the embankment. These lenses have typically been found to extend over a limited width and are not continuous.

The properties adopted for the tailings are summarised below. The properties are based on EGL's experience on similar facilities. It is noted that the tailings will be contained by a downstream construction embankment. The stability of the embankment is not sensitive to the strength of the tailings.

8.3.1.1. Tailings Density

The dry density of the tailings is used for assessing storage capacity, estimating consolidation, and informing embankment and drainage design. As site-specific laboratory testing data is not available, the assumed tailings densities have been derived from EGL's experience with similar tailings produced from the Macraes Gold Mine.

For planning purposes, a average tailings density of 1.25 t/m³ has been adopted. Tailings will likely achieve better than this depending on deposition rate, under drainage, and permeability of the tailings. Average dry densities up to 1.40 t/m³ could be expected.

The assumed dry densities will be reviewed and refined as part of detailed design, based on laboratory testing of actual tailings samples obtained from pilot processing or early operations.

8.3.1.2. Peak Drained Shear Strength

For static drained condition, the following peak drained shear strength have been adopted for the tailings.

Effective cohesion	$c' = 0 \text{ kPa}$
Effective friction	$\phi' = 32^\circ$

The adopted tailings drained friction angle is based on the critical state friction angle derived from the laboratory tests on tailings from the Macraes Gold Mine.

8.3.1.3. Peak Undrained Shear Strength

A peak s_u/σ_v' value of 0.19 has been adopted based on an empirical correlation method by Olson and Stark 2003 (Ref. 11). This method is based on the back-calculation of the yield strength ratio associated with thirty liquefaction flow failures. Peak undrained strength based on the Macraes Gold Mine laboratory test results via a critical state approach results in a s_u/σ_v' value of 0.26.

8.3.1.4. Residual Undrained Shear Strength

The residual undrained shear strength of the tailings is an important design parameter for both earthquake and static load conditions. During strong earthquake shaking saturated tailings can be expected to liquefy. A residual undrained shear strength ratio (s_r/σ_v') of 0.06 has been adopted based on the empirical correlation of the CPT data from other similar facilities and using the Olson and Stark 2002 method (Ref. 13). This correlation generally provides a lower bound estimate of residual undrained shear strength ratio compared with others, e.g., Robertson 2010 (Ref. 14). An estimate of the residual undrained strength based on the Macraes Gold Mine laboratory test results via a critical state approach results in a s_r/σ_v' value of 0.12.

8.3.1.5. Undrained Shear Strength during Earthquake Shaking

The residual undrained shear strength ratio of 0.06 is adopted for empirical seismically induced displacement calculations using the Bray and Macedo method (Ref. 15) for the mainshock (OBE and SEE) and aftershock.

8.4. Summary

The strength parameters adopted for stability analyses presented in this report for the embankment, tailings and the foundations are summarised in Table 3.

9.0 SEISMIC HAZARD

9.1. Background

The site is in an area of moderate seismicity. The nearest active faults are the Dunstan Fault (~12km surface distance) and the Pisa Fault (~13km surface distance). The Alpine Fault is the largest and most active fault in New Zealand and is the surface expression of the Australian – Pacific plate boundary. It is located about 110 km (surface distance) northwest of the site. The Otago region has undergone multiple faulting events related to oblique compression from evolution of the Australian and Pacific tectonic plate boundary compression across the Australian – Pacific plate boundary (Alpine Fault) since 25 Mya. The Alpine Fault has an annual mean slip rate of 25 mm/year and is considered capable of earthquakes of up to Mw 8.3 (Ref. 16).

The NZDSG (Ref. 2) recommend that dams be designed for two levels of earthquake shaking; the Operation Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE). The NZDSG also recommend considering the effects of an aftershock associated with the earthquake that is most likely to be associated with the SEE.

A site-specific seismic hazard assessment (SSSHA) for the site (Ref. 16) has been completed by EGL. The assessment used the 2022 National Seismic Hazard Model (NSHM22, Ref. 17) and the OpenQuake Engine (Ref. 18). NSHM22 represents a fundamental revision of the National Seismic Hazard Model across all components, incorporating the latest developments in scientific understanding of seismic sources within New Zealand and state-of-art knowledge with respect to estimates of seismic hazard.

9.2. Probabilistic Seismic Hazard Analyses

Probabilistic estimates of seismic hazard in terms of peak ground acceleration and spectral acceleration, for Vs30 values of 850, 1,000, and 1,500 m/s, were assessed in the SSSHA. A Vs30 value of 1,000 m/s has been adopted for the assessment of the Shepherds TSF. The spectral accelerations for the earthquake design loading cases for a High PIC dam are presented in the SSSHA. It includes estimates for the Operational Basis Earthquake (OBE) with a 1 in 150 Annual Exceedance Probability (AEP), Safety Evaluation Earthquake (SEE) with a 1 in 10,000 AEP, and aftershock following an SEE.

9.3. Deterministic Seismic Hazard Analyses

Based on disaggregation from the Probabilistic Seismic Hazard Analysis (PSHA), the deterministic analysis identified a Mw 8.0 earthquake at a 9 km source-to-site distance, attributed to the Dunstan Fault System as the Controlling Magnitude Earthquake

(CME). The magnitude 8.0 event is attributed to a co-rupture of the Dunstan fault and nearby faults.

Comparisons between the 84th percentile DSHA estimates and mean PSHA estimates are presented in the SSSHA (Ref. 16). The 84th percentile acceleration spectrum associated with a Mw 8.0 rupture on the Dunstan Fault is higher than the 1 in 10,000 probabilistic spectra for nearly all spectral periods. NZDSG requires the TSF to be designed for the lesser of the 1 in 10,000 AEP or CME response spectra, whichever is lower. The 1 in 10,000-year response spectra is proposed for the TSF SEE design case. The proposed OBE and SEE acceleration spectra for preliminary design of the TSF ($V_{s30}=1,000$ m/s) are summarised in Table 3 and plotted on Figure 3 in the SSSHA report (Ref. 16).

9.4. Aftershock

Aftershock PGA and acceleration response spectra values were derived deterministically. For peak ground acceleration and short spectral periods (0.15 s) the 1 in 10,000-year PSHA mean magnitude and mean rupture distance is Mw 6.7 to 6.8 at 20 km. Taking Mw 6.8 as the mean magnitude for the main earthquake shock, a magnitude Mw 5.8 was used to develop the response spectra for the aftershock. This is one magnitude less than the main shock. This approach aligns with NZDSG 2024 guidelines (Ref. 2). The proposed aftershock acceleration spectrum for preliminary design of the TSF ($V_{s30}=1,000$ m/s) are summarised in Table 3 and Figure 3 in the SSSHA (Ref. 16).

9.5. Orientation of Ground Motion

The spectra presented are SA_{RotD50} . It represents the median spectral acceleration across a range of orientations (0-90 degrees). It is considered appropriate for the design of structures that are azimuth-dependent, i.e., the dynamic properties of the structure (e.g., stiffness) are dependent on the orientation being considered (Ref. 19). The SA_{RotD50} is appropriate for geotechnical design, if the design method itself is derived based on SA_{RotD50} (e.g., when using the Bray and Macedo method (Ref. 15) for displacement estimation).

10.0 POTENTIAL IMPACT CLASSIFICATION

The NZDSG (Ref. 2) provides recommendations for the design, construction, and operation of dams. They are dependent on the Potential Impact Classification (PIC) of the dam. The PIC of a dam reflects the potential consequences of a failure on people, property, infrastructure, cultural and historical sites, and the environment. Assessment of the PIC needs to consider various factors including Population at Risk (PAR), Potential Loss of Life, damage to houses, infrastructure, environment, and community recovery time.

The PIC of the proposed Shepherds TSF is assessed to be **High** based on a dam breach assessment undertaken in accordance with the recommendations outlined in the NZDSG Module 2 (Ref. 2). The details of the dam breach study and assessed damage levels for different categories are provided in Appendix A. The assessed damage level is catastrophic with an estimated PAR of 11-100 and Potential Loss of Life of 1.

11.0 TSF DESIGN REQUIREMENTS AND CONCEPTS

11.1. Storage Capacity and Crest Level

The proposed BOGP is to produce 1.2-1.8 million tonnes of ore per annum. Total tailings storage tonnages for this assessment are assumed to be up to approximately 22 million tonnes, which includes potential tailings from RAS Pit, RAS Underground, CIT Pit, Srex and Srex East Pit. This total is assumed for sizing of the TSF for consenting only and has no relevance to any economic assessment.

The elevation storage curve for the proposed Shepherds TSF to 690 mRL is shown in Figure 24. The storage at 690 mRL is approximately 21,800,000 m³. Freeboard of 1 m above the Inflow Design Flood (IDF) is required (Ref. 2). At a 689 mRL the volume is approximately 21,300,000 m³. The design flood is the runoff from a 72-hour Probable Maximum Precipitation (PMP) rainfall event. The PMP volume is approximately 3,180,000 m³. This leaves approximately 18,000,000 m³ available for tailings storage. At average dry density of 1.25 t/m³ the total tailings storage available is approximately 22.6 million tonnes. With consolidation higher densities are expected. With consolidation to an average dry density of 1.40 t/m³ there is potential for approximately 25.3 million tonnes of tailings storage.

It is estimated that tailings will be discharged up to approximately 5 m below the crest and the normal operating level of the pond water will be typically 6 to 7 m below the crest. The pond level being lower than the top of the tailings in practice due to the slope of the tailings beach.

11.2. Surface Water Management on the Tailings Storage Facility

The IDF is the runoff from a 72-hour Probable Maximum Precipitation (PMP) rainfall event with a rainfall depth of 748 mm. A runoff coefficient of 1.0 for the tailings impoundment, and 0.7 for the upper catchment has used for the assessment. A more detailed assessment of the runoff coefficient for the upper catchment is required for detailed design. The total catchment is approximately 640 ha resulting in a PMP volume of approximately 3,180,000 m³. This case assumes full inflow of the full catchment above the TSF, including any catchment above any diversion channels (i.e.

it is assumed that the diversion channels are blocked). The freeboard required above the IDF (i.e. PMP) is 1 m under the NZDSG (Ref. 2).

Water will accumulate on the surface of the Shepherds TSF due to rainfall, water released from the tailings slurry when it is discharged into the pond (i.e., supernatant), and from water pumped from other mining operations (e.g., open pits). Water loss will be primarily due to evaporation and the site is assumed to be in a water balance deficit, requiring make up water. The operational pond volume may be as low as 100,000 m³ limited by the practical depth of pumping. Maximum normal operating pond volumes of around 400,000 m³ are expected. Larger maximum operational volumes are possible to manage water balance requirements with due consideration in detailed design of the TSF embankment (i.e. freeboard, tailings beach position, and seepage and erosion controls).

The water remaining on the TSF surface (decant pond) will be pumped to the Process Plant for re-use. It will be necessary to monitor the decant pond water level to ensure that operating water levels are consistent with design assumptions. It will also be necessary to undertake close monitoring of the tailings profile when it nears the maximum design profile to ensure there is enough storage for the IDF with 1 m freeboard.

Under normal operation the water in the pond is able to be kept away from the embankment crest or any landslide features in the impoundment by forming a tailings beach. This is managed by discharging tailings from a combination of spigots and end pipe methods along the area of interest. Running a tailings beach for starter embankment is recommended until the impoundment surface area increases and the depth of water in the impoundment becomes shallow.

11.3. Tailings Deposition Strategy

The tailings will be pumped from the Process Plant using high density polyethylene pipes and be discharged sub-aerially. In operation it is likely tailings discharge will be from the embankment. The main tailings pipeline will likely be laid along the embankment crest with multiple spigots discharging on the upstream side of the embankment. Tailings discharge via the spigots will be regulated to maintain a uniform beach profile against the embankment. By discharging tailings from the embankment crest it is possible to minimise water ponding directly against the embankment or adjacent abutments. Discharge of tailings against potential landslide features in the impoundment may also be required. This is to be assessed in detailed design.

Towards the end of the life of the TSF, it is proposed tailings be discharged from the south-east end of the impoundment to achieve a profile that falls towards the north side of the embankment. Further details on tailings management are described in Section 16.0 and rehabilitation is described in Section 17.0 .

11.4. Foundation Preparation

The Shepherds-TSF Embankment will be constructed on underlying bedrock. Foundation preparation will consist of stripping vegetation and excavating loess, colluvium, alluvium, residual soils, and any landslide debris overlying the schist bedrock.

Foundation surfaces below Zone A1 will be cleaned off with compressed air to enable observation of defects and assessment of the need for any special treatment such as slush or pressure grouting or the installation of additional subsoil drainage. Zone A1 will be taken down to a tight schist bedrock with low in situ permeability.

Low pressure and slush grouting may be necessary to infill any small fractures apparent following foundation excavation. If pressure grouting is required, this will be achieved most probably using angled drillholes from the original ground surface. Grouting of previous exploration or investigation boreholes may need to be undertaken where such holes underlie the Zone A1 foundations.

Any irregularities in the excavated foundation surface that cannot be removed by excavation will be profiled with dental concrete.

11.5. TSF Embankment and Shepherds ELF

The Shepherds TSF will be formed by a zoned downstream construction embankment. The starter embankment crest level is set as the minimum level at which tailings can be discharged while being able to manage a IDF with 1 m freeboard. At this level it provides storage for the first couple of months. Raising of the crest will continue immediately to develop a tailings storage buffer. The raise rate to achieve additional storage is easily achievable. It is recommended that tailings storage capacity is developed to be at least 6 months ahead of required storage. Developing storage capacity to be 1 to 2 years ahead of required storage is common.

The starter embankment with a crest of 643 mRL will be located over the upstream half of the full embankment footprint. It will be constructed using a combination of loess, colluvium, and weathered schist from local borrow pits within the TSF impoundment and Shepherds ELF footprint, and mine waste rock obtained from the RAS pit. As the embankment develops toward its maximum height it will be constructed predominantly from mine waste rock obtained from the RAS pit. The proposed embankment layout is shown in Figure 03 and 04, and the embankment and impoundment profiles are shown in cross sections in Figures 05 and 06.

The Shepherds ELF will be constructed directly downstream of the Shepherds TSF embankment. The profiles and levels of the Shepherds ELF vary with a potential maximum elevation of 770 mRL. The north side of the ELF will be left lower than the final tailings level and embankment crest to allow final surface water drainage off the closed surface of the TSF impoundment. The staging of the Shepherds ELF will be subject to the mining operation and the final profiles may be less than those shown in Figures 02 to 04.

11.6. Embankment Zoning

The embankment will be a zoned earth/rockfill structure as shown in Figure 06. The embankment zoning considers the depth of water that can be expected to pond against the upstream shoulder. Before the commencement of tailings discharge and the early stages of operation water can be expected to pond against the upstream shoulder of the embankment. As the crest is raised above the starter embankment and the impoundment area develops, less water is expected to pond against the upstream

shoulder of the embankment as tailings are discharged from the crest of the embankment will form a tailings beach and the pond can be pushed up the valley.

The proposed starter embankment has a low permeability central core (Zone A1) which also extends as a blanket beneath the upstream shoulder. The upstream and downstream shoulders are constructed from rockfill (Zone B). Above 643 mRL the low permeability Zone A1 is located on the upstream shoulder with the remainder of the embankment comprising rockfill (Zone B, B1 and C1).

The starter embankment includes a filter zone/chimney drain that is located near the downstream side of Zone A1 and extends up to 633 mRL. The extent of the chimney drain, and chimney drain base collector is shown in Figure 07. The filter zone/chimney drain is not proposed to be raised above RL633 because the potential depth of water that may pond against the upstream shoulder is minimal. Consequently, the risk of internal erosion developing and tailings piping through the embankment is considered negligible.

Comments on the principal features of the embankment zoning follow:

Zone A1

The primary function of this zone is to limit seepage. It also provides sufficient strength to prevent the likelihood of instability, particularly when subject to the design seismic loads. The low permeability Zone A1 can be sourced from mining waste or locally borrowed weathered schist supplemented with loess and colluvium as necessary. Additional weathered schist can be obtained from mining operations if necessary. Zone A will be placed in 0.35 m loose layers and subjected to compaction.

Zone A1 requires heavy compaction to achieve the specified permeability ($<10^{-7}$ m/s).

Zone B

Zone B is a structural fill zone placed in 0.6 m loose layers and subjected to compaction.

Zone B1

Zone B1 is structural fill placed between Zone A1 and Zone B to provide a transition zone. It has an intermediate particle size distribution, more suitable for filter compatibility, between the two fill types. Zone B1 is specifically selected, or reworked, to include a higher proportion of fines, sand and gravel, and a smaller maximum rock size than Zone B.

Zone C1

Zone C1 is bulk fill zone, and is to be placed in layers no higher than 2.5 m and subjected to systematic compaction with trafficking of loaded dump trucks.

11.7. Drainage Material

Two types (Type A1, and Type B) of drainage/filter material are proposed for the embankment construction.

Comments on the functions and principal features of these materials follow:

11.7.1. Type A1 Drainage Material

Type A1 is a drainage material that forms the chimney drain/filter in the starter embankment up to 633 mRL. It acts as a filter and collects seepage through the embankment. It also is a part of various tailings seepage collectors and outlet drains where it acts as a filter between the base material (tailings and Zone A1) and Type B drainage material. It prevents seepage water from eroding tailings or Zone A1 material into and clogging the Type B drainage material.

Type A1 material will be predominantly sand with some gravel. Type B will be designed using the method recommended by Fell et al (Ref. 20) for the design of critical filters with flow normal to the filter.

11.7.2. Type B Drainage Material

Type B material is used in tailings seepage collector and outlet drains. It will be required to be filter compatible with Type A1 drainage material. Type B will be designed using the method recommended by Fell et al (Ref. 20) for the design of critical filters with flow normal to the filter.

11.8. Tailings Seepage Collection Associated with Embankment

A network of subsurface drains will intercept and collect seepage from the tailings. Some of these drains are located beneath the Shepherds TSF embankment i.e., The upstream cut-off drain along the upstream toe, and the chimney drain base-collector (CDBC) at the downstream side of Zone A1. There is also a vertical chimney drain within the embankment to intercept seepage passing through the embankment. There are additional subsurface drains located beneath the tailings i.e., Tailings underdrains, and tailings seepage collection drain (along the upstream at 675 mRL). A plan showing the locations of all these drains is presented in Figure 07 and the individual drains are discussed in more detail below.

11.8.1. Tailings Underdrains and Seepage Collection Drain

The tailings underdrains extend along the main creeks underlying the tailings and are designed to intercept tailings seepage and shallow groundwater flows, thus improving consolidation of the tailings within the impoundment and limiting any seepage into the underlying groundwater. Proposed details are shown in Figure 10.

The tailings seepage collection drain will be located along the upstream slope at approximately 675 mRL and will discharge into the upstream cut-off drain on the abutments. A proposed detail for this drain is shown in Figure 12. This will provide additional underdrainage and accelerated consolidation of the tailings placed in the final tailings deposited in the area directly adjacent to the embankment.

11.8.2. Upstream Cut-off Drain

The upstream cut-off drain extends along the full length of the upstream toe of Zone A1 and is designed to intercept tailings seepage and shallow groundwater flows. It

improves the consolidation of the tailings against the upstream shoulder of the embankment and reduces the hydraulic gradient of seepage across the Zone A1 foundation, thus reducing seepage loss. The proposed drain detail is shown in Figure 09.

11.8.3. Chimney Drain and Base Collector

The chimney drain extends nearly full height along the downstream side of Zone A1 within the starter embankment. It is designed to intercept seepage through Zone A1 and provide a filter zone to protect against potential piping through the embankment. The CDBC drain at the bottom of the chimney drain collects the seepage, and intercepts seepage through the foundations beneath Zone A1. Chimney drain and base collector details are shown in Figure 08.

11.8.4. Sub-surface Drainage Outlets

The sub-surface drains all flow under gravity to the lowest point of the embankment (i.e., to Shepherds Creek) where unperforated pipe outlets pass beneath the Shepherds TSF embankment and to the downstream toe of the Shepherds ELF. There will be separate outlets for the CDBC (2 outlets), the upstream cut-off drain (2 outlets), and the tailings underdrains (3 outlets). This allows different sections to be monitored separately as well as providing some redundancy. Preliminary proposed details for the outlets are shown in Figure 11.

Initially the drainage outlets from the upstream cutoff drain will be closed until a tailings beach has been established. The tailing underdrain outlets will be closed until the underdrains are covered by tailings. The seepage flows will be collected and monitored in the Seepage Collection Manhole and discharged to the Seepage Collection Sump (refer Figures 3, 4 and 7). From the Seepage Collection Sump, collected water is piped under gravity back to the Process Plant circuit where water is pumped back to the TSF as part of the tailings flow.

11.9. Surface Water

Clean run-on water from the hills above the Shepherds TSF to the North will be diverted around the facility (TSF and ELF) to the Shepherds Creek using the North Diversion Channel. The channel will be largely formed by excavation with the excavated material used to form an adjacent access road. A typical detail is shown in Figure 13. The channel profile may need to be modified depending on ground conditions. The channel may require lining in areas where the ground is permeable or erodible. The length of the North Diversion Channel is approximately 6,200m from the top of the TSF impoundment, past the ELF and Shepherds Silt Pond.

The gullies above the diversion channel are generally of a moderate gradient. The diversion channel will intercept surface water flows from these gullies. Effects of the channel on groundwater within the gullies of a moderate gradient will be localized to a small extent beside the channel. If any gullies are at a low gradient the channel invert can be set close to the existing ground level by constructing the channel and access track on a fill profile to intercept the flows. There will be less than minor effects on the groundwater upstream of the diversion channels.

Runoff from within the area of Shepherds TSF during construction of the embankment will initially be managed using a cofferdam and a diversion culvert beneath the embankment. In addition, temporary earth bunds and sediment retention ponds will be required to intercept and retain sediment.

The TSF South Diversion Channel will only be constructed if it is required to manage the decant pond volume by limiting the amount of water run-off from the slopes above the TSF to the South.

In closure, the clean water diversion channels will be rerouted to discharge to the closure wetland and pass the North Diversion Channel around the north side of Shepherds ELF. The diversion channels around the TSF will be dis-established by opening the channels up in the gullies so they flow direct to the capped tailing surface and to the TSF wetland.

11.10. Construction Aspects

Shepherds TSF will require establishment works before tailings can be discharged. EGL estimate the starter embankment construction will take approximately 12-18 months to complete, depending on the construction sequencing, resourcing, and weather. Subsequent raises will be undertaken progressively to develop tailings storage as required.

The works include but are not limited to:

- Establishment of initial erosion and sediment controls
- Development of site access roads, site offices, water and wastewater facilities, workshop and maintenance facilities, fuel storage, and haul roads
- Clearing the site of farm fences and trees etc.
- Fencing the perimeter
- Establishment of the topsoil and surplus soil stockpiles
- Stripping the site of topsoil
- Construction of the cofferdam and diversion culvert and the clean water diversion channels and access (where required following a construction risk assessment)
- Construction of the upstream cut-off drains, tailings underdrains, chimney drain, and tailings seepage drains
- Supply of drainage materials and pipe works
- Construction of subsurface drain collection pipes to the Shepherds Seepage Collection Sump
- Construction of the starter embankment
- Installation of instrumentation
- Installation of the tailings delivery pipe and spigots
- Installation of the tailings decant pond pumps, barge, power, and water return pipes.

A construction risk assessment will be undertaken as part of detailed design. This can be used to confirm what risk controls are in place, including those used to manage the potential for surface water flooding during construction. This will help determine the return period used to size the cofferdam and diversion culverts, and the sequencing of clean water diversion channels.

The estimated volumes of materials for construction of the embankment are summarised in Table 4.

Materials required to be sourced offsite from external suppliers, such as drainage metal, sand filter material, rockfill lining, pipes, sumps, concrete, and decants are summarised in Table 5.

An Erosion and Sediment Control Report has been prepared by EGL for the project (Ref. 11). A site-specific erosion and sediment control plan will be prepared covering the TSF construction area.

More details covering construction are provided in Section 15 of this report.

12.0 DESIGN STANDARDS AND CRITERIA

Guidelines for the design, construction and operation of dams (water and tailings) have been produced by the NZSOLD. NZSOLD is a technical group of Engineering New Zealand. The guidelines are referred to as the NZDSG (Ref. 2). The latest version of the guidelines was published in December 2024. It represents current practice in New Zealand (based on international guidance) and adherence to the guidelines is often used as a means of demonstrating compliance with the Building Act by Building Consent Authorities, Regional Councils and Territorial Authorities. The NZDSG (Ref. 2) has a dam classification system that reflects the consequences of failure and includes engineering design advice appropriate to the hazard posed by the dam. The assessment of PIC aligns with the requirements in the Building (Dam Safety) Regulations 2022 that came into effect on 13 May 2024. A dam's consequence classification is termed its PIC. There are three classes, Low, Medium, and High. A High PIC classification has been used in developing design standards and criteria for the embankment forming the Shepherds TSF. Details of the adopted design criteria are summarised in Table 6.

The design of the proposed Shepherds TSF also aims to achieve general alignment with guidance recommendations contained within the Global Industry Standard for Tailings Management (GISTM) published by the International Council on Mining and Metals (ICMM), United Nations Environment Programme and Principles for Responsible Investments in August 2020 (Ref. 21). Under GISTM there is a different consequence classification system, with the possible classifications being Low, Significant, High, Very High, and Extreme. The Shepherds TSF has a High consequence classification according to the GISTM criteria. The design criteria for flood and earthquake load conditions required by the NZDSG for a High PIC dam equal or exceed the design requirements for a High consequence TSF in the GISTM.

12.1. Dam Design Criteria

12.1.1. Freeboard

The freeboard criteria in NZDSG have been adopted. They are summarised in Table 6. This includes freeboard requirements for the following conditions:

1. Maximum Normal Reservoir Level (MNRL) under operating condition
2. Maximum Reservoir Level (MRL) during the Inflow Design Flood (IDF) event
3. Maximum Normal Reservoir Level (MNRL) post-earthquake event

A 1m freeboard is required in accordance with NZDSG recommendations for a tailings dam.

Estimates of wave run-up and wind set-up are based on procedures recommended in Fell et al (Ref. 20). Wave run-up has been estimated for the highest 10 % of waves (R10%).

12.1.2. Inflow Design Flood (IDF)

The IDF for this assessment has been taken equal to the 72-hour PMF (Probable Maximum Flood, i.e. PMP) event which is estimated to be 748mm using Thompson and Tomlinson (Ref. 6). The PMF has been taken for this assessment is greater than required by NZDSG, based on the PAR of 11-100 and Potential Loss of Life of 1. NZDSG recommends an average of 1 in 10,000 AEP and PMF peak discharge for a PAR or 11-100. Taking the PMF for the IDF is appropriate at this stage of assessment. The selection on the final inflow design flood is a detailed design consideration and it is recommended that this includes a review of potential failure modes and risk.

12.1.3. Earthquake design criteria

The NZDSG require consideration of two earthquake loading conditions as described below.

The Operational Basis Earthquake (OBE) is the earthquake for which a dam, appurtenant structures and mechanical, electrical, power, control, and communication equipment that fulfils a dam safety critical function is designed to remain operational, with any damage being minor and readily repairable following the event (Ref. 2). It shall be taken as the earthquake with average return period of 150 years.

The Safety Evaluation Earthquake (SEE) is the earthquake that would result in the most severe ground motion which a dam and appurtenant structures must be able to endure without uncontrolled release of the reservoir (Ref. 2). It shall be taken equal to the 84th percentile level of the ground motion associated with the Maximum Credible Earthquake (MCE) but need not be greater than ground motion with an average return period of 10,000-years. For the Shepherds TSF the 10,000-year average return period earthquake is less than the MCE, and has been used for the SEE main shock. An aftershock one magnitude less than the main rupture is also considered following NZDSG (Ref. 2).

12.2. Clean Water Diversion Channels

It is proposed the TSF North Diversion Channel will be sized to pass a 10-year ARI (Average Recurrence Interval) 24 hour event during operation of the TSF.

12.3. Cofferdam and diversion culvert

A cofferdam that will form part of the starter embankment with a low-level culvert proposed to manage surface water during construction (see Figure 14). The NZDSG recommend for dams that are Low PIC during construction that the diversion works be capable of passing a 1 in 10 to 1 in 50 AEP IDF. For medium PIC it is for between 1 in 50 and 1 in 200 AEP. The cofferdam and diversion culverts have been sized for a 1 in 100 AEP. However, this will be reviewed at the detailed design stage based on a construction risk assessment.

12.4. Closure Spillway and Wetland Control Weir

It is proposed for closure there is a primary and auxiliary spillway. The primary closure spillway will be a culvert to throttle back flows that pass down the remaining North Diversion Channel around the north side of the Shepherds ELF. An auxiliary closure open channel spillway will prevent overtopping. It is proposed that the culvert and detention in the TSF manage up to a 1 in 1000 year AEP event and the auxiliary spillway be designed to pass a 1 in 10,000 AEP flood, assuming the primary culvert is blocked. The PAR and Potential Loss of Life lowers significantly in closure as the potential failure modes and consequences are a very low following buttressing with the Shepherds ELF. The 1 in 10,000 AEP flood is as recommended by GISTM (Ref. 20). Upstream of the culvert will be a wetland control weir which will manage water level in the wetland.

13.0 ASSESSMENT OF POTENTIAL FAILURE MODES

A potential failure mode (PFM) is defined as a specific chain of events or set of circumstances that could result in the uncontrolled release of all or part of the contents of a reservoir. The identification and assessment of potential failure modes for a dam is an important part of the design process for dams and is recommended by the NZDSG. The failure modes that are identified are not failures that are expected to occur but are hypothetical failures that could occur if appropriate design, construction, monitoring, and surveillance methods were not followed. By adopting appropriate design and construction methods, the risk of these failures is reduced to a very low and acceptable level.

A preliminary review of potential failure modes for the proposed Shepherds TSF has been undertaken. A further detailed review will be undertaken in Detailed Design. Potential failure modes that have been identified are summarised in Table 7. Eleven failure modes were identified (FM1-FM11). The potential failure mechanism is described within Table 7 along with TSF design mitigation and proposed dam safety monitoring. A summary of failure modes is given below.

PFMs under Normal Operation

- Internal erosion/piping through the embankment due to concentrated seepage (FM1).
- Instability from construction-induced weak layers, either from construction pauses or unsuitable fill materials (FM2, FM3).

- Instability due to rising piezometric pressures within the foundation or embankment (FM4).
- Static liquefaction of tailings leading to instability or large deformations (FM5).
- Rising groundwater triggered failure of northern slopes into the impoundment, generating a wave that overtops the dam (FM7).

PFMs Initiated by Extreme Rainfall

- Loss of freeboard and overtopping due to PMP event, causing erosion of embankment face and potential failure (FM6).
- Rainfall-triggered failure of northern slopes into the impoundment, generating a wave that overtops the dam (FM7).

PFMs Initiated by Seismic Events

- Seismic-triggered slope failure of northern slopes into the impoundment, generating a wave that overtops the dam (FM7).
- Seismic shaking causing deformation or settlement, potentially resulting in instability or overtopping (FM8, FM9).
- Liquefaction of tailings resulting in instability of the upstream shoulder of the embankment (FM10).
- Seismic-induced differential settlement leading to cracking and internal erosion (FM11).

The bedrock beneath the site is relatively strong so the risk of instability involving a bearing capacity type failure of the foundation is negligible and has not been included.

Piping arising from internal erosion is a potential mode of failure (FM1), particularly where the low permeability zone of the embankment is constructed from dispersive or erodible material. The low permeability zone of the embankment (Zone A1) will be constructed of weathered schist supplemented with loess and colluvium. The greatest risk is at low elevations where water can pond directly against the upstream shoulder of the embankment. To prevent internal erosion and piping developing a filter zone/chimney drain is proposed where there is risk of water permanently ponding against the embankment.

Instability of the embankment (FM 2, 3, and 4) are considered in further in the subsequent sections.

Loss of freeboard (FM 6, 7, 8, and 9) can arise due to seismically induced shaking, flooding from rainfall, settlement of the foundations and embankment under static loading conditions, or from landslides on the sides of the valley. Seismically induced deformations are considered in the analyses presented in the following sections for the eighth and ninth mode. The likelihood of large settlements leading to loss of freeboard under either static or seismic load conditions is considered unlikely. The foundations for the proposed dam are rock and the embankment is to be constructed from materials that have a relatively high stiffness and are not vulnerable to significant strength loss when subjected to earthquake ground motion. A summary of the freeboard scenarios is provided in section 14.5.

Landslide potential into the impoundment exists. The landslide movement can be managed through tailings and landslide underdrainage in combination with tailings beaching against landslides, which together provide a buttressing effect (FM 7). The mitigation of landslides into the reservoir will form part of the Detailed Design stage.

14.0 DESIGN ASSESSMENT

14.1. Embankment Geotechnical Stability

The potential for instability of the Shepherds TSF embankment because of a failure of the embankment or the foundations, or a combination of the two has been evaluated. The stability design criteria are outlined in Section 12.1.

Slope stability analyses for the proposed Shepherds TSF embankment have been carried out using 2D limit equilibrium software at the critical cross section. This is an adaptation of Section 3 shown in Figure 06. Section 3 has been adapted to represent the deepest part of the valley. The stability assessment considers varying slide surfaces, including through the foundation, and within the embankment.

Three stages of the embankment have been assessed. They are:

- Stage 1. Starter Embankment
- Stage 2. Final Embankment with no Shepherds ELF
- Stage 3. Final Embankment with partial construction of the Shepherds ELF

The analyses have been undertaken for the operational and closure cases for each of the stages.

Details of the analyses and the results are presented in Appendix C with a summary of the results provided in Tables 8, 9, and 10 for Stages 1, 2, and 3, respectively. The results of the stability assessments indicate:

1. Static limit equilibrium Factor of Safety (FoS) under peak drained and undrained conditions are all greater than the required 1.5 except for the case for the final embankment (Stage 2, Table 9) where a lower strength shear surface along foliations in the rock has been modelled. For both drained and undrained cases the assessed FoS is 1.4. Buttressing the final embankment with the ELF increases this FoS well above 1.5. Scheduling of rock from the pit indicates this is easily achievable for the embankment.
2. Static limit equilibrium FoS under residual undrained condition are all greater than the required 1.2.
3. Estimated seismically induced displacements under the OBE loading condition are estimated to be less than 23 cm. This meets the OBE criterion in the NZDSG “minor deformations are acceptable provided the dam remains functional and the resulting damage that is easily repairable”.
4. Using pseudo-static limit equilibrium methods, seismically induced deviatoric shear displacements (84 percentile) under the SEE loading conditions with aftershock up to 260 cm. Calculation of the freeboard for the post-earthquake load condition in Table 11 indicates that the embankment has sufficient freeboard to prevent loss of contents due to seismically induced settlement. Therefore, seismic stability meets the SEE criterion “some deformation and damage to the embankment are permitted but the contents retained by the embankment should not be released”. The estimated seismic displacements are for the full embankment not buttressed. Buttressed by the ELF the seismic displacement will be significantly less.

14.2. Embankment construction settlement

Settlement can occur in the foundation materials due to the application of the weight of the embankment, and/or internal settlement due to volumetric strain of the embankment fill due to its self-weight. A large proportion of this settlement occurs during construction of the embankment and the operational phase but can continue into closure. EGL's experience on other embankments constructed using similar materials have recorded settlement ratios in the order of 0.3-1.0%. For Shepherds TSF a settlement ratio of 0.75% has been applied for an initial assessment resulting in 0.81 m (0.75% x 108 m above rock) post construction.

The potential settlement in the foundation, and internal settlement are not likely to be critical in the long term. They are easily manageable by setting the final closure surface and level of the closure outlet channel to allow for any potential future settlements.

The effect of construction settlements on freeboard are considered in Section 14.5.

14.3. Seismic Displacements

Assessments of seismic deformations have considered the following components:

- Seismically induced shear deformations.
- Seismically induced volumetric deformations.

A preliminary assessment of seismically induced deviatoric shear displacements have been undertaken using the Bray and Macedo method (Ref. 15). The analysis is set out in detail in Appendix C with a summary of results presented in Tables 8 to 10. Seismically induced deviatoric shear displacements (84 percentile) under the SEE loading conditions with aftershock are estimated to be less than 260 cm. This displacement is in the upstream direction and would not result in a release of contents.

A preliminary estimate of seismically induced volumetric shakedown settlements of the fill are estimated to be less than 0.2% of the depth of fill when subjected to the 10,000-year ground motion. This estimate assumes that the embankment will be rockfill compacted in 0.25 m to 0.5 m thick layers with an expected SPT-N of 35+ and considers the stresses induced by the SEE earthquake (Cyclic Stress Ratio is less than 0.4). The maximum potential volumetric shakedown settlement, 0.2% of 108 m is approximately 22 cm.

Shakedown volumetric settlement is in addition to any settlement of the crest due to shear displacements. The effect of earthquake displacements on freeboard are considered in Section 14.5.

14.4. Wave set-up and wind run-up

Wind can result in waves that need to be considered when assessing embankment freeboard. There are two components: wave run-up and wave set-up. The significant wave height (Hs), wave run-up, and wind set-up have been calculated using the

procedures in Fell et al. (Ref. 20). Wave run-up has been estimated for the highest 10% of the waves. The results are summarised in Table 12. Wave set-up is negligible due to the short fetch of the impoundment. The effects of wave set-up and wind run-up on freeboard are considered in Section 14.5.

14.5. Freeboard scenarios

Specific freeboard calculations are undertaken for the different situations in operation and for closure. A summary of the calculated freeboards for the MNRL, MRL and the IDF events, and the MNRL post-earthquake event are provided in Table 11. For all scenarios the freeboard meets NZDSG recommendations.

Initial estimates indicate that for Shepherds TSF, the top of the tails beach will need to be at least 4 m below the minimum crest level and the normal operation water level will need to be 5 m below the minimum crest level. This allows for storage of the IDF (from a 72-hour PMP) above the maximum normal water operation level, with 1.0 m of freeboard remaining. This is the minimum freeboard level under the IDF recommended by the NZDSG.

In closure the outlet channel invert will need to be determined allowing for long term crest settlements and potential earthquake deformations. These settlements are easily managed for the proposed facility.

The main factor controlling freeboard for the embankment is the rise in water level during flood conditions together with waves. During operation it is necessary to undertake regular surveys of the tailings surface, pond water level, and embankment crest levels to confirm that safe freeboard requirements are maintained.

14.6. Groundwater and leachate seepage estimation

Estimates of groundwater and leachate seepage, including flows to the various subsurface drains, are based on seepage models have been assessed with the results reported in Appendix B. The models are based on the CSM described in section 7.3. The permeabilities of the different materials have been determined from in-situ testing, and the historic performance of the subsurface drain flow and piezometric levels measured at TSFs at other similar mining sites. The estimated maximum short-term flows to the drainage system are between 5 to 15 litres/s for Shepherds TSF. Following closure, seepage flows are expected to reduce significantly with time..

Estimates of groundwater and seepage flow for assessing the potential environmental effects of the Shepherds TSF have been assessed using the analyses set out in Appendix B. The effects have been evaluated with respect to the proposed drainage system, including underdrains installed beneath the tailings and chimney drains constructed in the embankment. It is expected that the installation of the drains will capture most of the tailings seepage and maintain hydraulic containment to within the valley. Any seepage into the underlying groundwater will be minor.

Additional ground investigations, groundwater monitoring, and modelling using MOD Flow or similar software will be required at detailed design.

14.7. Clean water diversion channel sizing

It is proposed the clean water diversion channel will be sized in accordance with the design criteria in Section 12.2. The design will include freeboard above the design flow to allow for sedimentation, and waves and unusual flow conditions that may occur. The fill and cut slopes associated with the drain will be designed to meet conventional factors of safety and performance for different load conditions. The drain will be constructed from materials that have inherent long-term durability (earth and rock). Armour rock or shotcrete will be used in locations where velocities could result in erosion of bare earth surfaces. Preliminary sizing for the North Diversion Channel includes a 1.2 m deep open trapezoidal channel with a base width of 1.2-2.1 m past the TSF. Downstream the past the ELF the Channel base width is estimated at 2.7 m. The slopes of the channel will be 1V:1H to 1V:2H. A 3 m wide access road will run alongside the North Diversion Channel. A typical cross section is shown on Figure 13.

14.8. Cofferdam and diversion culvert sizing

A coffer dam and diversion culvert, together with clean water diversion drains, will be used to manage surface water during the construction of the starter embankment (See Figure 14). It is proposed that the coffer dam form part of the permanent embankment. For preliminary design the cofferdam and diversion culvert have been sized in accordance with the design criteria in Section 12.3. The design concept includes a cofferdam with a crest at 615 mRL and two 560 mm OD ribbed PE pipes encased in concrete. The invert at the inlet to the culverts will be between 600 mRL and 605 mRL and will discharge back into the Shepherds Creek below the TSF construction area. The basis of design and design details will be reviewed at the Detailed Design stage based on a construction risk assessment.

14.9. Closure spillway and wetland control weir sizing

The closure spillway and wetland control weir will be sized in accordance with the design criteria in section 12.4. The design concept includes a low-level culvert with a higher-level open channel spillway. The culvert is required to maintain base flows in Shepherds Creek. In very large rainfall events or in the case of a blockage, surface water will flow through the open channel.

15.0 CONSTRUCTION DETAILS

15.1. Construction Volumes

The estimated construction volumes for the Shepherds TSF embankment to 690 mRL and starter embankment to 643 mRL are summarised in Tables 4 and 5.

Estimated volumes allow for an average of 1.5 m of foundation sub excavation below Zones A1 and B1 and the section of Zone B upstream of Zone A1 below 643 mRL. An average of 0.75m of foundation sub excavation has been allowed for elsewhere below Zone B and Zone C1. A large volume of fill is required, and construction will need to be carefully programmed to ensure that the design crest levels are achieved on time.

15.2. Embankment Construction

Embankment construction will be undertaken by a Contractor employed by MGL or with MGL's own mine fleet and civil equipment. Material will be sourced from within the impoundment area for Zone A1, supplemented with mine waste as necessary. Waste rock for Zones B and C1 will mostly come from the Rise and Shine Pit.

Materials for structural fill zones (Zones A1, B, and B1) are placed in layers (350 mm for Zone A1 and 600 mm for Zone B and B1) and compacted to achieve the specified gradation, density, and permeability requirements.

Compaction of Zone A1 can be achieved using sheepsfoot or vibrating steel drum rollers. The bulk of the Zone B and B1 material is generally track rolled and compacted using the plant hauling and placing the material. Material in Zone C1 can be end-dumped and bladed out to lift heights of no greater than 2.5 m with compaction by construction plant running over and spreading the material.

15.3. Control of Clean Surface Water

A coffer dam and diversion culvert will be constructed in the initial stages of the construction of the starter embankment to pass any clean water past the starter embankment construction area.

15.4. Erosion and Sediment Control

Good earthworks practices will be required to reduce the quantity of silt laden runoff. This includes construction of temporary sediment retention ponds downstream of the works and minimising areas of loose, uncompacted material.

An Erosion and Sediment Control Plan (ESCP) for the Project has been prepared (Ref. 11). The ESCP identifies the objectives, practises, and procedures to minimise erosion and sedimentation, and to treat runoff prior to discharge into the receiving environment. Erosion and sediment control for construction of the Shepherds TSF embankment will be undertaken in accordance with the ESCP recommendations. For the initial construction of the Shepherds TSF embankment, a cofferdam and diversion drain will be constructed to intercept and divert clean runoff from upstream of the embankment. An Initial Silt Pond will be constructed downstream of the proposed Shepherds TSF embankment. This pond will eventually be infilled when the Shepherds ELF is constructed.

Once the Shepherds TSF embankment is up to 643 mRL the diversion culvert will be grouted up. Runoff from the downstream shoulder of the Shepherds TSF starter embankment will be collected and treated in the Shepherds Creek silt pond located downstream of the ELF. Experience to date at the Macraes Gold Project indicates that only small quantities of silt laden runoff are generated from construction of embankments and rock stacks rock schist. This is because runoff percolates down through the rockfill which acts as a filter to intercept and retain sediment and clay sized particles make up only a minor fraction of the material.

15.5. Construction Control and Management

Construction of the embankment will be undertaken by a combination of the mining fleet and civil construction fleet (or sub-contractor). They will be under the direct supervision of MGL technical staff, with include engineering, survey, and civil testing experience. The Designer will review the construction monitoring, checking against the design drawings and specification. Construction monitoring will include control testing of fill placed in the embankment and undertake regular visual inspections.

A Quality Programme/Plan will be developed that will detail Quality Assurance and Quality Control procedures including testing to demonstrate compliance with the design (Specifications and Drawings). It will also set out the organisation and reporting structure, roles and responsibilities for staff involved in construction, and documentation and reporting requirements.

Regular surveys of the embankment will be undertaken to ensure works are correctly set out.

16.0 TAILINGS MANAGEMENT

16.1. General

Tailings disposal involves the pumping of tailings from the Process Plant to the TSF and discharge into the impoundment. Careful management of tailings discharge into the impoundment can produce the following benefits:

- higher tailings densities,
- the creation of a more permeable zone of tailings adjacent to the embankment,
- the prevention of ponding water against the embankment and abutments, and
- and the creation of a surface that can be rehabilitated to a useful landform.

Tailings will be pumped to the tailings impoundment from the Process Plant at an estimated solids content of 42% by mass. The specific gravity of the tailings solids is expected to be approximately 2.75 t/m³. The tailings dry densities adopted for assessing tailings storage in the proposed Shepherds TSF are summarised in Section 8.3.

16.2. Objectives of Tailings Management

To maximise the advantages that can be obtained with good tailings management it is recommended to discharge the tailings sub-aerially. This involves deposition of tailings above water (as opposed to deposition below water, i.e., subaqueous deposition) and is normally achieved by discharging the tailings slurry via multiple spigot discharge points. As the tailings slurry exits from the discharge points, the coarsest fraction tends to settle at, or close to the spigot, with the finer fractions moving with the flowing water towards the decant pond. With time, a tailings 'beach' is formed, the grading of which becomes finer the further the distance from the points of discharge.

Evaporation from the beach surface dries and increases the density of the tailings. To maximise the exposed area of tailings it is necessary to constantly pump off water

ponded on the tailings surface. Due to the relatively low rainfall at BOGP and the demand for water at the Process Plant, the area of tailings covered by water will only be part of the impoundment. However, during early stages of operation when the impoundment is smaller, surface runoff into the impoundment is more likely to result in full inundation of the tailings during periods of rain.

The advantages of sub-aerial deposition are summarised below:

- the density of the settled tailings is greater so that more tailings can be stored.
- the tailings will consolidate less with time which is helpful when contouring the final surface. The tailings will have higher shear strengths and be less susceptible to liquefaction when subjected to strong earthquake shaking.
- A zone of coarser, higher permeability tailings adjacent to the embankment can be created, if tailings are discharged from the embankment. This zone can act to drain the tailings mass via the underdrainage system and can substantially reduce seepage forces on the embankment. In addition, the likelihood of liquefaction of tailings immediately upstream of the embankment is substantially reduced.
- The sandy zone is typically filter compatible with the low permeability zone of the embankment (Zone A1). Tests by the USBR (Ref. 22) have shown that the tailings are sufficiently coarse to infill any cracks that develop in the embankments rather than flow through.
- The shape of the tailings beach can be controlled by varying the positions from which tailings are discharged. This allows control over areas where water is impounded. By discharging tailings from the embankment crest it is possible to avoid water ponding directly against the embankment or adjacent abutments.

The tailings deposition strategy is described in Section 11.3.

17.0 REHABILITATION AND CLOSURE

17.1. Introduction

The proposed rehabilitation and closure strategy for the Shepherds TSF involves construction of a dry cover and will allow the area to be returned to the pre-mining land use with the minimum potential for adverse environmental effects. A plan of the proposed finished contours and surface drainage is shown in Figure 15.

17.2. Objectives of Rehabilitation and Closure

The objectives of the rehabilitation and closure of the tailings' impoundment are:

- develop an acceptable post-closure land use;
- provide stable, post-closure landforms;
- ensure the secure storage of the tailings in a manner which minimises the risk associated with the release of potential contaminants into the environment in the longer term; and
- allow the eventual termination of all monitoring and maintenance procedures when environmental risks are assessed to be negligible.

17.3. Rehabilitation of Tailings Embankment

The downstream slope of the Shepherds TSF will be overlain by the Shepherds ELF. This provides a large buttress to the TSF embankment such that there is no credible long-term failure mode that could result in breach and release of tailings. The downstream batter of the Shepherds ELF will be rehabilitated once the ELF is complete, or as construction progresses. This will involve the direct placement of a growing medium over the rockfill batter slopes followed by revegetation with pasture/tussock species (Figure 15 and 16). The final profile for rehabilitation will depend on the final extent of the Shepherds Creek ELF.

17.4. Final Tailings Deposition Strategy

It is proposed to allow the tailings to settle for a period prior to placement of the final cover. The duration of this settlement period will be established during the final design phase for the tailings impoundment.

An assessment of the post-closure consolidation of the tailings will be undertaken at the final design stage. If it is significant, this effect could be allowed for, in part, by filling to above the final design landform grades with tailings during the final stage of tailings deposition.

17.5. Rehabilitation of Tailings Impoundment

Following completion of tailings deposition, the tailings impoundment will be covered with a minimum of 300 mm of weathered rock and 200 mm of site won topsoil material. Where required additional rockfill material will be placed beneath the weathered rock to provide profiling or access over the tailings. A wetland will be formed over this capping material in the centre.

The design of the cover needs to allow for long-term settlement of the tailings and to provide a surface that can be revegetated for the purposes of establishing post-closure land use similar to what it is now. The rehabilitated surface of the Shepherds TSF will slope down to the north-west. A control weir will be constructed to form a wetland area as illustrated in Figure 15. The control weir will discharge to an open channel that flows to the closure outlet.

The rehabilitation cover will be constructed as follows:

- progressive tailings discharge from the back of the facility to the front to achieve natural gradients for surface water;
- stabilisation of the tailings surface to provide a trafficable surface using rockfill;
- overfilling with waste rock any areas in which significant settlement due to tailings consolidation is anticipated;
- grading of the surface of the waste rock to promote stormwater runoff and the construction of stormwater drainage channels;

- ensuring that waste rock covers the highest levels of the tailings to a minimum depth such that tailings moisture content will not be significantly affected by evapotranspiration (i.e., the vadose zone);
- construction of the closure outlet and spillway (culvert, weir and outflow channel).
- spreading a layer of topsoil, and weathered schist over the surface of the waste rock as a vegetation growth layer; and
- proceeding with cultivation and vegetating as outlined above for the downstream batter of the Shepherds ELF and the surface of the impoundment, and establishment of the wetland.

17.6. Post Closure Spillway Design and Surface Drainage

The surface of the Shepherds TSF will be shaped to slope down to the north-west where the closure wetland, outlet, and spillway will be located (Figure 15). The outlet channel off the surface will drain along the edge of the Shepherds Creek ELF below the North Diversion Channel and discharge into Shepherds Creek.

The clean water diversion channels will be decommissioned, and runoff will be allowed to flow into the impoundment. The outlet off the TSF will be designed to throttle back flood flows to pass the final closure perimeter channel. Flows less than 1000 years will be retained on the TSF below the level of the auxiliary spillway.

17.7. Seepage

In closure the TSF drainage will continue to operate for a period and then can be expected to fail. While operating seepage will be collected and directed to the required water treatment facility. When the drains fail, seepage will naturally report to the toe of Shepherds ELF where it can be collected and directed to any required water treatment facility. Failure of the drains in closure pose no stability risk as the TSF will be buttressed.

17.8. Closure Manual

Following the granting of resource consents for the construction and operation of the Shepherds TSF, a Closure Manual will be prepared by MGL. The Closure Manual outlines the procedures and protocols for decommissioning and rehabilitating the TSF after it is no longer in use. It includes practical measures which will allow the facility to be operated in accordance with the conditions of the consents and to achieve the rehabilitation and closure objectives outlined in this section.

18.0 DAM SAFETY MANAGEMENT

18.1. General

Water and tailings storage dams constitute a potential danger to people, property and environment located downstream. A Dam Safety Management System (DSMS) is required to ensure the dam is maintained in a safe condition to protect life, property and the environment downstream, and to avoid severe economic loss or loss of facility to the public. The NZDSG provides guidance for developing a DSMS. It should incorporate:

- A dam safety policy/standard/statement that demonstrates the Owner's commitment to dam safety.
- A description of the elements of the DSMS including the work activities and the resources for completing the work activities.
- Responsibilities for implementing the elements of the DSMS.
- Procedures for implementing the elements of the DSMS including procedures for visual inspection, instrument monitoring, and review and notification if visual or instrument limits are exceeded.
- Procedures for checking and reviewing the performance of the dam and the DSMS.
- Procedures for identifying and addressing any issues and deficiencies in the performance of the dam and DSMS.
- Procedures for regular reporting on the performance of the dam and the adequacy of the DSMS to the Owner and, where appropriate, the regulator/s.
- Appropriate supporting systems for management, staff training, communication and information management.
- The DSMS should include procedures for the operation, maintenance and testing of mechanical and electrical equipment that fulfil dam and reservoir safety functions.

An Operations, Maintenance and Surveillance (OMS) Manual for Shepherds TSF will be prepared in accordance with the NZDSG. It will include surveillance requirements for the dam as well as guidance on management of surveillance records, presentation of data, performance evaluation, and reporting. The most important activities in the dam surveillance program are frequent and regular inspections for abnormalities or deterioration in conditions and the recording, collection, analysis and evaluation of monitoring data.

An important element of a dam safety management programme is regular dam safety reviews. An annual inspection and assessment of monitoring data and dam safety are required for High PIC dams. The NZDSG refer to such a review as an Intermediate Dam Safety Review (IDSR). Every five years a Comprehensive Dam Safety Review (CDSR) is recommended for High PIC dams. This involves a detailed review of the safety of a dam including design, construction, operation, maintenance, surveillance, and emergency preparedness. The NZDSG provides recommendations for undertaking IDSRs and CDSRs.

The overall responsibility for dam safety management lies with MGL. All personnel involved in dam safety are required to be trained and be familiar with dam safety procedures.

The Building (Dam Safety) Regulations 2022 took effect from 13 May 2024. It is concerned with the safety of dams. It requires dam owners to submit a PIC assessment for all large dams to the Regional Authority (Otago Regional Council) within three months after the dam is commissioned. The PIC assessment must be certified by a Recognised Engineer. If the dam is classified as Medium or High, it will require a Dam Safety Assurance Program (DSAP) certified by a Recognised Engineer. Annual certificates will need to be submitted by a Recognised Engineer that certify compliance with the DSAP. The Shepherds TSF will need to comply with the Dam Safety Regulations.

18.2. Operation and Water Management

The operation of the Shepherds TSF will be managed by MGL. During processing operations, water on the surface of the TSF will be pumped back to the Process Plant for re-use or to the Water Treatment Plant via pumps. Following closure and rehabilitation capping it is expected that the quality of the water quality will be suitable to be directly discharged to Shepherds Creek without treatment.

During operation the facility will operate as a full containment facility i.e. no release. To operate under this condition allowance for an extreme IDF (1 in 10,000 AEP to PMF) plus 1 m freeboard is recommended. See Section 12.1.2. Provision for an emergency spillway will be included in the detailed design. However, it is extremely unlikely allowing for an extreme flood and 1 m freeboard that this would be required.

A proposed initial tailings closure plan is shown in Figures 15 and 16. It will be necessary during the later stages of tailings discharge to regularly survey the tailings surface to check that the profile is in accordance with closure design requirements including that there is sufficient storage for the design rainfall event and to meet design freeboard requirements.

18.3. Maintenance

Maintenance activities include:

- Maintenance of vehicle access to and around the facility.
- Maintenance of surface drainage systems (removal of sediment, localised slips).
- Undertaking repairs due to erosion following heavy rainfall.
- Maintenance of the subsurface drain outlets, flowmeters, seepage collection sumps and pumps.
- Maintenance and testing of the decant pumps and inspection of the tailings and return water pipelines.
- Maintenance, testing, and repair of monitoring facilities (piezometers, flowmeters, inclinometers, survey benchmarks)
- Weed control and fertilising of pasture and vegetation on the embankment.
- Removal of sediment from the silt ponds.

18.4. Surveillance and monitoring

Surveillance (visual inspections) and monitoring of the Shepherds TSF is to be undertaken.. The purpose is to allow the performance of Shepherds TSF to be assessed and reported against design expectations; enable the detection and mitigation of potential deficiencies or adverse trends; and to fulfil legislative and regulatory requirements. Instrumentation for monitoring the performance is summarised below:

- i. Piezometers will be installed in the embankment and foundation to measure pore pressures. They are to be read monthly.
- ii. Inclinometers will be installed at the toe of the embankment and be measured monthly.
- iii. Deformation monitoring stations on the embankment are to be read at regular lift intervals determined by the Designer or at least annually.
- iv. Seepage flows in the various subsurface drains are to be measured weekly.
- v. The decant pond water level is to be measured weekly to check that sufficient freeboard is available.
- vi. Weekly visual inspection of the embankment, decant pond, adjacent areas and the clean water diversion channels.

The OMS Manual will include surveillance and monitoring requirements for Shepherds TSF. It will include trigger levels and trigger action response plans and include data evaluation and reporting requirements.

18.5. Emergency Preparedness and Action Plan

All medium and high PIC dams are to have emergency response procedures in place to manage and reduce the consequences associated with failure. The NZDSG provide guidance for an Emergency Action Plan (EAP) specific to dam safety. The EAP describes the procedures, responsibilities, and actions in emergency conditions. The purpose of the EAP for Shepherds TSF is to provide a pre-determined plan of actions to be implemented if a dam safety emergency develops. An EAP is designed to:

1. Minimise the potential for failure should a potential safety emergency arise.
2. Limit the effects of a failure on people, property and the environment if failure cannot be prevented.

An EAP includes the following information:

- Guidance on the identification of emergency conditions and the evaluation and classification of the conditions;
- Guidance on the notification procedure depending on the class of emergency;
- Inundation maps that show the possible extent of flooding in the event of a dam breach. Inundation maps for a dam breach are included in the Dam Breach Study which is described in Appendix B;
- Summary of possible emergency conditions and what to look for;
- Summary of actions to prevent failure;
- Contact list for emergency services and downstream property owners that could be affected by a TSF breach;
- Maps showing access to the site;
- Methods of communication in an emergency;

- Contact list for contractors;
- Sources of materials for emergency repairs
- Requirements for updating of the EAP, and
- Training.

19.0 BUILDING CODE COMPLIANCE

19.1. General

A Building Consent will be required as a requirement of the New Zealand Building Act before construction can commence. It will be processed by Environment Canterbury as a Building Consent Authority (BCA) for dams in the central and lower areas of the South Island of New Zealand. The design documentation for the Shepherds TSF embankment (i.e., Design Report, Drawings and Specifications) will be prepared to provide confirmation that the work will comply with the Building Act. Relevant sections of the Building Code to comply with the Building Act are discussed in the following sections. An independent peer review of the design documentation is required to support an application for a Building Consent for a High PIC dam.

19.2. Clause B1-Structure

The requirement of this clause is to ensure that relevant structures can withstand the combination of loads that are likely to occur over its design life. The proposed design will be undertaken in accordance with the NZDSG, relevant New Zealand and Australian standards, and referenced technical publications. A Producer Statement for Design-PS1 for Clause B1 will be provided to the BCA. The design will need to be independently reviewed because it is a High PIC dam, and a Producer Statement for Design Review-PS2 (or letter if international reviewer) will be provided to the BCA.

19.3. Clause B2-Durability

The requirement of this clause is to ensure that building materials and construction methods are sufficiently durable with normal maintenance to have a specified design life of 50 years. The embankment is constructed of natural durable materials which are expected to remain in perpetuity. The subsurface drains use durable materials which are expected to meet the 50-year design life. In closure it is assumed that subsurface drainage pipes may block, and the design must meet stability criteria in perpetuity with this assumption. A Producer Statement for Design-PS1 for Clause B2 will be provided to the BCA.

19.4. Clause E1-Surface Water

The requirement of this clause is to ensure that people and property are protected from surface water flooding. Surface water run-off from the catchment area of Shepherds TSF is reduced as flood flows are attenuated due to storage in the pond and detention of water in the Silt Ponds and controlled with surface water drainage systems. A Producer Statement for Design-PS1 for Clause E1 will be provided to the BCA.

19.5. Building (Dam Safety) Regulations 2022

The Building (Dam Safety) Regulations 2022 took effect from 13 May 2024. They are concerned with the safety of existing dams. Shepherds TSF will need to comply with these regulations once it is commissioned. The regulations do not affect the proposed design or construction.

20.0 POTENTIAL RISKS AND MITIGATION MEASURES

1. Potential risks associated with the proposed dam will be minimised by designing, constructing, and operating in accordance with the NZDSG.
2. The risks associated with inadequate design will be mitigated by using a dam Designer with appropriate experience. The NZDSG requires the design of High PIC dams to be subject to peer review. A peer reviewer with High PIC dam experience will be engaged to review the design for building consent.
3. The risks associated with construction not being in accordance with the design and not responding to actual site conditions, which may be different to those assumed, will be mitigated by the Designer having representation onsite as recommended by the NZDSG. The Designer will have full time representation on site during critical phases of construction, undertake inspections during construction to confirm design assumptions, advise on any design amendments, inspect critical details to ensure they are in accordance with the design and confirm that construction standards meet specified requirements.
4. The risks associated with poor construction will be mitigated by employing or contracting personnel with experience in the construction of similar Medium or High PIC dams to manage and monitor the construction works.
5. The main design risks are stability of the downstream slope during construction, internal erosion from seepage, stability when subjected to design earthquake ground motions, and overtopping in flood. These risks can be mitigated through adoption of sound design concepts, proper detailing of embankment zones, filter zones, freeboard controls, and full-time construction monitoring of the subsurface drains. Construction standards and quality requirements will be detailed in the Specification produced as part of detailed design.
6. Potential geotechnical risks will be investigated by undertaking geotechnical investigations and geomorphological mapping of the site and adopting design concepts and details that will eliminate or mitigate the risks. The risks are reviewed with site data and inspections during construction as outlined in Item 3 above.
7. Seepage from the deposited tailings will be controlled using tailings underdrains, cut off drains, and a chimney drain installed beneath and within the embankment dam.
8. The materials for construction of the dam will consist of rockfill from the open pits. These materials will have good strength and good performance when subject to earthquake ground motions.

9. Site specific erosion and sediment control plans will be in place prior to construction. The layout of the site allows for effective erosion and sediment control measures to be prepared.
10. Water for construction is available from the water bore supply line and pit dewatering.
11. Dust will be controlled by spraying dry surfaces with water. Water will also be required to condition the earthfill and this will assist in reducing the potential for dust.
12. Potential dam safety risks will be mitigated by adopting a dam safety management system (see Section 18). This is to ensure the dam is maintained in a safe condition to protect life, property, and the environment downstream. The Shepherds TSF design requirements will be incorporated into the Operation, Maintenance, and Surveillance Manual.
13. An Emergency Action Plan will be prepared in accordance with the NZDSG (Ref. 2)

21.0 PEER REVIEW

As the TSF is a High PIC dam, peer review of the detailed design is required for a Building Consent.

22.0 MANAGEMENT PLANS

Management plans have been developed for the site. Together they form an integrated environmental management system. Those which are relevant to Shepherd TSF include:

- Erosion and Sediment Control Management Plan;
- Ponds and Water Reservoir Management Plan;
- Tailings Management Plan;
- Engineered Landform Management Plan;
- Air Quality Management Plan;
- Water Management Plan;
- Mine Impacted Water Management Plan; and
- Rehabilitation and Closure Management Plan

23.0 RESOURCE CONSENT CONDITIONS

The resource consent conditions will refer to the Tailings Management Plan. It is recommended that between the consent conditions and the Tailings Management Plan the following items are required:

1. The approved Tailings Management Plan is in place and complied with.
2. Substantive changes to the Tailings Management Plan require approval by the Regional Council.
3. The TSF is designed by a professional with experience in High PIC tailings storage facilities and the design is approved by a Chartered Professional Engineer. This is required under the building consent process.
4. The TSF is design in general accordance with the NZDSG. Typically applied as an alternate solution as means of complying with the Building Act.

5. The design is peer reviewed. This is required under the building consent process.
6. A building consent is required for construction of the TSF. Requirement of the Building Act.
7. Construction is managed by personnel or a contractor experienced in the construction of a High PIC dams. Recommendation of the NZDSG.
8. A dam safety assurance programme is in place requiring assessment and review of PIC, routine surveillance, IDSRs, CDSRs, OMS, EAP, and maintenance of dam safety critical infrastructure. Required under the Building (Dam Safety) Regulations.
9. TSF rehabilitation and closure is planned for and regularly reviewed as the site is developed.

24.0 CONCLUSIONS

This technical report presents the proposed design, construction, operation, maintenance and surveillance of the proposed Shepherds TSF. Shepherds TSF will be formed by a 108 m high downstream constructed earth and rockfill embankment dam with a proposed crest at 690 mRL. The design analyses undertaken confirm that the design meets the design and performance criteria in the NZDSG. As the embankment is developed it will be buttressed downstream by the Shepherd ELF. This ELF provides a large buttress to the TSF embankment such that there is no credible long-term failure mode that could result in breach and release of tailings.

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TABLE 1: HIGH INTENSITY RAINFALL DATABASE (HIRDS V4) - DEPTHS

Rainfall depths (mm)		Rainfall Event Duration									
ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h
1.58	0.633	3.1mm	4.6	5.8	8.4	12.3	21.9	30.7	42.1	55.8	64.8
2	0.5	3.6	5.2	6.5	9.5	13.7	24.2	33.8	46.1	60.8	70.4
5	0.2	5.2	7.5	9.2	13.3	19.0	32.6	44.8	60.0	78.0	89.4
10	0.1	6.7	9.4	11.5	16.4	23.2	39.2	53.3	70.7	90.9	104.0
20	0.05	8.3	11.6	14.2	20.0	27.9	46.5	62.5	82.1	104.0	118.0
30	0.033	9.4	13.1	15.9	22.3	31.0	51.0	68.3	89.1	113.0	127.0
40	0.025	10.2	14.2	17.2	24.0	33.2	54.4	72.5	94.2	119.0	134.0
50	0.02	10.9	15.1	18.3	25.4	35.1	57.1	75.9	98.3	123.0	139.0
60	0.017	11.5	15.9	19.2	26.6	36.6	59.4	78.7	102.0	127.0	143.0
80	0.013	12.5	17.2	20.7	28.6	39.2	63.1	83.3	107.0	134.0	150.0
100	0.01	13.3	18.2	21.9	30.2	41.2	66.1	87.0	111.0	139.0	155.0
250	0.004	17.1	23.0	27.5	37.4	50.4	79.2	103.0	130.0	160.0	177.0

Source: HIRDS V4 - Historical Data

TABLE 2: HIGH INTENSITY RAINFALL DATABASE (HIRDS V4) - INTENSITIES

Rainfall intensities (mm/hr)		Rainfall Event Duration									
ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h	48h	72h
1.58	0.633	18.8mm/hr	13.8	11.5	8.4	6.2	3.7	2.6	1.8	1.2	0.9
2	0.5	21.4	15.6	13.0	9.5	6.9	4.0	2.8	1.9	1.3	1.0
5	0.2	31.4	22.4	18.5	13.3	9.5	5.4	3.7	2.5	1.6	1.2
10	0.1	39.9	28.2	23.0	16.4	11.6	6.5	4.4	2.9	1.9	1.4
20	0.05	49.8	34.8	28.4	20.0	14.0	7.8	5.2	3.4	2.2	1.6
30	0.033	56.4	39.3	31.8	22.3	15.5	8.5	5.7	3.7	2.4	1.8
40	0.025	61.2	42.6	34.4	24.0	16.6	9.1	6.0	3.9	2.5	1.9
50	0.02	65.4	45.3	36.6	25.4	17.6	9.5	6.3	4.1	2.6	1.9
60	0.017	69.0	47.7	38.4	26.6	18.3	9.9	6.6	4.3	2.6	2.0
80	0.013	75.0	51.6	41.4	28.6	19.6	10.5	6.9	4.5	2.8	2.1
100	0.01	79.8	54.6	43.8	30.2	20.6	11.0	7.3	4.6	2.9	2.2
250	0.004	102.6	69.0	55.0	37.4	25.2	13.2	8.6	5.4	3.3	2.5

TABLE 3: SUMMARY OF MATERIAL PROPERTIES FOR STABILITY ANALYSES

Material	Unit Weight (kN/m3)	Strength Parameters		Porewater Pressure
Embankment Fill				
Zone A1 Fill ⁽¹⁾	22.5	$\tau/\sigma'=2.43 \sigma'^{0.83}$		Phreatic surface. See stability figures.
Zone B, B1 Fill ⁽¹⁾	22.5	$\tau/\sigma'=2.43 \sigma'^{0.83}$		
Zone C ⁽¹⁾	21.5	$\tau/\sigma'=1.29 \sigma'^{0.91}$		
Rock Fill ⁽¹⁾	21.5	$\tau/\sigma'=1.29 \sigma'^{0.91}$		
Natural Ground				
In-situ Rock, 0 to 40m depth	26	c' = 50 kPa	$\phi' = 40 \text{ deg}$	Phreatic surface ⁽²⁾
In-situ Rock, greater than 40m	26	c' = 150 kPa	$\phi' = 45 \text{ deg}$	
In-situ Rock, shear strength along foliation +/- 10degree ⁽⁴⁾	26	c' = 47 kPa	$\phi' = 23 \text{ deg}$	
Tailings				
Peak Drained Shear Strength	18.6	c' = 0 kPa	$\phi' = 32 \text{ deg}$	Phreatic surface ⁽³⁾
Peak Undrained Shear Strength	18.6	$\tau/\sigma'=0.19$		
Residual Undrained Shear Strength	18.6	$\tau/\sigma'=0.06$		

Notes:

- (1) Strength function plotted below.
- (2) Embankment/foundation phreatic surface applied with a hydrostatic profile.
- (3) Supernatant pond water phreatic surface with a hydrostatic profile.
- (4) Rock shear strength along foliation applied to both in-situ rock above and below 40 m.

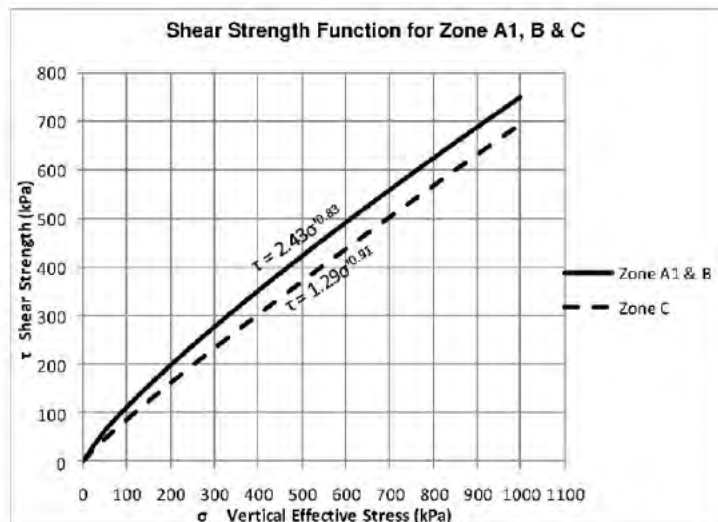


TABLE 4: SUMMARY OF EMBANKMENT FILL QUANTITIES

Item	Quantity to RL643 (Starter)	Quantity to RL690 (Full)	Quantity for Shepherds ELF	Units
Zone A1 (embankment)	<u>153,000</u>	190,000	-	m ³
Zone B (embankment)	675,000	1,166,000	-	m ³
Zone B1 (embankment)	17,300	26,300	-	m ³
Zone C (embankment)	-	1,346,300	-	m ³
Partial Construction of the Shepherds ELF (Waste Rock)	-	-	2,763,800	m ³
Closure Capping (Rockfill)	-	806,200	-	m ³
Closure Capping (Topsoil)	-	186,000	-	m ³

TABLE 5: SUMMARY OF EXTERNALLY SOURCED MATERIALS

Item	Quantity to RL643 (Starter)	Quantity to RL690 (Full)	Units
Drainage metal and filter sand	14,587	215	
Geotextile	4,158	476	m ²
Roading metal	2,640		m ³
Rockfill lining	4,065		
Concrete	20	-	m ³
Decants	1		No.
PE Delivery and Return Pipes	3,125	1,351	m
Chimney Drain (Type A1 Drainage material)	8,700	-	m ³
Chimney drain base collector pipeline below RL643 (125mm dia.)	267	-	m
Chimney drain base collector pipeline above RL643 (125mm dia.)	271	-	m
Chimney drain base collector pipeline below RL643 (125mm dia.)	267	-	m
Tailings Underdrain (125mm dia.) Requires drainage material volumes	5,750	-	m
Tailings Underdrain Drainage Material	537	418	m ³
Upstream cutoff drain (180mm dia.)	540	-	m
Upstream Drainage Material	211	215	m ³
Tailing Seepage collection Drain (125mm dia. at RL672)	-	380	m
Tailing Seepage collection Drain Drainage Metal	190	-	m3

TABLE 6: SUMMARY OF DAM DESIGN CRITERIA

Design Parameter	Design Criteria
Flood Protection • In Flow Design Flood	Runoff from PMP (72 hour) rainfall event
Earthquake Loading • OBE • SEE • Aftershock	Probabilistic 150-year return period 84th percentile level for the CME developed by a deterministic approach but need not exceed the 1 in 10,000 AEP ground motions developed by a probabilistic approach. Aftershock of one magnitude less than the SEE occurring within one day following an SEE.
Stability • Static • Seismic	-End of construction Factor of Safety (FOS)$\geq$1.3 -Long term operational steady state FOS$\geq$1.5 -Long term post closure steady state FOS$\geq$1.5 - Rapid drawdown FOS$\geq$1.3 - Post-earthquake conditions FOS³ 1.2 OBE: The performance requirement for the OBE is that the dam and appurtenant structures remain functional and that the resulting damage is minor and easily repairable. SEE (incl. Aftershock): The performance requirement for the SEE is that there is no uncontrolled release of the impounded contents when the dam is subjected to the seismic load imposed by the SEE. Damage to the structure may have occurred.

Design Parameter	Design Criteria
Freeboard - Maximum Normal Reservoir Level - Freeboard at Maximum Reservoir Level during the Inflow Design Flood (IDF) - Crest Freeboard at Maximum Normal Reservoir Level (MNRL) post-Safety Evaluation Earthquake event with aftershock	Wind set up and wave runup for the highest 10% of waves caused by a sustained wind speed, which is dependent on the fetch, with an AEP of greater than 1 in 100 The greater of a) 1.0m or b) the sum of the wind setup and wave runup for the highest of waves caused by sustained wind speed, which is dependent on the fetch, within an AEP of 1 in 10 For all sections allow for seismic settlement of embankment crest. Wind set-up and wave run-up for the highest 10% of waves caused by a sustained wind speed, which is dependent on the fetch, with an AEP greater than 1 in 10.

TABLE 7: ASSESSMENT OF POTENTIAL FAILURES MODES

Failure Mode	Initiating Hazard	Potential Failure Mechanism	Design Mitigation	Dam Safety Monitoring
FM1	Normal Operation	Concentrated Seepage within or beneath the embankment leads to internal erosion of embankment and high seepage pressure, resulting in piping failure of embankment.	Specify Zone A1 (low permeability fill) sufficiently wide to have low seepage gradients and very low risk of internal erosion. Design the tailings, Zone A1, Zone B1 and Zone B fills to be compatible. Install upstream cutoff drains and tailings seepage collection drains to lower the pore pressure against the embankment face. Zone B1 is used as a transition between Zone A1 (low permeability fill) and Zone B (rockfill). Supervision of construction and testing of embankment fill to ensure fill complies with specifications. Operating water management processes to maintain a	Visual inspections and seepage collection and monitoring for early detection of any increases in seepage flow.

Failure Mode	Initiating Hazard	Potential Failure Mechanism	Design Mitigation	Dam Safety Monitoring
			tailings beach under normal operating water levels.	
FM2	Normal Operation	A weak layer formed during a pause in construction creating potential failure plane and instability.	Undertake inspections during construction and undertake reworking and testing of the embankment surface prior to placement of new material.	Visual inspections and monitoring of embankment deformation.
FM3	Normal Operation	A weak layer within the embankment creating potential failure plane and instability.	Specified limits on particle size. Requirements for selection of material used to construct the embankment with testing and certification of the compacted fill.	Visual inspections and monitoring of embankment deformation.
FM4	Normal Operation	Rising piezometric levels within the foundations or embankment result in instability.	Installed underdrainage and the embankment is zoned to restrict seepage from the impoundment. Filter/chimney drain up to 633m RL. Upstream cutoff drains and tailings seepage collection drains installed to lower the pore pressure against the embankment face.	Monitoring of piezometric levels in the embankment, foundation, and embankment. Monitoring of seepage from underdrains, upstream cutoff drains and tailings seepage collection drains.
FM5	Normal Operation	Static liquefaction of the tailings due to rapid change of loading or changes in the state of drainage that cause instability or excessive embankment deformation.	The embankment is designed to have adequate performance under the event of static liquefaction.	Visual inspections and monitoring of embankment deformation.

Failure Mode	Initiating Hazard	Potential Failure Mechanism	Design Mitigation	Dam Safety Monitoring
FM6	Heavy Rainfall	Extreme rainfall events cause a rise in the decant pond level and overtops the embankment causing erosion on the face and abutments leading to failure of embankment.	The assessment of freeboard takes into account the tailings surface, normal operating decant pond volume, and runoff and direct rainfall from the design PMP rainfall event. The design crest level of the embankment must include 1 m freeboard above the level of water in the decant pond following a PMP rainfall event.	Visual inspections and monitoring of the decant pond volume and level relative to embankment crest level.
FM7	Normal Operation/ Heavy rainfall/ Seismic	Failure of northern slopes into the impoundment causing a wave which over tops the crest.	Assess the conditions for existing landslides and consider inundation scenarios in relation to impoundment.	After very heavy rainfall (1 in 10 year event) undertake inspection of slopes above facility for potential slope instability to identify any new potential instabilities risks.
FM8	Seismic	Extreme ground shaking causes excessive foundation and/or deformation of the embankment during the earthquake event leading to settlement or instability of the embankment and resulting in a release of tailings.	The embankment is designed using strength and stiffness parameters that are considered representative of the behavior of the embankment and foundation materials when subjected to the SEE loads. The deformations and FoS must meet acceptable performance requirements.	Visual inspections and monitoring of embankment deformation.
FM9	Seismic	Extreme ground shaking causes excessive deformation during the earthquake event results in settlement and	The assessment of freeboard takes into account the tailings surface, normal operating decant pond volume, wave runup and wind setup, and post-earthquake settlement of the	Visual inspections and monitoring of embankment deformation, monitoring of the decant pond volume and level

Failure Mode	Initiating Hazard	Potential Failure Mechanism	Design Mitigation	Dam Safety Monitoring
		then overtopping. Overtopping causes erosion of embankment face and then failure of embankment.	embankment. The maximum allowable normal operating decant pond level was assessed and control is set to minimise the risk of post-earthquake overtopping.	relative to embankment crest level.
FM10	Seismic	Earthquake-induced liquefaction of the tailings which results in instability of the upstream shoulder of the modified centerline section of the embankment.	The embankment is designed assuming liquefied strengths and reduced stiffness of the tailings. The deformations and FoS must meet acceptable performance requirements. The dynamic analysis confirms that the embankment core will maintain its integrity and will not lead to release of impoundment.	Visual inspections and monitoring of embankment deformation.
FM11	Seismic	Differential settlement causes transverse cracks and concentrated seepage through embankment leading to internal erosion and piping resulting in failure of embankment.	Risk of transverse cracks due to foundation settlement is low as foundations are rock. Filter zone is included in up to 633m RL. Tailings would likely seal any cracks as they are sandy and seepage gradients are low.	Visual inspections, monitoring of embankment deformation, monitoring of the decant pond volume and level relative to embankment crest level.

TABLE 8: STABILITY ANALYSES AND CO-SEISMIC DISPLACEMENTS – SECTION 3 – STARTER EMBANKMENT

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Static operation – Peak Drained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Drained strengths applied using effective stresses based on hydrostatic porewater pressure profile.	Downstream	PMP Inflow Design Flood levels to 642mRL and tailings to 605mRL	C01.01	Circular	FOS=1.91	Above FOS=1.5 recommended by NZDSG
				C01.02	Block	FOS=1.55	Above FOS=1.5 recommended by NZDSG
Static operation – Peak Undrained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Undrained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile.			C01.03	Circular	FOS=1.91	Above FOS=1.5 recommended by NZDSG
				C01.04	Block	FOS=1.55	Above FOS=1.5 recommended by NZDSG
Post-earthquake/ Static Liquefaction – Residual Undrained strengths	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile			C01.05	Circular	FOS=1.93	Above FOS=1.5 recommended by NZDSG
				C01.06	Block	FOS=1.66	Above FOS=1.2 recommended by NZDSG
Earthquake Embankment Response – Top 1/3 rd of embankment	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile	C01.07.01	Circular ky=0.45	OBE <0.5 to 1.6 cm	See Table C8 in Appendix C for seismic parameters used for determining co-seismic deformations.		
SEE 19.9 to 85.9 cm							
After shock 1.7 to 8.9 cm							
Earthquake Embankment Response – Top 2/3 rd of embankment		C01.07.02	Circular ky =0.39	OBE <0.5 cm			
				SEE 8.7 to 38.3 cm			
	After shock <0.5 to 0.5 cm						

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Earthquake Embankment Response – Full height of embankment				C01.07.03	Circular ky =0.37	OBE <0.5 cm	
						SEE 5.3 to 24.2 cm	
						After shock <0.5 cm	
				C01.08	Block ky=0.23	OBE <0.5 cm	
						SEE 12.6 to 54.4 cm	
						Aftershock <0.5 to 1.8 cm	
Static operation – Peak Drained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Drained strengths applied using effective stresses based on hydrostatic porewater pressure profile.	Upstream	Critical Initial Pond level and tailings to 605mRL	C01.09	Circular	FOS=1.51	Above FOS=1.5 recommended by NZDSG
Static operation – Peak Undrained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Undrained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile.			C01.10	Circular	FOS=1.51	Above FOS=1.5 recommended by NZDSG
Post-earthquake/ Static Liquefaction – Residual Undrained strengths	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile			C01.11	Circular	FOS=1.51	Above FOS=1.2 recommended by NZDSG

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Earthquake Embankment Response – Full height of embankment	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile			C01.12	Circular ky =0.22	OBE <0.5 to 4.9cm	See Table C8 in Appendix C for seismic parameters used for determining co-seismic deformations
						SEE 8.1 to 35.6 cm	
						Aftershock <0.5 cm	

TABLE 9: STABILITY ANALYSES AND COSEISMIC DISPLACEMENTS – SECTION 3 – FINAL EMBANKMENT

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Static operation – Peak Drained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Drained strengths applied using effective stresses based on hydrostatic porewater pressure profile.	Downstream	PMP Inflow Design Flood levels to 642mRL and tailings to 684mRL	C02.01	Circular	FOS=1.54	Above FOS=1.5 recommended by NZDSG
				C02.02A C02.02B	Block	FOS=1.55 FOS = 1.40	Less than the FOS=1.5 recommended by NZDSG
C02.03	Circular			FOS=1.54	Above FOS=1.5 recommended by NZDSG		
C02.04	Block			FOS=1.40	Above FOS=1.5 recommended by NZDSG		
Static operation –Peak Undrained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Undrained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile.			C02.05	Circular	FOS=1.54	Above FOS=1.5 recommended by NZDSG
				C02.06	Block	FOS=1.41	Above FOS=1.2 recommended by NZDSG
Post-earthquake/ Static Liquefaction – Residual Undrained strengths	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.						

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Earthquake Embankment Response – Top 1/3 rd of embankment	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.		Pond level and tailings to 684mRL	C02.07.01	Circular ky=0.31	OBE <0.5 to 4.1 cm	See Table C8 in Appendix C for seismic parameters used for determining co-seismic deformations.
						SEE 41.5 to 179.4 cm	
						Aftershock 3.3 to 14.7 cm	
				C02.07.02	Circular ky =0.25	OBE <0.5 to 0.7 cm	
SEE 22.1 to 95.6 cm							
Aftershock <0.5 to 2.9 cm							
Earthquake Embankment Response – Full height of embankment				C02.07.03	Circular ky =0.21	OBE <0.5 cm	
						SEE 9.6 to 41.8 cm	
						Aftershock <0.5 cm	
				C02.08	Block ky=0.16	OBE <0.5 cm	
						SEE 18.9 to 81.7 cm	
						Aftershock <0.5 to 1.5 cm	

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Static operation – Peak Drained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Drained strengths applied using effective stresses based on hydrostatic porewater pressure profile.	Upstream	Critical Design Flood level and tailings to 684mRL	C02.09	Circular	FOS=1.65	Above FOS=1.5 recommended by NZDSG
Static operation – Peak Undrained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Undrained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile.			C02.10	Circular	FOS=1.65	Above FOS=1.5 recommended by NZDSG
Post-earthquake/ Static Liquefaction – Residual Undrained strengths	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.			C02.11	Circular	FOS=1.68	Above FOS=1.2 recommended by NZDSG
Earthquake Embankment Response – Height of embankment above tailings surface	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.		Pond level and tailings to 684mRL	C02.12	Circular ky=0.20	OBE 5 to 22.7cm	See Table C8 in Appendix C for seismic parameters used for determining co-seismic deformations
						SEE 36.3 to 156.9 cm	
						Aftershock 23.9 to 103.2 cm	

TABLE 10: STABILITY ANALYSES AND COSEISMIC DISPLACEMENTS – SECTION 3 – FINAL EMBANKMENT WITH BUTTRESS

Stability Analyses	Strength Parameters	Embankment Shoulder	Impoundment Condition	Figure	Slide Surface	Result	Comment
Static operation – Peak Drained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Drained strengths applied using effective stresses based on hydrostatic porewater pressure profile.	Downstream	PMP Inflow Design Flood levels to 689mRL and tailings to 684mRL	C03.01	Circular	FOS=3.04	Above FOS=1.5 recommended by NZDSG
				C03.02	Block	FOS=2.70	Above FOS=1.5 recommended by NZDSG
C03.03	Circular			FOS=3.03	Above FOS=1.5 recommended by NZDSG		
C03.04	Block			FOS=2.68	Above FOS=1.5 recommended by NZDSG		
Static operation – Peak Undrained strength conditions	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Peak Undrained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile.		C03.05	Circular	FOS=3.09	Above FOS=1.5 recommended by NZDSG	
			C03.06	Block	FOS=2.68	Above FOS=1.2 recommended by NZDSG	
Post-earthquake/ Static Liquefaction – Residual Undrained strengths	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.						
Earthquake Embankment Response – Full height of embankment	<u>Main embankment and foundation</u> Drained strength parameters applied using effective stresses based on hydrostatic porewater pressure profile. <u>Tailings</u> Residual undrained strengths applied using effective stresses based on hydrostatic porewater pressure profile.		Pond level and tailings to 684mRL	C03.07	Circular ky=0.36	OBE <0.5 cm	See Table C8 in Appendix C for seismic parameters used for determining co-seismic deformations.
		SEE <0.5 to 8.4cm					
		Aftershock <0.5 cm					
		C03.08		Block ky=0.28	OBE <0.5 cm		
					SEE 1.96 to 18.5 cm		
					Aftershock <0.5 cm		

TABLE 11: SUMMARY OF EMBANKMENT FREEBOARD SCENARIOS

Parameters	Freeboard Scenarios*				
	Operation			Closure	
	Normal Conditions	Inflow Design Flood during operation	Post SEE Earthquake during operation	Inflow Design Flood after closure [#]	Post SEE Earthquake after closure
Embankment as-built crest level (RL)	690	690	690	690	690
Approximate tailings level against embankment	685	685	685	685	685
Reservoir/Pond water level (RL)	684	689	684	687.5 ^{&} (estimated closure outlet channel invert)	685 ^{&} (estimated level of tailings)
Static embankment fill settlement (m)	0m	0m	0m	0.75% x 108m = 0.81m	0.75% x 108m = 0.81m
SEE slope displacement related crest settlements affecting freeboard	-	-	2.6	-	2.6m
SEE fill shakedown related crest settlements	-	-	0.2% x 108m = 0.22m	-	0.2% x 108m = 0.22m
Freeboard without wind, or wave (m)	6 m [^]	1.0 m	3.18m	1.69m	1.37 m
Wind design event	1 in 100 AEP	1 in 10 AEP	1 in 10 AEP	1 in 10 AEP	1 in 10 AEP
Wind Set-up and Wave run-up (m)	0.45 m	0.40m	0.40m	0.40m	-
Freeboard allowing for wave run-up (m)	5.55 m	0.6m	2.78m	1.29m	1.37m

*Levels reported for the freeboard scenarios are based on operating experience and expected catchments for Shepherds TSF. Levels will vary during operation depending on the tailings surface profile and specific calculations are required to confirm sufficient freeboard is maintained at regular intervals by operational staff. This table is indicative of the likely scenarios.

[^]Normal operation freeboard is targeted to allow sufficient volume to hold the IDF with 1.0m freeboard remaining, without including wave runoff.

[#] Closure scenario assumes an outlet channel at normal water levels which spills clean water to receiving catchment. Outlet channel will need to be sized to pass sufficient volume to limit maximum water level under IDF (72-hour PMP) to maintain freeboard. To be confirmed at closure.

[&] Outlet channel invert level will need to consider tailings coverage with pond water where there is no dry capping and tailings level where there is capping. Level estimated. To be confirmed in closure.

TABLE 12: ESTIMATES OF WAVE RUN-UP AND WIND SETUP

AEP	H_s (m)	Wave run-up (R10%) (m)	Wind set-up (m)	Wave run-up (R10%) + Wind set-up (m)
1 in 10	0.396	0.39	0.01	0.40
1 in 100	0.469	0.42	0.03	0.45

FIGURES

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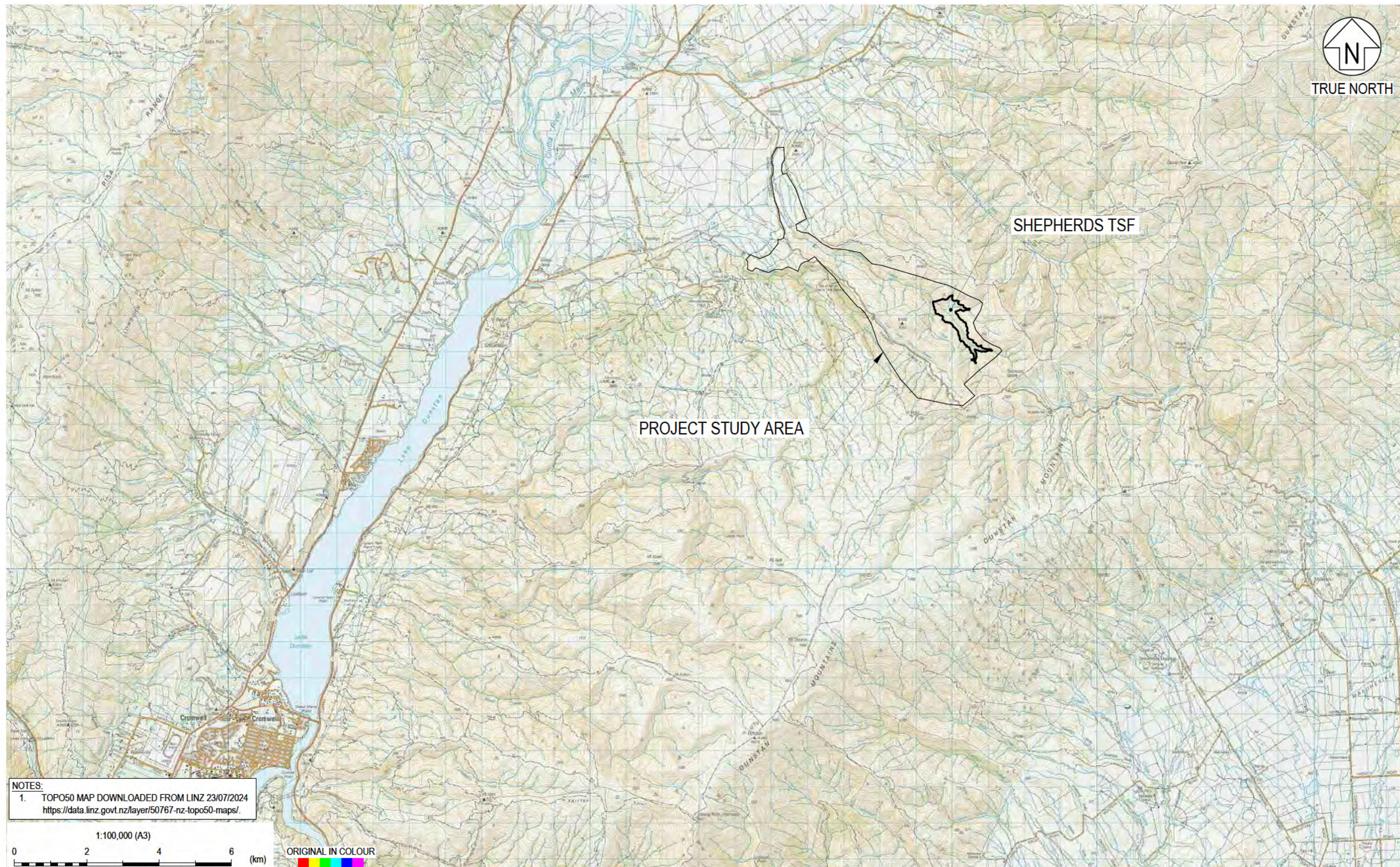
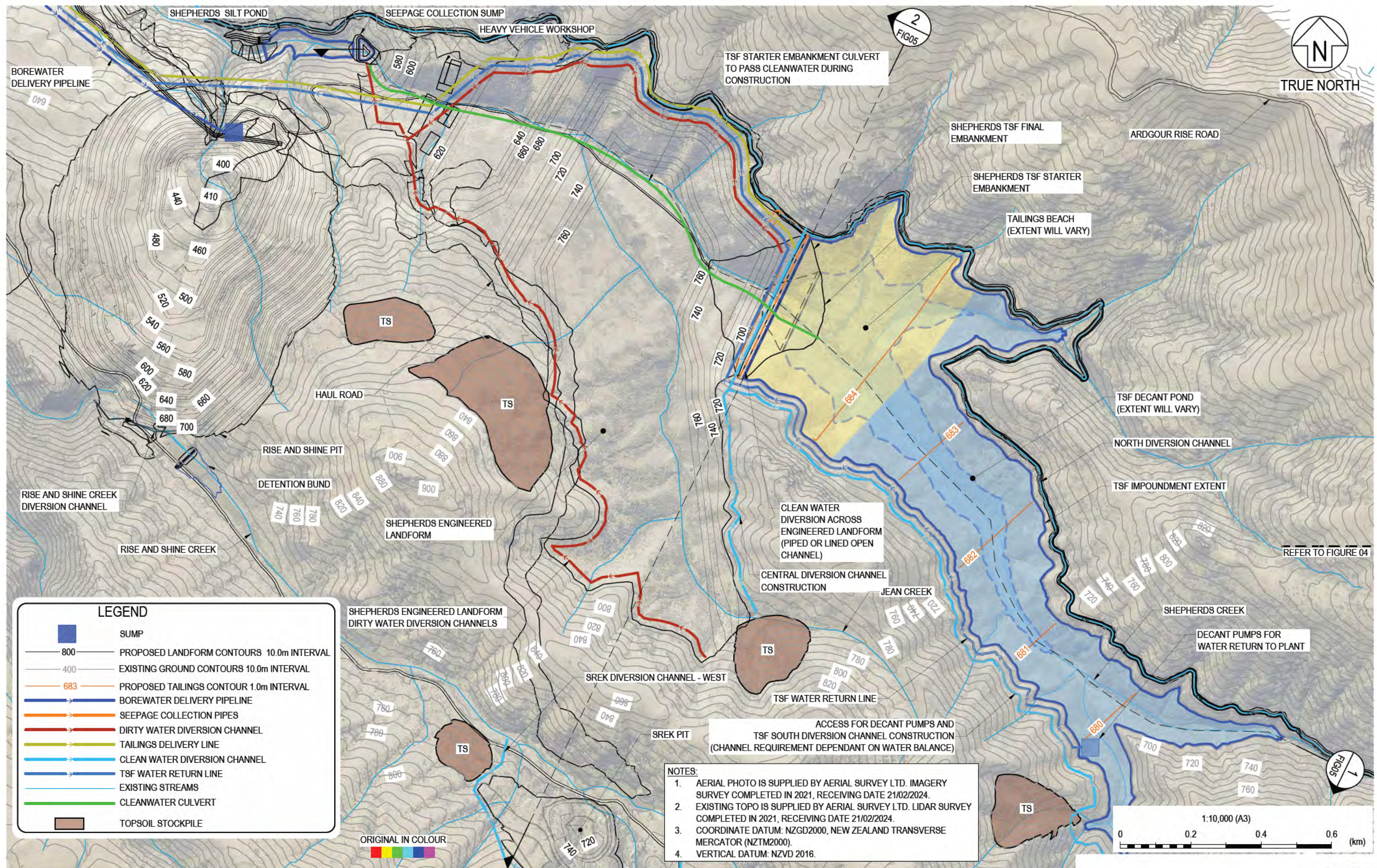


FIGURE 01



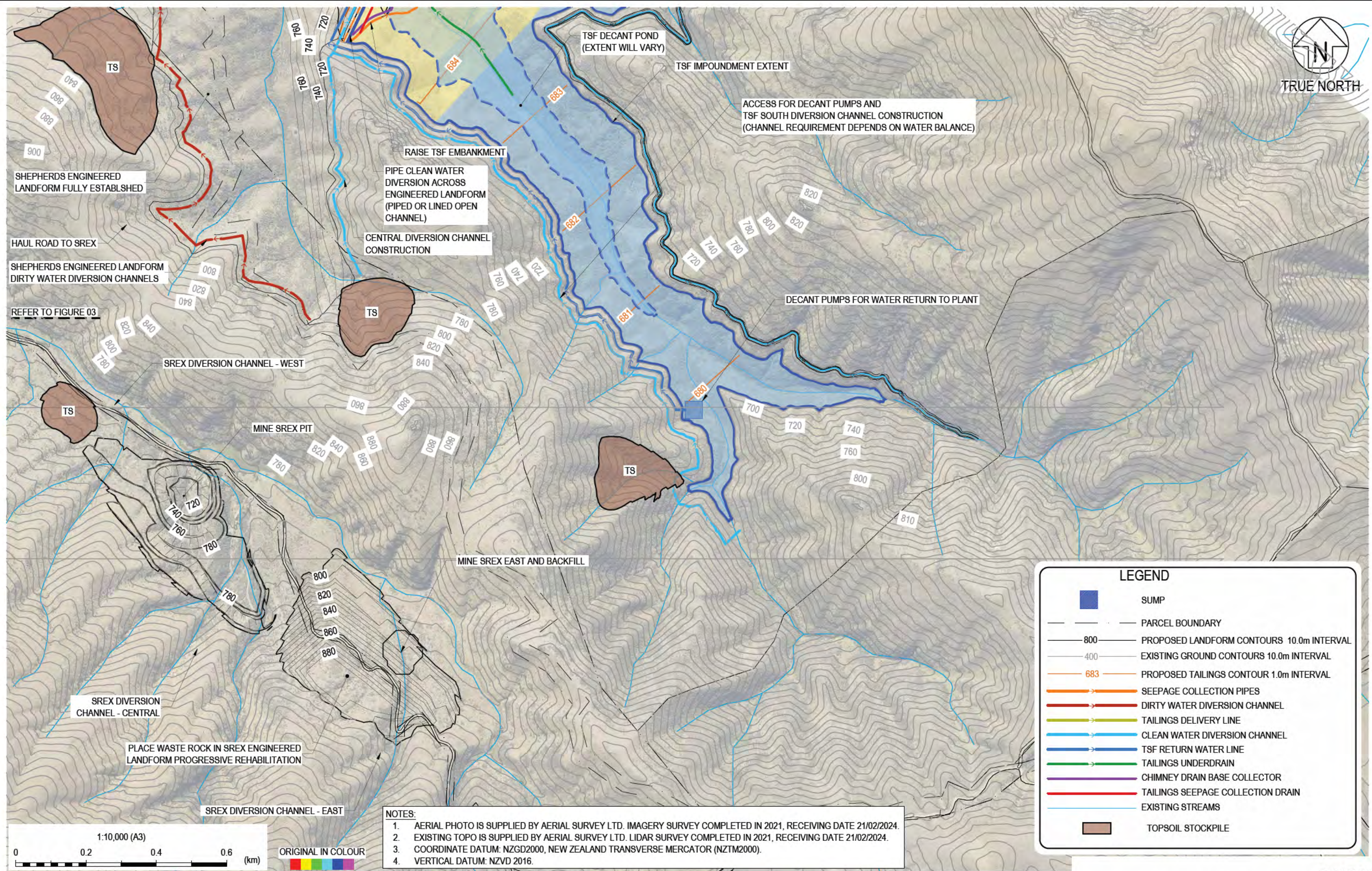
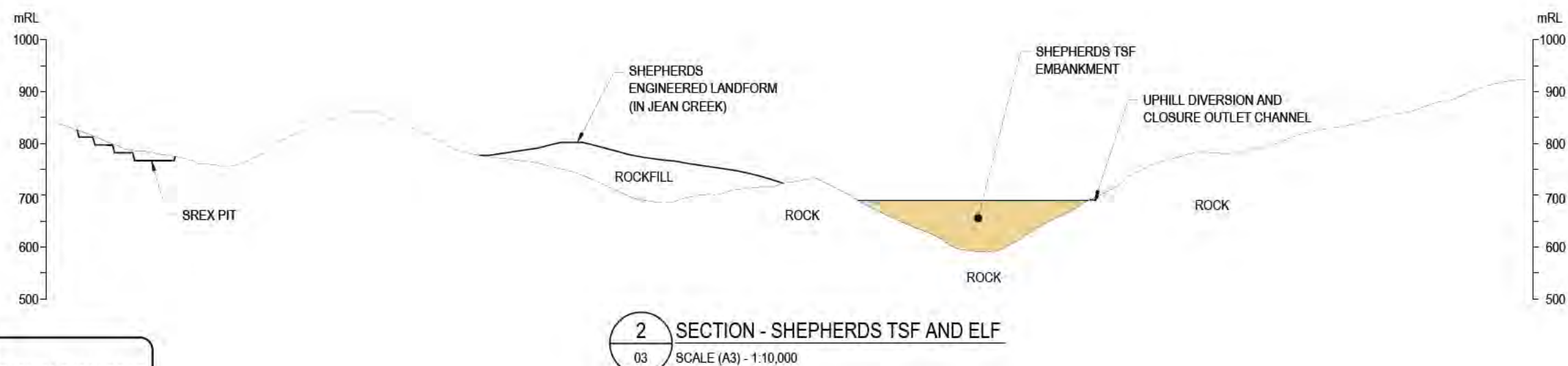
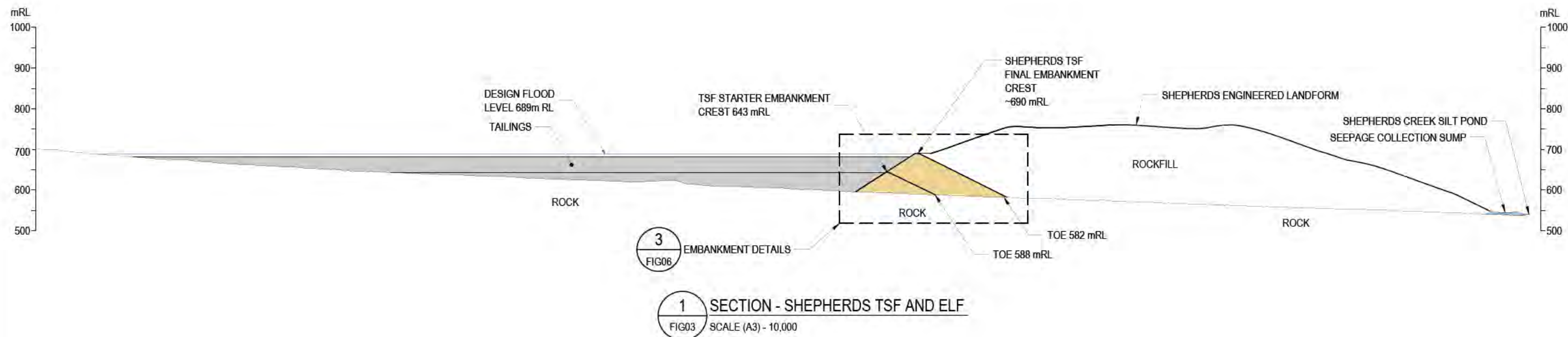


FIGURE 04



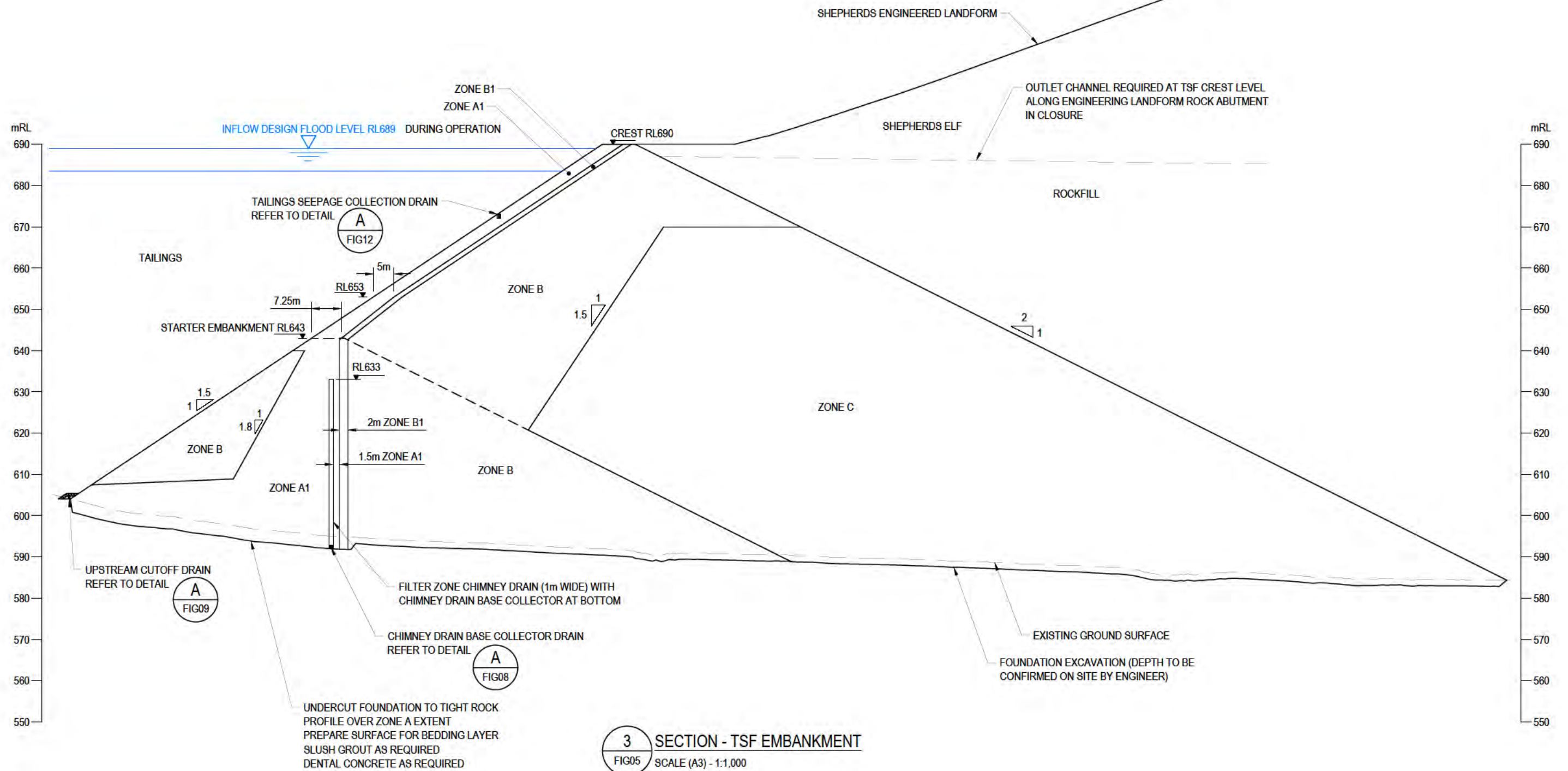
LEGEND

- ZONED ROCKFILL EMBANKMENT
- TAILINGS

- NOTES:**
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. VERTICAL DATUM: NZVD 2016.



FIGURE 05

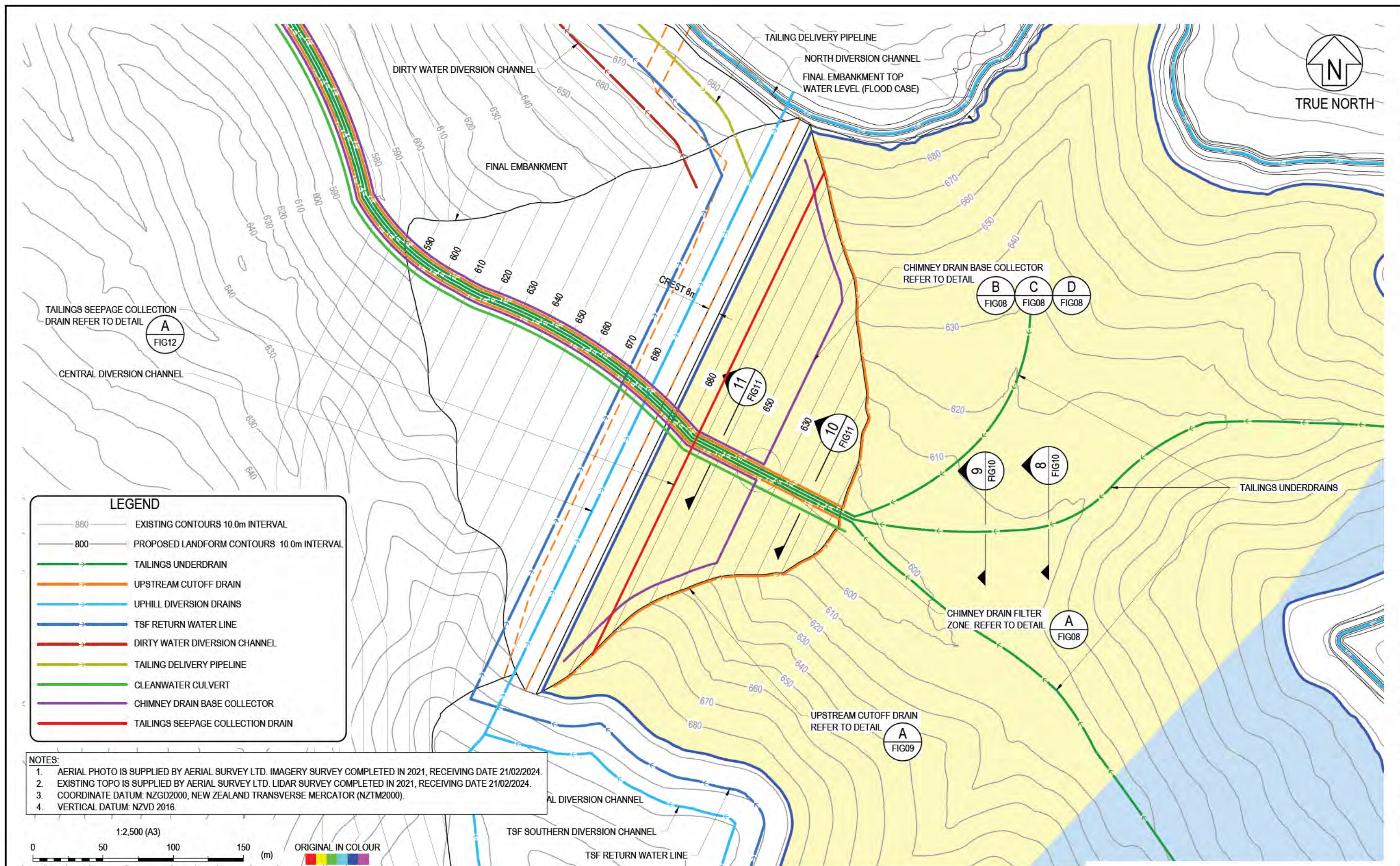


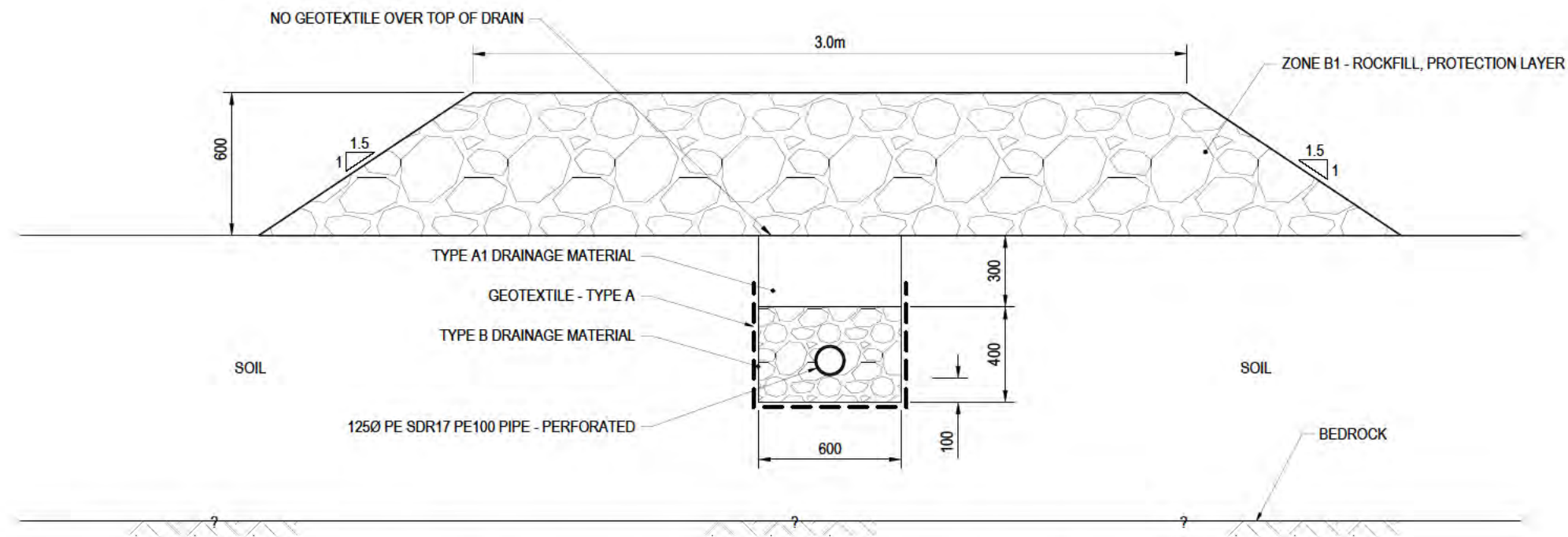
3 SECTION - TSF EMBANKMENT
FIG05 SCALE (A3) - 1:1,000

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. VERTICAL DATUM: NZVD 2016.

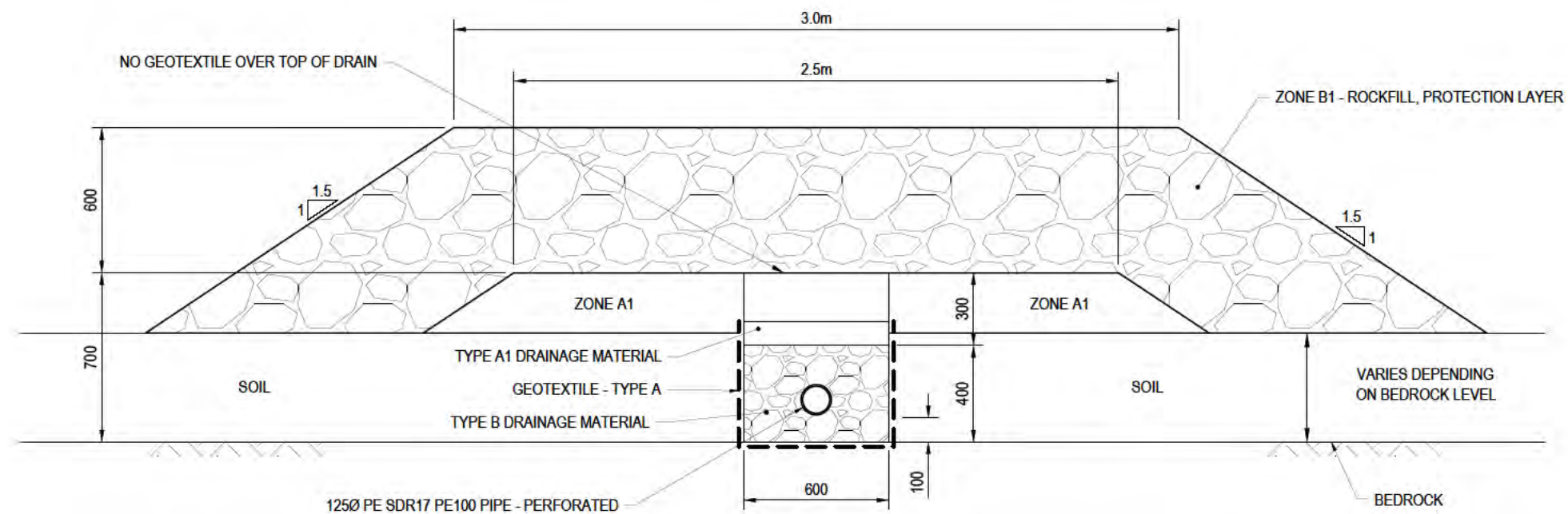


FIGURE 06





8 SECTION - UNDERDRAIN (TYPICAL) WHERE DEPTH TO BEDROCK GRATER THAN 0.7m
FIG07 SCALE (A3) - 1:25



9 SECTION - UNDERDRAIN (TYPICAL) WHERE DEPTH TO BEDROCK GRATER THAN 0.7m
FIG07 SCALE (A3) - 1:25

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.

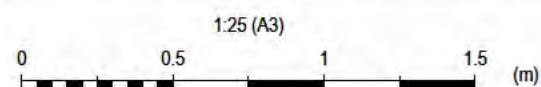
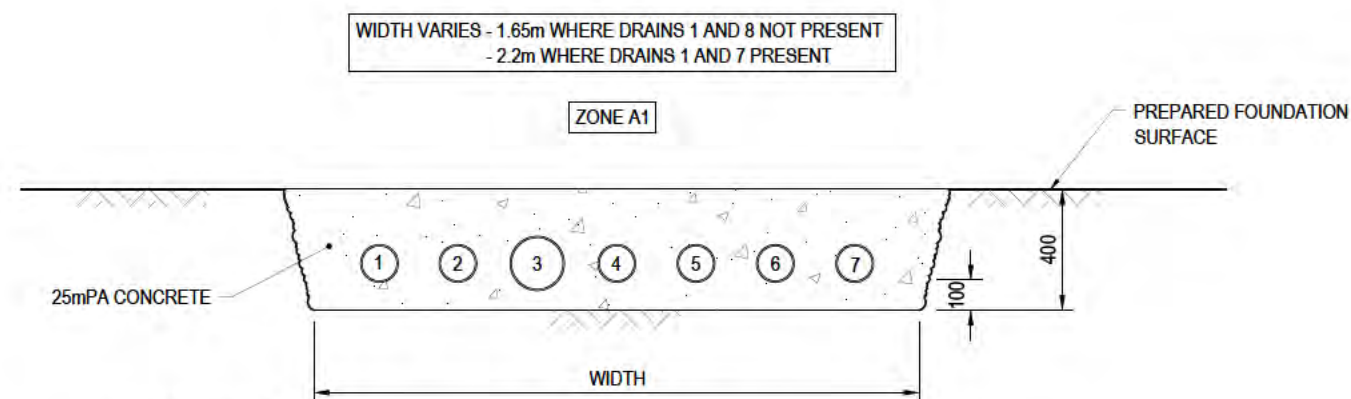
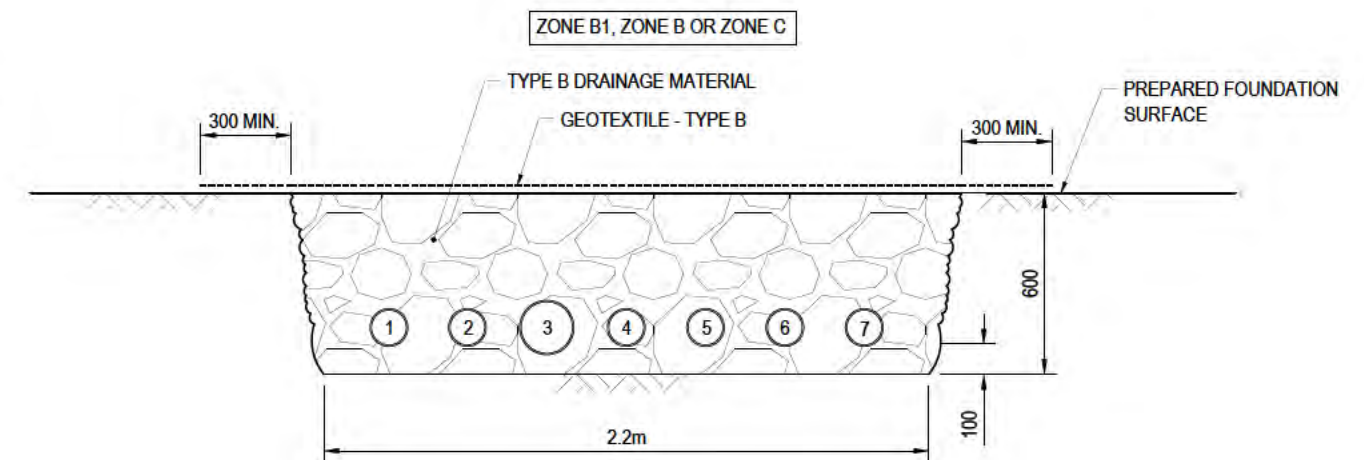


FIGURE 10

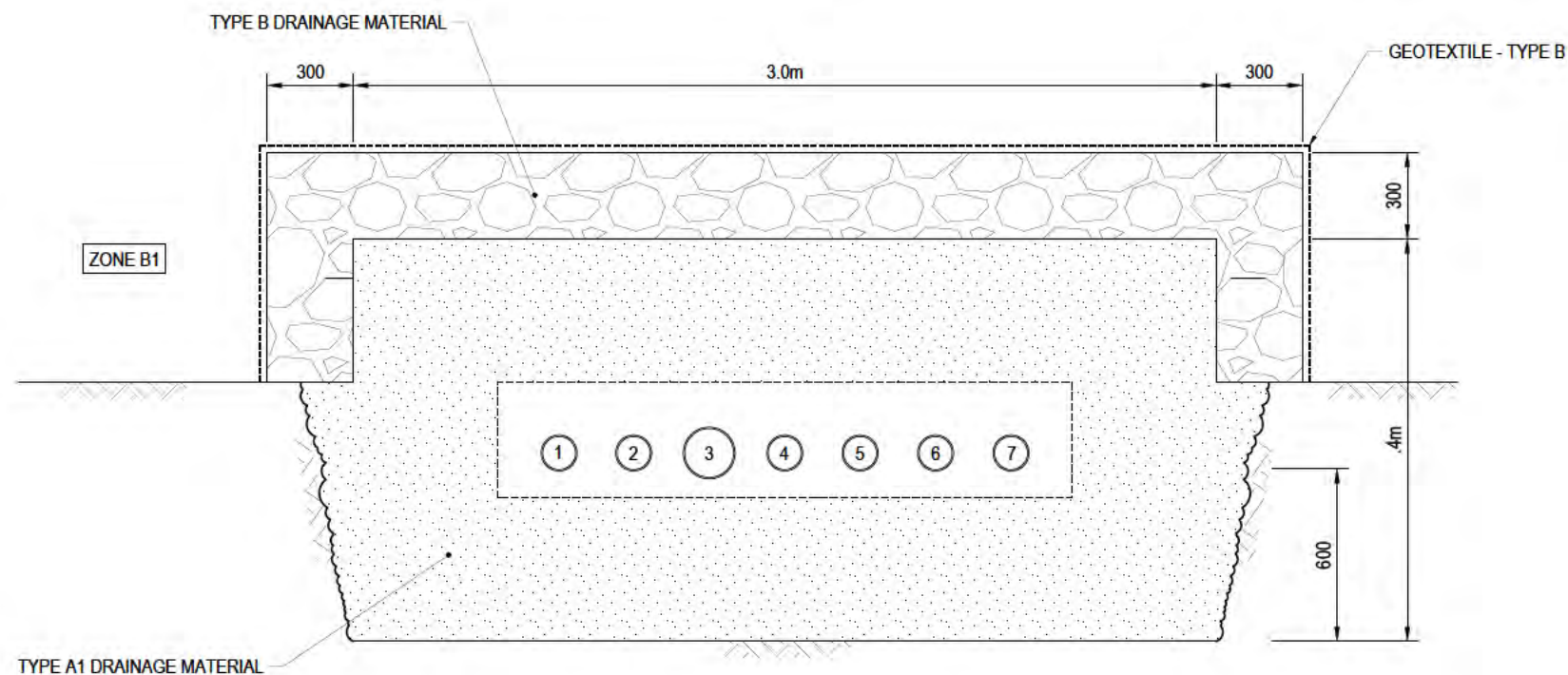


10 SECTION - COLLECTOR DRAIN DETAILS BELOW ZONE A1
FIG07 FIG08 SCALE (A3) - 1:25

NOTE:
CHIMNEY DRAIN COLLECTORS (DRAINS 1 AND 7) ONLY
PRESENT DOWNSTREAM OF CHIMNEY DRAIN.

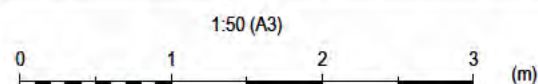


11 SECTION - COLLECTOR DRAIN DETAILS DOWNSTREAM OF FILTER ZONE
FIG07 FIG08 SCALE (A3) - 1:25



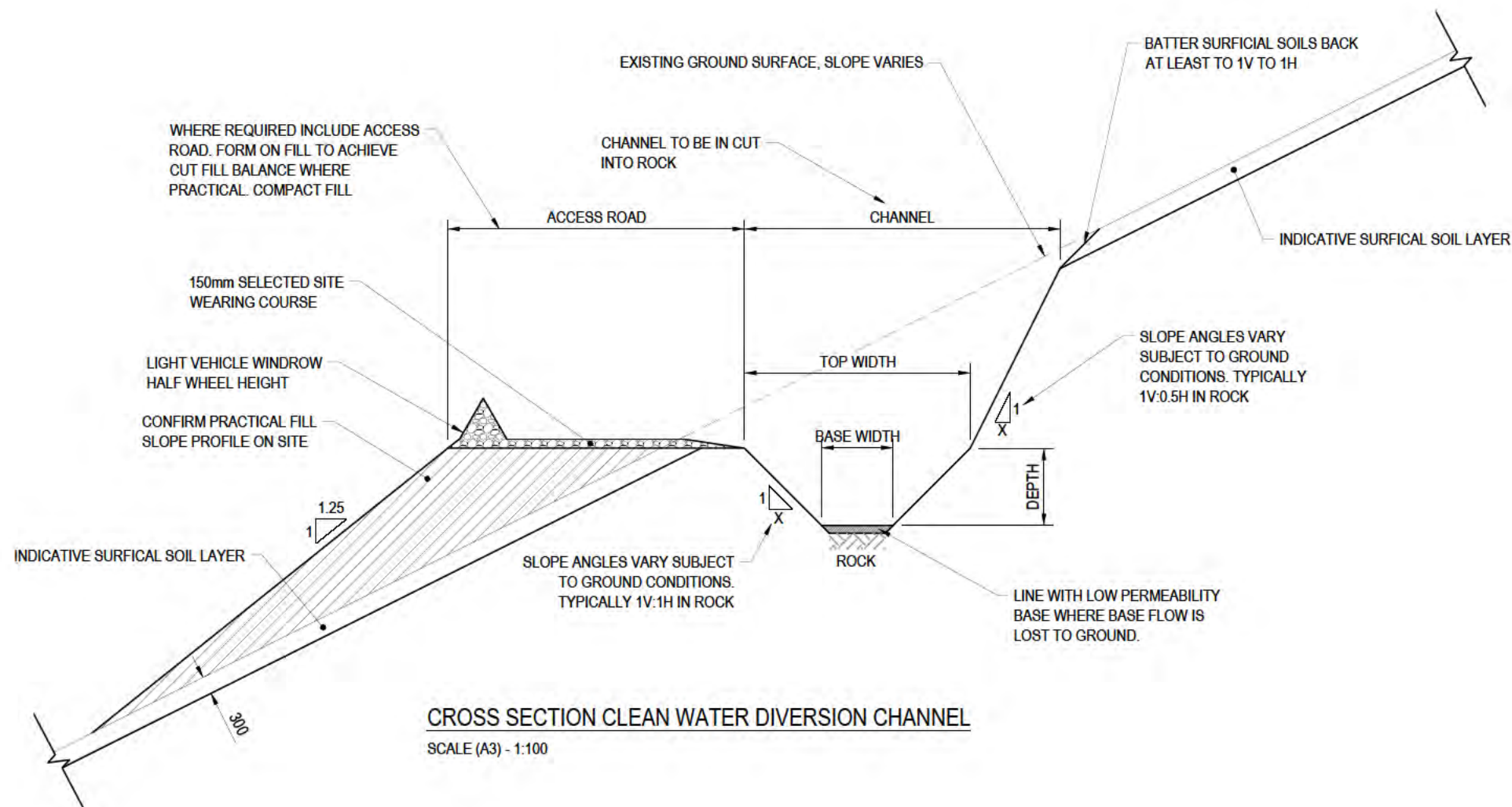
12 SECTION - COLLECTOR DRAIN DETAILS AT FILTER ZONE
FIG08 SCALE (A3) - 1:25

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. MINIMUM CLEAR DISTANCE OF 150mm REQUIRED BETWEEN PIPES.



DRAIN DETAILS		
DRAIN NUMBERS	PIPE DIA/CLASS	DRAIN
1	125Ø SDR17 PE100 - NON-PERFORATED	SOUTH CHIMNEY DRAIN BASE COLLECTOR
2	125Ø SDR17 PE100 - NON-PERFORATED	SOUTH UPSTREAM CUTOFF DRAIN
3	180Ø SDR17 PE100 - NON-PERFORATED	SOUTH UNDERDRAIN
4	125Ø SDR17 PE100 - NON-PERFORATED	CENTRAL UNDERDRAIN
5	125Ø SDR17 PE100 - NON-PERFORATED	NORTH UNDERDRAIN
6	125Ø SDR15 PE100 - NON-PERFORATED	NORTH UPSTREAM CUTOFF DRAIN
7	125Ø SDR15 PE100 - NON-PERFORATED	NORTH CHIMNEY DRAIN BASE COLLECTOR

FIGURE 11



NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.

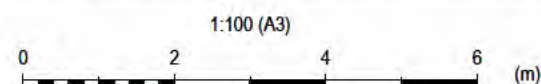
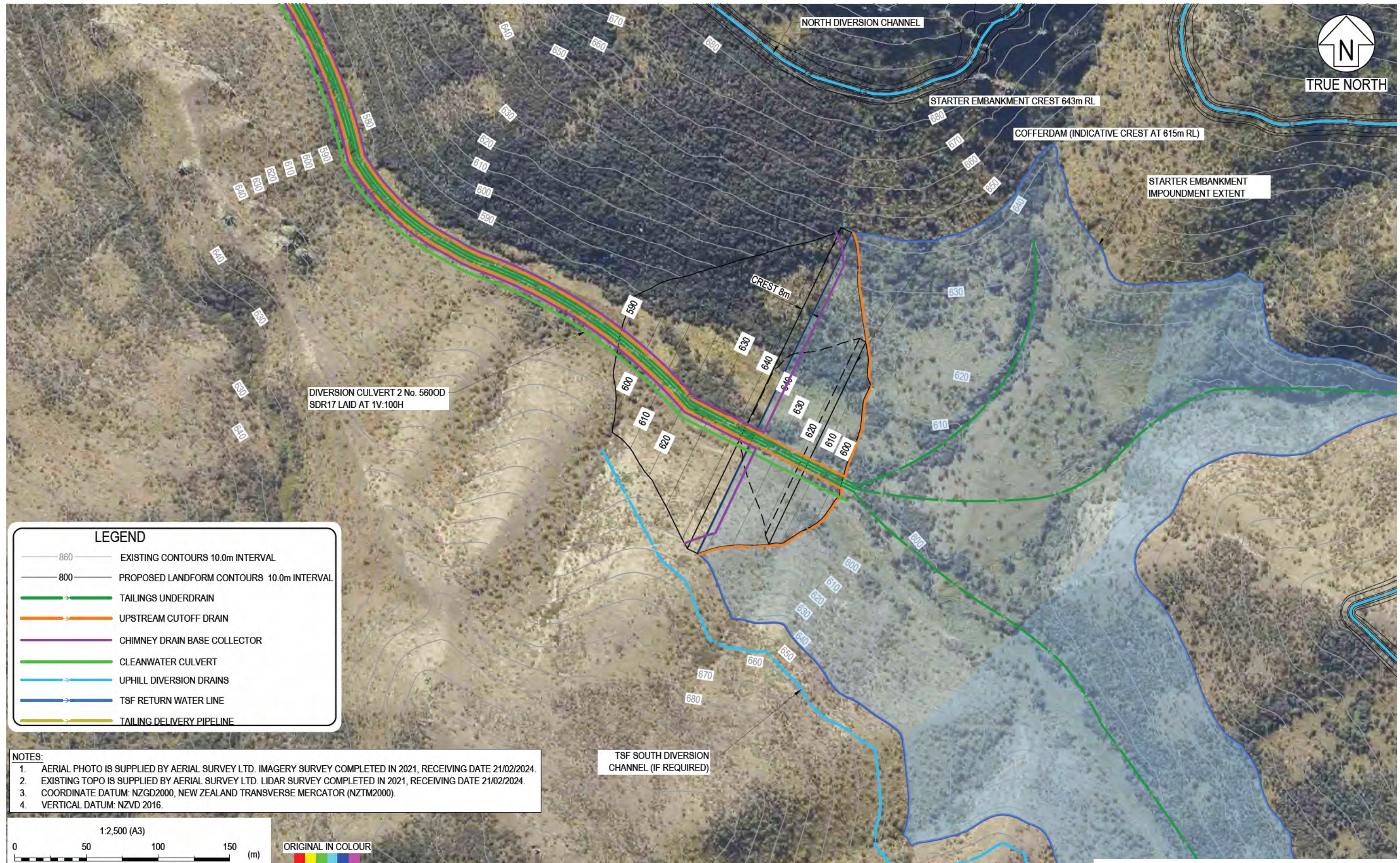
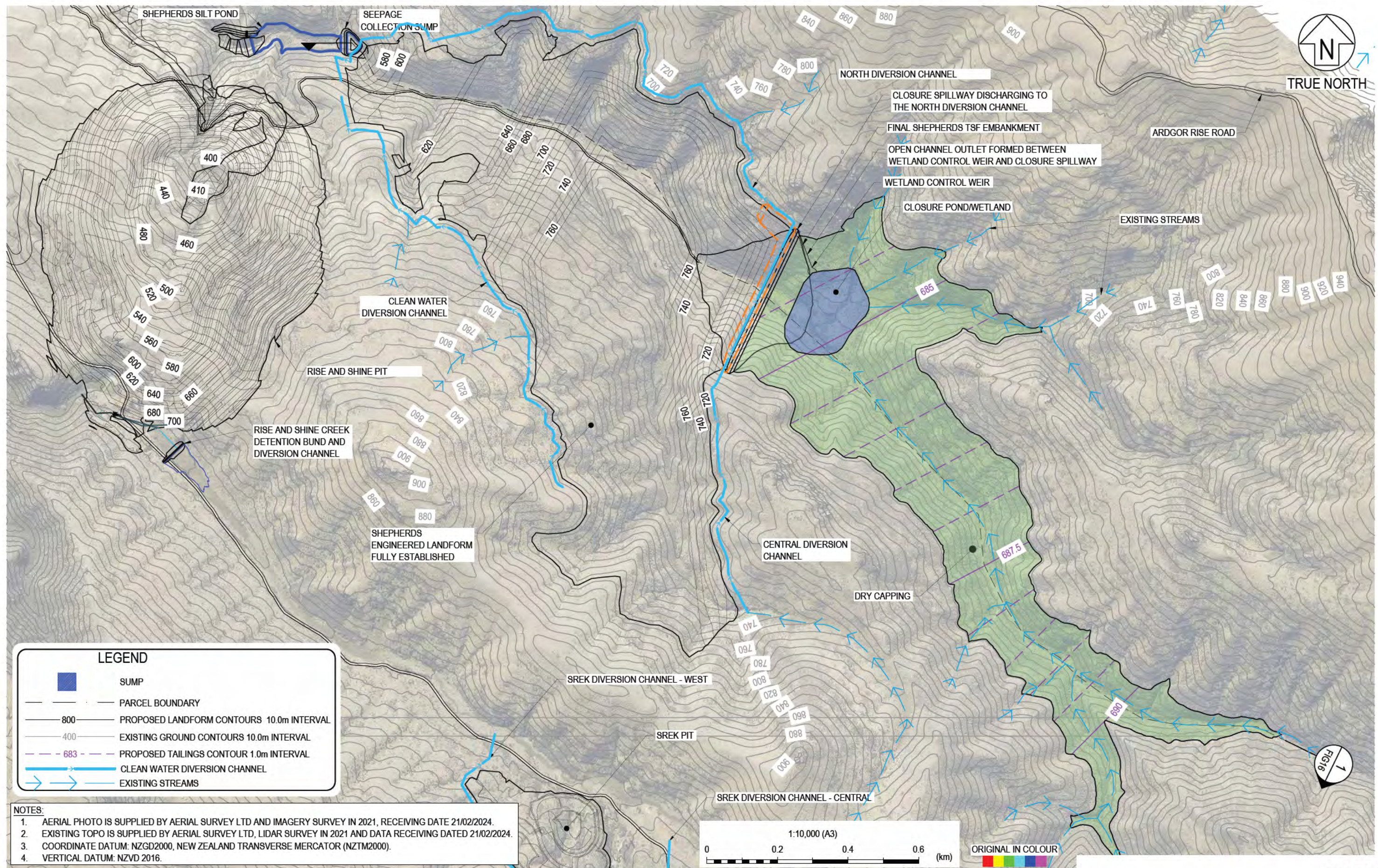


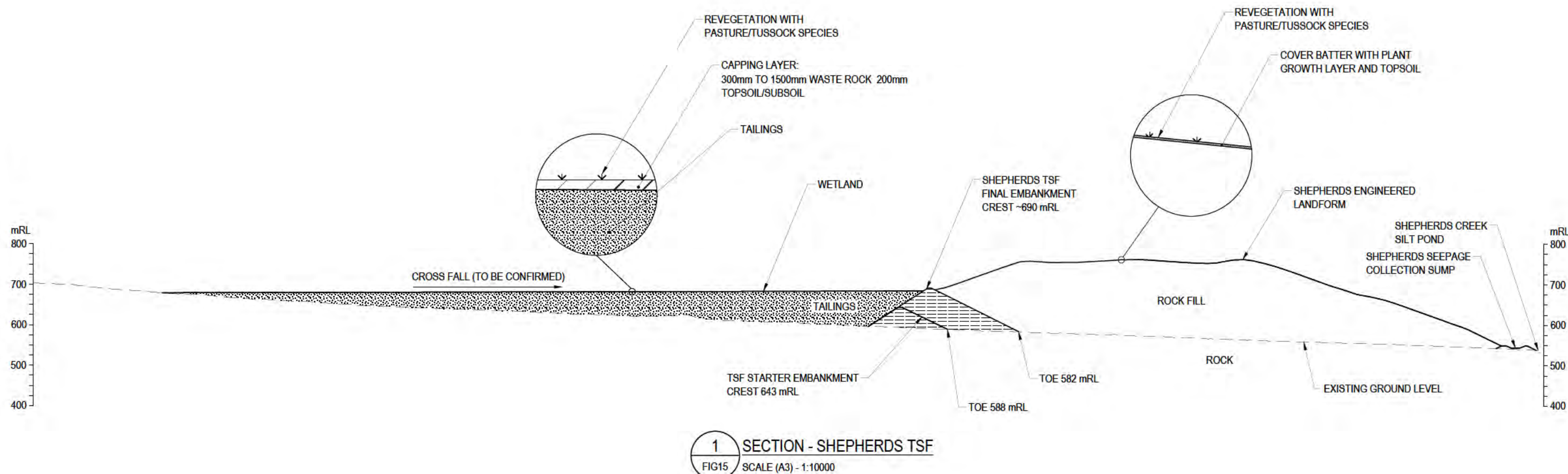
FIGURE 13





- NOTES:
1. AERIAL PHOTO IS SUPPLIED BY AERIAL SURVEY LTD AND IMAGERY SURVEY IN 2021, RECEIVING DATE 21/02/2024.
 2. EXISTING TOPO IS SUPPLIED BY AERIAL SURVEY LTD, LIDAR SURVEY IN 2021 AND DATA RECEIVING DATED 21/02/2024.
 3. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
 4. VERTICAL DATUM: NZVD 2016.

FIGURE 15



- NOTES:**
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. VERTICAL DATUM: NZVD 2016.
 3. THE SAME CLOSURE SECTION DETAILS TO BE ADOPTED IF EMBANKMENT TERMINATES AT LOWER CLOSURE LEVEL.

1:10,000 (A3)
0 0.2 0.4 0.6 (km)

FIGURE 16

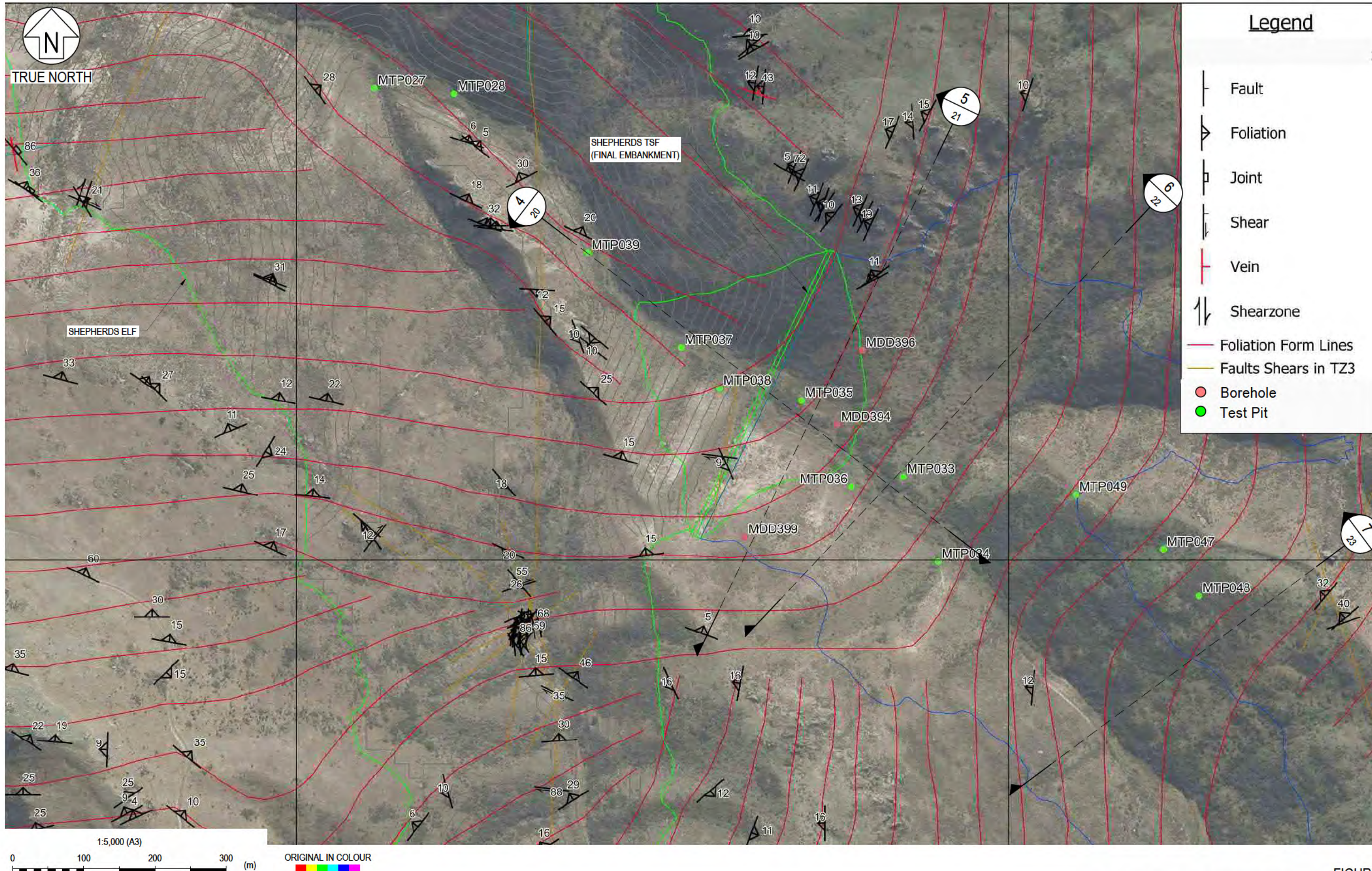
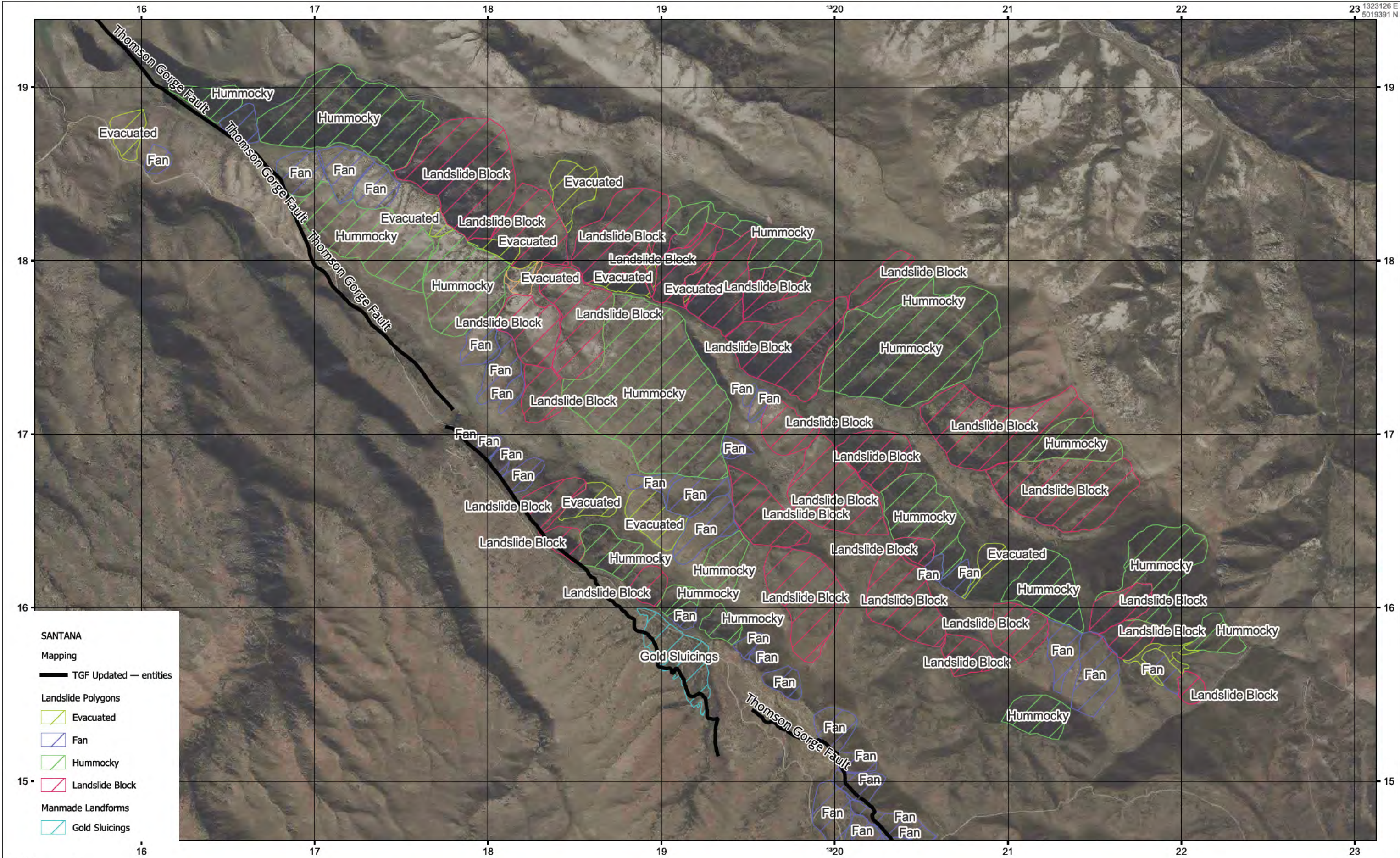


FIGURE 18

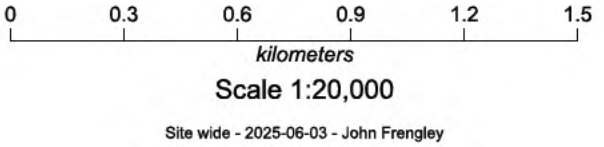


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5014656 N

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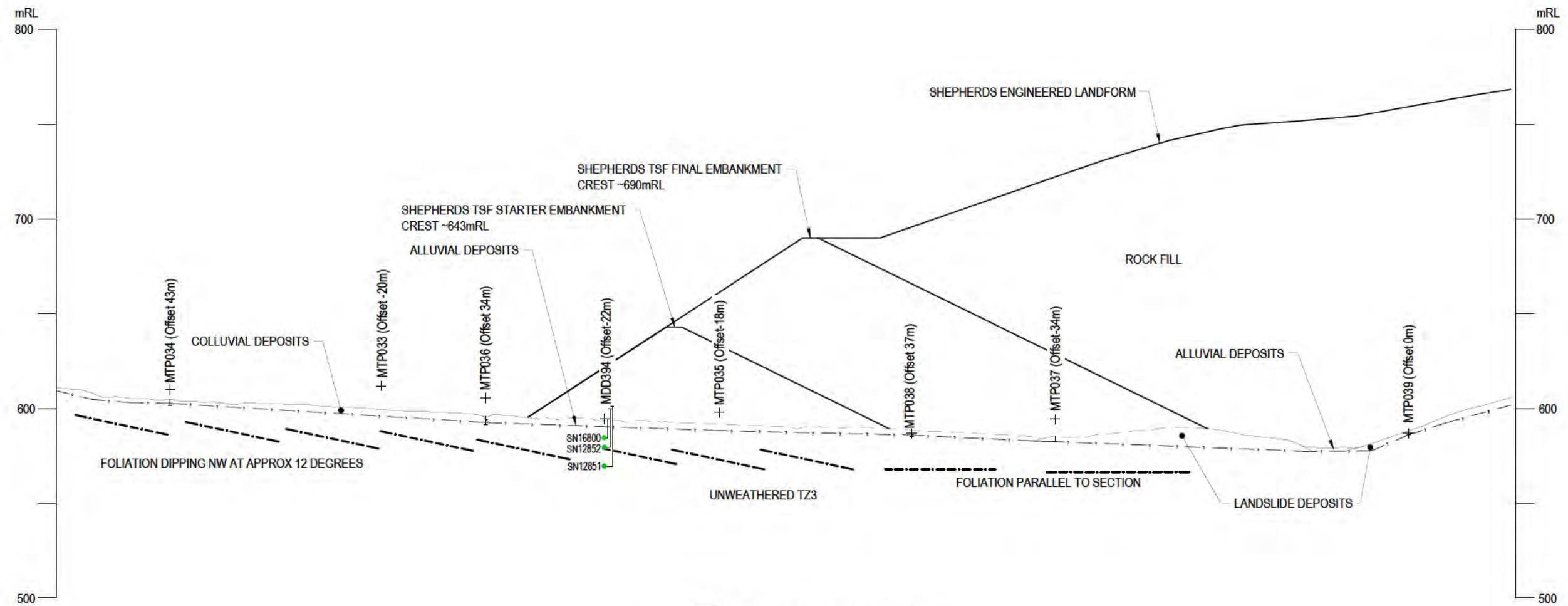


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PO Box 301054, Albany, Auckland 0752
www.egl.co.nz



Mapping information provided by Santana Minerals Limited.
Aerials and Topography from LINZ.
Projected in NZTM.

FIGURE 19



4 SECTION - TSF GEOLOGY
FIG18 SCALE (A3) - 1:2500

- NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. VERTICAL DATUM: NZVD 2016.
 3. PIEZOMETRIC TIP AND PIEZOMETRIC LEVEL
 4. PIEZOMETER READING BELOW TIP LEVEL

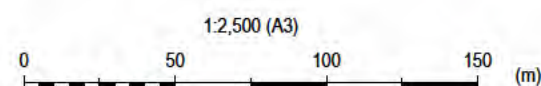
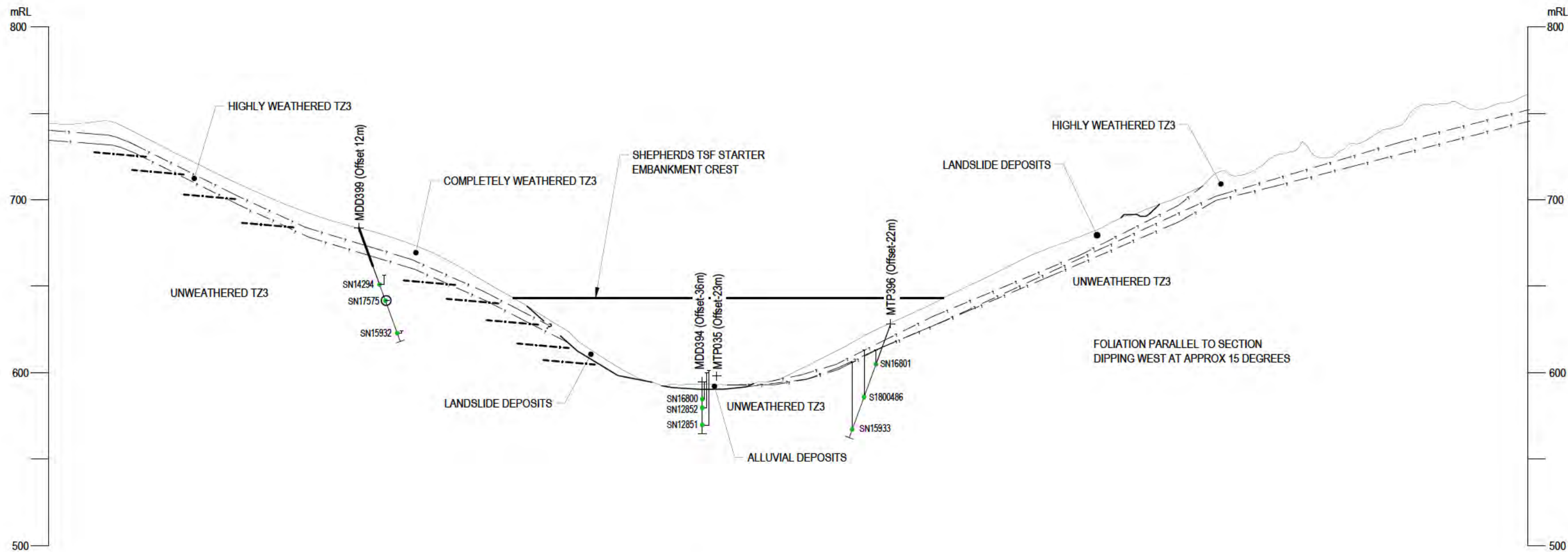
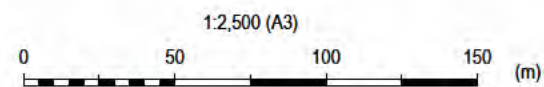


FIGURE 20

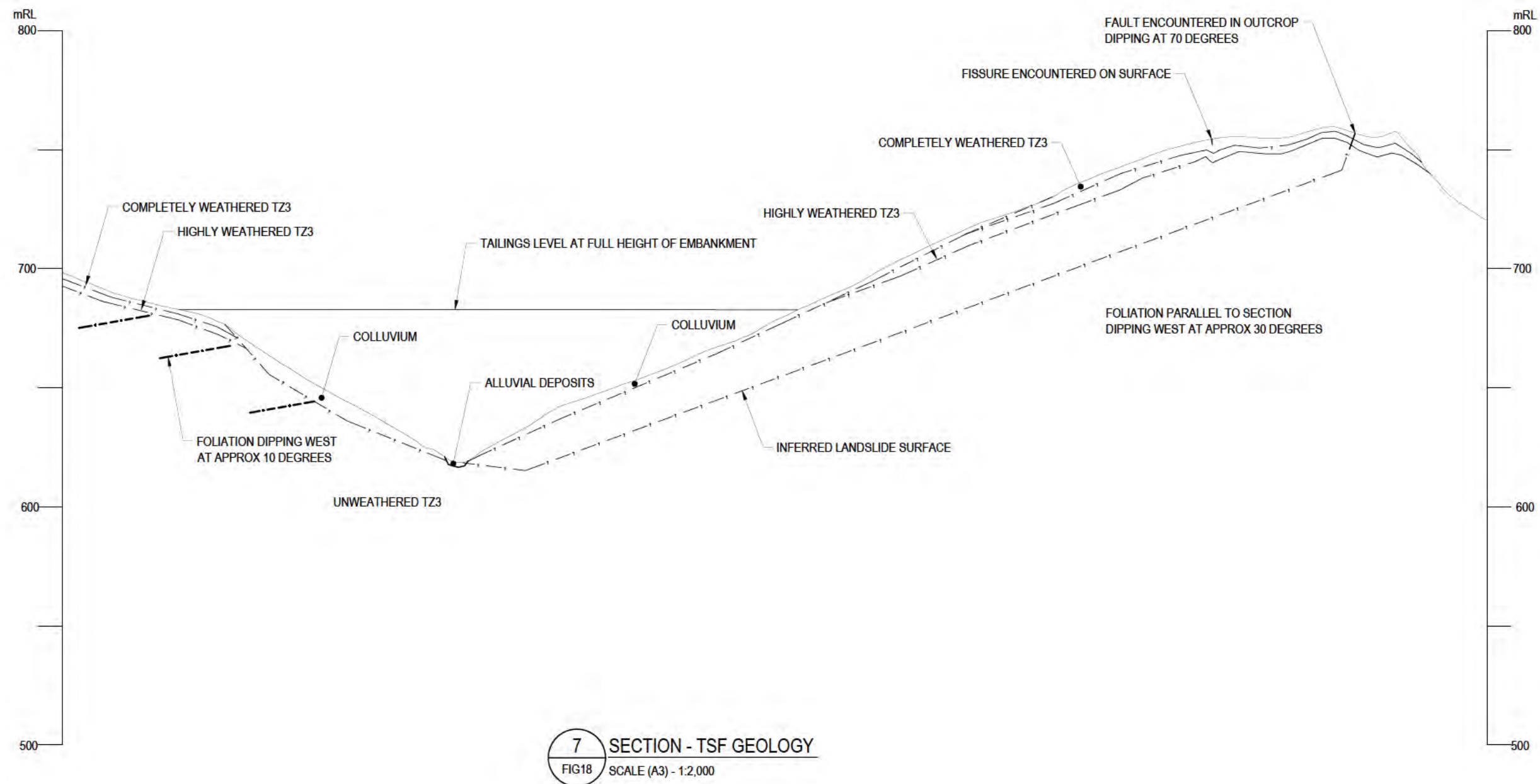


- NOTES:
1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. VERTICAL DATUM: NZVD 2016.
 3. PIEZOMETRIC TIP AND PIEZOMETRIC LEVEL
 4. PIEZOMETER READING BELOW TIP LEVEL



5 SECTION - TSF GEOLOGY
FIG18 SCALE (A3) - 1:2500

FIGURE 21



NOTES:
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
 2. VERTICAL DATUM: NZVD 2016.

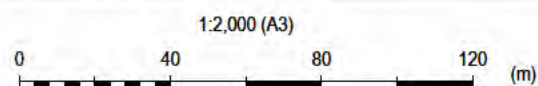
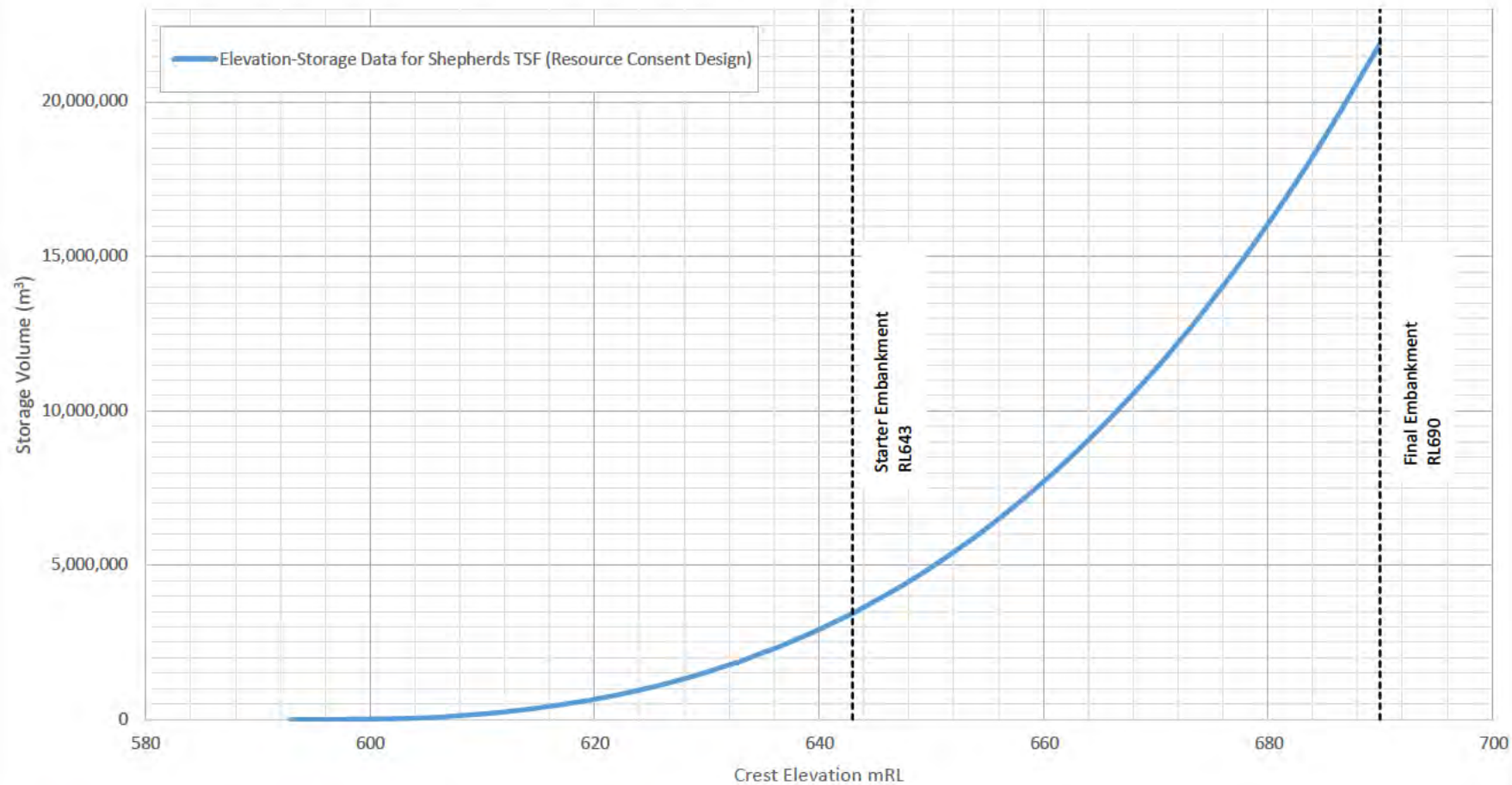


FIGURE 23



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 Shepherds TSF
 Elevation-Storage

Date: 19 February 2025
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 EGL Job No: 9702

APPENDIX A

DAM BREACH AND POTENTIAL IMPACT CLASSIFICATION ASSESSMENT

A1.0 INTRODUCTION

Matakanui Gold Limited (MGL) is developing the Bendigo-Ophir Gold Project in Central Otago, New Zealand. As part of this development, a purpose-built Shepherds Tailings Storage Facility (TSF) will be constructed in the Shepherds Valley to securely contain tailings from mining operations. This summary provides a high-level overview of the dam breach and consequence assessment undertaken for the TSF. The assessment is structured to align with the New Zealand Dam Safety Guidelines (NZDSG) (Ref. 1). The damage assessment is based on a worst-case scenario that the ELF buttress is not fully in place. This is hypothetical for the purpose of this assessment. In closure the ELF will be in place and remove these potential consequences.

A2.0 PURPOSE AND OBJECTIVES

The purpose of this assessment is to evaluate the potential consequences of hypothetical dam breach scenarios for the Shepherds TSF. The objectives are to:

- Identify and quantify the Population at Risk (PAR), Potential Loss of Life, and infrastructure impacts
- Determine the Potential Impact Classification (PIC) in accordance with the New Zealand Dam Safety Guidelines
- Inform the design, construction, and operational requirements for the TSF.
- Support emergency planning and response measures

The assessment has been undertaken to support the application for resource consent. The assessment should be updated as part of detailed design.

A3.0 DESCRIPTION OF FACILITY

The Shepherds TSF is designed as a full-containment facility using a downstream-constructed embankment. The initial stage, or starter embankment, will be constructed to a crest elevation of 643m RL, with provision for staged raising up to a final crest level of 690m RL. Tailings and operational water will begin to be discharged into the impoundment once the starter embankment has been commissioned.

The Shepherds TSF will be progressively buttressed by the Shepherds Engineered Landform (ELF) as mining progresses. However, for the purpose of this assessment, it is conservatively assumed that no Engineered Landform (ELF) buttress is in place at the time of breach, which maximises the potential downstream impact.

A4.0 DESCRIPTION OF DOWNSTREAM AREA

Figure 1 presents the potential path of the breach flood. A breach of the TSF embankment dam could result in discharge of TSF decant pond water and tailings into the Shepherds Creek, and over the flood plain further downstream, across Thomson Gorge Road and Ardgour Road. A breach flow would join the Lindis River and then the Clutha River.

The locations of downstream items of interest, including community buildings, roads, and bridges, are shown in Figure 1. The Mine Process Plant will be constructed on an engineered fill platform. Final platform levels are still to be determined. The Underground Mine Portal will be upstream of the Process Plant. The portal level is assumed to be set above the maximum dam breach flood level. The number of people expected to be at the facilities within the BOGP are summarised in Table A1.



Figure 1: Potential breach flood path, items of interest and approximate distance downstream (Source: Google)

A5.0 BREACH SCENARIO

This section describes the development of dam breach scenarios used to assess the potential consequences of the failure of the Shepherds Tailings Storage Facility (TSF). The scenarios are structured to reflect credible failure events under both operational and extreme weather conditions. This forms the basis for consequence classification in accordance with the NZDSG (Ref. 1).

A5.1. Dam Breach Assessment Approach

The breach assessment methodology was designed to quantify the timing, volume, and intensity of potential outflows from the TSF in the event of failure. This involved:

- Identifying plausible failure mechanisms,
- Defining breach geometry and failure dynamics using empirical methods,

- Developing breach hydrographs using industry-standard approaches, and
- Modelling inundation extents using two-dimensional hydraulic routing software (HEC-RAS 2D).

A5.2. Failure Modes and Breach Scenarios

The assessment considers two representative breach scenarios based on plausible failure modes that could arise during the TSF's operational life.

- **Sunny Day breach scenario** – a failure occurring during normal hydrologic conditions (i.e., not due to a storm event). There is no triggering storm or flood event and potentially no advanced warning of failure to the downstream areas in this scenario. During normal operations, the breach of the embankment dam could develop from overtopping failure modes due to instability of the embankment. Events causing instability could be strong earthquake shaking, elevated pore pressures in the embankment or foundation, or a developing embankment internal erosion (piping) mechanism.
- **Rainy Day breach scenario** - a failure occurring during an extreme rainfall event. Under this scenario, the dam could be overtopped, and the downstream face of the dam could be eroded, resulting in uncontrolled release of stored water. A flood condition may be occurring in the downstream environment. The downstream incremental impacts of the breach are assessed by comparing the consequences of flood with and without the failure of the dam.

Each scenario was assessed for both the starter embankment and the full embankment configurations. This distinction allows for analysis of breach consequence variation over the TSF life cycle.

A5.3. Breach Type

The breach of the starter embankment is conservatively assumed to consist of a discharge of water only.

For the breach of the full embankment, the breach type has been classified using the Canadian Dam Association's (CDA) Technical Bulletin: Guidelines for Tailings Dam Breach Analyses (TBDA, Ref. 2). Based on the assumed presence of supernatant water and the potential for tailings liquefaction, the Shepherds TSF breach aligns with Case 1A.

This breach type is characterised by two distinct discharge processes:

- **Process I:** An initial breach flow composed of water and eroded tailings resulting from overtopping or piping.
- **Process II:** A secondary, potentially rapid discharge of liquefied tailings triggered by undrained shear failure or breach-induced instability.

A6.0 MODELLING METHODOLOGY

This section outlines the hydrodynamic modelling approach adopted for the Shepherds Tailings Storage Facility (TSF) dam breach assessment. The modelling was undertaken to simulate the flood wave and inundation extents resulting from hypothetical breach scenarios under both fair weather (Sunny-Day) and extreme weather (Rainy-Day) conditions. The methodology integrates breach hydrograph generation, terrain-based flow routing, and estimation of downstream flood impacts.

The modelling outputs inform the consequence assessment by identifying:

- Peak flood depths and velocities at key downstream receptors;
- Arrival times for emergency response consideration;
- Estimated areas of inundation and tailings deposition;
- Hazard categories used for Potential Impact Classification (PIC) under NZDSG (Ref. 1).

A6.1. Modelling Software

The two-dimensional hydraulic model was developed using HEC-RAS 2D Version 6.0 (Ref. 3), developed by the U.S. Army Corps of Engineers.

A6.2. Terrain Model

The digital terrain model used for flood routing was constructed by combining two sources:

- 1 m LiDAR (2021): Site survey data provided by the client, covering the TSF area, valley floor, and mine infrastructure corridor down to the Process Plant (~3 km downstream).
- 8 m National LiDAR (2012): Sourced from the LINZ database and used for the wider floodplain downstream of the site, extending to the Lindis River.

The combined terrain data provided sufficient resolution to capture both critical infrastructure (roads, buildings) and natural drainage features over a ~13 km downstream model domain.

A6.3. Roughness and Boundary Conditions

Manning's n values were selected based on land use and guidance from the HEC-RAS manual:

- 0.05 – Site Access Road corridor (lined or constructed surfaces)
- 0.04 – Rural floodplain (pastoral and open land)
- 0.045 – Channelised or meandering creek systems

Boundary conditions:

- Upstream: Inflow hydrographs generated from breach scenario modelling
- Downstream: Normal depth based on topography

Rainy-Day scenarios also incorporated baseflow hydrographs from the 1-hour PMP event for incremental flood assessments.

A6.4. Breach Hydrograph Development

Breach hydrographs were generated for each scenario using an Soil Conservation Service (SCS) unit hydrograph shape (Ref. 4) and three empirical peak flow estimation methods:

- Froehlich, 1995 (Ref. 5)
- Langridge-Monopolis, 1984 (Ref. 6)
- Hagen, 1982 (Ref. 7)

The average peak outflow from the three methods was adopted, and total breach volumes (for both Process I and II) were derived from:

- TSF elevation-storage curve
- Supernatant pond volumes
- Empirical tailings mobilisation models (Concha Larrauri & Lall, 2018 (Ref. 8); Rico et al., 2008 (Ref. 9))
- Recommended assumption that Volume Eroded is taken equal to the Volume of Water (Ref. 10)

A6.5. Tailings Flow Behaviour and Runout

Informed by the TBDA framework, the two distinct flow types were modelled as follows:

- **Process I:** Modelled as a turbulent, water-dominant flood wave using HEC-RAS 2D, with entrained dam and tailings material.
- **Process II:** Process II flows are assumed to deposit within the valley. Modelling should be undertaken at Detailed Design.

These assumptions were incorporated into inundation and consequence modelling to differentiate between transient flooding and sediment deposition.

A6.6. Modelling Extents and Termination Criteria

Modelling extents were determined using FEMA (Ref. 11) guidance:

- **Sunny Day scenarios:** Extended until floodwaters re-entered natural channels or dissipated to within-bank conditions.
- **Rainy Day scenarios:** Simulations extended to where the incremental flood depth reduced below 0.3 m or the wave peak travelled beyond 24 hours downstream.

The downstream model extent terminated at the Lindis River floodplain. Cross sectional channel flow calculations were undertaken at the SH8 bridge.

A6.7. Hydrologic Analysis

The NZDSG (Ref. 1) requires that reservoir inflows and levels, and downstream watercourse flows, be those most likely to occur coincident with the potential dam failure mode, for both the Sunny-Day and Rainy-Day breach scenarios.

The facility is to be designed as a full containment TSF. This means that the tailings, normal operation pond water, and a Probable Maximum Flood (PMF) inflow from the full catchment upstream of the dam will be fully contained within the facility.

For the Sunny-Day breach scenario, the pond volume for the breach is assumed to be the maximum normal operation pond volume. The tailings are assumed to be at the maximum allowable level for the given crest level.

For the Rainy-Day it is assumed to be maximum normal operation pond volume, plus PMP, plus the volume of the 1 m freeboard. This represents a crest full scenario with the tailings level at a maximum allowable level for the given crest level.

For the Rainy-Day breach scenario, base flood flows for a PMP event with the 1-hr, 2-hr, and 6-hr duration were modelled. The PMP depths and temporal patterns were calculated by using the method of Thompson and Tomlinson 1993 and 1995 (Refs. 12, 13). The runoff coefficient of 0.8 was adopted for the applied PMP rainfall in the analysis. The most significant incremental impacts were observed with the 1hr PMP base flood event. This was selected as the critical Rainy-Day breach scenario base flood flows for the PIC assessment.

A6.8. Breach Parameters

The breach geometry and hydrograph parameters were developed using multiple empirical methods (Ref. 5, 6, and 7). Parameters were selected and breach flow rates averaged across methods to reflect typical embankment erosion processes. Tailings discharge volumes were estimated using empirical relationships (Ref. 8, and 9). The breach parameters are summarised in Table A2.

A7.0 INUNDATION MODELLING RESULTS

A7.1. Inundation Extents

The predicted flood extents vary with breach size and hydrologic condition. Maps of inundation depth and hazard category for all scenarios are provided in Figures A1 to A10. A summary of downstream distances, arrival times, and affected infrastructure is provided in Tables A3-A5.

The consequences outlined in the maps and tables apply to Process I only. In Process II, the liquefied tailings are less flowable compared to the outflow released during Process I. The Shepherds valley has a steep gradient, and the ground gradient becomes flat in the area downstream of the exit. Therefore, the tailings discharged in Process II are expected to be deposited in the valley from the toe of the TSF to the exit of the valley.

A7.2. Flood Hazard Categorisation

Flood hazard levels were assigned using the Smith et al. 2014 (Ref. 14) flood hazard classification method, endorsed in NZDSG. These categories incorporate both flood depth and velocity and are used to assess the risk to life and building functionality.

Hazard mapping is provided in Figures A4, A6, A8, A10 and informs the assessment of Population at Risk (PAR), Potential Loss of Life, and infrastructure damage categories.

A7.3. Arrival Times and Warning Implications

The arrival times of the breach flood at key locations are critical for emergency response and warning system design. These vary depending on breach size and condition. A summary of the breach times for each scenario are summarised in Tables A4 to A7.

The results highlight the warning time available to personnel on-site and the need for robust early warning and evacuation protocols as part of the TSF's Emergency Action Plan (EAP).

A8.0 CONSEQUENCE ASSESSMENT

This section presents the consequence assessment for breach scenarios of the Shepherds Tailings Storage Facility (TSF). It follows the framework established in NZDSG Module 2 for assessing the Potential Impact Classification (PIC) of dams in New Zealand.

The assessment incorporates:

- The number of people potentially at risk (PAR),
- Estimated Potential Loss of Life,
- Damage to community, cultural, and critical infrastructure,
- Environmental consequences and restoration practicability.

The PIC has been assessed for both Sunny-Day and Rainy-Day breach conditions, for the starter embankment and the full embankment configurations.

A8.1. Methodology

The consequence assessment methodology includes:

- Flood hazard assessment using the Smith et al. (Ref. 14) classification for flood hazard categories (H1 to H6);
- PAR and Potential Loss of Life estimation, using guidance from the U.S. Bureau of Reclamation's Reclamation Consequence Estimating Methodology (RCEM, Ref. 15) and adjusted for context-specific occupancy and warning times;
- Assessment of infrastructure and environmental damage, based on flood hazard thresholds and site-specific design levels;
- Assignment of PIC per Table 2.1 of NZDSG based on the worst-case consequence outcome across all breach scenarios.

According to the NZDSG, individuals inside buildings or occupied areas are considered part of the PAR if flood hazard levels exceed the H2 category, while road users are included if flood hazard levels exceed the H1 category. Building damage was assessed under the assumption that floor levels are at least 150 mm above ground level. This could be conservative. However, the assessment of PIC in Section 10.0 is mainly based on the combination of PAR and Potential

Loss of Life, which are not affected by the assumption of the floor level. As per NZDSG, buildings are considered uninhabitable or inoperable if flood hazard exceeds the H4 category. Potential Loss of Life was evaluated using fatality rates recommended by RCEM (Ref. 15). The upper limit of the recommended threshold for the little to no warning category was applied, per NZDSG (Ref. 1).

The PAR and Potential Loss of Life for road users were estimated using the Campbell method (Ref. 16). The AADT for roads further downstream were obtained from NZ Transport Agency (Ref. 17).

Tables A2 summarises the number of workers typically present on site for different breach scenarios.

The Potential Loss of Life is calculated based on the fatality rate and a time reduction factor, which accounts for the likelihood of a worker being present on site. The Potential Loss of Life is calculated using the fatality rate and an area reduction factor which is based on the ratio of the affected area to the total building area.

A8.2. Population at Risk and Potential Loss of Life

The estimated PAR and Potential Loss of Life under each breach scenario are summarised in Tables A3 to A7.

Starter Embankment PAR is 243 for a Sunny-Day event. Incremental PAR for a Rainy-Day event is 78.

Full Embankment PAR is 213 for a Sunny-Day event. Incremental PAR for a Rainy-Day event is 81.

Starter Embankment Potential Loss of Life is 1 for a Sunny-Day event. Incremental Potential Loss of Life for a Rainy-Day event is 1.

Full Embankment Potential Loss of Life is 1 for a Sunny-Day event. Incremental Potential Loss of Life for a Rainy-Day event is 1.

A8.3. Damage Assessment

The damage assessment is based on a worst-case scenario that the ELF buttress is not fully in place. This is hypothetical for the purpose of this assessment. In closure the ELF will be in place and remove these potential consequences.

Community Infrastructure

- Starter and Full Embankment Scenarios result in potential flood hazard categories H4 to H6 at the Process Plant and Site Access Road. Process Plant hazard depends on final platform levels.
- The Administration Building is affected in most scenarios, but to a lesser degree (H4–H5).
- Multiple downstream dwellings and farm buildings are inundated in the Rainy-Day scenarios (up to 6 structures in H5–H6 hazard).

Cultural and Historical Sites

- No known cultural heritage sites or wāhi tapu areas are located within the inundation footprint. The damage in this category is therefore assessed as Minimal.

Critical or Major Infrastructure

- The SH8 bridge, are rendered inoperable.

Natural Environment

- Tailings and sediment entrainment result in widespread environmental impact, particularly along Shepherds Creek and farmland adjacent to the Lindis River.
- Given the potential presence of hazardous constituents in the tailings and the depositional footprint, the environmental damage is assessed as Major to Catastrophic, depending on the scenario.

A8.4. Potential Impact Classification (PIC)

The consequence assessment confirms that both the starter embankment and full embankment configurations of the Shepherds TSF warrant classification as High Potential Impact Classification (PIC) structures under NZDSG. This classification reflects:

- The credible potential for one or more fatalities. Potential significant damage to the Process Plant and Administration Buildings;
- Significant damage to community infrastructure and key transport routes;
- Inoperability of the SH8 bridge under extreme conditions;
- Major environmental harm extending beyond the site boundary.

This PIC designation has sets for the TSF's design criteria, operational monitoring, and the development of a robust Emergency Action Plan (EAP), as outlined in subsequent sections.

A9.0 RISK AND EMERGENCY RESPONSE CONTEXT**A9.1. Overview**

This section places the breach and consequence assessment in the broader context of dam safety risk management and emergency response planning for the Shepherds Tailings Storage Facility (TSF). It outlines how the breach scenarios and consequence outcomes inform:

- The design and implementation of a facility-specific Emergency Action Plan (EAP),
- The classification and regulatory obligations under the New Zealand Dam Safety Guidelines (NZSOLD, 2024),
- The interface with the Civil Defence Emergency Management (CDEM) system, and
- Key assumptions and limitations regarding residual risk and uncertainty.

Given the High Potential Impact Classification (PIC) assigned to the Shepherds TSF, a precautionary, consequence-informed approach to emergency preparedness is required.

A9.2. Implications of High PIC Classification

The High PIC rating for both the starter and full embankment configurations has the following direct implications under NZSOLD (2024):

- Mandatory development and maintenance of an Emergency Action Plan (EAP) in accordance with Module 4 of the guidelines;
- Independent Dam Safety Assurance Programme (DSAP) submissions, including a Dam Safety Management System (DSMS);
- Annual reviews and updates of consequence assessments, especially if site staging or downstream development alters exposure;
- Design performance criteria that align with the need to prevent uncontrolled failure modes, including those triggered by seismic or hydrological events.

The breach modelling and consequence results presented in this report must therefore be integrated into the TSF's operational safety systems and compliance schedule.

A9.3. Residual Risk and Uncertainties

While the modelling adopts conservative breach scenarios and well-established methods, residual risks remain due to:

- Limitations in LiDAR resolution (particularly in the downstream floodplain),
- Uncertainties in tailings rheology and potential for partial flow liquefaction,
- Assumptions regarding occupancy and warning times,
- Evolution of downstream land use or infrastructure development.

Accordingly, the consequence assessment should be periodically reviewed and updated, particularly:

- At each TSF stage raise or operational milestone,
- Following any significant changes in the downstream environment,
- In response to new monitoring or geotechnical data that affects failure likelihood or flow behaviour.

A9.4. Integration with the Dam Safety Management System

The results and assumptions from this breach assessment are to be embedded into the broader Dam Safety Management System (DSMS) for the Shepherds TSF. This includes:

- Hazard classification documentation,
- The EAP and supporting inundation maps,
- Trigger Action Response Plans (TARPs) that reflect breach likelihood indicators (e.g. seismic events, observed seepage),
- Risk registers and operational protocols linked to early warning and failure detection.

The DSMS should be linked to site-wide health and safety systems and mine emergency protocols.

A10.0 CONCLUSIONS

A dam breach assessment was completed for both the starter and full embankment configurations of the Shepherds TSF under Sunny-Day and Rainy-Day conditions. For the starter embankment, the breach scenarios indicate flooding of site infrastructure, with estimated Potential Loss of Life of one person under both scenarios. For the full embankment, the Potential Loss of Life ranges from one to two persons. In both cases, the Rainy-Day breach scenario results in more significant incremental consequences.

Damage assessments classify the Sunny-Day scenarios as Major and the Rainy-Day scenarios as Catastrophic, reflecting impacts to critical infrastructure and the environment. Based on these outcomes, the TSF is classified as High PIC under all breach scenarios.

It is noted that this assessment does not consider the probability of failure, and results are intended solely to inform consequence classification and emergency planning.

A11.0 REFERENCES

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Table A1	Summary of Worker Numbers for Site Buildings
Table A2	Summary of Breach Parameters
Table A3	Summary of Consequences for Rainy Day Base Flood (PMP 1 hr) Scenario
Table A4	Summary of Consequences for Sunny Day Breach Scenario
Table A5	Summary of Consequences for Rainy Day Breach Scenario
Table A6	Summary of PAR and Potential Loss of Life for Sunny Day Breach Scenario
Table A7	Summary of PAR and Potential Loss of Life for Rainy Day Breach Scenario

Table A1: Summary of Worker Numbers for Site Buildings

Area	Process Plant	Administration Building
Typical Average Number of Workers in Area During the Day (12 hr per day) (applies to Sunny and Rainy Day conditions)	30	30
Minimum number of workers possible in area (applies to Sunny and Rainy Day conditions)	10 (Nightshift and weekends)	10 (Nightshift and weekends)
Maximum number of workers in area for special situations (applies to Sunny Day condition only)	Up to 200 during scheduled shutdown/maintenance (approx. two weeks a year)	-

Table A2: Summary of Breach Parameters

Parameters	Starter Embankment		Full Embankment	
	Sunny Day	Rainy Day	Sunny Day	Rainy Day
Breach Scenarios				
Breach Bottom (mRL)	594	594	681.4	668.5
Process I Water & Tailings Depth at Breach (m)	24	49	3.1	21.5
Height of breach (m) for Process I Hydrograph	49	49	8.6	21.5
Volume of Water Discharge in Process I (m ³)	580,000	3,800,000	580,000	4,400,000
Volume of Tailings Discharge in Process I (m ³)	0	0	580,000	4,400,000
Volume of Total Discharge in Process I (m ³)	580,000	3,800,000	1,160,000	8,800,000
Peak Breach Outflow (m ³ /s)	1750	5420	812	4266
Volume of Discharge in Process II (m ³)	-	-	5,320,000	1,500,000

Table A3. Summary of Consequences for Rainy Day Base Flood (PMP 1 hr) Scenario

Items	Distance Downstream (km)	No. of Buildings Affected	Time of Arrival	Hazard Category (No. of Buildings)	Inundated Length (km)	PAR	Potential Loss of Life
Site Access Roads in Valley (AADT = 200)	1.0	-	-	H6	3.0	0.90	0.6300
Process Plant	3.0	-	-	-	-	-	-
Administration Building	5.0	-	-	-	-	-	-
Thomson Gorge Rd (AADT = 259)	6.5	-	-	-	-	-	-
Farmland (~70ha)	2.7	-	-	H6	-	0.08	0.0000
Buildings Downstream	7.5	1	-	H3 (1 dwelling) H4 (1 dwelling) H5 (2 commercial)	-	8.10	0.0008
Ardgour Road (AADT = 400)	8.0	-	-	H5	0.7	1.08	0.0357
SH8 Bridge (AADT = 1945)	11.5	-	-	-	-	-	-
Summary						10.16	1 (0.67)

Table A4. Summary of Consequences for Sunny Day Breach Scenario

Items	Distance Downstream (km)	No. of Buildings Affected	Time of Arrival	Hazard Category (No. of Buildings)	Inundated Length (km)	PAR	Potential Loss of Life
<u>Starter Embankment</u>							
Site Access Roads in Valley (AADT = 200)	1.0	-	<1 min	H6	3.7	0.90	0.6300
Process Plant	3.0	1	10 min	H6	-	200	0.1903
Administration Building	5.0	1	10 min	H4 to H5	-	30	0.0059
Thomson Gorge Rd (AADT = 259)	6.5	-	15 min	H5	<0.1	0.11	0.0000
Farmland (~100ha)	2.7	-	20 min	H6	-	0.07	0.0000
Buildings Downstream	7.5	5	20 min	H6 (1 commercial) H5 (1 commercial and 1 dwelling) H4 (2 dwellings)	-	10.8	0.0014
Ardgour Road (AADT = 400)	8.0	-	25 min	H5	1.0	1.13	0.0100
SH8 Bridge (AADT = 1945)	11.5	-	-	-	-	-	-
Summary						243	1 (0.84)
<u>Full Embankment</u>							
Site Access Roads in Valley (AADT = 200)	1.0	-	<1 min	H6	3.0	0.90	0.6300
Process Plant	3.0	1	15 min	H4 to H6	-	200	0.0294
Administration Building	5.0	-	-	H1	-	-	-
Thomson Gorge Rd (AADT = 259)	6.5	-	45 min	H5	0.25	0.11	0.0000
Farmland (~100ha)	2.7	-	50 min	H6	-	0.11	0.0001
Buildings Downstream	7.5	5	50 min	H6 (1 commercial) H5 (1 commercial and 3 dwellings)	-	10.8	0.0016
Ardgour Road (AADT = 400)	8.0	-	55 min	H5	1.3	1.13	0.0100
SH8 Bridge (AADT = 1945)	11.5	-	-	-	-	-	-
Summary						213	1 (0.67)

Table A5. Summary of Consequences for Rainy Day Breach Scenario

Items	Distance Downstream (km)	No. of Buildings Incrementally Affected	Time of Arrival	Hazard Category (No. of Buildings)	Inundated Length (km)	PAR	Potential Loss of Life
<u>Starter Embankment</u>							
Site Access Roads in Valley (AADT = 200)	1.0	-	<5 min	H6	3.7	0.90	0.6300
Process Plant	3.0	1	5 min	H6	-	30	0.2730
Administration Building	5.0	1	10 min	H5 to H6	-	30	0.0150
Thomson Gorge Rd (AADT = 259)	6.5	-	10 min	H6	0.1	0.11	0.0000
Farmland (~180ha)	2.7	-	10 min	H6	-	0.20	0.0002
Buildings Downstream	7.5	7	15 min	H6 (5 dwellings, 4 commercials) H5 (1 commercial)	-	24.30	0.0113
Ardgour Road (AADT = 400)	8.0	-	45 min	H6	0.2	1.41	0.0100
SH8 Bridge (AADT = 1945)	11.5	-	1 hr	H6	0.15	1.41	1.1900
Summary						88	2 (2.13)
Incremental Summary						78	1 (1.46)
<u>Full Embankment</u>							
Site Access Roads in Valley (AADT = 200)	1.0	-	<5 min	H6	3.7	0.90	0.6300
Process Plant	3.0	1	5 min	H6	-	30	0.1560
Administration Building	5.0	1	10 min	H5 to H6	-	30	0.0105
Thomson Gorge Rd (AADT = 259)	6.5	-	10 min	H6	1.2	0.11	0.0000
Farmland (~100ha)	2.7	-	10 min	H6	-	0.11	0.0001
Buildings Downstream	7.5	8	15 min	H6 (3 dwellings, 3 commercials) H5 (1 commercial) H4 (1 dwelling)	-	27	0.0132
Ardgour Road (AADT = 400)	8.0	-	45 min	H6	2	1.41	0.0100
SH8 Bridge (AADT = 1945)	11.5	-	1 hr	H6	0.15	1.41	1.1900
Summary						91	2 (2.01)

Incremental Summary	81	1 (1.34)
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Table A6. Summary of PAR and Potential Loss of Life for Sunny Day Breach Scenario

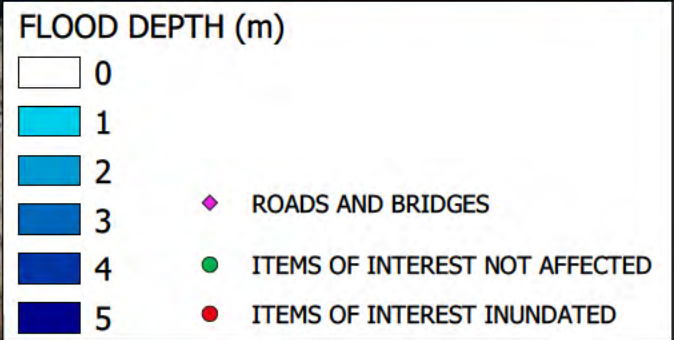
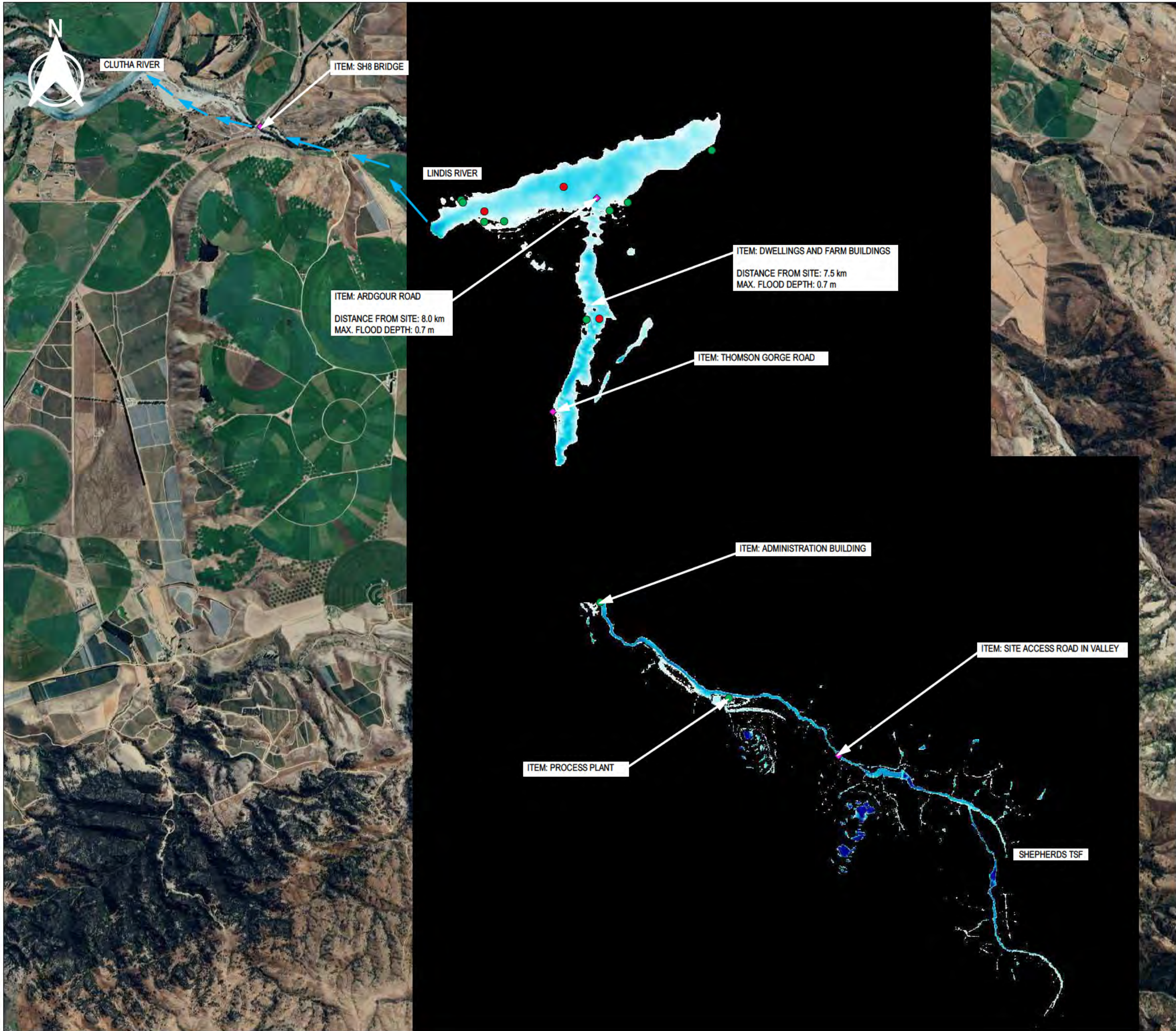
Breach Scenario	Item	PAR	Potential Loss of Life	Damage				Potential Impact Classification (PIC)
				Community	Cultural	Critical and Major Infrastructure	Natural Environment	
Starter Embankment	Buildings	240.80	0.1975	Moderate	Minimal	Major	Major	High PIC
	Roads & Bridges	2.14	0.6386					
	Farmlands	0.07	0.0000					
	Summary	243.01	1 (0.84)					
Full Embankment	Buildings	210.81	0.0311	Moderate	Minimal	Major	Major	High PIC
	Roads & Bridges	2.14	0.6400					
	Farmlands	0.11	0.0001					
	Summary	213.06	1 (0.67)					

Table A7. Summary of PAR and Potential Loss of Life for Rainy Day Breach Scenario

Breach Scenario	Item	PAR	Potential Loss of Life	Damage				Potential Classification (PIC)	Impact
				Community	Cultural	Critical and Major Infrastructure	Natural Environment		
Rainy Day Base Flood (PMP – 1 hr)	Buildings	8.10	0.0008	-	-	-	-	-	
	Roads & Bridges	1.98	0.6657						
	Farmlands	0.08	0.0000						
	Summary	10	1 (0.67)						
Starter Embankment	Buildings	84.30	0.2993	Moderate	Minimal	Catastrophic	Major	High PIC	
	Roads & Bridges	3.83	1.8286						
	Farmlands	0.20	0.0002						
	Summary	88.33	2 (2.13)						
	Incremental	78	1 (1.46)						
Full Embankment	Buildings	87.00	0.1797	Major	Minimal	Catastrophic	Major	High PIC	
	Roads & Bridges	3.83	1.8300						
	Farmlands	0.11	0.0001						
	Summary	90.94	2 (2.01)						
	Incremental	81	1 (1.34)						

List of Figures in Appendix A

- | | |
|-------------------|--|
| Figure A1 | Base Flood Depths for Rainy Day (PMP – 1hr) |
| Figure A2 | Base Flood Hazard for Rainy Day (PMP – 1hr) |
| Figure A3 | Starter Embankment Sunny Day Breach Flood Depth Map |
| Figure A4 | Starter Embankment Sunny Day Breach Flood Hazard Map |
| Figure A5 | Starter Embankment Rainy Day Breach Flood Depth Map |
| Figure A6 | Starter Embankment Rainy Day Breach Flood Hazard Map |
| Figure A7 | Full Embankment Sunny Day Breach Flood Depth Map |
| Figure A8 | Full Embankment Sunny Day Breach Flood Hazard Map |
| Figure A9 | Full Embankment Rainy Day Breach Flood Depth Map |
| Figure A10 | Full Embankment Rainy Day Breach Flood Hazard Map |



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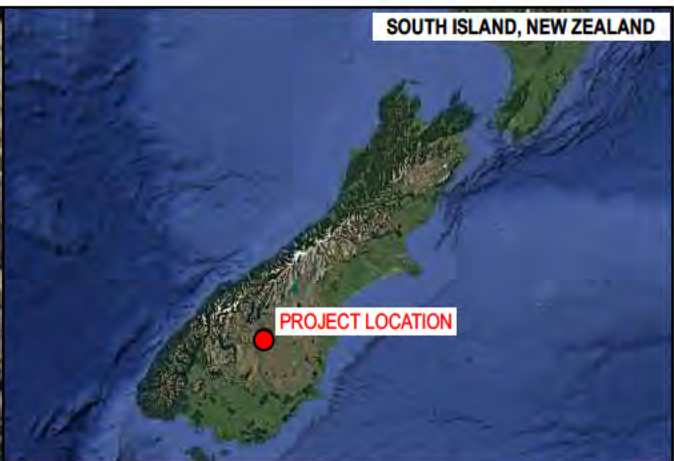
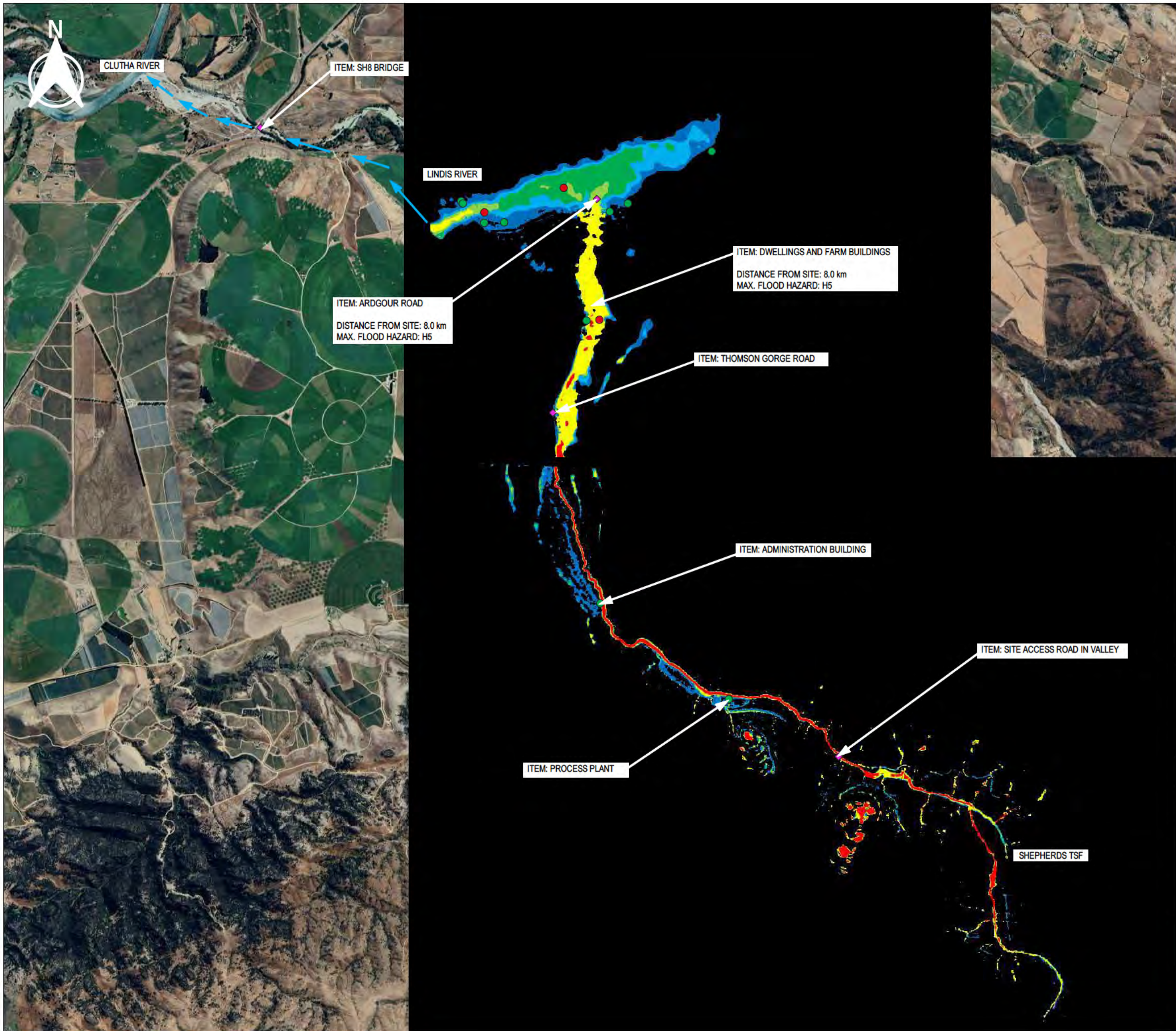
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PROJECT
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TITLE
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BASE FLOOD PMP 1 hr
FLOOD DEPTHS MAP

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FLOOD HAZARD CATEGORY	
H1	
H2	
H3	
H4	
H5	
H6	
	◆ ROADS AND BRIDGES
	● ITEMS OF INTEREST NOT AFFECTED
	● ITEMS OF INTEREST INUNDATED

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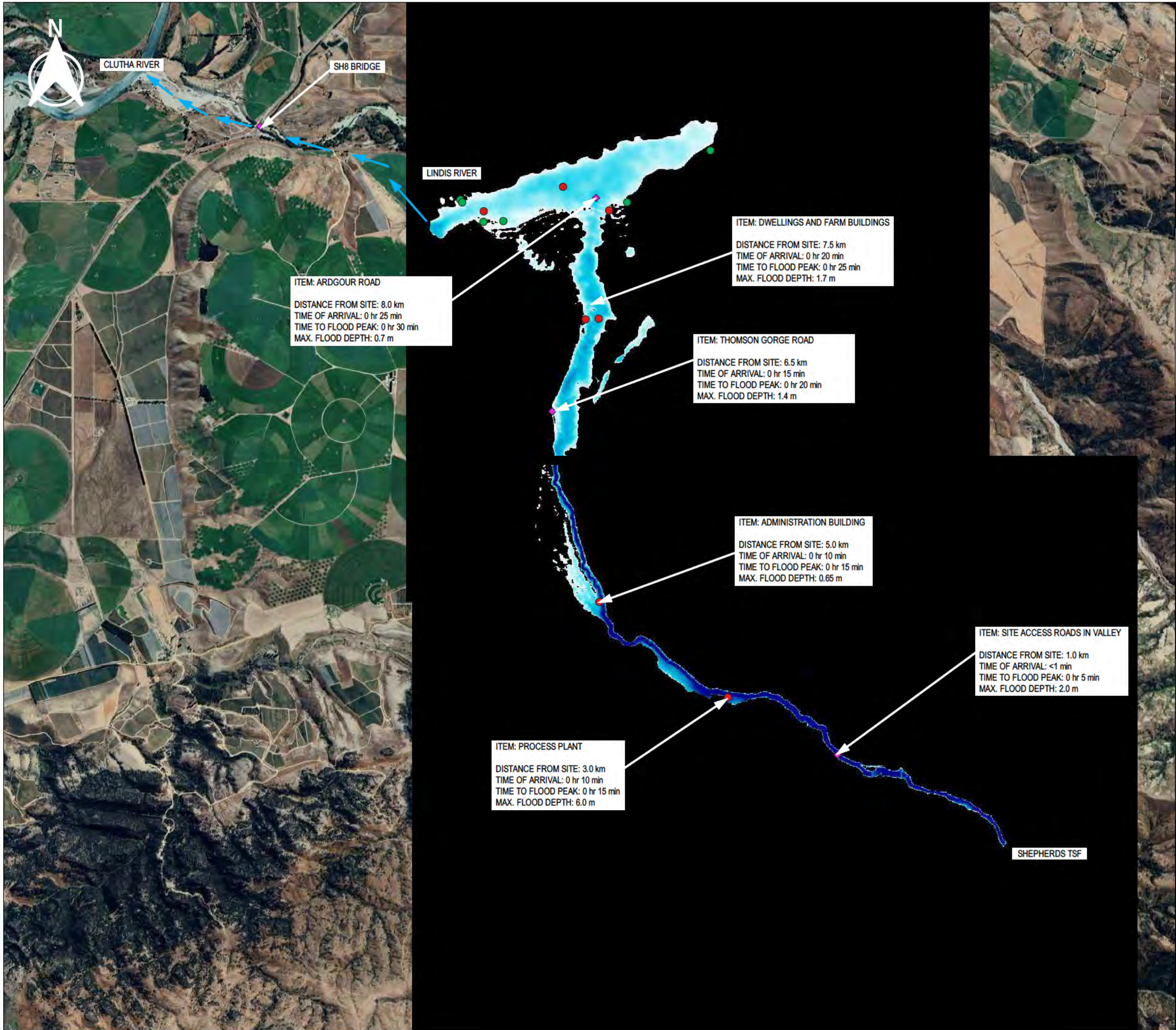
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0.25 0 0.25 0.5 km
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SOUTH ISLAND, NEW ZEALAND

PROJECT LOCATION

FLOOD DEPTH (m)

0	
1	
2	
3	
4	
5	

◆ ROADS AND BRIDGES
● ITEMS OF INTEREST NOT AFFECTED
● ITEMS OF INTEREST INUNDATED

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0.25 0 0.25 0.5 km

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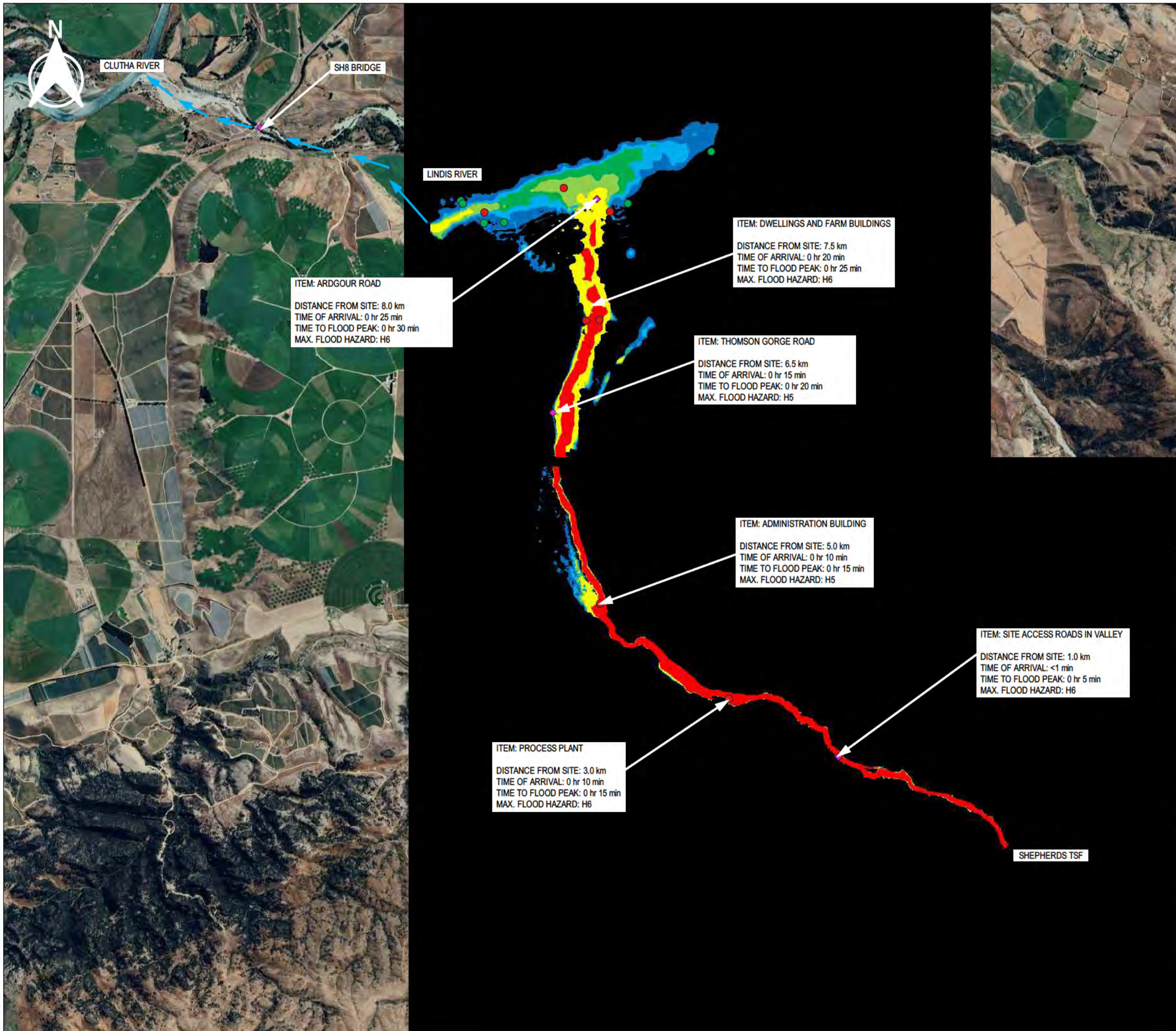
STARTER EMBANKMENT 643 mRL
SUNNY DAY BREACH
FLOOD DEPTHS MAP

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FIGURE A3



SOUTH ISLAND, NEW ZEALAND

PROJECT LOCATION

FLOOD HAZARD CATEGORY

H1	ROADS AND BRIDGES
H2	
H3	
H4	
H5	ITEMS OF INTEREST NOT AFFECTED
H6	ITEMS OF INTEREST INUNDATED

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0.25 0 0.25 0.5 km

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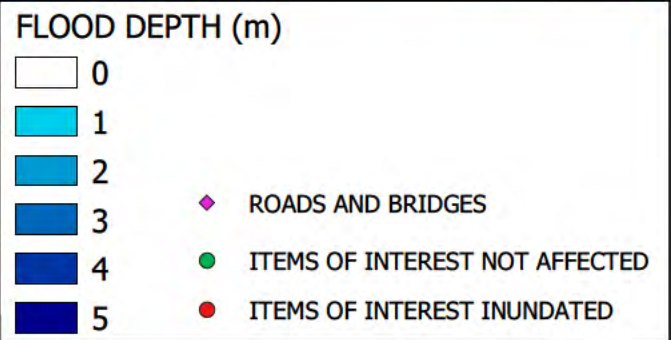
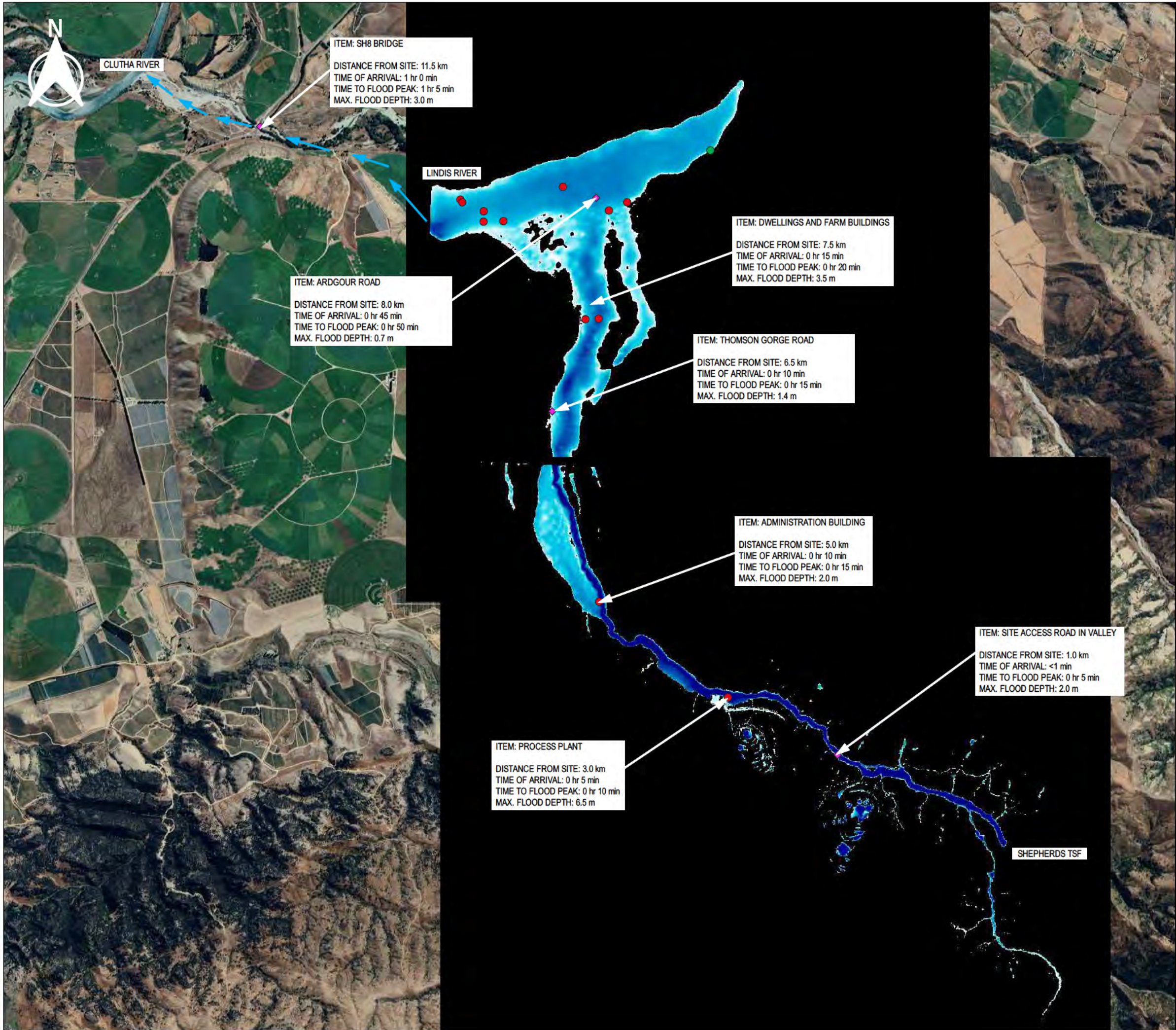
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SUNNY DAY BREACH
FLOOD HAZARD MAP

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0.25 0 0.25 0.5 km

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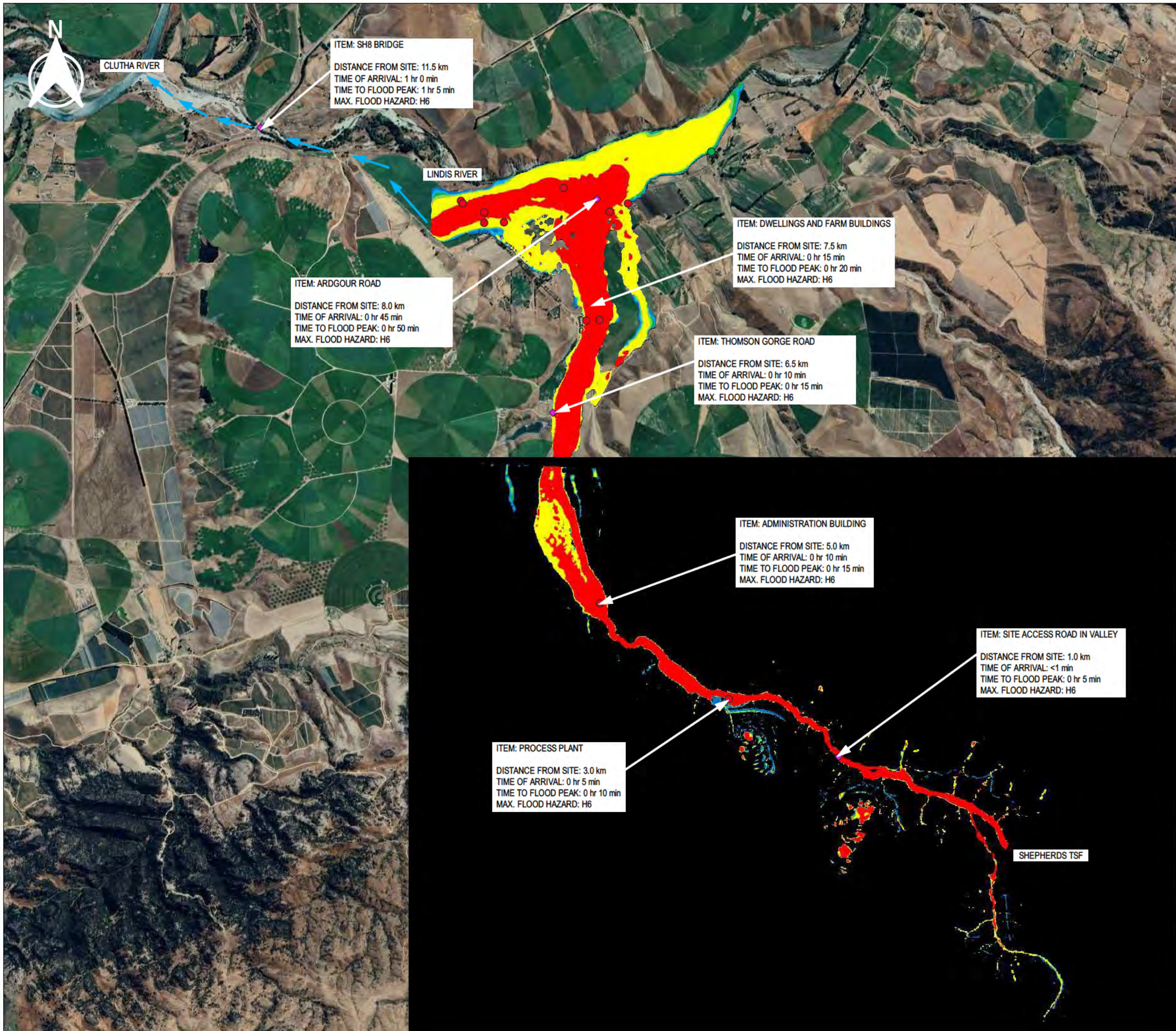
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PROJECT LOCATION

FLOOD HAZARD CATEGORY

H1	ROADS AND BRIDGES
H2	
H3	
H4	
H5	ITEMS OF INTEREST NOT AFFECTED
H6	ITEMS OF INTEREST INUNDATED

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0.25 0 0.25 0.5 km

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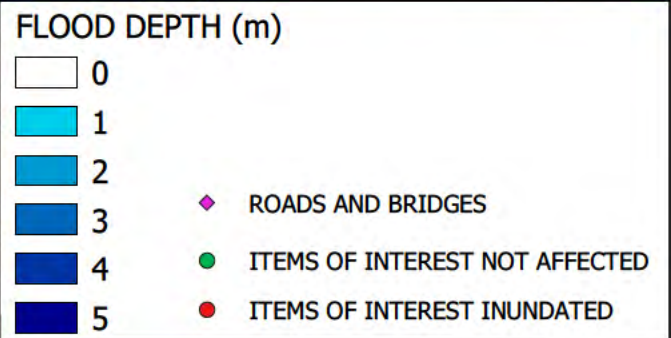
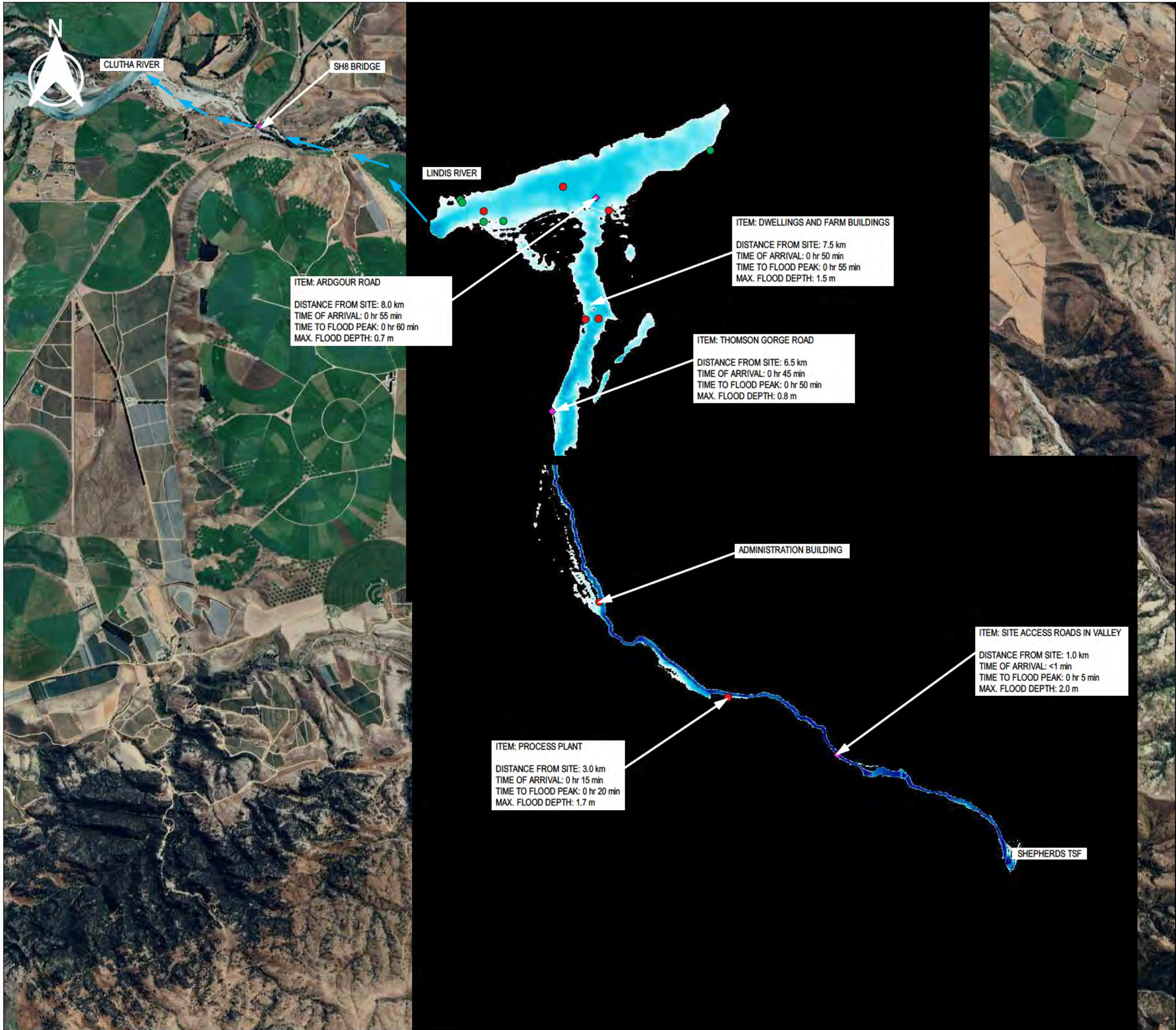
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FLOOD HAZARD MAP

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0.25 0 0.25 0.5 km

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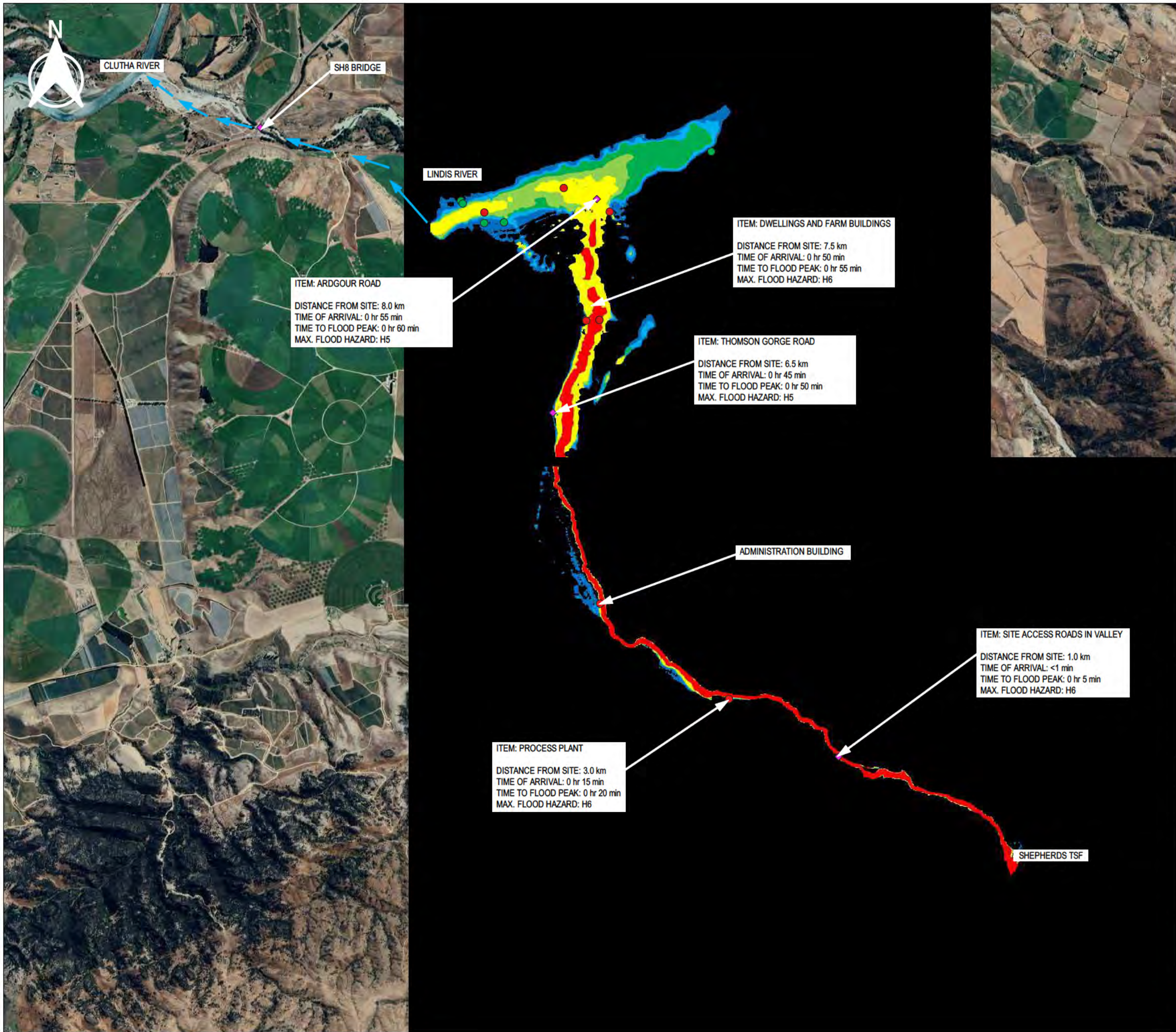
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SUNNY DAY BREACH
FLOOD DEPTHS MAP

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SOUTH ISLAND, NEW ZEALAND

PROJECT LOCATION

FLOOD HAZARD CATEGORY

H1	ROADS AND BRIDGES
H2	
H3	ITEMS OF INTEREST NOT AFFECTED
H4	
H5	ITEMS OF INTEREST INUNDATED
H6	

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0.25 0 0.25 0.5 km

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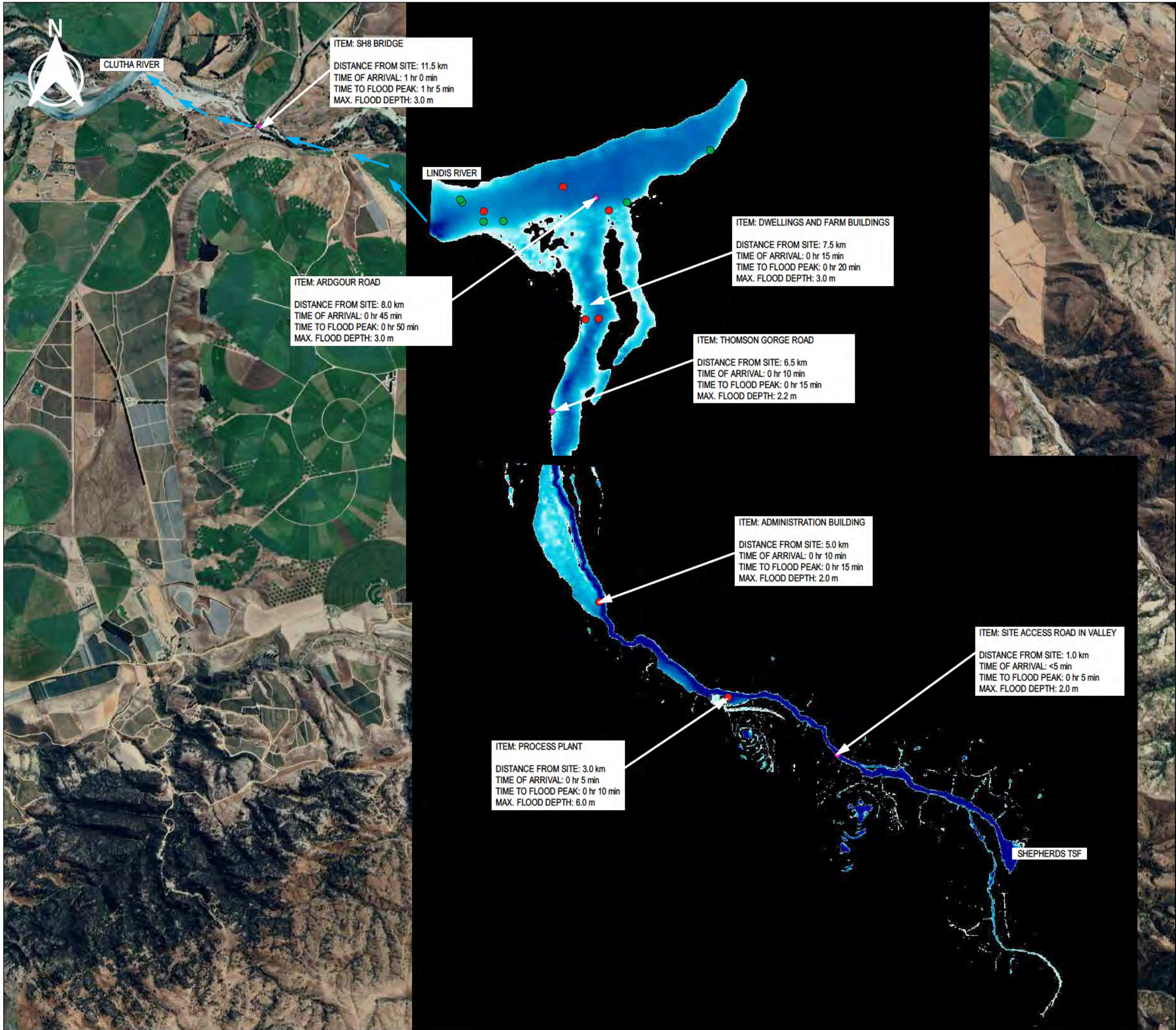
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SUNNY DAY BREACH
FLOOD HAZARD MAP

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SOUTH ISLAND, NEW ZEALAND

PROJECT LOCATION

FLOOD DEPTH (m)

0	
1	
2	
3	
4	
5	

◆ ROADS AND BRIDGES

● ITEMS OF INTEREST NOT AFFECTED

● ITEMS OF INTEREST INUNDATED

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0.25 0 0.25 0.5 km

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PROJECT

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TITLE

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FULL EMBANKMENT 643 mRL

RAINY DAY BREACH

FLOOD DEPTHS MAP

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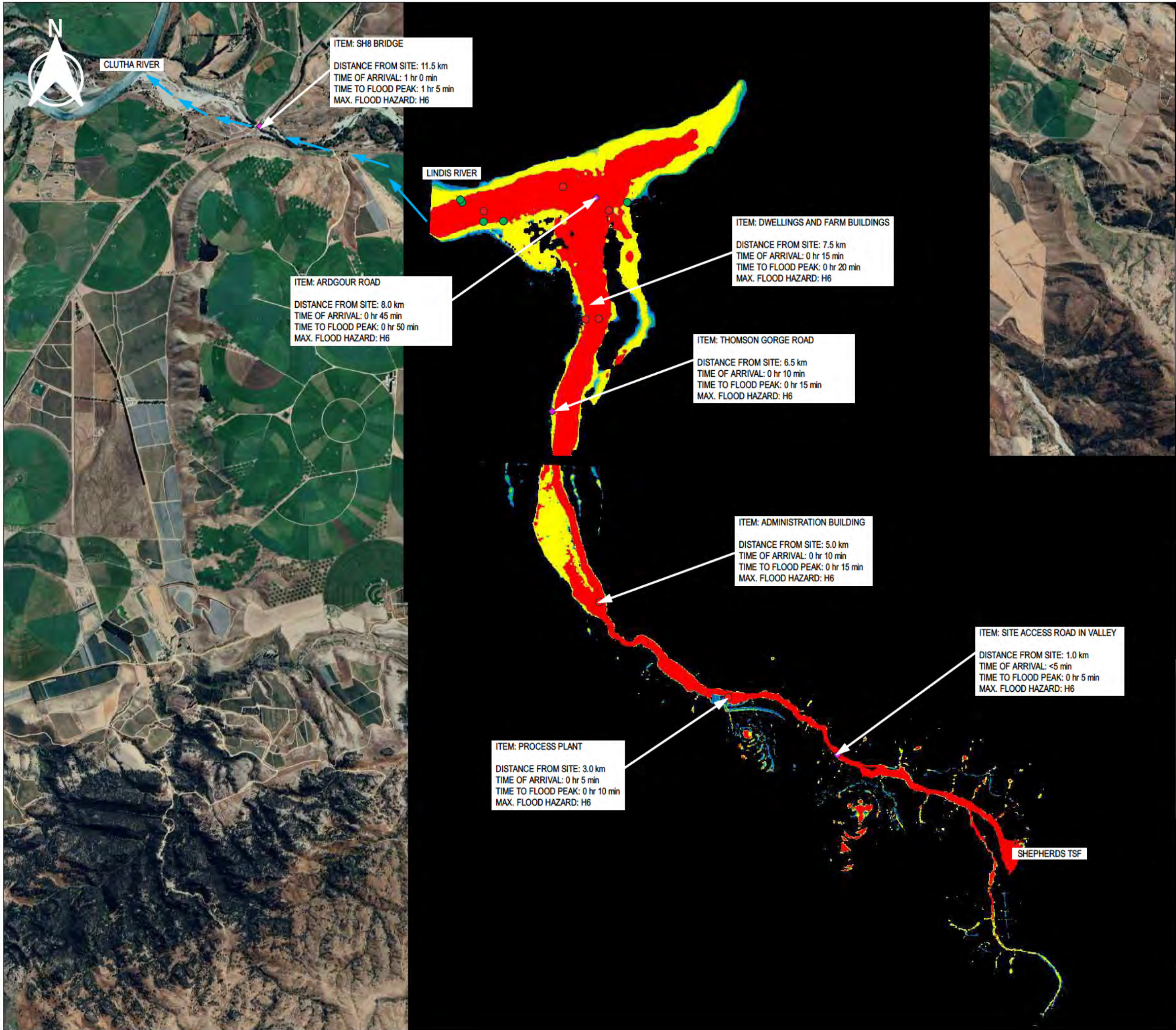
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FIGURE A9



FLOOD HAZARD CATEGORY

H1	ROADS AND BRIDGES
H2	
H3	ITEMS OF INTEREST NOT AFFECTED
H4	
H5	ITEMS OF INTEREST INUNDATED
H6	

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0.25 0 0.25 0.5 km
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TITLE
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RAINY DAY BREACH
FLOOD HAZARD MAP
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APPENDIX B

SEEPAGE ANALYSIS

APPENDIX B: SEEPAGE MODELLING SUMMARY

B1.0 PURPOSE AND SCOPE

This appendix summarises the assumptions and results of seepage analyses conducted for the proposed embankment raise of the new Shepherds Tailings Storage Facility (Shepherds TSF) to 690m RL. The TSF is expected to influence groundwater levels within the impoundment area. To manage this, a network of subsurface drains is incorporated to intercept and collect seepage from the tailings. Key drainage features beneath the embankment include the cut-off drain along the upstream toe of the embankment, a chimney drain base-collector (CDBC) at the downstream side of Zone A1, and a vertical chimney drain within the embankment to capture seepage passing through it. Additional subsurface drains beneath the tailings include the tailings underdrains beneath the impoundment and a seepage collection drain located along the upstream edge of the embankment at 675m RL.

Two major underdrains—the southern and northern drains—run along the main creeks beneath the tailings and are designed to intercept seepage and shallow groundwater, enhancing tailings consolidation and reduce seepage into the underlying aquifer. A conceptual site model has been developed and 2D seepage analyses undertaken for two representative cross-sections to estimate total flows expected from the tailings underdrains.

B2.0 MODELLING APPROACH

Seepage modelling was carried out using Geostudio SEEP/W (Ref. 2), with analyses based on the embankment raised to 690m RL, tailings deposited to the maximum permitted elevation, and rainfall infiltration at the tailings surface. Both the final operational condition and the post-closure condition were considered. For the operational condition, a decant pond is assumed to be present with a tailings beach located adjacent to the embankment, while for the closure condition, rainfall infiltration occurs across the entire tailings surface. Specific seepage modelling scenarios include:

- Two steady-state modelling scenarios: The first represents conditions at the end of operations, with a decant pond at approximately 686m RL. Water sources in this scenario include the decant pond, rainfall on the tailings beach, and natural groundwater inflow from the surrounding ridge. This scenario serves as the initial condition to define the baseline seepage at the end of operations. The second scenario represents the long-term closure condition, where the pond is removed and the tailings are capped. In this case, water inputs are limited to rainfall and natural groundwater flow from the ridge.
- Transient seepage modelling scenario: This simulates the drainage of the tailings following pond removal and cover placement. The initial boundary conditions match those of the operational steady-state scenario, while subsequent conditions reflect the closure steady-state scenario. This analysis allows assessment of the change in seepage rate over time and the duration required to transition from operational to post-closure steady-state conditions.

Two seepage models were developed along the southern underdrain (SUD) and northern underdrain (NUD) at the location of the highest embankment. The locations of these drains are shown in Figure 15, while the model extents are presented in Figures B1 and B2. A constant water head of 686m RL was applied to represent pond inflow, and rainfall infiltration was modelled as a constant water flux across the tailings surface. The upstream ridge boundary was also assigned a constant head of 686m RL, consistent with the maximum pond level. The downstream boundary was defined by a constant head at the ground surface, while a zero-pressure (seepage face) condition was applied along the downstream slope of the TSF and across the underdrains, upstream cut-off drains, and chimney drains. Seepage discharge points were defined in the model at locations corresponding to the underdrains, upstream cut-off drains, chimney drain, and the upstream embankment drain at 665m RL. The number and distribution of these discharge points were determined based on the TSF impoundment area, the lengths of the underdrains, and the seepage model extent.

Hydraulic conductivities used at a comparable mine site in Macraes were adopted for this assessment, with sensitivity analyses performed on key parameters. Best estimate values are summarised in Table B1. The analyses incorporated unsaturated flow in both the tailings and the embankment using the Fredlund and Xing method (Ref. 3).

To convert seepage from 2D to 3D, an embankment length of approximately 440 m and a height conversion ratio of 0.56 were used. Given the different model lengths for the NUD and SUD, the final TSF seepage flow was taken as the average of the results from both models. Seepage through the system was estimated at the following key sections (see Figures B1 and B2):

- Total drain flow: the combined seepage collected by the underdrains, upstream cut-off drains, chimney drain, and upstream embankment drain at 665m RL.
- Flow through the embankment: collected at the section immediately upstream of the chimney drain.
- Flow through the foundation: measured at two sections—one upstream of the chimney drain and the other beneath the embankment toe.

B3.0 MODEL CALIBRATION AND SENSITIVITY

To validate the modelling outputs, the estimated seepage flows were compared with monitored flows from the Mixed Tailings Impoundment (MTI) TSF and the Top Tipperary TSF (TTTSF) at the Macraes Operation. The Macraes Operation, a gold mine located at Macraes Flat in East Otago, comprises three TSFs: TTTSF, MTI, and the Southern Pit Option 11A (SP11A) embankment.

TTTSF is currently the only operating TSF with a maximum embankment height of approximately 80 m and tailings impoundment volume of approximately 49.6 Mm³, and a total catchment area of approximately 160 ha. The embankment forming the TTTSF is a zoned rockfill embankment and is constructed to RL560 by downstream construction. The raise to RL570 is a combination of downstream construction and modified centreline construction methods. Construction continued through to March 2025, when the crest reached the design level of RL570. Construction activities for the upcoming 2025 to 2026 period will include tailings discharge in the southern area of the impoundment. Based on the Intermediate Dam Safety Review (IDSR) of TTTSF in

2025 (Ref. 4), the historical seepage flows in total are generally ranging from 10 to 22 L/s.

The MTI TSF downstream embankment was completed to RL515 in October 2001. The TSF has subsequently been raised above this level to RL548 using upstream and downstream construction embankments. The RL548 upstream embankment was effectively completed in 2013. The MTI TSF has since then been resting, and work is currently underway on the closure of the TSF. The MTI TSF has a maximum embankment height of approximately 88 m, tailings impoundment volume of approximately 50.4 Mm³, and a total catchment area of approximately 92 ha. Based on the IDSR of MTI TSF in 2025 (Ref. 5), the historical seepage flows in total are generally ranging from 5 to 15 L/s.

The proposed Shepherds TSF has a 108m high embankment and a total impoundment storage volume of approximately 21.5 Mm³. Allowance will be made to safely manage surface water from extreme storm events on top of the tailings. The volume available for tailings storage is estimated at approximately 18.0 Mm³. The impoundment area is approximately 70 ha, with a direct upstream catchment area of about 156 ha (includes only the area on the southern side of the TSF that is not diverted by diversion channels). Although its total storage volume is less than half that of the TTTSF and MTI TSF, the Shepherds TSF could have comparable total seepage flows due to several key factors. First, its embankment is the tallest among the three facilities, generating a greater hydraulic head and consequently stronger seepage-driving forces. Second, its catchment area is nearly as large as that of TTTSF and significantly larger than MTI, implying substantial surface water inflows, especially during storm events. Furthermore, the design allows for the management of extreme rainfall events and potential additional runoff diverted from adjacent catchments by an uphill diversion drain, which may contribute to elevated phreatic surfaces during peak conditions.

Seepage analyses using best estimate parameters were supported by sensitivity analyses to evaluate the effects of key variables, including tailings hydraulic conductivity, rainfall infiltration rate, and underdrain functionality during closure. Tailings hydraulic conductivity was varied to 0.2 and 2 times the best estimate. Rainfall infiltration rates of 10%, 20% (best estimate), and 30% were tested. Closure scenarios were assessed both with and without the functionality of the underdrain system.

B4.0 RESULTS

Based on the seepage modelling results, the total seepage flow from the Shepherds TSF was estimated by combining the flows from each modelled section and scaling them according to the embankment length and height they represent. Table B2 summarises the seepage flow rates from the end of tailings deposition (i.e., the initial condition) through to 100 years post-closure, including the final steady-state. Seepage rates are reported separately for flows captured by the seepage collection drains and for flows passing through the natural ground downstream of the TSF. Figures B3 to B12 illustrate the total water head contours over the 100-year period under best estimate conditions.

The modelling results indicate that seepage flow rates decrease exponentially following closure. Over time, both the flow into the drains and the flow through the natural ground

approach a steady-state condition, where rates become constant. For example, the average total drain flow begins at approximately 8.0 L/s immediately after deposition ends and declines to around 0.7 L/s at steady state. In general, the drain flow reaches approximately 65% of the steady-state value within 5 years, 80% within 10 years, and nearly 100% within 50 years.

B5.0 SENSITIVITY ANALYSIS

Table B3 summarises the total drain flow rates over the 100-year post-closure period for the various sensitivity analysis scenarios. In all cases, seepage flows gradually decline from the initial condition and eventually reach a final steady state. The hydraulic conductivity of the tailings has a significant influence on seepage behaviour. When conductivity is doubled (2K), the average initial seepage flow reaches approximately 13.4 L/s, whereas reducing conductivity to 0.2K lowers the initial flow to around 2.5 L/s. The functionality of the underdrain system during closure is also critical for seepage reduction. For example, under best estimate parameters, the 1-year seepage flow is approximately 6.0 L/s (67% of the steady-state value) with functional underdrains, compared to just 2.9 L/s (27% of steady-state) without them. Rainfall infiltration rate has a relatively minor effect on overall seepage. Reducing the infiltration rate from 20% to 10% results in a slight decrease in seepage flows throughout the simulation, without significantly affecting the time to reach steady state.

Overall, considering variations in tailings hydraulic conductivity, rainfall infiltration rate, and underdrain functionality, total drain flows range between 2.5 L/s and 15 L/s. This range is consistent with seepage rates observed at other mine sites based on prior experience.

Tables B1-01 and B2-01 present the seepage flow rates for all sensitivity scenarios. Corresponding water head contours are shown in Figures B1-01 to B1-25 and B2-01 to B2-25.

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APPENDIX B
TABLES

Appendix B List of Tables

Table B1 – Adopted Material Properties

Table B2 – Summary of Seepage Flow Rates Over Time (Best Estimate)

Table B3 – Summary of Total Drain Flow Rates Over Time for Sensitivity Analysis

Table B1. Adopted Material Properties

Material	Horizontal Hydraulic Conductivity, K_x (m/s)	K_y/K_x Ratio	Effective Porosity (m^3/m^3)
Original Ground (0-20m)	5×10^{-7}	2.5	0.03
Original Ground (20-60m)	2×10^{-7}	2.5	0.006
Zone A1	1×10^{-7}	0.1	0.2
Zone B	5×10^{-6}	0.1	0.25
Zone C	1×10^{-6}	1.0	0.25
Drainage Material (Chimney Drain)	1×10^{-1}	1.0	0.4
Tailings	4×10^{-7}	0.5	0.4

Table B2. Summary of Seepage Flow Rates Over Time (Best Estimate)

Scenario	Total Drain Flow Rate (L/s) Over Time (Northern Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.8	6.7	3.6	2.5	1.7	1.3	1.3	1.3
Chimney Drain Flows	2.2	1.5	0.5	0.2	0.1	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.1	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.6	2.4	1.9	1.6	1.3	1.2	1.2	1.2
Flow through Foundation after Chimney	0.9	0.8	0.6	0.6	0.5	0.5	0.5	0.5

Scenario	Total Drain Flow Rate (L/s) Over Time (Southern Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	7.2	5.4	2.8	1.7	0.7	0.1	0.1	0.1
Chimney Drain Flows	2.2	1.5	0.6	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.5	2.4	1.8	1.5	1.2	1.0	0.9	0.9
Flow through Foundation after Chimney	1.6	1.7	1.4	1.2	1.0	0.8	0.8	0.8

Scenario	Total Drain Flow Rate (L/s) Over Time (Average)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.0	6.0	3.2	2.1	1.2	0.7	0.7	0.7
Chimney Drain Flows	2.2	1.5	0.6	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.5	2.4	1.8	1.5	1.3	1.1	1.1	1.1
Flow through Foundation after Chimney	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.6

Table B3. Summary of Total Drain Flow Rates Over Time for Sensitivity Analysis

Scenario	Total Drain Flow Rate (L/s) Over Time (Northern Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
20% Rainfall, K, with Underdrain (Best Estimate)	8.8	6.7	3.6	2.5	1.7	1.3	1.3	1.3
20% Rainfall, K, without Underdrain	8.8	3.0	1.8	1.3	0.9	0.6	0.5	0.5
20% Rainfall, 0.2K, with Underdrain	3.0	2.8	2.2	1.8	1.4	1.1	1.1	1.1
20% Rainfall, 2K, with Underdrain	14.4	9.2	4.4	2.8	1.8	1.5	1.5	1.5
10% Rainfall, K, with Underdrain	8.8	6.6	3.6	2.4	1.6	1.2	1.2	1.2
30% Rainfall, K, with Underdrain	8.8	6.7	3.7	2.6	1.8	1.5	1.5	1.5

Scenario	Total Drain Flow Rate (L/s) Over Time (Southern Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
20% Rainfall, K, with Underdrain (Best Estimate)	7.2	5.4	2.8	1.7	0.7	0.1	0.1	0.1
20% Rainfall, K, without Underdrain	7.2	2.9	1.8	1.3	0.8	0.4	0.3	0.3
20% Rainfall, 0.2K, with Underdrain	1.9	1.7	1.2	0.8	0.4	0.1	0.0	0.0
20% Rainfall, 2K, with Underdrain	12.4	7.9	3.7	2.0	0.8	0.2	0.1	0.1
10% Rainfall, K, with Underdrain	7.2	5.4	2.8	1.6	0.6	0.1	0.1	0.0
30% Rainfall, K, with Underdrain	7.2	5.4	2.9	1.7	0.8	0.3	0.2	0.2

Scenario	Total Drain Flow Rate (L/s) Over Time (Average)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
20% Rainfall, K, with Underdrain (Best Estimate)	8.0	6.0	3.2	2.1	1.2	0.7	0.7	0.7
20% Rainfall, K, without Underdrain	8.0	2.9	1.8	1.3	0.8	0.5	0.4	0.4
20% Rainfall, 0.2K, with Underdrain	2.5	2.3	1.7	1.3	0.9	0.6	0.6	0.6
20% Rainfall, 2K, with Underdrain	13.4	8.5	4.1	2.4	1.3	0.8	0.8	0.8
10% Rainfall, K, with Underdrain	8.0	6.0	3.2	2.0	1.1	0.6	0.6	0.6
30% Rainfall, K, with Underdrain	8.0	6.0	3.3	2.2	1.3	0.9	0.8	0.8

APPENDIX B
FIGURES

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Figure B6 – Water Head Contours for NUD at 100 Year after Closure

Figure B7 – Water Head Contours for NUD under Final Steady State after Closure

Figure B8 – Water Head Contours for SUD under Operational Condition (Initial Steady State)

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Figure B10 – Water Head Contours for SUD at 10 Year after Closure

Figure B11 – Water Head Contours for SUD at 100 Year after Closure

Figure B12 – Water Head Contours for SUD under Final Steady State after Closure

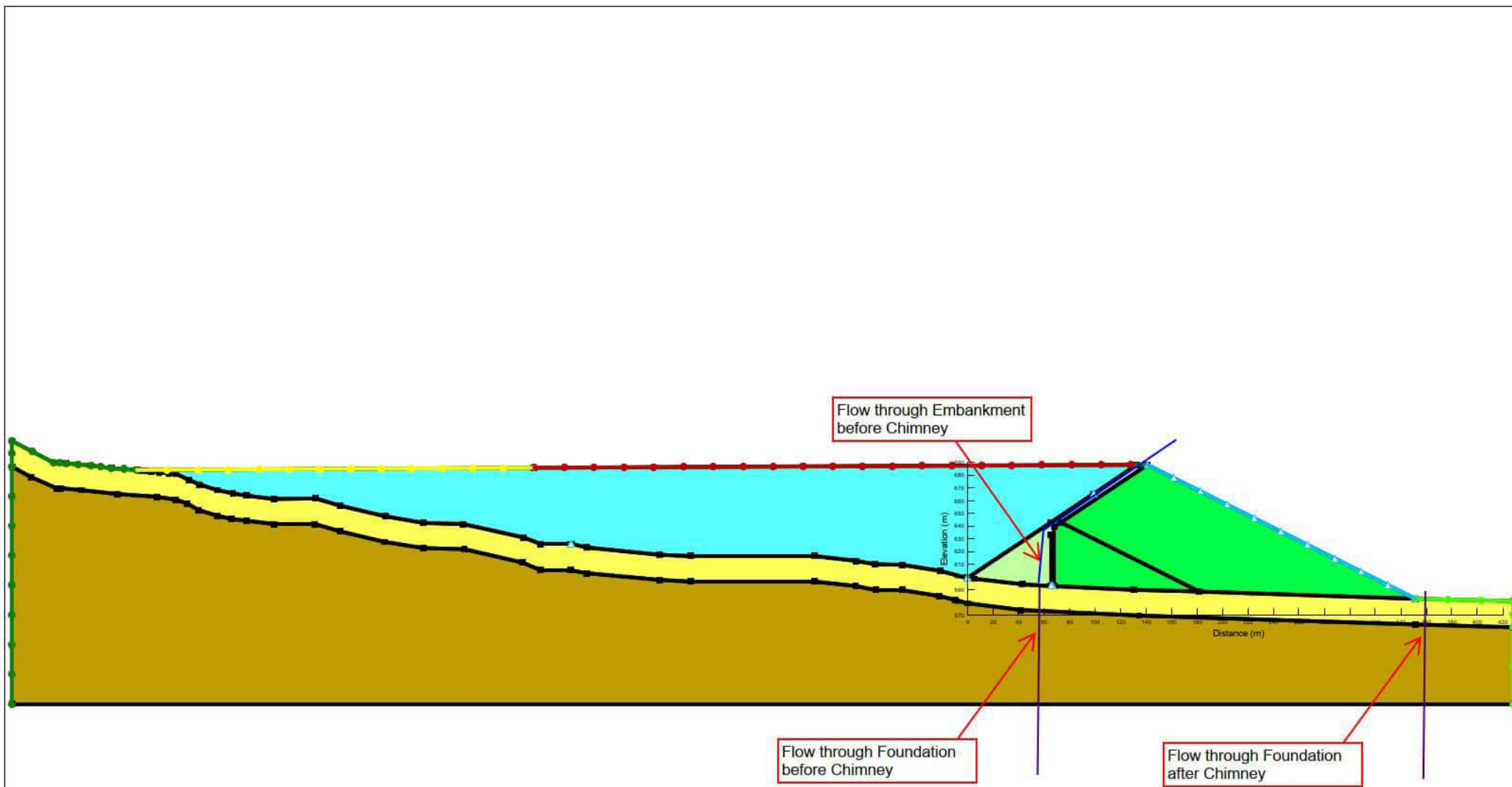


Figure B1. Seepage Model for Northern Underdrain Cross Section

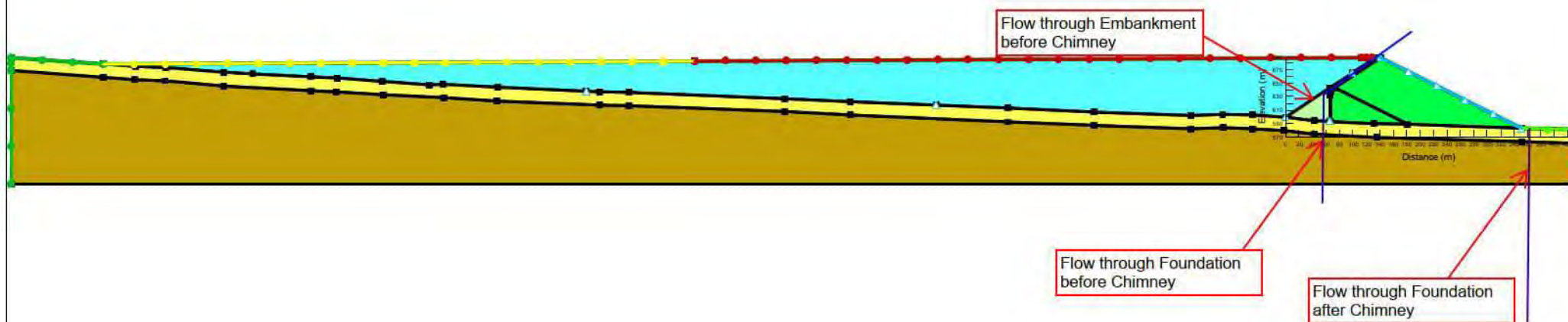


Figure B2. Seepage Model for Southern Underdrain Cross Section

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

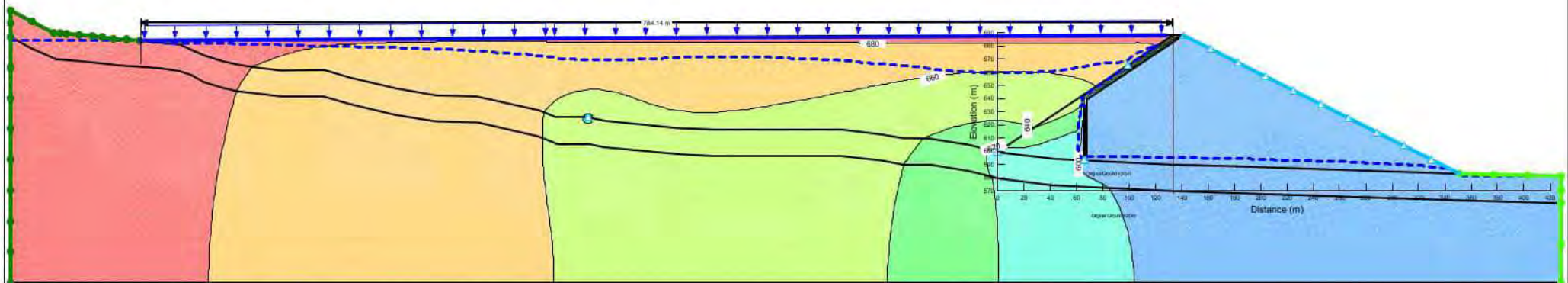


Figure B4. Water Head Contours for NUD at 1 Year after Closure

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

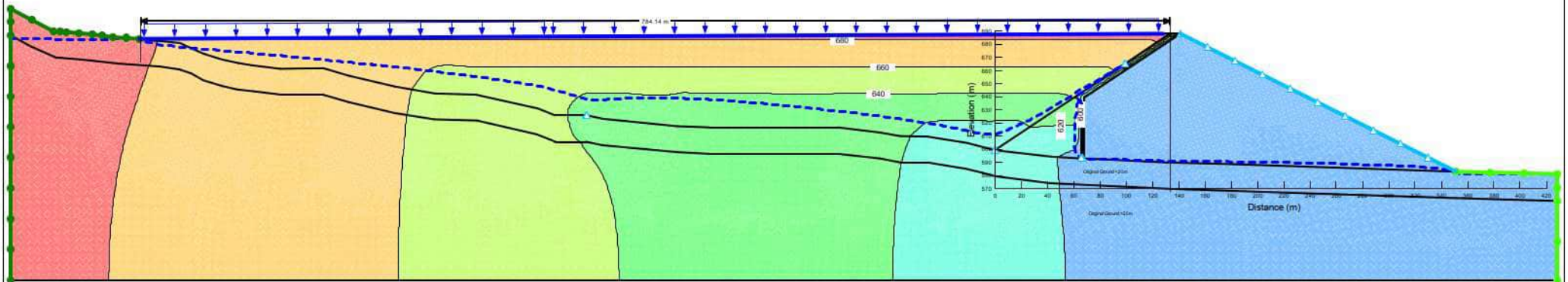


Figure B5. Water Head Contours for NUD at 10 Year after Closure

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

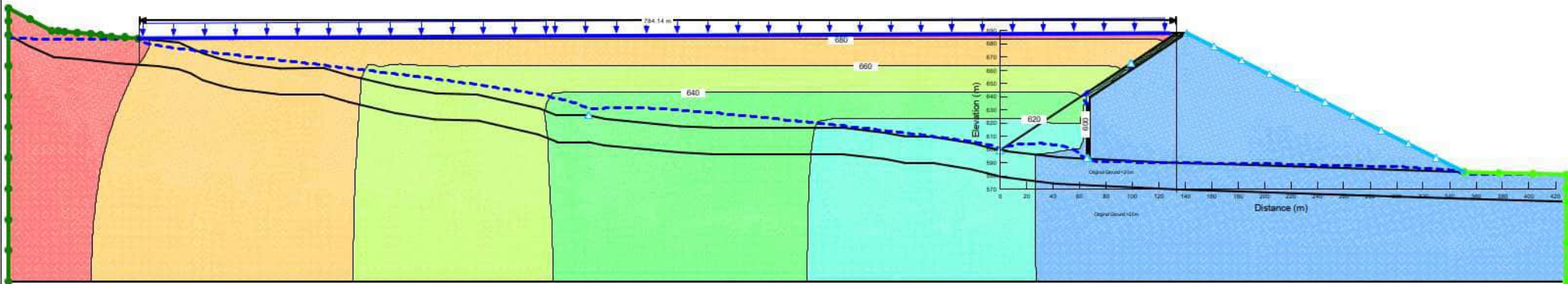


Figure B6. Water Head Contours for NUD at 100 Year after Closure

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

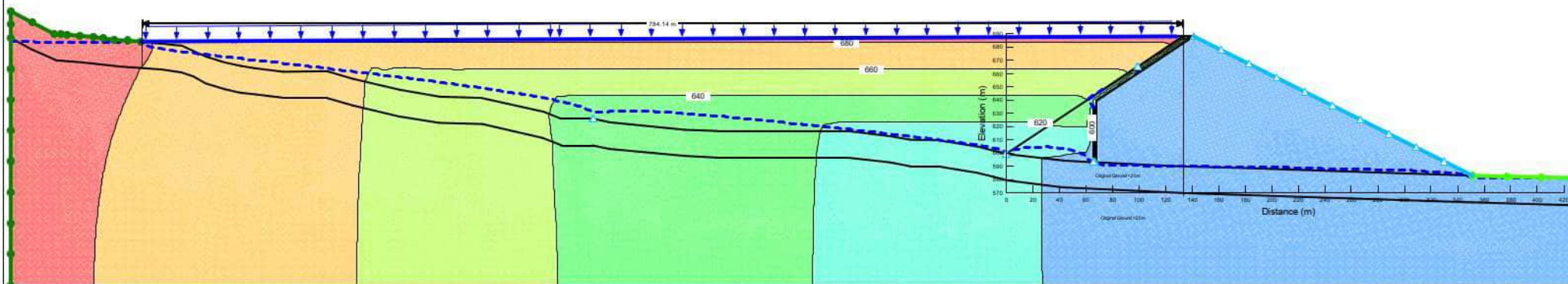


Figure B7. Water Head Contours for NUD under Final Steady State after Closure



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Shepherd TSF - Seepage Analysis
Northern Underdrain

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

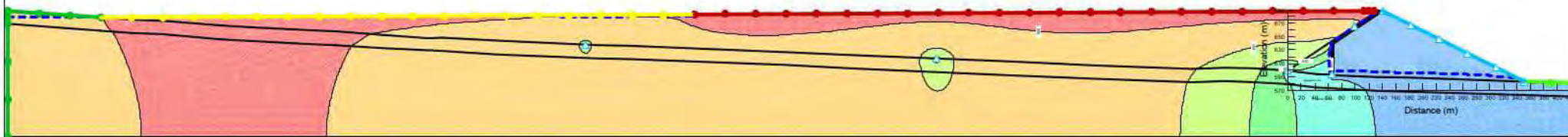


Figure B8. Water Head Contours for SUD under Operational Condition (Initial Steady State)



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Southern Underdrain

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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

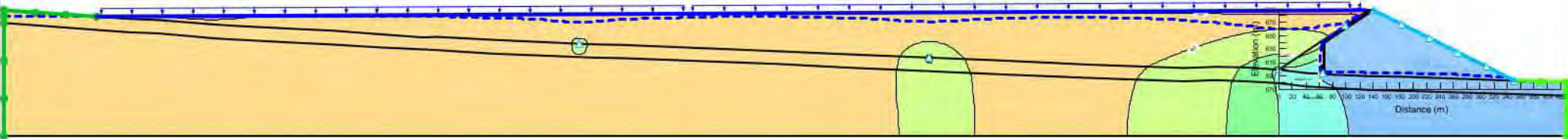


Figure B9. Water Head Contours for SUD at 1 Year after Closure

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

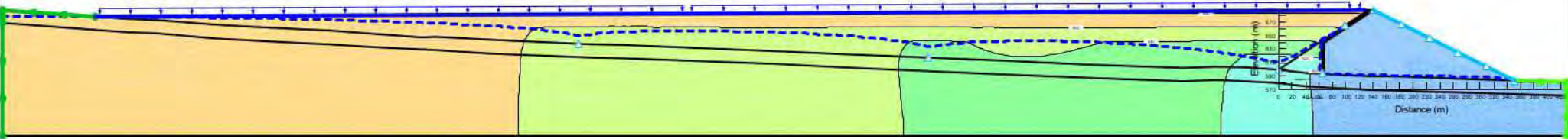


Figure B10. Water Head Contours for SUD at 10 Year after Closure

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

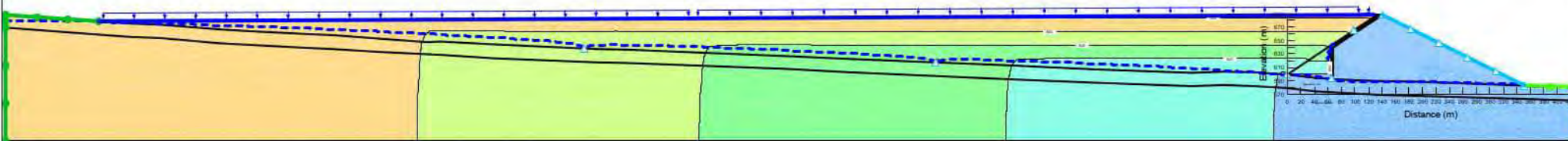


Figure B11. Water Head Contours for SUD at 100 Year after Closure



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Shepherd TSF - Seepage Analysis
Southern Underdrain

Date: 19-Jun-2025
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 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

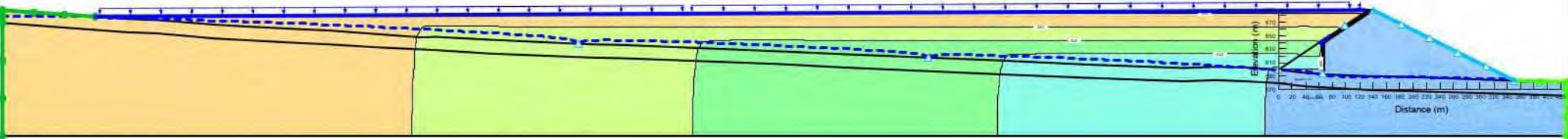


Figure B12. Water Head Contours for NUD under Final Steady State after Closure

Table B1-01. Summary of Seepage Flow Rates Over Time for NUD

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, K, with Underdrain (Best Estimate))							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.8	6.7	3.6	2.5	1.7	1.3	1.3	1.3
Chimney Drain Flows	2.2	1.5	0.5	0.2	0.1	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.1	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.6	2.4	1.9	1.6	1.3	1.2	1.2	1.2
Flow through Foundation after Chimney	0.9	0.8	0.6	0.6	0.5	0.5	0.5	0.5

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, K, without Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.8	3.0	1.8	1.3	0.9	0.6	0.5	0.5
Chimney Drain Flows	2.2	2.9	1.8	1.3	0.8	0.5	0.5	0.5
Flow through Embankment before Chimney	2.2	2.0	0.8	0.4	0.2	0.2	0.1	0.1
Flow through Foundation before Chimney	2.6	3.7	3.1	2.8	2.4	2.0	2.0	2.0
Flow through Foundation after Chimney	0.9	1.0	0.8	0.8	0.7	0.6	0.6	0.6

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, 0.2K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	3.0	2.8	2.2	1.8	1.4	1.1	1.1	1.1
Chimney Drain Flows	0.7	0.6	0.4	0.2	0.1	0.0	0.0	0.0
Flow through Embankment before Chimney	0.5	0.5	0.3	0.2	0.1	0.1	0.1	0.1
Flow through Foundation before Chimney	1.8	1.8	1.6	1.5	1.4	1.3	1.3	1.3
Flow through Foundation after Chimney	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, 2K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	14.4	9.2	4.4	2.8	1.8	1.5	1.5	1.5
Chimney Drain Flows	3.1	1.6	0.4	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	3.3	1.2	0.2	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.9	2.6	1.8	1.5	1.3	1.2	1.2	1.2
Flow through Foundation after Chimney	1.0	0.8	0.6	0.6	0.5	0.5	0.5	0.5

Location of Drains	Seepage Flow Rate (L/s) Over Time (10% Rainfall, K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.8	6.6	3.6	2.4	1.6	1.2	1.2	1.2
Chimney Drain Flows	2.2	1.5	0.5	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.1	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.6	2.4	1.9	1.6	1.3	1.2	1.2	1.2
Flow through Foundation after Chimney	0.9	0.8	0.6	0.6	0.5	0.5	0.5	0.5

Location of Drains	Seepage Flow Rate (L/s) Over Time (30% Rainfall, K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	8.8	6.7	3.7	2.6	1.8	1.5	1.5	1.5
Chimney Drain Flows	2.2	1.5	0.5	0.3	0.1	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.1	0.1	0.1
Flow through Foundation before Chimney	2.6	2.4	1.9	1.6	1.4	1.3	1.3	1.3
Flow through Foundation after Chimney	0.9	0.8	0.6	0.6	0.5	0.5	0.5	0.5

APPENDIX B
WATER HEAD CONTOURS FOR NUD

Appendix B List of Figures for NUD

Figure B1-01 – Water Head Contours for NUD under Initial Steady State (No Underdrain after closure)

Figure B1-02 – Water Head Contours for NUD at 1 Year after Closure (No Underdrain after closure)

Figure B1-03 – Water Head Contours for NUD at 10 Year after Closure (No Underdrain after closure)

Figure B1-04 – Water Head Contours for NUD at 100 Year after Closure (No Underdrain after closure)

Figure B1-05 – Water Head Contours for NUD under Final Steady State after Closure (No Underdrain after closure)

Figure B1-06 – Water Head Contours for NUD under Initial Steady State (0.2K)

Figure B1-07 – Water Head Contours for NUD at 1 Year after Closure (0.2K)

Figure B1-08 – Water Head Contours for NUD at 10 Year after Closure (0.2K)

Figure B1-09 – Water Head Contours for NUD at 100 Year after Closure (0.2K)

Figure B1-10 – Water Head Contours for NUD under Final Steady State after Closure (0.2K)

Figure B1-11 – Water Head Contours for NUD under Initial Steady State (2K)

Figure B1-12 – Water Head Contours for NUD at 1 Year after Closure (2K)

Figure B1-13 – Water Head Contours for NUD at 10 Year after Closure (2K)

Figure B1-14 – Water Head Contours for NUD at 100 Year after Closure (2K)

Figure B1-15 – Water Head Contours for NUD under Final Steady State after Closure (2K)

Figure B1-16 – Water Head Contours for NUD under Initial Steady State (10% Rainfall Infiltration)

Figure B1-17 – Water Head Contours for NUD at 1 Year after Closure (10% Rainfall Infiltration)

Figure B1-18 – Water Head Contours for NUD at 10 Year after Closure (10% Rainfall Infiltration)

Figure B1-19 – Water Head Contours for NUD at 100 Year after Closure (10% Rainfall Infiltration)

Figure B1-20 – Water Head Contours for NUD under Final Steady State after Closure (10% Rainfall Infiltration)

Figure B1-21 – Water Head Contours for NUD under Initial Steady State (30% Rainfall Infiltration)

Figure B1-22 – Water Head Contours for NUD at 1 Year after Closure (30% Rainfall Infiltration)

Figure B1-23 – Water Head Contours for NUD at 10 Year after Closure (30% Rainfall Infiltration)

Figure B1-24 – Water Head Contours for NUD at 100 Year after Closure (30% Rainfall Infiltration)

Figure B1-25 – Water Head Contours for NUD under Final Steady State after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m ³ /sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m
	RL686	Hydraulic	Water Total Head	686 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

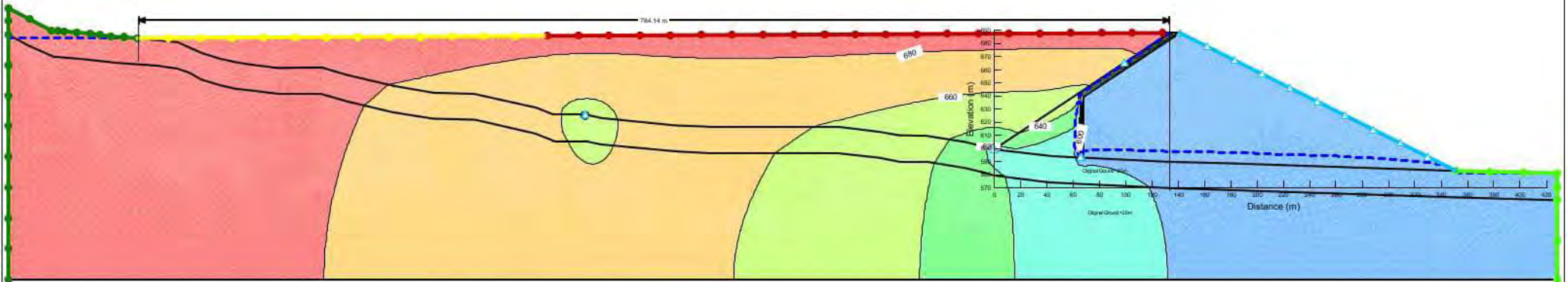


Figure B1-01 – Water Head Contours for NUD under Initial Steady State (No Underdrain after closure)



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Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

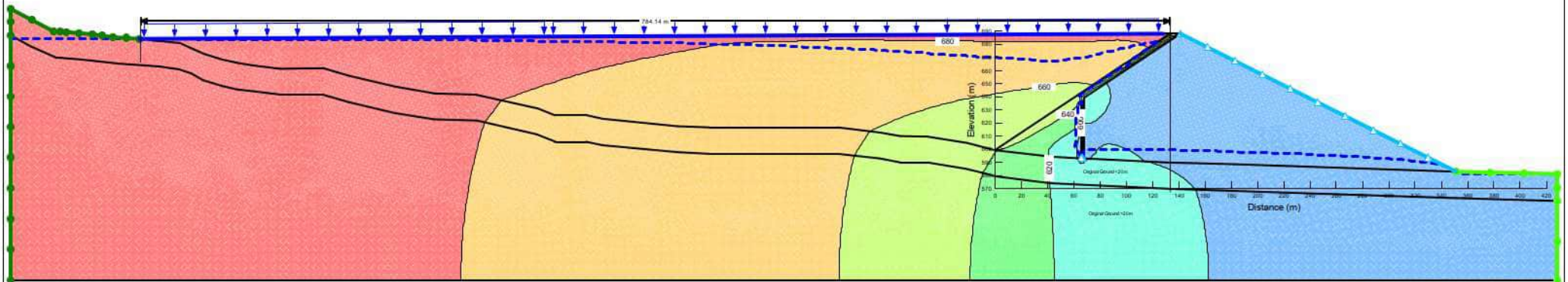


Figure B1-02 – Water Head Contours for NUD at 1 Year after Closure (No Underdrain after closure)



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Northern Underdrain

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

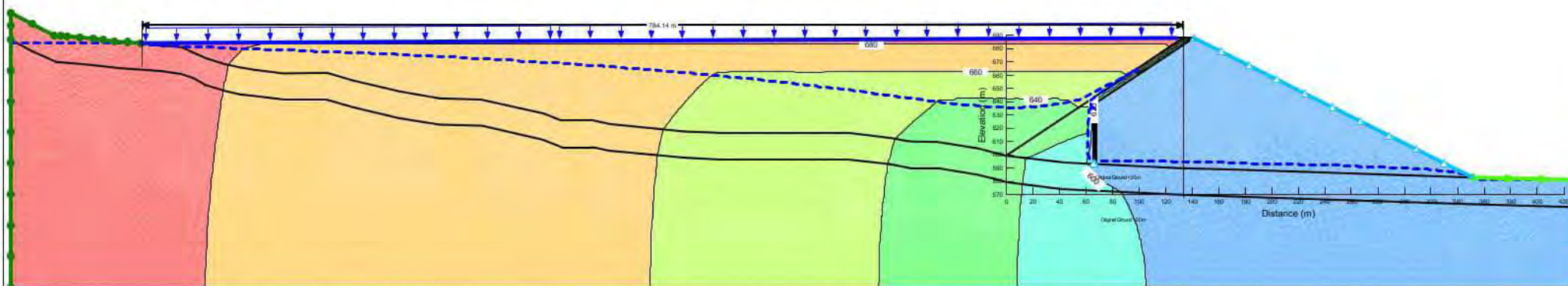


Figure B1-03 – Water Head Contours for NUD at 10 Year after Closure (No Underdrain after closure)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

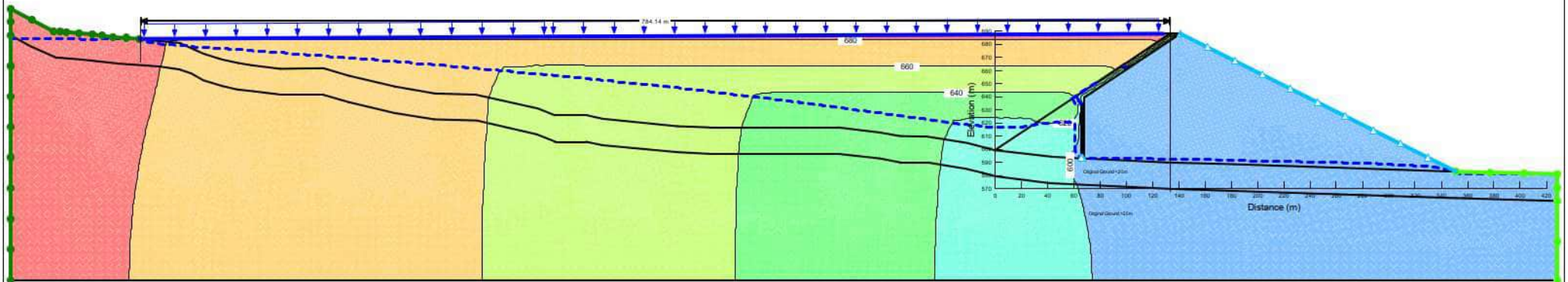


Figure B1-04 – Water Head Contours for NUD at 100 Year after Closure (No Underdrain after closure)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

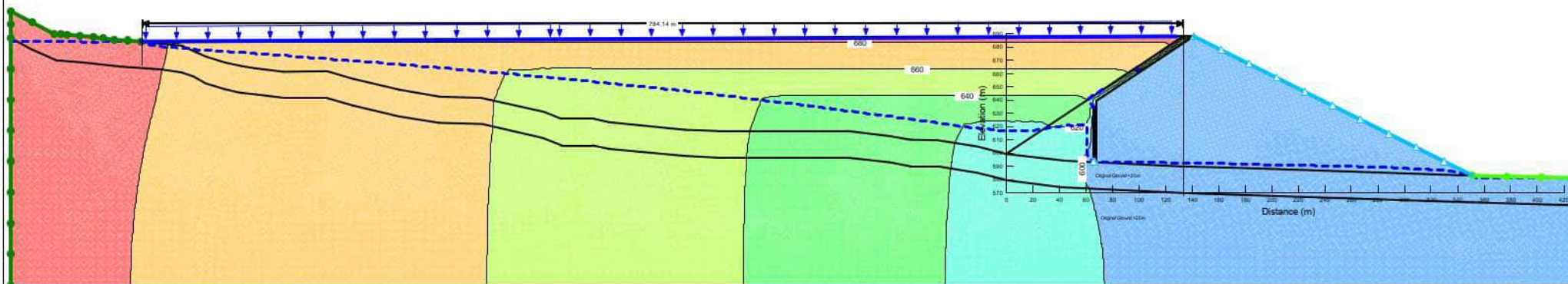


Figure B1-05 – Water Head Contours for NUD under Final Steady State after Closure (No Underdrain after closure)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

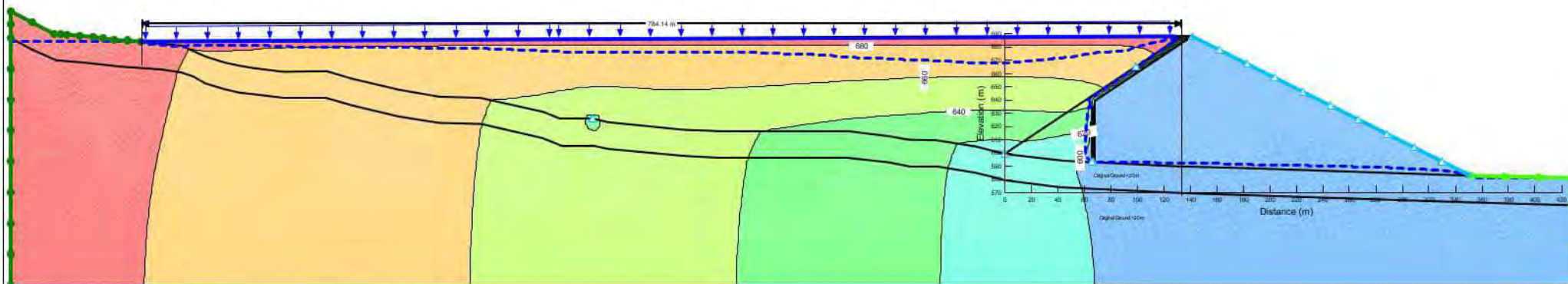


Figure B1-07 – Water Head Contours for NUD at 1 Year after Closure (0.2K)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

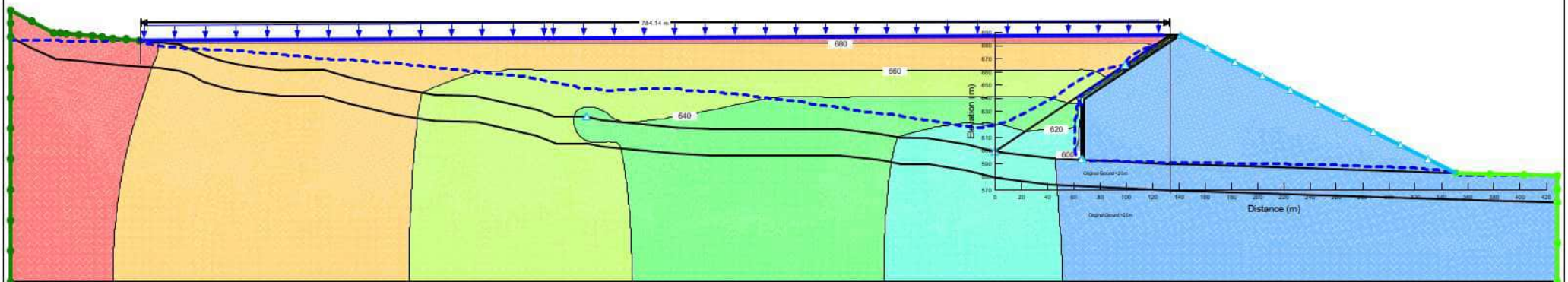


Figure B1-08 – Water Head Contours for NUD at 10 Year after Closure (0.2K)



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Date: 19-Jun-2025
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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

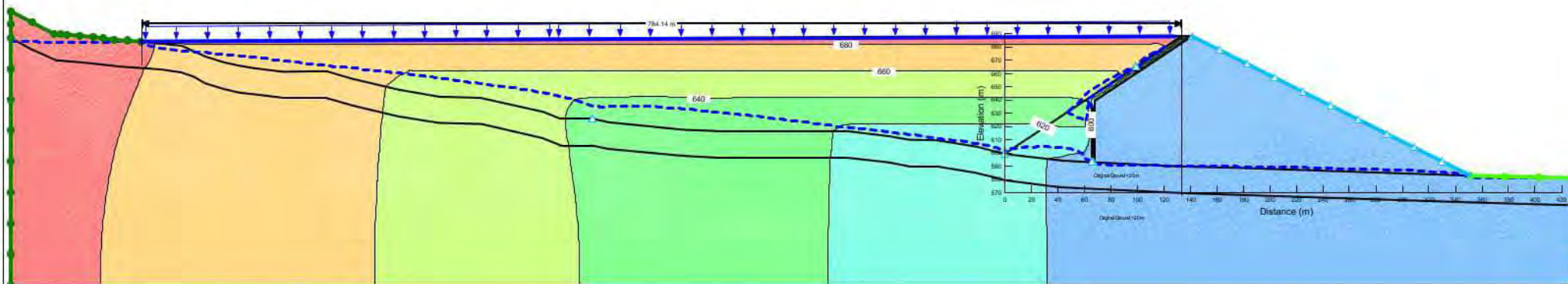


Figure B1-09 – Water Head Contours for NUD at 100 Year after Closure (0.2K)



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Date: 19-Jun-2025
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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

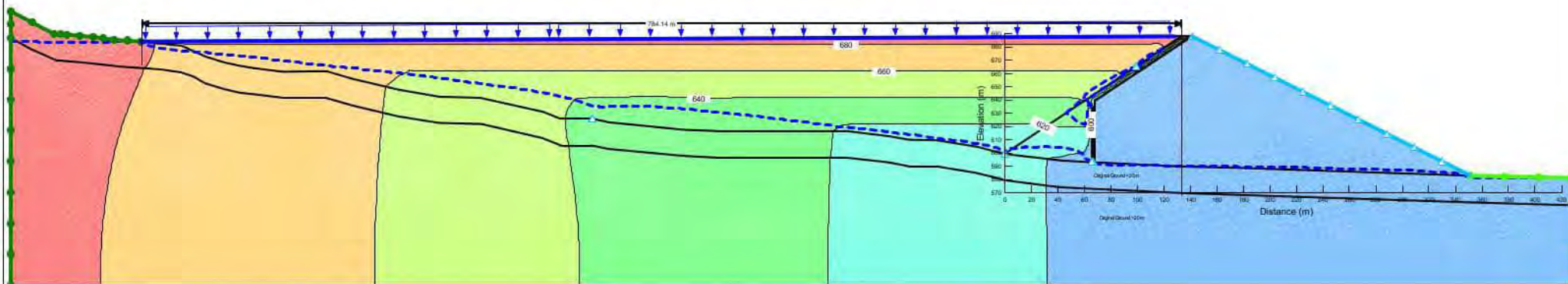
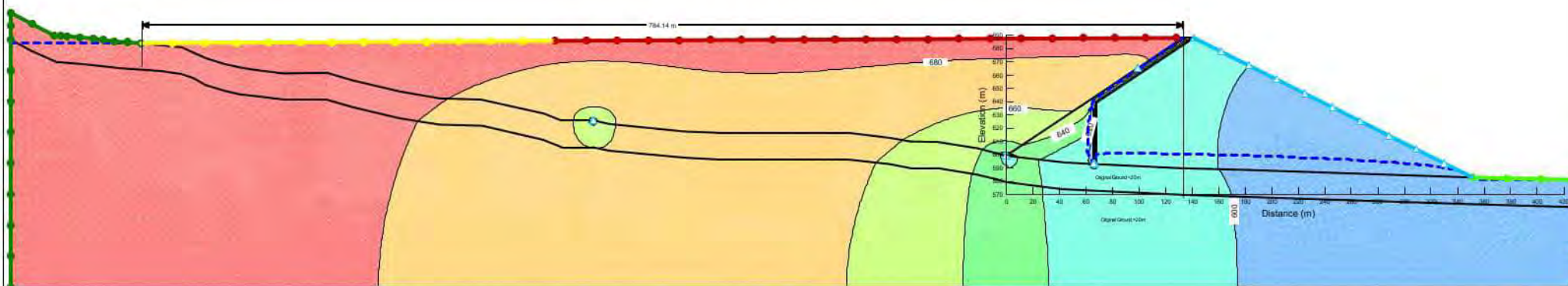


Figure B1-10 – Water Head Contours for NUD under Final Steady State after Closure (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m ³ /sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m
	RL686	Hydraulic	Water Total Head	686 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

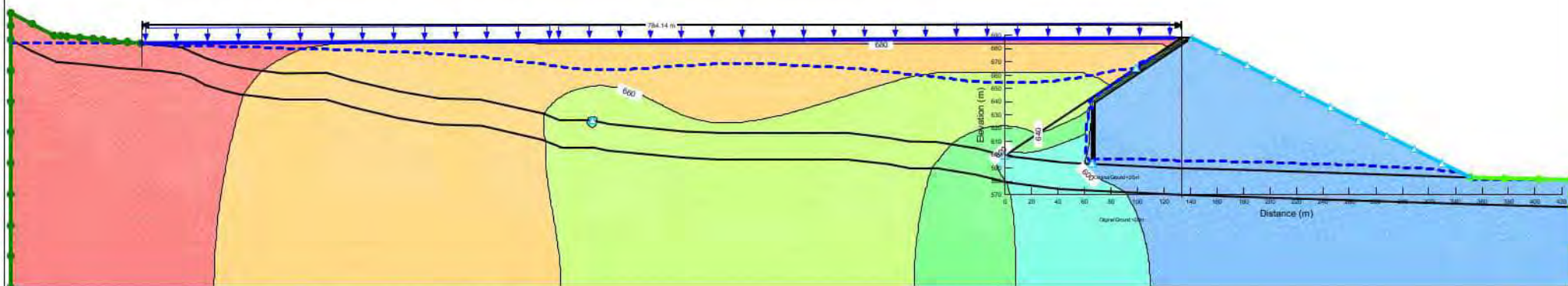


Figure B1-12 – Water Head Contours for NUD at 1 Year after Closure (2K)



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Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

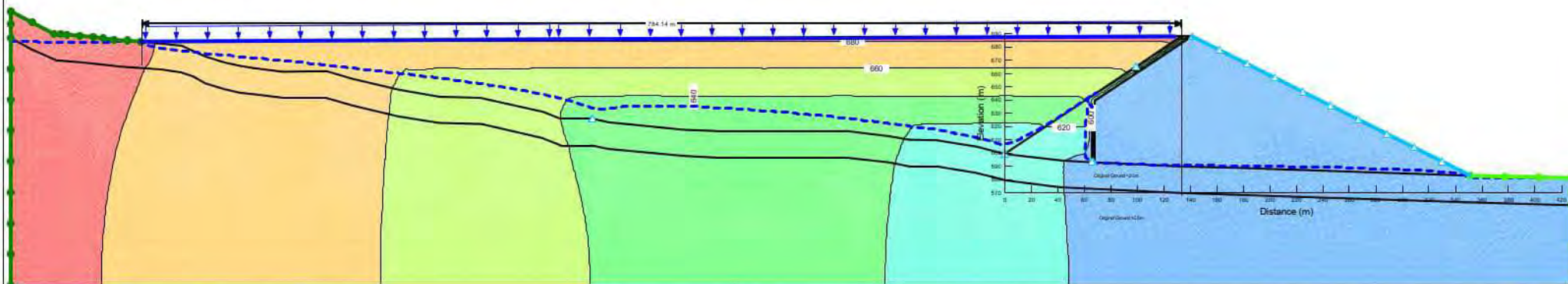


Figure B1-13 – Water Head Contours for NUD at 10 Year after Closure (2K)



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MATAKANUI GOLD LIMITED **Shepherd TSF - Seepage Analysis** **Northern Underdrain**

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

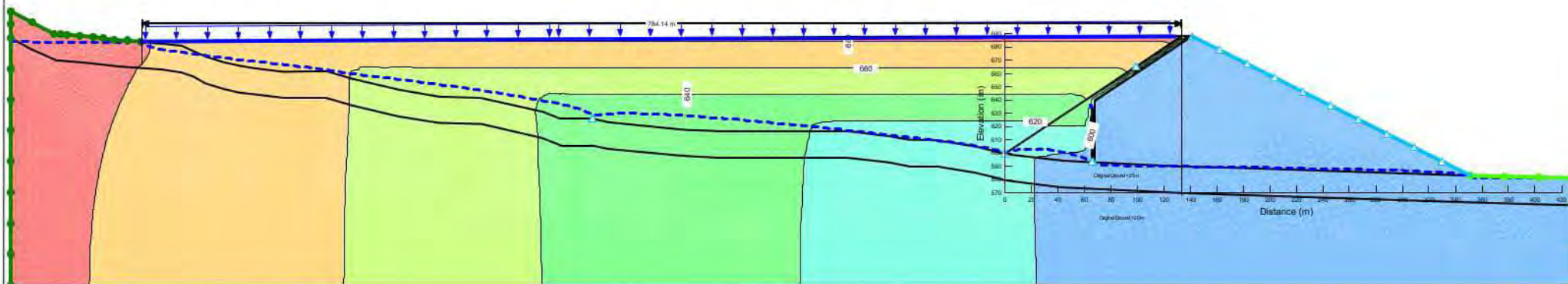


Figure B1-14 – Water Head Contours for NUD at 100 Year after Closure (2K)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

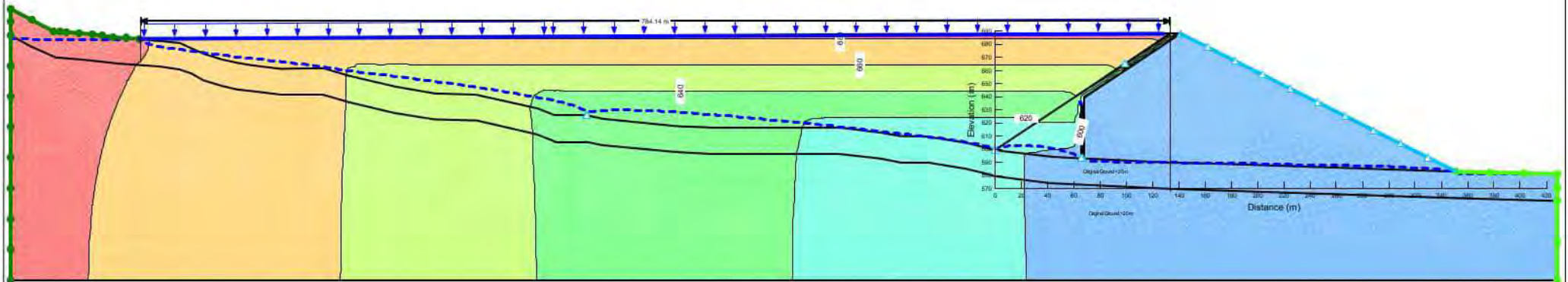


Figure B1-15 – Water Head Contours for NUD under Final Steady State after Closure (2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m ³ /sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m
	RL686	Hydraulic	Water Total Head	686 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

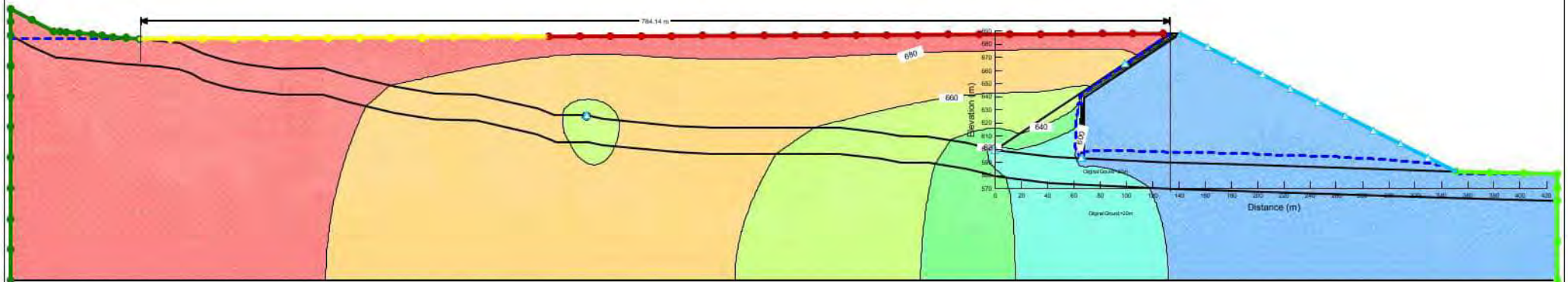


Figure B1-16 – Water Head Contours for NUD under Initial Steady State (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

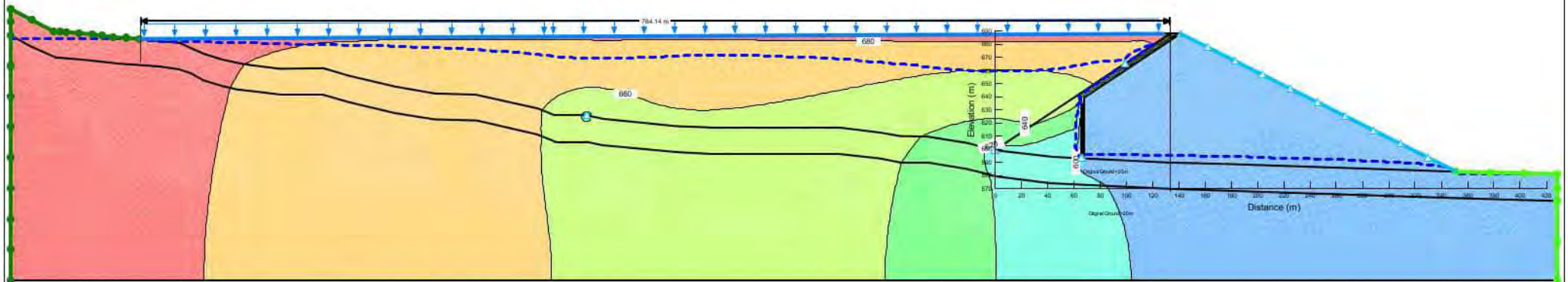


Figure B1-17 – Water Head Contours for NUD at 1 Year after Closure (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

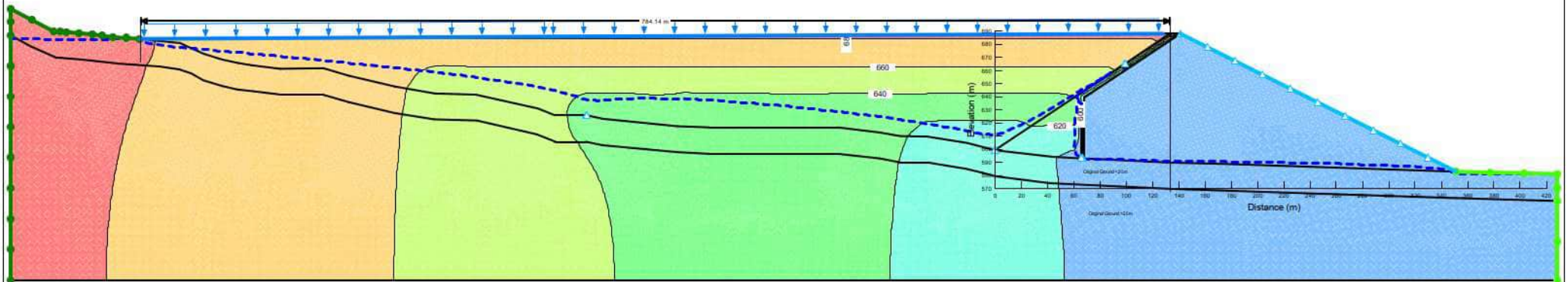


Figure B1-18 – Water Head Contours for NUD at 10 Year after Closure (10% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

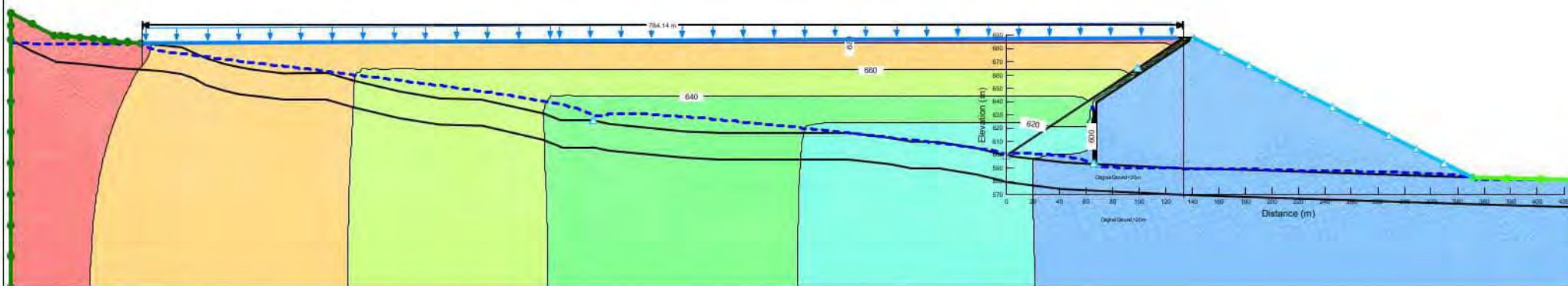


Figure B1-19 – Water Head Contours for NUD at 100 Year after Closure (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

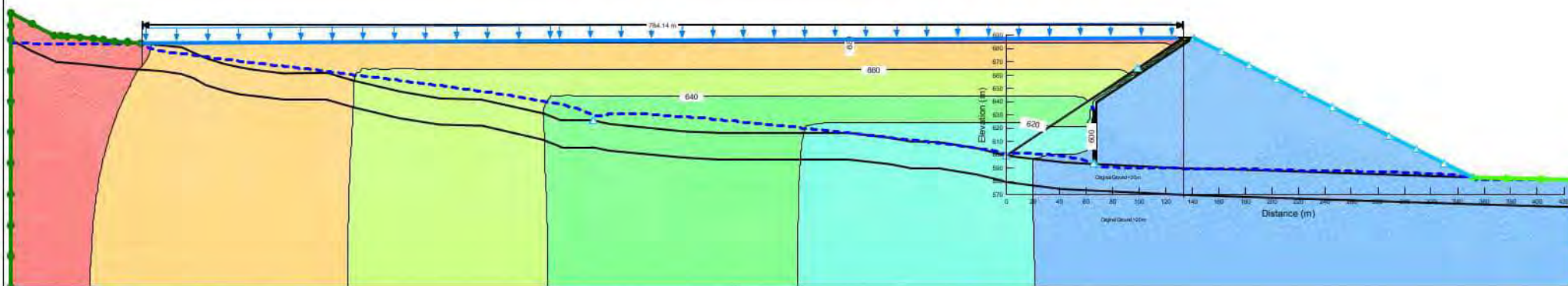


Figure B1-20 – Water Head Contours for NUD under Final Steady State after Closure (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m
	RL686	Hydraulic	Water Total Head	686 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

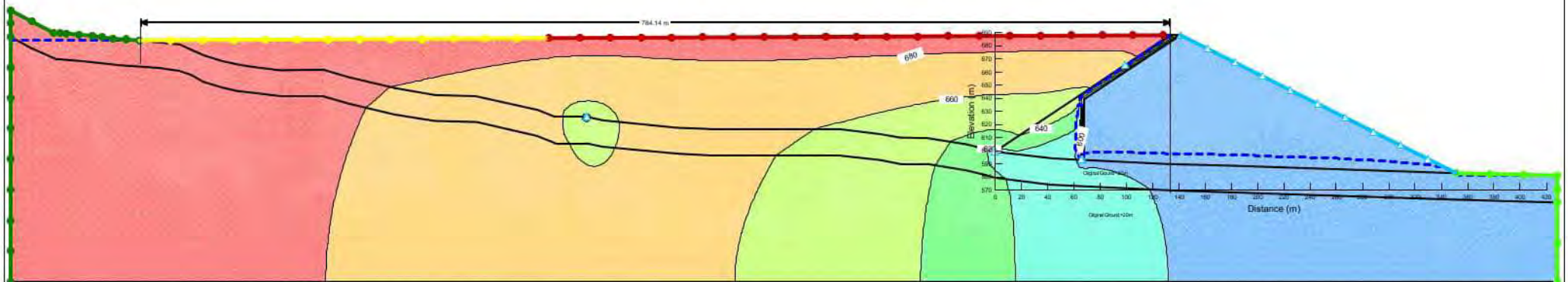


Figure B1-21 – Water Head Contours for NUD under Initial Steady State (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

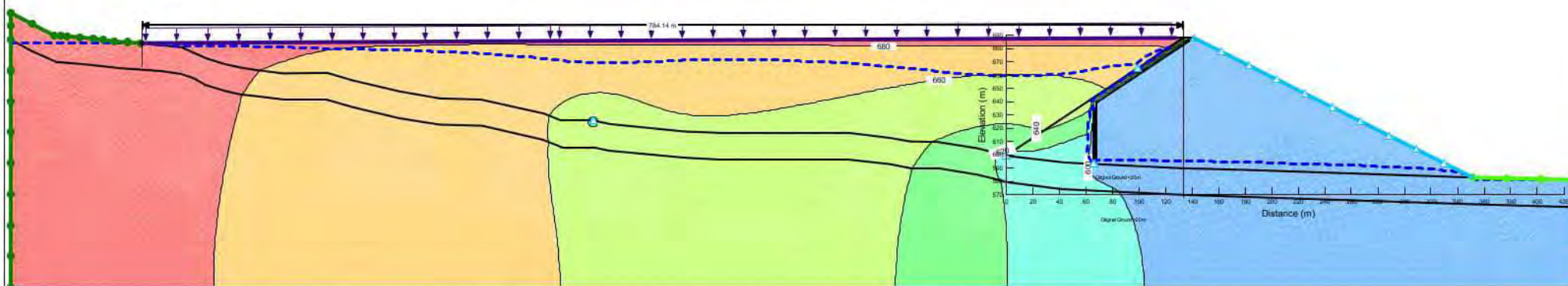


Figure B1-22 – Water Head Contours for NUD at 1 Year after Closure (30% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

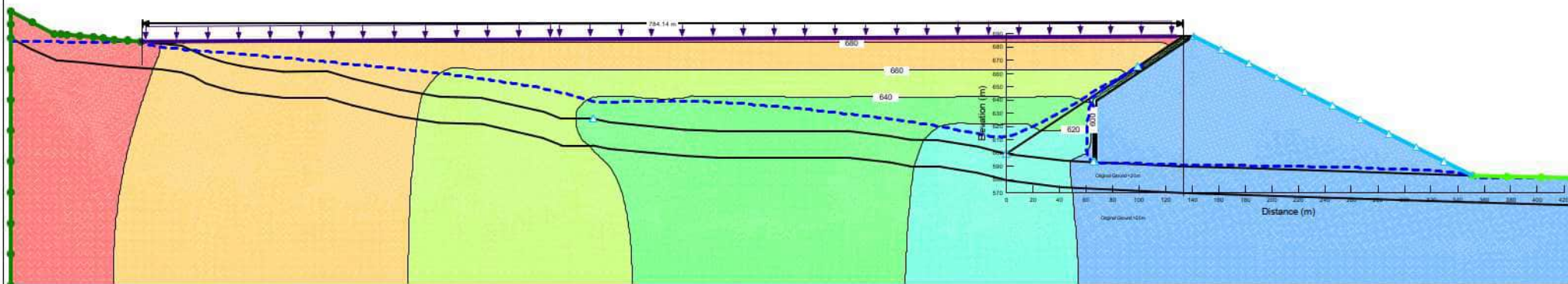


Figure B1-23 – Water Head Contours for NUD at 10 Year after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

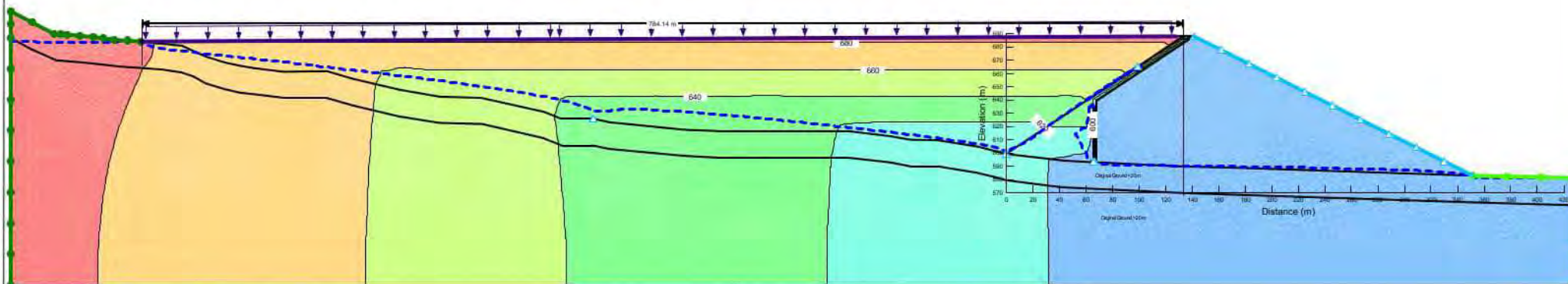


Figure B1-24 – Water Head Contours for NUD at 100 Year after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL684 Left	Hydraulic	Water Total Head	684 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx' Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

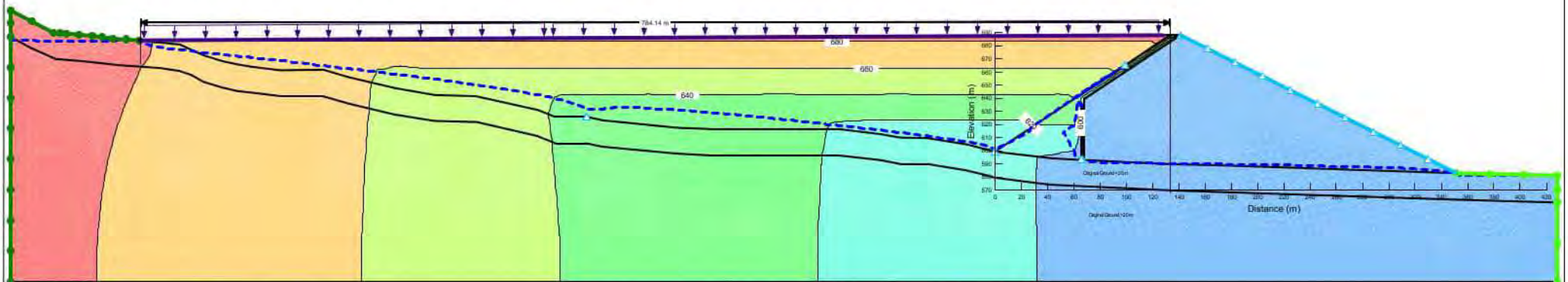


Figure B1-25 – Water Head Contours for NUD under Final Steady State after Closure (30% Rainfall Infiltration)

Table B2-01. Summary of Seepage Flow Rates Over Time for SUD

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, K, with Underdrain (Best Estimate))							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	7.2	5.4	2.8	1.7	0.7	0.1	0.1	0.1
Chimney Drain Flows	2.2	1.5	0.6	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.5	2.4	1.8	1.5	1.2	1.0	0.9	0.9
Final Flow through Foundation	1.6	1.7	1.4	1.2	1.0	0.8	0.8	0.8

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, K, without Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	7.2	2.9	1.8	1.3	0.8	0.4	0.3	0.3
Chimney Drain Flows	2.2	2.9	1.8	1.2	0.8	0.4	0.3	0.3
Flow through Embankment before Chimney	2.2	2.0	0.8	0.4	0.2	0.1	0.1	0.1
Flow through Foundation before Chimney	2.5	3.6	3.1	2.7	2.3	1.8	1.6	1.5
Final Flow through Foundation	1.6	2.4	2.2	1.9	1.7	1.4	1.3	1.2

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, 0.2K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	1.9	1.7	1.2	0.8	0.4	0.1	0.0	0.0
Chimney Drain Flows	0.6	0.6	0.3	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	0.5	0.4	0.2	0.2	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	1.6	1.6	1.4	1.3	1.1	1.0	0.9	0.9
Final Flow through Foundation	1.3	1.2	1.1	1.1	1.0	0.8	0.8	0.8

Location of Drains	Seepage Flow Rate (L/s) Over Time (20% Rainfall, 2K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	12.4	7.9	3.7	2.0	0.8	0.2	0.1	0.1
Chimney Drain Flows	3.0	1.7	0.5	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	3.3	1.2	0.2	0.1	0.0	0.0	0.0	0.0
Flow through Foundation before Chimney	2.8	2.6	1.8	1.4	1.1	1.0	0.9	0.9
Final Flow through Foundation	1.7	1.8	1.4	1.1	1.0	0.8	0.8	0.8

Location of Drains	Seepage Flow Rate (L/s) Over Time (10% Rainfall, K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	7.2	5.4	2.8	1.6	0.6	0.1	0.1	0.0
Chimney Drain Flows	2.2	1.5	0.6	0.2	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.5	2.4	1.8	1.5	1.1	0.9	0.8	0.8
Final Flow through Foundation	1.6	1.7	1.4	1.2	1.0	0.8	0.7	0.6

Location of Drains	Seepage Flow Rate (L/s) Over Time (30% Rainfall, K, with Underdrain)							
	Initial Condition	1Yr	5Yr	10Yr	20Yr	50Yr	100Yr	Final Steady State
Total Drain Flows	7.2	5.4	2.9	1.7	0.8	0.3	0.2	0.2
Chimney Drain Flows	2.2	1.5	0.6	0.3	0.0	0.0	0.0	0.0
Flow through Embankment before Chimney	2.2	1.2	0.3	0.1	0.1	0.0	0.0	0.0
Flow through Foundation before Chimney	2.5	2.4	1.8	1.5	1.2	1.0	1.0	1.0
Final Flow through Foundation	1.6	1.7	1.4	1.2	1.0	0.9	0.9	0.9

APPENDIX B
WATER HEAD CONTOURS FOR SUD

Appendix B List of Figures for SUD

Figure B2-01 – Water Head Contours for SUD under Initial Steady State (No Underdrain after closure)

Figure B2-02 – Water Head Contours for SUD at 1 Year after Closure (No Underdrain after closure)

Figure B2-03 – Water Head Contours for SUD at 10 Year after Closure (No Underdrain after closure)

Figure B2-04 – Water Head Contours for SUD at 100 Year after Closure (No Underdrain after closure)

Figure B2-05 – Water Head Contours for SUD under Final Steady State after Closure (No Underdrain after closure)

Figure B2-06 – Water Head Contours for SUD under Initial Steady State (0.2K)

Figure B2-07 – Water Head Contours for SUD at 1 Year after Closure (0.2K)

Figure B2-08 – Water Head Contours for SUD at 10 Year after Closure (0.2K)

Figure B2-09 – Water Head Contours for SUD at 100 Year after Closure (0.2K)

Figure B2-10 – Water Head Contours for SUD under Final Steady State after Closure (0.2K)

Figure B2-11 – Water Head Contours for SUD under Initial Steady State (2K)

Figure B2-12 – Water Head Contours for SUD at 1 Year after Closure (2K)

Figure B2-13 – Water Head Contours for SUD at 10 Year after Closure (2K)

Figure B2-14 – Water Head Contours for SUD at 100 Year after Closure (2K)

Figure B2-15 – Water Head Contours for SUD under Final Steady State after Closure (2K)

Figure B2-16 – Water Head Contours for SUD under Initial Steady State (10% Rainfall Infiltration)

Figure B2-17 – Water Head Contours for SUD at 1 Year after Closure (10% Rainfall Infiltration)

Figure B2-18 – Water Head Contours for SUD at 10 Year after Closure (10% Rainfall Infiltration)

Figure B2-19 – Water Head Contours for SUD at 100 Year after Closure (10% Rainfall Infiltration)

Figure B2-20 – Water Head Contours for SUD under Final Steady State after Closure (10% Rainfall Infiltration)

Figure B2-21 – Water Head Contours for SUD under Initial Steady State (30% Rainfall Infiltration)

Figure B2-22 – Water Head Contours for SUD at 1 Year after Closure (30% Rainfall Infiltration)

Figure B2-23 – Water Head Contours for SUD at 10 Year after Closure (30% Rainfall Infiltration)

Figure B2-24 – Water Head Contours for SUD at 100 Year after Closure (30% Rainfall Infiltration)

Figure B2-25 – Water Head Contours for SUD under Final Steady State after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

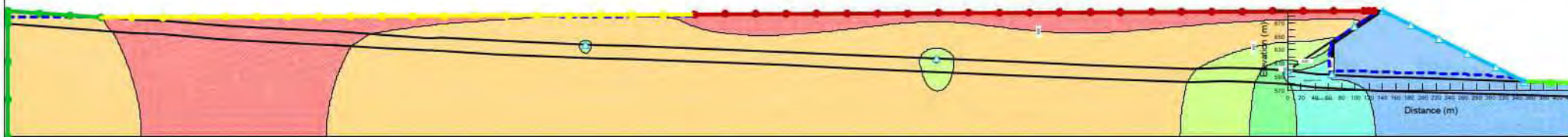


Figure B2-01 – Water Head Contours for SUD under Initial Steady State (No Underdrain after closure)



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Shepherd TSF - Seepage Analysis
Southern Underdrain

Date: 19-Jun-2025
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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

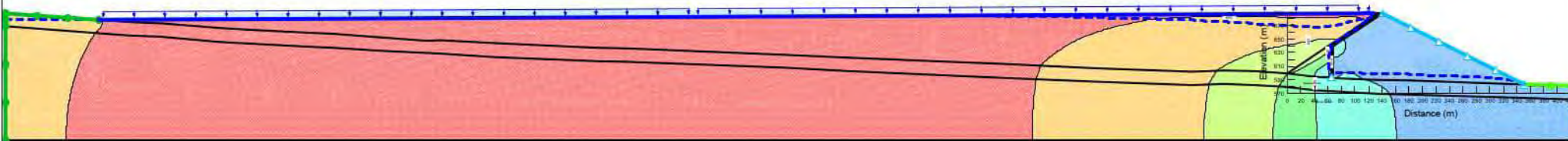


Figure B2-02 – Water Head Contours for SUD at 1 Year after Closure (No Underdrain after closure)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

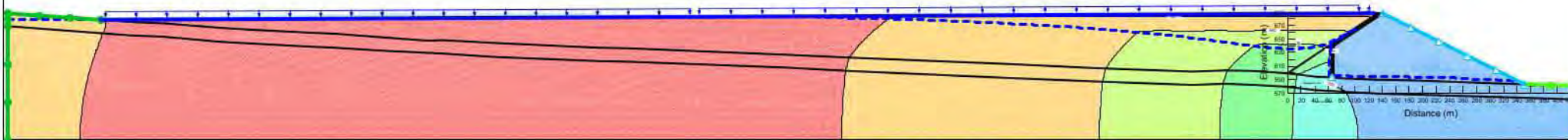


Figure B2-03 – Water Head Contours for SUD at 10 Year after Closure (No Underdrain after closure)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

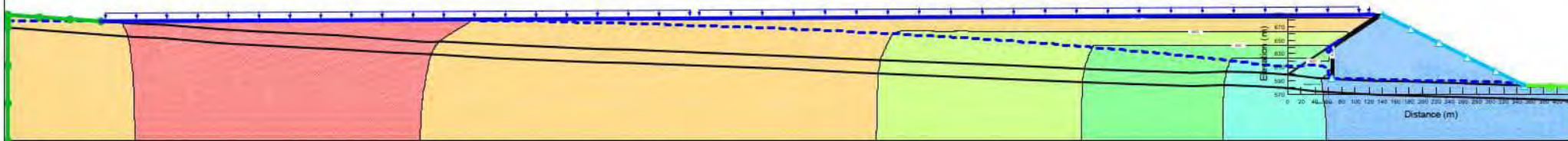


Figure B2-04 – Water Head Contours for SUD at 100 Year after Closure (No Underdrain after closure)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

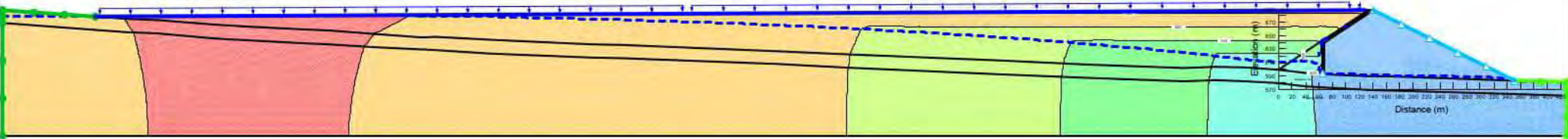


Figure B2-05 – Water Head Contours for SUD under Final Steady State after Closure (No Underdrain after closure)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

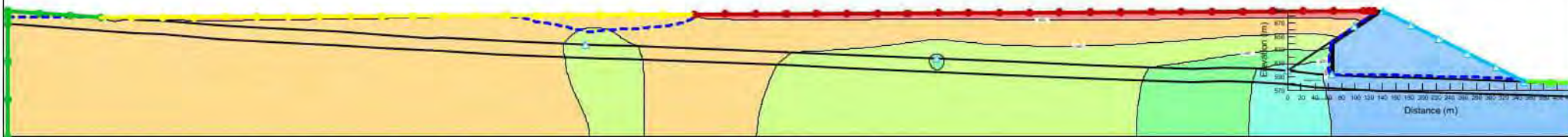


Figure B2-06 – Water Head Contours for SUD under Initial Steady State (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

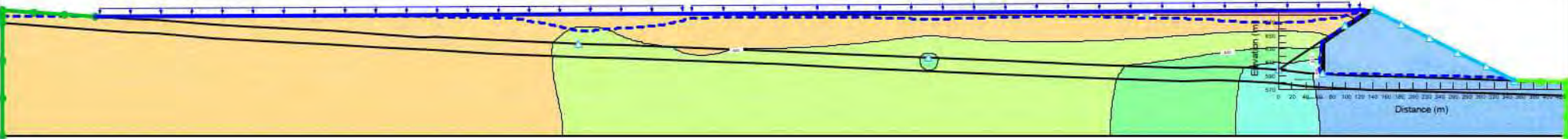


Figure B2-07 – Water Head Contours for SUD at 1 Year after Closure (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

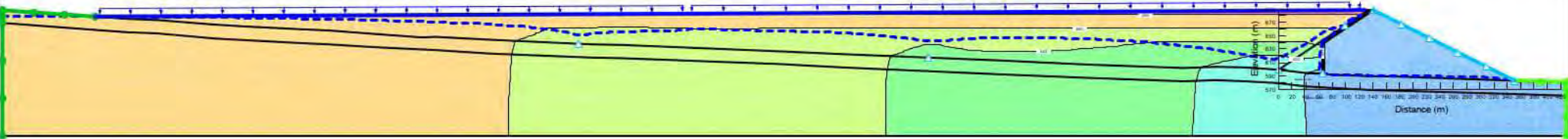


Figure B2-08 – Water Head Contours for SUD at 10 Year after Closure (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/I Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

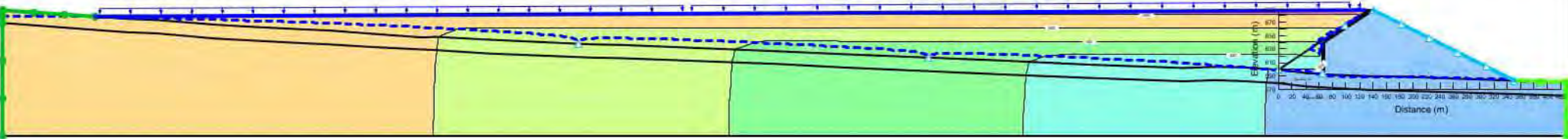


Figure B2-09 – Water Head Contours for SUD at 100 Year after Closure (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings LP	Saturated / Unsaturated	Tailings	Tailings LP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

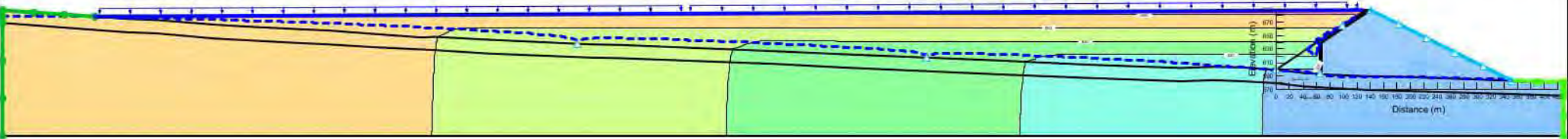


Figure B2-10 – Water Head Contours for SUD under Final Steady State after Closure (0.2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/K Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

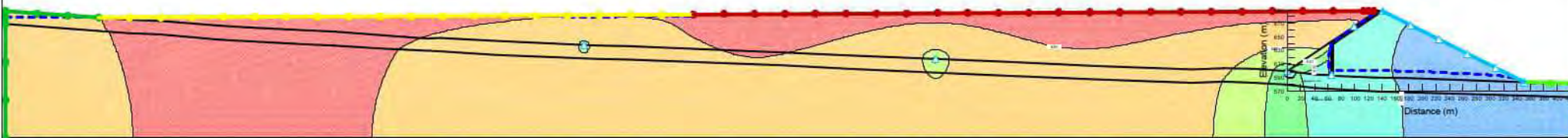


Figure B2-11 – Water Head Contours for SUD under Initial Steady State (2K)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

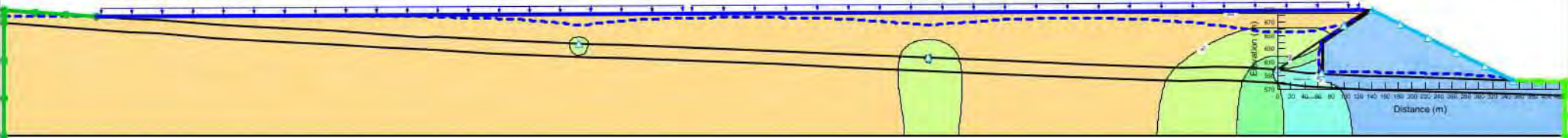


Figure B2-12 – Water Head Contours for SUD at 1 Year after Closure (2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/K Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

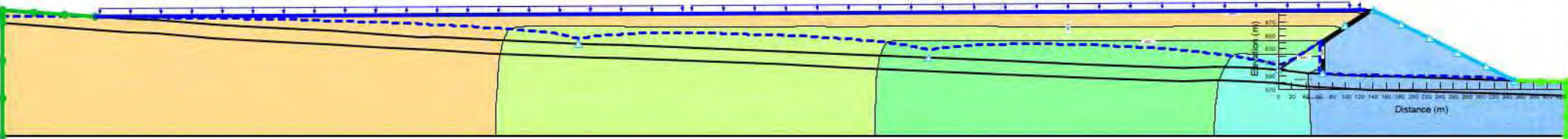


Figure B2-13 – Water Head Contours for SUD at 10 Year after Closure (2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

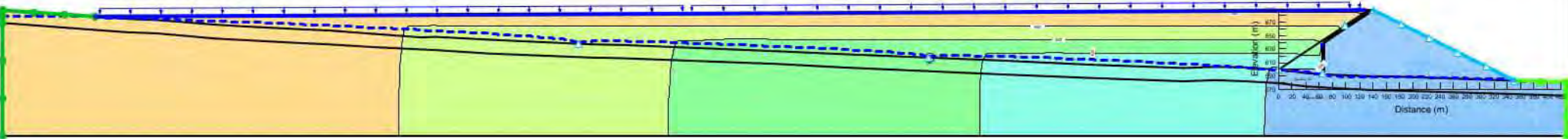


Figure B2-14 – Water Head Contours for SUD at 100 Year after Closure (2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 20	Hydraulic	Water Flux	3.9583333e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Hz Ratio
	Drainage Material	Saturated Only			0.1	1
	Original Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings HP	Saturated / Unsaturated	Tailings	Tailings HP		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

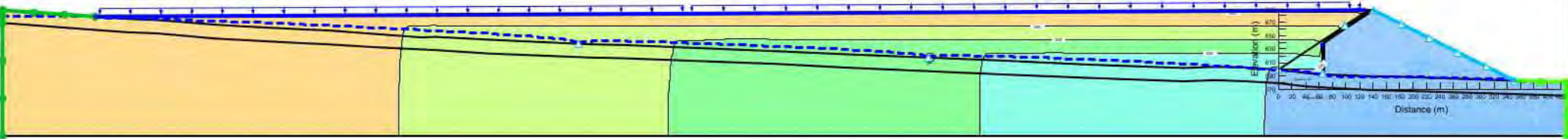


Figure B2-15 – Water Head Contours for SUD under Final Steady State after Closure (2K)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

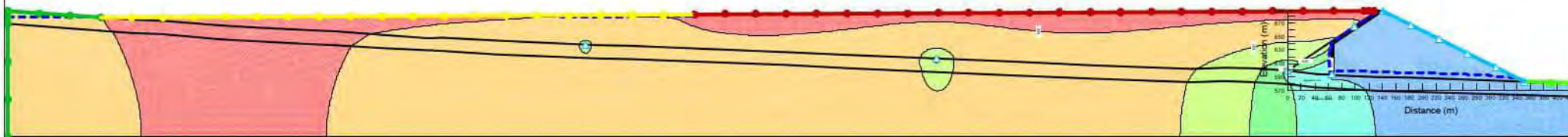


Figure B2-16 – Water Head Contours for SUD under Initial Steady State (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

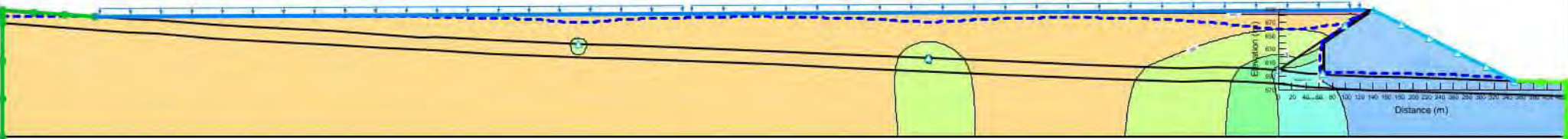


Figure B2-17 – Water Head Contours for SUD at 1 Year after Closure (10% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

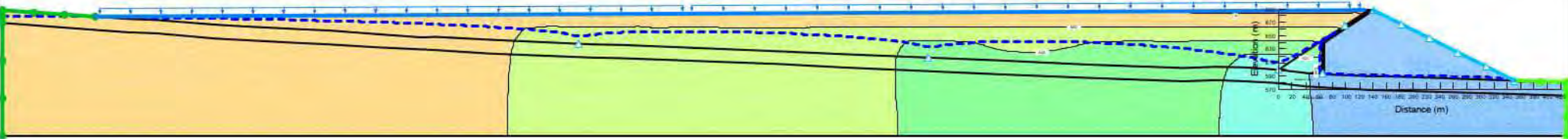


Figure B2-18 – Water Head Contours for SUD at 10 Year after Closure (10% Rainfall Infiltration)



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Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

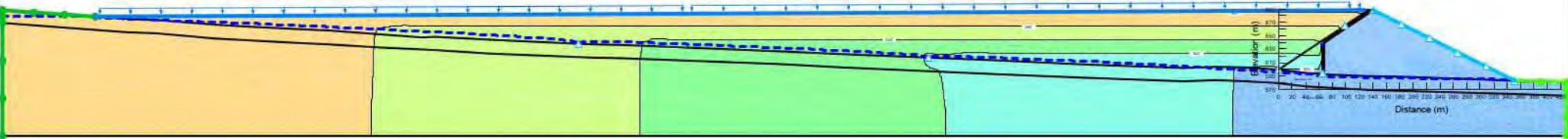


Figure B2-19 – Water Head Contours for SUD at 100 Year after Closure (10% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 10	Hydraulic	Water Flux	1.9791667e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

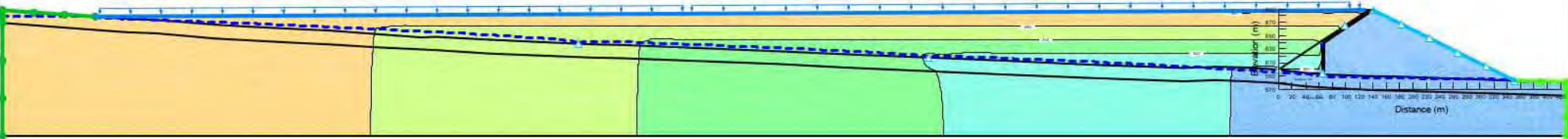


Figure B2-20 – Water Head Contours for SUD under Final Steady State after Closure (10% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m
	RL680.7	Hydraulic	Water Total Head	680.7 m
	Zero Pressure	Hydraulic	Water Pressure Head	0 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

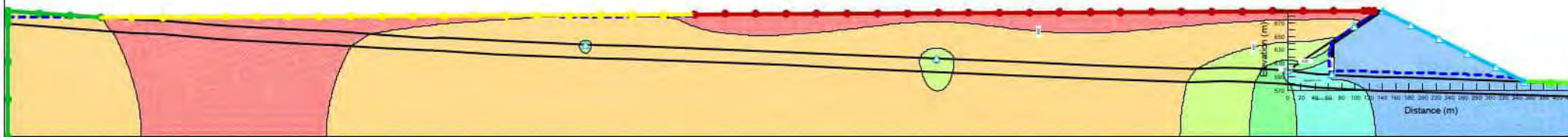


Figure B2-21 – Water Head Contours for SUD under Initial Steady State (30% Rainfall Infiltration)



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Shepherd TSF - Seepage Analysis
Southern Underdrain

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

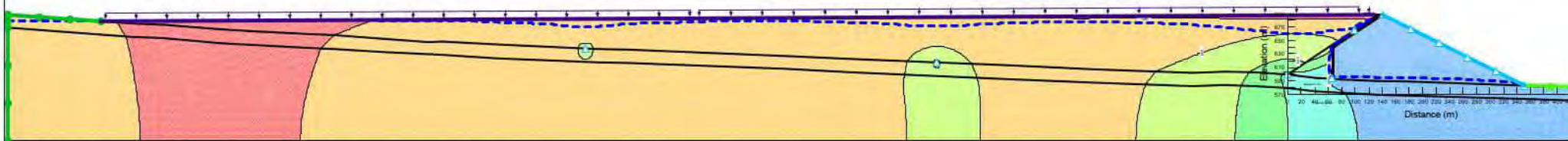


Figure B2-22 – Water Head Contours for SUD at 1 Year after Closure (30% Rainfall Infiltration)



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Shepherd TSF - Seepage Analysis
Southern Underdrain

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

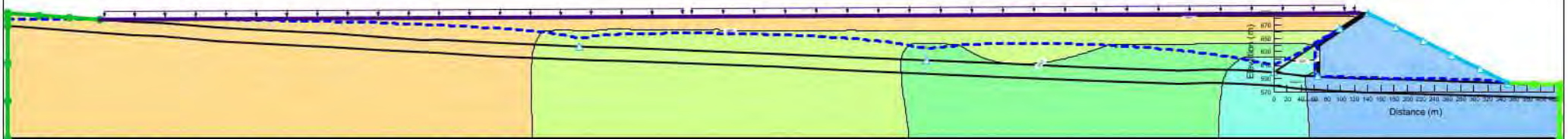


Figure B2-23 – Water Head Contours for SUD at 10 Year after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kx Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

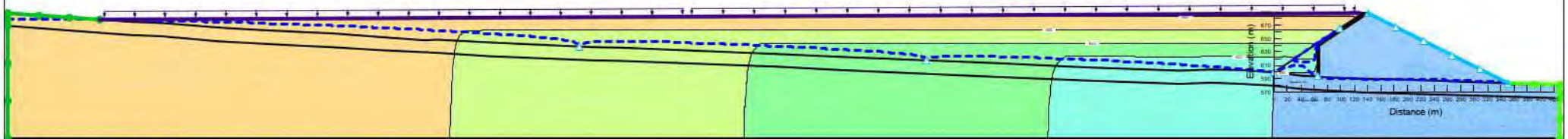


Figure B2-24 – Water Head Contours for SUD at 100 Year after Closure (30% Rainfall Infiltration)

Color	Name	Category	Kind	Parameters
	Potential Seepage Face	Hydraulic	Water Rate	0 m³/sec
	Rainfall Infiltration 30	Hydraulic	Water Flux	5.9490741e-09 m/sec
	RL580.9 Right	Hydraulic	Water Total Head	580.9 m
	RL678.7 Left	Hydraulic	Water Total Head	678.7 m

Color	Name	Hydraulic Material Model	Vol. WC. Function	K-Function	Sat Kx (m/sec)	Ky/Kz Ratio
	Drainage Material	Saturated Only			0.1	1
	Orginal Ground >20m	Saturated Only			5e-07	2.5
	Original Ground <20m	Saturated Only			2e-07	2.5
	Tailings	Saturated / Unsaturated	Tailings	Tailings		0.5
	Zone A1	Saturated / Unsaturated	Zone A1	Zone A1		0.1
	Zone B	Saturated Only			5e-06	0.5

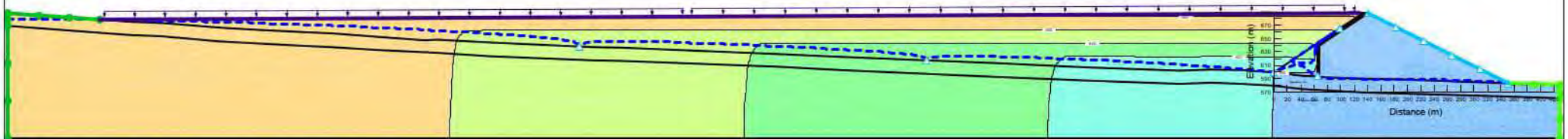


Figure B2-25 – Water Head Contours for SUD under Final Steady State after Closure (30% Rainfall Infiltration)



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Shepherd TSF - Seepage Analysis
Southern Underdrain

Date: 19-Jun-2025
 Drawn: YW
 Ref: 9702

APPENDIX C

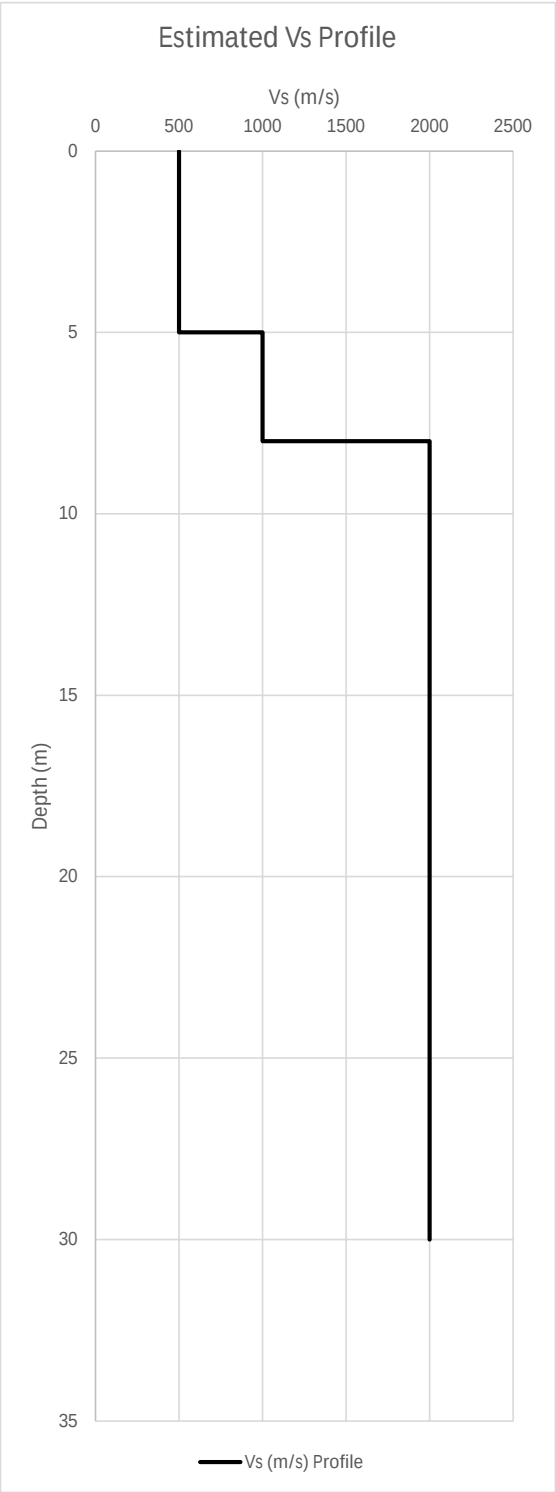
STABILITY ANALYSES CO-SEISMIC DEFORMATION CALCULATIONS

V_{s30} Assessment

Shearwave Velocity Profile Estimate - Based on Downhole Shear Wave Testing in MDD394

Simplified Soil Profile

Depth (m)	
0m	Alluvial or landslide deposits - shear wave velocity based on EGL past experience and tests in similar soil conditions.
8m	Torlesse TZ3 Schist - shear wave velocity based on downhole shear wave testing in MDD394.
30m	End of hole

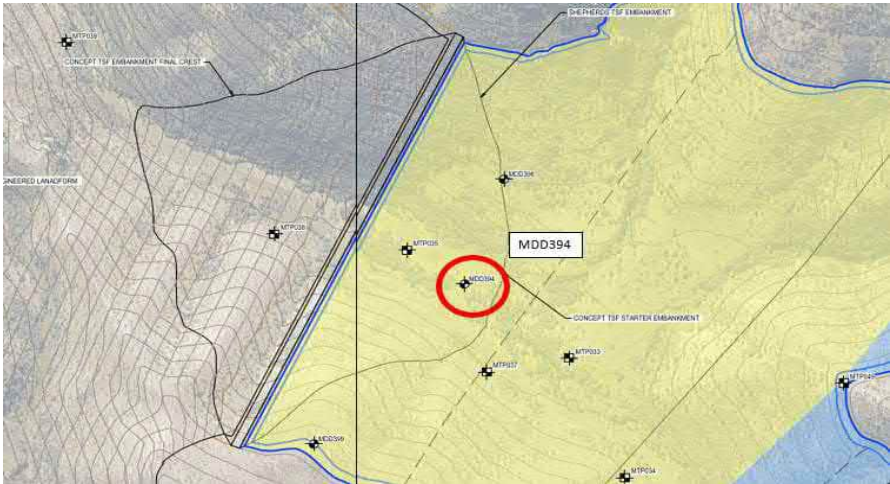


Vs Profile for Vs30 estimate

Layer No.	Layer thickness (m)	Layer Top (m)	Layer Bottom (m)	Vs (m/s) Profile	Layer travel time (s)
1	5	0	5	500	0.0100
2	3	5	8	1000	0.0030
3	2	8	10	2000	0.0010
4	2	10	12	2000	0.0010
5	3	12	15	2000	0.0015
6	5	15	20	2000	0.0025
7	5	20	25	2000	0.0025
8	5	25	30	2000	0.0025

Vs30 Estimate 1250 m/s

Location of MDD394 circled in red.



Stability Analysis Result Outputs

Section 3 – Starter Embankment

Section 3 – Starter Embankment
Without FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.91

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$					1

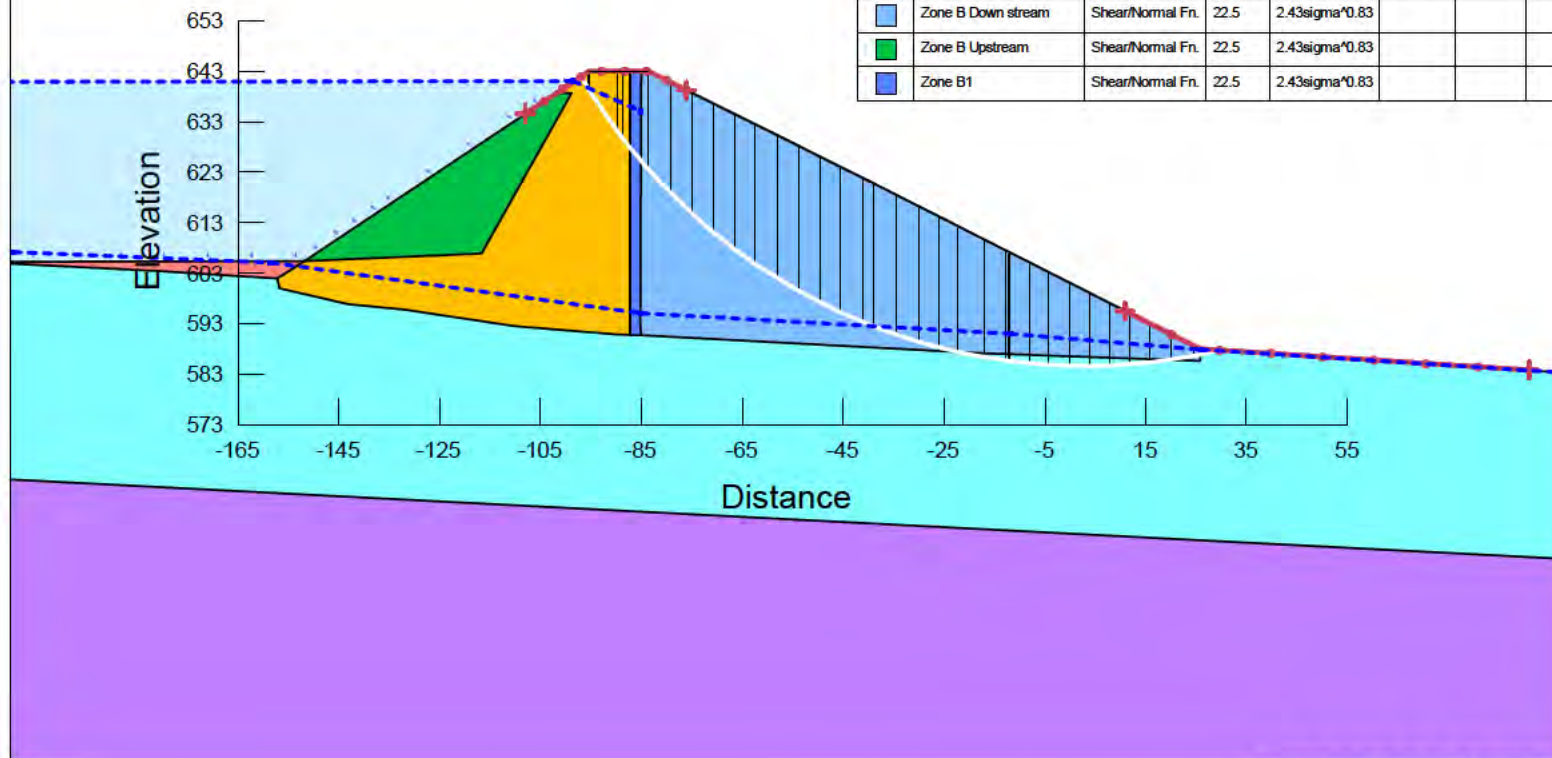


Fig C01.01-StartEmbOp-DS-PMP-Circ-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.55

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1

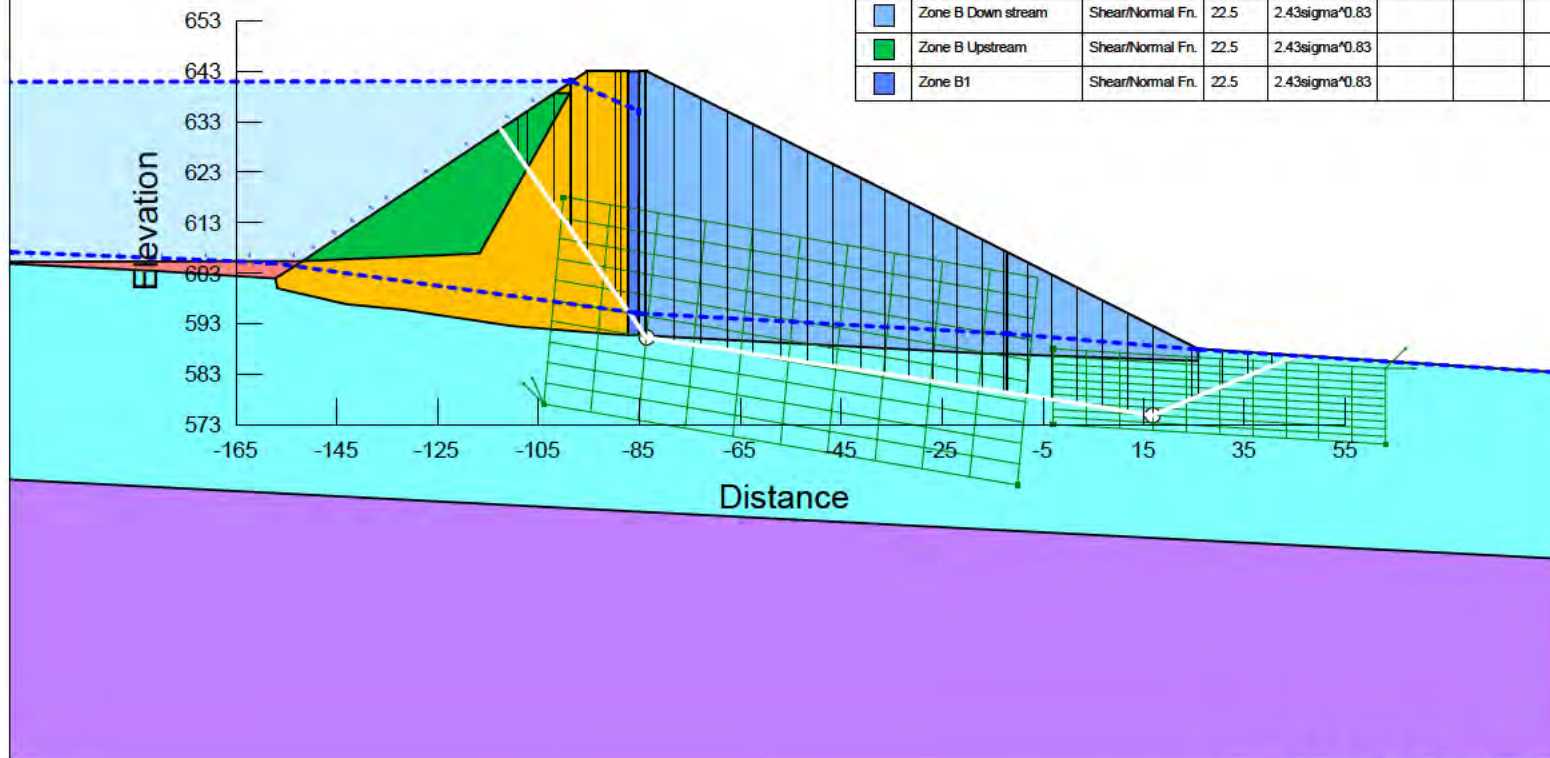


Fig C01.02-StartEmbOp-DS-PMP-Block-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.91

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma \cdot 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma \cdot 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma \cdot 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma \cdot 0.83$							1

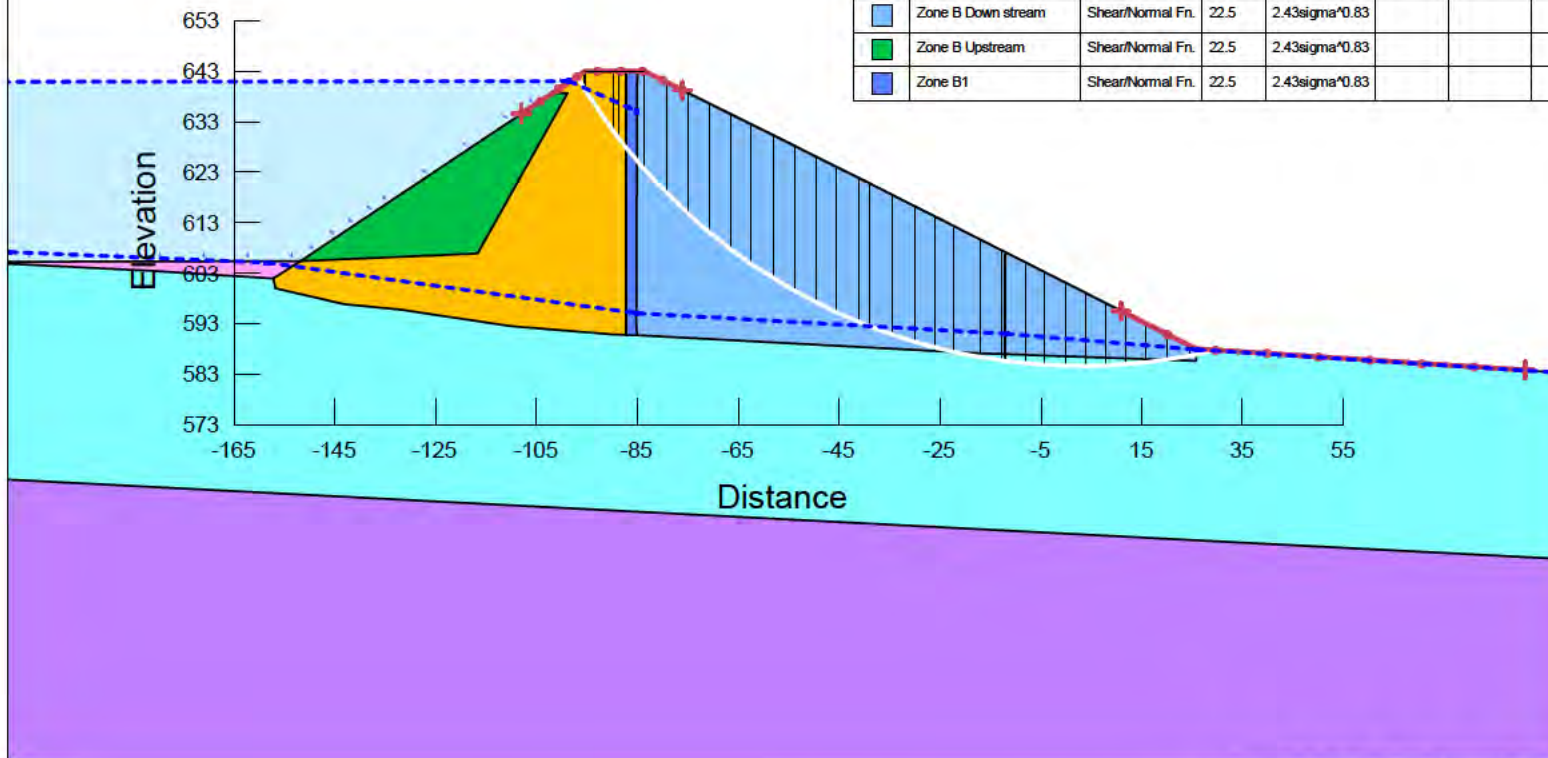


Fig C01.03-StartEmbOp-DS-PMP-Circ-PeakUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.55

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1

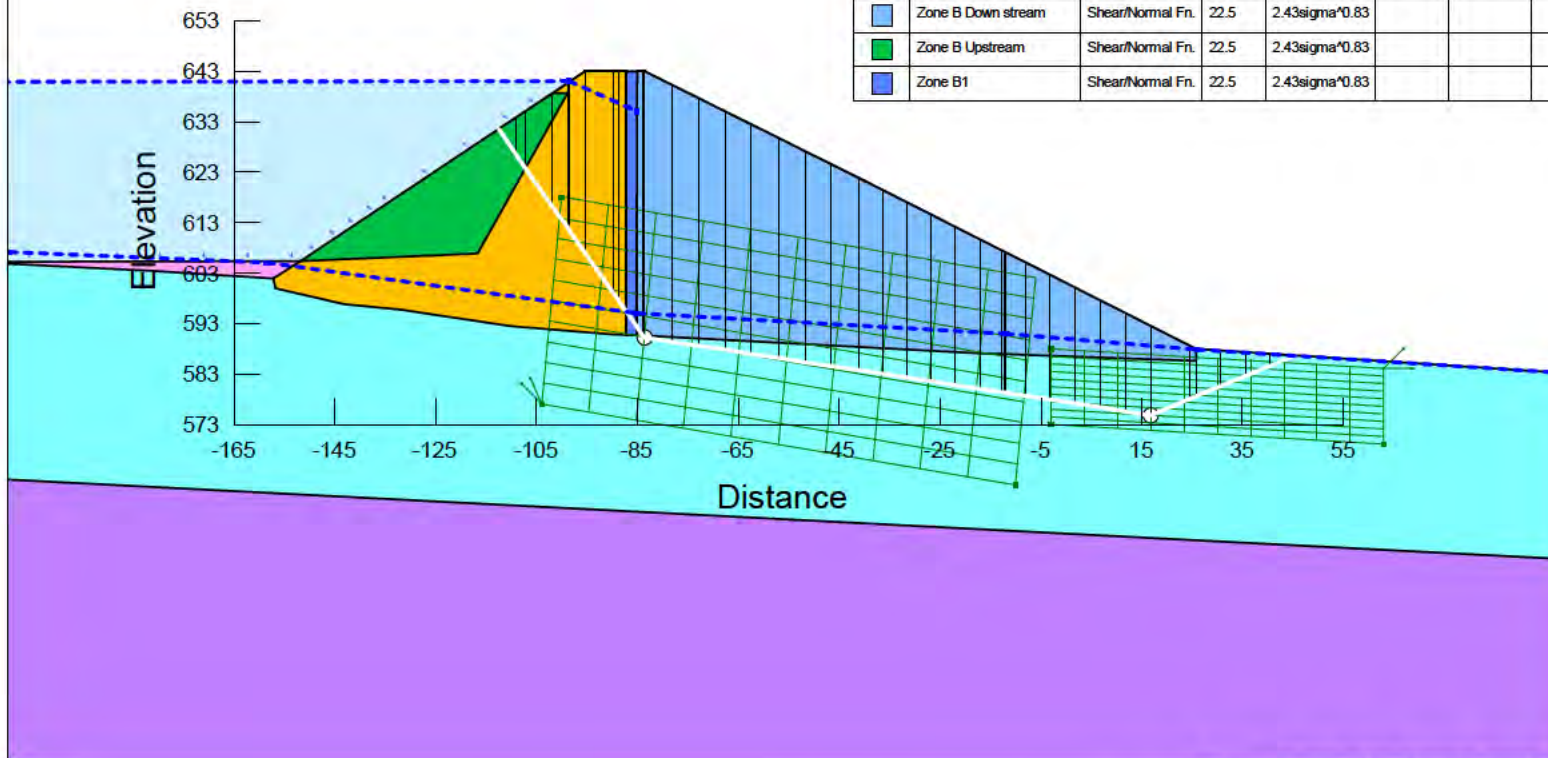


Fig C01.04-StartEmbOp-DS-PMP-Block-PeakUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.93

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

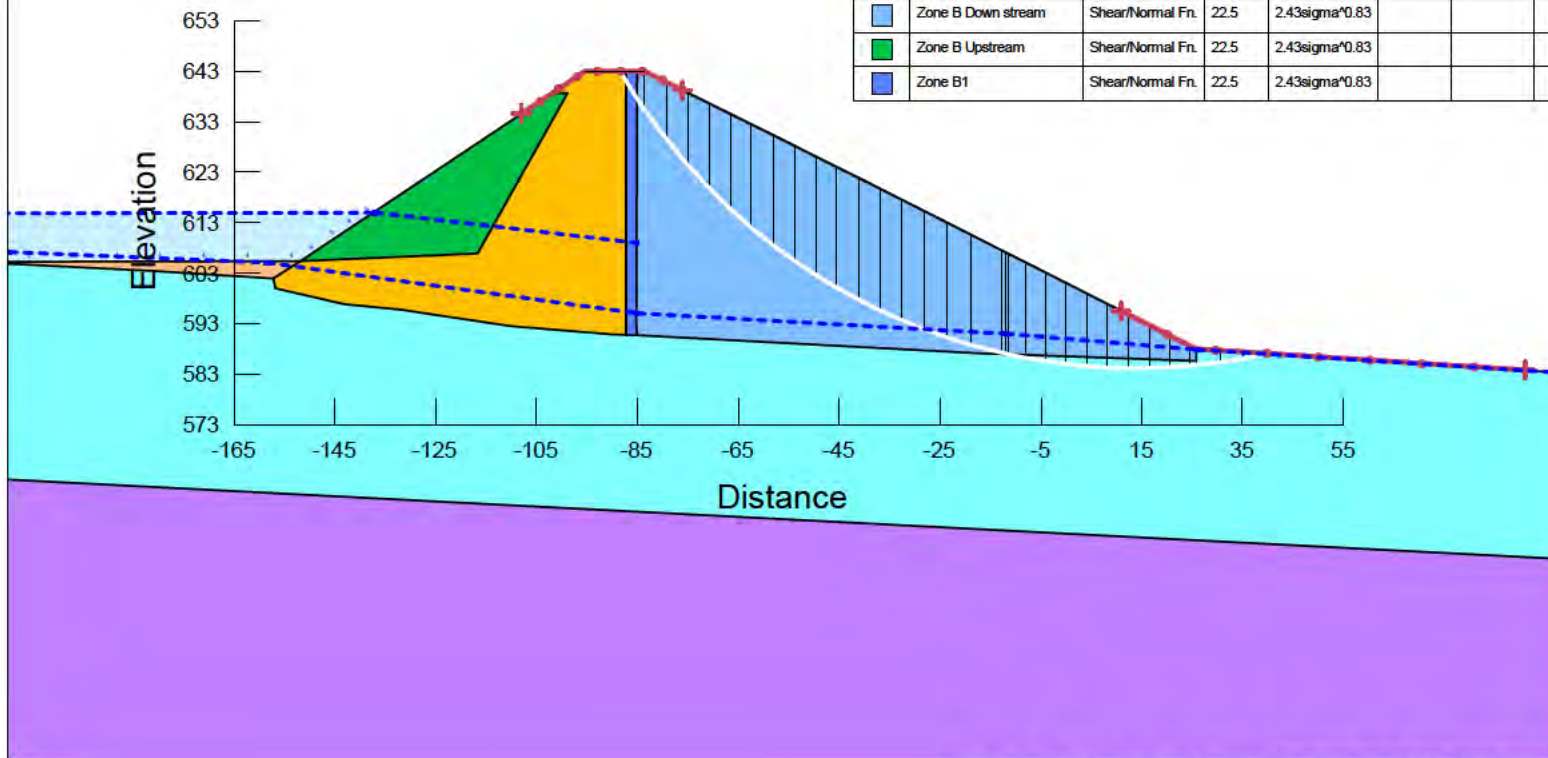


Fig C01.05-StartEmbOp-DS-NOL-Circ-PostEQ/StaticLiq.-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.66

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

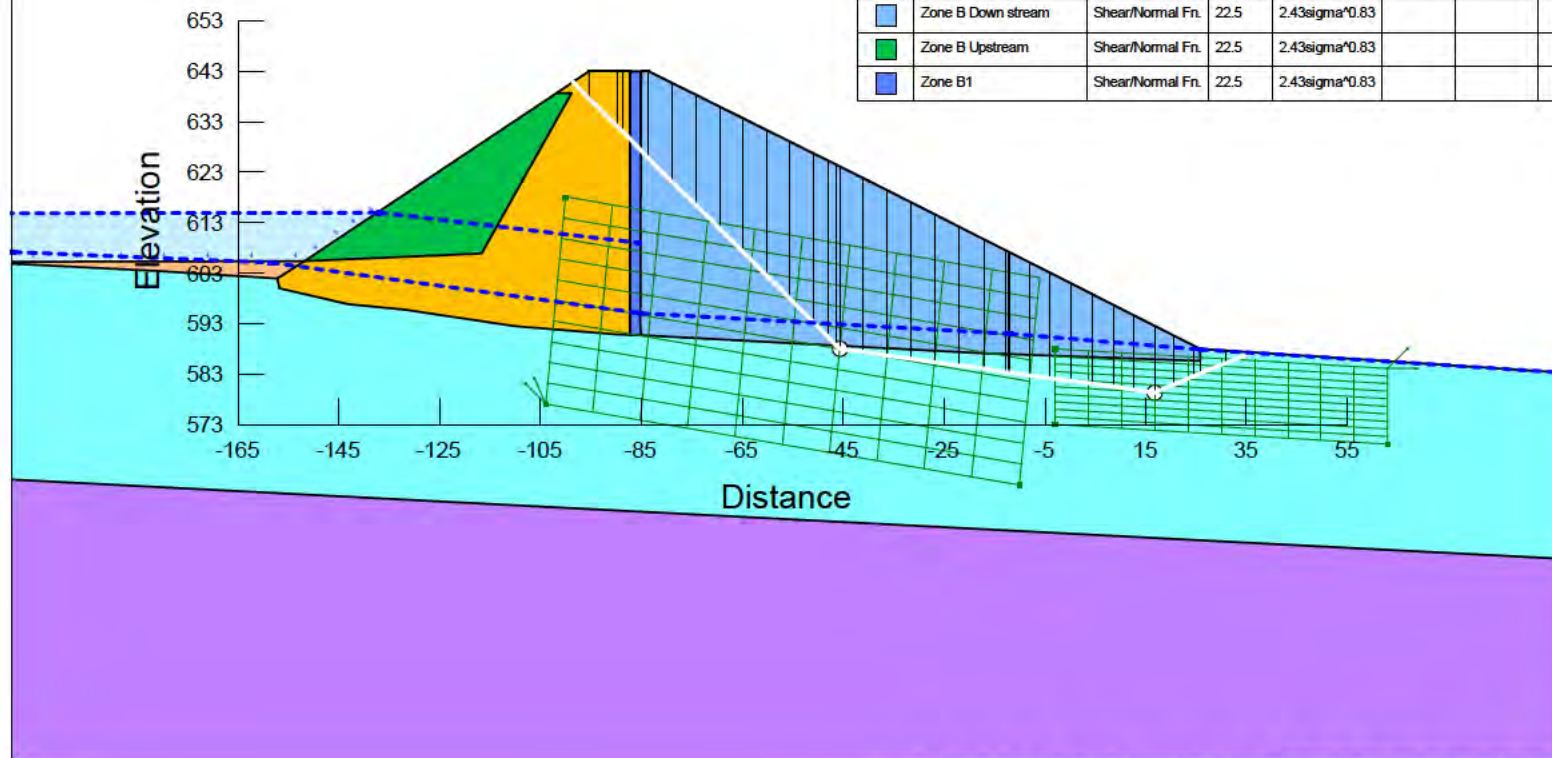


Fig C01.06-StartEmbOp-DS-NOL-Block-PostEQ/StaticLiq.-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.445

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

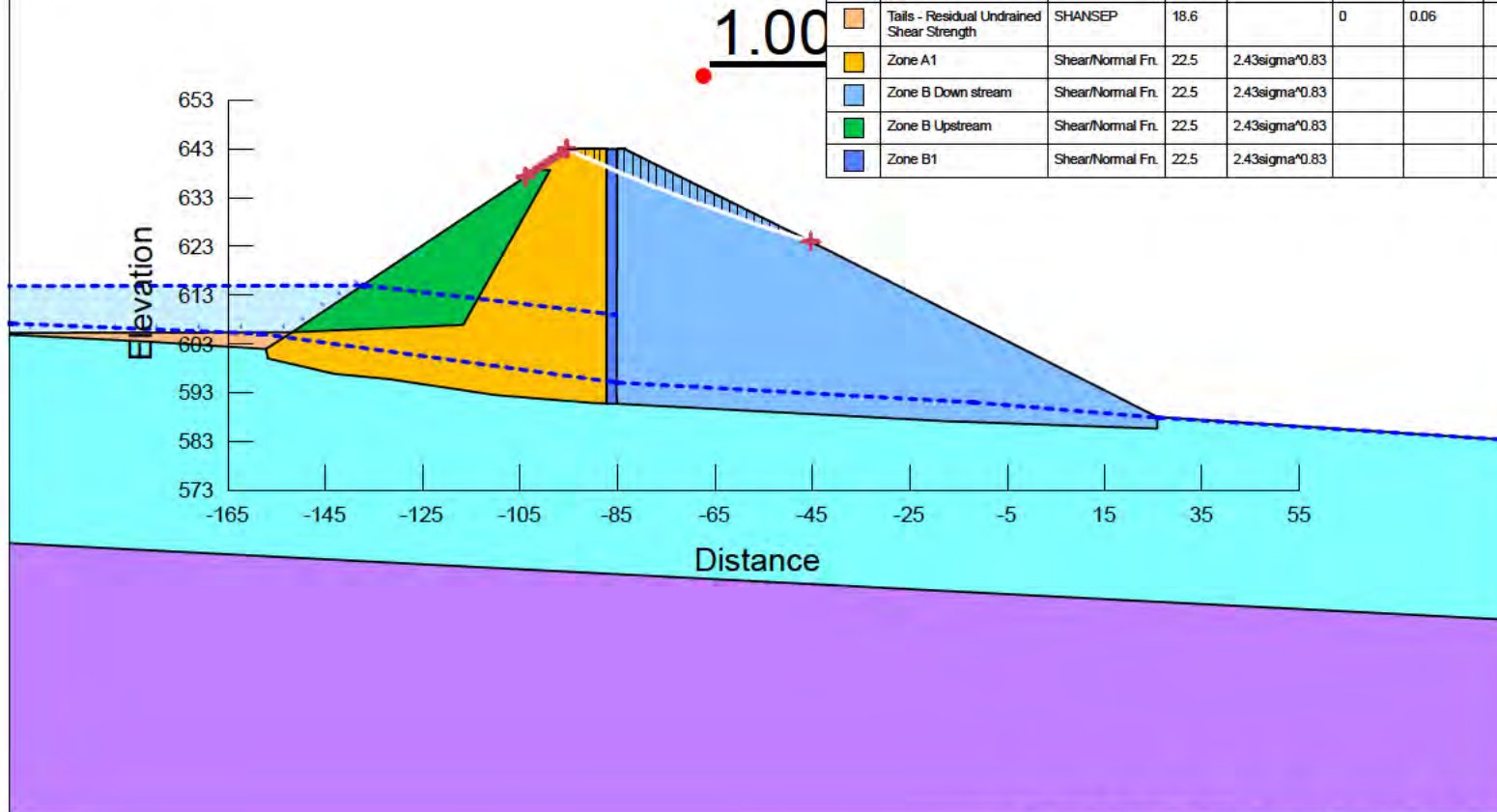


Fig C01.07.01-StartEmbOp-DS-NOL-Circ EQ 1/3H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.389

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$							1

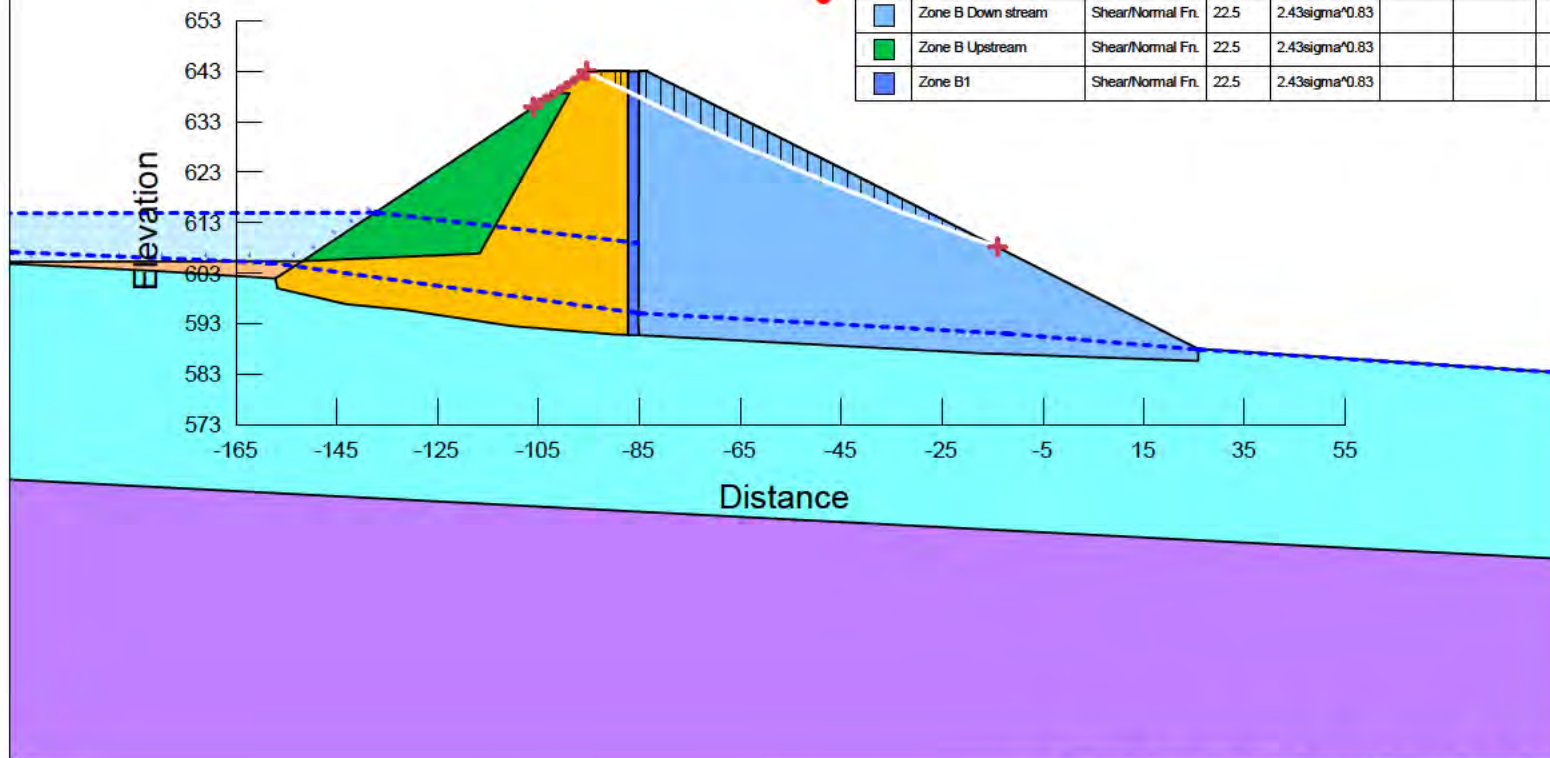


Fig C01.07.02-StartEmbOp-DS-NOL-Circ EQ 2/3H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.365

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

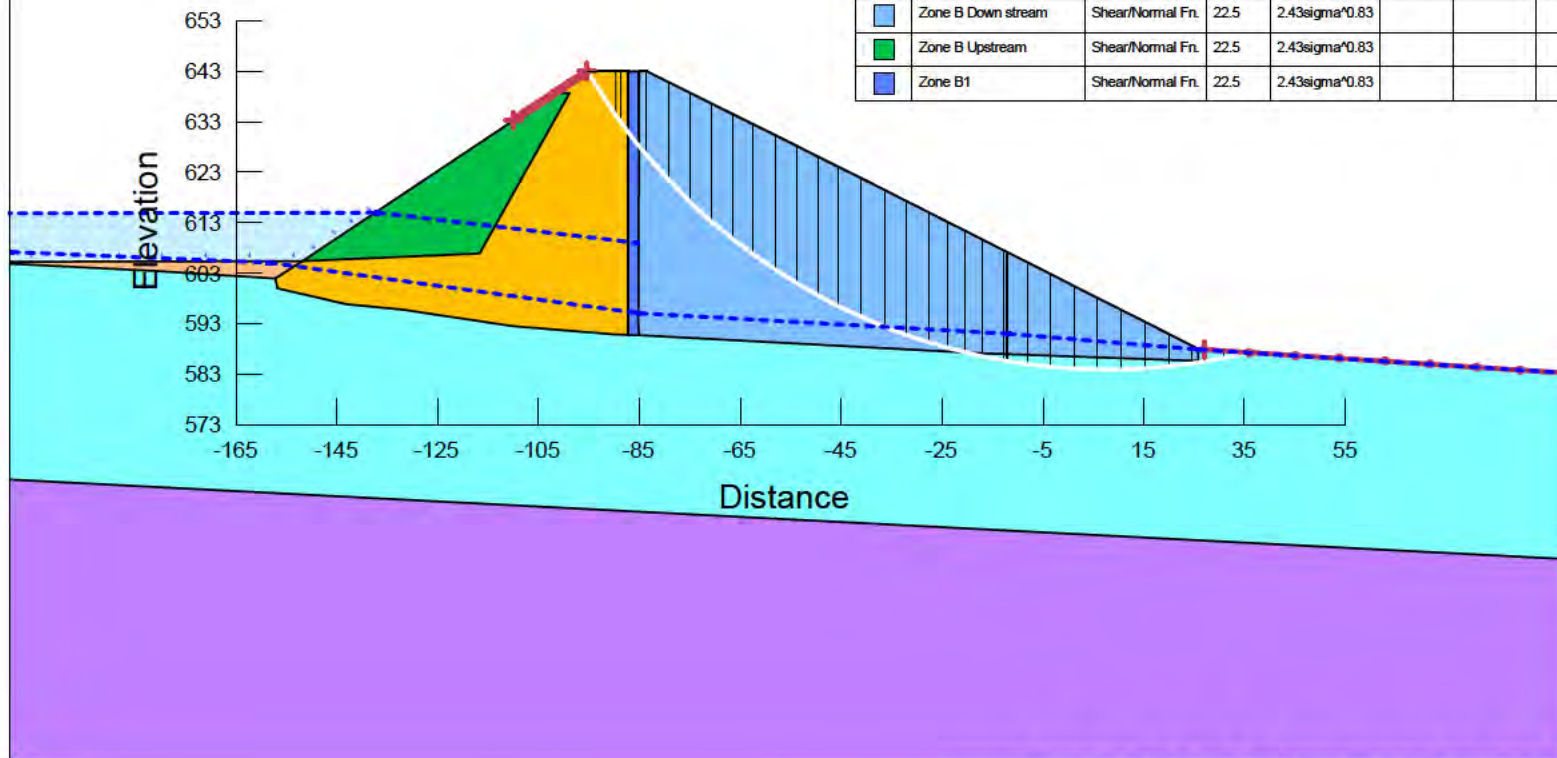


Fig C01.07.03-StartEmbOp-DS-NOL-Circ EQ Full H-ResUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.233

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

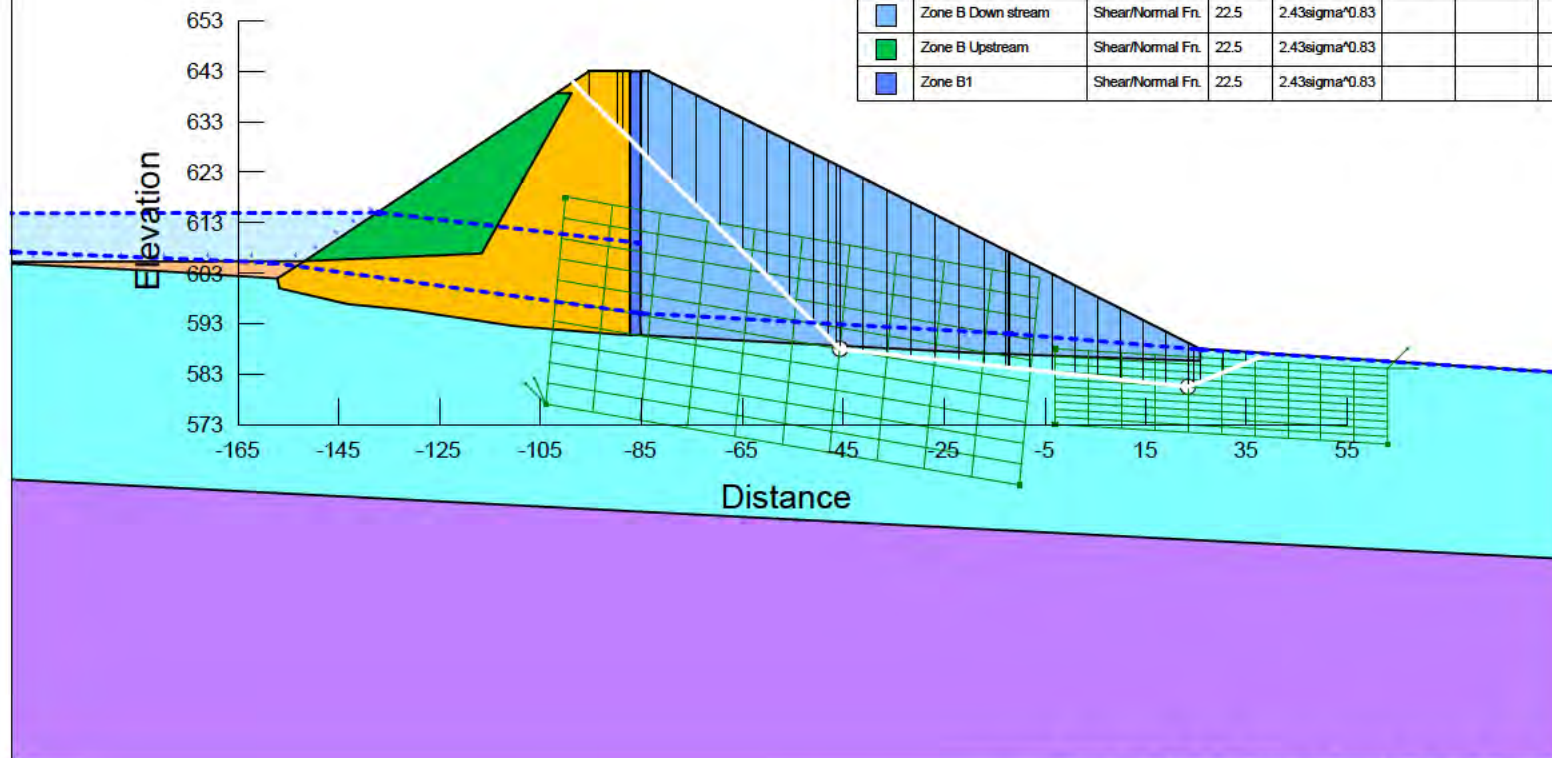


Fig C01.08-StartEmbOp-DS-NOL-Block EQ Full H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.51

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1

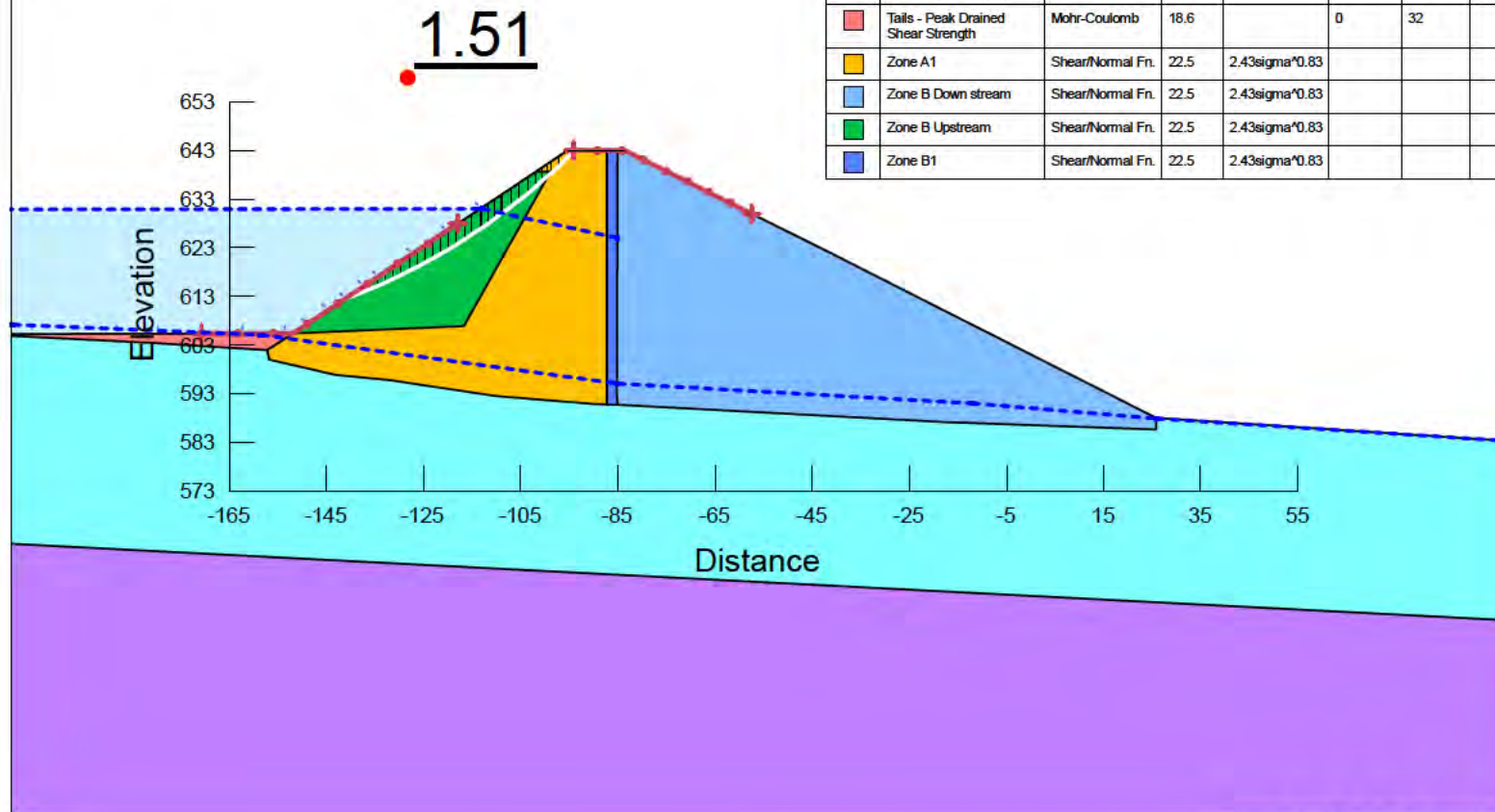


Fig C01.09-StartEmbOp-US-CritPond-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.51

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma \times 0.83$							1

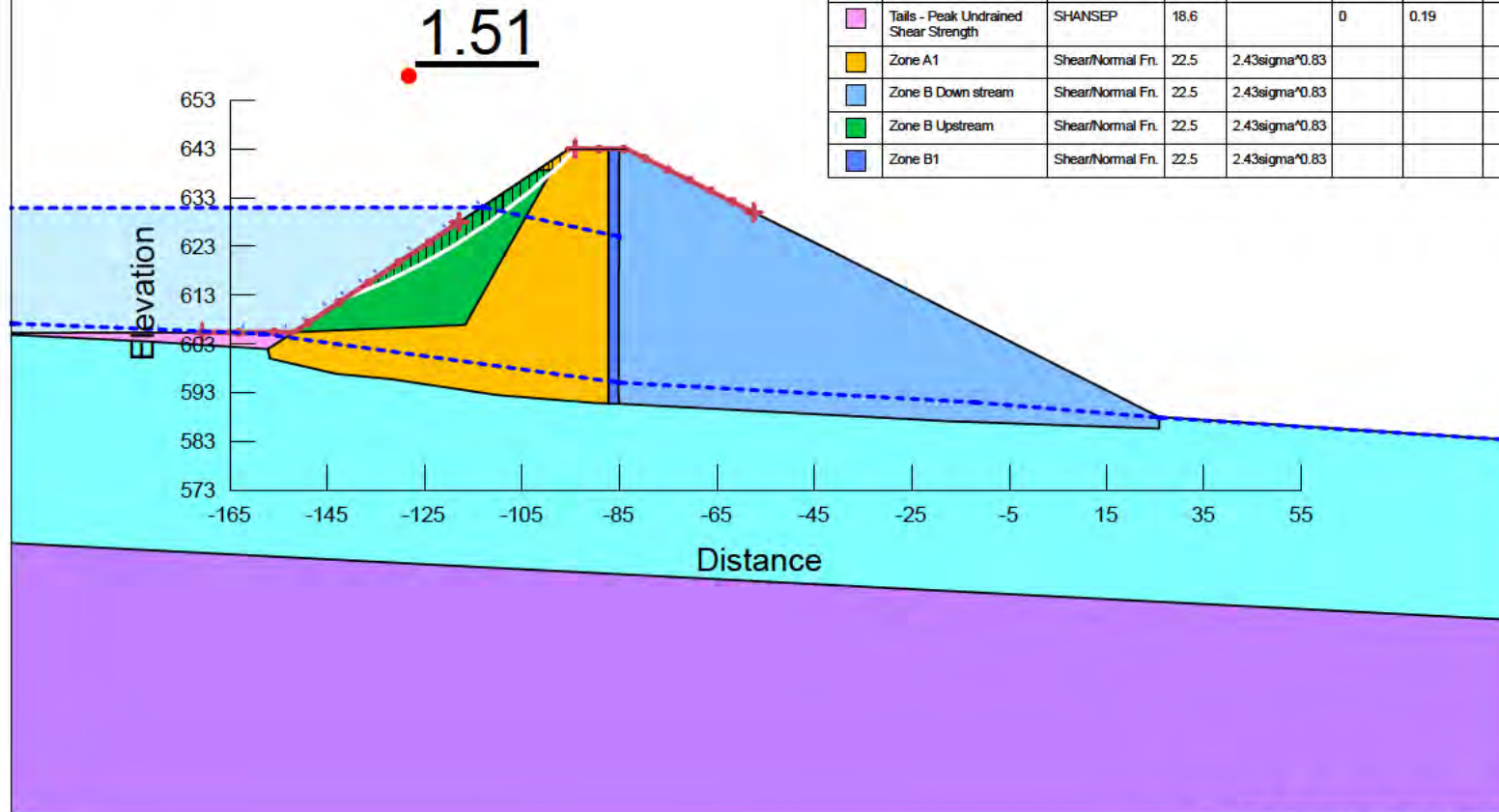


Fig C01.10-StartEmbOp-US-CritPond-PeakUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.52

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

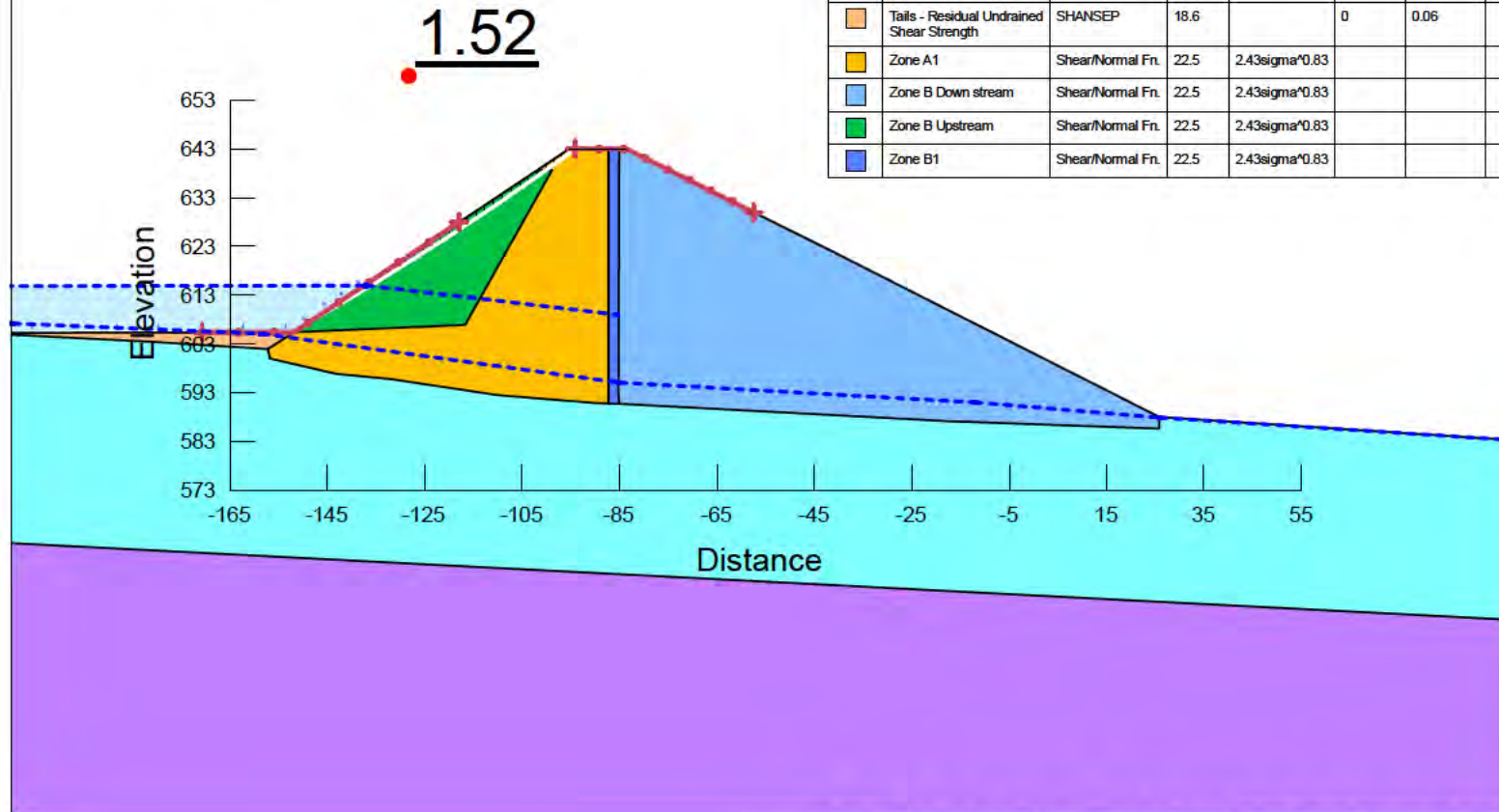


Fig C01.11-StartEmbOp-US-CritPond-PostEQ/StaticLiq-NOL.-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.277

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

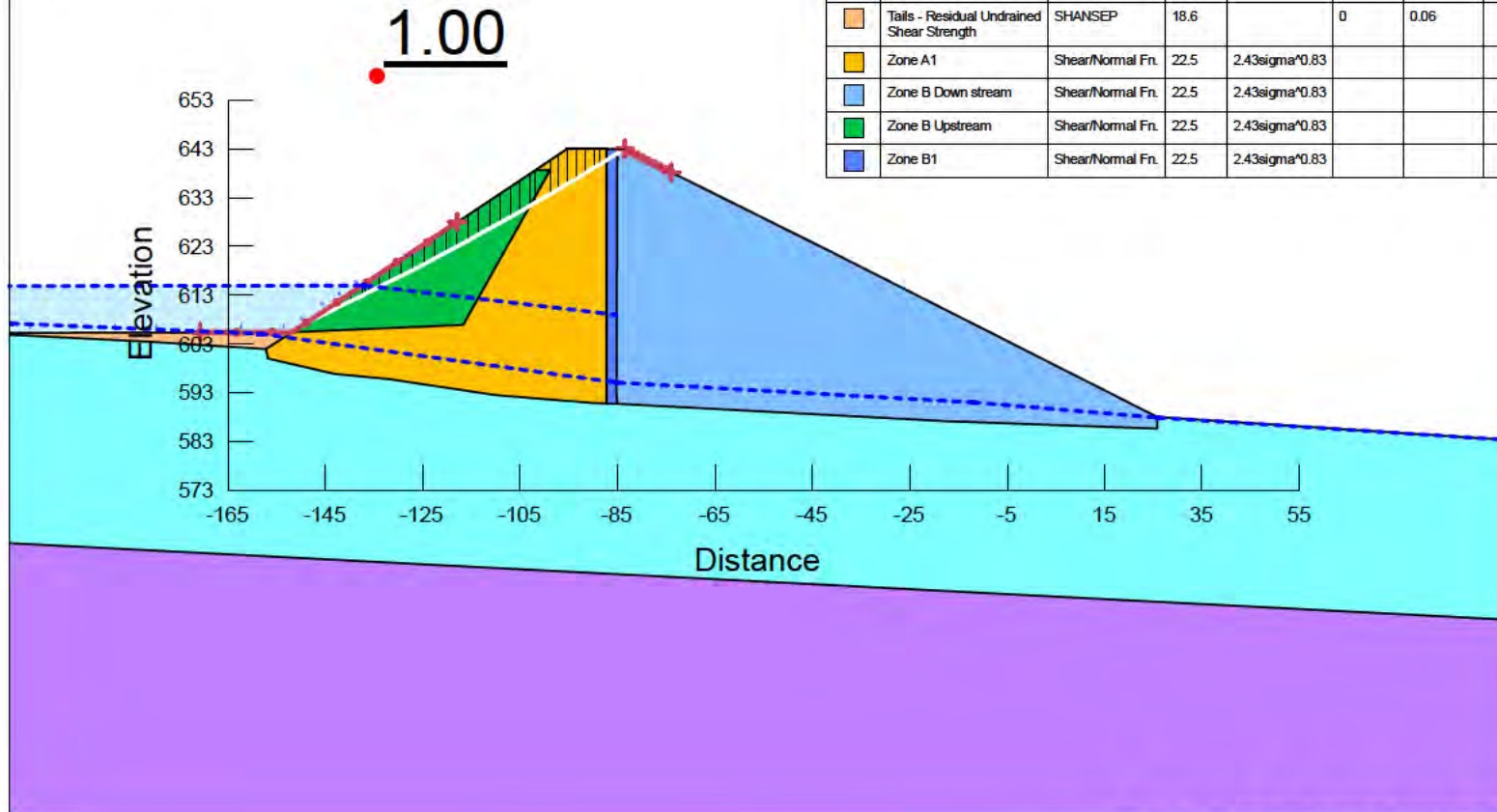


Fig C01.12-StartEmbOp-US-NOL-EQ Full H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Section 3 – Starter Embankment
With FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.91

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1

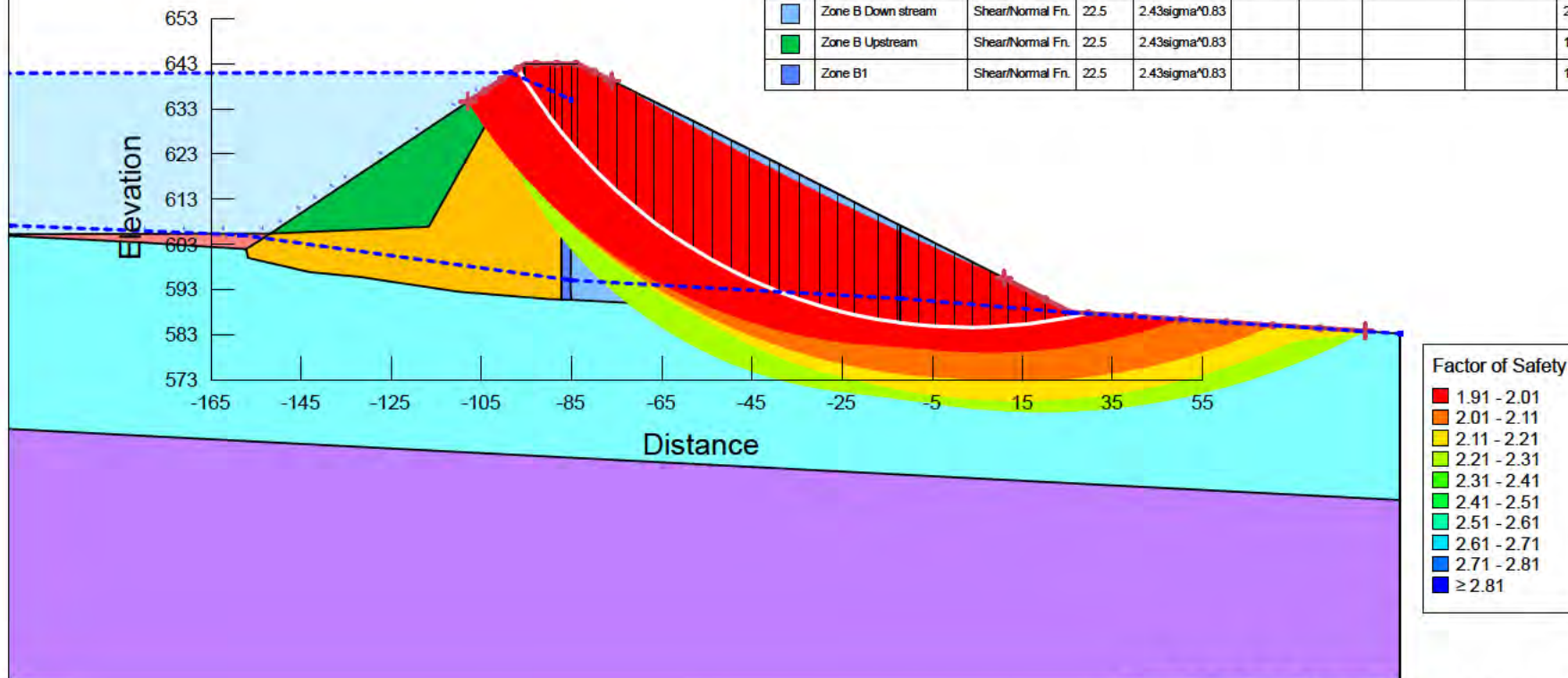


Fig C01.01-StartEmbOp-DS-PMP-Circ-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.55

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v^{0.83}$					1

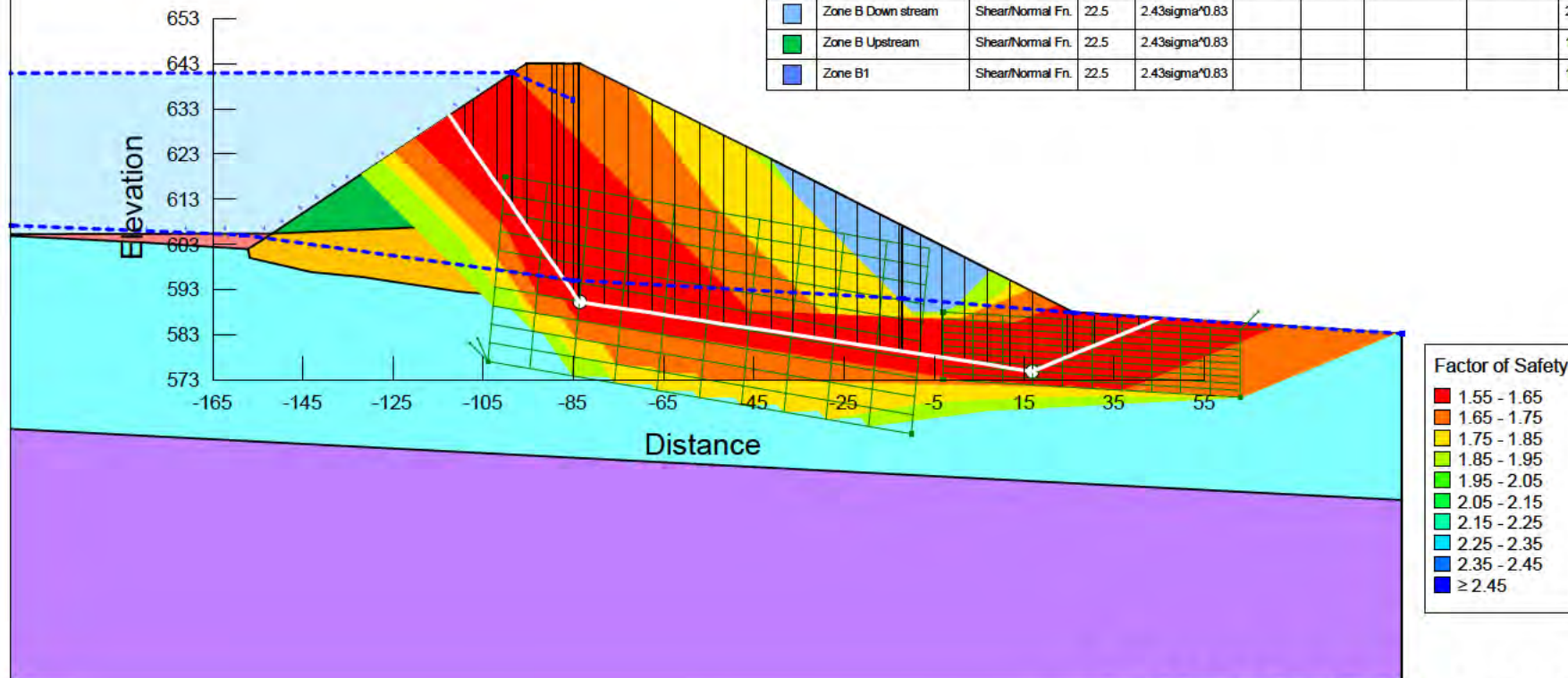


Fig C01.02-StartEmbOp-DS-PMP-Block-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.91

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

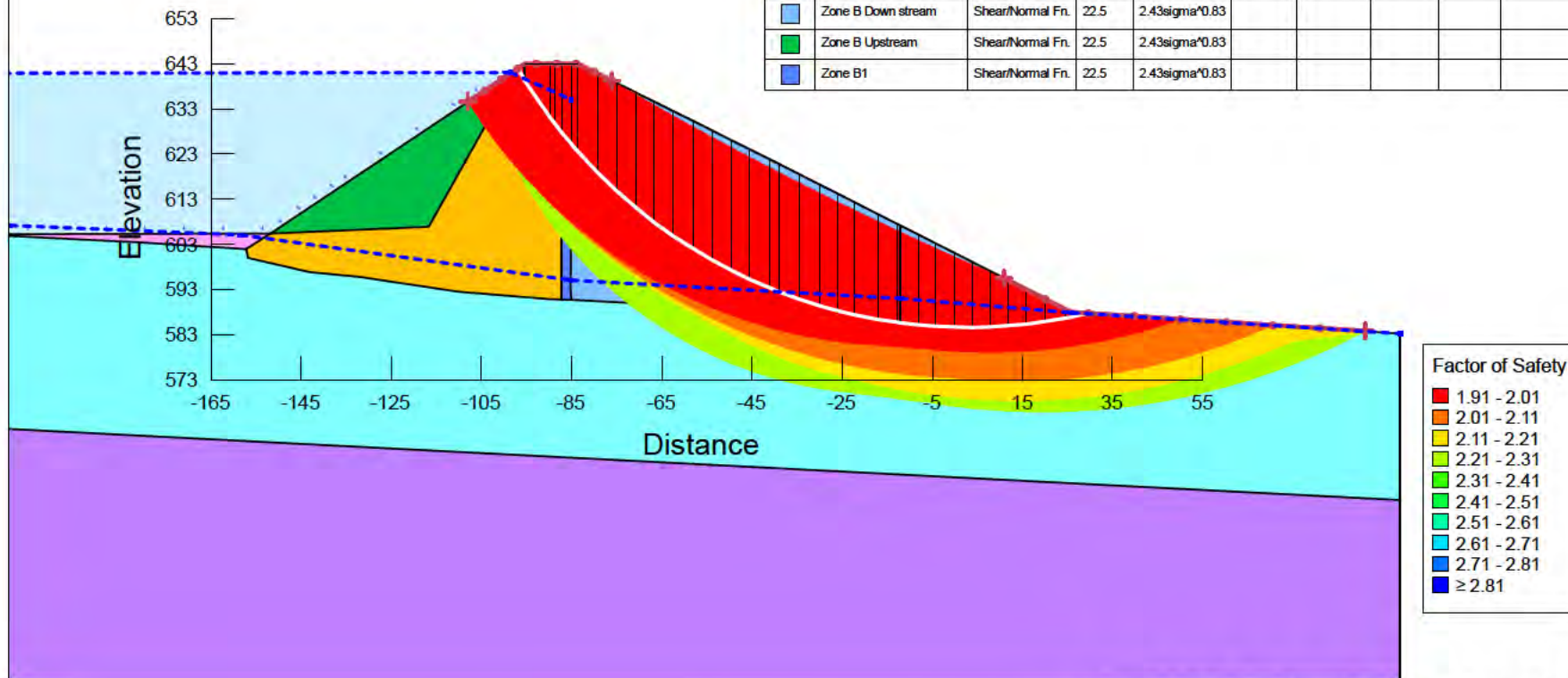


Fig C01.03-StartEmbOp-DS-PMP-Circ-PeakUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.55

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

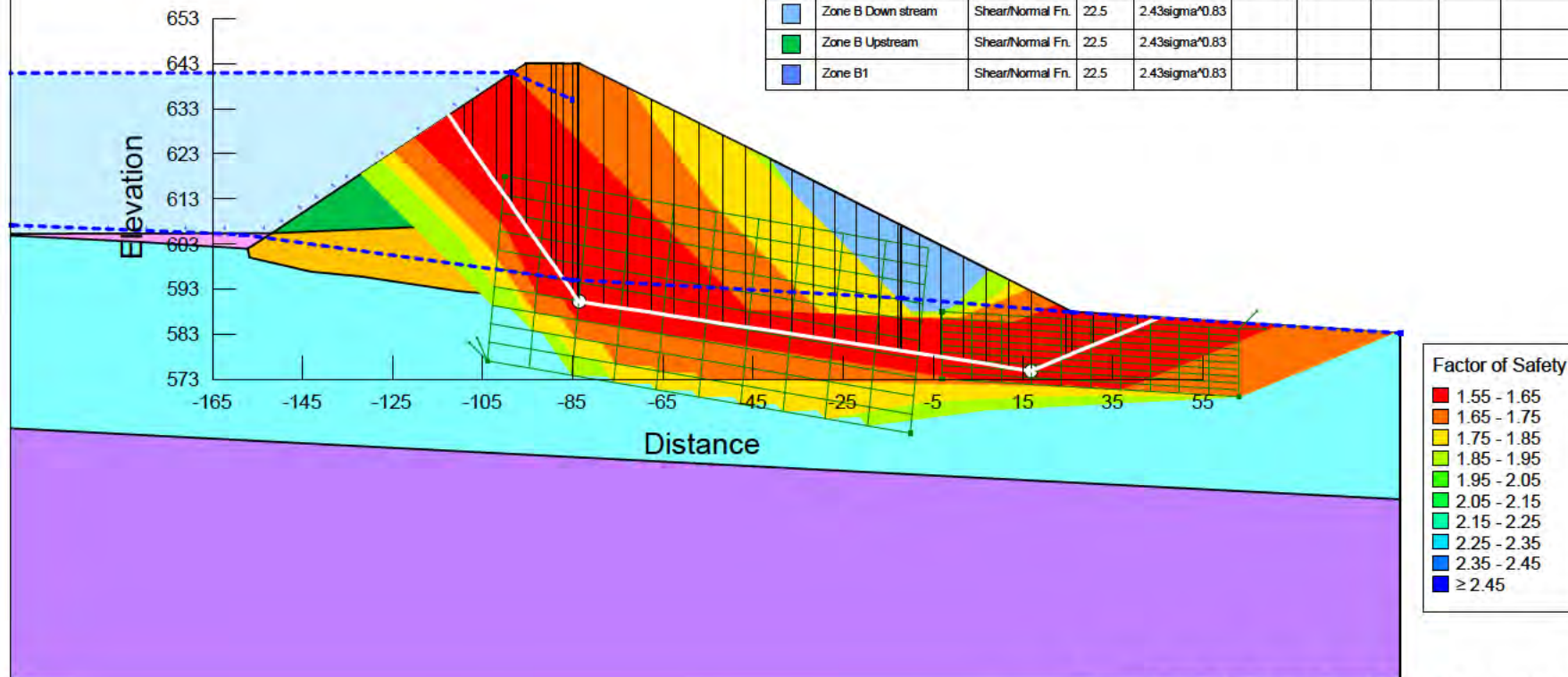


Fig C01.04-StartEmbOp-DS-PMP-Block-PeakUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.93

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

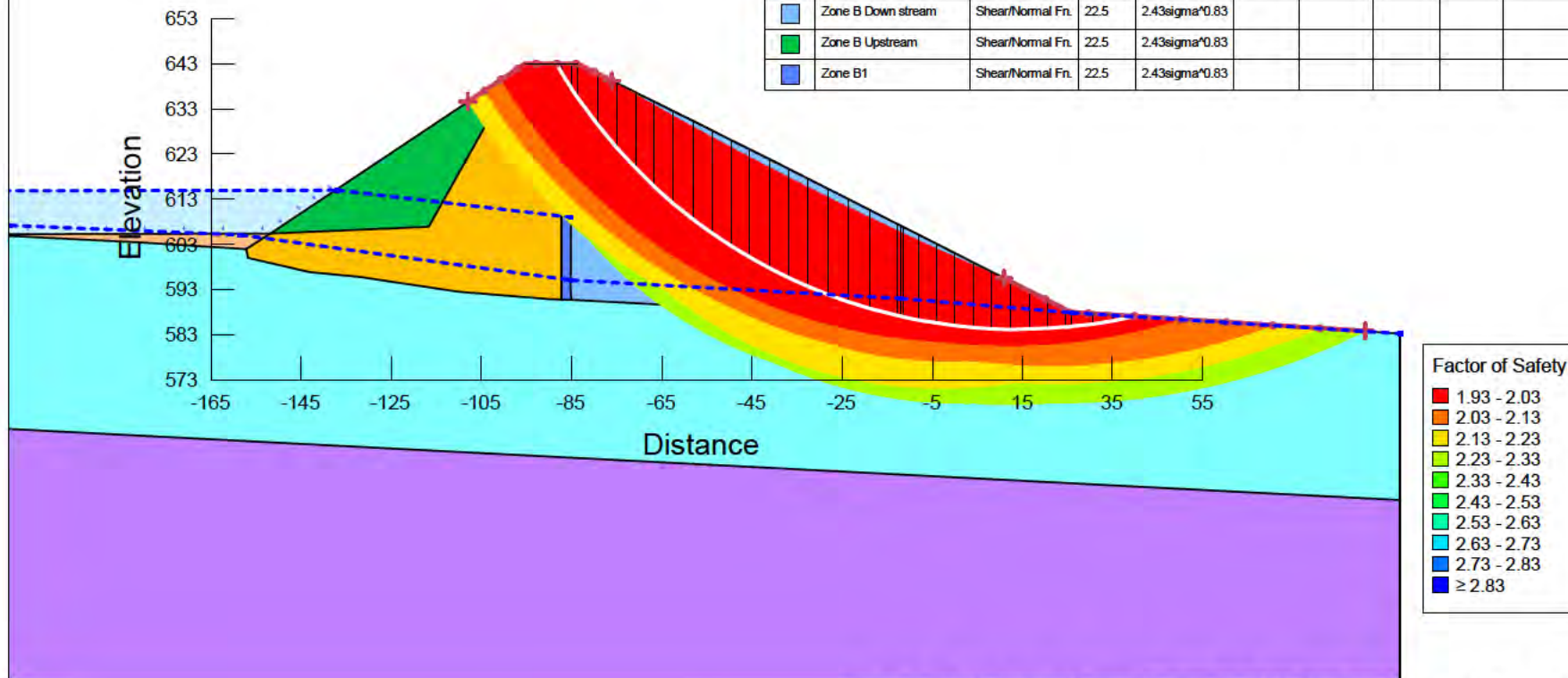


Fig C01.05-StartEmbOp-DS-NOL-Circ-PostEQ/StaticLiq.-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.66

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

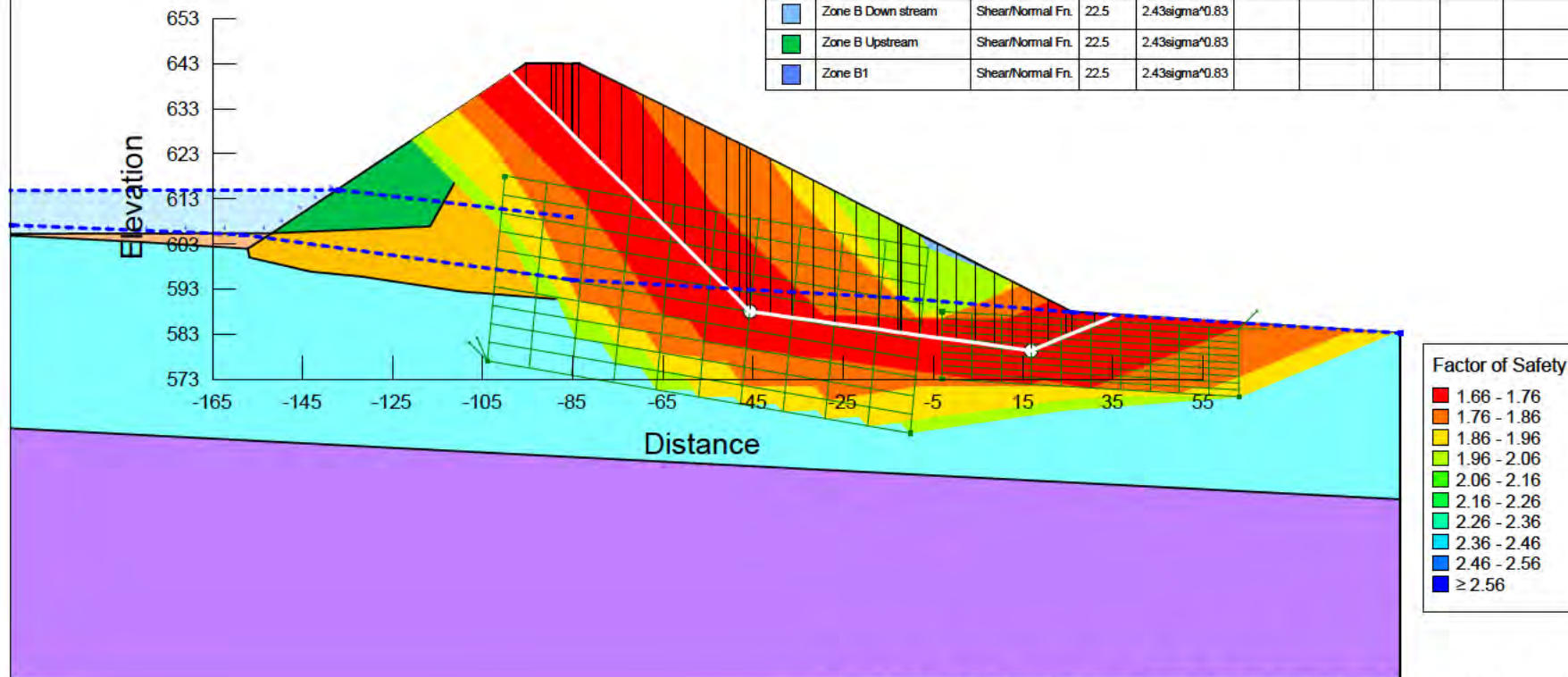


Fig C01.06-StartEmbOp-DS-NOL-Block-PostEQ/StaticLiq.-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.445

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

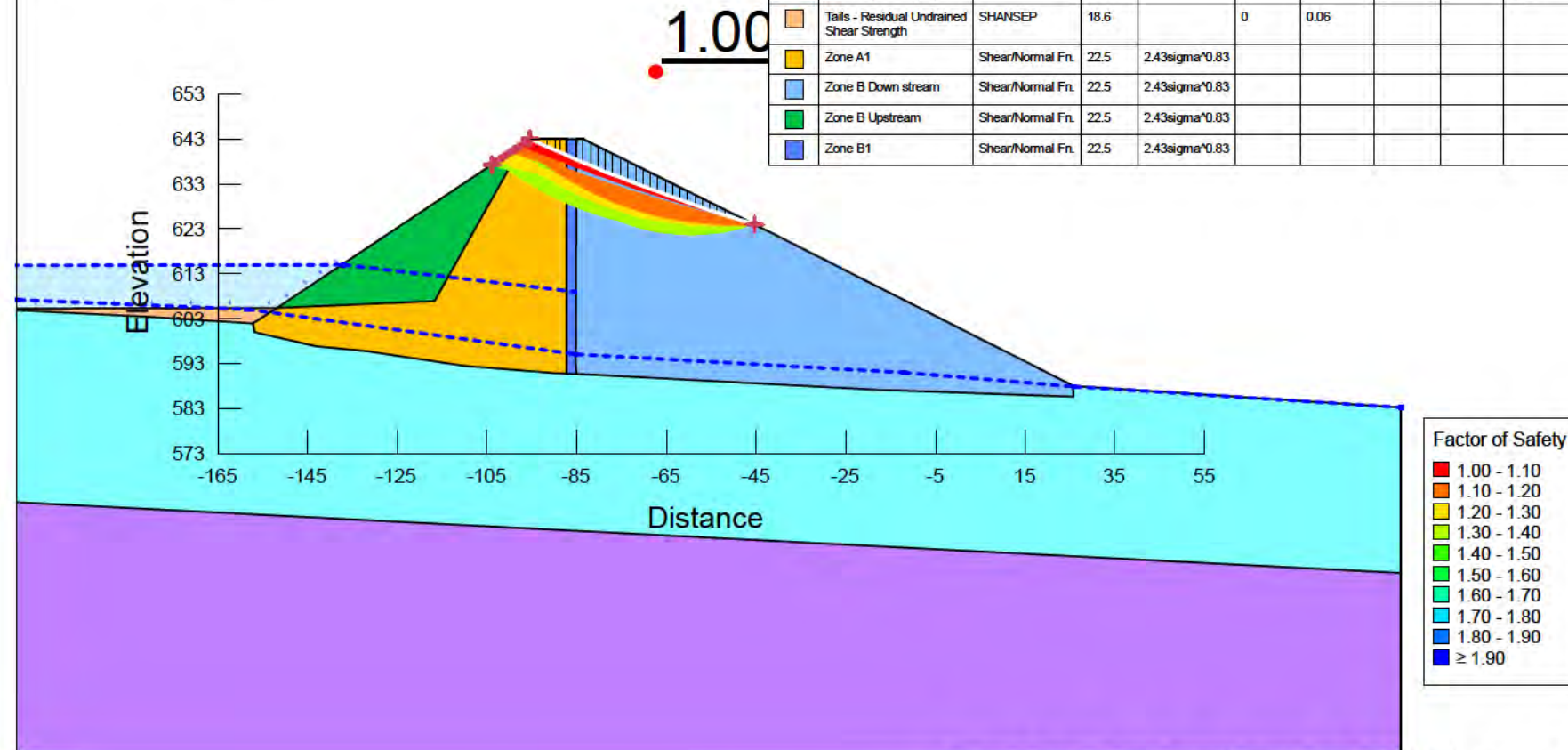


Fig C01.07.01-StartEmbOp-DS-NOL-Circ EQ 1/3H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.389

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

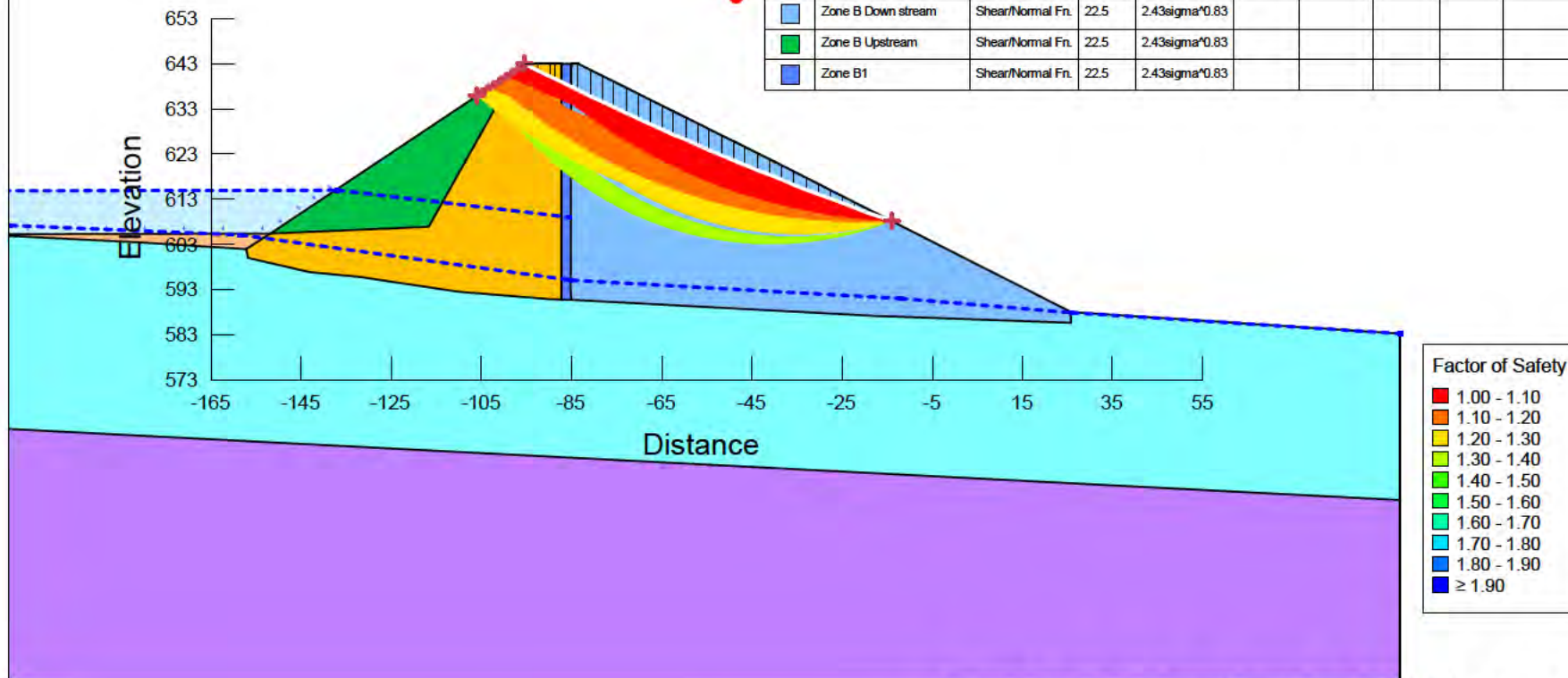


Fig C01.07.02-StartEmbOp-DS-NOL-Circ EQ 2/3H-ResUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.365

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Dark Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

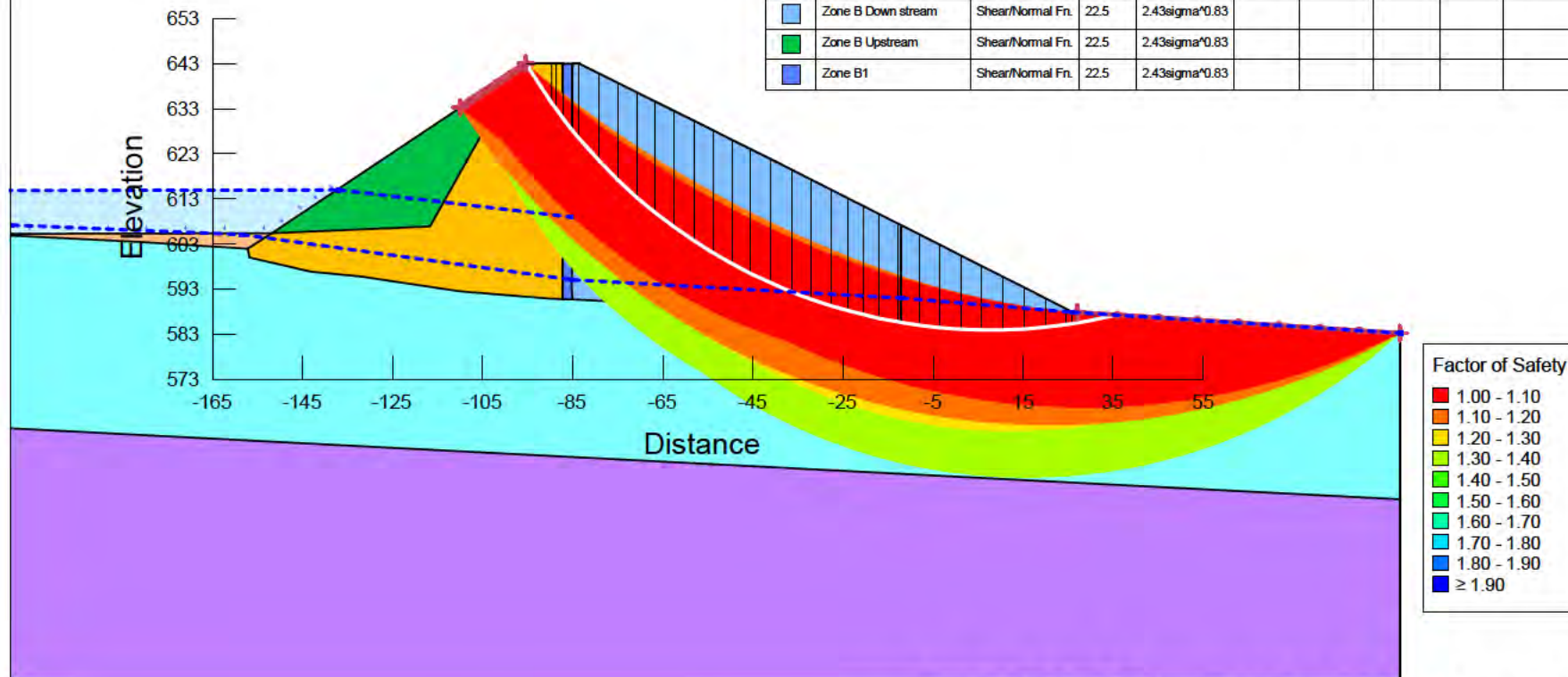


Fig C01.07.03-StartEmbOp-DS-NOL-Circ EQ Full H-ResUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.233

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

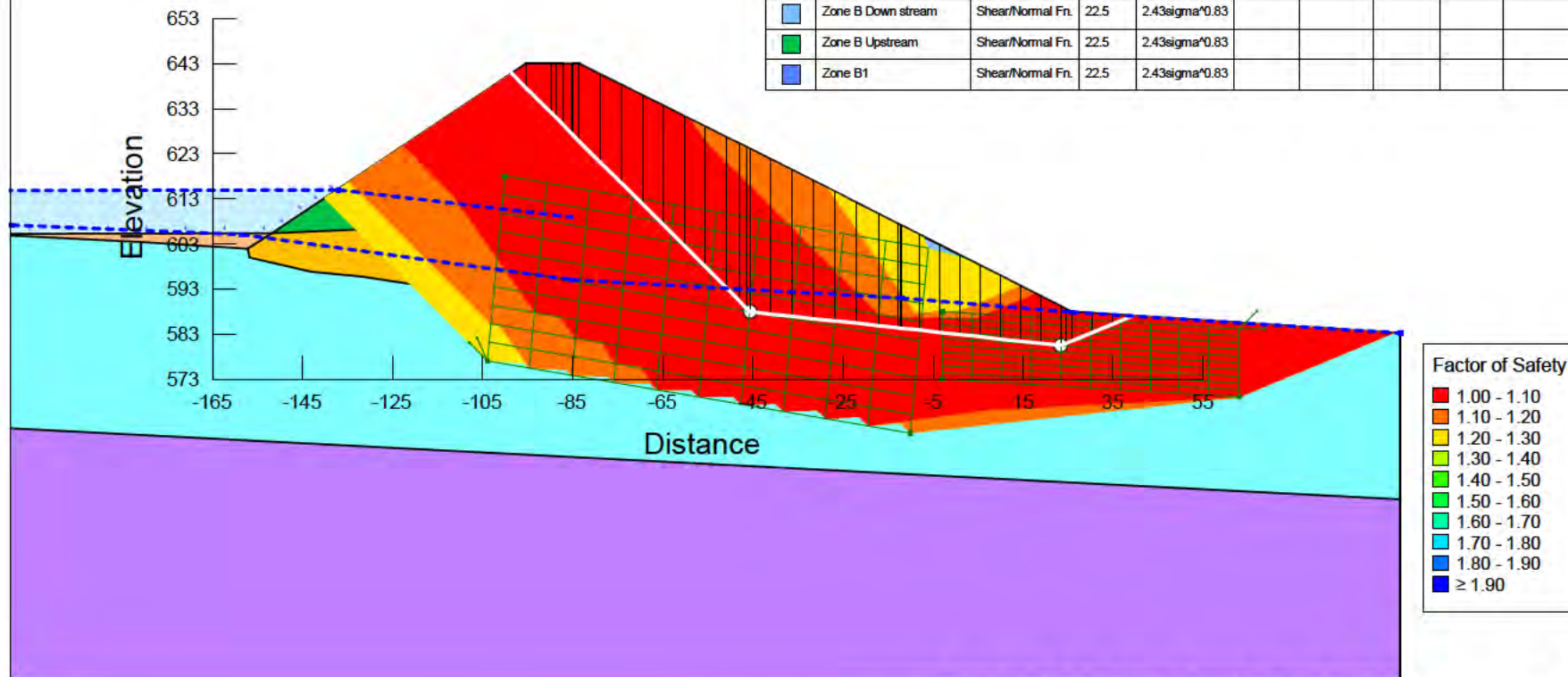


Fig C01.08-StartEmbOp-DS-NOL-Block EQ Full H-ResUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.51

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v \cdot 0.83$					1

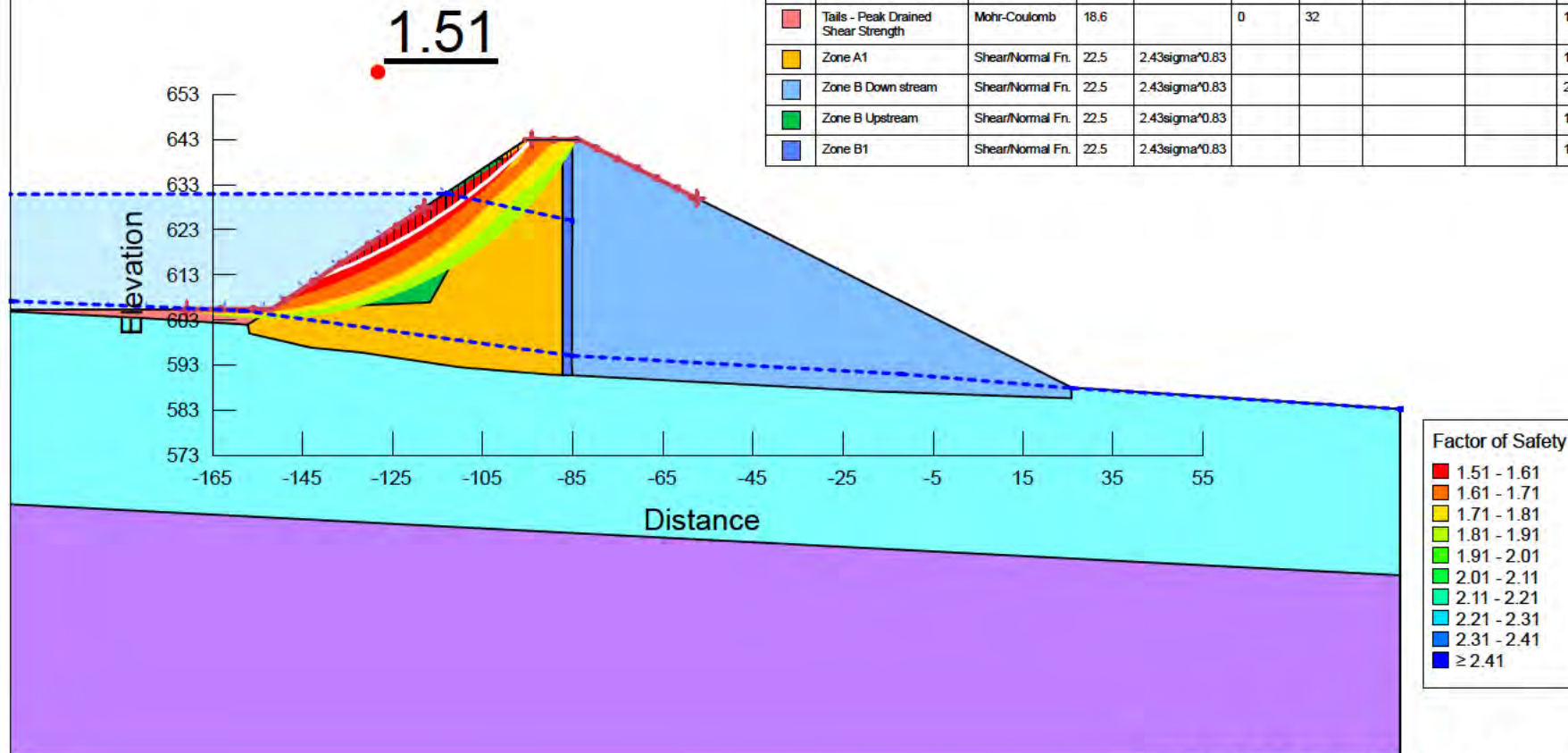


Fig C01.09-StartEmbOp-US-CritPond-PeakD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.51

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

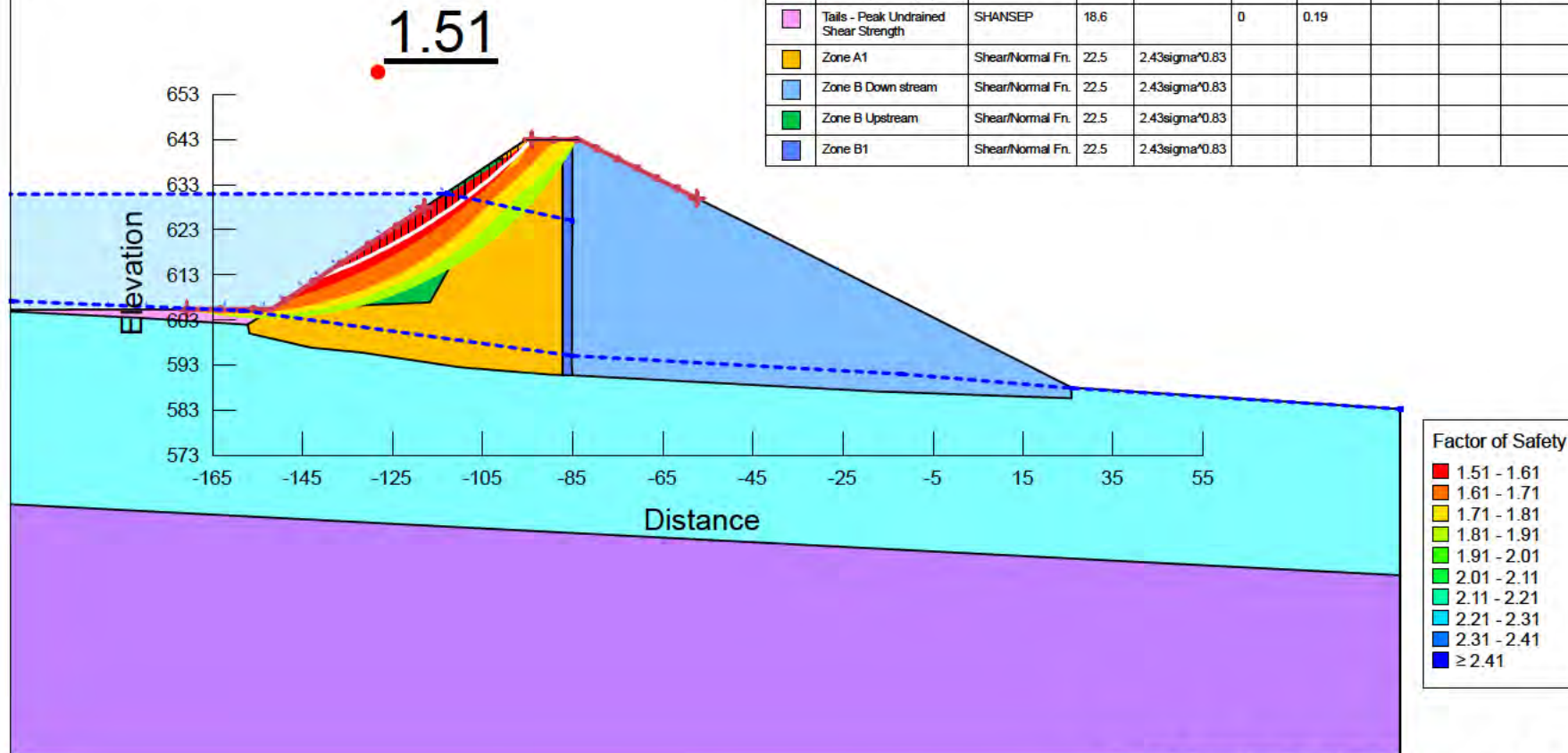


Fig C01.10-StartEmbOp-US-CritPond-PeakUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.52

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

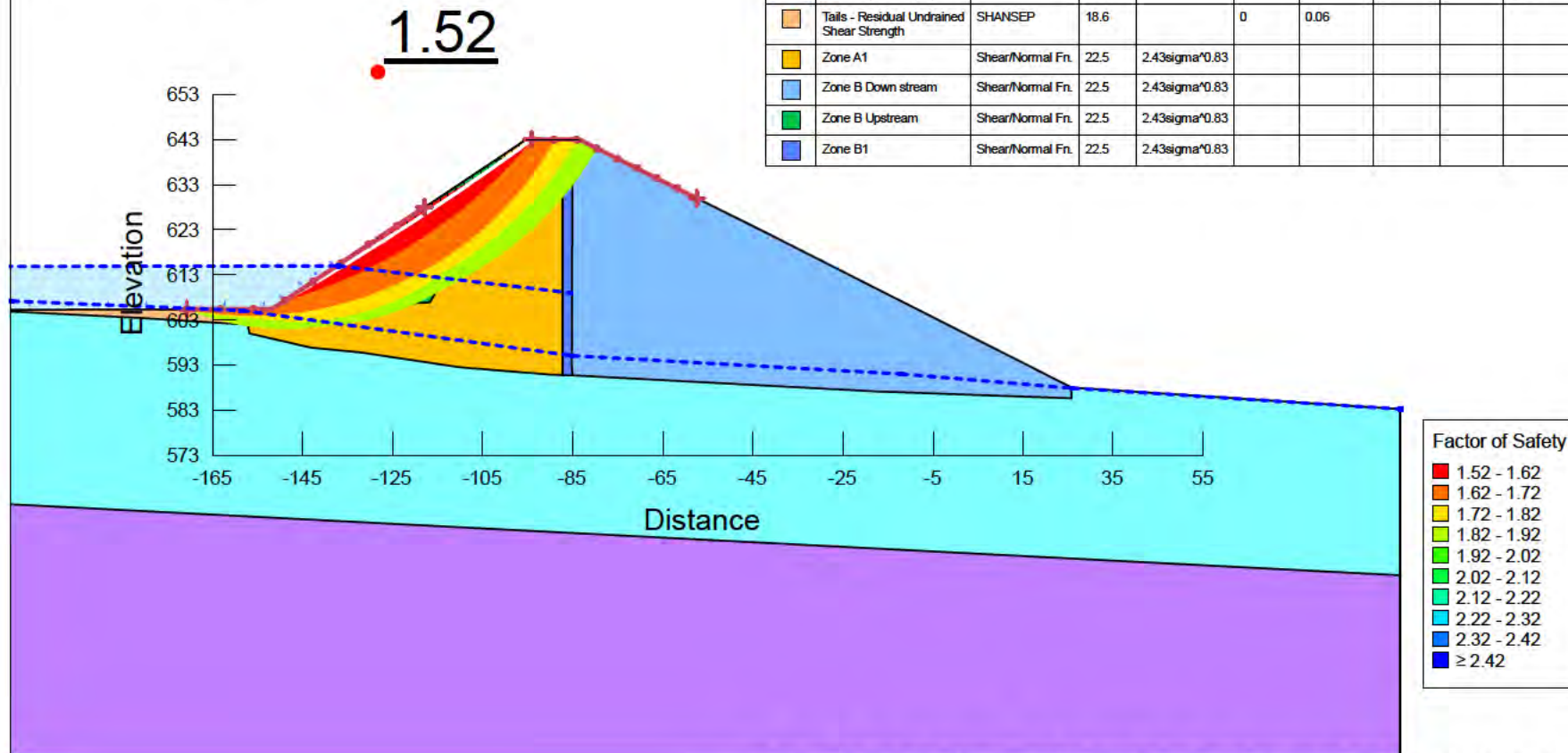


Fig C01.11-StartEmbOp-US-CritPond-PostEQ/StaticLiq-NOL.-ResUD



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MATAKANUI GOLD LIMITED

Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9702
 Scale: 1:1,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.277

Analysis Results

Factor of Safety: 1.00

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation (anisotropic)	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1

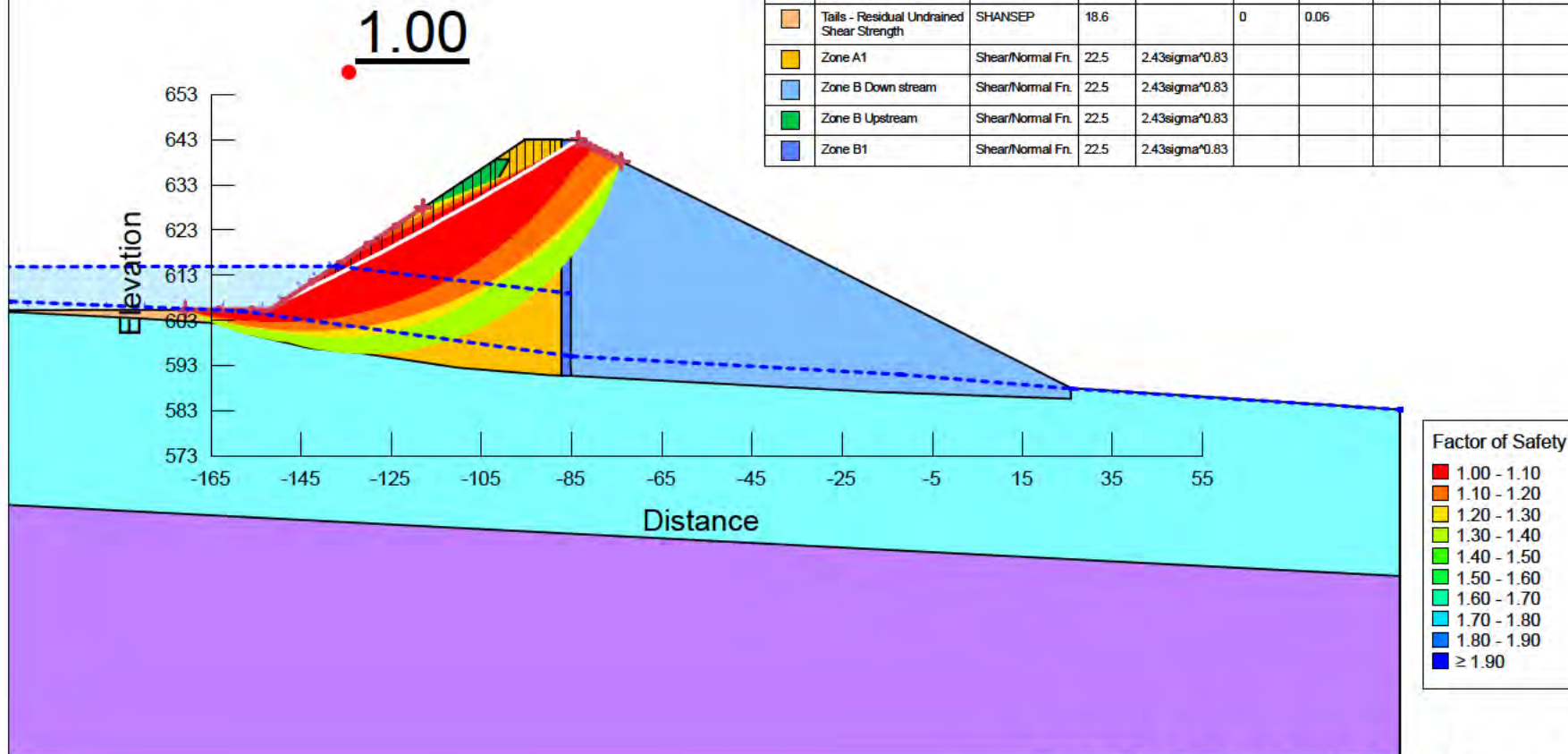


Fig C01.12-StartEmbOp-US-NOL-EQ Full H-ResUD



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Shepherd TSF - Stability Analysis
 Section 3 - Starter Embankment

Date: 13/03/2025

Drawn: RW

Ref: 9702

Scale: 1:1,500

Section 3 – Final Embankment

Section 3 – Final Embankment Without FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.536

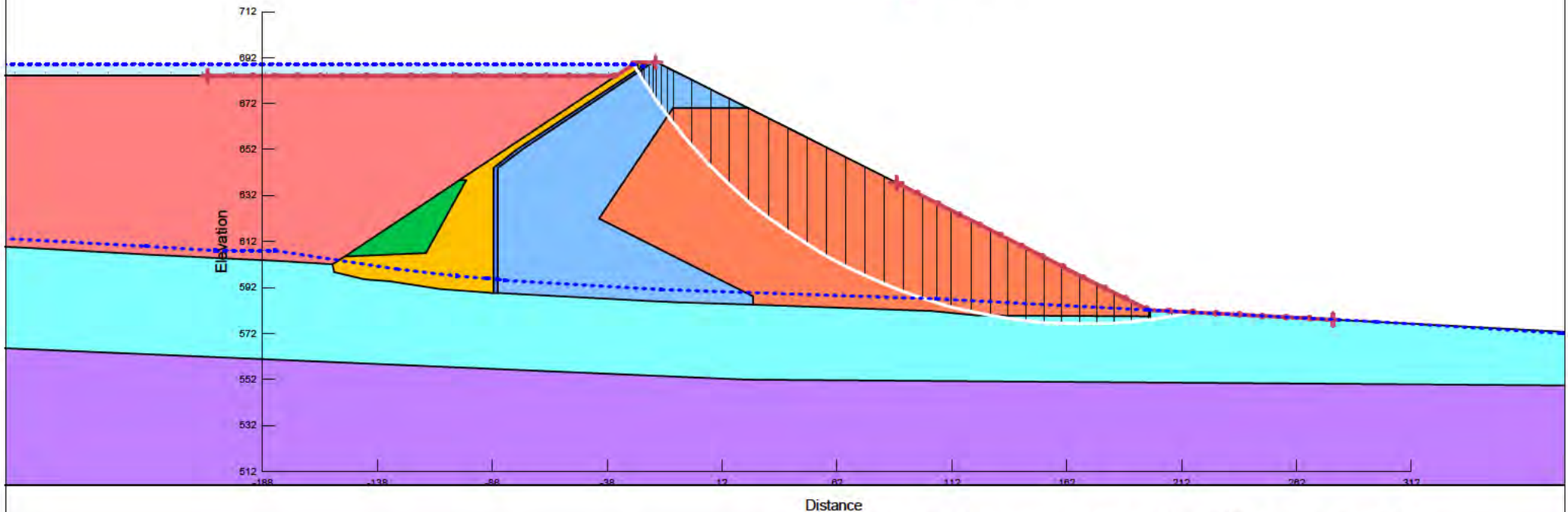


Figure C02.01-FinalEmbOp-DS-PMP-Circ-PeakD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.402

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.402

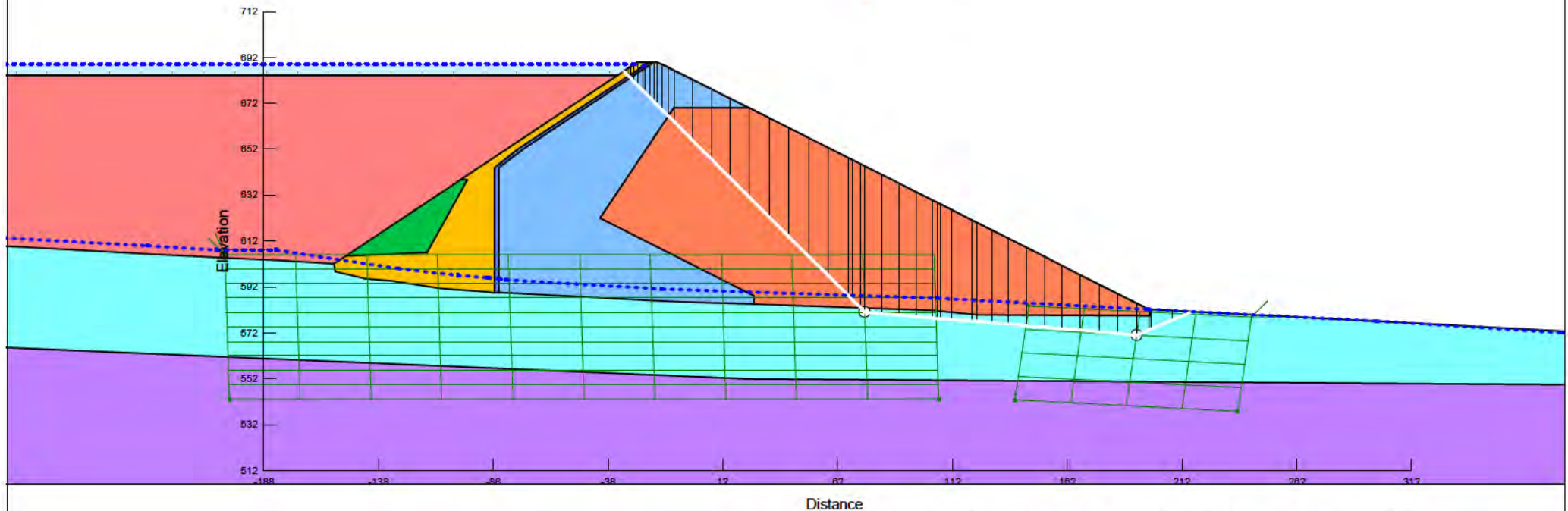


Figure C02.02-FinalEmbOp-DS-PMP-Block-PeakD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_v + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_v + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_v + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_v + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma_v + 0.91$							2

1.536

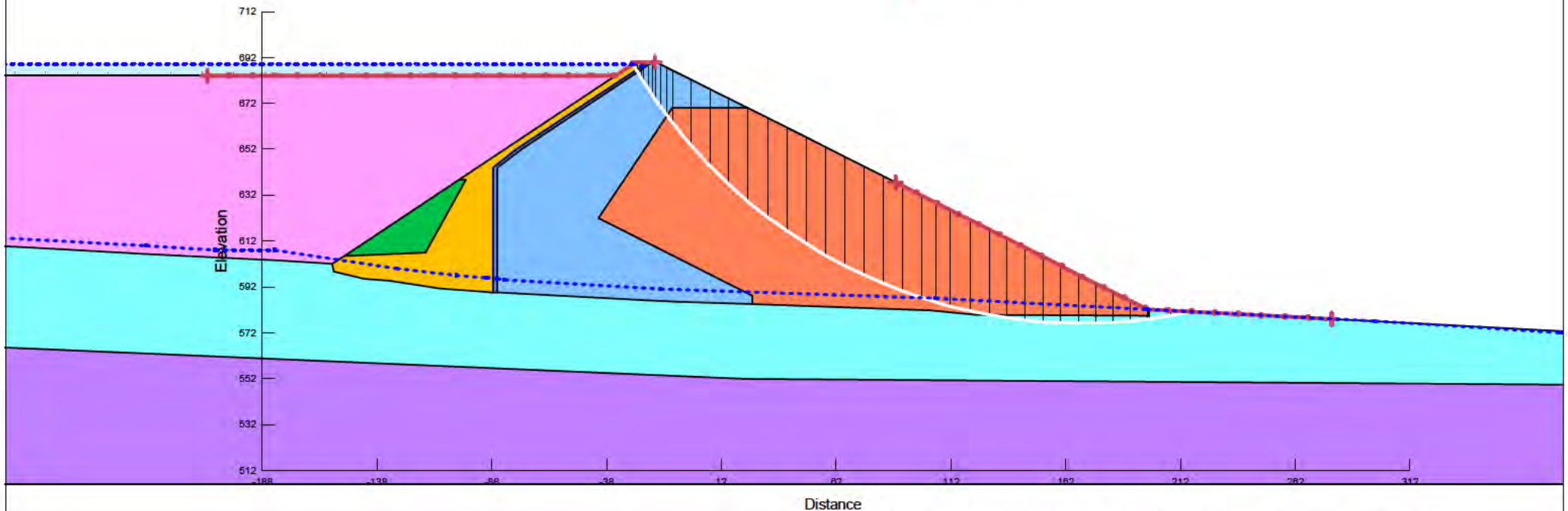


Figure C02.03-FinalEmbOp-DS-PMP-Circ-PeakUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.404

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.404

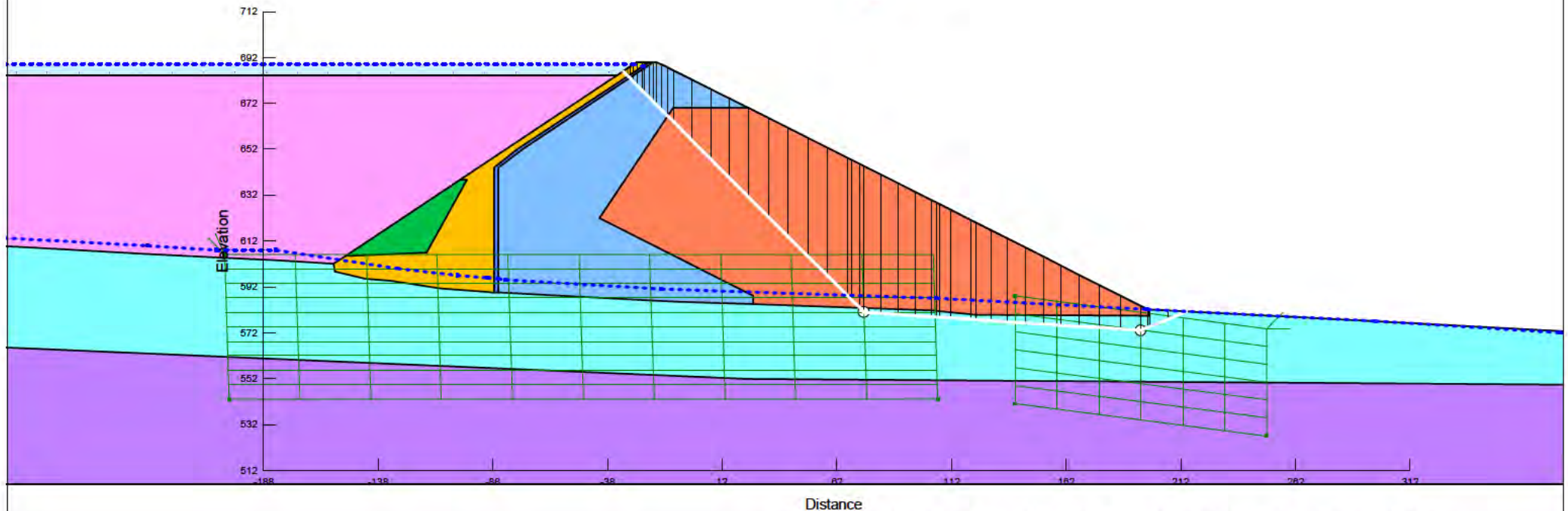


Figure C02.04-FinalEmbOp-DS-PMP-Block-PeakUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.536

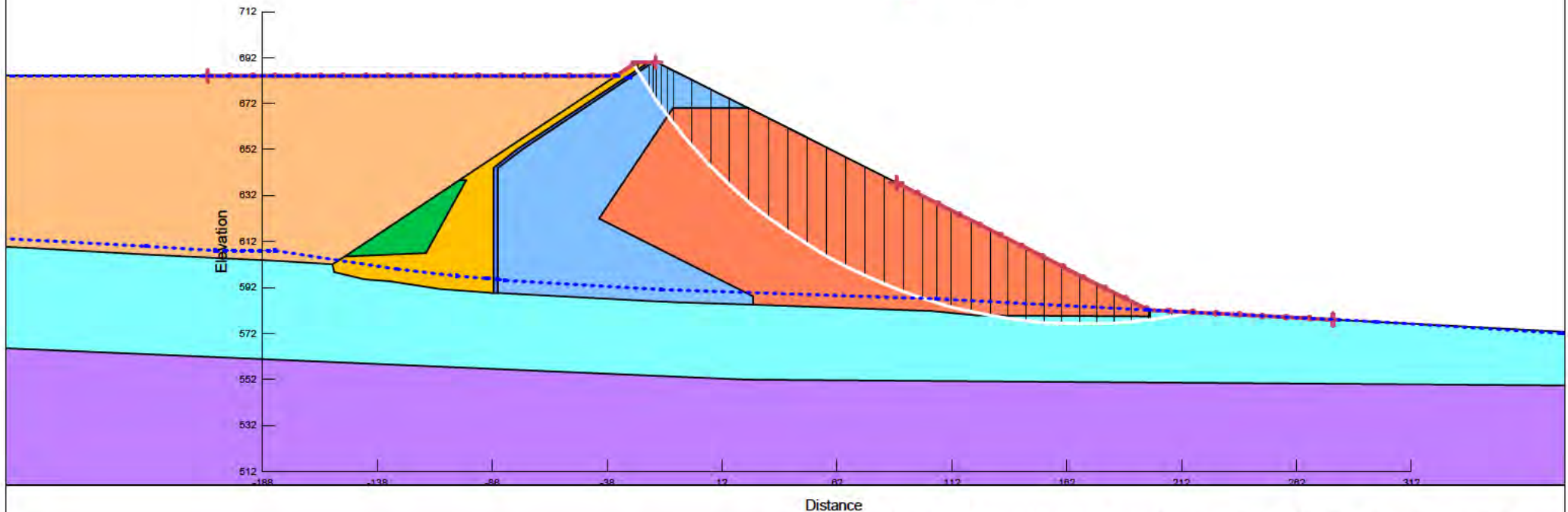


Figure C02.05-FinalEmbOp-DS-PostEQNOL-Circ-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.405

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.405

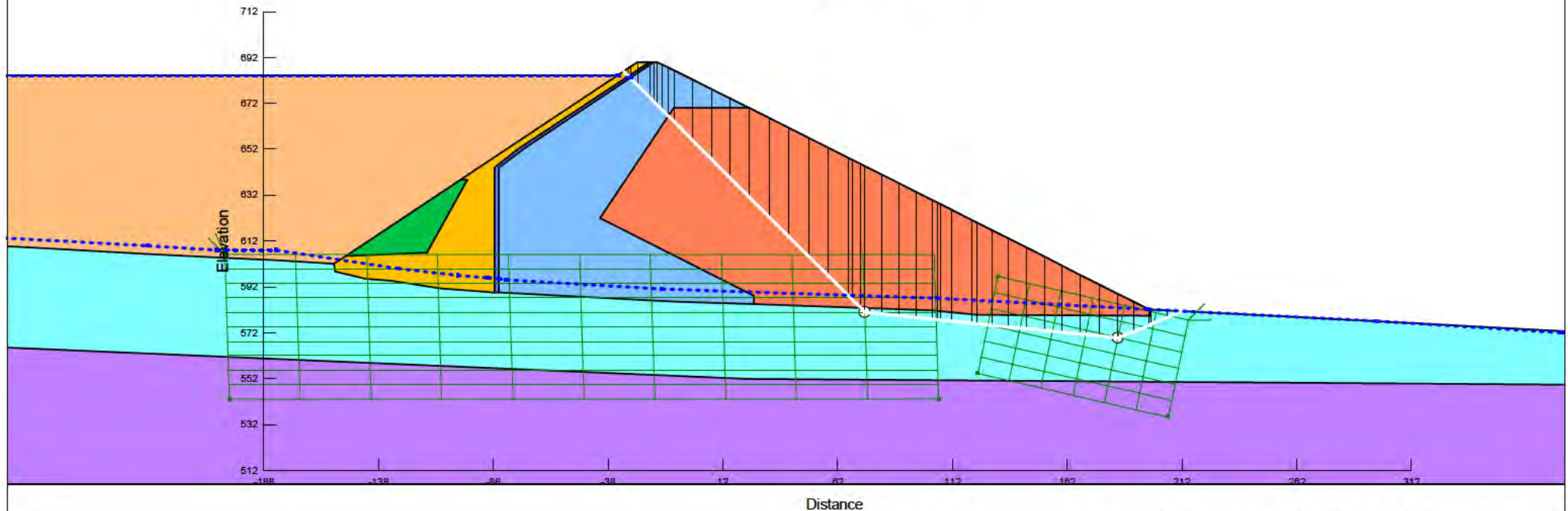


Figure C02.06-FinalEmbOp-DS-PostEQNOL-Bock-ResUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

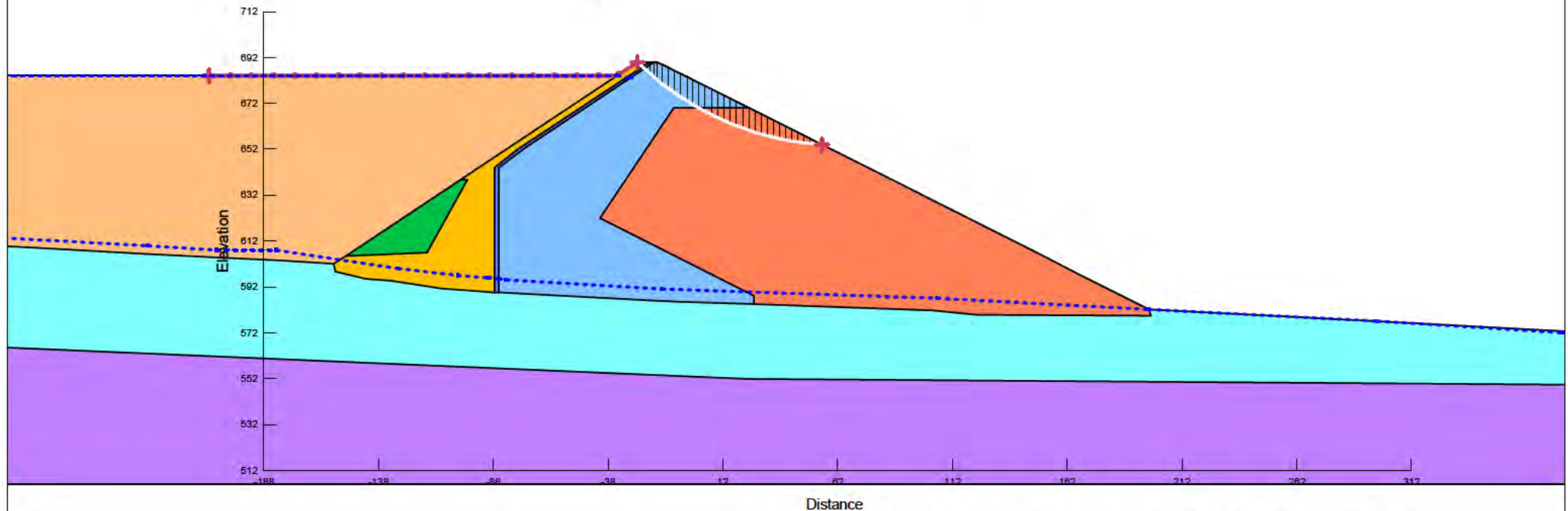
Horz Seismic Coef.: 0.3125

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Purple	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Cyan	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Dark Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Red	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000



Distance

Figure C02.07.01 DS EQ Circ 1/3H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2487

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

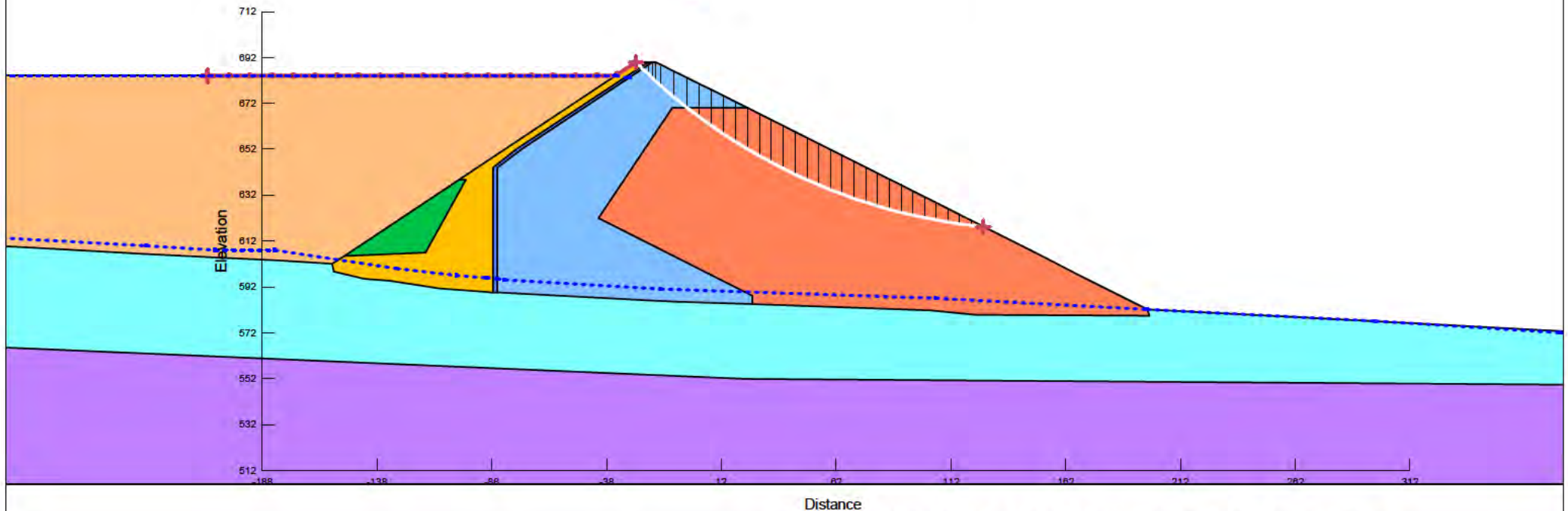


Figure C02.07.02 DS EQ Circ 2/3H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2143

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

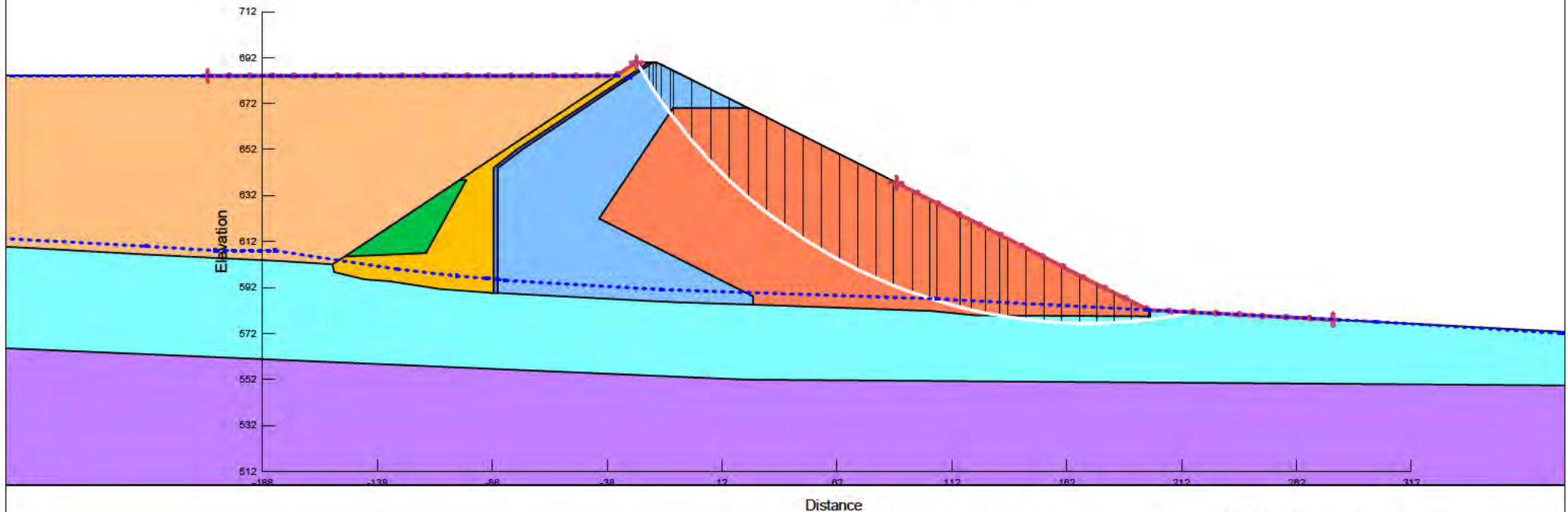


Figure C02.07.03 DS EQ Circ Full H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.1575

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

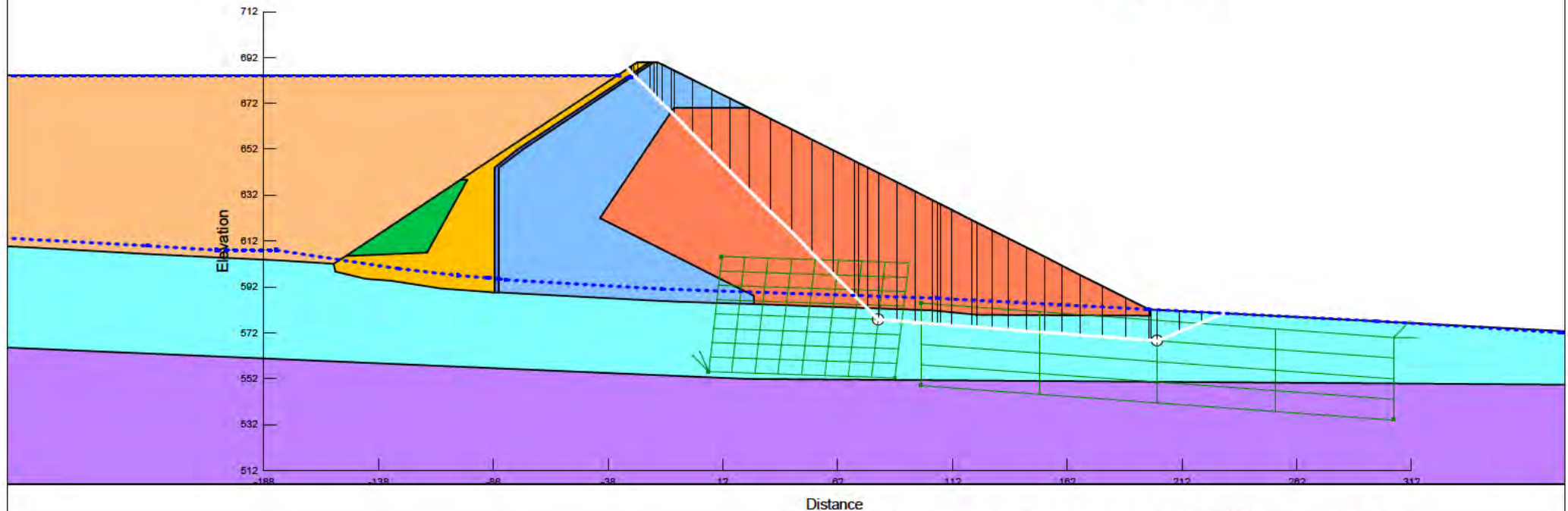


Figure C02.08 DS EQ Block Full H-NOL-ResUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.648

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.648

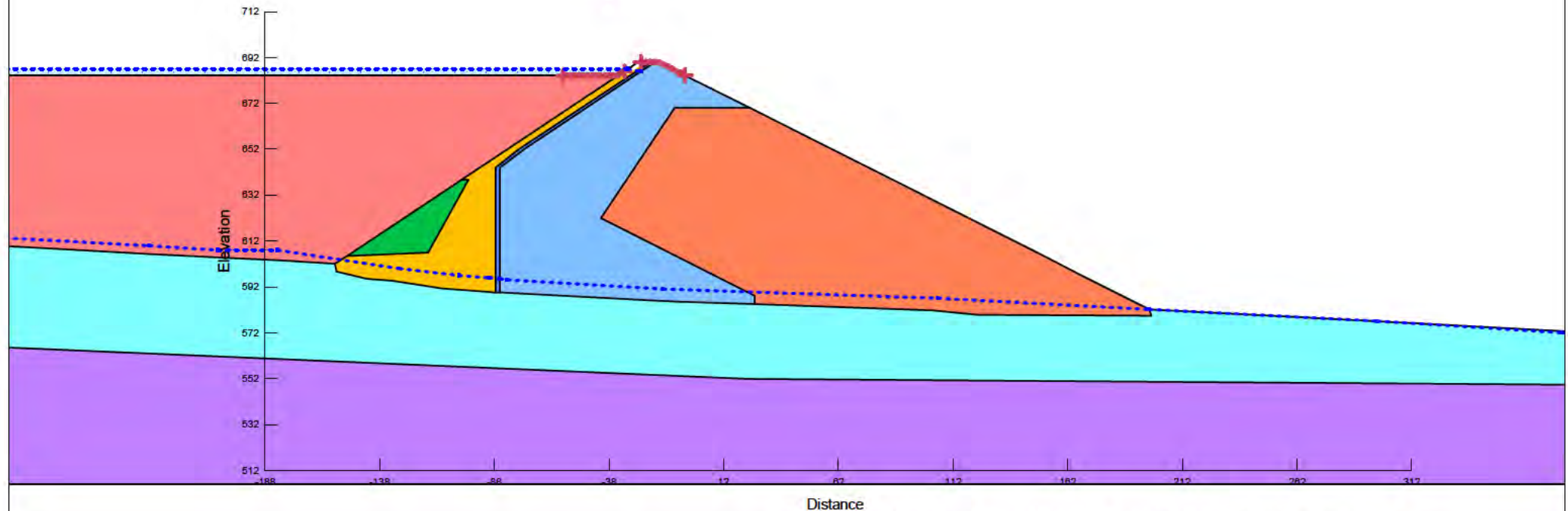


Figure C02.09-FinalEmbOp-US-CDF-Circ-PeakD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.648

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.648

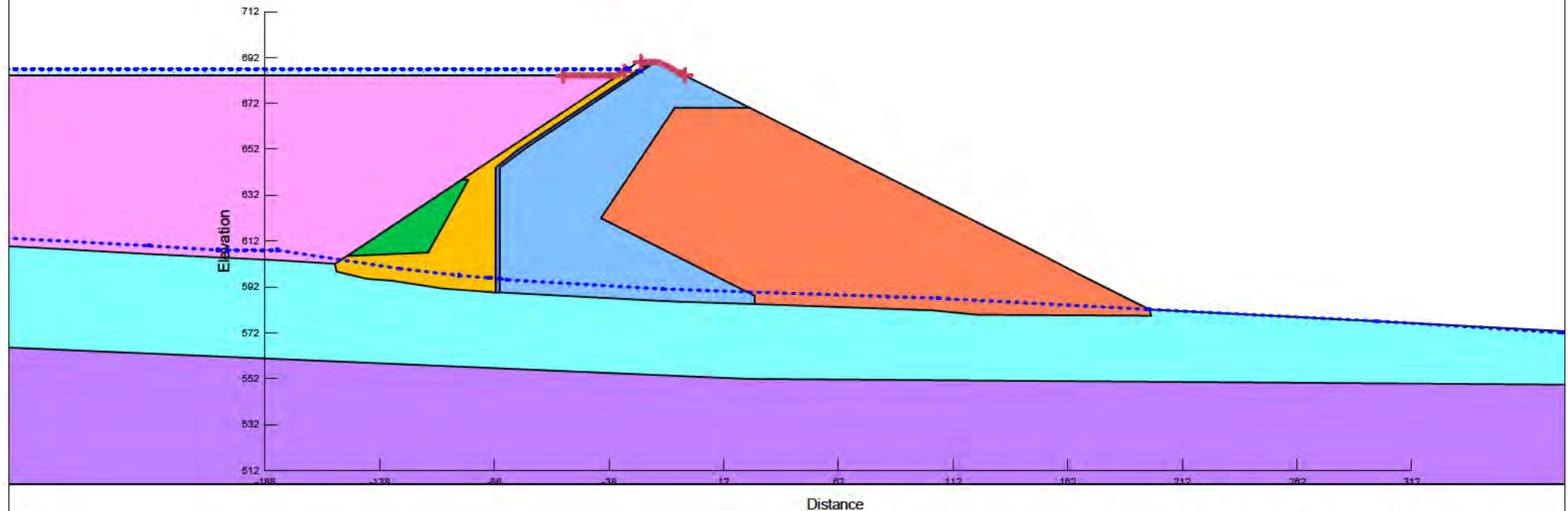


Figure C02.10-FinalEmbOp-US-CDF-Circ-PeakUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.681

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.681

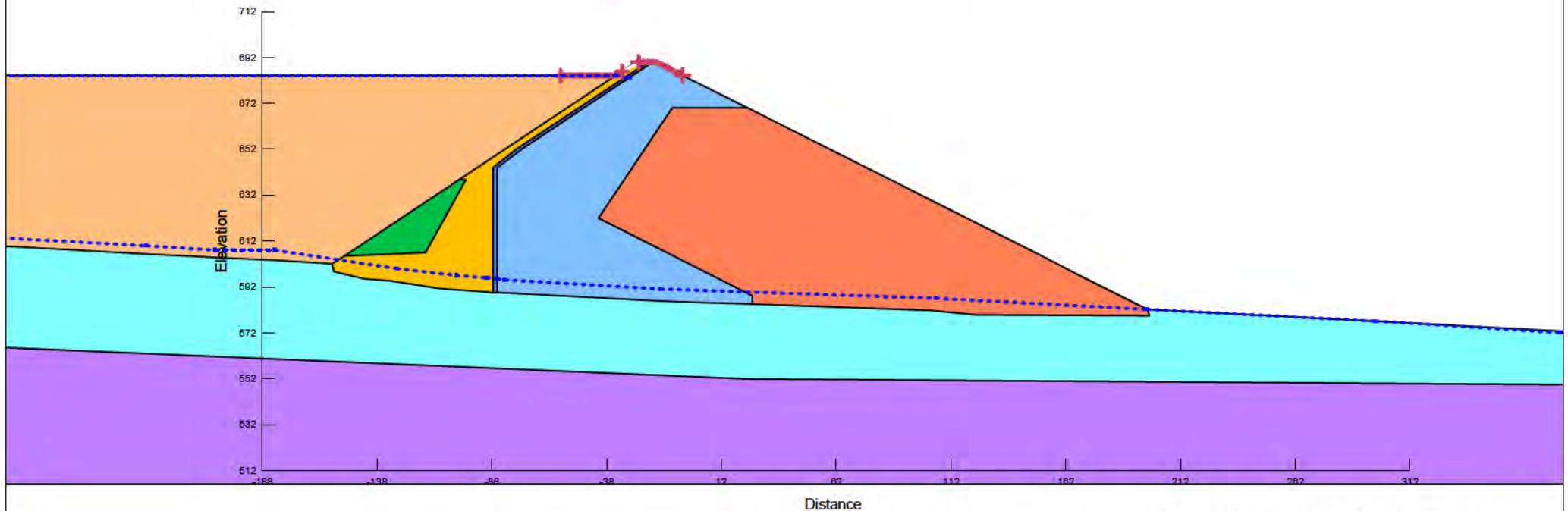


Figure C02.11-FinalEmbOp-US-CDF-PostEQNOL-Circ-ResUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2035

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma_n \cdot 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma_n \cdot 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma_n \cdot 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma_n \cdot 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma_n \cdot 0.91$							2

1.000

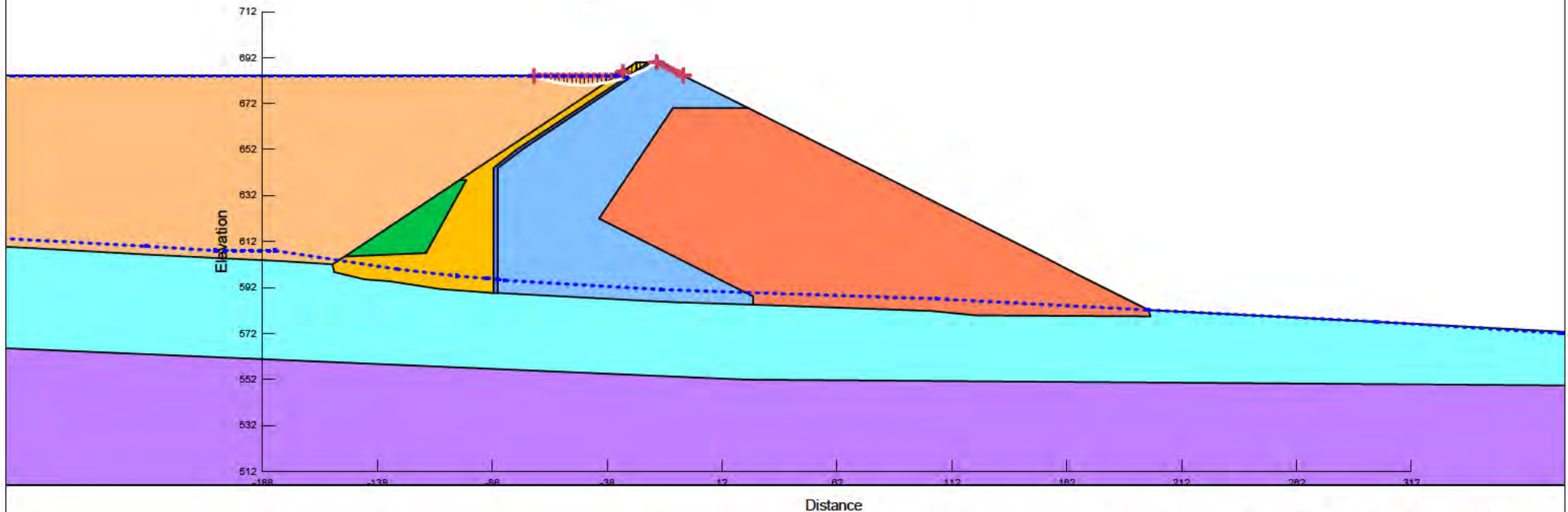


Figure C02.12-FinalEmbOp-US-CDF Circ EQ-NOL-ResUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Section 3 – Final Embankment With FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.536

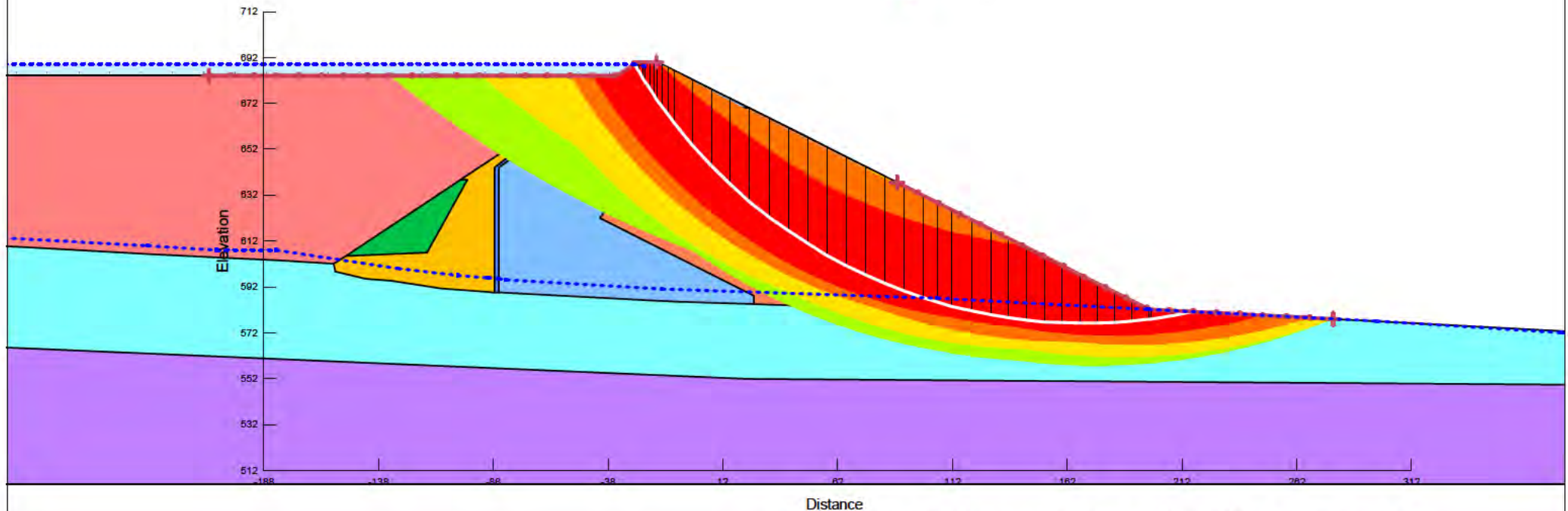


Figure C02.01-FinalEmbOp-DS-PMP-Circ-PeakD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.402

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.402

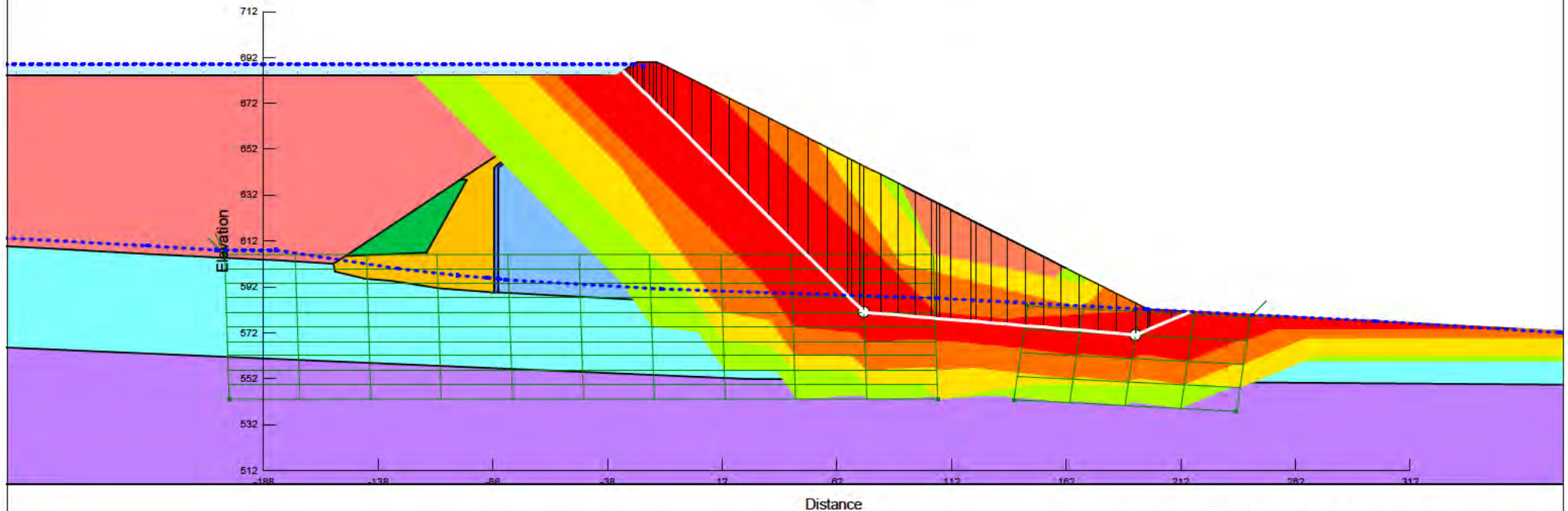


Figure C02.02A-FinalEmbOp-DS-PMP-Block-PeakD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.550

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Piezometric Line
Light Pink	Insitu Rock >40m without foliation	Mohr-Coulomb	26		150	45	2
Teal	Insitu Rock 0 to 40m without foliation	Mohr-Coulomb	26		50	40	2
Light Red	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32	1
Yellow	Zone A1	Shear/Normal Fr.	22.5	$2.43\sigma_v^{0.83}$			1
Light Blue	Zone B Down stream	Shear/Normal Fr.	22.5	$2.43\sigma_v^{0.83}$			2
Green	Zone B Upstream	Shear/Normal Fr.	22.5	$2.43\sigma_v^{0.83}$			1
Dark Blue	Zone B1	Shear/Normal Fr.	22.5	$2.43\sigma_v^{0.83}$			1
Orange	Zone C	Shear/Normal Fr.	21.5	$1.29\sigma_v^{0.91}$			2

1.550

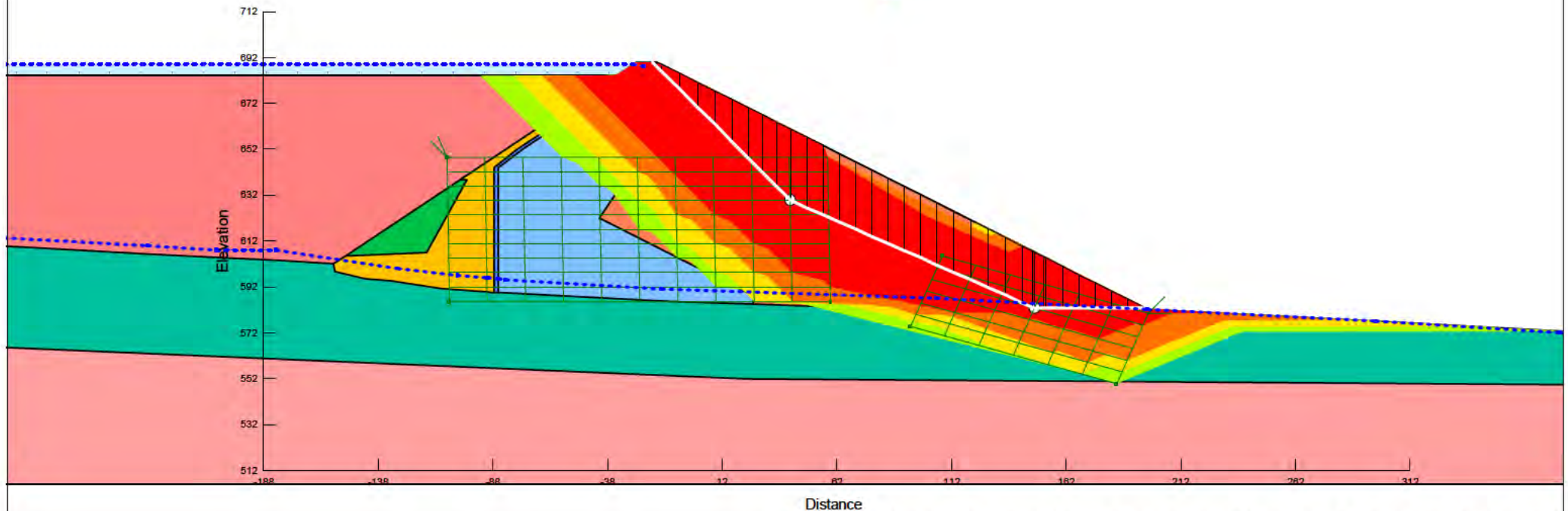


Figure C02.02B-FinalEmbOp-DS-PMP-Block-PeakD-NoFoliation



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.536

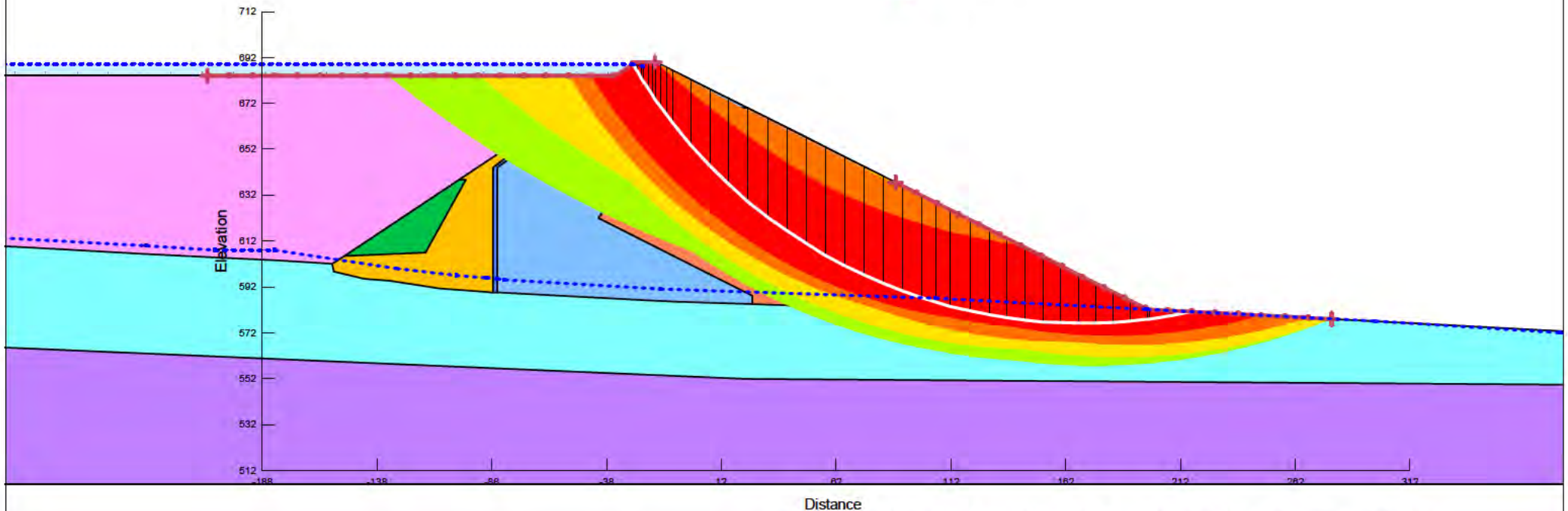


Figure C02.03-FinalEmbOp-DS-PMP-Circ-PeakUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.404

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.404

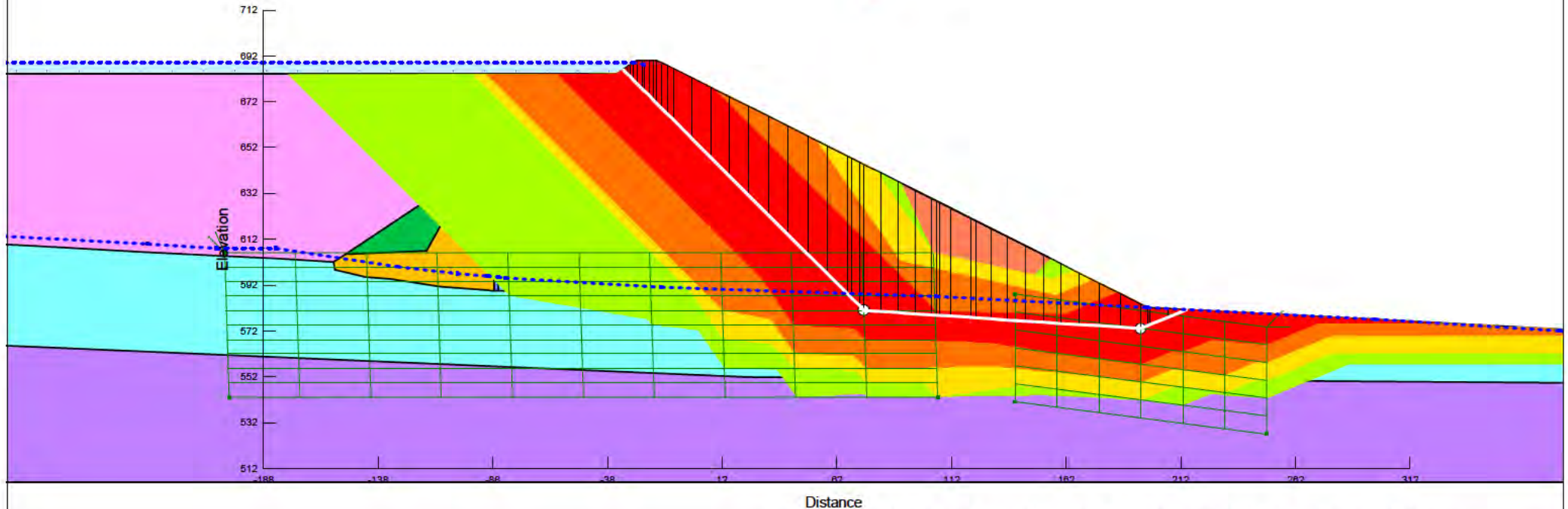


Figure C02.04-FinalEmbOp-DS-PMP-Block-PeakUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.536

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Purple	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Blue	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.536

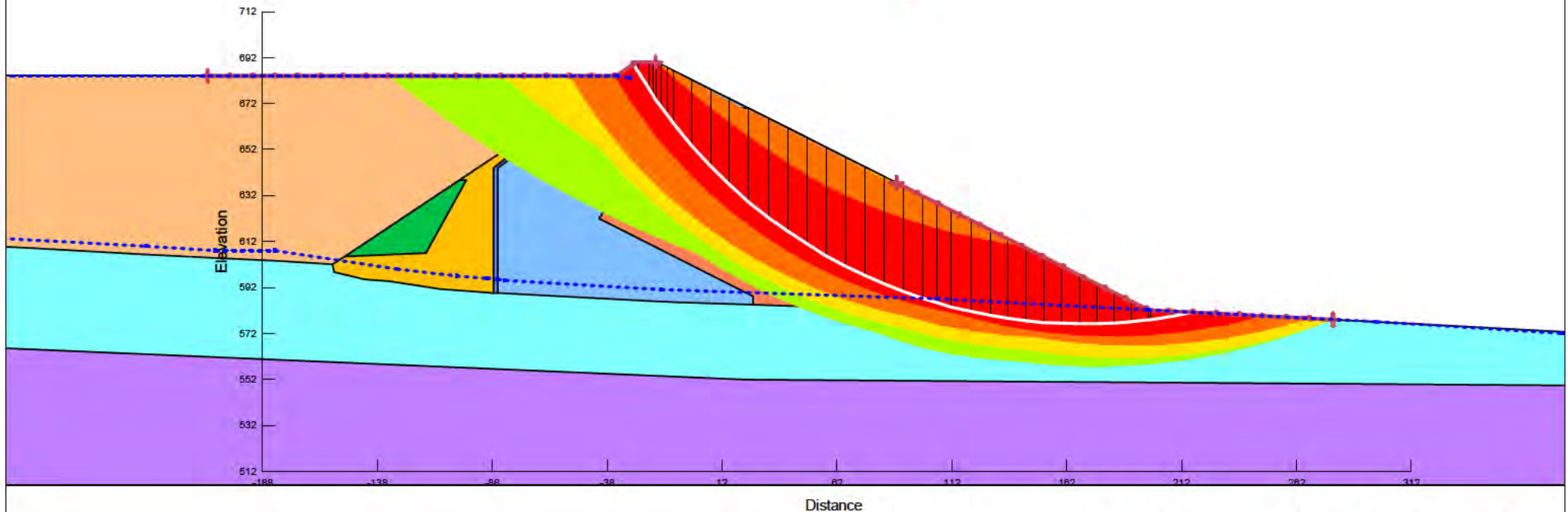


Figure C02.05-FinalEmbOp-DS-PostEQNOL-Circ-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.405

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.405

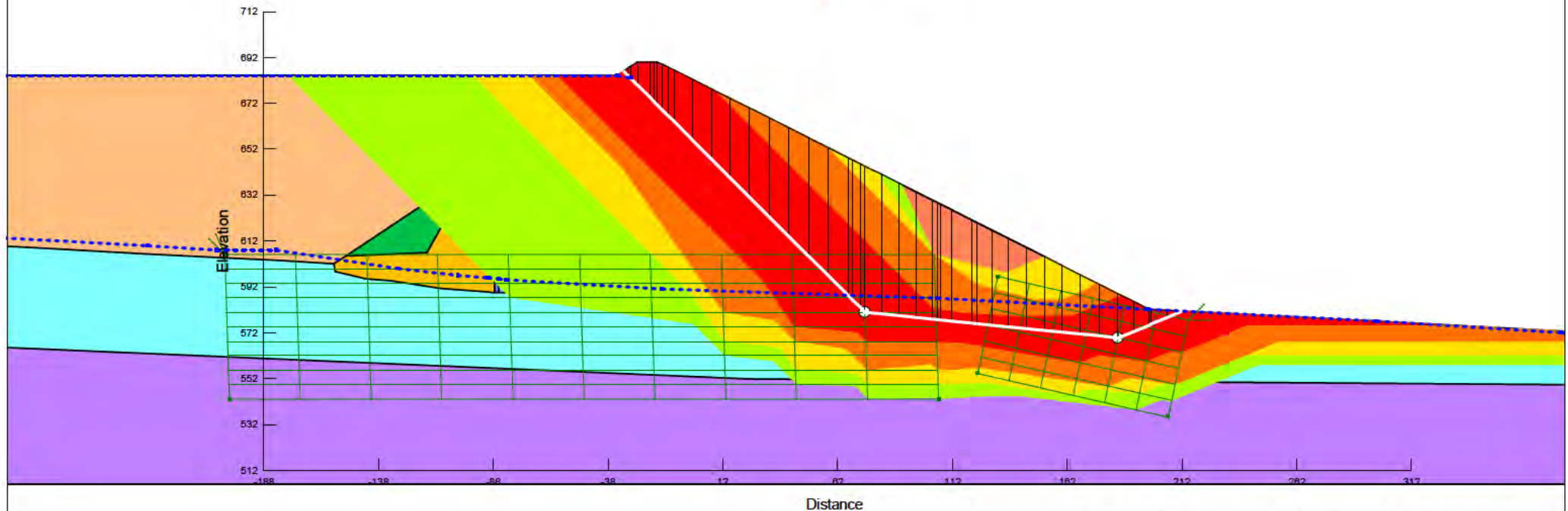


Figure C02.06-FinalEmbOp-DS-PostEQNOL-Bock-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.3125

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Purple	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Cyan	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Dark Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Red	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

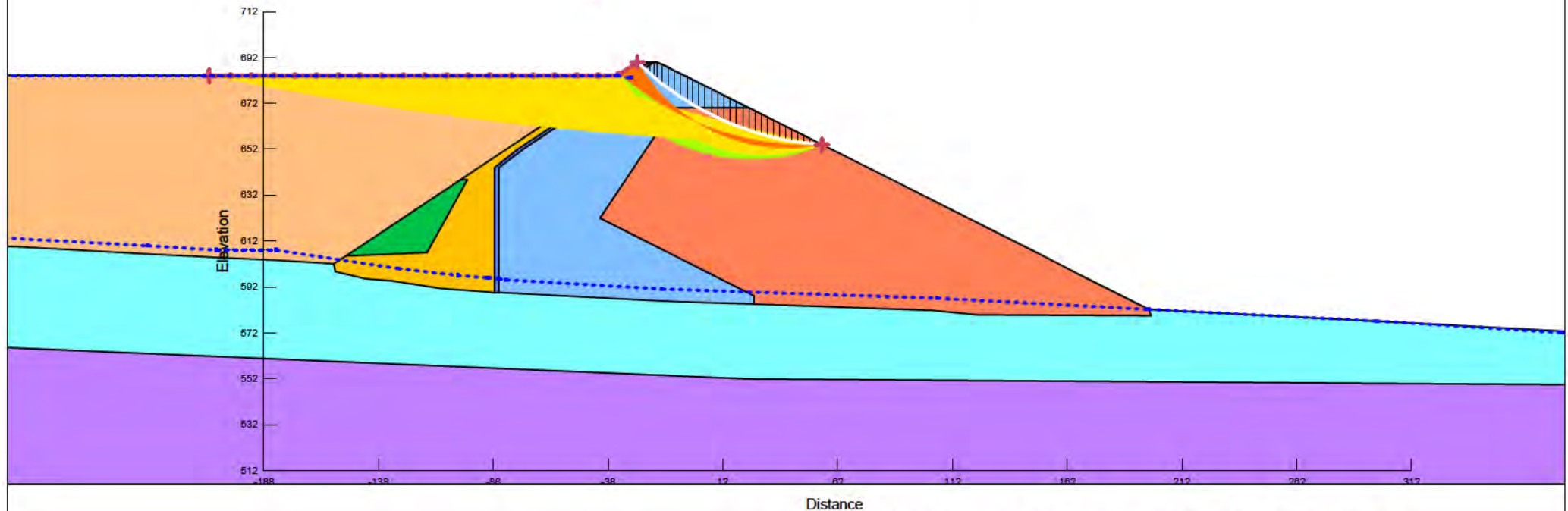


Figure C02.07.01 DS EQ Circ 1/3H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2487

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

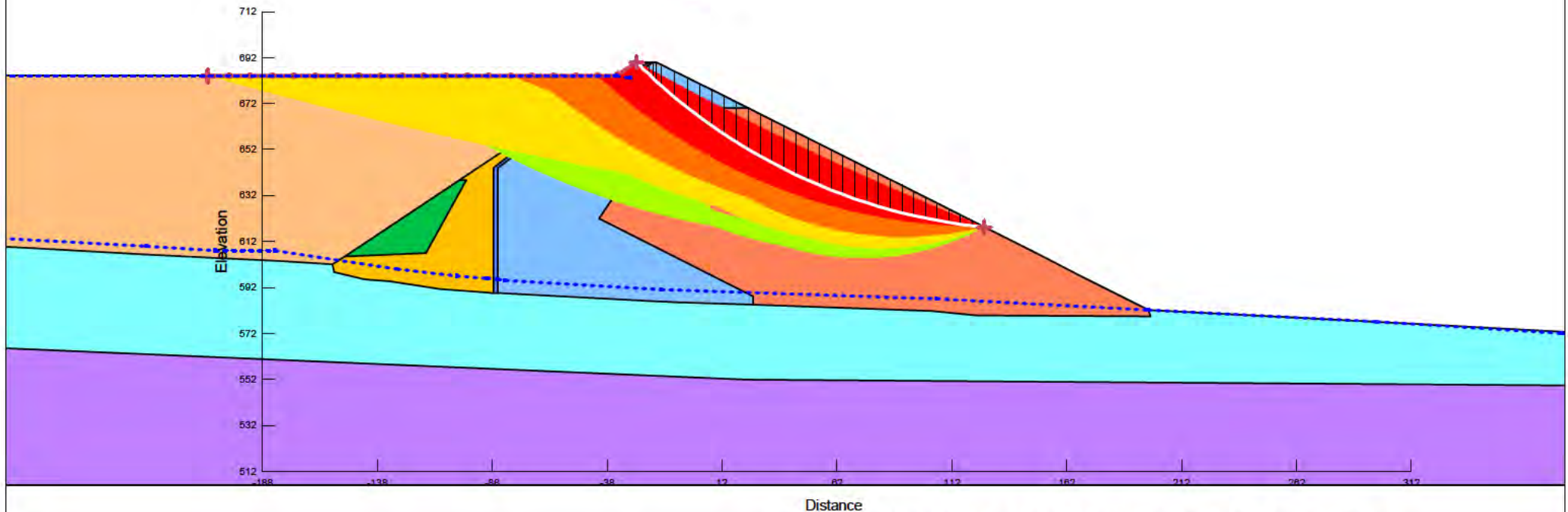


Figure C02.07.02 DS EQ Circ 2/3H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2143

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

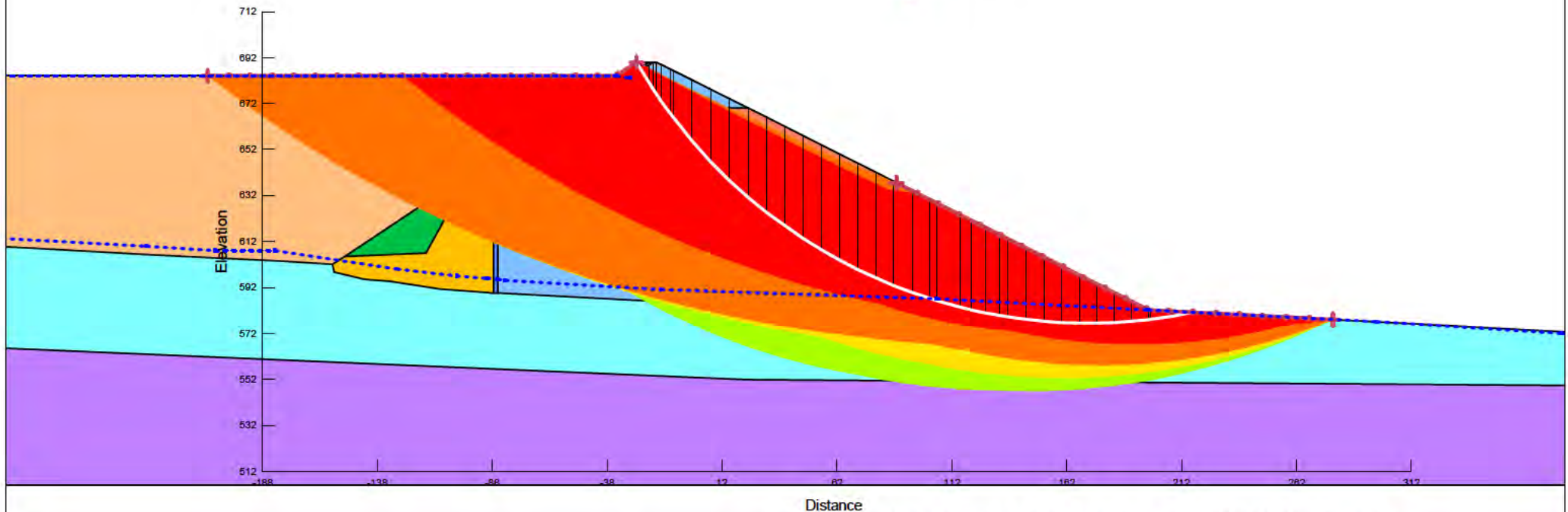


Figure C02.07.03 DS EQ Circ Full H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.1575

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Light Blue	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Light Green	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Light Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Orange	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

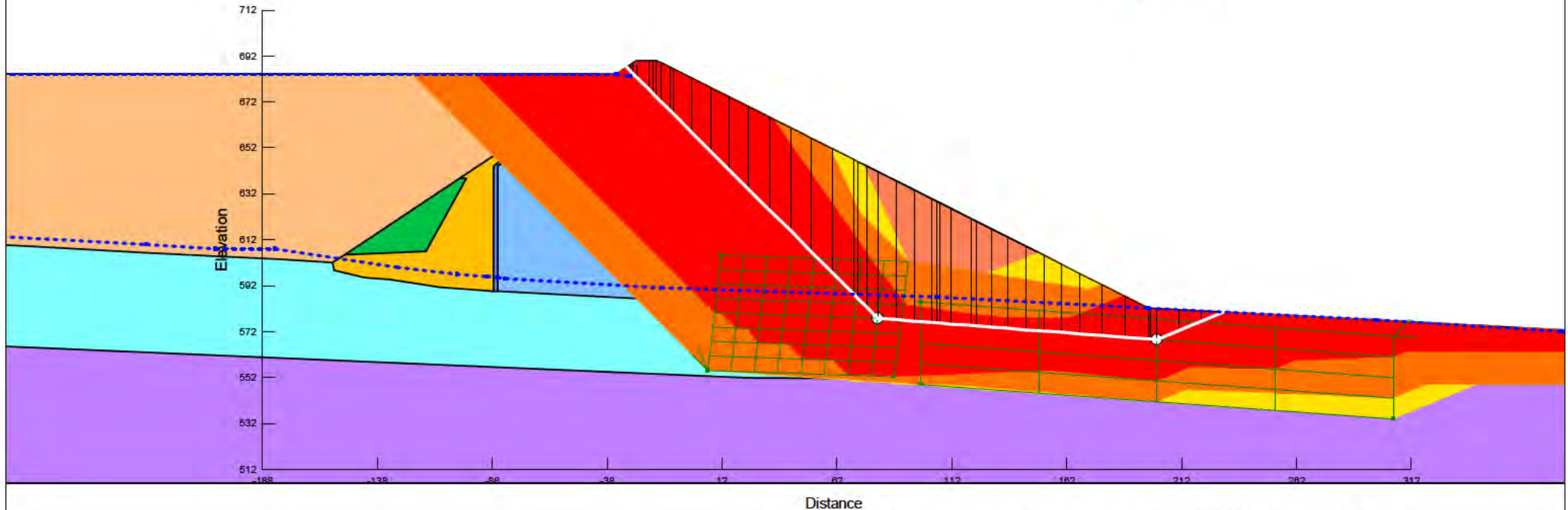


Figure C02.08 DS EQ Block Full H-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.648

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

1.648

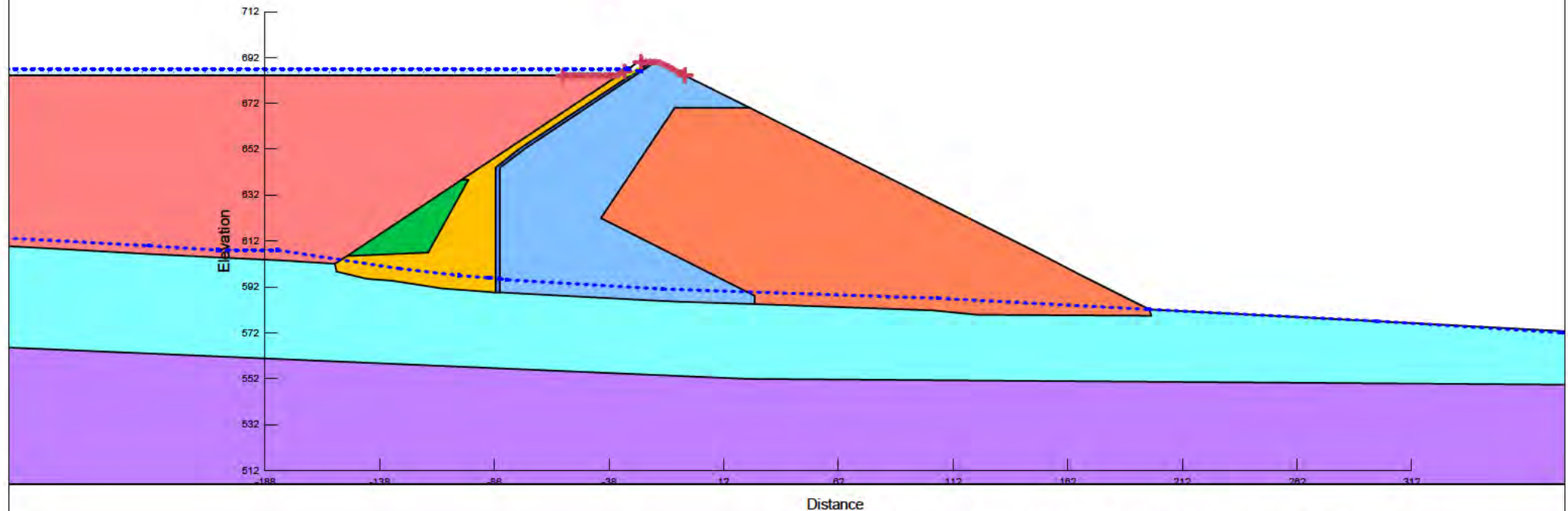


Figure C02.09-FinalEmbOp-US-CDF-Circ-PeakD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.648

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Peak Undrained Shear Strength	SHANSEP	18.6		0	0.19					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.648

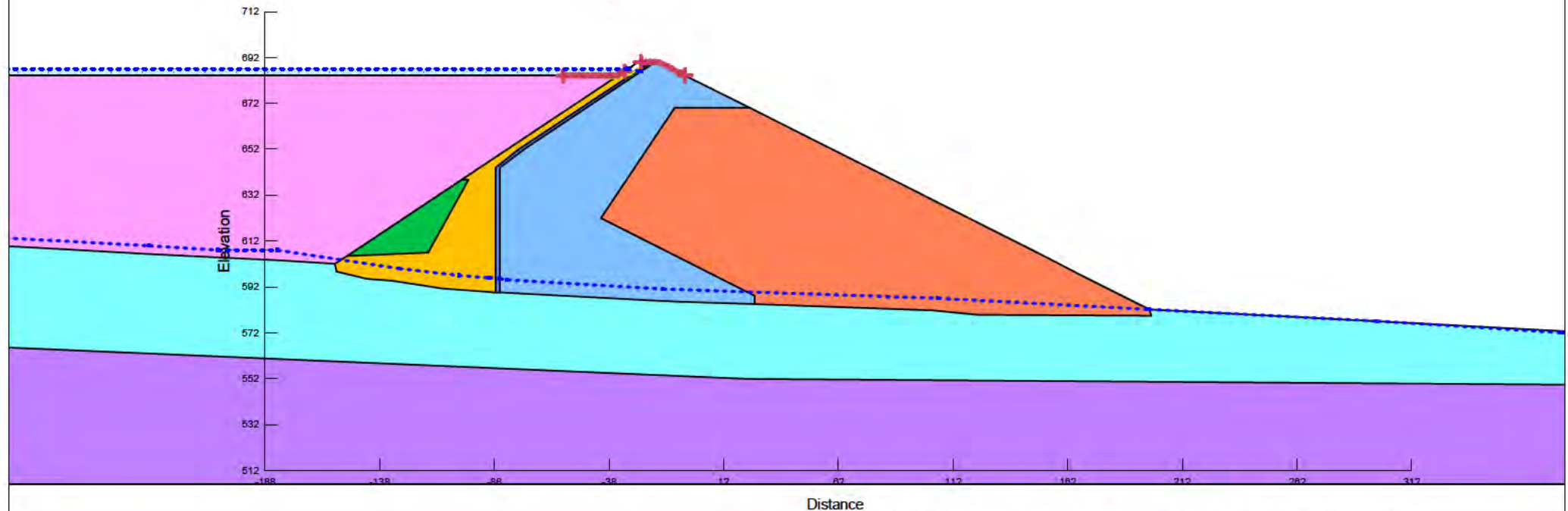


Figure C02.10-FinalEmbOp-US-CDF-Circ-PeakUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 1.681

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
Purple	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
Cyan	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
Orange	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
Yellow	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Light Blue	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
Green	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Dark Blue	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
Red	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.681

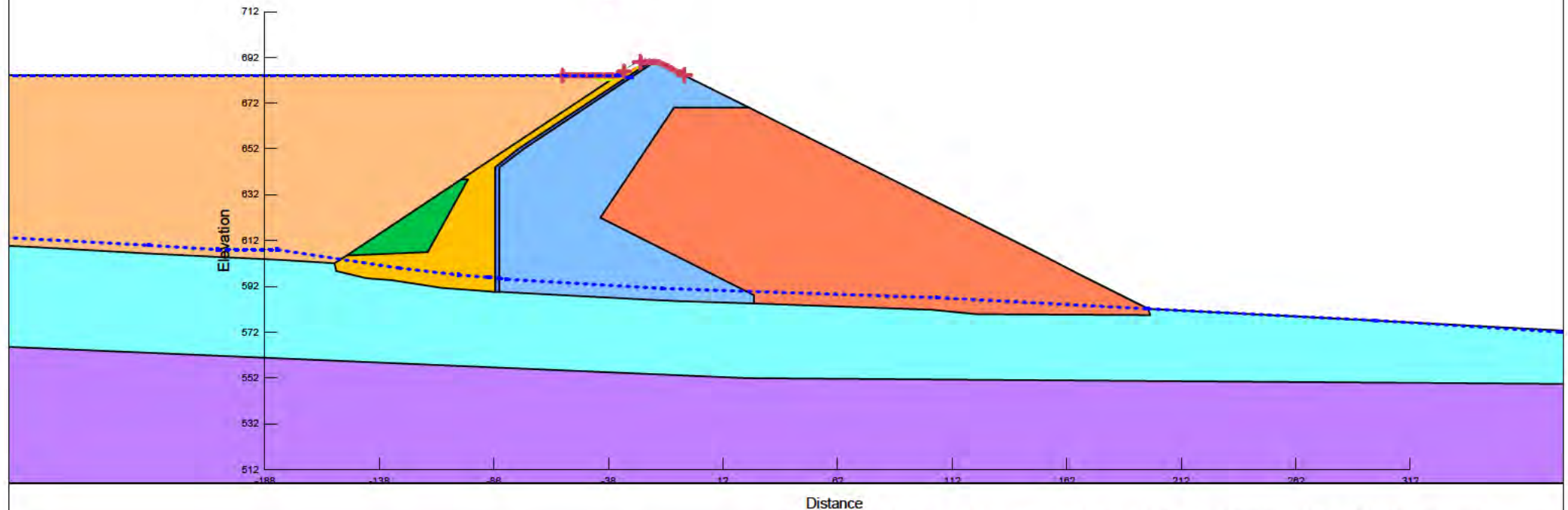


Figure C02.11-FinalEmbOp-US-CDF-PostEQNOL-Circ-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Analysis Parameters

Method: Spencer

Direction of movement: Right to Left

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.2035

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Minimum Strength (kPa)	Tau/Sigma Ratio	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m with foliation (anisotropic)	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6		0	0.06					1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma + 0.83$							1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma + 0.91$							2

1.000

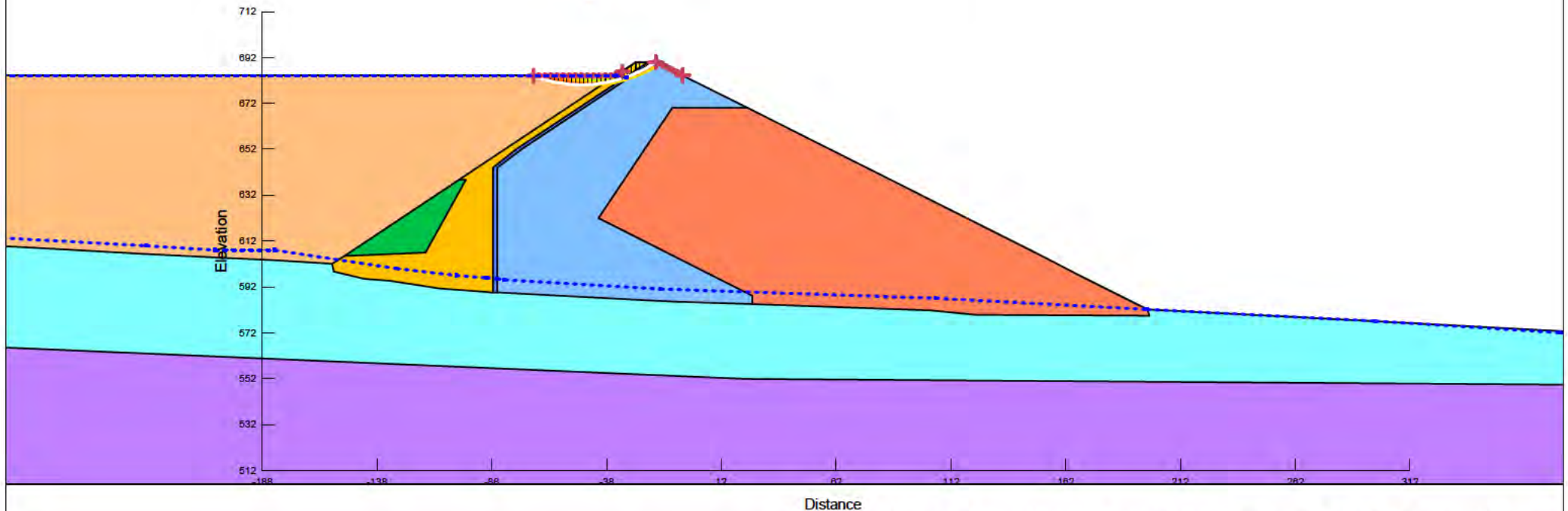


Figure C02.12-FinalEmbOp-US-CDF Circ EQ-NOL-ResUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:2,500

Section 3 – Final Embankment with Partial Buttrressing

Section 3 – Final Embankment with Partial Buttrressing
Without FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.044

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	In situ Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2
	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

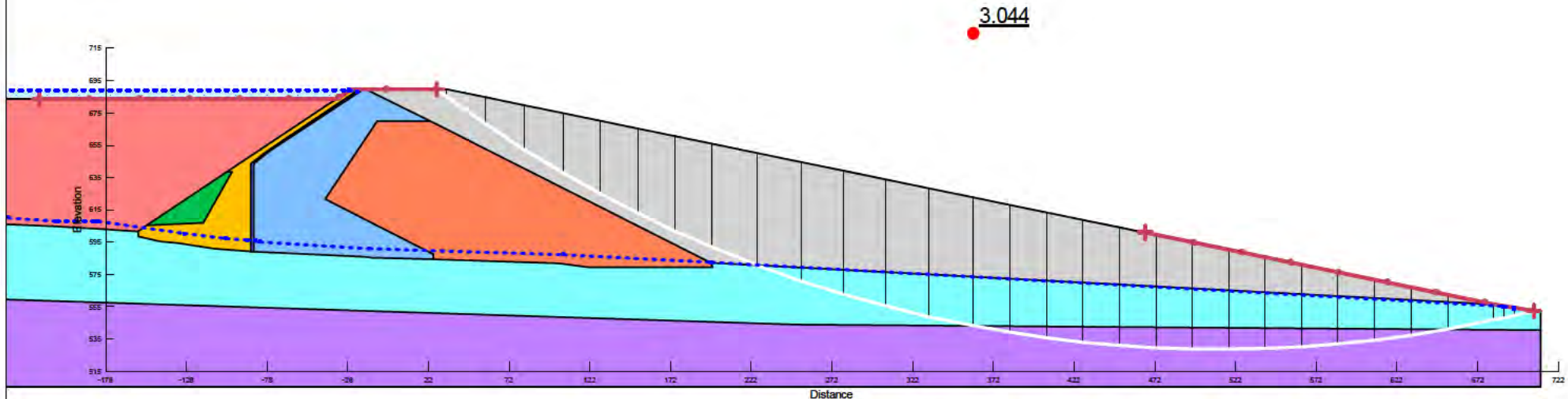


Figure C03.01-FinalEmButOp-DS-PMP-Circ-PeakD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2
■	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
■	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

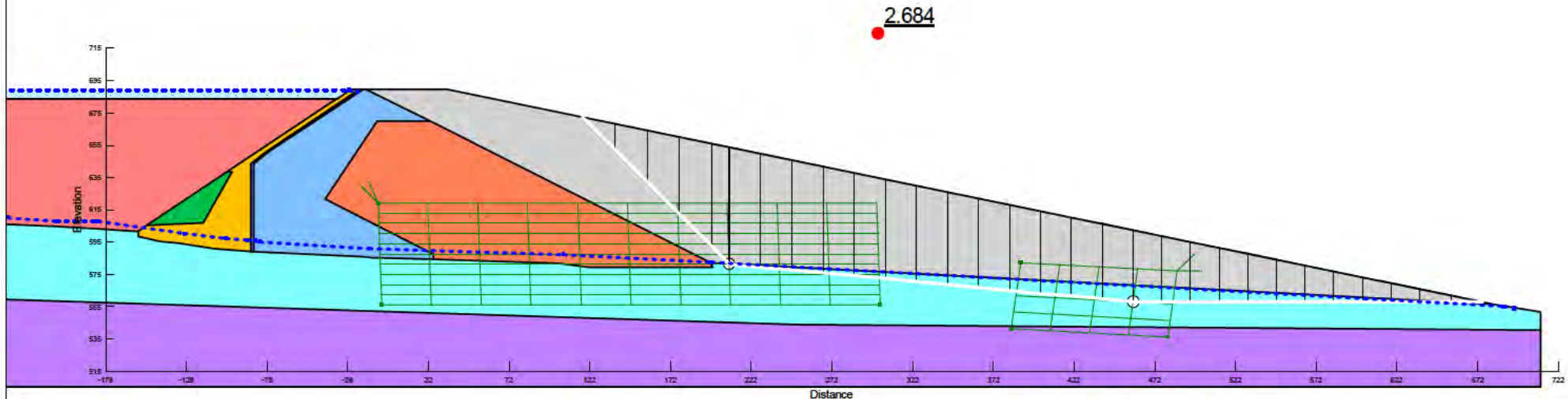


Figure C03.02-FinalEmButOp-DS-PMP-Block-PeakD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.030

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
	Tails - Peak Undrained Shear Strength	SHANSEP	18.6	0	0.19						1
	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

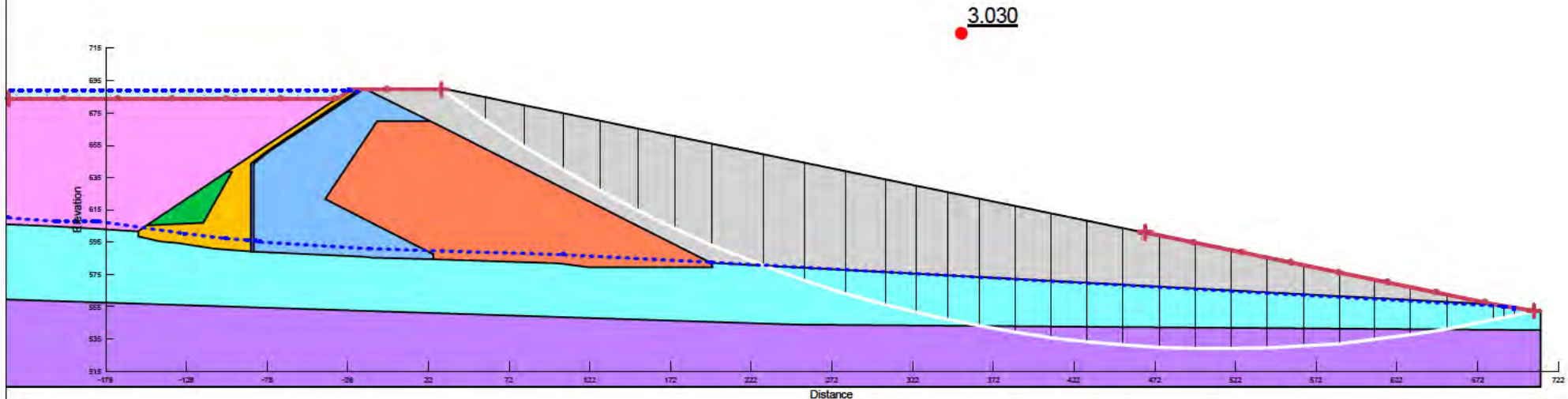


Figure C03.03-FinalEmButOp-DSPMP-Circ-PeakUD



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Shepherds TSF - Stability Analysis

Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
	Tails - Peak Undrained Shear Strength	SHANSEP	18.6	0	0.19						1
	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

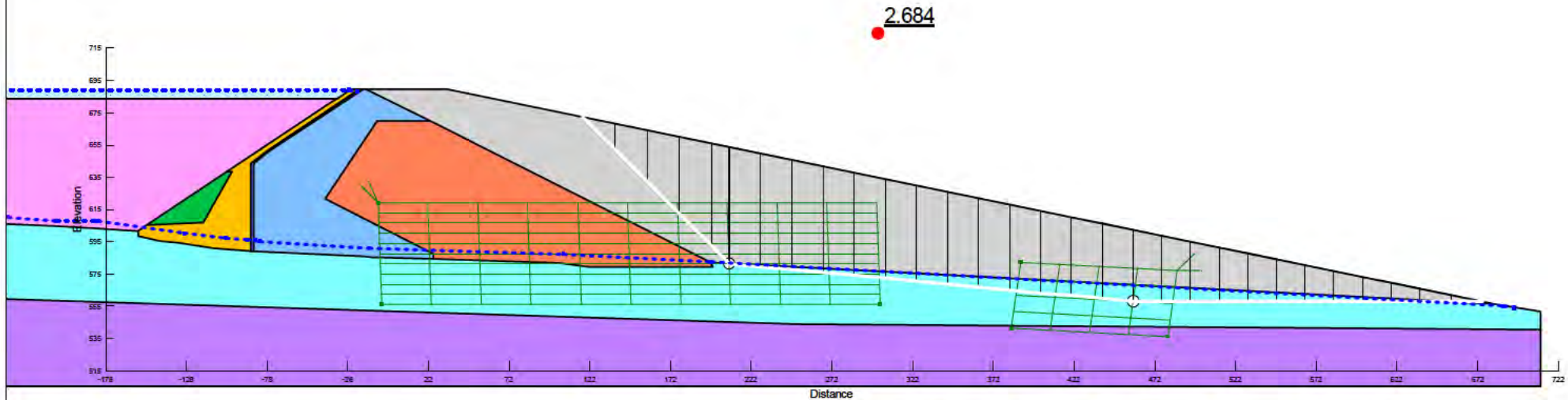


Figure C03.04-FinalEmButOp-DS-PMP-Block-PeakUD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.087

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	In situ Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

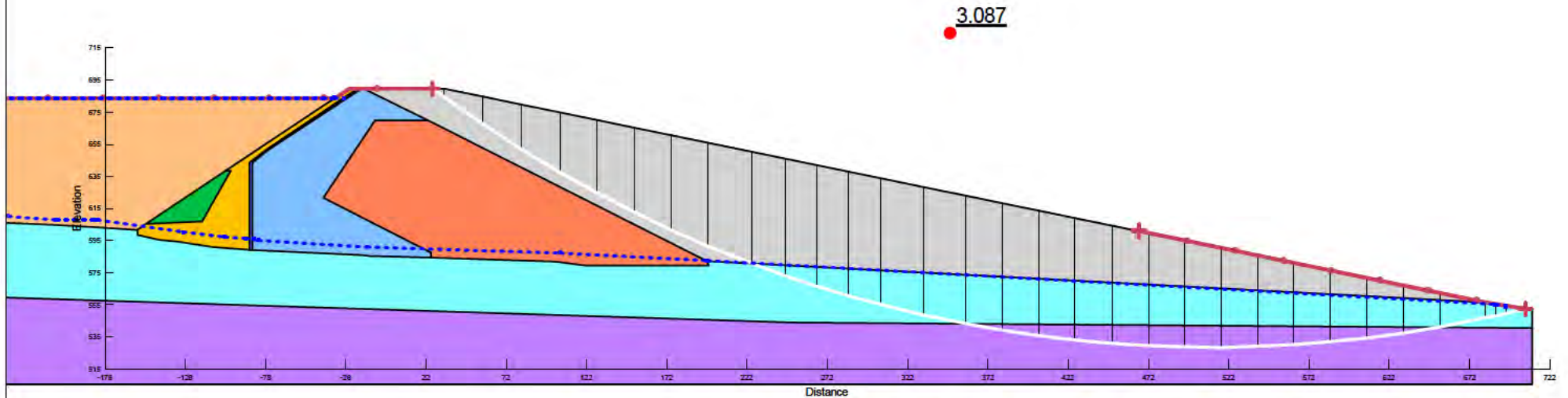


Figure C03.05-FinalEmButOp-DS-NOL-Circ-PostEQ-ResUD



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Shepherds TSF - Stability Analysis

Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

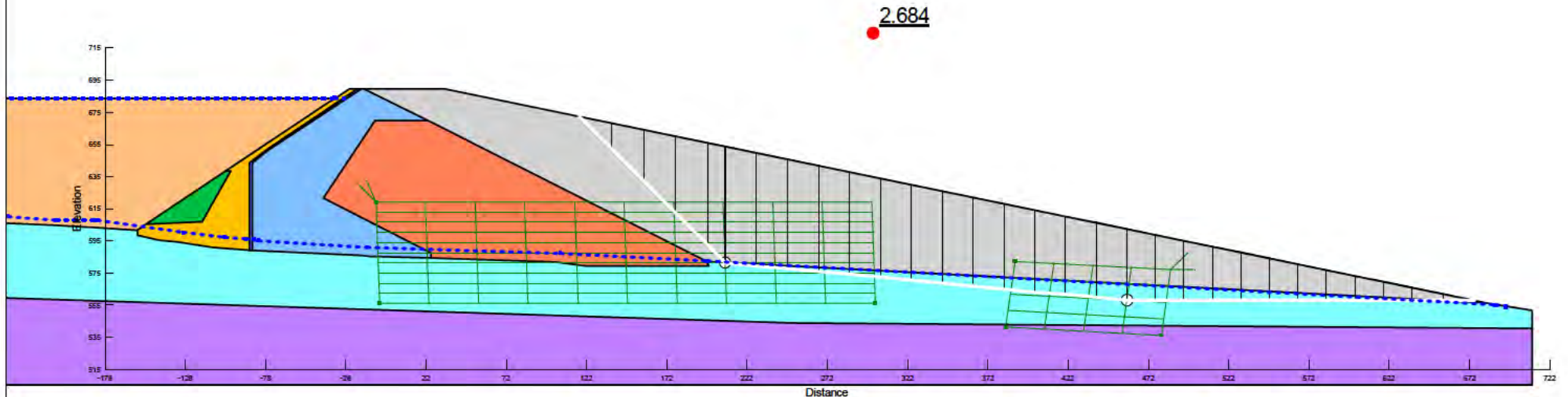


Figure C03.06-FinalEmButOp-DS-NOL-Block-PostEQ-ResUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.362

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	In situ Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

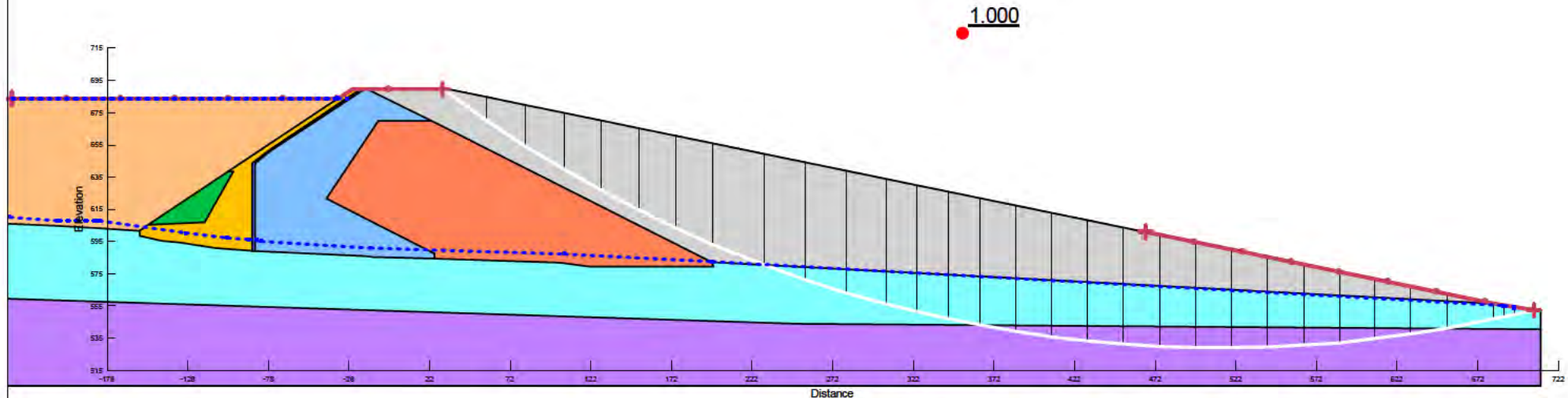


Figure C03.07-FinalEmButOp-DS-NOL-EQ-Circ-ResUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.2845

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

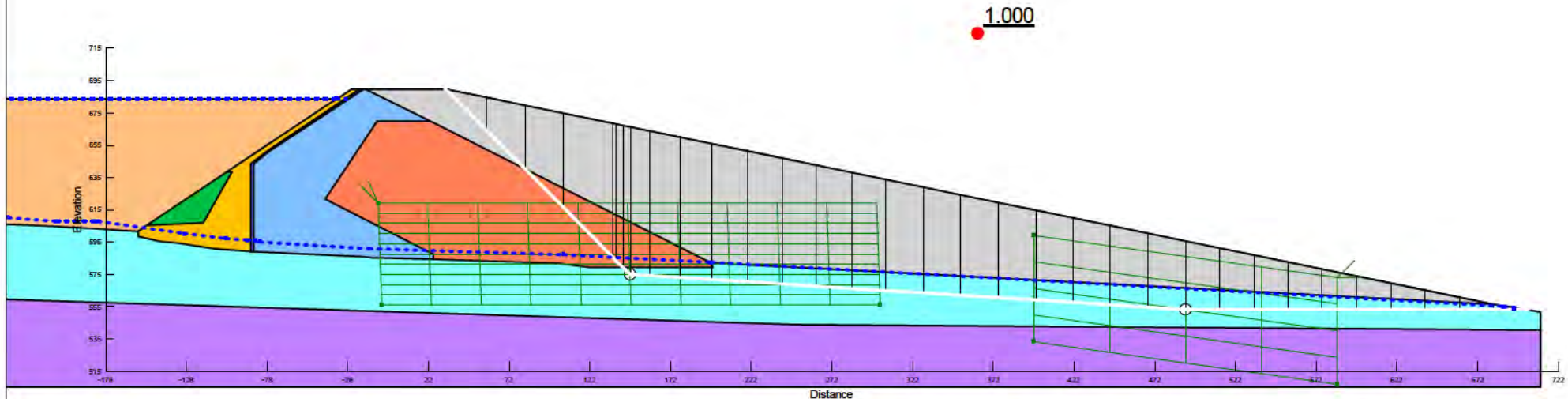


Figure C03.08-FinalEmButOp-DS-NOL-EQ-Block-ResUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis
Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Section 3 – Final Embankment with Partial Buttrressing
With FOS Shading

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.044

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	In situ Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2
	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

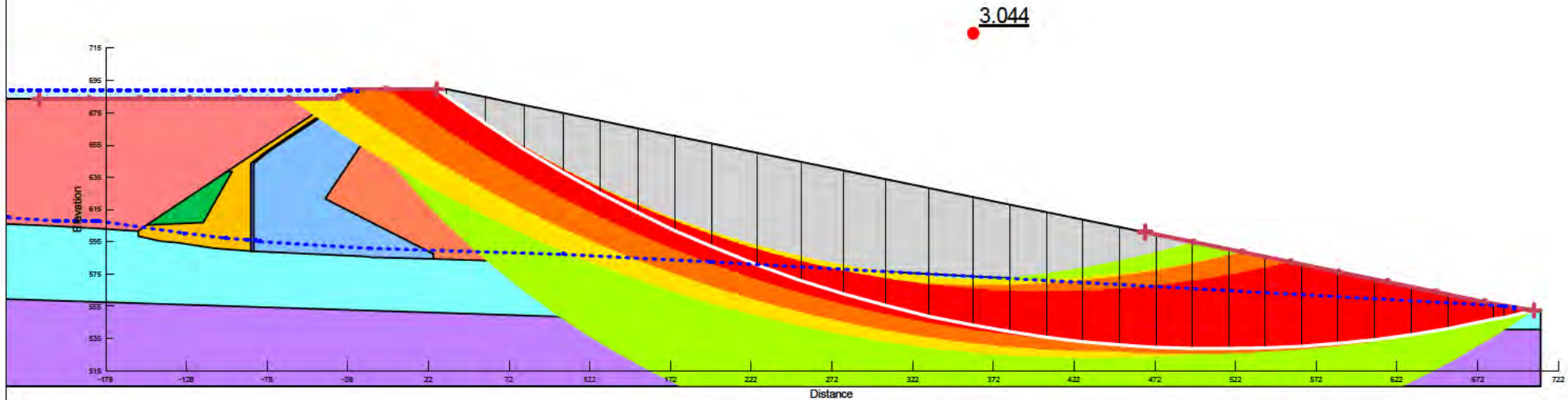


Figure C03.01-FinalEmButOp-DS-PMP-Circ-PeakD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation	Anisotropic Fn.	26		150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26		50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2
	Tails - Peak Drained Shear Strength	Mohr-Coulomb	18.6		0	32			1
	Zone A1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5	$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5	$1.29\sigma^*0.91$					2

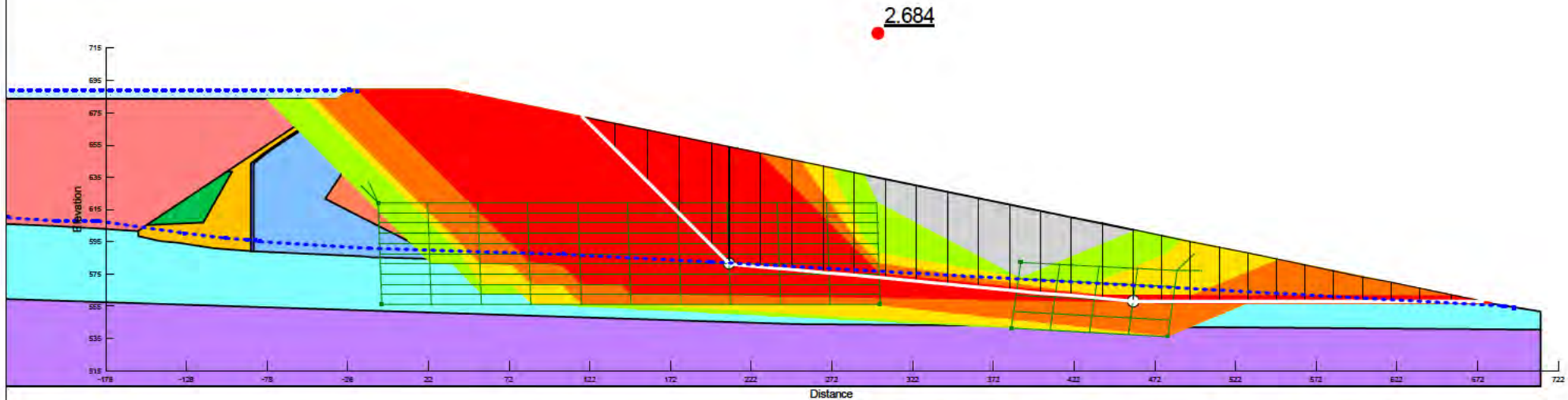


Figure C03.02-FinalEmButOp-DS-PMP-Block-PeakD



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Shepherds TSF - Stability Analysis
 Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.030

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
	Tails - Peak Undrained Shear Strength	SHANSEP	18.6	0	0.19						1
	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

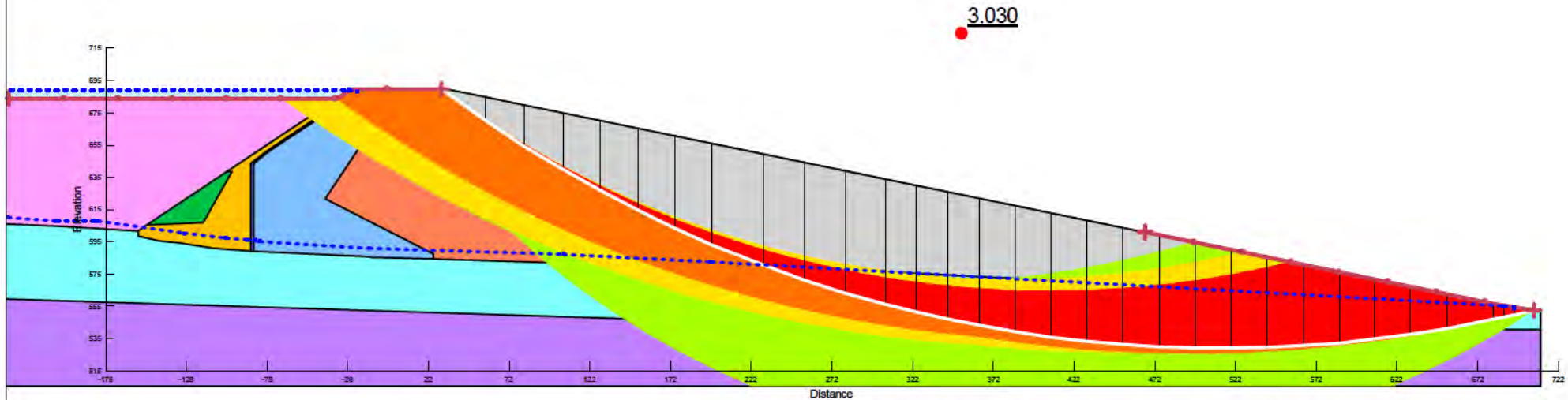


Figure C03.03-FinalEmButOp-DSPMP-Circ-PeakUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
	Tails - Peak Undrained Shear Strength	SHANSEP	18.6	0	0.19						1
	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

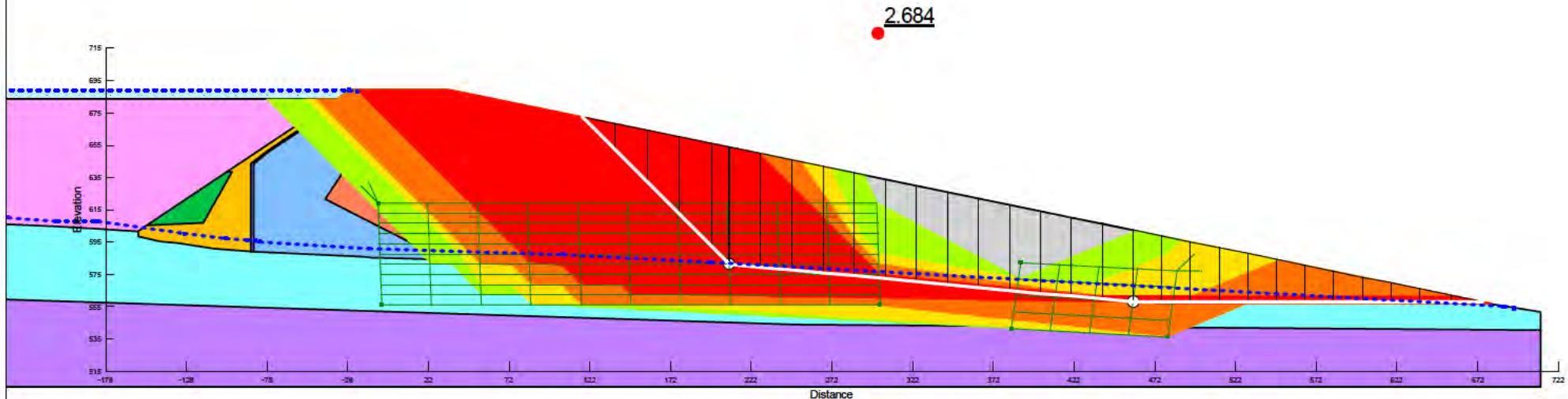


Figure C03.04-FinalEmButOp-DS-PMP-Block-PeakUD



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MATAKANUI GOLD LIMITED

Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 3.087

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	In situ Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

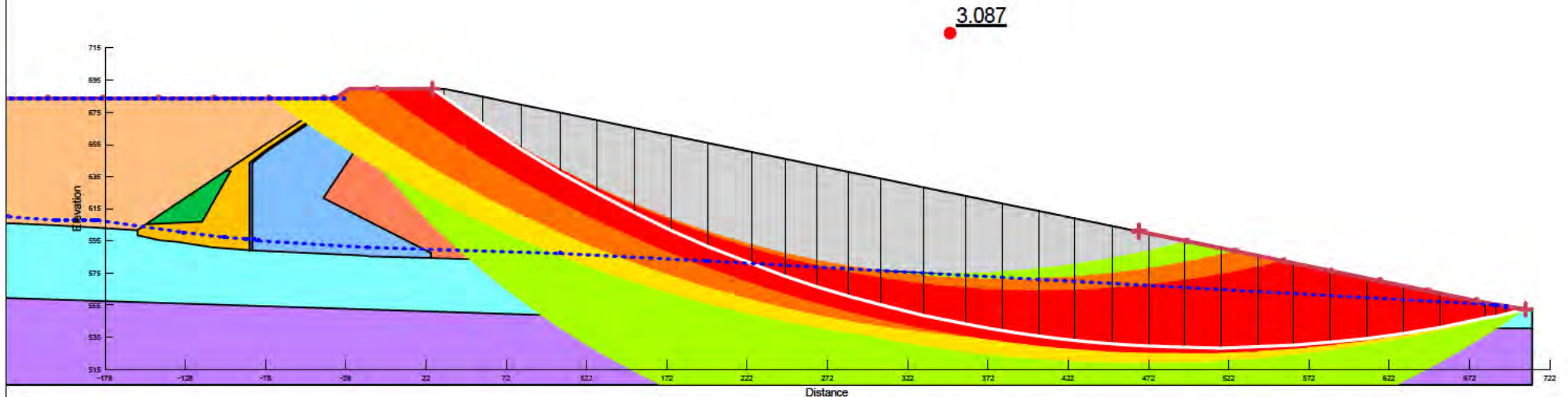


Figure C03.05-FinalEmButOp-DS-NOL-Circ-PostEQ-ResUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.:

Analysis Results

Factor of Safety: 2.684

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	In situ Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	In situ Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

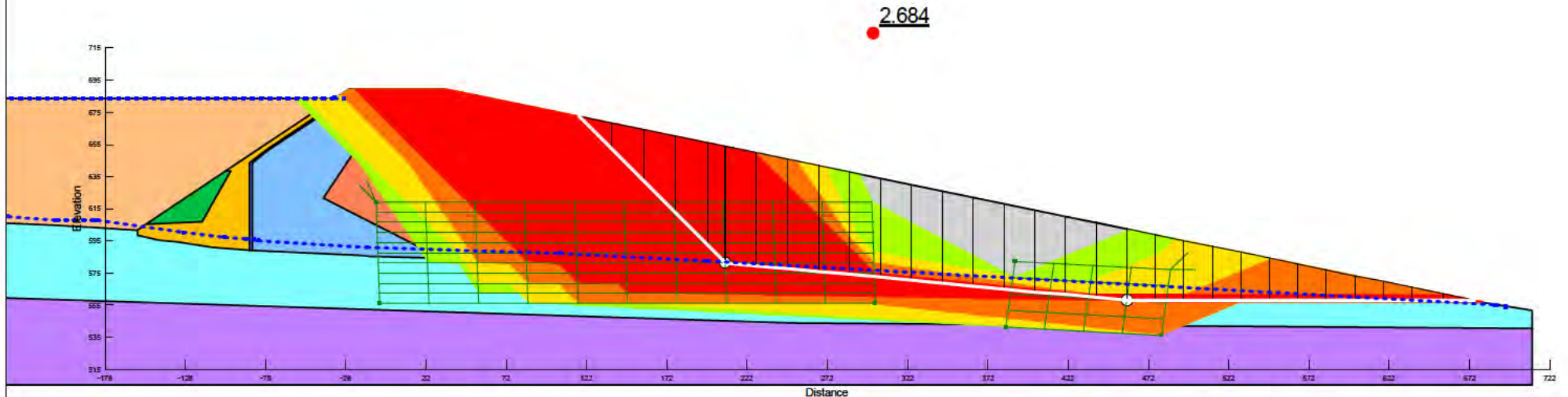


Figure C03.06-FinalEmButOp-DS-NOL-Block-PostEQ-ResUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Spencer

Direction of movement: Left to Right

Slip Surface Option: Entry and Exit

Horz Seismic Coef.: 0.362

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

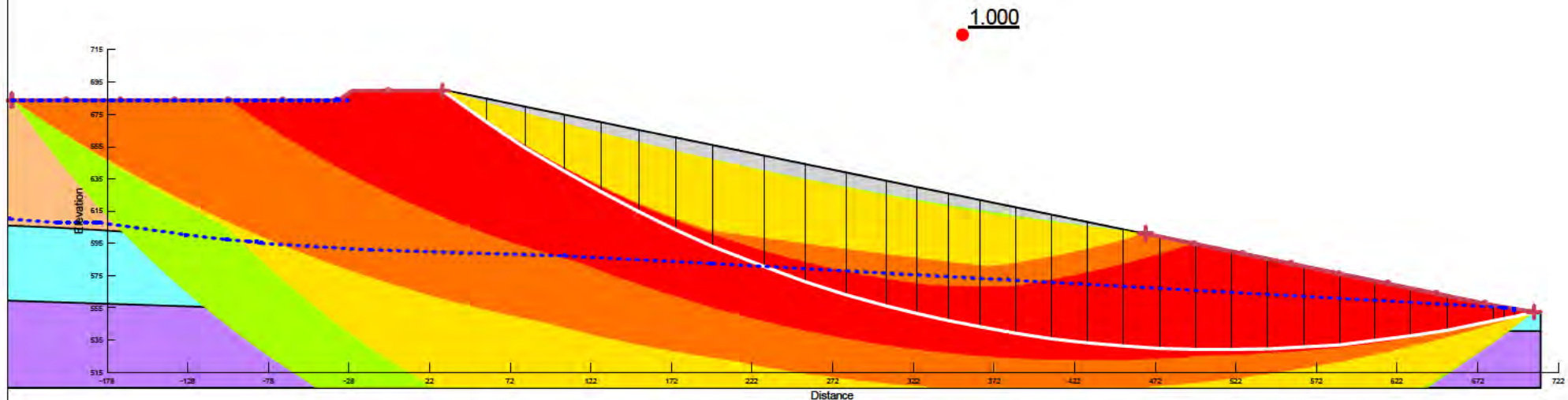


Figure C03.07-FinalEmButOp-DS-NOL-EQ-Circ-ResUD



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Shepherds TSF - Stability Analysis

Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

Analysis Parameters

Method: Janbu

Direction of movement: Left to Right

Slip Surface Option: Block

Horz Seismic Coef.: 0.2845

Analysis Results

Factor of Safety: 1.000

Color	Name	Slope Stability Material Model	Unit Weight (kN/m ³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Strength Function	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.	Piezometric Line
■	Insitu Rock >40m with foliation	Anisotropic Fn.	26				150	45	Anisotropic phi 0.51	Anisotropic C 0.313	2
■	Insitu Rock 0 to 40m (anisotropic) shear strength with foliation	Anisotropic Fn.	26				50	40	Anisotropic phi 0.575	Anisotropic C 0.94	2
■	Rockfill	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2
■	Tails - Residual Undrained Shear Strength	SHANSEP	18.6	0	0.06						1
■	Zone A1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B Down stream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					2
■	Zone B Upstream	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone B1	Shear/Normal Fn.	22.5			$2.43\sigma^*0.83$					1
■	Zone C	Shear/Normal Fn.	21.5			$1.29\sigma^*0.91$					2

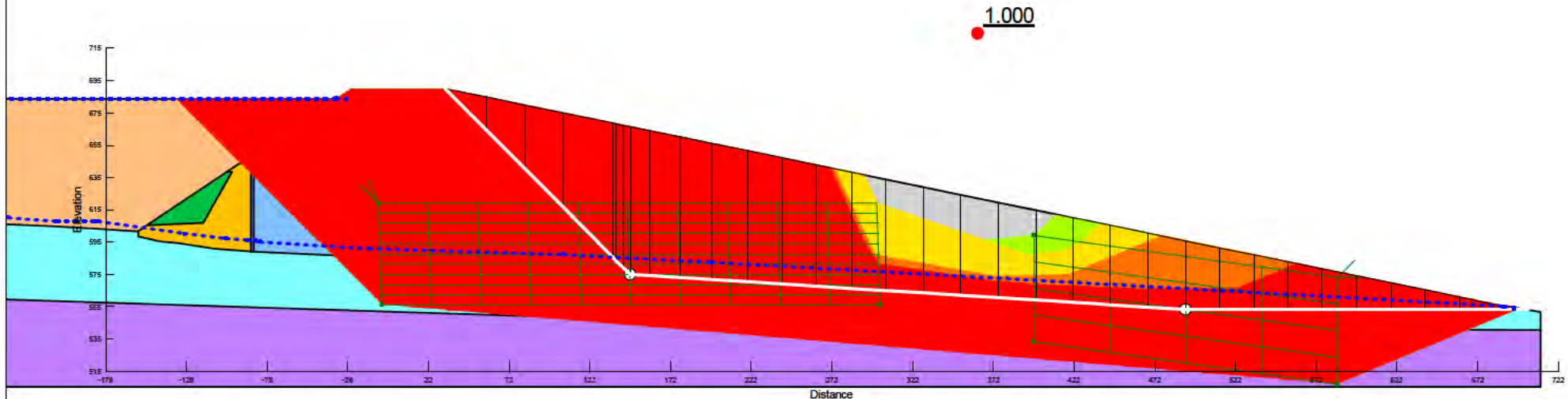


Figure C03.08-FinalEmButOp-DS-NOL-EQ-Block-ResUD



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Shepherds TSF - Stability Analysis Section 3 - Final Embankment with Buttress

Date: 13/03/2025
 Drawn: RW
 Ref: 9072
 Scale: 1:3,700

EMBANKMENT CO-SEISMIC DEFORMATION CALCULATIONS

C1. PURPOSE

Estimate the potential co-seismic deviatoric (shear) embankment deformations under earthquake loading for Shepherds Tailings Storage Facility (Shepherds TSF) embankment.

C2. OBJECTIVES

1. Select design response spectra and mean moment magnitudes (M_w) for the dam site under the earthquake events:
 - a. Estimate V_{s30} for the dam site
 - b. Operational Basis Earthquake - 150 year return period event
 - c. Safety Evaluation Earthquake - 10,000 year return period event and aftershock
2. Estimate the embankment shear wave velocity profile
3. Estimate the amplification factors (base to crest) for embankment spectral response and topographical effects
4. Estimate the ground motion variation through the embankment
5. Estimate the co-seismic deviatoric deformations induced by earthquake shaking using the Bray and Macedo (2019) calculation method

C3. DESIGN RESPONSE SPECTRA

EGL has undertaken a site-specific seismic hazard assessment (SSSHA, Ref. 1) for the Bendigo-Ophir Gold Project (BOGP). The associated calculations have been completed based on the National Seismic Hazard Model 2022 (Ref. 2) using OpenQuake Engine (Ref. 3). The study provided the mean probabilistic uniform hazard spectra for the required:

- 150-year return period earthquake event
- 10,000-year return period earthquake event and aftershock

3.1. V_{s30} Estimation

The SSSHA analysis has been conducted by adopting representative V_{s30} values for three different site conditions, including $V_{s30} = 850, 1000, \text{ and } 1500 \text{ m/s}$.

Based on a downhole shear wave velocity test undertaken at the Shepherds TSF and past experience in similar geological conditions at Macraes, EGL has estimated that the V_{s30} for the TSF is approximately 1250 m/s. This is shown in Figure C1 titled “Shepherds TSF - V_{s30} Assessment”.

The SSSHA results for the $V_{s30} = 1000 \text{ m/s}$ assumption shows higher design spectral values than that of $V_{s30} = 1500 \text{ m/s}$. Consequently, EGL has adopted the SSSHA results for the $V_{s30} = 1000 \text{ m/s}$ assumption to estimate the potential co-seismic embankment deformations.

3.2. Operational Basis Earthquake - 150 year return period earthquake event

The Operational Basis Earthquake probabilistic 150-year return period uniform hazard spectrum is shown in Figure C1 and Table C2. The associated disaggregation plots are shown

in Figure C2 to Figure C6. The mean magnitude of the disaggregated rupture sources for PGA (Peak Ground Acceleration), SA(0.15s), SA(0.5s), SA(1.0s) and SA(3.0s) are summarised in Table C1.

TABLE C1: ESTIMATED MEAN MAGNITUDES FOR 150 YEAR RETURN PERIOD SPECTRAL ACCELERATIONS

Intensity Parameter	Mean Magnitude (Mw)
PGA	6.4
SA(0.15s)	6.3
SA(0.5s)	7.3
SA(1.0s)	7.3
SA(3.0s)	7.7

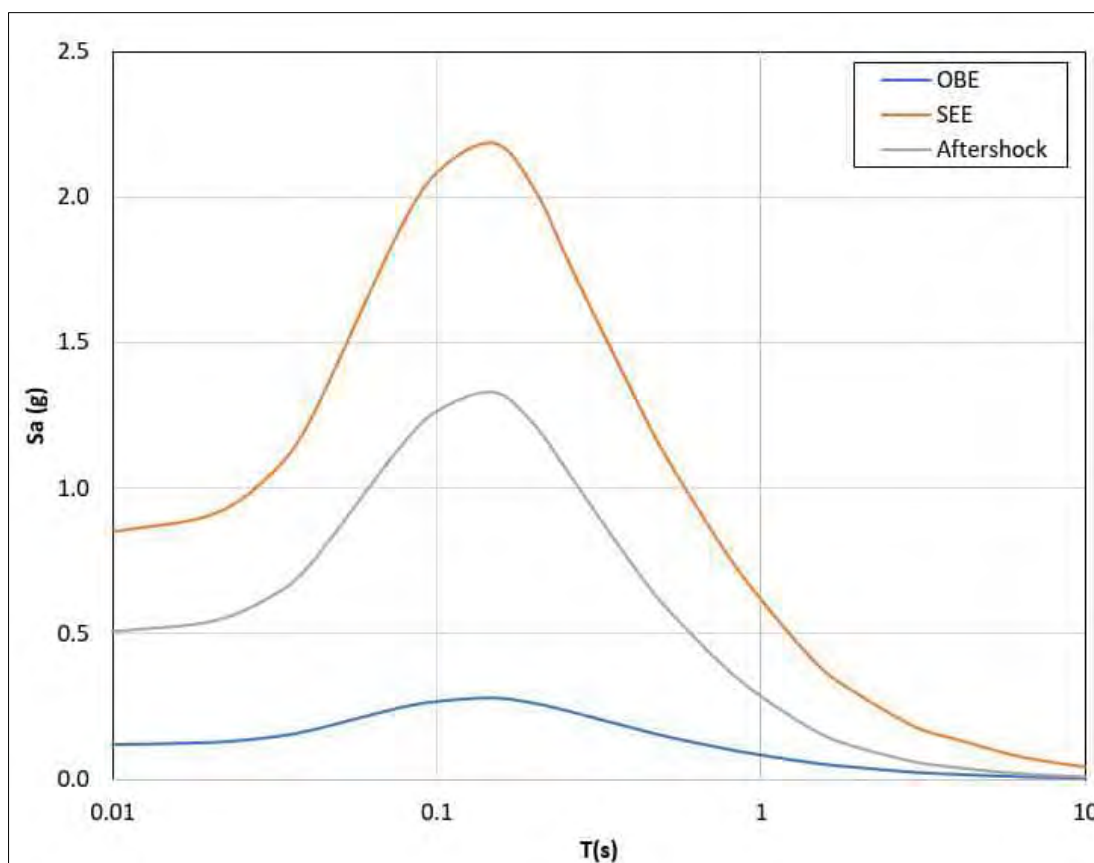


FIGURE C1: MEAN RESPONSE SPECTRA (OBE, SEE, AND AFTERSHOCK) FOR BOGP ($V_{s30} = 1000$ M/S)

TABLE C2: RESPONSE SPECTRA (5% DAMPED) FOR DESIGN AND EVALUATION OF BOGP (UNIT: G) WITH VS30 = 1,000 M/S.

Period (s)	BOGP (Vs30 = 1,000 m/s)		
	OBE (1 in 150 AEP)	SEE (1 in 10,000 AEP)	Aftershock
PGA	0.120	0.850	0.400
0.01	0.120	0.850	0.419
0.02	0.127	0.907	0.480
0.03	0.144	1.037	0.561
0.04	0.166	1.217	0.871
0.075	0.243	1.864	0.984
0.1	0.268	2.084	1.042
0.15	0.280	2.185	0.939
0.2	0.262	2.027	0.822
0.25	0.237	1.797	0.717
0.3	0.214	1.613	0.556
0.4	0.178	1.333	0.445
0.5	0.150	1.124	0.282
0.75	0.109	0.807	0.194
1	0.084	0.618	0.103
1.5	0.055	0.393	0.067
2	0.041	0.292	0.035
3	0.024	0.180	0.024
4	0.018	0.138	0.016
5	0.013	0.107	0.012
6	0.010	0.084	0.008
7.5	0.008	0.063	0.005
10	0.005	0.043	0.400

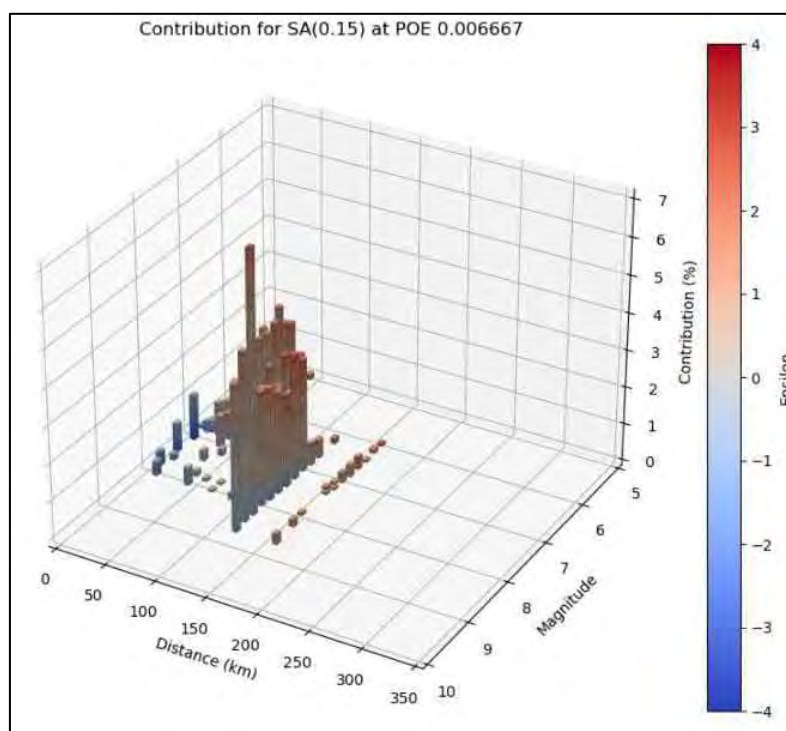


FIGURE C2: PGA HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 150 AEP)

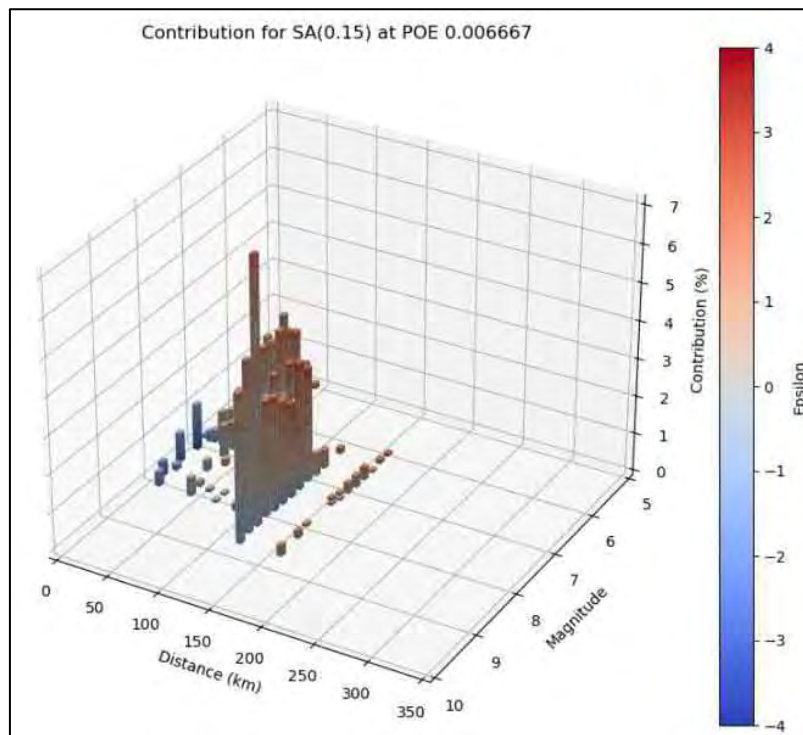


FIGURE C3: SA (0.15S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 150 AEP)

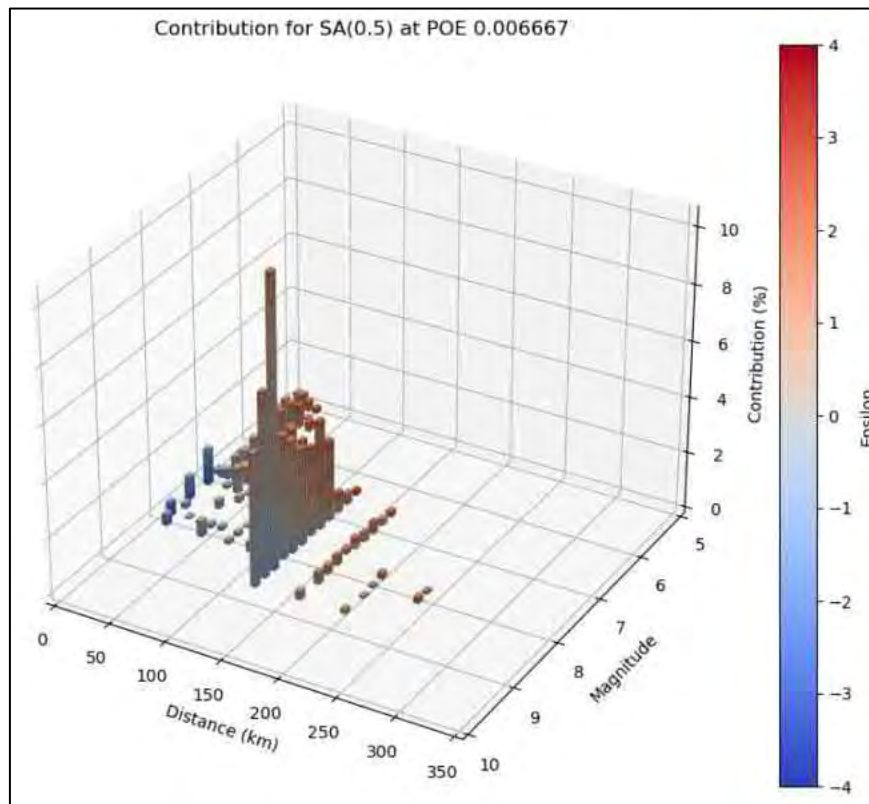


FIGURE C4: SA (0.5S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 150 AEP)

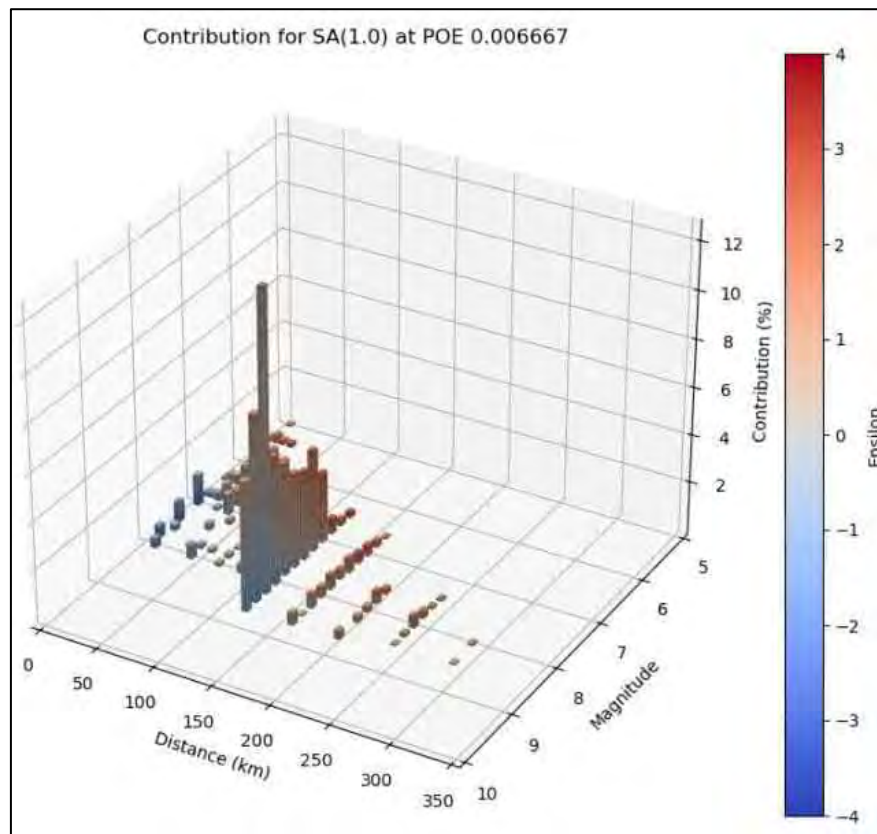


FIGURE C5: SA (1.0S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 150 AEP)

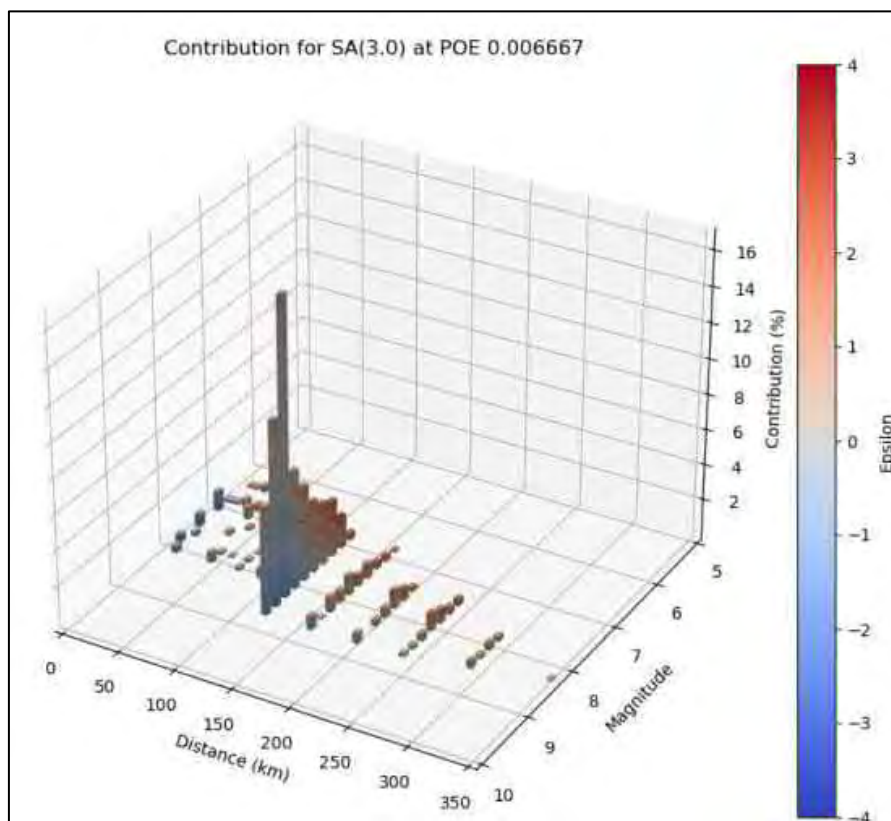


FIGURE C6: SA (3.0S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 150 AEP)

3.3. Safety Evaluation Earthquake - 10,000-year return period earthquake event and aftershock

The probabilistic 10,000 year return period uniform hazard spectrum is shown in Figure C1 and the associated disaggregation plots are shown in Figure C7 to Figure C11. The mean magnitude of the disaggregated rupture sources for PGA (Peak Ground Acceleration), SA(0.15s), SA(0.5s), SA(1.0s) and SA(3.0s) are summarised in Table C3 for use in estimating co-seismic displacement.

TABLE C3: ESTIMATED MEAN MAGNITUDES FOR 10,000 YEAR RETURN PERIOD SPECTRAL ACCELERATIONS

Intensity Parameter	Mean Magnitude (Mw)
PGA	6.8
SA(0.15s)	6.7
SA(0.5s)	7.5
SA(1.0s)	7.4
SA(3.0s)	8.0

The Safety Evaluation Earthquake (SEE) is based on the 1 in 10,000 AEP mean probabilistic seismic hazard analysis (PSHA) results and 84th percentile of Controlling Maximum Earthquake (CME) from the deterministic seismic hazard analysis (DSHA) results. Based on disaggregation, the DSHA considered an Mw 7.1 event at a 9 km source-to-site distance, attributed to the Dunstan Fault (surface distance: 12.7 km), identified as the CME. Comparisons between the 84th percentile DSHA estimates and mean PSHA estimates indicate that the deterministic results exceed the probabilistic estimates at short periods but fall slightly below them at long periods. Consequently, the mean PSHA spectra for the 1 in 10,000 AEP event are adopted as the SEE design loads as it is higher over the periods of interest.

The aftershock spectrum was derived deterministically using, using Mw 6.1 at D = 9 km, one magnitude lower than the CEE. Since PSHA estimates were adopted for the SEE spectra, the aftershock spectra were adjusted to reflect the same number of standard deviations as the PSHA results.

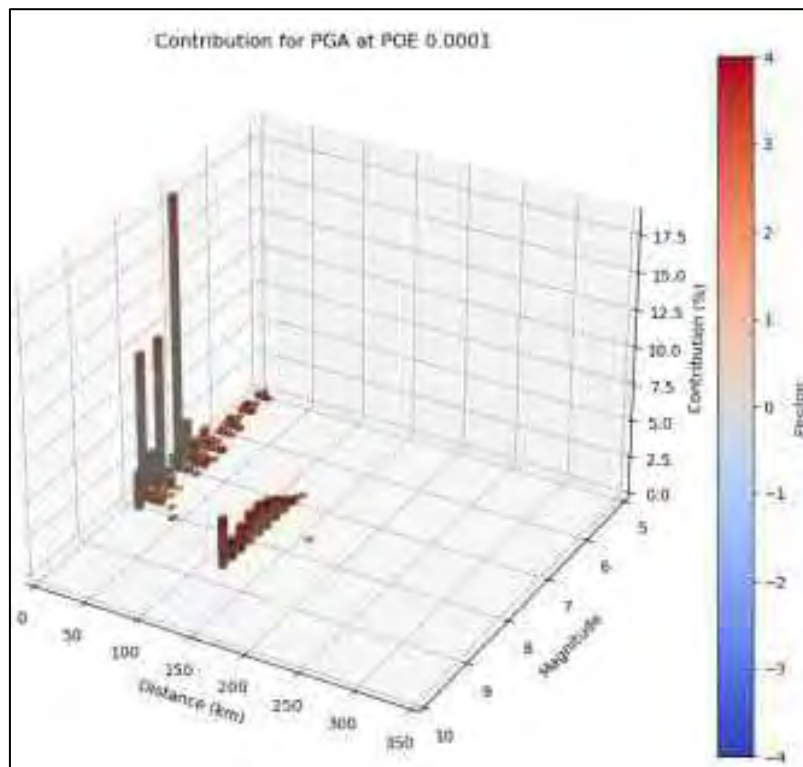


FIGURE C7: PGA HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 10,000 AEP)

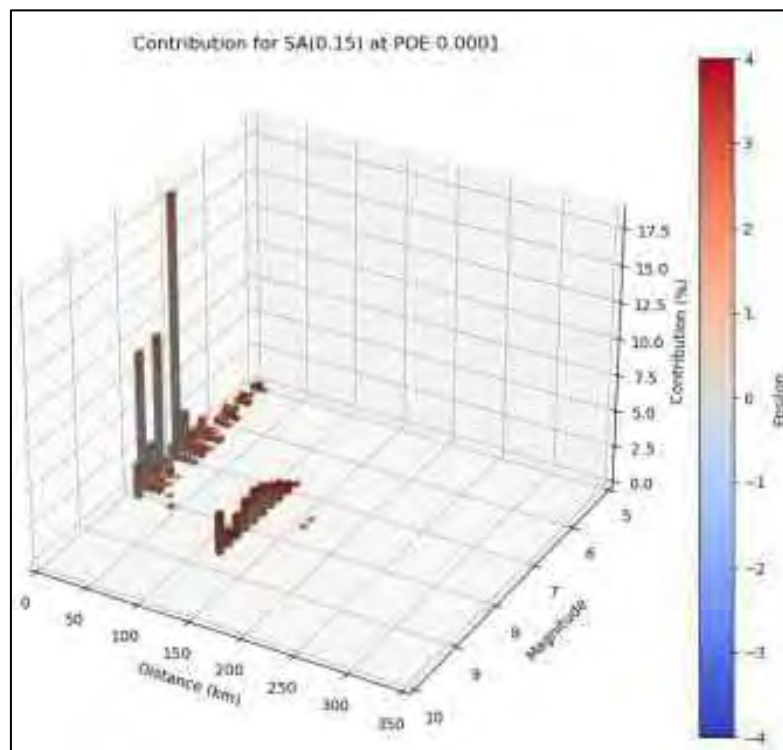


FIGURE C8: SA (0.15S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 10,000 AEP)

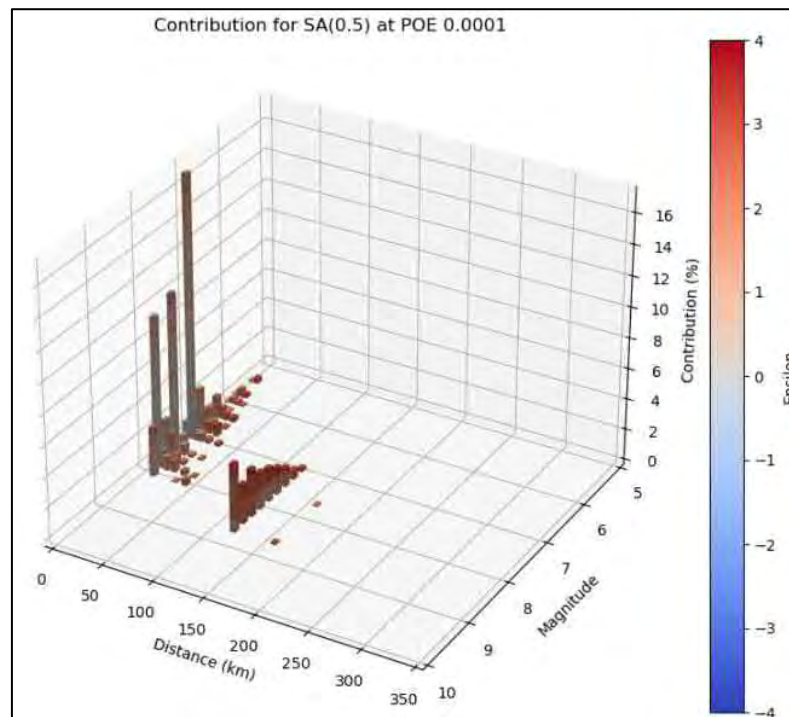


FIGURE C9: SA (0.5S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 10,000 AEP)

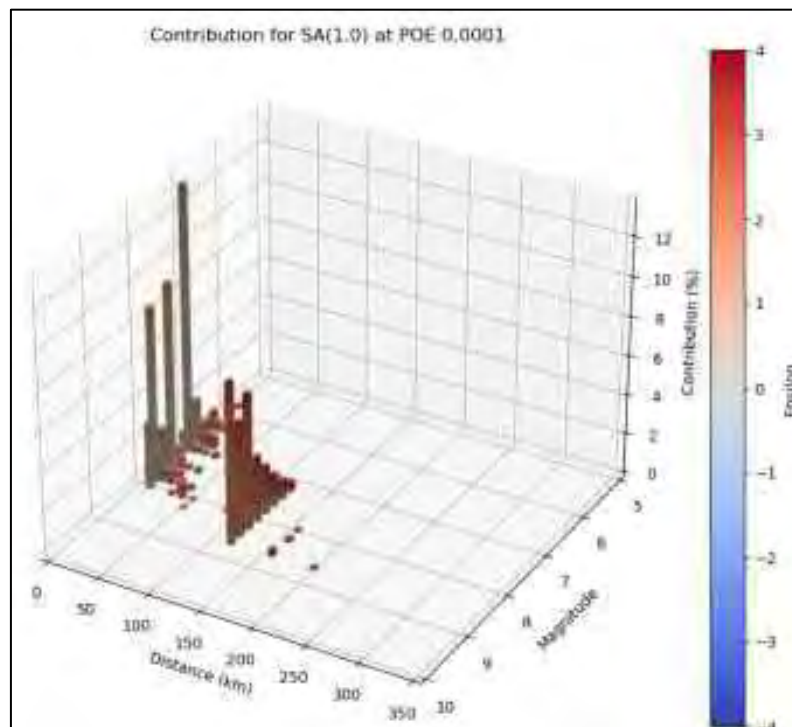


FIGURE C10: SA (1.0S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 10,000 AEP)

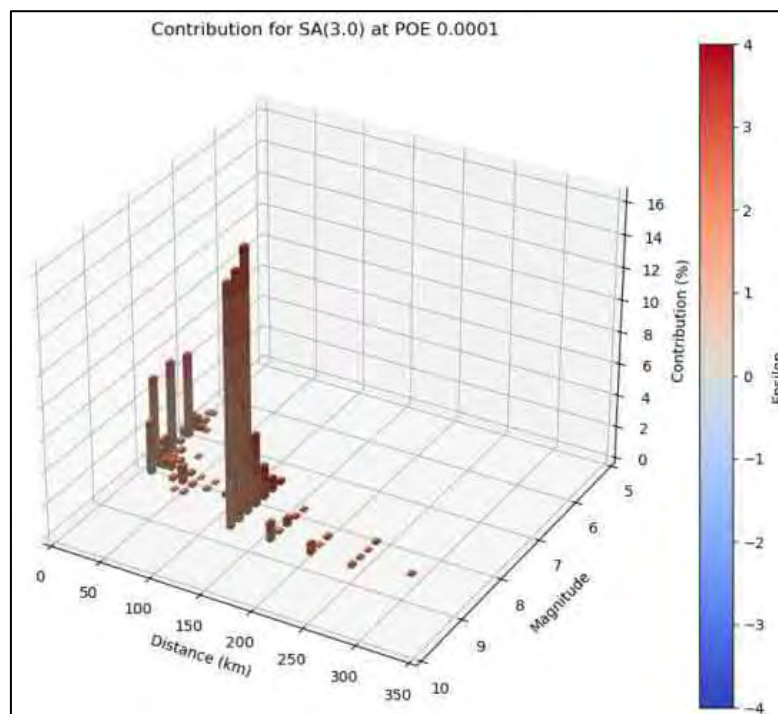


FIGURE C11: SA (3.0S) HAZARD DISAGGREGATION BY MAGNITUDE AND DISTANCE FOR BOGP (1 IN 10,000 AEP)

3.4. Adopted Mean Moment Magnitude for Co-Seismic Displacement Estimation

The mean magnitude adopted for each earthquake event is selected based on a representative embankment fundamental period of 0.5 s, to estimate potential co-seismic displacement. The representative embankment fundamental period of 0.5s was selected based on the estimates presented in Table C4. The mean magnitude of the disaggregated rupture sources for SA(0.5s) are summarised in Table C5 for use in estimating co-seismic displacement.

TABLE C4: ESTIMATES OF EMBANKMENT FUNDAMENTAL PERIOD

Analysis Section	Embankment Height, H (Crest to d/s Toe)		Time averaged shear wave velocity, V_{sH} (m/s)	Fundamental period on downstream slope of embankment $T = 2.6H/V_{sH}$
	Description	Height		
3	Starter Embankment	56 m	$V_{s56} = 479\text{m/s}$	0.31s
	Final Embankment	108 m	$V_{s108} = 434\text{m/s}$	0.56s

TABLE C5: ADOPTED MEAN MAGNITUDES FOR EARTHQUAKE EVENTS

Intensity Parameter	Earthquake Event	Mean Magnitude (Mw)
SA(0.5s)	OBE	7.3
	SEE	7.5
	SEE Aftershock	6.5

C4. EMBANKMENT SHEARWAVE VELOCITY PROFILE

The embankment shear wave velocity has been estimated based on EGL past experience and testing on rockfill at Macraes Mine. Zone A1 will be a low permeability zone sourced from mining waste or locally borrowed weathered schist supplemented with loess and colluvium as necessary. Zone B and Zone B1 will mainly be a rockfill. The V_s of Zone A1 is expected to be lower than Zone B/B1.

Sawada and Takahashi (Ref. 4) provide empirical recommendations for estimating V_s for rockfill dam core zones. The recommendation was developed based on the results from seismograph recordings of three earth and rockfill dams in Japan with heights above 90m. The recommended lower bound of Sawada and Takahashi is used for Zone A1 and the recommended upper bound is used for Zone B, Zone B1 and Zone C. The adopted V_s values for embankment fill versus depth are shown in Figure C12 and summarised in Table C6.

TABLE C6: ADOPTED SHEARWAVE VELOCITIES FOR THE EMBANKMENT

Material	Shear Wave Velocity	
	0m - 5m	> 5m
Zone A1	$V_s=210$	$V_s=140Z^{0.34}$
Zone B/B1	$V_s=210$	$V_s=180Z^{0.35}$

Z = Depth below finished embankment level

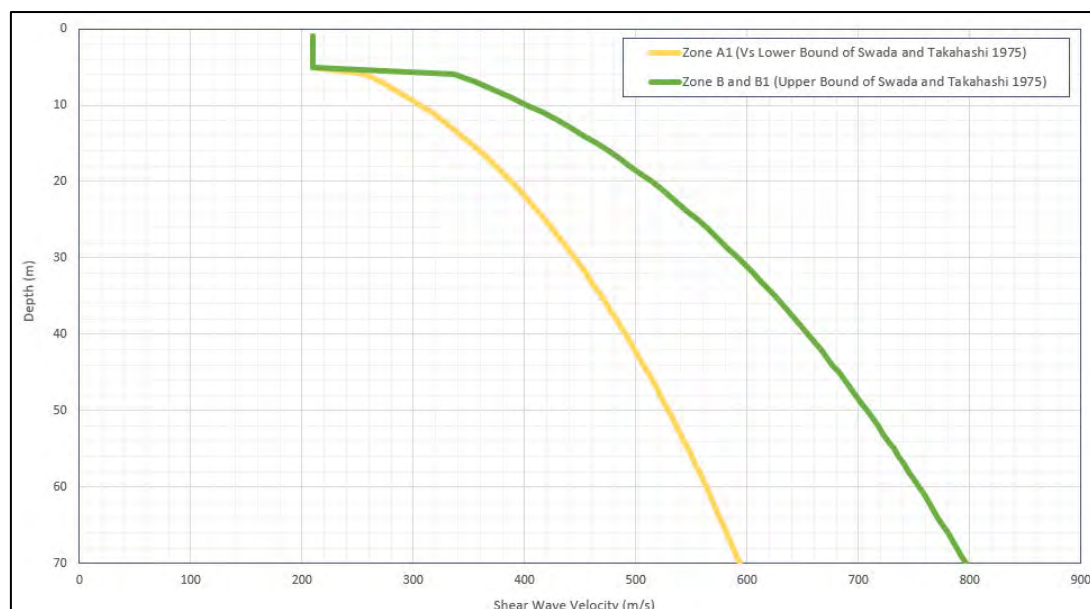


FIGURE C12: ADOPTED EMBANKMENT SHEARWAVE VELOCITY PROFILE

C5. EMBANKMENT SPECTRAL AND TOPOGRAPHIC AMPLIFICATION FACTORS

Amplification of ground motions from the base of the embankment to the crest are applied for earthquake displacement analyses.

For the OBE earthquake, the amplification value selected is based on recorded amplification of peak ground acceleration at the crest and base of earth-rockfill dam. The case histories are summarised by Harder (1998) (Ref. 5) and Park et al. (2019) (Ref. 6) and are shown in Figure C13. The best-estimate curve and 84th percentile estimate from Park et al., and the

tentative upper bound curve from Harder are also shown on Figure C13. The 84th percentile curve from Park et al. and the Harder curve have been used to select the crest peak acceleration for the OBE event. The adopted amplification ratio for OBE event is shown indicatively on Figure C13 and presented in Table C7.

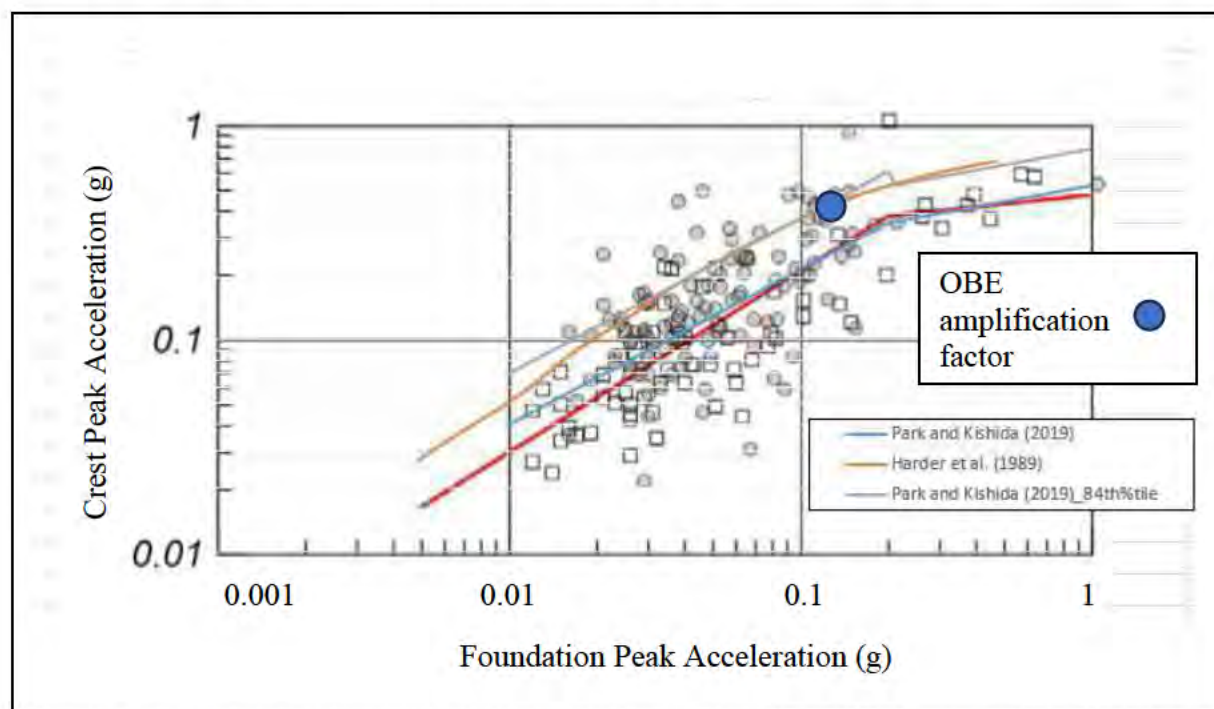


FIGURE C13: HARDER (1998) AND PARK ET AL. (2019) RECORD OF CREST AND BASE PEAK GROUND ACCELERATIONS

The base to crest amplification ratio for the SEE main rupture event is selected based on EGL past experience of undertaking dynamic analysis for a dam site at Macraes mine with similar geology and embankment materials. The SEE amplification ratio adopted is 1.1 for $T < 0.1$ s, 2.5 for $T > 0.5$ s and linearly interpolated as required for $0.1 < T < 0.5$ s.

The amplification ratio of the SEE aftershock event has been adopted as the average of the OBE and SEE event amplification.

The adopted peak accelerations at the embankment base and the corresponding amplification ratios are summarised in Table C7.

TABLE C7: ADOPTED AMPLIFICATION RATIOS FROM EMBANKMENT BASE TO CREST

Earthquake Event	Emb. Base Peak Acceleration (g)	Crest/Base Amplification Ratio
OBE	0.12	3.6
SEE	0.85	1.1 for $T < 0.1$ s 2.5 for $T > 0.5$ s Linearly interpolated between 1.1 and 2.5 for $0.1 < T < 0.5$ s
SEE Aftershock	0.42	Average between OBE and SEE amplification ratio

C6. GROUND MOTION INTENSITY VARIATION THROUGH THE EMBANKMENT

Ground motion intensity will increase up the embankment. Different slide masses will experience varying ground motion intensities depending on what portion of the embankment is encompassed by the slide mass. The dynamic response of the embankment is complex with many modes resulting in different parts of the embankment being in and out of phase during an earthquake. Makidisi and Seed (1977) (Ref. 7) summarised work on the variation of the maximum acceleration ratio with depth of sliding mass from the top of embankments. The summary of the work is a range of ratios varying with depth of the sliding mass shown in Figure C14.

For Shepherds TSF assessment a simplified approach has been taken for the application of amplification. Factors have been selected based on which third of the embankment the toe of the slide mass extends too, as summarised in Table C8. For slide masses which extend from the crest to between the top one third of the embankment height, the full crest response has been applied. Makdisi and Seed (1977) indicates 0.62 to 1.0 for comparison. For slide masses which encompass the full height of the embankment the ratio is taken as the inverse of the crest amplification ratio selected, so that a slide of the full embankment would be applied the response spectra equal to that at the base of embankment. The ratio ends up being between 0.27 to 0.33. Makdisi and Seed (1977) indicates 0.20 to 0.62 for comparison. For slide masses which extend from the crest to between one third to two thirds of the embankment height, the average of the top third and the full height has been taken, which results in values between 0.64 to 0.67. Makdisi and Seed (1977) indicates 0.3 to 0.9 for comparison.

TABLE C8: COMPARISON OF MAKDISI AND SEED (1977) MAXIMUM ACCELERATION RATIOS WITH DEPTH OF SLIDING MASS TO VALUES SELECTED FOR SHEPHERDS TSF CO-SEISMIC DISPLACEMENT ASSESSMENT

y/h	Makidisi and Seed (1977) Range	Selected kmax_slide/kmax_crest for Storage 1A RL182 assessment – NSHM (2022)		
		150 year R.P EQ.	10,000 year R.P EQ.	10,000 year R.P A.S.
0 to 0.33	0.62 to 1.0	1	1	1
0.33 to 0.67	0.30 to 0.90	$(1+0.28)/2$ = 0.64	$(1+0.33)/2$ = 0.70	$(1+0.33)/2$ =0.66
0.67 to 1.0	0.20 to 0.62	$1/3.6$ = 0.28	$1/2.5$ = 0.40	$1/3.1$ =0.33

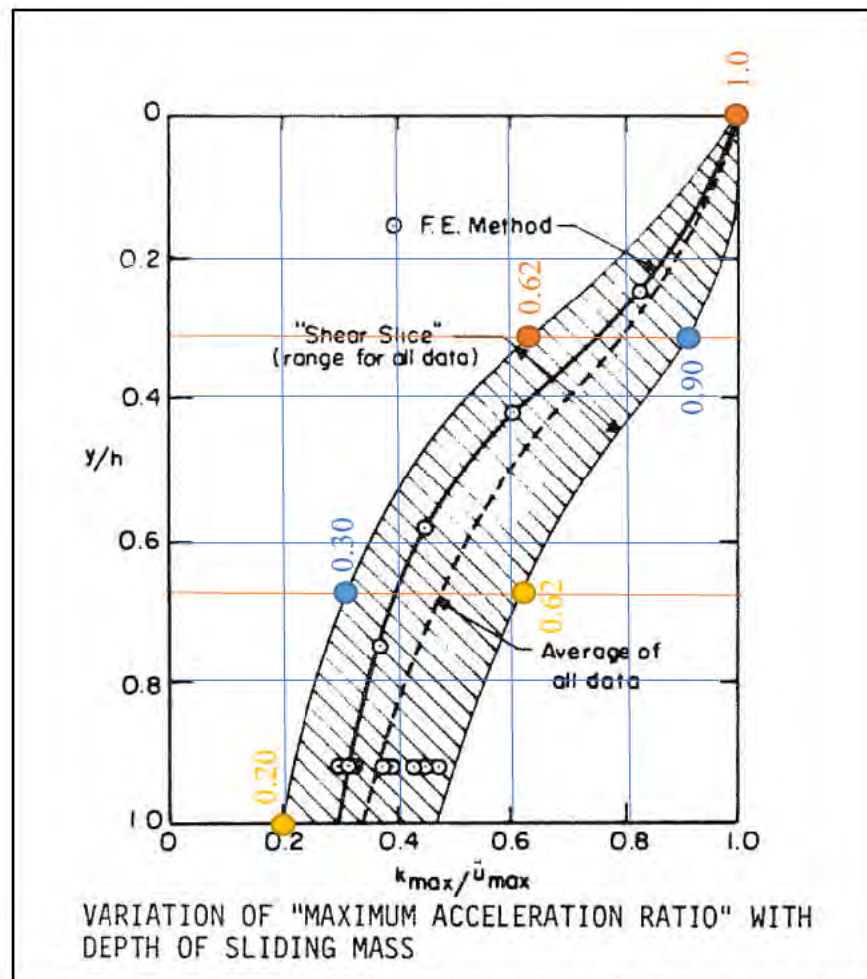


FIGURE C14: MAKDISI AND SEED (1977) MAXIMUM ACCELERATION RATIO WITH DEPTH OF SLIDING MASS SUMMARY

C7. CO-SEISMIC DEVIATORIC DEFORMATIONS

Co-seismic deviatoric (shear) deformation of slide masses within the embankment are estimated using the method of Bray and Macedo (2019) "Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquake" (Ref. 8). The method is based on a fully coupled 1-dimension idealisation of slide mass response with displacement accumulated on the slide surface when the felt horizontal acceleration exceeds the pseudo-static yield acceleration of the slide mass. Application of this method for Shepherds TSF requires assessment of the slide mass, slide mass pseudo-static yield acceleration, and the slide mass fundamental period of resonance. The slide mass pseudo-static yield acceleration requires judgement regarding what is a realistic slide surface as pseudo-static limit equilibrium methods do not consider the complex dynamics of the system. The analysed yield surfaces are included in Appendix C in C01.07.01, C01.07.02, C01.07.03, C01.08, C01.12, C02.07.01, C02.07.02, C02.07.03, C02.08, C02.12, C03.07 and C03.08. The parameter assessed and estimated co-seismic displacements are summarised in Table C9.

Estimation of the period of the slide mass depends on the geometry of the mass. For circular slide masses a relationship of $2.6H/V_s$ is applied, where H is the overall height of the slide mass and V_s is the average shear wave velocity in the slide mass.

TABLE C9: ESTIMATED CO-SEISMIC SLOPE DEFORMATION CALCULATION INPUTS FOR SECTION 3

									OBE					SEE 1 in 10,000 year Earthquake					SEE 1 in 10,000 year Earthquake Aftershock				
Section	Scenario Direction/ Profile		Slip Surface	Total Height of Slip Surface (m)	Slide mass velocity V _s (m/s)	T _s (s)	1.3T _s (s)	k _y (g)	Sa (1.3T _s) (g)	Amp. Ratio	Amp. Sa(1.3T _s)	Mean Mw	Seismic Def. (cm)	Sa (1.3T _s)	Amp. Ratio	Amp. Sa(1.3T _s)	Mean Mw	Seismic Def. (cm)	Sa (1.3T _s)	Amp. Ratio	Amp. Sa(1.3T _s)	Mean Mw	Seismic Def. (cm)
3	DS	Starter emb.	Top 1/3 rd emb Circular	20	210.00	0.25	0.32	0.45	0.21	3.6	0.74	7.3	<0.5 to 1.6	1.55	1.9	2.90	7.5	19.9 to 85.9	0.53	2.7	1.44	6.5	1.7 to 8.9
3	DS	Starter emb.	Top 2/3 ^{rds} emb. Circular	36	210.00	0.45	0.58	0.39	0.14	2.3	0.32	7.3	<0.5	1.02	1.4	1.47	7.5	8.7 to 38.3	0.25	1.2	0.30	6.5	<0.5 to 0.5
3	DS	Starter emb.	Full emb. Circular	56	468.00	0.31	0.40	0.37	0.18	1	0.18	7.3	<0.5	1.32	1.0	1.32	7.5	5.3 to 24.2	0.44	1.0	0.44	6.5	<0.5
3	DS	Starter emb.	Full emb. Block	56	464.00	0.31	0.41	0.23	0.18	1	0.18	7.3	0.5	1.32	1.0	1.32	7.5	12.6 to 54.4	0.43	1.0	0.43	6.5	0.5 to 1.8
3	US	Starter emb.	Full emb. Circular	37	262.00	0.3672	0.48	0.28	0.16	3.6	0.56	7.3	<0.5 to 4.9	1.17	1.0	1.17	7.5	8.1 to 35.6	0.32	1.0	0.32	6.5	<0.5
3	DS	Final emb.	Top 1/3 rd emb Circular	36	291.00	0.32	0.42	0.31	0.17	3.6	0.62	7.3	<0.5 to 4.1	1.30	2.2	2.85	7.5	41.5 to 179.4	0.42	2.9	1.20	6.5	3.3 to 14.7
3	DS	Final emb.	Top 2/3 ^{rds} emb. Circular	71	349.00	0.53	0.69	0.25	0.12	2.3	0.27	7.3	<0.5 to 0.7	0.89	1.6	1.42	7.5	22.1 to 95.6	0.22	2.0	0.43	6.5	<0.5 to 2.9
3	DS	Final emb.	Full emb. Circular	108	503.00	0.56	0.73	0.21	0.11	1.0	0.11	7.3	<0.5	0.84	1.0	0.84	7.5	9.6 to 41.8	0.20	1.0	0.20	6.5	<0.5
3	DS	Final emb.	Full emb. Block	108	597.00	0.47	0.61	0.16	0.13	1.0	0.13	7.3	<0.5	0.98	1.0	0.98	7.5	18.9 to 81.7	0.24	1.0	0.24	6.5	<0.5 to 1.5
3	US	Final emb.	Above Tailings Surface. Circular	6	210.00	0.07	0.10	0.20	0.26	3.6	0.95	7.3	5 to 22.7	2.05	1.1	2.26	7.5	36.3 to 156.9	1.03	1.1	1.14	6.5	23.9 to 103.2
3	DS	Final emb. & buttress	Full emb. Circular	121	443.00	0.71	0.92	0.36	0.09	1.0	0.09	7.3	<0.5	0.68	1.0	0.68	7.5	<0.5 to 8.4	0.13	1.0	0.13	6.5	<0.5
3	DS	Final emb. & buttress	Full emb. Block	115	416.00	0.72	0.93	0.28	0.09	1.0	0.09	7.3	<0.5	0.67	1.0	0.67	7.5	1.96 to 18.5	0.13	1.0	0.13	6.5	<0.5

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APPENDIX D

FREEBOARD CALCULATION AND POST CLOSURE SPILLWAY DESIGN

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APPENDIX D

FREEBOARD CALCULATION AND POST CLOSURE SPILLWAY DESIGN

D1.0 INTRODUCTION

This appendix summarises the freeboard calculation and spillway design during post-closure stage for the MGL Shepherds Tailings Storage Facility (TSF) embankment with the crest at RL690.

D2.0 DESIGN STANDARDS AND CRITERIA

The freeboard criteria in New Zealand Dam Safety Guidelines 2024 (NZDSG, Ref. 1) have been adopted. They are summarised in Table D1. This includes the freeboard requirements for the Inflow Design Flood (IDF) event and a more frequent 1 in 1,000 AEP flood event. The IDF is taken as the PMP rainfall event.

D3.0 POST-CLOSURE SPILLWAY PLAN

The post-closure plan is shown in Figure 15. A post-closure spillway will be constructed on the northern abutment to discharge stormwater runoff collected within the impoundment. The final tailings surface will be capped and vegetated and surface water runoff on the Shepherds TSF will drain westwards to the post-closure wetland and spillway with a gradient of 1 in 200.

The proposed post-closure spillway comprises an open channel inlet weir and a culvert. The invert of the weir is at RL687.5 with a bottom width of 8 m and side slopes of 2H:1V. The concrete culvert has an invert level at the RL684 and a nominal diameter of 900 mm. The layout is shown in Figure 15. The stage-discharge curve of the spillway is shown in Figure D1.

D4.0 WIND SET-UP AND WAVE RUN-UP

Wind set-up and wave run-up estimations are required for freeboard calculations. The criteria in the NZDSG are adopted, as summarised below:

- **Freeboard during the Inflow Design Flood (IDF)** – the greater of a) 1.0 m for tailings dam or b) the sum of the wind set-up and wave run-up for the highest 10% of waves caused by a sustained wind speed, which is dependent on the fetch, with an AEP of 1 in 10.

For a more frequent flood event, the required freeboard is adopted as the sum of the wind set-up and wave run-up under a 1 in 100 AEP wind. Estimates of wave run-up and wind set-up are based on procedures recommended by Fell et al. (Ref. 2). Wave run-up has been estimated for the highest 10% of waves (R10%). The results are summarised in Table D2.

D5.0 DECANT WATER, CATCHMENT AND INFLOW DESIGN FLOOD

The catchment of the Shepherds TSF impoundment is approximately 583 hectares. Under normal conditions, the storage capacity on top of the tailings surface in the Shepherds TSF is assumed at about 2,126,000 m³. The elevation-storage curve above the tailings surface in the post-closure plan (Figure 15) adopted for modelling is shown in Figure D2.

The estimated PMP rainfalls for different durations were estimated using the Thompson and Tomlinson methods (Refs. 3 & 4). For durations less than 6 hours, the catchment average PMP method outlined in Thompson and Tomlinson 1993 (Ref. 4) is adopted. For 12 to 72-Hr durations, the method provided in Thompson and Tomlinson 1995 (Ref. 3) is adopted. The estimated PMP rainfalls are summarised in Table D3. The 1 in 1,000 AEP rainfall depths were interpreted based on the calculated PMP depths and the 1 in 250 AEP rainfall depths obtained from the National Institute of Water and Atmospheric Research (NIWA) High Intensity Rainfall System (HIRDS) Version 4 (Ref. 5). Runoff coefficients of 0.715 and 0.8 were further applied to 1 in 1,000 AEP and PMP events, respectively. This considers the fact that the capped tailings and the catchment above the tailings impoundment have some infiltration capacity.

Temporal patterns for the PMP events have been provided by Thompson and Tomlinson (Refs. 3 & 4). Patterns for 1 in 1,000 rainfall events with various return periods have been provided by the NIWA report (Ref. 5). Sensitivity analyses have been carried out to identify the critical temporal rainfall pattern for this project area.

D6.0 HYDRAULIC ROUTING

Hydraulic routing has been undertaken using HEC-HMS (Hydrologic Modelling System from the Hydrologic Engineering Centre).

The hydraulic routing curves under the PMF events are shown in Figures D3 to D9 and the routing results are summarized in Table D4. The results of hydraulic routing indicate that the 72-Hr duration PMP is most critical in reservoir level and flow. Therefore, the 72-Hr PMP rainfall event was adopted for the design scenario. The peak reservoir level reaches RL688.73 with the outflow through the culvert and weir of 3.87 and 22.95 m³/s, respectively. The downstream diversion drain connected with the culvert has a capacity of about 4.4 m³/s, which is sufficient to discharge the peak culvert flow.

The hydraulic routing curves under the 1 in 1,000 AEP flood event are shown in Figures D10 to D16 and the routing results are summarized in Table D4. The 72-Hr 1 in 1,000 AEP event is most critical, resulting in a peak reservoir level at RL686.38, which is below the invert of the overflow weir, and a peak outflow of 2.57 m³/s through the culvert.

D7.0 FREEBOARD ASSESSMENT

The available freeboard is 6.0 m which is from the invert of the culvert at RL684 and the embankment crest at RL690. Table D5 compares the required freeboard and the available freeboard under different rainfall events. Under the 1 in 1,000 and PMP events, the minimum freeboards are 2.82 and 5.73 m, respectively, which are smaller than the 6.0 m available freeboard. This meets the freeboard requirements in NZDSG 2024 (Ref. 1).

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APPENDIX D

TABLES

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TABLE D1. Adopted Freeboard Criteria.

Design Parameter	Design Criteria
Flood Protection and Freeboard	
Freeboard with the Inflow Design Flood (IDF)	72-Hr PMP (IDF, 641 mm) plus the greater of a) 1m freeboard or b) the sum of wind set-up and wave run-up for the highest 10% of waves caused by a sustained wind speed, which is dependent on the fetch, with an AEP of 1 in 10
Freeboard with the 1 in 1,000 AEP Flood	72-Hr 1 in 1,000 AEP (IDF, 249 mm) plus the sum of wind set-up and wave run-up for the highest 10% of waves caused by a sustained wind speed, which is dependent on the fetch, with an AEP of 1 in 10

TABLE D2. Estimates of Wave Run-up and Wind Set-up.

Wind Speed AEP	Water Level	Wave Run-up Slope(3)	Fetch (km)	Significant Wave Heights, Hs (m)	Wave Run-up, R10% (m)	Wind Set-up (m)	Wave Run-up and Wind Setup (m)
1 in 10	PMF ⁽¹⁾	1V:1.5H	0.82	0.17	0.390	0.010	0.40
1 in 100	1 in 1,000 AEP Flood ⁽²⁾	1V:1.5H	0.82	0.20	0.417	0.026	0.44

Notes:

(1) Water level during the 72-Hr PMF (i.e., Inflow Design Flood IDF) of RL688.73, as shown in Table D4.

(2) Water level during the 72-Hr 1 in 1,000 AEP flood event of RL686.38, as shown in Table D4.

TABLE D3. Estimated Rainfall Depths.

Return Period	Rainfall Depth (mm)						
	1 Hr	2 Hr	6 Hr	12 Hr	24 Hr	48 Hr	72 Hr
1 in 1,000 AEP	56	74	110	137	156	214	249
PMP	160	187	212	283	316	502	641

Note: Runoff coefficients of 0.715 and 0.8 were further applied to 1 in 1,000 AEP and PMP rainfall events, respectively.

TABLE D4. Summary of Routing Results.

Rainfall Event⁽¹⁾	Peak Reservoir Level (RL)	Peak Inflow (m³/s)	Peak Outflow through Culvert (m³/s)	Peak Outflow through Weir (m³/s)	Flood Rise (m)	Freeboard (m)
PMP 1-Hr	686.99	108.07	2.96	0.00	2.99	3.01
PMP 2-Hr	687.26	102.79	3.12	0.00	3.26	2.74
PMP 6-Hr	687.41	58.73	3.20	0.00	3.41	2.59
PMP 12-Hr	688.01	44.26	3.53	5.49	4.01	1.99
PMP 24-Hr	688.05	33.27	3.54	6.06	4.05	1.95
PMP 48-Hr	688.53	36.44	3.78	16.91	4.53	1.47
PMP 72-Hr	688.73	36.52	3.87	22.95	4.73	1.27
1 in 1,000 AEP 1-Hr	685.27	26.51	1.62	0.00	1.27	4.73
1 in 1,000 AEP 2-Hr	685.47	28.08	1.85	0.00	1.47	4.53
1 in 1,000 AEP 6-Hr	685.77	20.58	2.12	0.00	1.77	4.23
1 in 1,000 AEP 12-Hr	686.05	14.43	2.33	0.00	2.05	3.95
1 in 1,000 AEP 24-Hr	686.08	11.08	2.36	0.00	2.08	3.92
1 in 1,000 AEP 48-Hr	686.31	10.45	2.52	0.00	2.31	3.69
1 in 1,000 AEP 72-Hr	686.38	9.52	2.57	0.00	2.38	3.62

Note: Routing analyses were undertaken with a channel invert weir level at RL687.5, with a concrete culvert at RL684.

TABLE D5. Summary of Embankment Freeboard.

Parameter	1 in 1,000 AEP Flood	PMP
Flood Rise ⁽¹⁾ (m)	2.38	4.73
Wind Set-up and Wave Run-up Required Freeboard ⁽²⁾ (m)	Wind set-up and wave run-up for the highest 10% of waves under 1 in 100 AEP	a) 1.0 m or b) wind set-up and wave run-up for the highest 10% of waves under 1 in 10 AEP
	0.44	1.00 ⁽³⁾
Total Required Freeboard (m)	2.82	5.73
Available Freeboard (m)	6.00 ⁽⁴⁾	

Notes:

- (1) The flood rise is from the most critical rainfall duration in Table D4.
- (2) The freeboard required is based on estimates of wind set-up and wave run-up in Table D2.
- (3) The freeboard required is taken as the greater of options a) or b), which is 1.0 m.
- (4) Available freeboard is the depth from the embankment crest to the invert of the culvert.