# Appendix R Geotechnical Assessment

# Geotechnical Assessment Report – Pit Slopes

## Taharoa Ironsand Mine

## Taharoa, Waikato

**Date**: 01 October 2025

**Job Reference**: BGL000119A v2.0

**Report prepared for**: Taharoa Ironsands Limited

BASELINE GEOTECHNICAL

## Document Control

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# 1 Introduction

## 1.1 General

Baseline Geotechnical Limited (BGL) has been engaged by Taharoa Ironsands Limited (TIL) to undertake a geotechnical assessment of proposed pit walls for the proposed continuation of mining within the Central and Southern Blocks of the Taharoa Ironsand Mine.

We understand that TIL is applying for consents under the Fast Track Approvals Act 2024 and require a range of technical reports to support that application.

The relationship between geotechnical performance of cut slopes and environmental effects is generally limited as pit wall instability typically occurs into a consented mining area. However, there is the risk that large slope failures, at the limits of the mining area, could retrogress back beyond the mining limit and potentially affect water bodies within and adjacent to the site, adjacent properties or other land areas with particularly high ecological or cultural values.

Rehabilitation at the site typically comprises backfilling of mined areas with tailings and reinstatement of a dune profile, which stabilises the previous mined out areas. The critical case for stability is therefore during operations at the maximum cut height, which is expected to be when mining occurs below the water table. This is when the ground is most vulnerable to instability.

The scope of work for this assessment is detailed in our offer of service, dated 23 April 2025.

## 1.2 Scope of works

The following summary of the scope of works was agreed with TIL for this geotechnical assessment:

1. Review of previous documentation relating to mining below the water table, current designs and collate existing geotechnical data.
2. Liaise with project team:
    a. Discuss constraints, assumptions and objectives.
    b. Incorporate outcomes of hydrogeology assessment prepared by Williamson Water and Land Advisory (WWLA, 2025[1]) for the Fast-track application.
3. Site visit to overview previously mined areas and proposed mine areas.
4. Undertake slope stability analysis on representative previously mined areas and representative future mine areas (four design sections).

[1] Williamson Land and Water Advisory 2025 Taharoa Mine Expansion Assessment of Groundwater Effects, Prepared for Taharoa Ironsands Limited Ref WWLA1303 Rev6.

## 1.3 Summary of existing data & ground investigation

To assist in the development of ground models for site, TIL has provided us with the following data:

- Geotechnical investigation report for "Clay Ridge" in the southern area of the site prepared by Beca (1998).
- A pond wall geotechnical design for the central area prepared by Beca (2004).
- A feasibility geotechnical design report for tailings prepared by Beca (2008).
- Interpretative report on CPT testing prepared by LDE (2009).
- A factual geotechnical investigation report prepared by MWH (2014).
- A revised 2014 mine stratigraphic column (Appendix A).
- A storage pond geotechnical report prepared by Beca (2013).
- A feasibility stage geotechnical assessment report for process infrastructure prepared by Tonkin + Taylor (T+T 2015a).
- A geotechnical assessment to support central tailings short term development prepared by T+T (2015b).
- A generic geotechnical tailings bund design prepared by T+T (2015c).
- Pond and Bund geotechnical inspection report prepared by T+T (2018).
- Geotechnical Design Report – Mine Tailings. Taharoa Ironsand Mine. Draft v0.2. Prepared by Baseline Geotechnical (BGL 2020).
- Geotechnical Assessment - Wainui Pit Extension. Taharoa Ironsand Mine, prepared by Baseline Geotechnical Limited (BGL 2024).
- Taharoa Mine Expansion Assessment of Groundwater Effects, prepared by Willamson Water and Land Advisory Limited (WWLA 2025).
- Cross sections cut through the resource geology model for the site.
- Current topography (July 2025).

# 2 Site description

The Taharoa Mine is primarily defined by catchment boundaries and the coast, with the site broadly divided into the northern, central and southern mining areas by the two main streams that run from east to west. The study area of this assessment focuses on the central and southern mining areas.

The Mitiwai Stream catchment covers the 7.5 $km^2$ northern portion of the study area. The Wainui Stream catchment covers a total of 13.8 $km^2$, covering 46% of the study area for this analysis. Lake Taharoa covers an area of 2.2 $km^2$ along the eastern portion of the study area.

The mine site comprises undulated topography with sand dunes and a modified landscape. The Northern Block is generally higher in elevation, ranging from RL 3 m to RL 105 m. Rugged hilly terrain surrounds the mine site to the north and east, comprises steeper terrain and reaches significantly higher elevation toward the eastern edge of the Mitiwai Stream catchment.

Over most of the current and proposed mining area, surface water runoff (albeit minimal, other than the stream catchments, due to high infiltration) and groundwater flows occur directly to the ocean.

# 3 Mining operations and rehabilitation

The mining methodology is described in detail in the Substantive Application Report for the project (T&T 2025[2]). It is summarised below.

## 3.1 Extraction of ironsand

Ironsand is extracted using various methods and equipment depending on ground conditions. Above the water table, mining activities include:

- Vegetation and topsoil removal (as described in the Substantive Application Report)
- Overburden removal.
- Extraction of ironsand.

Heavy earthmoving machinery (excavators, trucks, dozers etc) is used to remove and stockpile overburden (clays and sands that sometimes overlie the resource). This stockpiled material is reused for landform recontouring during rehabilitation.

In upper layers, standard earthmoving machinery such as excavators, bulldozers, and trucks is used to collect the ironsand and deposit it into a Dry Mining Unit (DMU). The DMU mixes the ironsand with water to form a slurry, which is then pumped to a treatment plant for titanomagnetite extraction. The DMU may be located immediately adjacent to the mining area to receive ironsand pushed in directly or trucks may be used to cart material to the DMU. Multiple active mining areas may feed one DMU, or a DMU can be dedicated to a single mining panel.

During this process, groundwater and surface water may enter the active excavation area. To maintain dry working conditions, this water may be pumped out as required.

As mining progresses to deeper layers, maintaining a dry pit may become impractical. In such cases, a cutter-suction dredge is used in a water-filled pond. The dredge floats on the water and uses a submerged dredge head to cut, fluidise, and pump the ironsand slurry through a pipeline to the treatment plant. The dredge is capable of operating at depths of 8 to 15 meters below the pond surface. In some instances, a long-reach excavator may also be used to extract material from within the pond.

## 3.2 Rehabilitation

In terms of a final closure landform the intent is that as areas of the site are progressively mined out, tailings operations will follow the mining operations and progressively backfill the mined out areas. Following mining, rehabilitation would then be completed with a combination of previously stockpiled tailings and overburden.

[2] T&T (2025). Substantive Application report prepared by Tonkin and Taylor Ltd, dated September 2025.

The result is the reinstatement of a similar land profile to that which previously existed prior to mining, but at a slightly lower overall elevation (to account for the extracted sand resource).

Large cut slopes could therefore be expected to remain open for a period of approximately 2-3 years, prior to being substantially backfilled by tailings.

The exception to this is the final pit developed at the site. Once mining ceases there will be no tailings available to backfill the final pit, which may remain below the natural groundwater level. The location of the final pit has not yet been confirmed but we anticipate that some localised reshaping of pit slopes and floor levels will be required in order to achieve long term stability. This is addressed in Section 7.

# 4 Site geology

## 4.1 Geological context

For the purposes of our geotechnical assessment the overall Taharoa sub-surface conditions may be broken up into three main units being:

- Mitiwai Sand Formation;
- Upper Te Ake Ake Sand;
- Lower Te Ake Ake Sand;

The Mitiwai Sand Formation (Nukumiti and Paparoa Sands) is thought to have been deposited within the last 10,000 years and comprises the surface layer of the site, mantling older Te Ake Ake Sands.

The Te Ake Ake Sand member is understood to be older than 42,000 years old, based on the interpretation of Rotoehu Ash overlying a paleosol (buried soil horizon) at the top of the Te Ake Ake Sand member. These older dune sequences are interpreted to have been sourced from exposed sea floor sediments at a time of lower sea level (Pain, 1976).

For the purposes of our assessment that follows, the ash, paleosol and higher fines content sands in the upper part of the Te Ake Ake member have been separated from the silty sands below.

## 4.2 Geotechnical units

### 4.2.1 Tailings sand

All mined sands are passed through a refinery to extract the titanomagnetite mineral content. Once the resource is extracted, the waste material (tailings) is transported from the processing plant and deposited back on site into various tailings disposal areas.

Tailings is placed by one of two methods:

- Traditional tailings stackers, which deposit tailings as a slurry, resulting in development of long, gently graded tailings beaches or deltas. Tailings water either runs off the tailings surface or infiltrates into the tailings area.

- New tailings cyclone stackers, which remove a significant volume of water from tailings, allowing steeper stacking of tailings more akin to paddock dumping. Little water runoff is observed from these areas, with some seepage occurring into the tailings area.

Regardless of placement methodology the tailings sand, once drained of any tailings water, present as a medium dense, fine to medium grained sand, with rare, discontinuous thin lenses of clay/silt.

#### 4.2.2 Tailings slimes

Tailings slimes refer to silt and clay particles, which settle out over time within decant lakes impounded behind pushed up bunds at the lowermost crest of the tailings areas.

Tailings slimes make up a very small proportion of the overall tailings and are pushed out through the water recovery system rather than being encapsulated within the tailings area decant ponds.

Minor quantities of slimes are expected to be mixed with tailings sands during progressive decant raises, but for the purposes of design these are not expected to significantly influence tailings sand geotechnical parameters.

Tailings slimes are eventually encapsulated in shallow ponds at the crest of tailings areas and are used in site rehabilitation.

#### 4.2.3 Mitiwai Sand (Md & Mz)

The Mitiwai Sand typically comprises loose to medium dense wind deposited, grey, fine to medium sand. It is the youngest in-situ unit on site having been deposited over the last 10,000 years.

This unit is not consolidated but will stand at slope angles up to 50° when moist. As it dries the slopes slowly rill, accumulating dried sand at the base of the cuts resulting in a long-term landform that approaches the angle of internal friction for this material (approximately 32-34°).

This material is the high-grade resource at Taharoa but has been largely mined out during historical and current mining operations. In places lower in the sequence peats and clays may be apparent in thin lenses within the Mitiwai Sand.

#### 4.2.4 Upper Te Ake Ake member (Ap)

An ash layer and paleosol separates the Mitiwai Sands from the Te Ake Ake Sand units below. It is typically clay rich, orange brown, very stiff to hard with a combined thickness ranging between 0.5 m to 5 m.

It is not present everywhere across the site but lenses out in places where the Mitiwai Sands are found immediately overlying the lower Te Ake Ake sand units.

### 4.3 Lower Te Ake Ake (Ad & Az)

The lower Te Ake Ake sand is typically a brown or grey silty fine sand. These sands are lightly cemented by leaching and iron oxidization which, along with a higher level of silt within the deposit, results in the material typically remaining stable in steep batter slopes when cut.

A higher silt component is present within the Az layer, which is interlayered within the Te Ake Ake sand, but outcrops at surface in the southern extent of the mine. This is typically a mixture of orange brown sandy silt, silt and clay.

The Lower Te Ake Ake sand forms part of the overall resource at Taharoa and is the primary resource that is extracted by the mining operations that are proposed as part of the Fast Track Approvals application.

### 4.4 Geological structure

Geological structure within the sand units on site is largely limited to disconformities related to breaks in deposition between the various sand units.

These contacts are sharp, but our previous experience suggests that there is no pervasive shearing or associated strength reduction along these surfaces, which are often undulating on a large scale. The clay rich material present at most disconformities typically acts as a barrier to groundwater flow and seepage is often observed at these contacts.

## 5 Site observations

BGL visited the site on 1 July 2025. The site visit focused on the existing area of mining operations to the south of the Mitiwai Stream where large mined slopes have been developed and mining below the water table is currently occurring (Figure 5-1).


**Figure 5-1 August 2025 aerial photograph showing areas of interest in yellow dashed polygon.**

The northern portion of the remnant mined out pit wall is approximately 30 m high and was observed to be performing acceptably at its current slope angle of 33-34°. This slope has been formed with the dry mining method.

Some damp spots could be observed in the cut slopes, but no groundwater seepage was observed. A shallow area of localised instability was observed at a previously over-steepened part of the slope. The resulting slope angle in this area (excluding the headscarp) is approximately at 33°.

The materials exposed in the cut slope mainly comprise Te Ake Ake sand (AD and AZ units) as the Mitiwai Sands have been previously mined out in this area. The base of the cut exposed a clay rich low grade unit of Te Ake Ake sand (assumed ABL).

The current dredge area was operational at the time of our site visit. We understand that pond level has been lowered since initial dredging operations commenced. The previously dredged floor was exposed during our visit. The mined-out topography shows areas of localised steep cuts due to how the dredge cutting head operates. While these areas mostly appear to be performing acceptably in the short term, we expect that they will slowly regress towards their natural angle of repose in the longer term. Erosion channels are also observed at various locations around the dredged pit.

Shallow instability was observed on the southern slope away from the dredged area. Groundwater seepage flow can be observed at this location at the contact between the in-situ Te Ake Ake sands and overlying oversize disposal materials where there is a permeability contrast (Figure 5-2). The lower unit is higher in fines content which provides a lower permeability surface allowing groundwater pressure build up and associated seepage.


**Figure 5-2 Groundwater seepage between geological contacts**

Tailings Area 16 (TA16, formerly known as Wainui Pit) was an area of previous dredging and has been mined out and subsequently backfilled with tailings.

While performance of the mined-out wall could not be assessed during our July site visit, previous observations of the cut batters in this area[3] indicated slopes of approximately 30 m high (above water level), at slope angles of between 32-34°. At the time of the site visit the pond level was not being actively pumped and had been allowed to rise to a level of approximately RL 5 m. The mined out floor in this dredged area was between approximately RL -15 to -20m. The slopes were performing acceptably when reviewed at this time (Figure 5-3).

**Figure 5-3: Wainui Pit in March 2025. Now backfilled with tailings.**

# 6 Slope Stability Assessment

## 6.1 Design cases for assessment

Cut slopes at Taharoa have two distinctly different design cases as set out below:

- The **operational case** where mining has been completed, but backfilling has not yet occurred.
- The **long-term case**, where mined out areas have been rehabilitated by backfilling with tailings and stockpiled overburden.

The **operational case** is typically critical as large temporary cut slopes up to 60 m deep are expected during dredging operations.

In the **long-term case** a moist, sand rich dune with relatively gentle gradients is anticipated as the former cut slopes are expected to be largely buttressed by tailings sand backfill.

[3] BGL 2025, Geotechnical review of Tailings Ponds and Bunds. Taharoa Ironsand Mine, ref: BGL000087H dated 24 March 2025. Prepare for Taharoa Ironsands Limited

## 6.2 Selection of design cross sections

### 6.2.1 Existing topography

There will be a variety of pit slope orientations, geological conditions and groundwater conditions and these are likely to vary over relatively short distances within the mine, making it impractical to undertake detailed assessment of every pit wall location.

Instead, we have identified several key areas as being representative of the highest slope instability risk due to:

- Elevated consequence of failure (primarily areas located close to waterways).
- Depth of excavation.

The cross section locations are illustrated on Figure 1, Appendix B. Ground conditions have been adopted based on the site resource model at these cross section locations (refer Appendix C) and groundwater conditions have been adopted based on information provided in WWLA (2025).

### 6.2.2 Proposed excavation

Target excavation depths have been developed for the Central Area and for Pits 1-3 of the Southern Block, based on information provided by TIL (Appendix D). We have used this information to develop the lowest elevation of our proposed cut slope geometry.

We have considered an initial starting point of a 33° overall slope based on excavations currently being undertaken in the Central Area and those previously undertaken for the Wainui Pit dredging project.

## 6.3 Seismicity

Seismic loads have been calculated in accordance with The Waka Kotahi NZTA Bridge Manual, NZS1170.0:2004 and MBIE 2021, Module 1[4] with the following considerations:

Operational case:

- A 5 year design life (pit extraction expected to be completed and buttressed over this period).
- Importance Level 1 (where buffer zones are provided for waterways, adjacent properties or cultural/archaeological reserves).
- Deep soil site (Class D).
- An annual exceedance probability of 1:25.
- A peak ground acceleration (PGA) and magnitude pairing of 0.07g & M5.9.

[4] New Zealand Geotechnical Society (NZGS) and Ministry of Business Innovation & Employment (MBIE), 2021, Earthquake geotechnical engineering practice. Module 1, Overview of the Guidelines, November 2021.

## 6.4 Liquefaction

In a broader context, cone penetration tests historically completed for previous infrastructure design and construction projects at the mine site[5,6,7,8] have indicated a low liquefaction risk for the materials at the site. Those assessments were undertaken for much higher seismic loads associated with design of structures, meaning the risk of liquefaction at the lower seismic loads adopted for this assessment is also expected to be low.

Overall, it is our view that the risk of liquefaction and lateral spread associated with mining below the water table, is low.

## 6.5 Design criteria

For operational cases lower levels of stability than normal cut slopes can be considered as the slopes are temporary and will be buttressed with tailings on completion, with a similar, but lower dune profile being developed on completion.

We understand that TIL proposes to retain an existing 30 m buffer between mining operations and perennial waterbodies as part of the suite of resource consents being applied for.

For the purposes of our slope stability analyses, we have adopted design criteria for a Limit Equilibrium assessment as outlined below (Table 6-1). These Factor of Safety ("FoS") criteria consider lower levels of stability on the immediate mined slope, with progressive increase in stability with distance from the crest. Higher levels of stability than those outlined below are anticipated at the waterbodies themselves.

**Table 6-1: Limit equilibrium design criteria for critical loading cases**

| Design Case | Scenario | Factor of Safety (FoS) | Comment |
|---|---|---|---|
| Operational Case | Static – Local Face stability | 1.1 | |
| | Static – At 10 m from crest | 1.3 | |
| | Static – At 20 m from crest | 1.4 | |
| | Seismic - At 10 m from crest | >1* | If FoS <1 use displacement analysis |

[5] BGL 2021. Komatsu workshop and mine infrastructure area. Geotechnical Assessment. BGL000105 v1.0, dated 18 November 2021. Prepared for Taharoa Ironsands Limited.

[6] BGL 2021. Helicopter hanger. Geotechnical Assessment. BGL000105 v1.0, dated 26 November 2021. Prepared for Taharoa Ironsands Limited.

[7] BGL 2021. Spiral separation plant support building. Geotechnical Assessment. BGL000105 v1.0, dated 30 November 2021. Prepared for Taharoa Ironsands Limited.

[8] BGL 2022. Fuel tanks. Geotechnical Assessment. BGL000105A v1.0, dated 04 February 2022. Prepared for Taharoa Ironsands Limited.

## 6.6 Material parameters

A range of designs for a variety of end uses have been undertaken at Taharoa over the years with an associated range of material parameters adopted. A wider review of material parameters was undertaken in BGL (2020), and those material parameters were refined further in BGL (2024).

The values are considered average conditions and are based on our experience at Taharoa and similar materials observed at Waikato North Head iron sand mine. Our adopted material parameters are presented in Table 6-2 below.

**Table 6-2 Material parameters**

| Material | Density (kN/m³) | Effective Cohesion (c' – kPa) | Effective Friction Angle (ϕ' – degrees) |
|---|---|---|---|
| Tailings Sand | 19 | 0.5 | 34 |
| Mitiwai Sand (MDH, MDL, MOC, MOB) | 23 | 1 | 34 |
| Mitiwai (MT Peat) | 20 | 3 | 28 |
| Mitiwai Base (ML/ME Clays) | 23 | 5 | 30 |
| Upper Te Ake Ake (Ap Clay) | 20 | 8 | 32 |
| Lower Te Ake Ake (AD, AZ, Adh, Abh Abl. At) | 25 | 2 | 40 |
| Basement Fluvial Sands (Qs) | 18 | 2 | 38 |
| Residual Greywacke (RC) | 20 | 12 | 35 |

## 6.7 Groundwater pressure

As set out above, groundwater conditions have been adopted based on information provided in WWLA (2025).

Additionally, based on our previous experience at the site and with similar materials at other sites, slopes in the sand resource are often able to be formed at an angle that is steeper than the angle of repose of the sand due to the presence of matric suction (negative pore pressures). As the sand dries, thin sloughing failures occur and sand slowly rills down the slope from crest to toe, eventually relaxing oversteepened slopes back towards the angle of repose.

Allowing for these matric suction pressures is essential if the behaviour of the sands is to be correctly modelled. For the purposes of this assessment, we have conservatively adopted an air entry value of 0 kPa, and an unsaturated shear strength angle, $\phi_b$ of half of the effective friction angle. We have capped maximum matric suction at 50 kPa in our modelling.

## 6.8 Methodology

Our stability assessment has been undertaken using Slide2, a limit equilibrium software package that compares driving forces and resisting forces as a ratio, called a Factor of Safety (FoS). Where driving forces exceed resisting forces a factor of safety below 1 is calculated, indicating a slope failure condition.

## 6.9 Results

We have carried out stability analyses for the cross sections illustrated in Figure 1, Appendix B, and have applied the material parameters outlined in Table 6-2 above.

Key slope stability outputs are presented in Appendix E, and a summary of the analysis results is presented in Table 6-3.

**Table 6-3: Summary of slope stability analysis results**

| Section Location | Design Case | Factor of Safety (FoS) | Comment |
|---|---|---|---|
| Cross Section 2 | Operational case - Static | 1.33 | OK |
| | Operational Case- at 10m from crest | 1.45 | OK |
| | Operational Case - at 20m from crest | 1.67 | OK |
| | Operational Case - Seismic | 1.07 | OK |
| Cross Section 5 | Operational case - Static | 1.21 | OK |
| | Operational Case- at 10m from crest | 1.40 | OK |
| | Operational Case - at 20m from crest | 1.57 | OK |
| | Operational Case - Seismic | 1.04 | OK |
| Cross Section 7 | Operational case - Static | 1.17 | OK |
| | Operational Case- at 10m from crest | 1.23 | OK |
| | Operational Case - at 20m from crest | 1.30 | OK |
| | Operational Case - Seismic | 0.99 | Surficial instability within the site boundary - OK |
| Cross Section 9 | Operational case - Static | 1.34 | OK |
| | Operational Case- at 10m from crest | 1.36 | OK |
| | Operational Case - at 20m from crest | 1.42 | OK |
| | Operational Case - Seismic | 1.13 | OK |

## 6.10 Discussion

Our analysis results have indicated that acceptable levels of stability can be achieved for the operational slopes, which are expected to be the critical case for the Taharoa Mine site, provided that the following design recommendations can be managed by conditions.

The current 33° slope angle for cut batters up to 60 m in height are considered acceptable for slopes that are largely developed within the slightly cemented Te Ake Ake Formation (Section 2 & 9 for example).

Slopes developed primarily within the overlying uncemented Mitiwai Formation should be limited to a maximum overall slope angle of 30° for slopes up to 60 m in height (Section 5 & 7 for example).

The 30 m buffer zone proposed to be retained between mining slopes and adjacent perennial watercourses remains appropriate and assists in reducing the risk of instability affecting waterways to negligible.

Our analytical work indicates that a similar approach should be taken with Cultural/Archaeological Reserves and other property boundaries (where no other agreement between parties exists) to ensure that appropriate levels of stability exist during operations at the boundary. Accordingly, we recommend a minimum 20 m setback from the crest of any excavation to an Iwi Reserve or other adjacent property boundary, unless a location specific geotechnical assessment can identify a reduced setback based on site specific ground conditions and cut heights.

# 7 Monitoring and performance verification

Stability modelling undertaken to date for representative parts of the proposed Taharoa Mine development indicates that acceptable levels of stability can be achieved and that there is a low to negligeable risk of instability affecting waterways or cultural/archaeological reserves.

However, we also understand that mining will be undertaken over a large area and that both ground and groundwater conditions may change locally within specific parts of the site. This presents a degree of uncertainty that similar levels of slope performance will be achieved in all parts of the site.

We recommend that this uncertainty be managed by undertaking an annual review of pit slope performance in proximity to property boundaries, waterways and cultural/archaeological reserves. This could be incorporated into the annual independent review of tailings slopes and ponds that TIL already undertake.

If more adverse ground conditions or worse than anticipated slope stability performance is identified during these monitoring reviews, then local stability improvements could be achieved by:

- developing a gentler overall slope angle,
- provision of a bench mid-slope, or
- earlier placement of waste sand to buttress the affected area.

One or more of these contingency options can be accommodated during all stages of pit slope excavation.

The final pit cannot be backfilled by tailings once excavation and processing has ceased but the position of the final pit is indicative and is unlikely to be confirmed for several years. On this basis we consider that detailed geotechnical design of the final pit excavation will need to be deferred but expect that this can be managed by way of a suitably worded condition of consent.

We note that a range of geotechnical design options are available to reshape the final pit to provide acceptable levels of long term stability. This could include dozing down sand from the walls of the final pit to flatten pit slopes and reduce overall cut height, or excavation of previously placed tailings sand and placement in the floor of the final pit to lift levels.

# 8 Summary and conclusions

Baseline Geotechnical Limited has completed a geotechnical assessment for the pit walls proposed to be developed as part of the Taharoa Ironsand Mines application for consent for ongoing mining at the site.

The wider site is underlain by a range of uncemented to weakly cemented sands which form the resource from which titanomagnetite is extracted. The larger part of the overlying high grade, uncemented Mitiwai Sands have already been extracted and the underlying weakly cemented Te Ake Ake sands are the primary target of future mining.

The proposed extraction of the resource includes dry mining, by direct push to Dry Mining Units (DMU) or by truck and shovel operations feeding the DMU's. Extraction of the resource below the water table is expected to be undertaken by dredging which will include dewatering to lower the groundwater level allowing extraction of deeper parts of the resource.

We have assessed the stability of representative cross sections through the resource model for the site. Proposed pit slopes up to 60 m high are expected to perform acceptably provided that:

- Slopes developed primarily with Te Ake Ake sands are limited to 33°.
- Slopes developed primarily within Mitiwai sands are limited to 30°.
- A 30 m buffer separating the crest of pit slopes from perennial waterways is implemented as proposed.
- A 20 m buffer is adopted between the crest of pit slopes and cultural/archaeological reserves or adjacent property boundaries, unless a location specific geotechnical assessment can identify a reduced setback based on site specific ground conditions and cut heights.

Overall, stability modelling (and historical slope performance) indicates that acceptable levels of stability can be achieved and that there is a low to negligible risk of instability affecting waterways or cultural/archaeological reserves.

We recognise that there remain some uncertainties relating to ground and groundwater conditions in areas away from the representative cross sections considered as part of this assessment. Daily to weekly monitoring of the mining areas is currently undertaken by the mine planning team, and annual independent geotechnical reviews of ponds and tailings are proposed to be extended to include pit slope performance in proximity to property boundaries, waterways and cultural/archaeological reserves to manage this uncertainty (as noted above).

We recommend that detailed design of the final pit be deferred until the location can be confirmed. A condition of consent that requires detailed geotechnical design of this final pit would be appropriate and could form part of the final rehabilitation plan for the site.

Overall, we consider that the monitoring oversight proposed provides an appropriate level of mitigation for any residual geotechnical risks.

If required, a range of contingency options exist to improve pit slope stability as set out in Section 7 above.

# 9 Applicability

This report has been prepared for the exclusive use of our client Taharoa Ironsands Limited, with respect to the particular brief given to us.

We understand and agree that our client will submit this report as part of an application under the Fast-track Approvals Act 2024 and that an Expert Panel as the consenting authority will use this report for the purpose of assessing that application. We understand and agree that this report will be used by the Expert Panel in undertaking its regulatory functions

Our report may not be relied upon in other contexts or for any other purpose, or by any person other than those set out above, without our prior written agreement.

We trust that this report meets your present requirements. If you have any queries or wish to discuss any aspect, please contact the undersigned.

For and on behalf of Baseline Geotechnical Limited:

........[redacted]........................

Cameron Lines

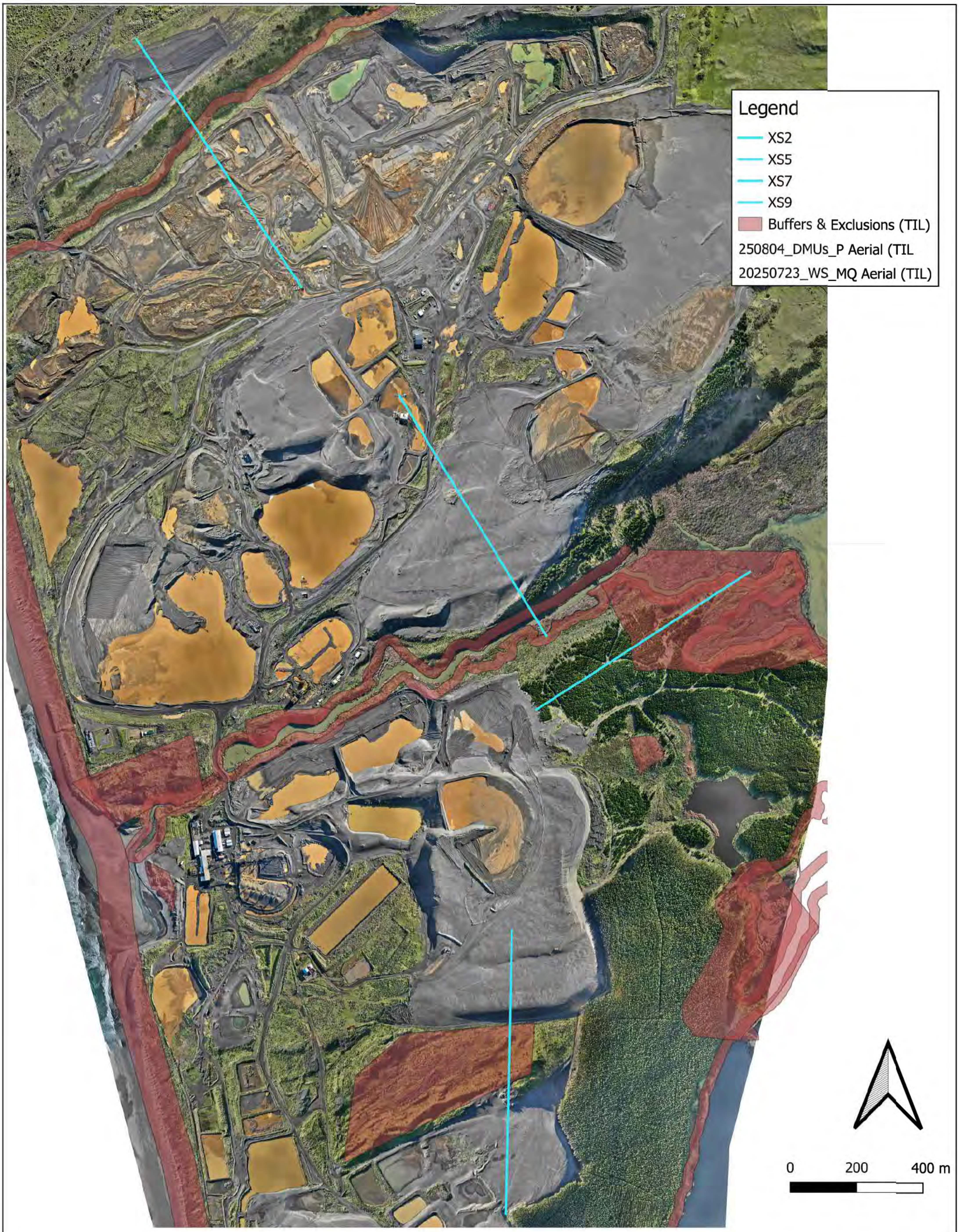
Principal Engineering Geologist

## Appendix A – Site stratigraphic column

## *Revised Taharoa Ironsands Stratigraphic Column after 2014 drilling program*

| Geological Unit: Age (Ma) | Geological Unit: Tauranga Group Subaqueous deposits | Geological Unit: Kaihu Group Subaerial deposits | Lithology: Units | Lithology: Unit colour | Description | PLYS: Updated convention | PLYS: Redundant convention | Ply Description |
|---|---|---|---|---|---|---|---|---|
| Pliocene to Holocene | Titano-magnetite dominated facies sands | Mitiwai Formation; Paparoa and Nukimiti Sand | F | | Tailings and fill | F | Tailings | Tailings |
| | | | Md | | Free flowing grey to black sand | MDH<br>MDL<br>MOC<br>MOB | VGCA<br>VGCA<br>LVGC<br>VGCB | >30% mags<br><30% mags<br>Dark grey to brown, <30% mags, <50% FeMags<br>>30% mags |
| | | | Mz | | Localised thin layers of silt and sandy silt | MZ | | Localised silt layers |
| | | | Mt | | Peat | Mt | | Mud and peat, generally within MOC/MOB |
| | (Upper) Tauranga Group | | Ma1 | | Clay and alluvium | Ma1 | | |
| | | | Ml | | Sloppy brown lacustrine mud | Ml | MLF | Uneconomical Mitiwai Base |
| | | | Ma | | Greenish to bluish clays and silts (alluvium) | Ma | | |
| | | | Me | | Bluish mud and sandy mud with shell, at base of Md in paleochannel | Me | | |
| | | Waiau Formation; Te Ake Ake Sand | Ap | | Ash and paleosol (brown to orange silt and clay) | Ap | BV CLAY | Semi continuous ash/paleosol |
| | | | Az | | Silt, sandy silt and clay, brown to orange to reddish brown, as layers and lenses within Ad; forms homogeneous deposits in southern area (Clay ridge, Az1) | Az | BVGCA<br>HBVGC<br>BVGCB<br>HBVGL | Low mags, high slimes |
| | | | Ad | | Silty fine sand, brown, and grey, may be consolidated. | Ad | | Low grade sand <30% mags |
| | | | At | | Peat,as localised lenses within Ad | At | | |
| | | | Adh | | fine to medium sand, some silt, black, high mags, below Ad | Adh | | High grade black sand >30% mags |
| | | | Abh | | Medium to fine sand, clean, black, may contain gravel. High mags | Abh | | |
| | | | Abl | | Medium to fine sand, clean, brown to orange to grey-black, low mags, may contain gravel. May interfinger with Ac | Abl | | Low grade sand <30% mags |
| | (Lower) Tauranga Group | | Ac | | Silty sand, silt and sand, local peat; dark brown, grey, black, low mags | Ac | | Subeconomical to uneconomical Te Ake Ake Base |
| | | | Ae | | Bluish grey to grey incompetent mud, muddy sand; some shell | Ae | Silica Clay Base | Uneconomical Te Ake Ake Base |
| | | | Au | | Pumiceous and siliceous sand and silt, light brown to white to pink | Au | | |
| | | | Aa | | Alluvial silt and clay,competent, bluish grey, green, brown; some peat | Aa | | |
| | | Awhitu Sand | Qs | | Silty quartzofeldspathic sand, yeallow to orange to green | Qs | | Uneconomical Material |
| Mesozoic | Greywacke basement | | Rc | | Residual soils: clay and silty clay, orange to red to yellow; (weathered greywacke) | Rc | | |
| | | | GW | | Greywacke basement | GW | | |

## Appendix B – Figures

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Checked: CJL
Project No: BGL000119A
Scale: 1:10,000
Original Size: A3

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Insert client logo

Figure Number:

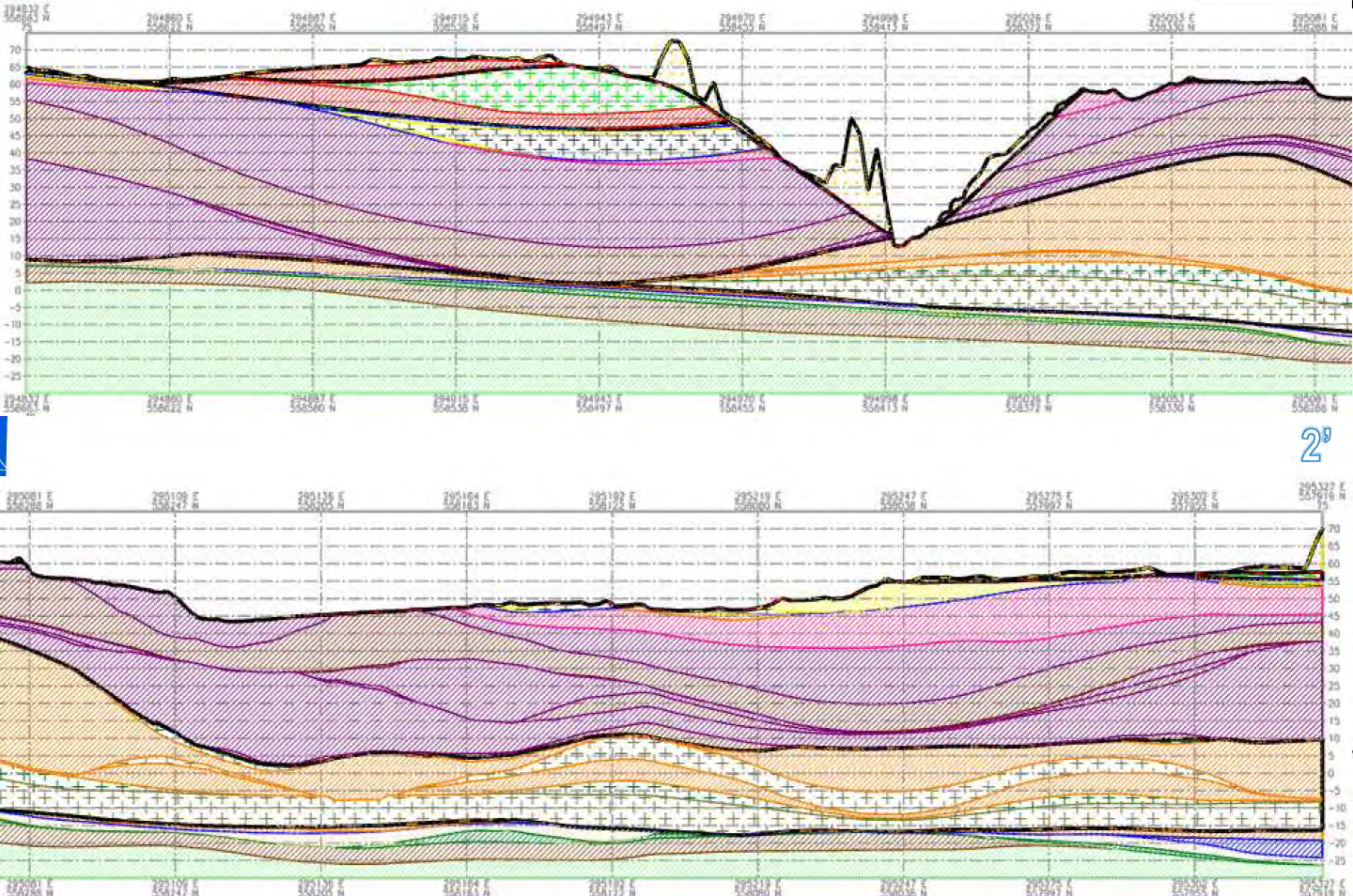
Rev:

## Appendix C – TIL Cross Sections

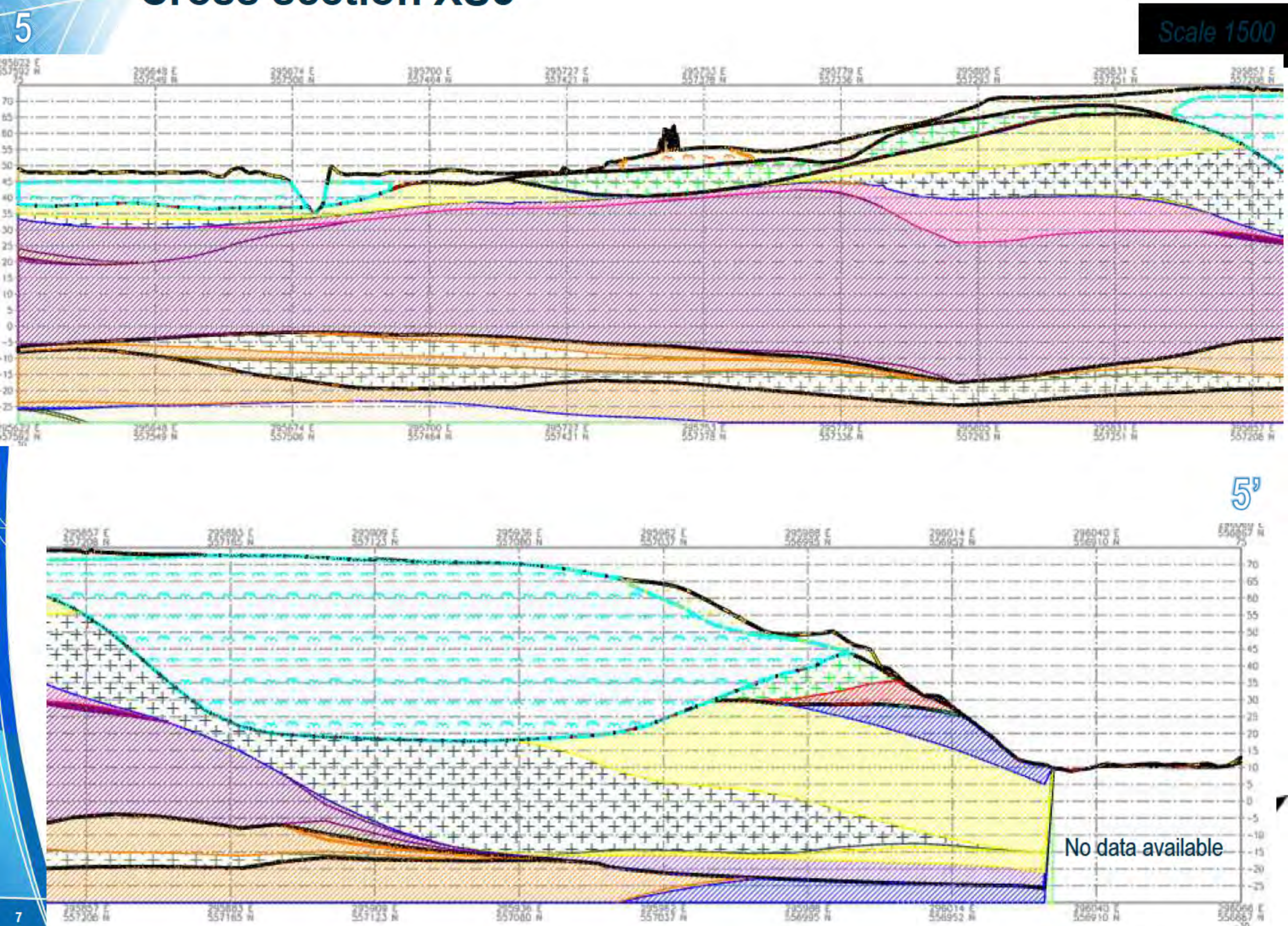
# Cross section XS2'

2

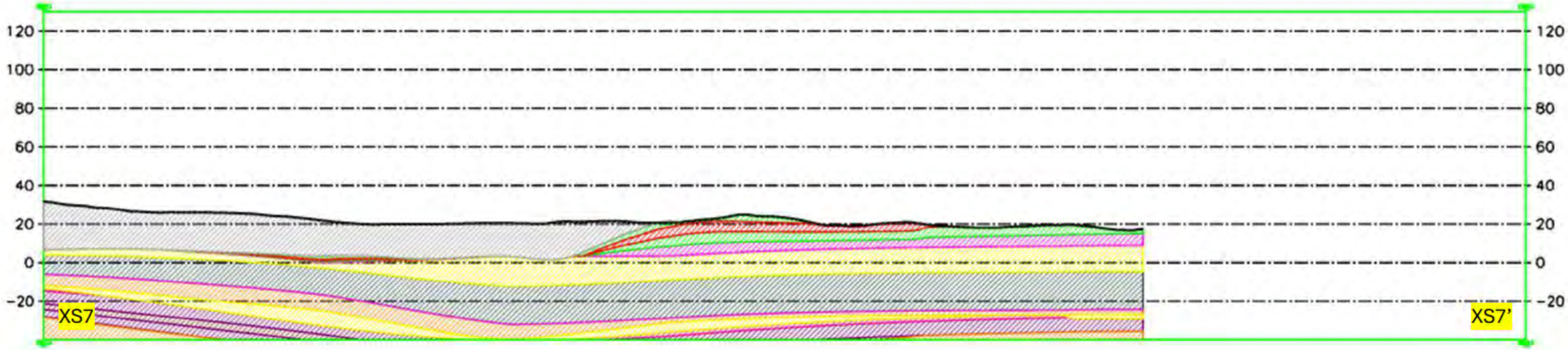
Scale 1500



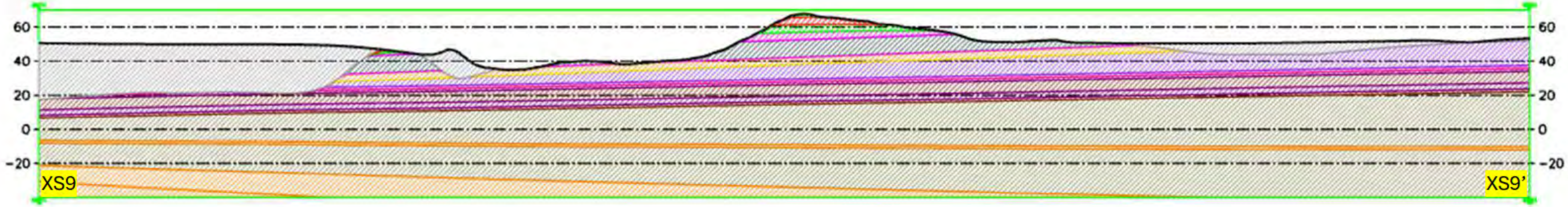
# Cross section XS5'



XS7



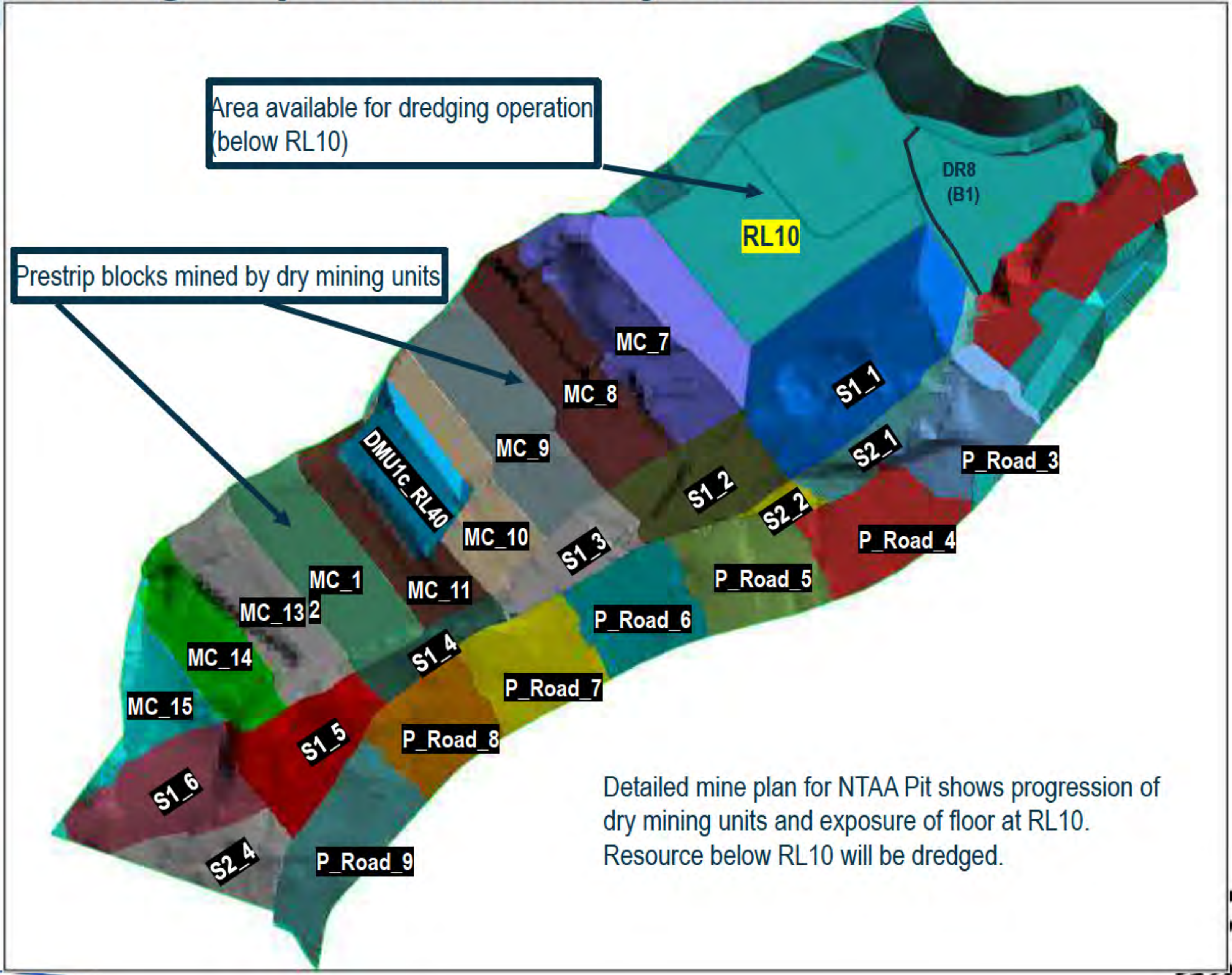
XS9



## Appendix D – Indicative mining floor levels

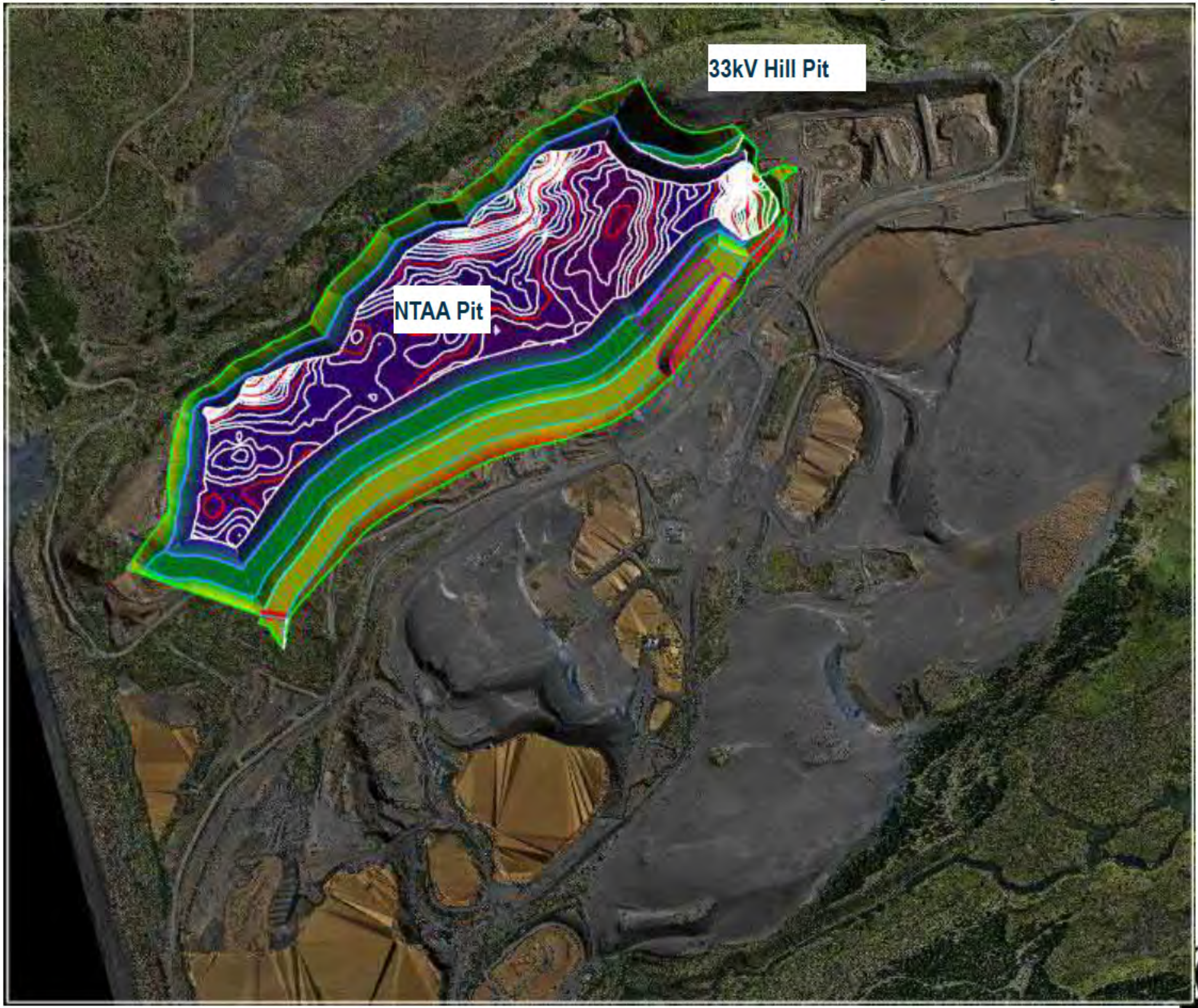
# Central  Taharoa Mining and Dredging Sequence

# Mining Sequence, February 2025 NTAA Pit

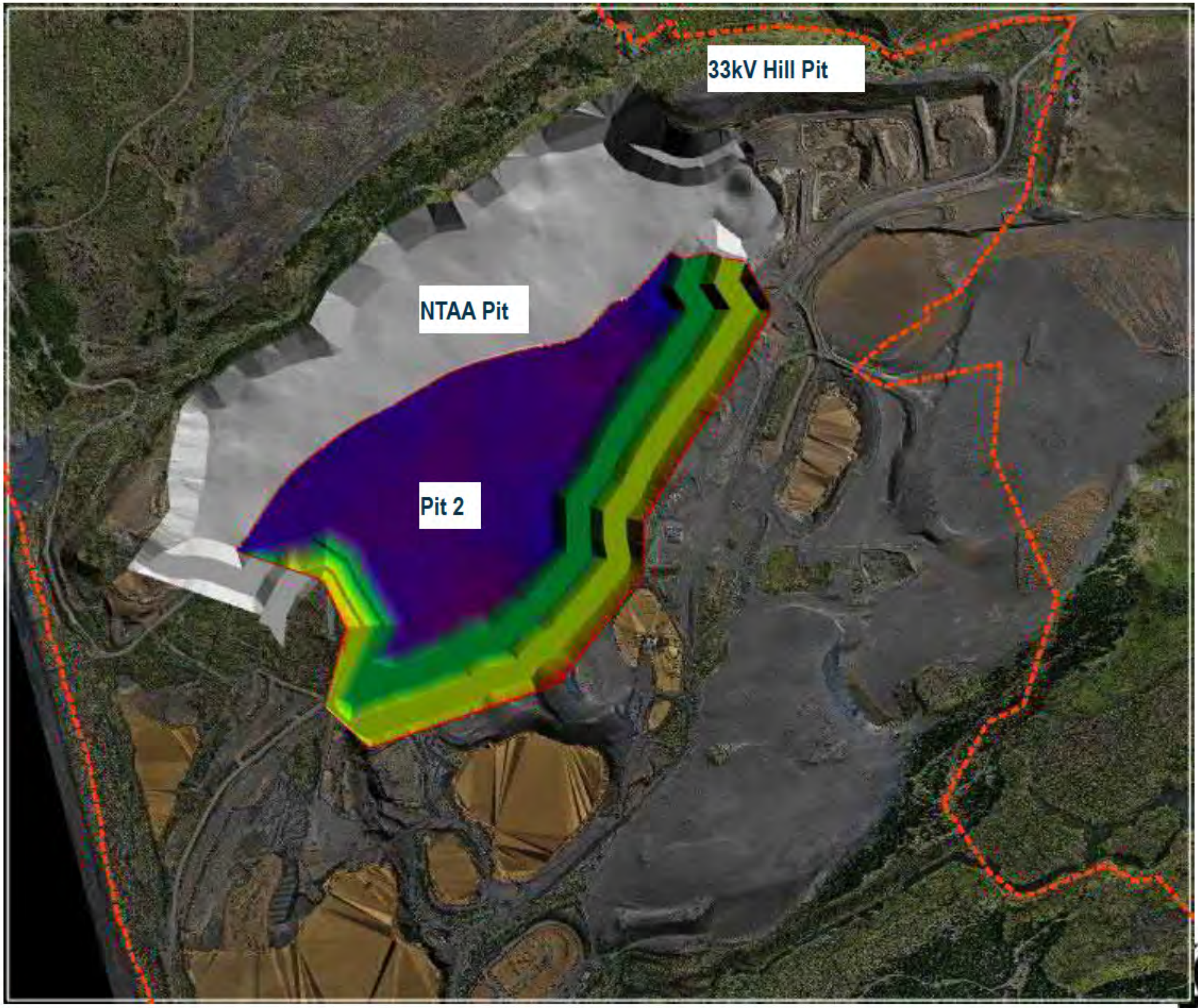



Detailed mine plan for NTAA Pit shows progression of dry mining units and exposure of floor at RL10. Resource below RL10 will be dredged.

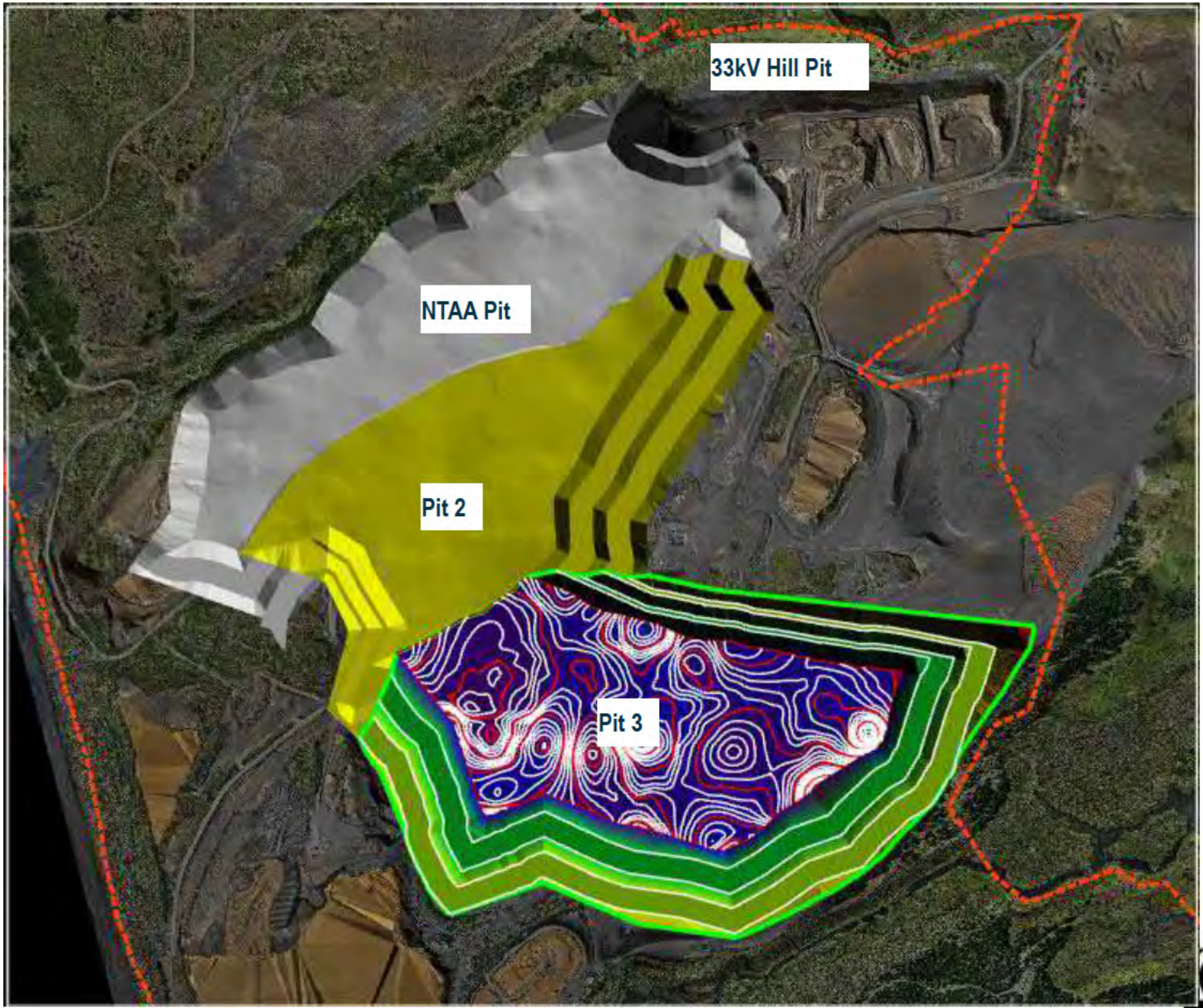
# Pits in Central Area – NTAA Pit (current)



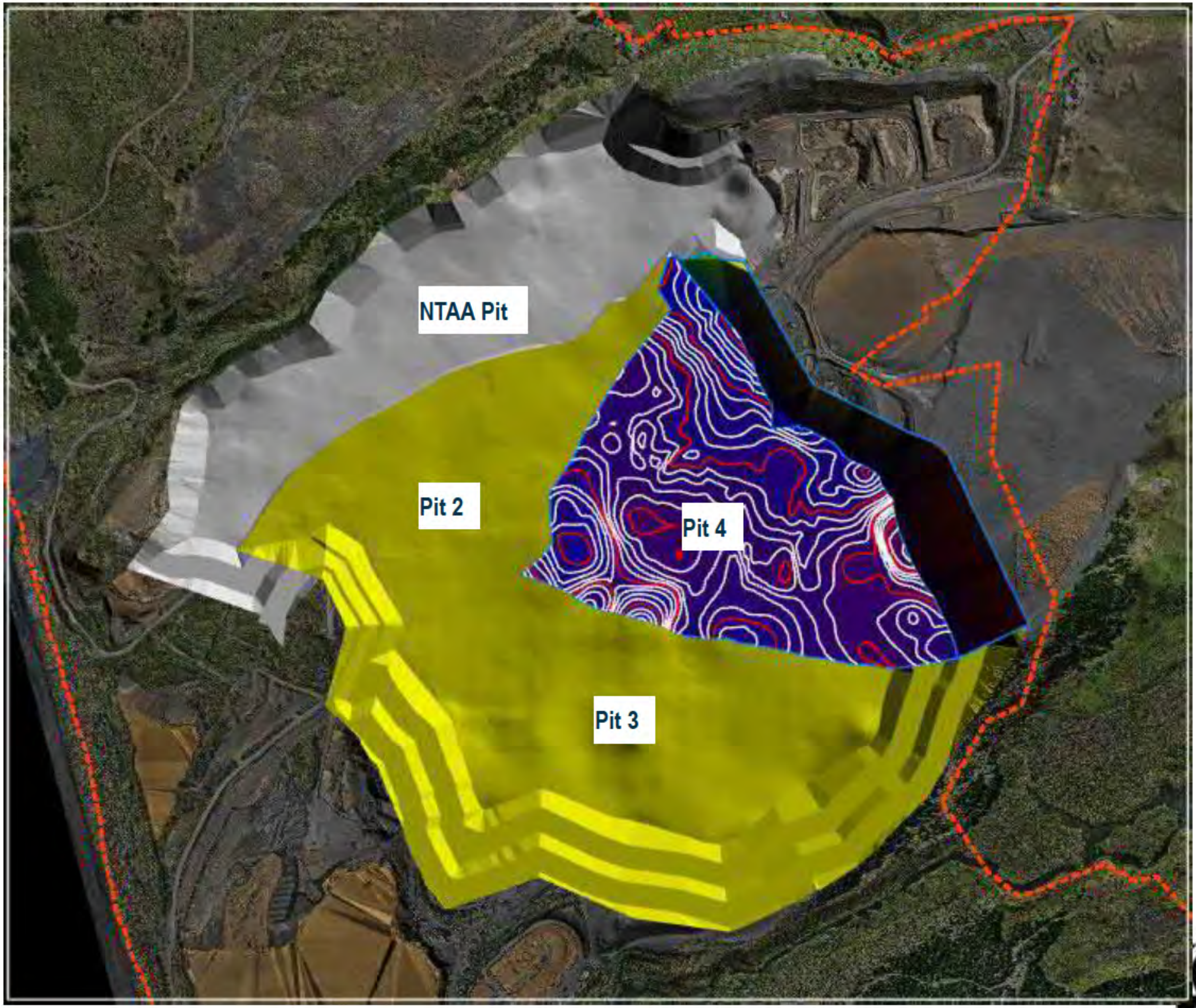
# Pits in Central Area – Pit 2



# Pits in Central Area – Pit 3

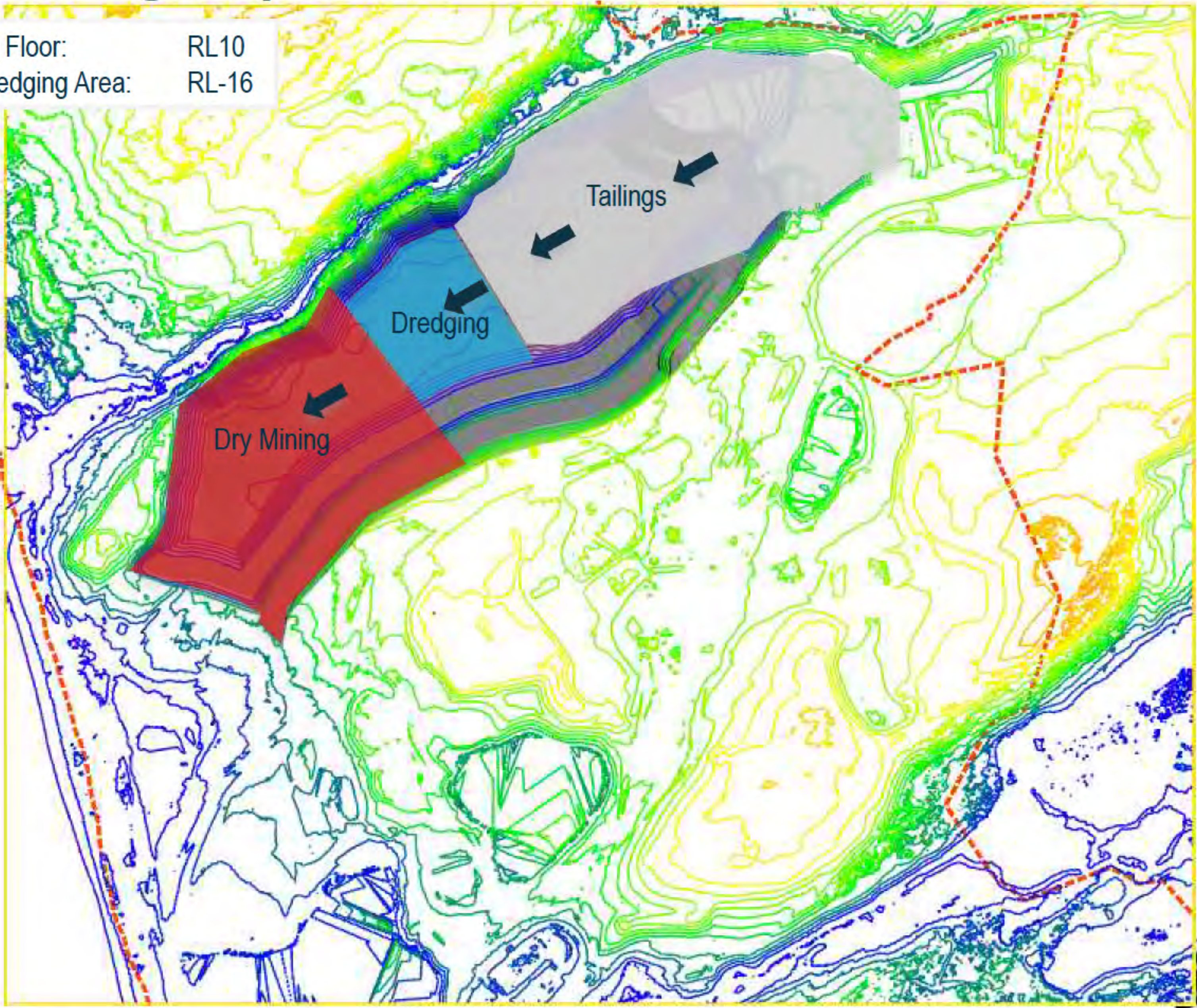


# Pits in Central Area – Pit 4



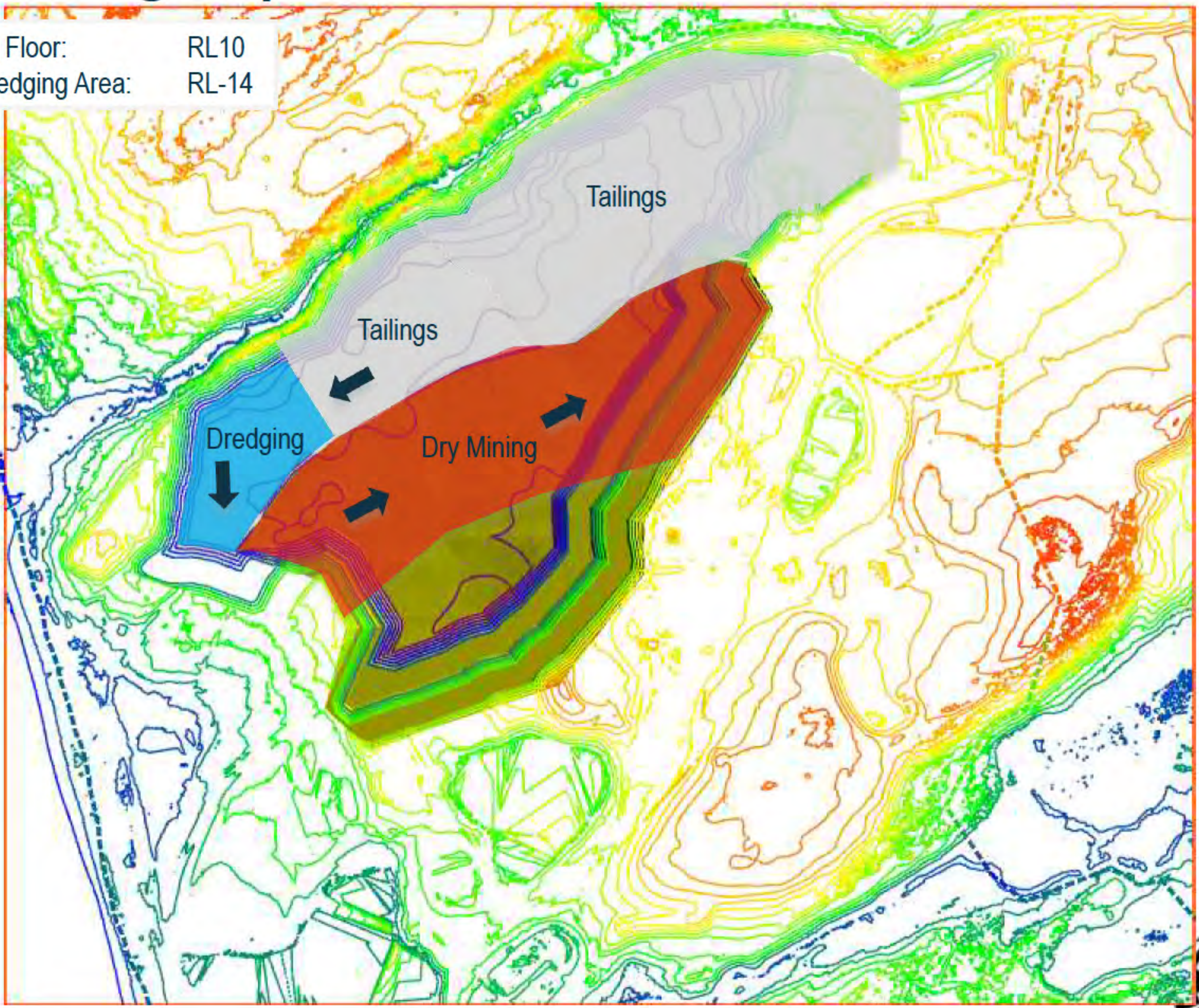
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-16



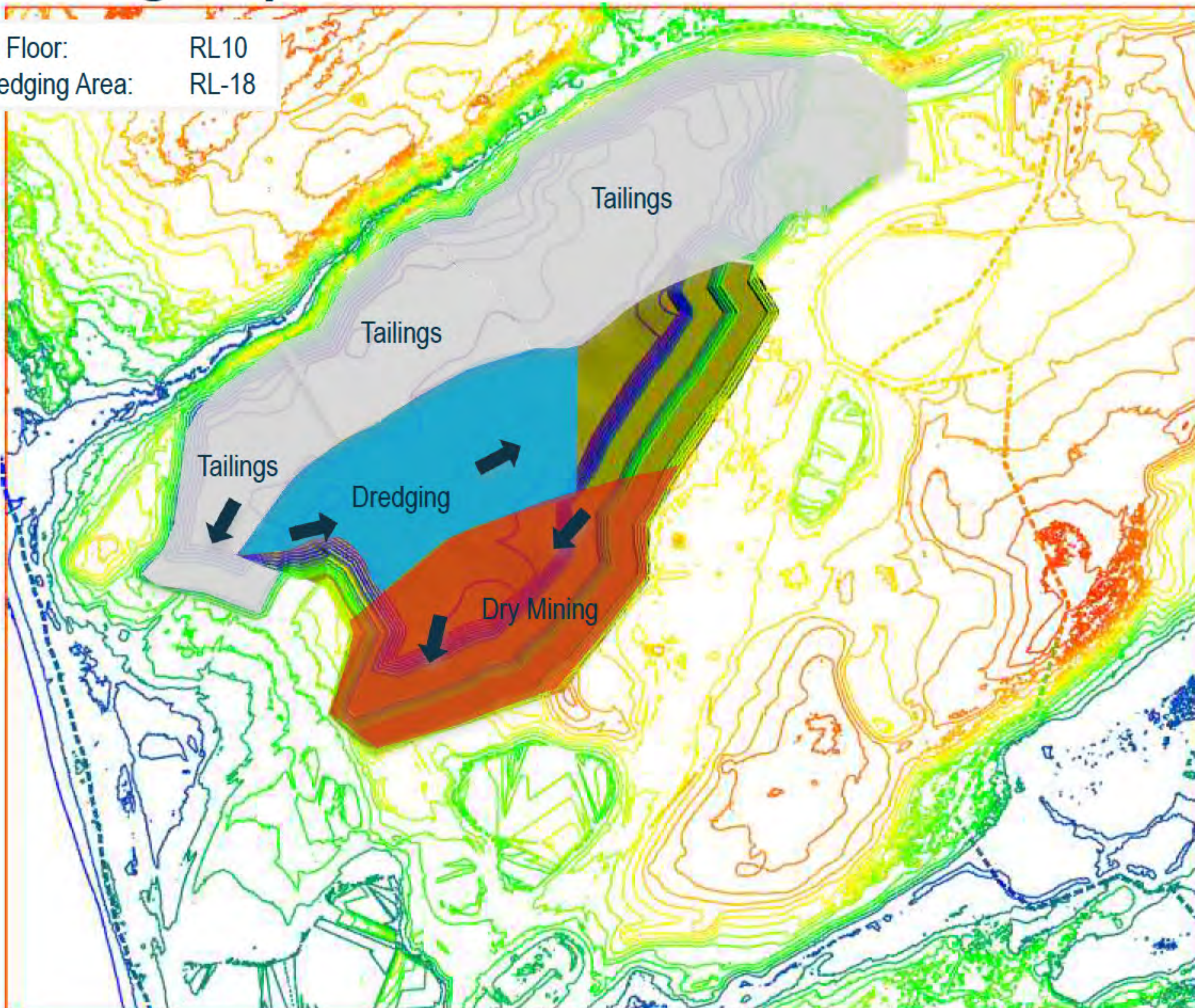
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-14



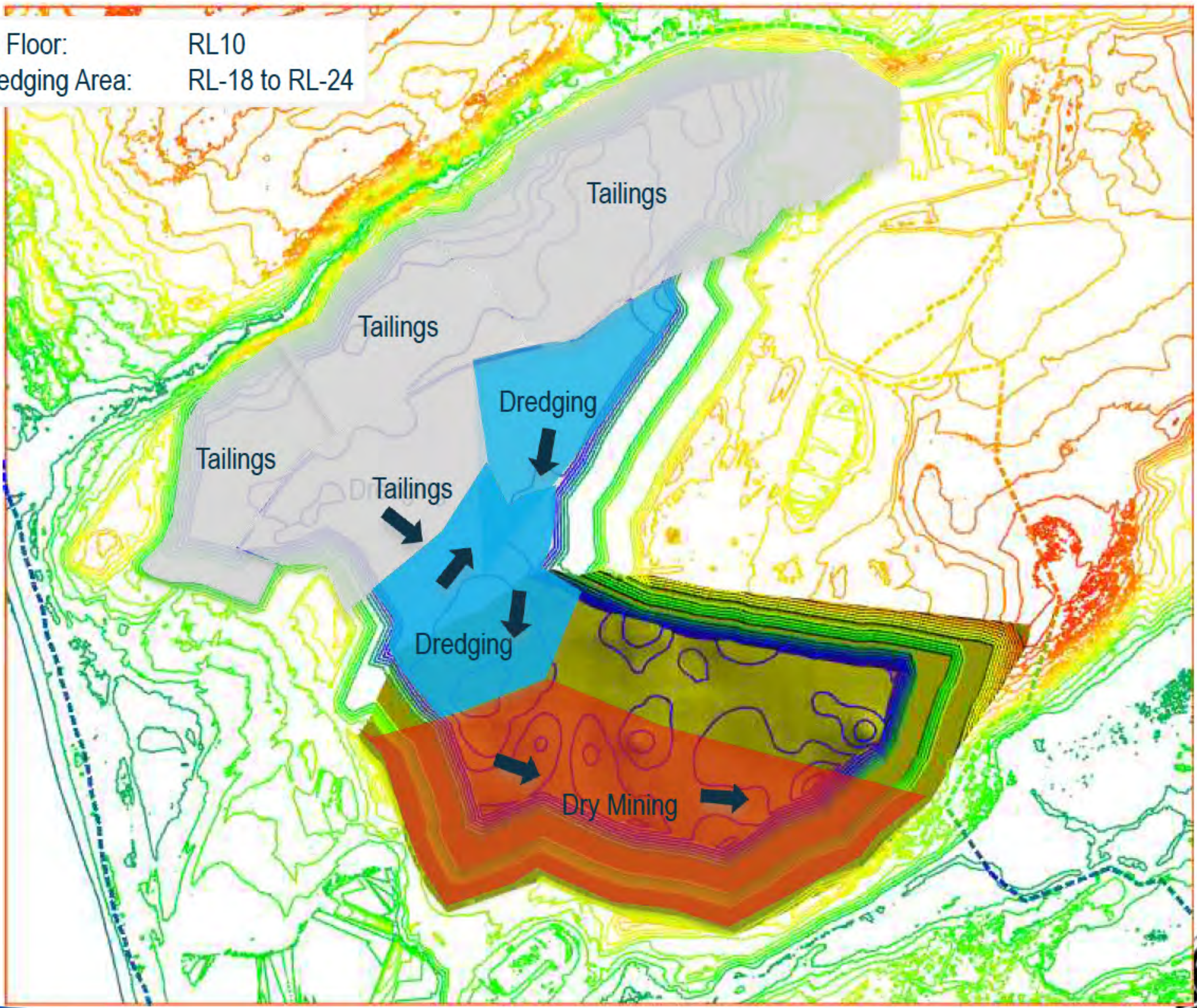
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-18



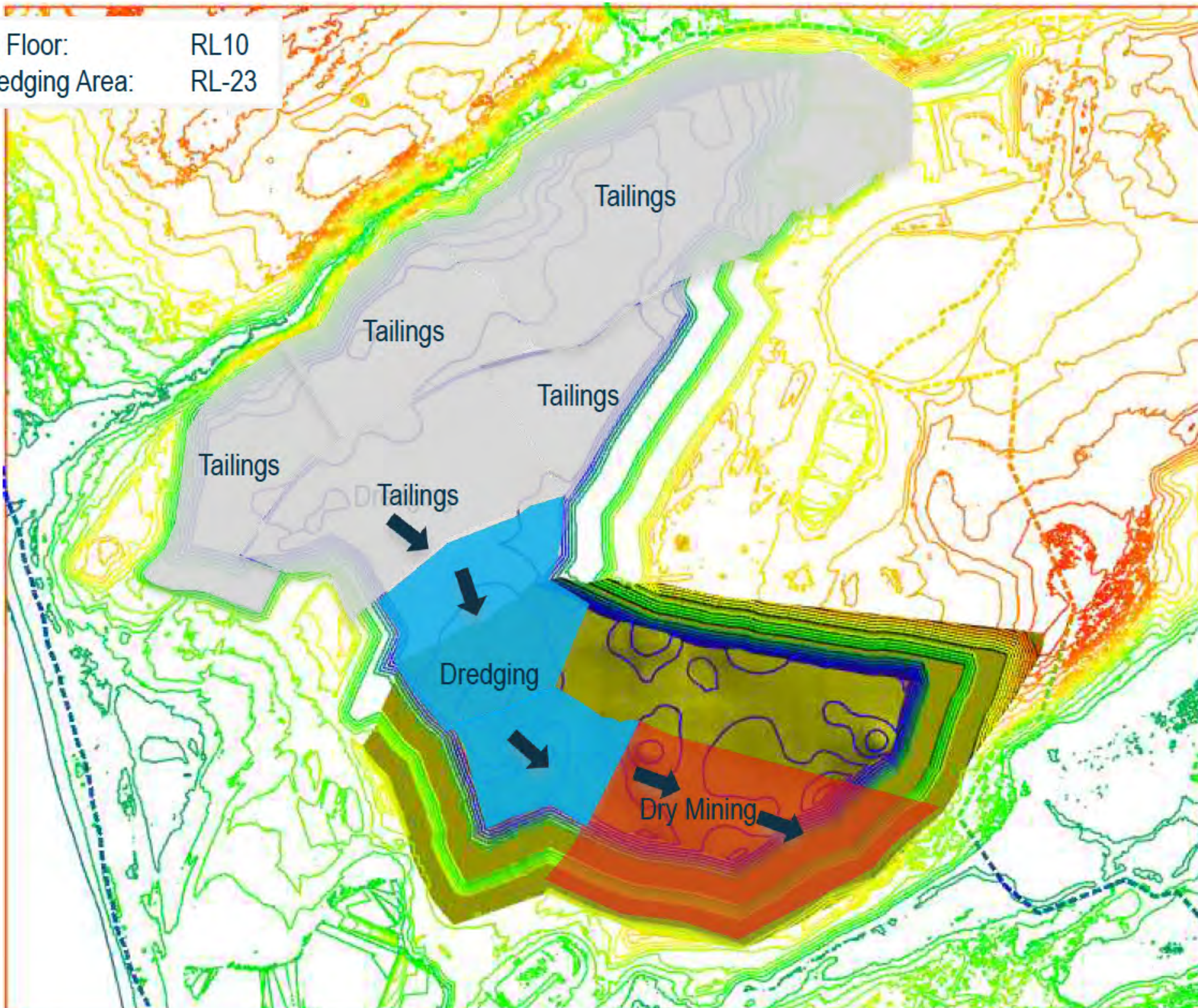
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-18 to RL-24



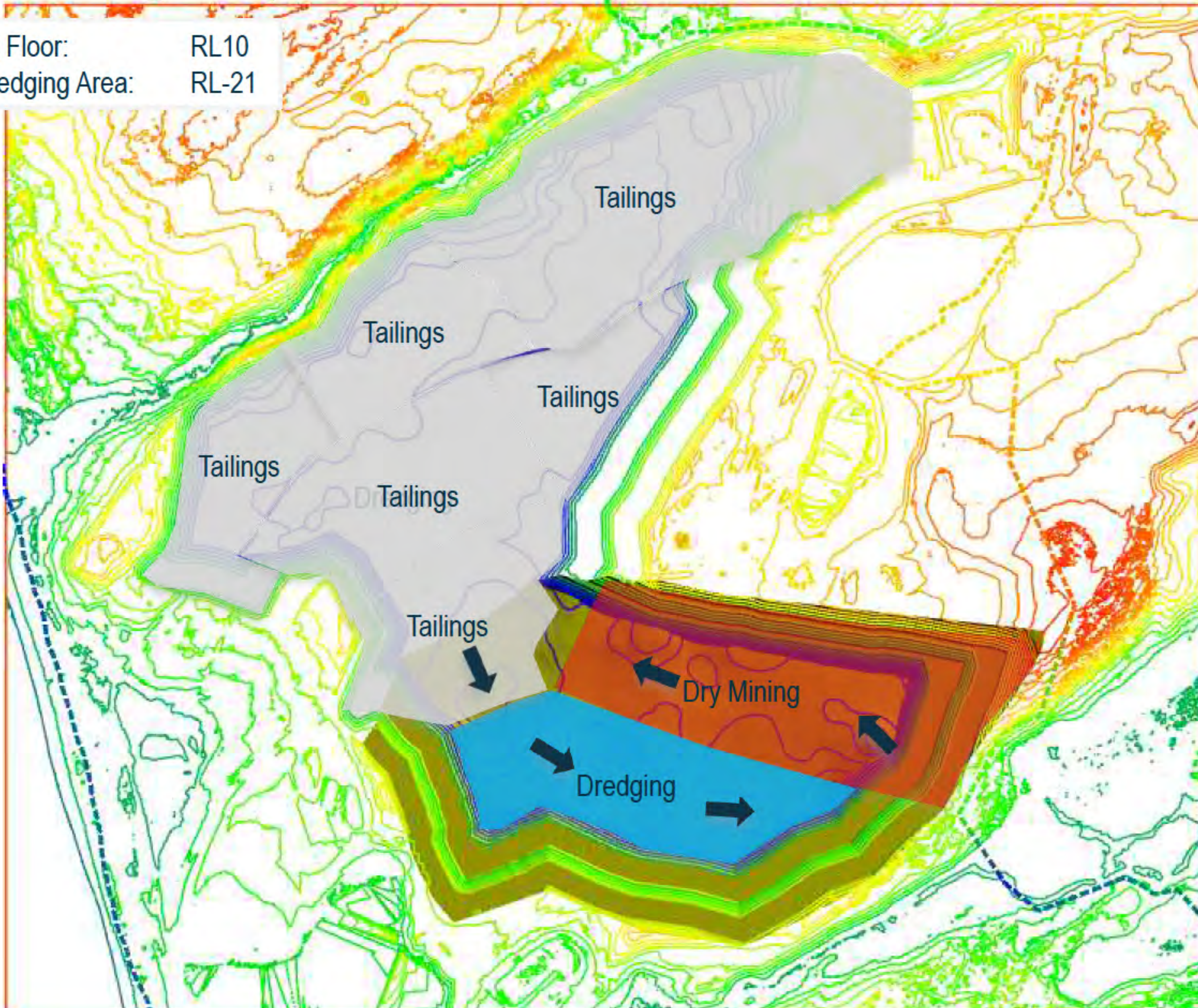
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-23



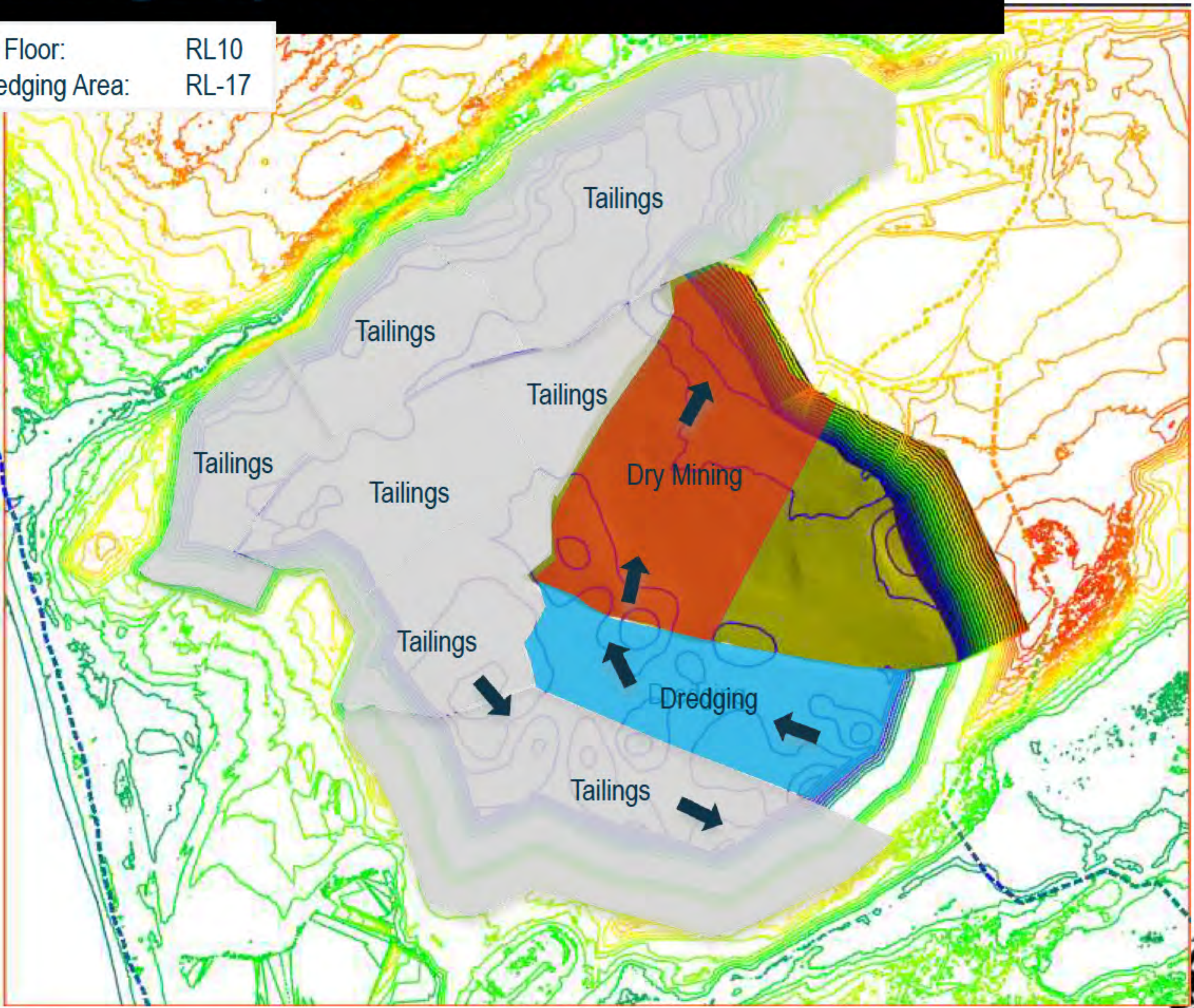
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-21



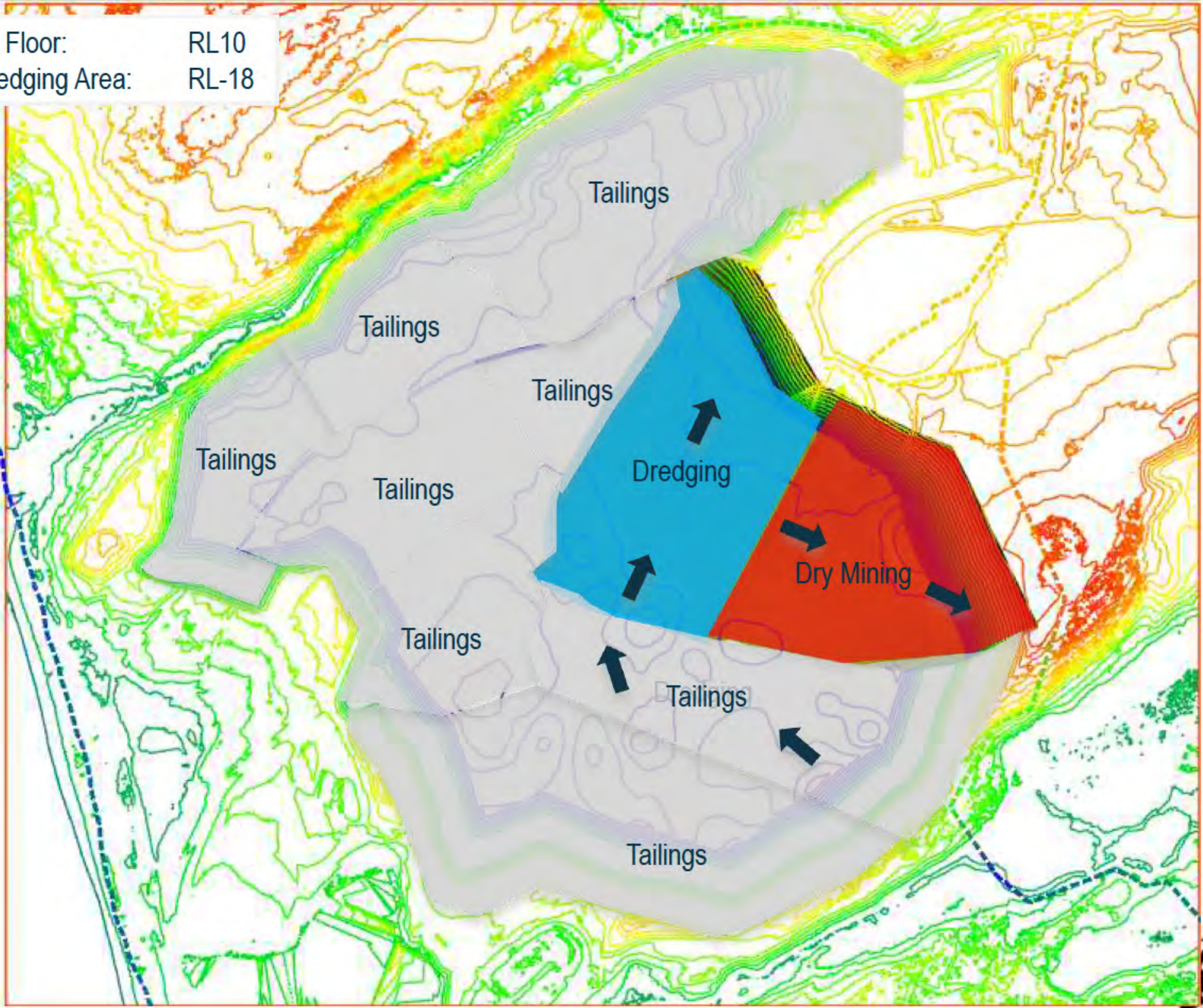
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-17



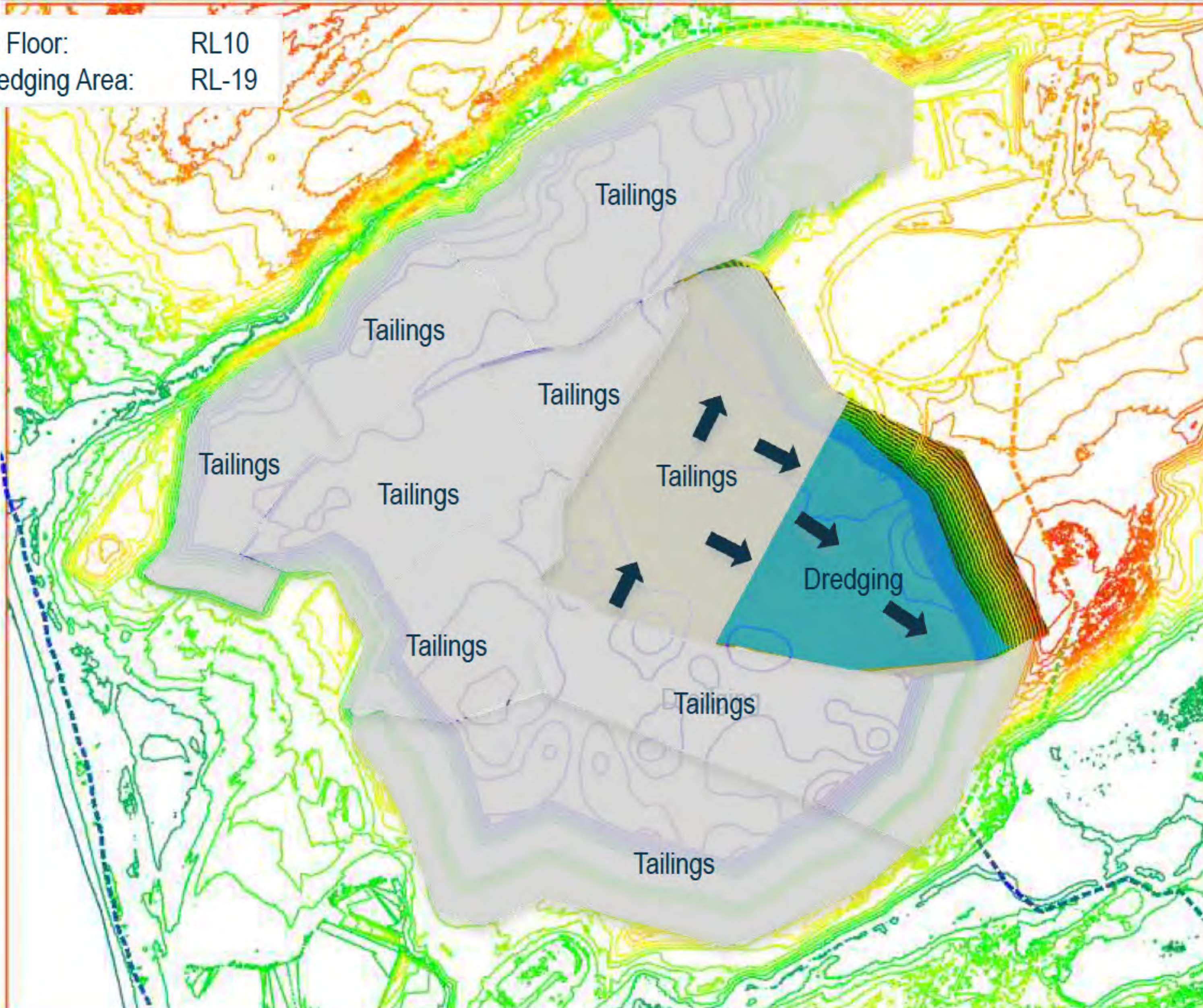
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-18



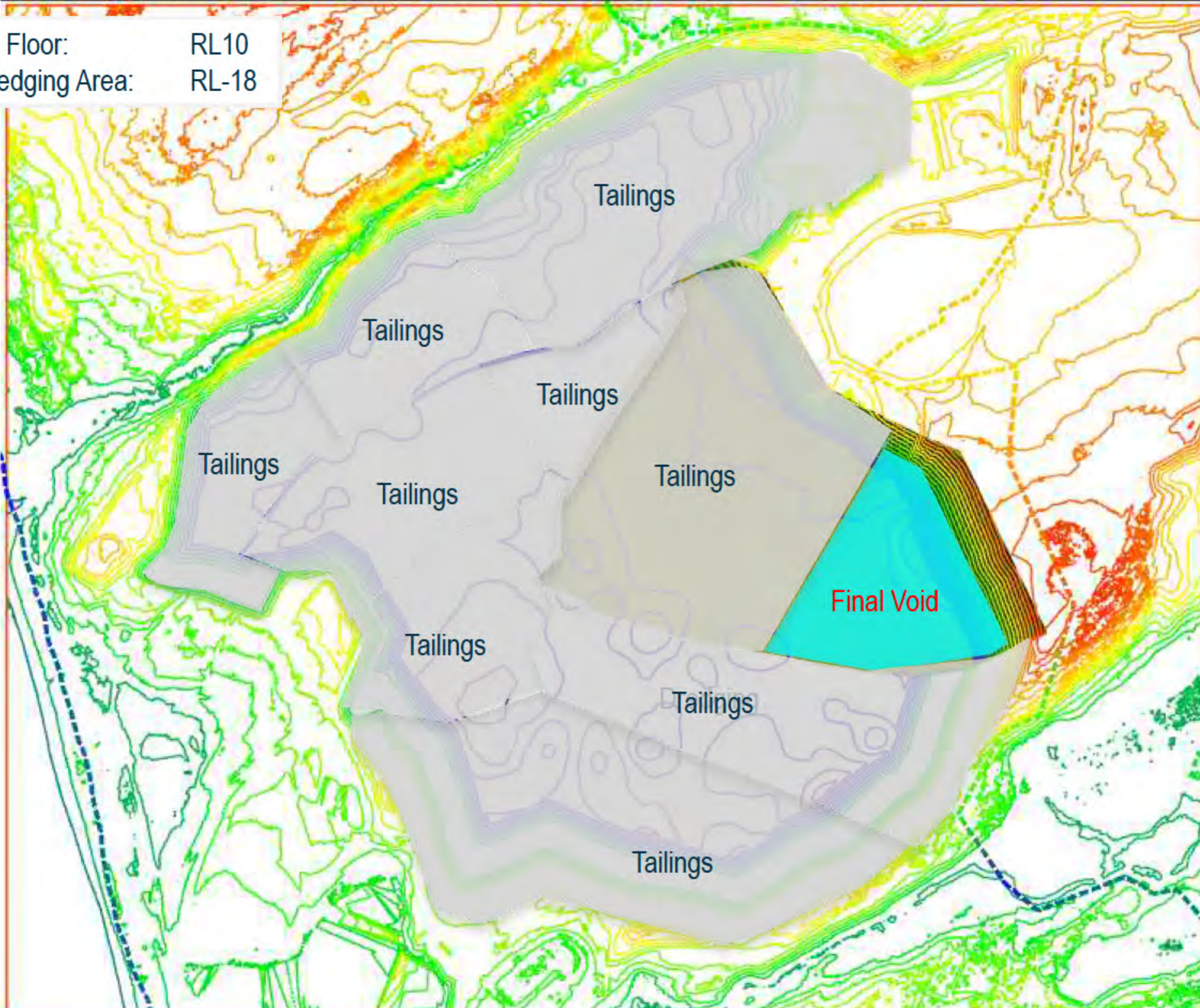
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-19



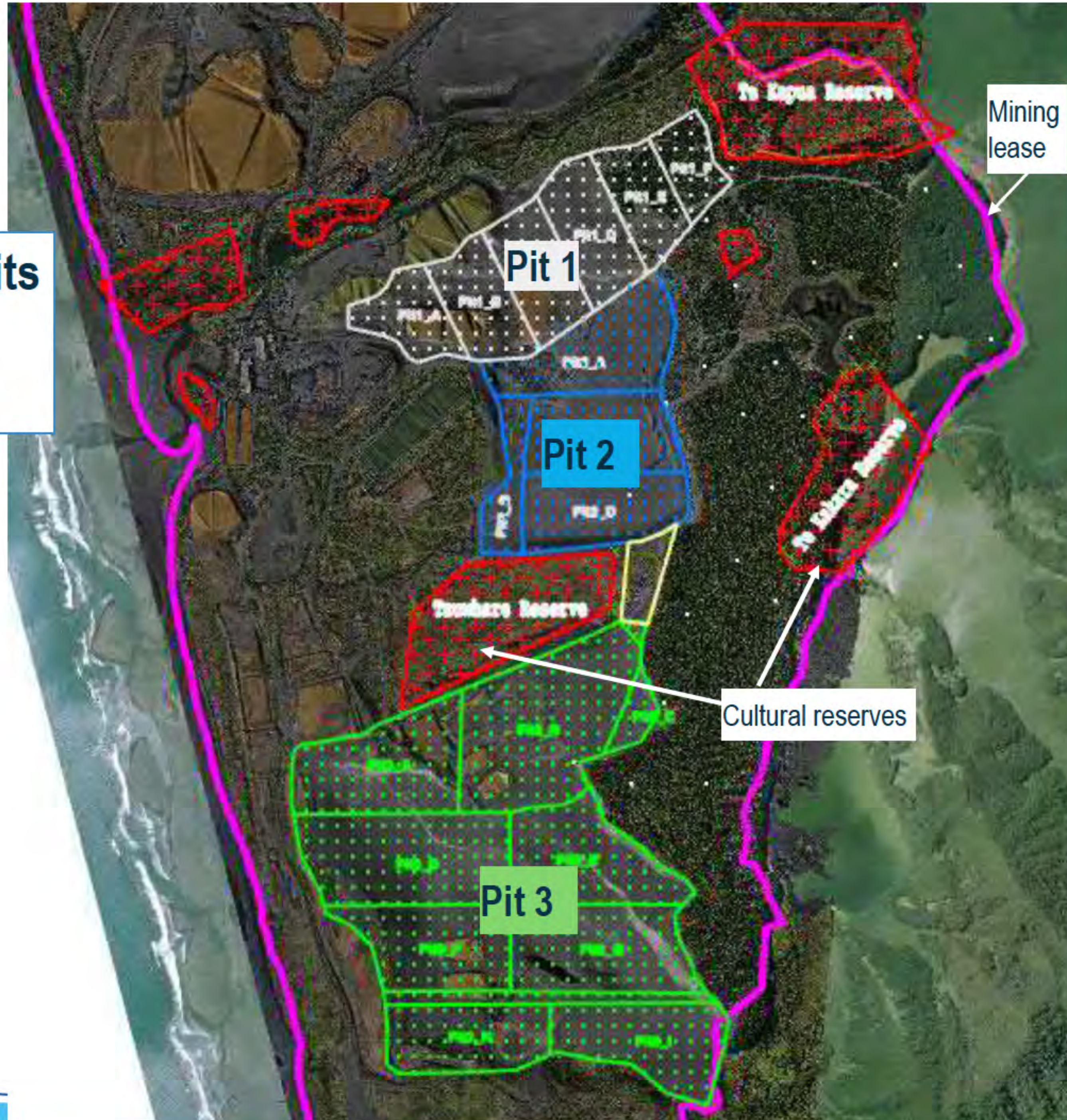
# Mining Sequence

Dry Mining Floor: RL10
Floor in Dredging Area: RL-18

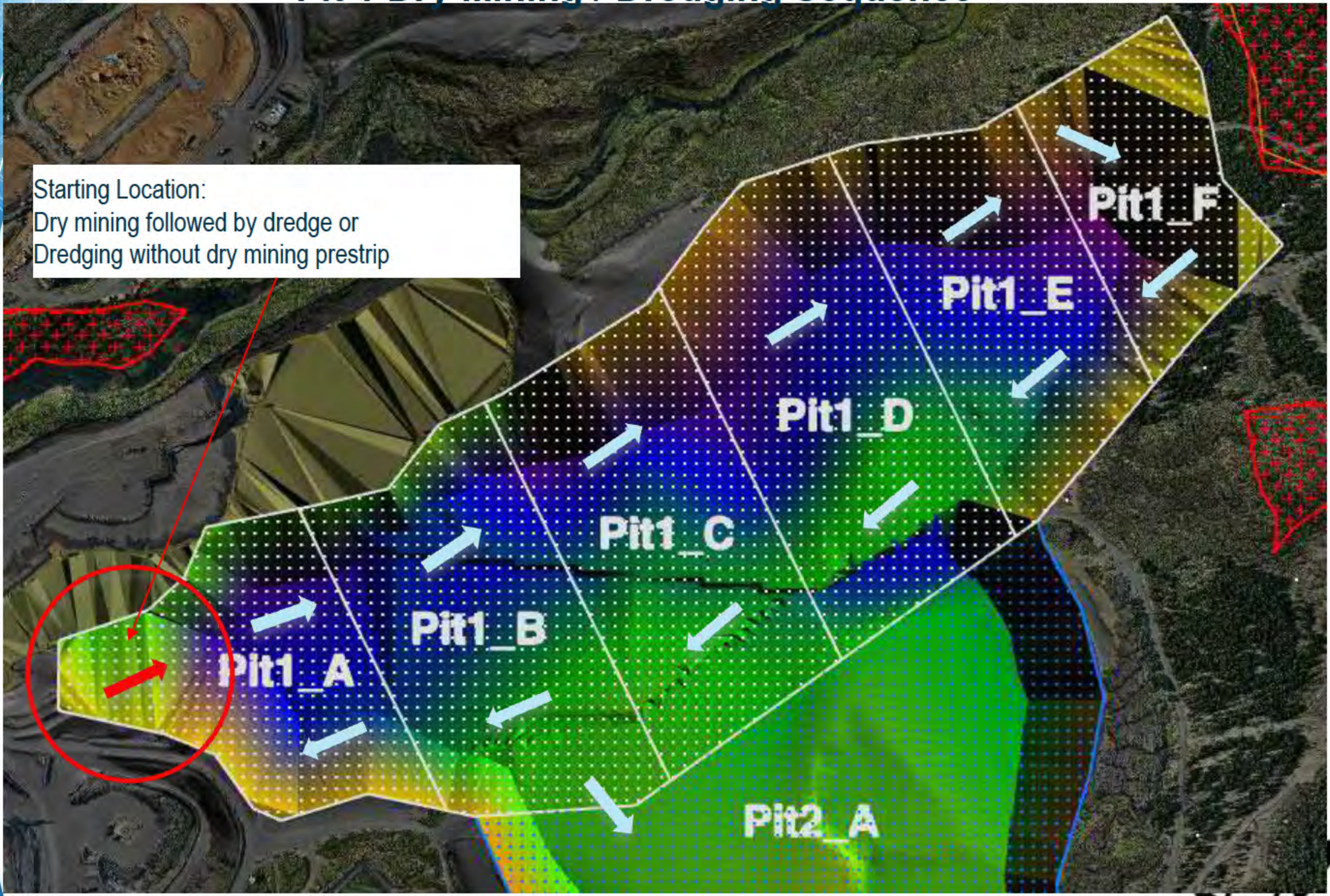


# South  Taharoa Mining and Dredging Sequence

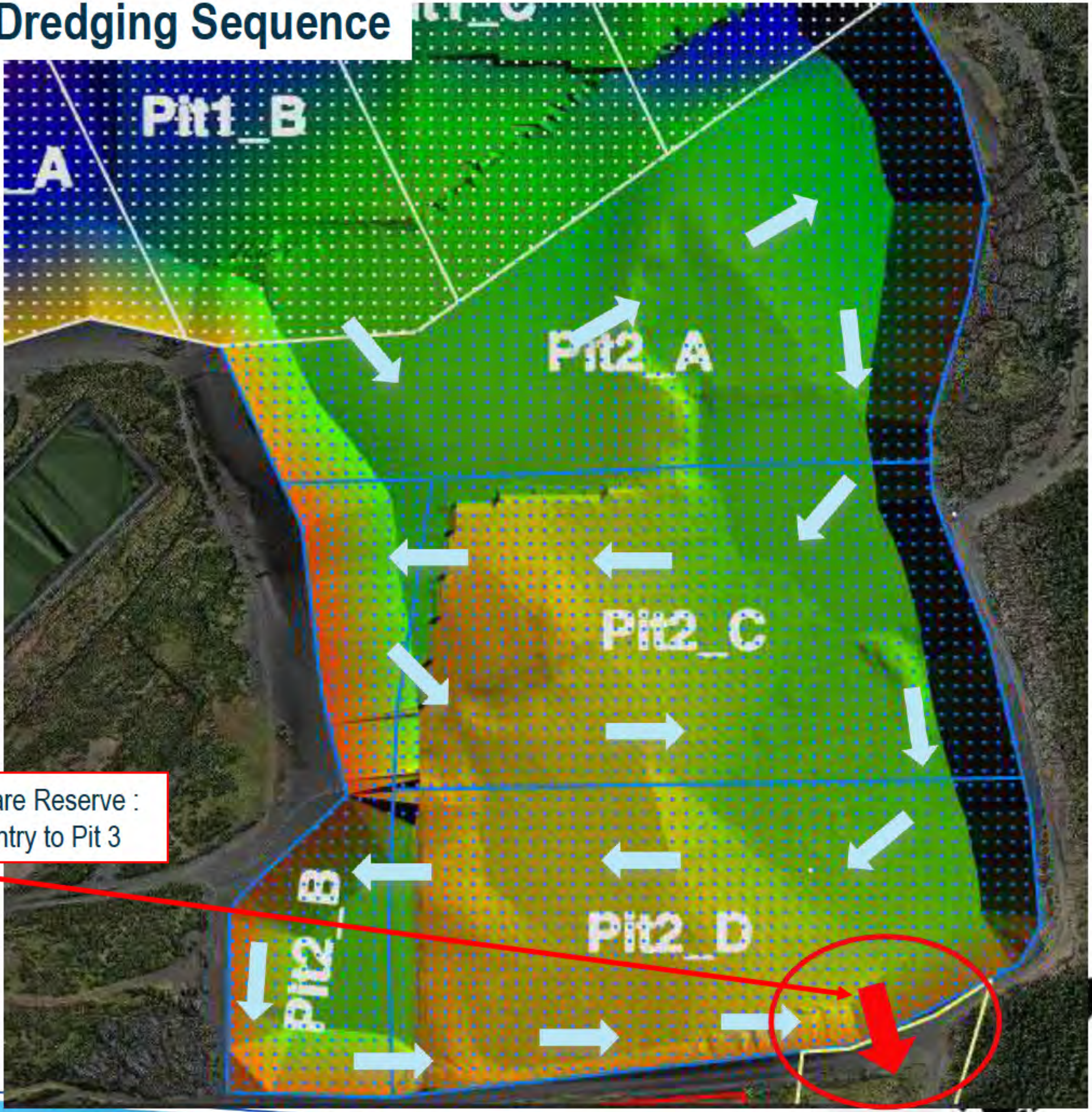
# Currently Planned Pits in South Taharoa



# Pit 1 Dry Mining / Dredging Sequence



# Pit 2 Dry Mining / Dredging Sequence




Entry to a corridor, East of the Tauwhare Reserve :
The corridor will allow transfer and entry to Pit 3

# Pit 3 Dry Mining / Dredging Sequence

# Possible Expansion of Mining Areas

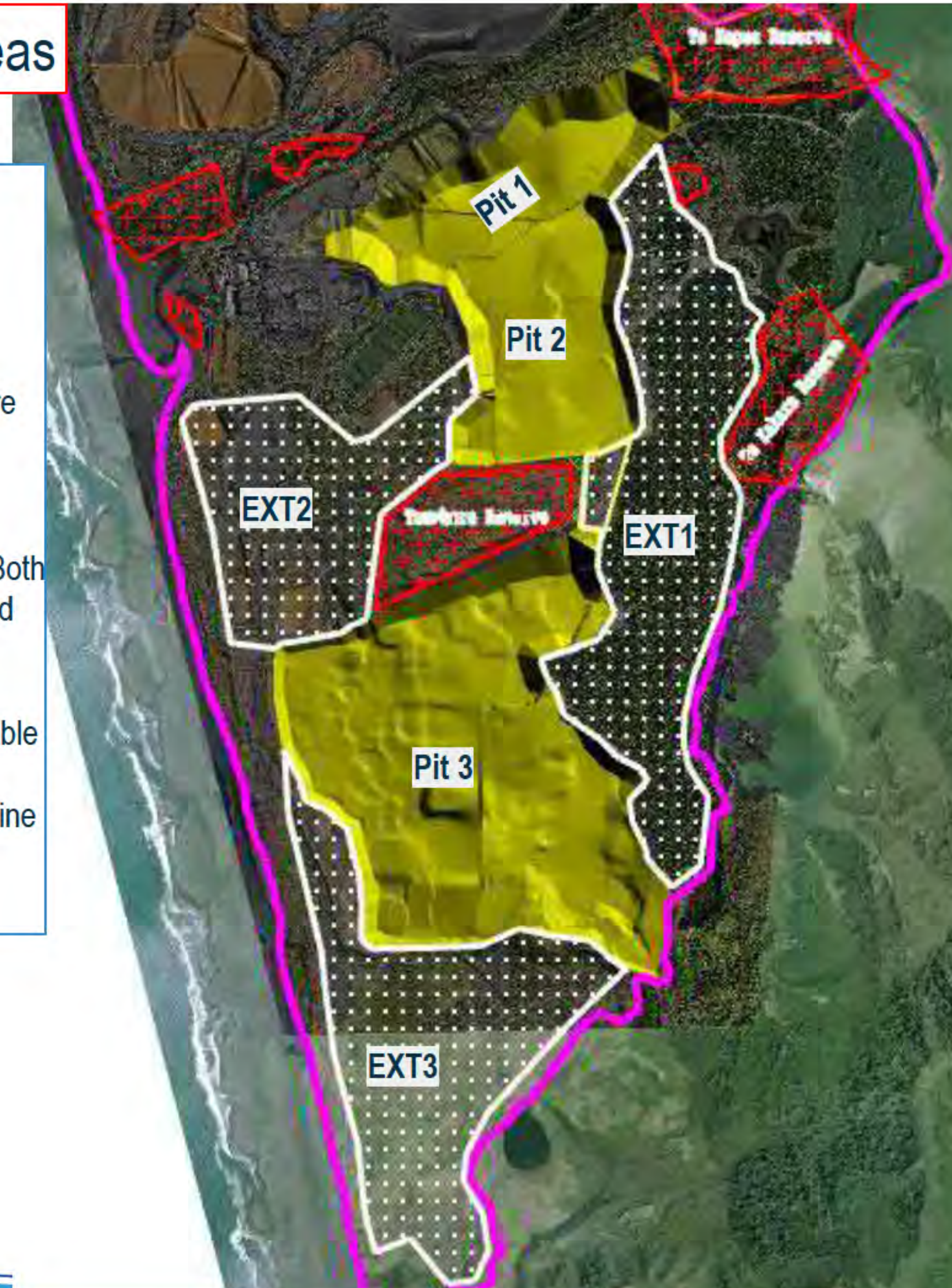
Areas with prefix EXT have not yet been developed into mining or dredging pits.

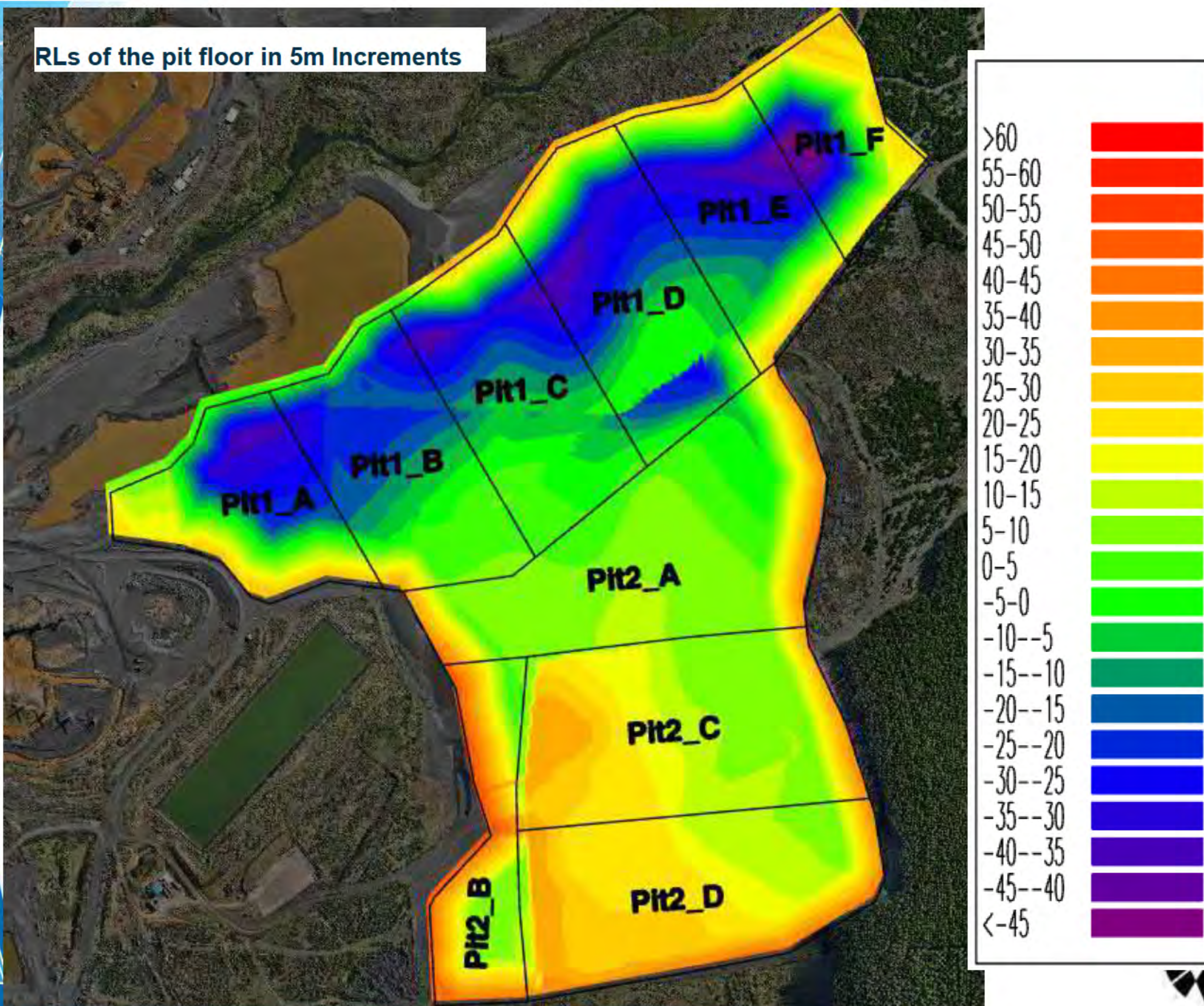
EXT1 has 28 boreholes drilled in 2015 to determine remaining reserves of high grade below the old dredge path and old tailings. These boreholes are yet to be modelled.

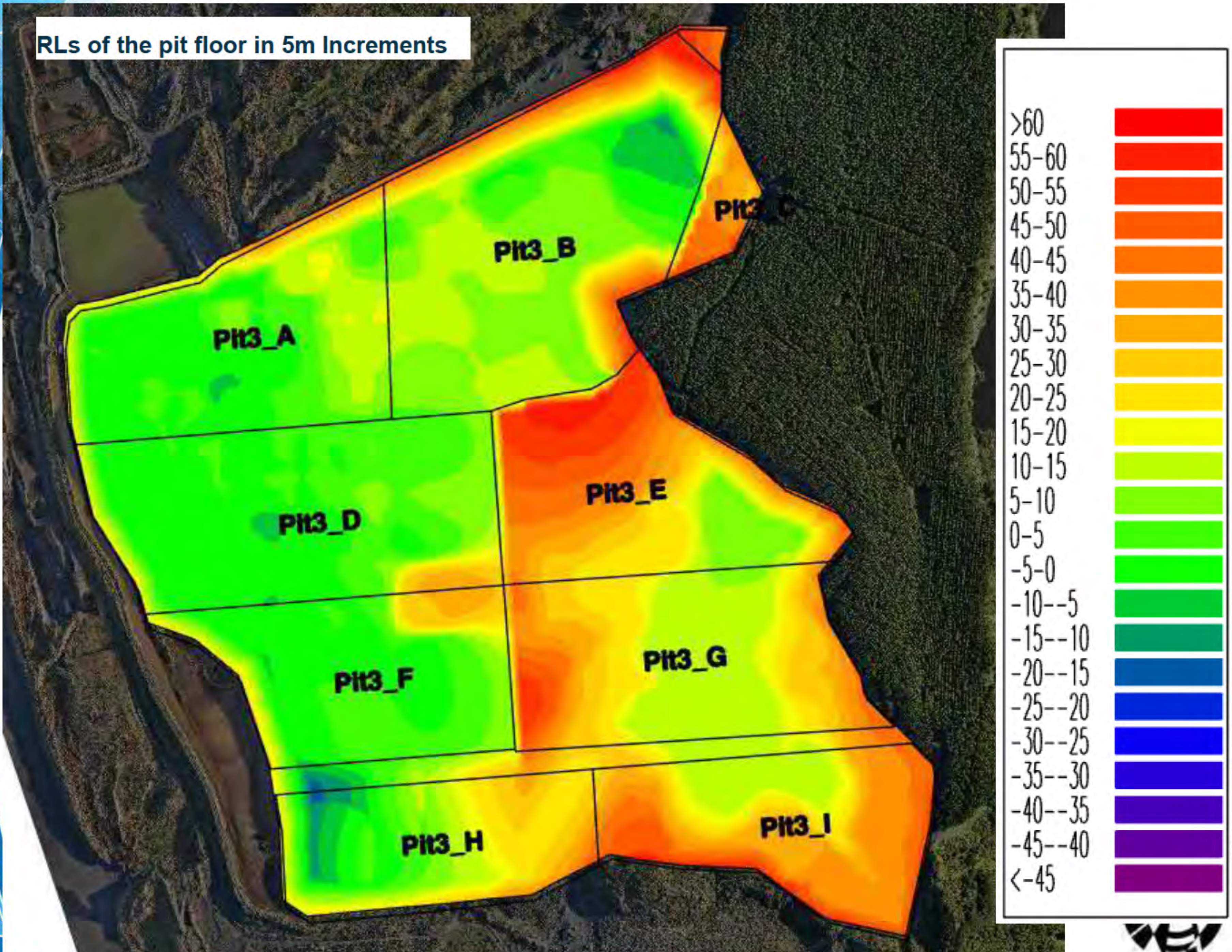
EXT2 and EXT3 have been mined before and contain tailings as well as in-situ (not mined ) material. Both areas can be mined / dredged but will need more detailed designs.

For a relative size of these three areas please see the table below.
Reserves for these areas will be provided after further mine planning work is completed.

| | Area (Ha) |
|---|---|
| EXT1 | 62.3 |
| EXT2 | 38.0 |
| EXT3 | 53.9 |




RLs of the pit floor in 5m Increments
Pit1_F
Pit1_E
Pit1_D
Pit1_C
Pit1_B
Pit1_A
Pit2_A
Pit2_C
Pit2_B
Pit2_D
>60
55-60
50-55
45-50
40-45
35-40
30-35
25-30
20-25
15-20
10-15
5-10
0-5
-5-0
-10--5
-15--10
-20--15
-25--20
-30--25
-35--30
-40--35
-45--40
<-45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Pit3_B
Pit3_D
Pit3_E
Pit3_F
Pit3_G
Pit3_H
Pit3_I
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55-60
50-55
45-50
40-45
35-40
30-35
25-30
20-25
15-20
10-15
5-10
0-5
-5-0
-10--5
-15--10
-20--15
-25--20
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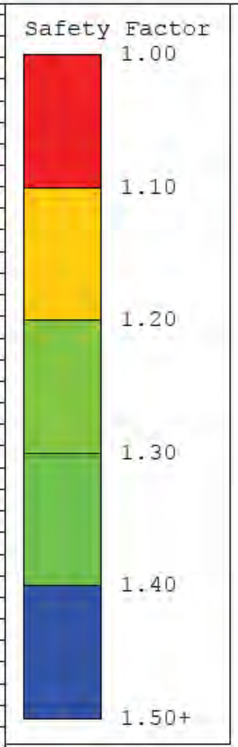
-35--30
-40--35
-45--40
<-45

# Appendix E – Selected Slope Stability Outputs

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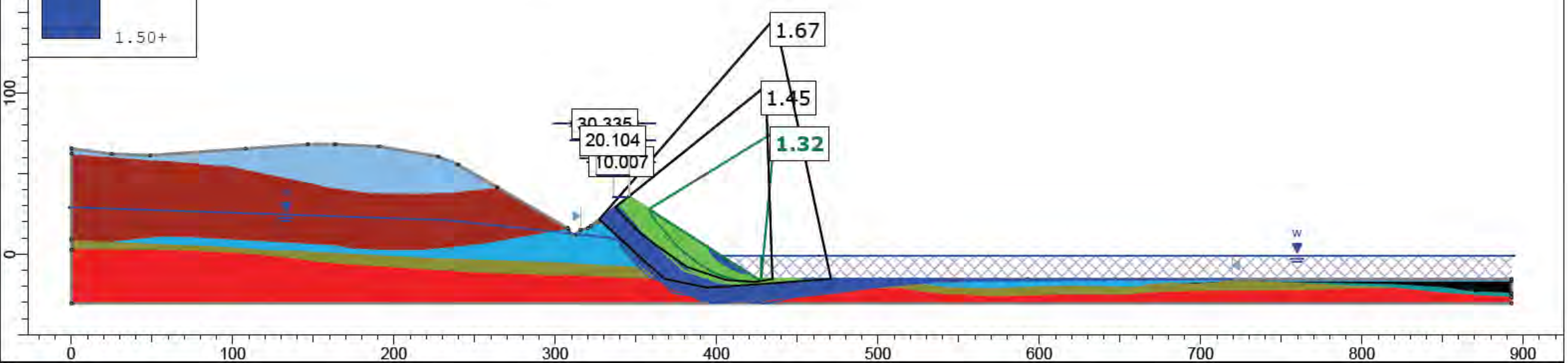
Analysis: XS2
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Left to Right
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | None | | | 0 | 17 | 0 |
| Mt | | 20 | Mohr-Coulomb | 3 | 28 | Water Table | Custom | 1 | | 14 | 0 |
| Az/Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Ae | | 18 | Mohr-Coulomb | 3 | 26 | Water Table | Custom | 1 | | 13 | 0 |
| Qs | | 18 | Mohr-Coulomb | 2 | 38 | Water Table | Custom | 1 | | 19 | 0 |
| Rc | | 20 | Mohr-Coulomb | 12 | 35 | Water Table | Custom | 1 | | 17.5 | 0 |

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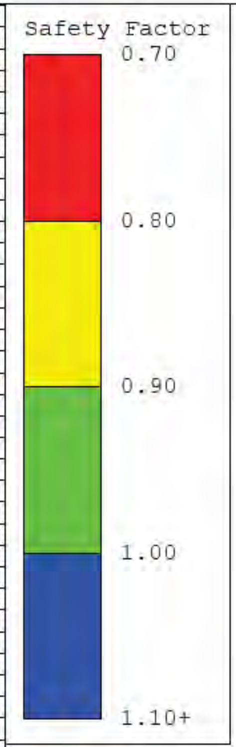
| | *Analysis Description* | XS2- Wet Mining 30 m Offset | |
| | *Drawn By* CJL | *Scale* 1:3500 | *Company* Baseline Geotechnical Limited |
| SLIDEINTERPRET 9.037 | *Date* 09/09/2025 | | *File Name* Section 2 -v2.slmd |

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Analysis: XS2
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Left to Right
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | None | | | 0 | 17 | 0 |
| Mt | | 20 | Mohr-Coulomb | 3 | 28 | Water Table | Custom | 1 | | 14 | 0 |
| Az/Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Ae | | 18 | Mohr-Coulomb | 3 | 26 | Water Table | Custom | 1 | | 13 | 0 |
| Qs | | 18 | Mohr-Coulomb | 2 | 38 | Water Table | Custom | 1 | | 19 | 0 |
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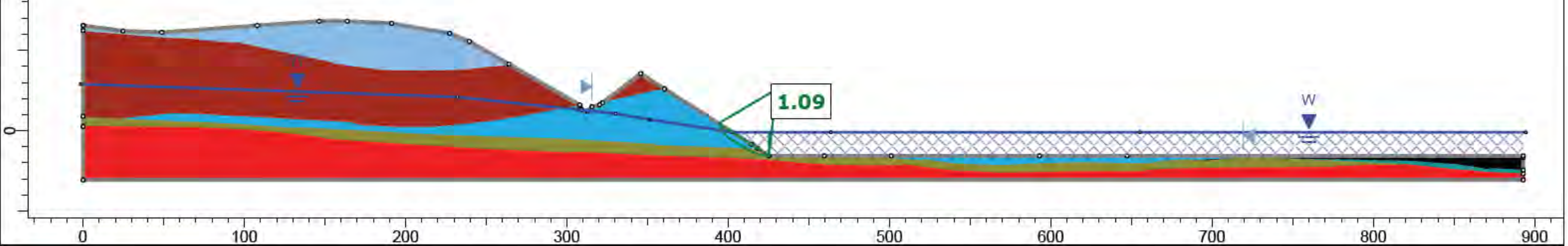
0.07




BASELINE GEOTECHNICAL

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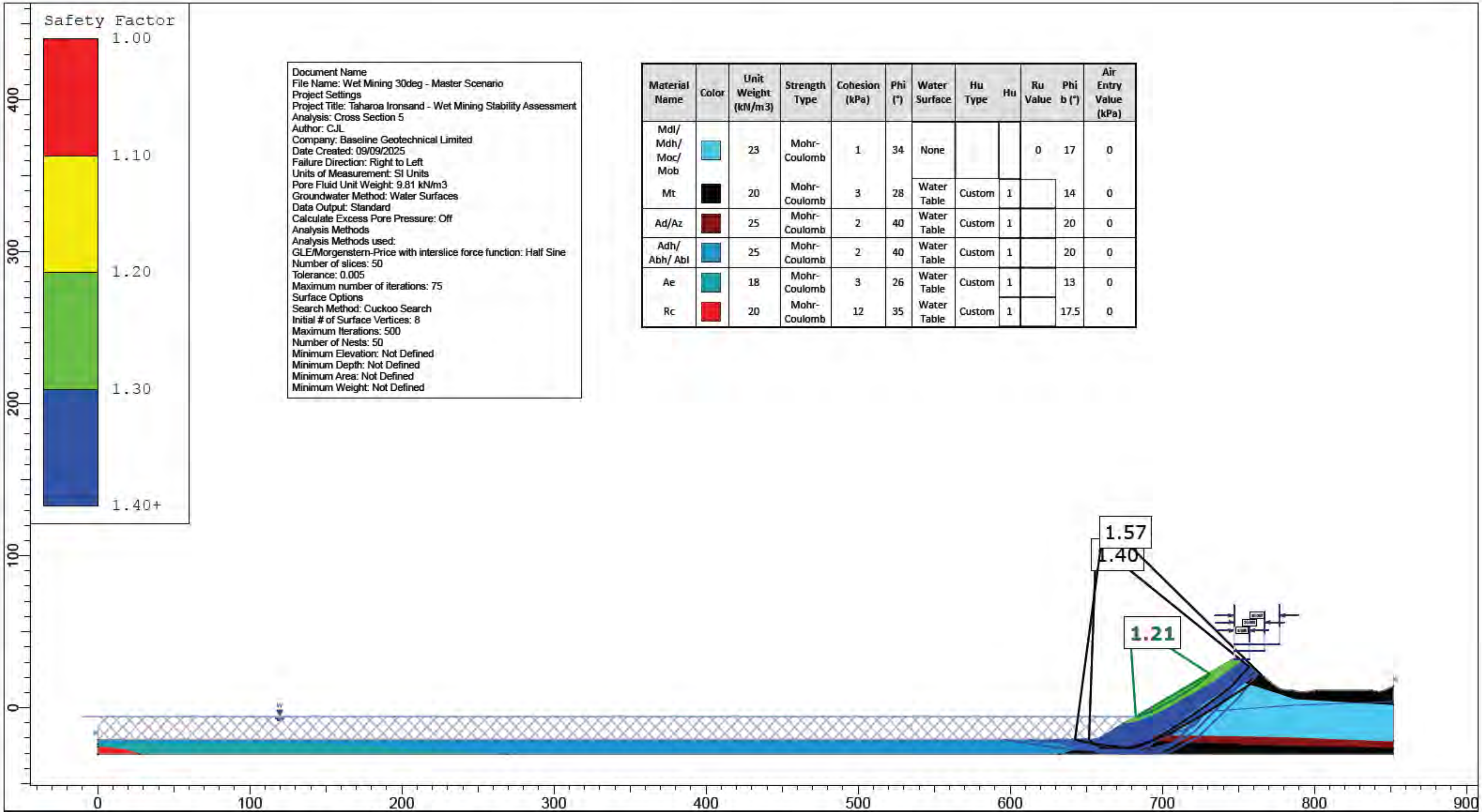
| *Analysis Description* | XS2- Seismic 1:25 0.07g |
| *Drawn By* | CJL |
| *Scale* | 1:3500 |
| *Company* | Baseline Geotechnical Limited |
| *Date* | 09/09/2025 |
| *File Name* | Section 2 -v2.slmd |

SLIDEINTERPRET 9.037

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Analysis: Cross Section 5
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mdl/ Mdh/ Moc/ Mob | | 23 | Mohr-Coulomb | 1 | 34 | None | | | 0 | 17 | 0 |
| Mt | | 20 | Mohr-Coulomb | 3 | 28 | Water Table | Custom | 1 | | 14 | 0 |
| Ad/Az | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Ae | | 18 | Mohr-Coulomb | 3 | 26 | Water Table | Custom | 1 | | 13 | 0 |
| Rc | | 20 | Mohr-Coulomb | 12 | 35 | Water Table | Custom | 1 | | 17.5 | 0 |

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SLIDEINTERPRET 9.037

| | | | |
|---|---|---|---|
| *Project* | Taharoa Ironsand - Wet Mining Stability Assessment | | |
| *Analysis Description* | XS5- Wet Mining 30 Degrees | | |
| *Drawn By* | CJL | *Scale* | 1:3500 |
| *Company* | Baseline Geotechnical Limited | | |
| *Date* | 09/09/2025 | *File Name* | Section 5 - v3.slmd |

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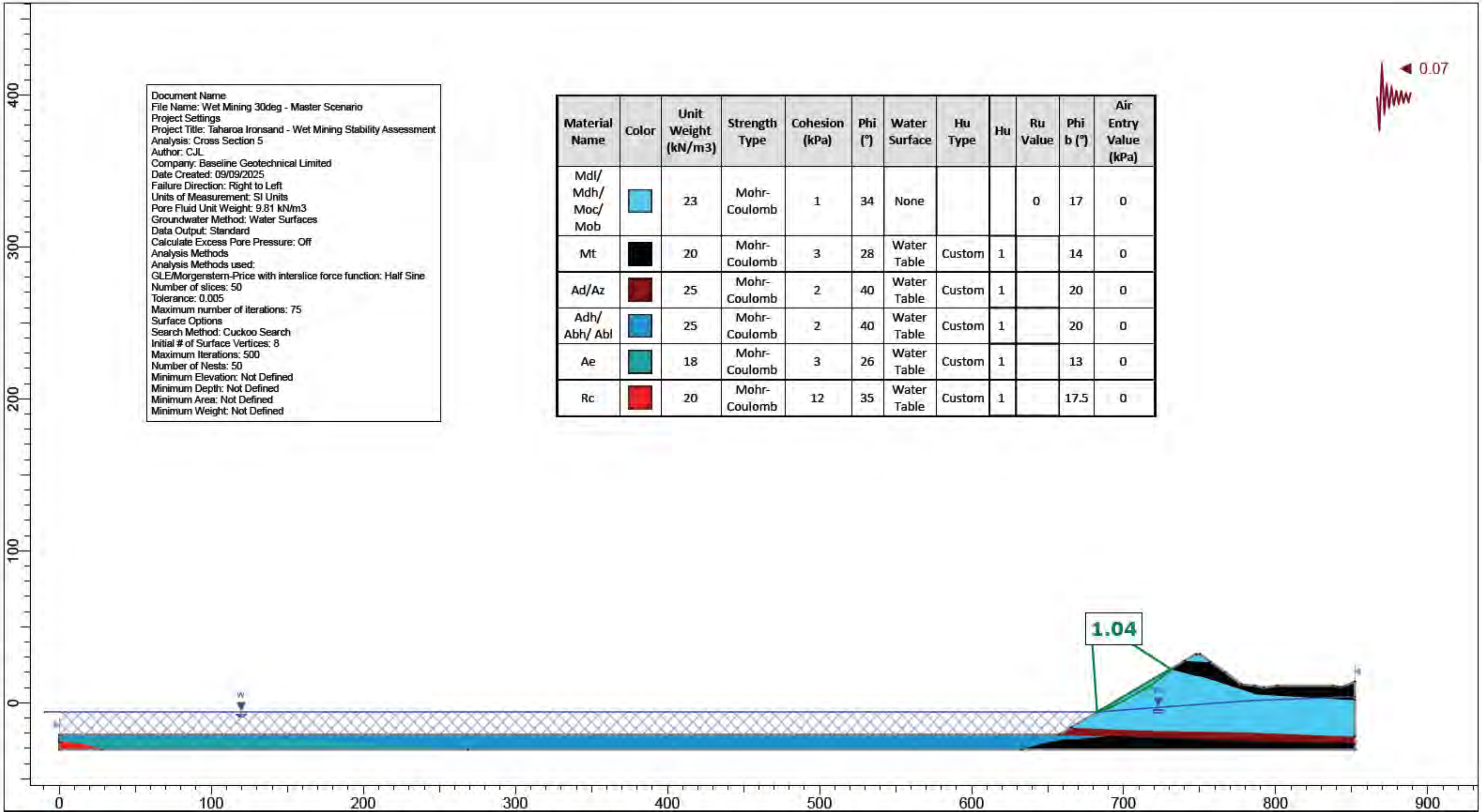
Analysis: Cross Section 5
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mdl/ Mdh/ Moc/ Mob | | 23 | Mohr-Coulomb | 1 | 34 | None | | | 0 | 17 | 0 |
| Mt | | 20 | Mohr-Coulomb | 3 | 28 | Water Table | Custom | 1 | | 14 | 0 |
| Ad/Az | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | | 20 | 0 |
| Ae | | 18 | Mohr-Coulomb | 3 | 26 | Water Table | Custom | 1 | | 13 | 0 |
| Rc | | 20 | Mohr-Coulomb | 12 | 35 | Water Table | Custom | 1 | | 17.5 | 0 |

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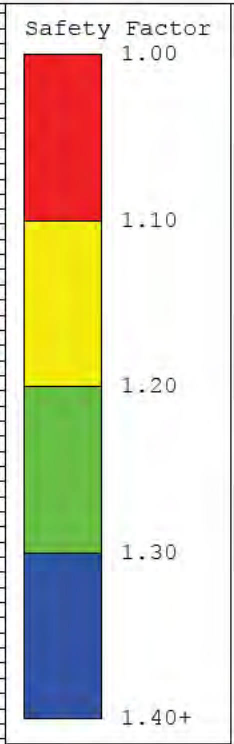
| Project | Taharoa Ironsand - Wet Mining Stability Assessment | | |
| Analysis Description | XS5- Seismic 1:25 0.07g | | |
| Drawn By | CJL | Scale | 1:3500 |
| Company | Baseline Geotechnical Limited | | |
| Date | 09/09/2025 | File Name | Section 5 - v3.slmd |

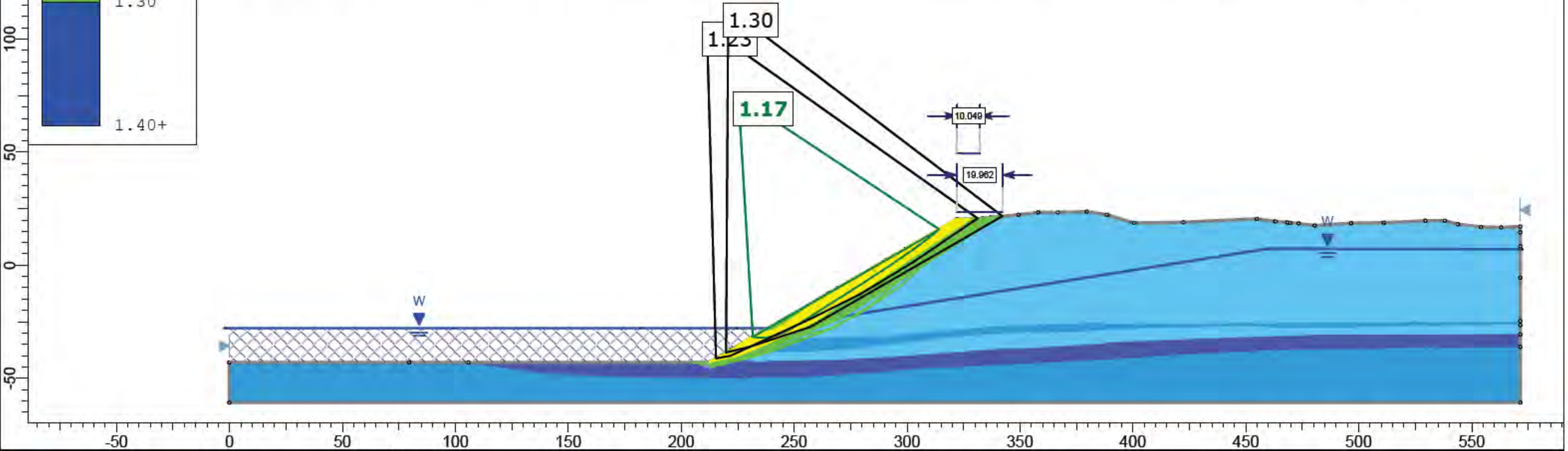
BASELINE GEOTECHNICAL

SLIDEINTERPRET 9.037




Document Name
File Name: Wet Mining - 15 m offset 30deg - Master Scenario
Project Settings
Project Title: Taharoa Ironsand - Wet Mining Stability Assessment
Analysis: XS7
Author: CJL
Company: Baseline Geotechnical Ltd
Date Created: 09/09/2025
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | Water Table | Custom | 1 |
| Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 |




BASELINE GEOTECHNICAL
SLIDEINTERPRET 9.037

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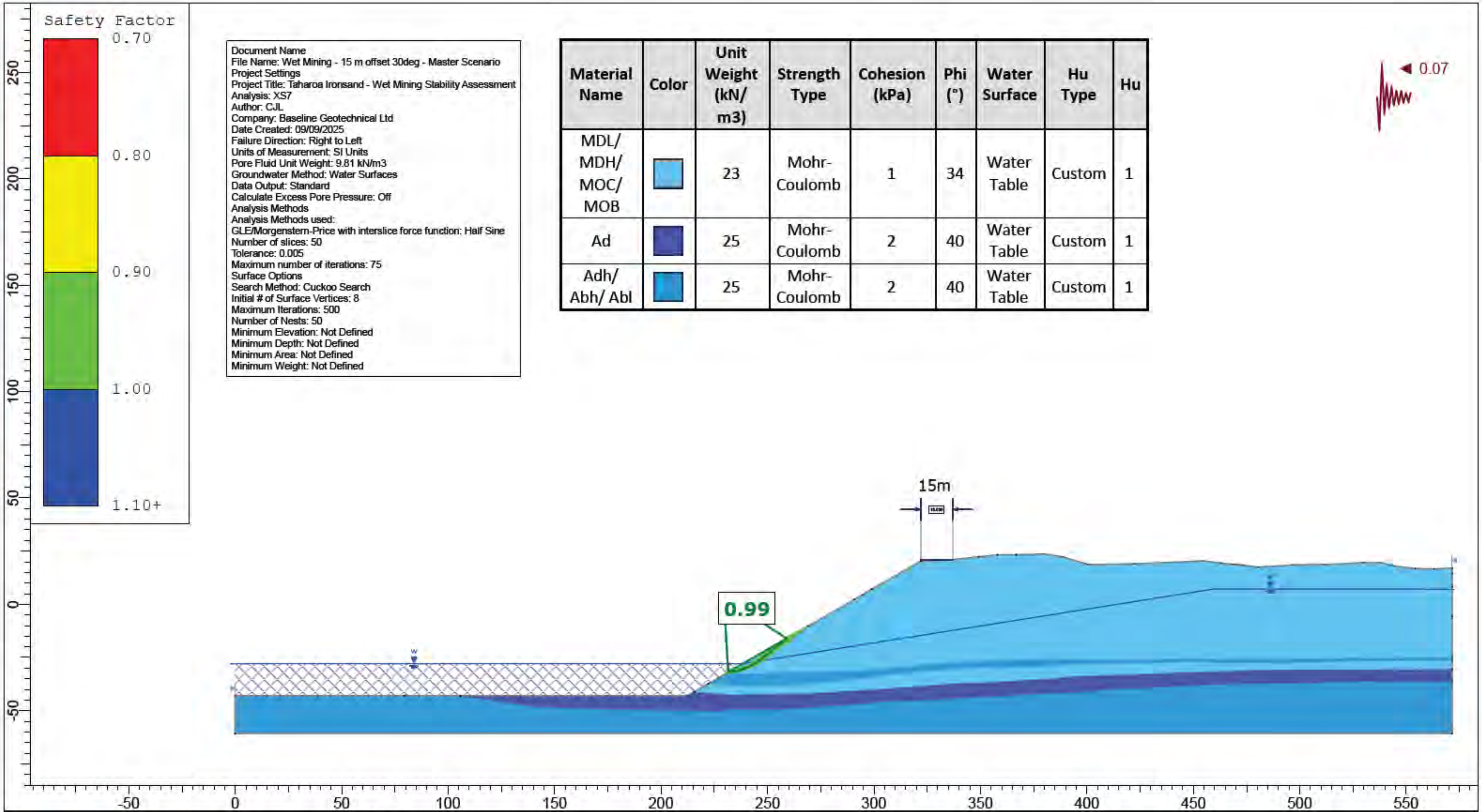
|---|---|
| Project | Taharoa Ironsand - Wet Mining Stability Assessment |
| Analysis Description | XS7- Wet Mining 15 m Offset |
| Drawn By | CJL |
| Scale | 1:2500 |
| Company | Baseline Geotechnical Ltd |
| Date | 09/09/2025 |
| File Name | Section 7v2.slmd |




Document Name
File Name: Wet Mining - 15 m offset 30deg - Master Scenario
Project Settings
Project Title: Taharoa Ironsand - Wet Mining Stability Assessment
Analysis: XS7
Author: CJL
Company: Baseline Geotechnical Ltd
Date Created: 09/09/2025
Failure Direction: Right to Left
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | Water Table | Custom | 1 |
| Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 |

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SLIDEINTERPRET 9.037

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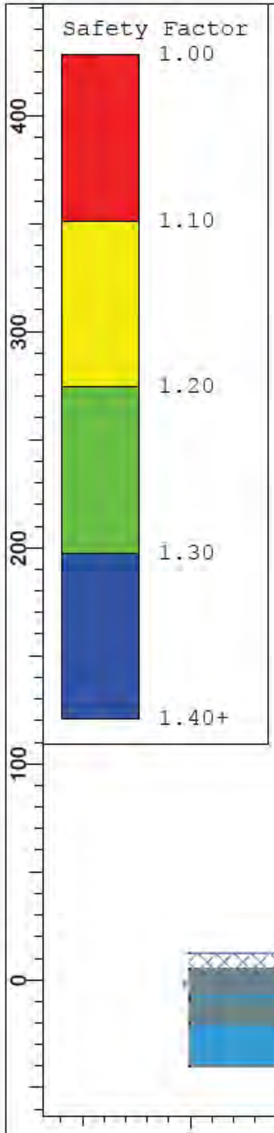
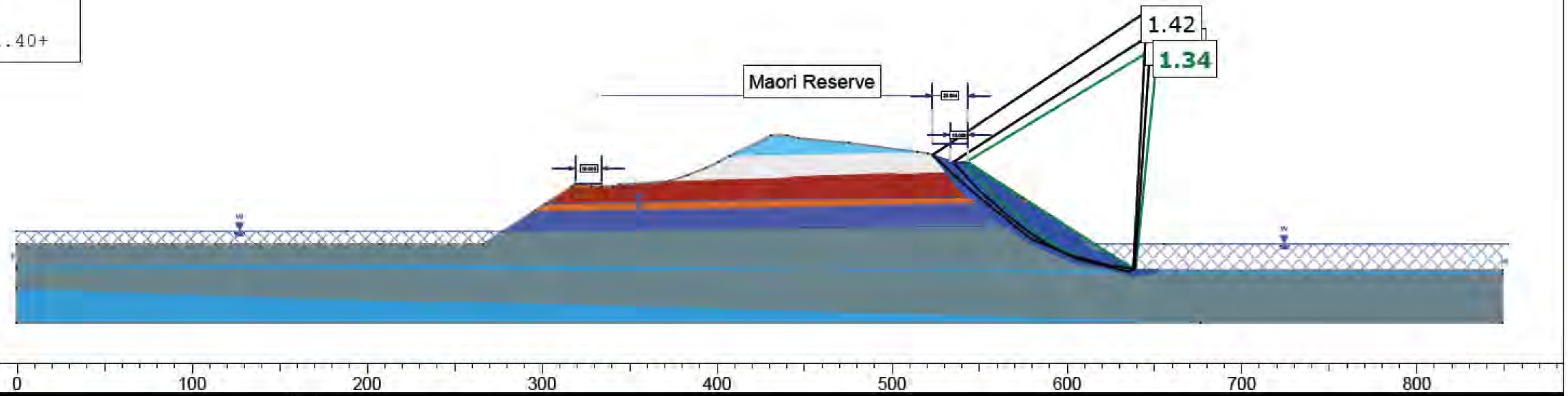
|---|---|
| *Project* | Taharoa Ironsand - Wet Mining Stability Assessment |
| *Analysis Description* | XS7- Seismic 1:25 0.07g |
| *Drawn By* | CJL |
| *Scale* | 1:2500 |
| *Company* | Baseline Geotechnical Ltd |
| *Date* | 09/09/2025 |
| *File Name* | Section 7v2.slmd |




Document Name
File Name: Wet Mining 15 m offset [Right] - Master Scenario
Project Settings
Project Title: Taharoa Ironsand - Wet Mining Stability Assessment
Analysis: XS9
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Left to Right
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|
| Undifferentiated Mitiwai Sands | | 23 | Mohr-Coulomb | 1 | 34 | Piezometric Line 2 | Custom | 1 | 17 | 0 |
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | Piezometric Line 2 | Custom | 1 | 17 | 0 |
| AP | | 20 | Mohr-Coulomb | 8 | 32 | Piezometric Line 2 | Custom | 1 | 16 | 0 |
| Az | | 25 | Mohr-Coulomb | 2 | 40 | Piezometric Line 2 | Custom | 1 | 20 | 0 |
| Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |
| At | | 23 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |




BASELINE GEOTECHNICAL

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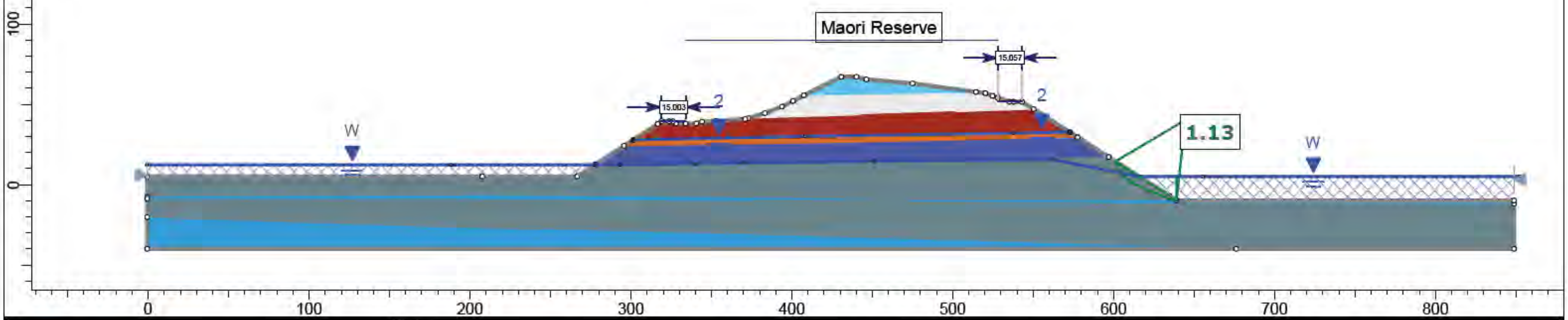
|---|---|---|---|
| *Project* | Taharoa Ironsand - Wet Mining Stability Assessment | | |
| *Analysis Description* | XS9- Wet Mining 15 m Offset | | |
| *Drawn By* CJL | *Scale* 1:3500 | *Company* | Baseline Geotechnical Limited |
| *Date* | 09/09/2025 | *File Name* | Section 9 v2.slmd |

SLIDEINTERPRET 9.037

Document Name
File Name: Wet Mining 15 m offset [Right] - Master Scenario
Project Settings
Project Title: Taharoa Ironsand - Wet Mining Stability Assessment
Analysis: XS9
Author: CJL
Company: Baseline Geotechnical Limited
Date Created: 09/09/2025
Failure Direction: Left to Right
Units of Measurement: SI Units
Pore Fluid Unit Weight: 9.81 kN/m3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Analysis Methods
Analysis Methods used:
GLE/Morgenstern-Price with interslice force function: Half Sine
Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 75
Surface Options
Search Method: Cuckoo Search
Initial # of Surface Vertices: 8
Maximum Iterations: 500
Number of Nests: 50
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

| Material Name | Color | Unit Weight (kN/ m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Phi b (°) | Air Entry Value (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|
| Undifferentiated Mitiwai Sands | | 23 | Mohr-Coulomb | 1 | 34 | Piezometric Line 2 | Custom | 1 | 17 | 0 |
| MDL/ MDH/ MOC/ MOB | | 23 | Mohr-Coulomb | 1 | 34 | Piezometric Line 2 | Custom | 1 | 17 | 0 |
| AP | | 20 | Mohr-Coulomb | 8 | 32 | Piezometric Line 2 | Custom | 1 | 16 | 0 |
| Az | | 25 | Mohr-Coulomb | 2 | 40 | Piezometric Line 2 | Custom | 1 | 20 | 0 |
| Ad | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |
| Adh/ Abh/ Abl | | 25 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |
| At | | 23 | Mohr-Coulomb | 2 | 40 | Water Table | Custom | 1 | 20 | 0 |


BASELINE GEOTECHNICAL
SLIDEINTERPRET 9.037

| | |
|---|---|
| *Project* | Taharoa Ironsand - Wet Mining Stability Assessment |
| *Analysis Description* | XS9- Seismic 1:25 0.07g |
| *Drawn By* | CJL |
| *Scale* | 1:3500 |
| *Company* | Baseline Geotechnical Limited |
| *Date* | 09/09/2025 |
| *File Name* | Section 9 v2.slmd |