PRIMARY GOLD

Appendix G - TSF Design Documentation

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Volume 1

Contents

HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT

FEASIBILITY DESIGN REPORT

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PE801-00102/04
Rev 1
September, 2022

Knight Piésold CONSULTING

DOCUMENT CONTROL PAGE

HANKING AUSTRALIA INVESTMENT

RUSTLERS ROOST GOLD PROJECT

FEASIBILITY DESIGN REPORT

KP Job No. PE801-00102/06

KP Report No. PE801-00102/04

DOCUMENT INFORMATION

REV	DESCRIPTION	PREPARED	REVIEW	KNIGHT PIÉSOLD APPROVAL	DATE
A	Issued for Review	AMM	DJTM	DJTM	22/12/2021
B	Modified Basin	AMM AMM	DJTM DJTM	DJTM DJTM	20/05/2022
0	Issued as Final	AMM AMM	DJTM DJTM	DJTM DJTM	16/08/2022
1	Geochemistry Added	[signature] AMM	[signature] DJTM	[signature] DJTM	16/08/2022

DOCUMENT DISTRIBUTION

REV	DESTINATION	HARD COPY	ELECTRONIC COPY
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EXECUTIVE SUMMARY

General

Hanking Investment Australia (Hanking) is developing the Rustlers Roost Gold Project (Rustlers Roost) in the Mt Bundey region of the Northern Territory. Knight Piésold Pty Ltd (KP) was engaged by Hanking to undertake the design of the Tailings Storage Facility (TSF).

Rustlers Roost is located in the Mount Bundey region of the Northern Territory, approximately 100 km south east of Darwin. The project will comprise of several open pit mining operations, tailings storage facility (TSF), waste dumps and process plant. A total of 48.0 Mt of ore will be processed over an operating life of 11 years.

Site Conditions

The average annual rainfall for Rustlers Roost is 1,481 mm, and the average annual pan evaporation is 2,290 mm. The annual wet season lasts approximately 7 months (October to April), with four months of notably wetter conditions (December to March).

Geotechnical Investigation

A site investigation was completed in July 2021 for the TSF. Key findings from the geotechnical investigation are summarised as follows:

- Typically the ground conditions comprise:
  - An organic topsoil thickness averaging approximately 200 mm.
  - Transported and residual soil extending to an average depth of 0.7 m, some of which is lateritic and variable comprising fine and coarse grained material that is overconsolidated and medium dense to very dense (or stiff to hard).
  - Extremely weathered material extending to an average depth of 1.5 m and commonly comprising silty Gravel with sand that is overconsolidated typically dense. In places the surface soil layer is thin, and highly weathered rock was encountered at or close to the surface.
  - Highly weathered interbedded sandstone and siltstone of very low and low strength becoming low and medium strength at depth.
- Groundwater is present at shallow depth and may be encountered in deeper excavations, subject to the season when the earthworks are constructed.

- The characteristics of the near surface ground are variable with some areas comprising fine grained material whilst other areas comprise more permeable coarse grained material and/or weak rock. It is estimated that approximately 60% of the site has suitable material below the topsoil layer to scarify and recompact to form a suitable subgrade for an HDPE liner, with the remainder of the site requiring material to be sourced from borrow. Prior to construction a closely spaced shallow depth investigation and mapping will be completed to confirm this.

Groundwater Assessment

A groundwater assessment of the Rustlers Roost Gold Project was completed, which comprised of a desktop review of the CDM Smith groundwater modelling report. This report was based on information derived from historical groundwater investigations, information from existing bores in the region, groundwater monitoring, sampling and limited water bore installation and aquifer testing. Based on this information, a steady state numerical model was constructed to simulate and predict groundwater impacts related to future dewatering activities, pit inflow predictions and regional impacts.

Probabilistic predicted pit inflows range from 0 L/s at AK Dam East pit, to 133 L/s at Rustlers Roost PA pit. The numerical modelling did not predict staged dewatering requirements with pit progression. It is recommended that a targeted groundwater site investigation is designed and undertaken to characterise the aquifer systems in the Project area in more detail, to allow for the construction of a more representative numerical groundwater model.

Tailings Testing

Physical testing of a combined tailings sample derived from the different ore bodies was conducted by KP during the study.

The rate of supernatant release for the "Rustlers Roost Composite" sample was moderately quick and reached moderate dry densities from settling, with a good increase due to drying and consolidation. With suitable underdrainage, a small supernatant pond and air drying of a large tailings beach, dry densities of 1.35 t/m^3 to 1.50 t/m^3 are expected over the life of the facility.

The geochemical testing of a combined tailings sample derived from the different ore bodies was conducted by CDM Smith during the study. KP conducted an independent review of the report which indicated that the tailings are Potentially Acid Forming (PAF). Additional geochemical testing of a separate combined tailings sample was completed in 2022 including supernatant testing, multi-element analysis of the tailings solids and acid base accounting to assess element enrichments and potential implications for tailings management.

Both tailings samples indicate that the tailings are potentially acid forming, the closure design will need to include a low permeability layer capping to reduce long term infiltration and oxidation. It should also be water shedding, resistant to erosion and include a growth medium to promote vegetation. In this regard based on the site setting, a composite store and release cover system may be suitable. This cover configuration has been incorporated into the TSF design and will isolate tailings solids from the environment. On the basis of supernatant testing it is also envisaged that the facility will need a robust engineered basal liner system.

A composite basin liner comprising a compacted soil subgrade, overlain with HDPE geomembrane liner has been adopted for the design to reduce seepage.

Waste Rock Geochemistry

Geochemical testing of 150 waste rock samples (from the two deposits) was completed by CDM Smith. The majority of fresh samples from Rustlers Roost were found to be non acid forming (NAF), while the transitional samples were predominantly uncertain (UC) due to conflicting ABA results. Only one oxide sample was analysed which was also classified as UC. CDM Smith state that all of the major lithologies present within the deposit were found to contain acid forming material. However, this is not apparent from the data. In addition, the sample selection appears to be biased towards sulfide bearing material rather than being representative of the range of waste rock to be mined.

CDM Smith recommended that any materials mined from within the transition and fresh zones of the deposit should be managed as PAF, with the oxide material considered to be NAF. KP is of the opinion that this is too simplistic and will lead to a large amount of NAF material being handled as PAF given that 13 out of 16 fresh samples were classified as NAF. KP recommends the development of practical criteria for identifying PAF material during mining, such as the establishment of sulfur and carbon cut-offs and ABA testwork.

Specific testing on material intended for construction will be conducted to determine its acid forming and leaching characteristics. Given the variability and geochemical risk of the waste rock identified in the studies conducted to date, QA/QC geochemical testing of material will be required prior to use, to verify that it is appropriate for use in the embankments. Additional geochemical testing and analysis are being planned to confirm and expand on the findings of the CDM Smith report.

Site Water Management

In order to understand (and control) the flow of water around the site, a water balance model was developed. Key findings from the water balance modelling are as follows:

- The TSF is designed to hold the tailings plus the design rainfall conditions, and thus has sufficient storm water storage capacity for all design storm events and rainfall sequences.
- The supernatant pond should be removed (and treated if necessary) as soon as practicable after decommissioning.
- Process water shortfall is expected to occur under average and design dry climatic conditions. Peak shortfalls occur in year 2 of operation, primarily due to lower runoff in the initial stages of operation and an increasing tailings beach, resulting in lower recovery of supernatant from the TSF.
- Make up water up to 1.86 Mm^3/year will be required to cover shortfalls from the TSF with an additional 0.57 Mm^3/year to cover the additional site water requirements. This water will be sourced from either pit dewatering and/or bore field supply.

Tailings Storage Facility Design

The TSF will consist of a zoned cross-valley earth fill embankment, forming a total footprint area of approximately 152.5 ha for the Stage 1 TSF and 243.9 ha for the final TSF. The final TSF is designed to accommodate 48.0 Mt of tailings.

The TSF embankment will be constructed in annual raises to suit storage requirements and the availability of suitable mine waste. The Stage 1 TSF will provide 16 months of storage capacity, in order to allow Stage 2 construction to be carried out during the subsequent dry season. Downstream raise construction methods will be utilised throughout operation.

A compacted soil subgrade will be constructed over the entire TSF basin area, comprising either reworked in situ material or imported low permeability soil. An HDPE liner will be installed over the subgrade within the TSF basin.

A number of seepage control and underdrainage collection features have been integrated into the TSF design in order to reduce seepage losses through the base of the TSF, including the following components:

- Cut-off trench.
- A composite basin liner comprising HDPE liner overlying a low permeability soil subgrade.
- Basin underdrainage collection system.
- Embankment upstream toe drain.

- Leachate collection and recovery system (LCRS).

Based on the supernatant test results, these measures are considered to be appropriate for the operational phase. Post closure the cover system required to manage the elemental enrichment and acid generating potential of the tailings will reduce infiltration into the facility thereby further reducing the seepage potential post closure.

Supernatant water will be removed from the TSF decant abstraction system located along an access causeway constructed over the course of operation. Solution recovered from the decant system will be pumped back to the plant for re-use in the process circuits.

An emergency spillway will be available at all times during TSF operation, constructed in an embankment abutment. The closure spillway will be located at the eastern extent of the facility directing runoff into the existing pit, and will be constructed to ensure all rainfall runoff from the TSF will safely discharge after operation ceases.

Tailings will be discharged into the TSF by sub-aerial deposition methods, using a combination of spigots at regularly spaced intervals from the embankment.

The stability and seepage performance of the facility were designed to international guidelines and standards. Monitoring instrumentation has been incorporated into the design to facilitate detection of any potential issues which may arise during operations.

TSF Dam Break Assessment

A dam breach assessment based on ANCOLD guidelines (Ref. 1) was carried out for the Rustlers Roost TSF to estimate the Population at Risk (PAR), business risk and environmental impact in the event of a dam failure. The likelihood of failure is not considered in the ANCOLD Consequence Category Assessment.

In the event of dam failure, the severity of impact on the environment is likely to be Catastrophic as defined by ANCOLD 2019. This is primarily due to the impact on national parks located downstream of the Rustlers Roost TSF.

Based on the PAR calculation and Dam Failure Severity Level review, the consequence category for the Rustlers Roost TSF is 'High A' and the Environmental spill consequence category for the Rustlers Roost TSF is 'Significant'.

Water Storage Dam Design

The Water Storage Dam (WSD) is the primary storage pond for clean process water on site, and is able to store sufficient makeup water at its maximum operating level. The WSD is located within the northern extent of the TSF basin, and will become inundated by the progression of tailings during the latter stages of operation. The water collected in the WSD will be pumped back to the plant to supply plant raw water requirements and process make-up water requirements.

Rehabilitation

At the end of the TSF operation, the downstream faces of the embankment will have a slope of 3H:1V, with 5 m wide benches located at 10 m height intervals. The profile will be inherently stable under both normal and seismic loading conditions and allow revegetation.

At closure, the TSF should be fully water shedding. After the water in the TSF has been proven to be benign, runoff can be allowed to discharge via the closure spillway. The closure spillway will be excavated through the eastern ridge line, discharging into the existing pit downstream of the TSF.

It is anticipated that a low permeability layer capping will be required on the final tailings surface to reduce rainfall infiltration into the tailings mass. It should also be water shedding, resistant to erosion and include a growth medium to promote vegetation. In this regard, and based on the site setting, a composite store and release cover system may be suitable.

1. INTRODUCTION

1.1 SCOPE OF REPORT

Hanking Australia Investment (Hanking) is developing the Rustlers Roost Gold Project (Rustlers Roost) in the Mount Bundey region, approximately 100 km south east of Darwin. Knight Piésold Pty Ltd (KP) was engaged by Hanking to undertake the design of the Tailings Storage Facility (TSF) and Water Storage Dam (WSD).

This report presents the feasibility study (FS) design of the TSF and WSD. The site general arrangement is shown on Drg. No. 801-102-A3001-100.

1.2 PROJECT DESCRIPTION

The project is located in the Mount Bundey region of the Northern Territory, approximately 100 km south east of Darwin. The project will recommence open pit mining operations across two mine sites, Rustlers Roost and Quest 29. The project will include a tailings storage facility (TSF), waste dumps and process plant. Ore will be processed at an average rate of 4.1 Mtpa (ranging from 4.0 to 5.0Mtpa) over a 11-year mine life (total ~45 Mt). Hanking advised that although the current processing schedule requires 45 Mt of storage, the TSF design should be based on a total tonnage of 48 Mt to allow for additional resources due to future exploration drilling.

1.3 DESIGN OBJECTIVES

The design objectives for the TSF are as follows:

- Permanent and secure containment of all solid waste materials (tailings) generated by the process plant.
- Maximisation of tailings densities using sub-aerial deposition.
- Removal and reuse of free water.
- Control of seepage.
- Containment of extreme storm events and design rainfall sequences within the TSF to comply with ANCOLD (2019) guidelines (Ref. 1).
- Ease of operation.
- Rapid and effective rehabilitation.
- Monitoring network comprising embankment (standpipe and vibrating wire) piezometers, survey pins and groundwater bores.

The design objectives for the WSD are as follows:

- Secure clean water supply for the process plant, and make-up process water during dry conditions, with a view to optimising discharge to downstream environments after the storage requirements are met.
- Storage of water from pit dewatering.
- Containment of runoff from surrounding catchments.

1.4 DESIGN PARAMETERS

Design parameters adopted for this study are summarised in Table 1.1.

Table 1.1: TSF design parameters

TSF DESIGN	
TSF Consequence Category	High A
Storage Capacity - Stage 1 - Final (Stage 11) Embankment Freeboard	 5.33 Mt (16 months). 48 Mt (11 years). (i) 0.3 m above maximum tailings elevation, or (ii) 0.8 m above maximum design stormwater elevation.
Stormwater Capacity - Short duration - Long duration	 1% AEP, 72 hour duration storm event superimposed over 10% AEP, wet season rainfall (90 days, 100% runoff, no evaporation). 1 in 100 year recurrence interval, wet annual rainfall sequence
Spillway - Flow capacity - Erosion Protection	 PMP, critical duration. 1 in 100 year recurrence interval, critical duration.
Earthquake Loading - Operating Basis Earthquake (OBE) - Maximum Credible Earthquake (MCE) - Safety Evaluation Earthquake (SEE)	 0.1% AEP earthquake (0.04g). 0.105 g. 0.01% AEP or equivalent to MCE (0.105 g).
Factors of Safety (minimum) - Long-term drained - Short-term undrained (potential loss of containment) - Short-term undrained (no potential loss) - Post-seismic	 1.5 1.5 1.3 1.0 – 1.2
Embankment Design - Crest Width - U/S Slope - D/S Slope (intermediate) - D/S Slope (final, overall)	 10 m 2.5H:1V 3H:1V 3.5H:1V
TSF OPERATION	
Slurry Characteristics - Target % Solids - Specific Gravity (solids) - Maximum density (air drying) - Adopted density	 55% solids by weight. SG = 2.86. Max. Density = 1.69 t/m^3 1.50 t/m^3

Table 1.1 (cont'd): TSF design parameters

TSF OPERATION	
Fluid Management	Basin underdrainage gravity system into collection sump. Return to supernatant pond via submersible pump*. Leachate collection and recovery system (LCRS) installed beneath composite basin liner in main drainage course within the TSF basin, discharging to a collection sump, pumped to supernatant pond. Turret system* for removal of supernatant solution and recycle to the plant. Turret system will comprise of an access causeway and drainage slot to allow for supernatant pond migration throughout operation. Embankments to be constructed with seepage interception and collection system, reporting to a collection sump downstream of the TSF, returned to the TSF*.
Deposition	Upstream spigot deposition of tailings from spigot offtakes situated on the embankment crest. The supernatant pond is to be maintained at the turret location, remote (where practicable) from the main embankments.
TSF DETAILS	
Basin Liner	Composite liner of HDPE and low permeability subgrade to reduce seepage. Compacted soil subgrade comprising primarily in situ soils, scarified and re-compacted throughout basin area to form a 200 mm soil subgrade. Where in situ materials are unsuitable for soil subgrade, low permeability material (Zone A) will be imported to provide the soil subgrade (300 mm). 1.5 mm smooth HDPE geomembrane liner above compacted soil subgrade for majority of the basin area (subject to ground conditions encountered within Annie's Dam).
Embankment	Multi-zoned earthfill embankment, utilising upstream low permeability zone. Upstream face lined with HDPE geomembrane. Downstream raise construction methods for all raises. Upstream toe cut-off trench through residual/transported material.
Tailings Underdrainage System	Collector drains and finger drains throughout the TSF basin area, water collected from the tailings mass and discharged to a collection sump, pumped to the supernatant pond. Collector Drains - Corrugated, perforated tubing (with filter sock), surrounded by sand (Zone F1), wrapped in geotextile. Finger Drains - Corrugated, perforated tubing (with filter sock), surrounded by sand (Zone F1) and wrapped in geotextile.
Leachate Collection and Recovery Systems (LCRS)	Leachate collection and recovery system (LCRS) installed beneath composite basin liner. Drains excavated in existing drainage courses with slotted pipe, backfilled with sand (Zone F2) and capped with low permeability material (Zone A) below basin liner.

Table 1.1 (cont'd): TSF design parameters

MATERIAL SUPPLY (EARTHWORKS)	
Low Permeability Fill (Zone A)	Selected material won from local borrow areas established by the civil contractor.
Transition Zone (Zone B)	Selected material won from local borrow areas established by the civil contractor.
Structural Fill (Zone C/Zone C1)	Sourced from mine waste material, delivered to embankment by mining fleet. Traffic compacted by loaded haul trucks.
Random Fill (Zone D)	Selected material won from local borrow areas established by the civil contractor, or local excavations.
Erosion Protection (Zone E)	Rip rap. Won from waste dumps from off-site, delivered to stockpile for use by civil contractor. May be sourced from mining operations during later stages.
Drainage/Filter Material (Zone F1/Zone F2)	Drainage medium (sand or gravel). Imported from off-site, delivered to stockpile for use by civil contractor. May be sourced from local sand borrow/quarry.
Wearing Course	Selected material won from local borrow areas established by the civil contractor.
TSF REHABILITATION	
Final Embankment Slopes	3.5H:1V (overall), with 5 m horizontal benches at 10 m height increments.
Cover Profile	Shaped to achieve dry closure with no ponding (water shedding). Closure spillway to be excavated in ridgeline on the eastern side of the facility and discharged into the existing pit.
Capping [*1]	0.5 m capillary break, comprising mine waste rockfill material. 0.3 m thick low permeability layer. 0.2 m thick topsoil as growth medium.

* – Pump and Pipe design by others

[*1] – Indicative only to be confirmed with future geochemical testing during operation.

Table 1.2: Water Storage Dam design parameters

WSD DESIGN	
Spillway Capacity	Probable Maximum Precipitation (PMP). Water level assumed to be at full storage level.
Earthquake Loading	As per Table 1.1
Factors of Safety	As per Table 1.1
WSD DETAILS	
Construction Description - Embankment	 Single zone earthfill embankment, utilising low permeability fill.
Basin Liner	Composite liner of HDPE and low permeability subgrade to reduce seepage. Compacted soil subgrade comprising primarily in situ soils, scarified and re-compacted throughout basin area to form a 200 mm soil subgrade. Where in situ materials are unsuitable for soil subgrade, low permeability material (Zone A) will be imported to provide the soil subgrade (300 mm). 1.5 mm smooth HDPE geomembrane liner above the compacted soil subgrade for majority of the basin area (subject to ground conditions encountered within Annie's Dam).
Embankment	Single zoned earthfill embankment, utilising low permeability fill. Upstream face, embankment crest and downstream face will be HDPE geomembrane lined for erosion protection and to reduce seepage.
Fluid Management	Turret system* for removal of water and recycle to the plant. Turret system will comprise of an access causeway and drainage slot to allow for WSD pond migration throughout operation.
MATERIAL SUPPLY (EARTHWORKS)	
Low Permeability Fill (Zone A)	Selected material won from local borrow areas established by the civil contractor.
Random Fill (Zone D)	Selected material won from local borrow areas established by the civil contractor, or local excavations.
Wearing Course	Selected material won from local borrow areas established by the civil contractor.
WSD REHABILITATION	
Rehabilitation	The WSD will form part of the final TSF footprint, therefore rehabilitation will be as per Table 1.1.

* – Design of pump and pipe by others

1.5 DESIGN GUIDELINES

The following documents were used for the design:

- Australian National Committee on Large Dams (ANCOLD), "Guidelines on Tailings Dams", 2019 (Ref. 1).
- Australian National Committee on Large Dams (ANCOLD), "Guidelines for Design of Dams for Earthquakes", 1998 (Ref. 2).

- Global Tailings Review, “Global Industry Standard on Tailings Management”, August 2020 (Ref. 3).
- Australian National Committee on Large Dams (ANCOLD), “Guidelines on Selection of Acceptable Flood Capacity for Dams”, March 2000 (Ref. 4).

2. SITE CHARACTERISTICS

2.1 GENERAL

The site characteristics for Rustlers Roost are summarised as follows:

- The Rustlers Roost area is located at approximately 773054.09 mE, 8570018.29 mS.
- Rustlers Roost is located in the Mount Bundey region of the Northern Territory, approximately 100 km south east of Darwin.
- Rustlers Roost Project is located in an area that has a Köppen climate classification of tropical, savannah with distinct wet and dry seasons. The annual wet season lasts approximately 7 months (October to April), with four months of notably wetter conditions (December to March).
- A design climatology assessment was completed for this study and is included in Appendix A (and summarised below).
  - Daily rainfall data (1889 to 2021) from the Scientific Information for Land Owners (SILO) database were used for the climatic analysis.
  - Daily pan evaporation values were also sourced from the SILO dataset. While the SILO dataset starts in January 1889, the daily pan evaporation data pre-1970 are interpolated long term averages; as such this portion of the dataset was discarded and data from January 1970 onwards was utilised.
  - Design storms were developed using the BOM 2016 IFD generating tool. Probable Maximum Precipitation (PMP) was estimated using the methods developed by the BOM.
  - Key information is summarised as follows:
    - The 1% AEP, wet annual rainfall total is 2,519 mm.
    - The 1% AEP, dry annual rainfall total is 1,010 mm.
    - The 10% AEP wet season (90 days duration) is 1,394 mm.
    - The design 1% AEP, 24 hour duration storm event magnitude is 293.2 mm.
    - The design 1% AEP, 72 hour duration storm event magnitude is 441.1 mm.
    - The design 0.1% AEP, 24 hour duration storm event magnitude is 457 mm.
    - The design 0.05% AEP, 24 hour duration storm event magnitude is 516.1 mm.
    - The design Probable Maximum Precipitation (PMP), 24 hour duration storm event magnitude is 1,200 mm.

- The average annual evaporation for Rustlers Roost was determined using daily pan evaporation data from the SILO data set. The average annual pan evaporation used for water balance modelling is 2,290 mm, equating to a lake evaporation total of 1,641 mm/year.

A site-specific seismic hazard assessment was carried out for the Project. Available historical data, earthquake catalogues, and technical publications on the tectonics and seismicity of the region have been reviewed. A probabilistic seismic hazard analysis was carried out to determine appropriate seismic design parameters for Rustlers Roost, and is included in Appendix B. The analysis is summarised below:

- The analysis was carried out using a seismic hazard model developed using the computer program OpenQuake (Ref. 5).
- It is recommended that the 1 in 1,000 AEP earthquake is adopted for the OBE, based on a High A consequence category. The estimated PGA for a 1,000 year average return period earthquake is 0.04 g for Site Class C. The dam, appurtenant structures, and equipment should remain functional, and damage from the occurrence of earthquake shaking not exceeding the OBE should be easily repairable.
- The estimated SEE earthquake was calculated in the probabilistic analysis as a 10,000-year return period earthquake PGA of 0.105 g for Site Class C (50% fractile, ANCOLD 2019). Damage due to a SEE earthquake can be accepted, but there should be no uncontrolled release of water from the reservoir or tailings from tailing dams.
- The MCE has been assumed as the “Megathrust Timor” subduction source with a magnitude of 7.9 and a distance of 500 km, causing a peak ground acceleration of 0.02 g. The 1 in 10,000 AEP event with a PGA of 0.105 g for site Class C is recommended for post closure design.

3. GEOTECHNICAL SITE INVESTIGATION

3.1 INTRODUCTION

A geotechnical investigation of the proposed TSF site was undertaken. The scope and findings of the geotechnical investigation are reported in detail in the Feasibility Study Geotechnical Interpretative Report (Ref. 6), and summarised in this section.

The scope of the site investigation comprised the following:

- Drilling of 4 No. boreholes using diamond coring techniques, including SPT and falling head tests.
- Machine excavating 42 No. test pits.
- Sampling of soil and rock for laboratory testing.
- Laboratory testing of selected samples.

Key findings from the geotechnical investigation are summarised in the following sections.

3.2 TOPOGRAPHY

The majority of the TSF footprint comprises undulating bushland which supports cattle. The northern part of the facility comprises Annie's Dam which holds a waterbody of approximately 9.5 ha. Seepage occurs from the dam and a downstream pond and watercourse drainage channel have formed. Close to the east of the facility is an existing pit which is full of with water. At the south-east of the facility is an existing heap leach pad which is planned to form part of the TSF embankment.

3.3 GROUND CONDITIONS AT THE TSF

The site investigation identified that typically the ground conditions comprise:

- An organic topsoil thickness averaging approximately 200 mm.
- Transported and residual soil extending to an average depth of 0.7 m, some of which is lateritic and variable comprising fine and coarse grained material that is overconsolidated and medium dense to very dense (or stiff to hard).
- Extremely weathered material extending to an average depth of 1.5 m and commonly comprising silty Gravel with sand that is overconsolidated typically dense. In places the surface soil layer is thin, and highly weathered rock was encountered at or close to the surface.

- Highly weathered interbedded sandstone and siltstone of very low and low strength becoming low and medium strength at depth.

In specific locations the ground has been altered by past development, including: the heap leach pad, Annie's Dam and the area of waterlogged ground downstream of Annie's Dam.

The site is considered suitable for the construction of a TSF.

The cut-off trench will need to key into competent ground and where practicable, into low permeability ground. A typical cut-off trench depth of approximately 1.5 m is expected to be required which will key into extremely and/or highly weathered rock. The required depth of cut-off trench will be assessed on site during construction.

The in situ material at the old heap leach pad will need to be compacted and sheeted with low permeability material. Alternatively, the heap leach pad material can be used as Zone B, Zone D and/or Zone C backfill, provided that it is geochemically inert. The geochemical testing of the HLP material was conducted by CDM Smith during the study (Ref. 11). KP conducted an independent review of the report which indicated that the HLP material is Non-Acid Forming (NAF). Multi-element testing of the solids indicated that the material was highly enriched with Arsenic, significantly enriched in Bismuth and slightly enriched with Antimony. Additional distilled water extract testing of the material and cyanide speciation analysis of the leachate should be completed to confirm if these elements are leachable. The HLP material if suitable for construction will be encapsulated with mine waste.

3.4 CONSTRUCTION MATERIALS

The characteristics of the near surface ground are variable with some areas comprising fine grained material whilst other areas comprise more permeable coarse grained material and/or weak rock. It is estimated that approximately 60% of the site has suitable material below the topsoil layer to scarify and recompact to form a low permeability subgrade suitable for an HDPE liner, with the remainder of the site requiring material to be sourced from borrow. More closely spaced shallow depth investigation and mapping are required to confirm this.

Zone C is bulk fill that will be used as the structural zone of the embankments. It is assumed that Zone C will be sourced from mine waste or the spent ore on the heap leach pad. Excavated in situ material from within the TSF basin is considered suitable for use as Zone C.

No significant sources of naturally occurring sand and/or gravel with sufficiently low fines content were observed within the site. There is the potential that drainage sand and gravel with less than 5% fines may be won from selected areas of the heap leach pad. However, the laboratory testing undertaken indicated that the samples had approximately 15% fines. Additional investigation may identify areas within the heap leach pad where suitable material is available as a result of particle segregation that can occur during leaching. Provisionally it should be assumed that drainage material will need to be sourced from either an off-site source, screening of heap leach pad material or from crushing and processing rock on site.

It is expected that erosion protection stone will be sourced from mine waste or an onsite quarry. Rock that appeared to be very high strength was observed in the waste dumps.

3.5 CONSTRUCTION CONSIDERATIONS

The average annual rainfall is 1,481 mm with 80% to 85% of this rainfall occurring between December and February (the wet season). It is recommended that the earthworks are undertaken during the dry season so that the moisture content of earthworks materials can be better controlled and less temporary surface water management is required. Surface soils can possess high fines content and some areas are likely to rut, be slippery and for construction traffic when wet.

Assuming that the works are undertaken during the dry season and once the soil has dried, it is expected that fill material will need to be moisture conditioned with additional water.

There is a waterlogged area downstream of Annie’s Dam which is likely to require dewatering prior to construction of the TSF embankment. A permeable gravel layer was encountered in TP-TSF-04 at 900 mm depth at Annie’s Dam and the test pit filled with water relatively rapidly.

Groundwater is present at shallow depth and may be encountered in deeper excavations, subject to the season when the earthworks are constructed.

No significant excavation into the natural ground is expected to be required for the construction of the TSF. The key excavations required are expected to be for the cut-off trench, decant drainage slot, underdrainage sump, toe/collector drain and for sourcing borrow material. Competent rock is not expected to be encountered in significant quantity.

Eight Emerson dispersion tests were undertaken with six samples indicating non-dispersive material and two samples indicating potentially dispersive behaviour. The materials are considered suitable for Zone A and Zone C material for the construction of embankments if the design incorporates measures to mitigate against the dispersive nature of the soils.

There is a recently constructed small water dam located just outside the south east corner of the TSF. Numerous tension cracks can be seen along the dam wall and the earthworks are not considered to be suitably stable. This structure should be removed or repaired as part of the surface water management works associated with the TSF.

All boreholes within the footprint of the TSF should be grouted to full depth to prevent the boreholes acting as permeable pathways for seepage from the TSF. This includes the four boreholes undertaken during the geotechnical investigation which were not grouted on completion and the other boreholes within the TSF footprint that are understood to be sterilisation holes.

4. GROUNDWATER ASSESSMENT

4.1 GENERAL

This section outlines the groundwater assessment for the proposed open pit developments at Rustlers Roost and Quest 29. The assessment is based on a groundwater modelling report by CDM Smith. The objectives of the modelling exercise were to estimate the potential maximum drawdown extents induced by the proposed open pit mining at Rustlers Roost and Quest 29, and the potential groundwater inflows into these proposed pits.

The major findings of the study are reported in detail in the groundwater modelling report (Ref. 7), and summarised in this section.

Rustlers Roost is situated near a catchment divide at the headwaters of Mount Bundey Creek. Mount Bundey Creek is ephemeral and typically flows for four to six months of the year during the wet season. The local catchment comprises a series of ridges and dissected hills that are drained by small steep rivulets, which converge into two main creek channels. The landscape has been altered due to prior mining and processing operations in the Project area. Today, there are two permanent water bodies located on the Rustlers Roost site, the pit lake and Annie's Dam (Ref. 7).

The Project area is located in the Mount Bundey region and is remote from any communities. The closest major town is Humpty Doo, which is approximately 46 km north-west of the Project with Darwin located approximately 85 km northwest.

Rustlers Roost has been in care and maintenance since 1998, with exploration works conducted by PGO in 2003, 2017 to 2018 and more recently during 2020. At Quest 29, limited exploration activities have taken place until more recently, during 2020. No mining activities have been conducted at Quest 29 since 2004.

The most extensive land use in the vicinity of the Project area is pastoral, involving the grazing of beef cattle over the woodland terrain. Land use in the region includes agriculture (orchards and pastoral operations) and mining, with historic iron ore mining at Mount Bundey and gold mining at Toms Gully, Quest 29 and Rustlers Roost mines. A number of conservation reserves and parks managed by the Parks and Wildlife Commission of the Northern Territory occur within a 50 km radius of the project area (Ref. 7).

Rustlers Roost and Quest 29 lie on the northern flank of the Pine Creek Orogen (PCO), and are underlain by shallow marine, iron rich and tuffaceous sediments of the South Alligator Group which are openly to tightly folded about gently south plunging axes. The South Alligator Group includes the Koolpin Formation, Geowrie Tuff, Mount Bonnie Formation and the intrusive Zamu Dolerite.

The Koolpin Formation is comprised of ferruginous siltstone and shale, with silicified haematite and chert breccias and minor silicified dolomite over an average thickness of 100 metres. The Geowrie Tuff (600 m thick) consists predominantly of thinly interbedded fine-grained sediments, glassy crystal tuffs and tuffaceous cherts. Both the Koolpin Formation and Geowrie Tuff show extensive attenuation at fold hinges.

The Mount Bonnie Formation occupies the major portion of the Rustlers Roost Project area and consists of interbedded pelites, greywackes and tuffaceous sediments for an average thickness of 650 metres. The Mount Bonnie Formation shows little tectonically induced thickness variation. All early Proterozoic rocks within the Rustlers Roost portion of the Project area have been regionally metamorphosed to lower greenschist facies. The Rustlers Roost Gold Mine is predominantly underlain by folded greywacke and mudstone units. The greywacke units vary between 20 and 50 metres thick.

The Quest 29 portion of the Project is mainly underlain by the Koolpin Formation and intruded Zamu Dolerite (massive quartz dolerite). Regionally, the Koolpin formation averages 100 m in thickness but ranges up to 200 m in fold hinges. Two main auriferous trends have been identified along approximately north-south oriented shear structures. There are no other major faults mapped on the mining lease (Ref. 7).

4.2 HYDROGEOLOGY

The hydrogeological study of the project area was based on the following (Ref. 7).

- Publicly available data and information.
- Historical investigations undertaken by Environmental and Earth Sciences in 1993 comprising:
  - Water level measurements in existing exploration holes.
  - A pumping test in one cased production bore (RN024143), to determine basic hydraulic aquifer parameters in the southern section of the “Backhoe” prospect.

   - Groundwater sampling and analysis from exploration bores in the vicinity of the four proposed pits (Backhoe, Beef Bucket, Dolly Pot and Sweat Ridge) and from two background locations within the mining lease.
- Drilling logs, lithological logs and well construction details of registered bores, including bores installed at the project area in September/October 2020.
- Groundwater monitoring and sampling undertaken by Primary Gold between 2016 and 2019.
- Groundwater, surface water and open pit monitoring and sampling undertaken by EcOz in 2020-2021.

4.2.1 Aquifer Systems

At Rustlers Roost, aquifers are typically associated with increased structural deformation within the metasediments. The local aquifer system recharges by direct infiltration of rainfall and run-off through areas of aquifer outcrop or shallow subcrop, and overlying cover materials.

At Quest 29, there is limited groundwater information available onsite or in the immediate vicinity of the lease. Regional scale mapping suggests aquifers across the lease are local scale systems in fractured and weathered rocks with expected bore yields of 1-3 L/s in the metasediments and <0.75 L/s in the Mt Bundey Granite. Higher permeabilities are likely associated with structural deformation within the metasediments/dolerite and at local scale (Ref. 7).

4.2.2 Aquifer Hydraulic Properties

A 26-hour constant rate pumping test conducted at 1.76 L/s at Rustlers Roost in 1993 in the vicinity of the Backhoe Prospect indicated a T value of 93 m^3/d/m and a hydraulic conductivity of 3.3 m/day. Calculated storativity values range from 2×10^{-3} to 8×10^{-4}.

Slug tests conducted in groundwater monitoring wells at Rustlers Roost and Quest 29, as reported by Groundwater Enterprises in 2021, indicated the hydraulic conductivity at Rustlers Roost ranges from 0.8 m/day to 12.5 m/day, with a geometric mean of 4.1 m/day and at Quest 29 it ranges from 0.3 m/day to 38.8 m/day with geometric mean of 5.2 m/day. The derived hydraulic conductivities are representative of the more permeable, heavily fractured intervals of the aquifer system. The screened intervals of the tested Rustlers Roost bores ranged from 27 mbgl to 67 mbgl mainly within shale, siltstone and saprolite. At Quest 29 the screened intervals of the bores tested range from 19 mbgl to 52 mbgl mainly within shale, dolerite, siltstone and sandstone.

Pumping tests conducted at the nearby Toms Gully Mine indicated hydraulic conductivities ranging from 0.1 m/day to 1 m/day for the fractured and jointed siltstone basement. The calibration of the Toms Gully groundwater model (2019) assumed a hydraulic conductivity value of 0.001 m/day for the bedrock and 0.2 m/day to 20 m/day for the ore body (Ref. 7).

4.2.3 Groundwater Levels (2020 – 2021) and Flow Direction

The groundwater levels in the Rustlers Roost and Quest 29 areas generally rise during and immediately following the wet season, in response to increased rainfall and direct rainfall recharge to the aquifers. The response to the rainfall recharge is similar for all monitored bores.

The regional groundwater flow direction is to the east/northeast of Rustlers Roost, towards the Mary River. However, the groundwater flow direction is modified on a local scale by the local topography (e.g. the north-east trending hills) and, to a minor extent, by the open pit. The groundwater flow direction that can be inferred from observations is consistent with the topographic relief indicating that the water table resembles a subdued representation of the surface elevation. The open pit does not appear to act as a groundwater sink and is most likely a source of groundwater recharge, with localised outward radial groundwater flow (Ref. 7).

4.2.4 Groundwater Quality

Based on field water quality parameters, it can be concluded that the groundwater at Rustlers Roost is acidic to slightly acidic, with pH levels varying from 3.77 to 6.78 (average of 5.7). The groundwater is fresh, with EC values varying from 36 µS/cm to 305 µS/cm (average 155 µS/cm) and TDS values varying from 23 mg/L to 196 mg/L (average of 105 mg/L).

Overall, the groundwater quality monitoring has shown groundwater is typically fresh, acidic to near neutral and has exceedances of aquatic ecosystems guideline values for some metals and nutrients at some sampling occasions and locations. The elevated phosphorus and metal concentrations may be associated with underlying mineralogical deposits entailing weathered zones.

The groundwater monitoring bores show limited impacts from previous mining activities. One bore (located next to the heap leach pad), does not show any influence from potential waste rock leachate.

Based on the field water quality parameters, it can be concluded that the groundwater at Quest 29 is acidic to neutral, with pH levels varying from 4.47 to 7.6 (average 6.38). The groundwater is fresh, with EC values varying from 4.3 µS/cm to 1,213 µS/cm (average 473 µS/cm) and TDS values varying from 25 mg/L to 676 mg/L (average 247 mg/L).

Overall, the groundwater at Quest 29 is acidic to neutral and fresh. Exceedances of the adopted aquatic freshwater trigger values were observed for several analytes in all monitoring wells. It must be noted that, given the absence of GDEs in the Project area and the absence of groundwater discharge into local creeks and drainages, these trigger values are only relevant in case of abstraction of groundwater and discharge to surface water (e.g. for pit dewatering). All monitoring bores, except for Q29MB01 and Q29MB02, showed similar water chemistry with small variations indicating limited impacts from previous mining activities (Ref. 7).

4.2.5 Groundwater Modelling

The CDM Smith groundwater numerical model was developed using MODFLOW and Groundwater Vistas, and FloPy were used as the pre- and post-processor for the model. CDM Smith assessed the model as a Class 2 numerical model (Ref. 7), this was confirmed by a third party review conducted by HydroGeoLogic (Ref. 8). Australian Groundwater Modelling Guidelines define a system to classify the confidence level of groundwater models based on the following factors:

- Available data
- Calibration procedures;
- Calibration and prediction consistency; and
- Level of stress (i.e. hydraulic stress in the model).

Models are classified as Class 1, 2 or 3 in order of increasing confidence and complexity. The Class 2 groundwater model developed for Rustlers Roost and Quest 29 is considered adequate for predicting the impacts on groundwater levels due to the dewatering of the pits during mining. As it is considered that the assumptions and simplifications inherent in the model have resulted in an overestimation of the predicted impacts, the model is considered fit-for-purpose to assess the potential impacts on existing and future groundwater levels.

Given the limited data available, the Rustlers Roost and Quest 29 numerical model was developed in a simple and conservative manner to ensure the predicted drawdowns and groundwater inflows were not underestimated. The results of the groundwater model are considered preliminary due to the lack of detailed data (e.g. transient groundwater levels, aquifer hydraulic property data) that could be used for model refinement and model calibration.

The simulated groundwater levels from the calibrated base model realisation indicates the following:

- In the Quest 29 area, groundwater generally flows to the east/south-east towards the McKinlay River, with a groundwater mound to the north-east of the site that coincides with the topographic high.
- The Rustlers Roost portion of the Project area is located on a groundwater divide, with some groundwater flowing to the east towards Mount Bundey Creek and some flowing to the west towards the Marrakai Creek.

4.2.5.1 Model Results from Dewatering Groundwater Drawdown

The predictions indicated that the 1 m drawdown contours extend up to 2.3 km to the east and west, 5.3 km to the north and 3.7 km to the south of the Rustlers Roost pits. The predictive modelling suggests that the Mary River and McKinlay River are unlikely to be impacted by the proposed pits. The 95th percentile 1 m drawdown contours remain at least 11km and 4.6 km away from the Mary River and the McKinlay River, respectively. Topography is inferred to have a strong control on the shape and extent, and longevity of drawdown impacts. At Rustlers Roost drawdown predominantly follows a north/south topographic high with local water levels modelled to take up to 40 years to recover.

With the Quest29 mining pits, drawdown is centralised around the Taipan and Zamu pits. For the Quest 29 area, the drawdown contours appear to be much more radial in nature. Drawdowns of up to 1 m extend 2 km from the Taipan pit to the north, south and east, and 4.5km to the west. The drawdown extent looks to be limited to the north by the sharp topographic high, though extends to the west along a more subdued topographic high. The predictive modelling suggests that the Mary River and McKinlay River are unlikely to be impacted by the proposed pits (Ref. 7).

4.2.5.2 Modelled Groundwater Inflows to Proposed Pits

The groundwater seepage into the open pits is the largest contributor to the water balance inflow as it amounts to about 77% of all inflows. The groundwater seepage is expected to increase as the pits deepen during mining operations.

At the Rustlers Roost mine site there are three pits with deepening works happening at different times; Rustlers Roost pit begins operation in March 2023 and is active for the rest of the operating period whereas deepening of Annie Oakley pit and Annie Dam pit only occurs for 4 months and 10 months respectively, in 2023 and 2024. At the end of the mining operations, groundwater inflow into the Rustlers Roost pits would be 100 L/s. However, uncertainty analysis suggests that this inflow could vary between 30 L/s and 270 L/s.

For the Q29 pits, operations start in July 2025 at Zamu pit which is mined until end of June 2030, followed by operations in South Koolpin, North Koolpin and Taipan pits from July 2030 and BHS pit from August 2032. This means that the maximum groundwater seepage rate occurs around April 2031 where an estimated inflow of 200 L/s for all Q29 pits is expected, although with an uncertainty range from 60 L/s to 370 L/s.

Total combined pit inflows are expected to be at their maximum in April 2031 at 290 L/s, with an uncertainty range from 90 L/s to 360 L/s.

Average dewatering requirements (to maintain dry environment in the pits) from the pits (combination of groundwater seepage, rainfall and runoff minus evaporation) are estimated at 103 L/sec for the Rustlers Roost pit (maximum rate of 600 L/sec) and between 15 and 52 L/sec for the Quest 29 pits (maximum rate of 125 L/sec applied based on pump capacity).

4.2.6 Conclusions

The 100 calibrated model results predicted that the extent of the 1m drawdown contours resulting from the dewatering of the proposed pits would be as follows:

- At Rustlers Roost, predicted drawdowns would occur 2.3 km to the east and west, 5.3 km to the north and 3.7 km to the south of the Rustlers Roost pits.
- At Quest 29, approximately 2 km from the Taipan pit to the north, south and east, and 4.5km to the west.
- The modelling suggests that the probability of Marrakai Creek, Mary River and McKinlay River being impacted by the proposed pits is minimal.
- Total combined pit inflows are expected to be at their maximum in April 2031 at 290 L/s, with an uncertainty range from 90 L/s to 360 L/s.
- Average dewatering requirements from the pits (combination of groundwater seepage, rainfall and runoff minus evaporation) are estimated at 103 L/sec for the Rustlers Roost pit and between 15 and 52 L/sec for the Quest 29 pits.
- Based on the model predicted groundwater drawdown, no identified groundwater users will be impacted as a result of pit dewatering activities.

4.2.7 Recommendations

To increase confidence in the estimation of dewatering requirements and extents of cumulative drawdown, KP recommends the following:

- A more technically rigorous model of the project area should be developed incorporating geological and structural data and information.
- A comprehensive hydrogeological site investigation should be undertaken to characterise aquifers in the project area. This investigation should include production and monitoring bores targeting deeper geological structures and features in the area, using available geophysical and geological data.
- Long term aquifer testing of the successful bores should be undertaken to determine hydraulic properties of the weathered and fractured rock aquifer.
- A numerical model should be constructed using existing data and information, as well as new data and information gained from a thorough groundwater investigation.
- Incorporate the mine schedule with bench progression into the model to simulate changes in pit inflows with time.

5. TAILINGS TESTING

5.1 INTRODUCTION

As part of the Feasibility Study, physical and geochemical testing of the tailings derived from the combined ores was completed. Two buckets of tailings sample (21 kg in total) were prepared by ALS Metallurgy and sent to the KP laboratory in Perth in May 2020.

Two 10 kg bags of dry tailings sample were sent to the KP laboratory in Perth from ALS Metallurgy in July 2021. The samples were both labelled "Hanking RR Tailings Composite" and were assumed to be the same. A portion of each of the two bags were combined with Perth tap water, as instructed by Hanking, to achieve the target percent solids of 60% solids w/w. The sample is referred to as "Rustlers Roost Composite" for the purposes of this report.

A preliminary assessment of the tailings geochemistry was conducted by CDM Smith initially in 2021 and updated to include the results of kinetic testing in 2022 (Ref. 9). Additional geochemical testing including multi-element testing of the tailing solids, water quality analysis of supernatant and acid base accounting on a representative tailings sample was completed in September 2022 by ALS Metallurgy to further characterise the potential tailing streams.

5.2 TAILINGS PHYSICAL TESTING

5.2.1 General

A detailed write up of the tailings physical testing is included in Appendix C, and summarised in this section.

The following tests were carried out on the sample:

- Classification tests to determine:
  - Particle size distribution of the tailings.
  - Supernatant liquor density.
  - Tailings solids particle density.
  - Atterberg limits of the tailings solids.
- Undrained and drained sedimentation tests.
- Air drying tests.
- Permeability tests.
- Consolidation tests.

The results of these tests are summarised below:

- The sample consisted of 19% sand, 66% silt and 15% clay with a P_{80} of approximately 70 µm. The sample is a low plasticity SILT with sand and clay and would be classified in accordance with the Unified Soil Classification System as CL. The grading curve indicates that the tailings generally falls within the boundary of potentially liquefiable soils.
- The tests indicate that the tailings will settle moderately quickly with complete settlement taking approximately three days. The sample released approximately 37% supernatant in the undrained test and 26% in the drained test, and achieved a moderate dry density (voids ratio 1.0) from settling before air drying or consolidation.
- The sample achieved a maximum dry density of 1.69 t/m^3 from air drying. The dry density achieved is high with a voids ratio of approximately 0.7.
- In the range of expected settled densities, the vertical permeability is approximately 1 x 10^{-7} m/s. As the tailings consolidate, it is anticipated that the permeability will reduce by half an order of magnitude.
- The results indicate the sample is moderately compressible and will consolidate moderately with loading.

5.2.2 Predicted Physical Behaviour

Based on testing conducted on the “Rustlers Roost Composite” sample, the predicted behaviour expected at 60% solids is summarised below:

- The release of water following deposition of the tailings can be estimated from the results of drained and undrained sedimentation tests. The rate of release will determine the amount of liquor available in the supernatant pond for collection, treatment and return to the process plant. It is expected water release will be in the order of 26 to 37% of the water in slurry. Underdrainage release could be as high as 22% of the water in slurry, although underdrainage release in the field would be expected to be between 5% and 10% depending on the arrangement of underdrainage collection and basin treatment or lining.
- The settled dry density of tailings deposited into the TSF can be predicted from laboratory testing and appropriate site water balance taking into account climatic conditions. It has been observed over a number of years that densities achieved in the field are generally lower than those obtained in the laboratory. The test results indicated that the sample will reach high dry densities from settling alone with a good increase due to drying and consolidation over a longer time frame.

With suitable underdrainage, a small supernatant pond and air drying of a large tailings beach, dry densities of 1.35 t/m^3 to 1.50 t/m^3 are expected over the life of the facility. Final densities are dependent on a number of aspects of TSF design such as rate of rise and water management. Therefore water balance and density modelling were undertaken as part of the TSF design and are summarised in Section 7.

5.3 TAILINGS GEOCHEMICAL TESTING

5.3.1 General

A preliminary assessment of the tailings geochemistry has been conducted by CDM Smith (Ref. 9). The sample was understood to be representative of the LOM tailings to be produced. The scope of work comprised acid base accounting on the tailings solids and distilled water extract of the solids with cyanide speciation analysis. Additional tailings geochemistry testing was conducted by ALS Metallurgy in 2022 including multi-element analysis of the tailings solids, water quality analysis of the supernatant and acid base accounting on the tailings solids. A detailed write up of the tailings geochemistry is included in Appendix G, and summarised in this section.

5.3.2 Results

The results of these tests are summarised below:

- The two tailings samples tested (CMD Smith and September 2022 sample) both indicate that the tailings are potentially acid forming but have a reasonably high acid neutralising capacity and the tailings supernatant will be alkaline.

- The results of the multi element analysis indicate that the 2022 sample has a moderate number of elemental enrichments. Arsenic and Bismuth are the only highly enriched elements with Silver, Cadmium, Molybdenum and Sulfur significantly enriched and Lead slightly enriched. It should be noted that the detection limit of Silver, Bismuth and Cadmium are higher than their relative crustal abundance leading to their enriched status. No multi element analysis was completed on the CDM Smith sample.

- Comparison of the multi-element analysis results with a set of soil quality screening guidelines for human health, ecology and intervention values for site contamination indicate the sample exceeded the threshold for Arsenic across all three sets of screening values, together with the ecological guidelines for Cadmium, Chromium, Copper, Nickel, Lead and Zinc.

- The assays of the tailings supernatant water have been compared to two sets of reference water standard, namely a generic standard to assess release which comprises a combination of IFC mining release guidelines and Australian livestock drinking water guidelines. Secondly, they have been compared to Australian Drinking Water standard. Mercury, copper, WAD cyanide and pH were the only parameters (excluding those with high testing limits), that exceeds the reference release guidelines. Additionally Copper, Sodium, Mercury and pH were the only parameters (excluding those with high testing limits), that exceeds the drinking guidelines.

5.3.3 Implications for TSF Design Results

5.3.3.1 Acid Forming Potential

The two tailings samples tested (CMD Smith and September 2022 sample) both indicate that the tailings are potentially acid forming but have a reasonably high acid neutralising capacity and the tailings supernatant will be alkaline. Therefore, management of acid generation during operation should be relatively easy to achieve through regular rotation of the tailings deposition to limit the time that tailings are exposed prior to the next layer of tailings being deposited.

Post closure a cover will be required for the tailings to limit the oxidation of the tailings beach. The cover will need to include a low permeability layer capping to reduce long term infiltration and oxidation. It should also be water shedding, resistant to erosion and include a growth medium to promote vegetation. In this regard, and based on the site setting, a composite store and release cover system may be suitable.

5.3.3.2 Multi-Element Results

The tailings samples recorded a moderate number of element enrichments, with the level of enrichment in those elements varying from slightly to high. Arsenic and Bismuth are the only highly enriched elements with Silver, Cadmium, Molybdenum and Sulfur significantly enriched and Lead slightly enriched.

The tailings sample exceeded the threshold for arsenic across all three sets of screening values, together with the ecological guidelines for Cadmium, Chromium, Copper, Nickel, Lead and Zinc.

During operations, limiting dust to prevent migration of the tailings to the surroundings will be required, however this should be achieved by the regular rotation of the tailings which should be implemented to limit oxidation. The post closure cover, proposed to manage acid generation, will isolate the tailings solids from the environment and therefore will be appropriate to reduce the risk of exposure of the metal enriched tailings.

5.3.3.3 Supernatant Water Quality

The supernatant was found to be of a poor quality with high cyanide and metal(loid) concentrations and also high pH. Seepage mitigation measures have been included into the design of the tailings storage facility including the following components:

- Cut-off Trench;
- HDPE Geomembrane liner;
- Basin underdrainage collection system;
- Underdrainage Sump and Riser Pipe;
- Leachate Collection and Recovery System (LCRS);
- Underdrainage Sump and Riser Pipe; and
- LCRS Sump and Riser Pipe.

The above are on the higher end of design features for the region as a whole and are considered to be appropriate for the operational phase. Post closure the cover system required to manage the elemental enrichment and acid generating potential of the tailings will reduce infiltration into the facility thereby further reducing the seepage potential post closure.

6. WASTE ROCK GEOCHEMISTRY

6.1 INTRODUCTION

An assessment of the waste rock geochemistry was conducted by CDM Smith (Ref. 9). The scope of work comprised a desktop geochemical assessment, followed by a static testing programme of 150 samples collected from available drill core from Rustlers Roost and Quest 29. It is understood that a kinetic testing programme consisting of ten columns containing waste, low grade ore, ore and tailings has been completed over a 12 month schedule. However, these data were not available for review by KP.

KP has reviewed the waste rock geochemical results for Rustlers Roost as it is proposed to use the waste material for TSF construction.

The geochemical scope of work for Rustlers Roost is provided in Table 6.1.

Table 6.1: Geochemical Scope of Work (Rustlers Roost)

Analytical Suite	No. of Samples
Paste pH, paste EC and total sulfur and total carbon	131
Acid base accounting (ABA): Net acid generation – NAG, single addition Acid neutralising capacity – ANC Calculation of net acid production potential, NAPP and maximum potential acidity, MPA from total S Multi elemental determination via four acid digest	30
Kinetic NAG and Acid buffering characterisation curves (ABCC)	6
Mineralogy – quantitative x-ray diffraction	4 (composites)
Batch leach test program in de-ionised (DI) water Sequential 18 hr bottle roll at low liquid solid ratio (2:1) (5 steps) Assessment of leachates for a broad suite of components Note that that if no readily soluble materials are present this DI program can be replaced by a sequential NAG and liquor characterisation program to assess the drainage composition from the oxidation of fresh materials.	25

6.2 RESULTS

The majority of fresh samples from Rustlers Roost were found to be non acid forming (NAF), while the transitional samples were predominantly uncertain (UC) due to conflicting ABA results. Only one oxide sample was analysed which was also classified as UC. CDM Smith state that all of the major lithologies present within the deposit were found to contain acid forming material. However, this is not apparent from the data. In addition, the sample selection appears to be biased towards sulfide bearing material rather than being representative of the range of waste rock to be mined. A large number of samples were classified as UC and this material should be reclassified as either NAF or PAF based on the kinetic NAG and ABCC testwork.

Assessment of leachate quality was based on NAG liquors, which assumes complete oxidation of the sample and may not be representative of the actual contact water quality. Consequently, increased solubility of metal(loid)s was observed in samples where the NAG solutions became acidic.

It should be noted that the leachate results were compared to ANZECC guidelines for freshwater aquatic protection (95% protection level) which may be overly conservative and appropriate guidelines should be confirmed with the regulatory authority. Comparison to baseline surface and groundwater quality monitoring data is also recommended.

CDM Smith recommended that any materials mined from within the transition and fresh zone of the deposit should be managed as PAF, with the oxide material considered to be NAF. KP is of the opinion that this is too simplistic and will lead to a large amount of NAF material being handled as PAF given that 13 out of 16 fresh samples were classified as NAF. Conversely, the single oxide sample was plotted as being uncertain in Figure 19, indicating a NAPP slightly below zero and a NAG pH of around 2.6, however, in Table 10 this sample is reported to have a NAG pH of 6.9 and NAPP of -1.40 kg H_2SO_4/t and, as such, would be classified as NAF. Classification of all oxide material based on a single sample is not appropriate.

KP recommends that further work is needed to develop practical criteria for identifying PAF material in advance of mining such as the establishment of sulfur and carbon cut-offs and possibly other ABA testwork. In addition, it is requested that the raw data be provided to KP to conduct an independent assessment of the suitability of the material for TSF construction and identify potential controls.

Specific testing on material intended for construction is required to determine its acid forming and leaching characteristics. Given the variability and geochemical risk of the waste rock identified in the studies conducted to date, QA/QC geochemical testing of material will also be required prior to placement to verify that it is appropriate for use in the embankments.

7. SITE WATER MANAGEMENT

7.1 GENERAL

The management of water is a critical aspect of the design for Rustlers Roost Project. In order to understand (and control) the flow of water around the site, a water balance model was developed.

The site wide water balance modelling was completed by CDM Smith reported in the Updated Groundwater Modelling report (Ref. 7). Knight Piésold was responsible for the Tailings Storage Facility and plant site water balance model with the remaining infrastructure covered in the CDM Smith report (Ref. 7). The summary provided herein only covers the TSF and plant site water balance.

The site water balance modelling is reported in detail in Appendix D and summarised in the following sections.

The primary objectives of the water balance modelling are summarised below:

- Establish the filling rate for tailings solids within the TSF.
- Estimate the insitu tailings density within the TSF, taking into consideration tailings properties from laboratory testing and the TSF basin storage parameters.
- Determine supernatant pond volumes within the TSF under average climatic conditions throughout operation.
- Determine supernatant pond volumes within the TSF for design wet rainfall sequences and storm events, check TSF storm water storage capacity and confirm the suitability of the current TSF design philosophy.
- Determine staged embankment crest elevations, to ensure containment of tailings and design supernatant pond volumes.
- Determine the likelihood of recycle water shortfalls during average conditions and design dry rainfall sequences.
- Determine the required make-up water supply rate to provide additional make-up water for shortfalls.
- Assess risk factors for water balance modelling.

The water balance modelling included the TSF with a view to determining site water storage requirements. Design wet conditions were modelled to ensure that the TSF is designed with sufficient storage capacities to comply with ANCOLD guidelines (Ref. 1).

For the water management modelling, the following water requirements and priorities were assumed to supply the required process plant water demand:

- The water present in the ore was allowed for.
- Water collected from Plant Site runoff was not allowed for.
- The minimum raw water requirement (for use in the process plant) is sourced from the bore field and pit dewatering.
- The additional raw water requirement for dust suppression and wash down (external to the process) is sourced from the bore field and pit dewatering.
- After allowing for the bulleted items above, the model tries to supply the remaining process water requirement from the TSF supernatant pond.
- After including the process water return from the TSF, any further water requirements (make-up water) are provided from the external make-up supply i.e., pit dewatering and/or bore field supply.
- If the process water requirement is not met, the model then determines any shortfall volume.

Various design rainfall conditions were modelled for selected operational years. The following rainfall sequences were modelled:

- Average conditions.
- 1 in 100 year recurrence interval, 1 year dry rainfall sequence.
- 1 in 100 year recurrence interval, 1 year wet rainfall sequence.
- 1 in 100 year recurrence interval, 72 hour duration storm event superimposed over 1 in 10 year recurrence interval wet season (90 days duration), with 100% runoff and no evaporation.

For all design rainfall conditions it was assumed that average climatic conditions occur prior and subsequent to the design events or rainfall sequences.

7.2 WATER BALANCE MODELLING RESULTS

Key conclusions from the modelling are summarised as follows:

Tailings Storage Facility

- The TSF is designed to hold the tailings plus the design rainfall conditions, and thus has sufficient storm water storage capacity for all design storm events and rainfall sequences.

- The supernatant pond volume peaks in March each year (at the end of the wet season), before returning to the minimum operating pond volume during the subsequent dry season.
- Prior to commissioning, the stored volume in the TSF in September 2023 is negligible.
- During operation assuming average conditions, the peak volume increases from 142,000 m^3 in December 2023 to 1,140,000 m^3 in March 2034.
- The facility ceases operating in Year 11, with 50,000 m^3 within the supernatant pond, and the water balance remains positive after decommissioning (increasing pond volume).
- The supernatant pond volume in the final 12 months of operation ranges from 1,140,000 m^3 (in March 2034) to 50,000 m^3 (in November 2034), and accumulates water thereafter. Therefore, the supernatant pond should be removed (and treated if necessary) as soon as practicable after decommissioning and the TSF should be rehabilitated as a water shedding structure.

Plant Site and Water Supply

- Process water shortfall is expected to occur under average and design dry climatic conditions. Peak shortfalls occur in year 2, primarily due to lower runoff in the initial stages of operation and a smaller tailings beach, resulting in lower recovery of supernatant from the TSF.
- Make up water up to 1.86 Mm^3/year will be required to cover shortfalls from the TSF with an additional 0.57 Mm^3/year to cover the additional site water.

8. TAILINGS STORAGE FACILITY DESIGN

8.1 GENERAL

The TSF will consist of a zoned cross valley earth fill embankment, forming a total footprint area (basin and embankment) of approximately 152.5 ha for the Stage 1 TSF and 243.9 ha for the final TSF. The current mining schedule is for 45 Mt over 10.5 years, however Hanking advised that the final TSF should be designed to accommodate 48.0 Mt of tailings due to potential increase in tonnage. The Stage 1 TSF is designed for 16 months storage capacity.

Expansion of the TSF with downstream construction is limited as the lease boundary will be encroached. Expansion may be possible if the 50m offset from the lease boundary can be reduced or alternative construction methods such as centreline raises are utilised. Expansion above the nominated tonnage and suitability of other construction methods will need to be considered in a separate assessment.

General arrangements for the TSF are shown on Drg. Nos. 801-102-A3001-101 and 801-102-A3001-108, for Stage 1 and final configurations respectively. Typical details and components of the TSF are shown on Drg. Nos. 801-102-A3001-201 to 801-102-A3001-601. Design parameters are provided in Table 1.1.

The TSF embankments will be constructed in annual raises to suit storage requirements, however this may be adjusted to biennial raises to suit mine scheduling during the operation. Downstream raise construction methods will be utilised throughout operation.

The TSF basin area will be cleared, grubbed and stripped of topsoil, and a compacted subgrade constructed over the entire TSF basin area, comprising either reworked in situ material (200mm depth) or imported Zone A material (300 mm depth). An HDPE geomembrane liner will be installed over the TSF basin area and on the upstream embankment face to reduce seepage from the facility.

The design incorporates an upstream toe drain and basin underdrainage system in low-lying basin areas to reduce pressure head acting on the liner, reduce seepage, increase tailings densities, and improve the geotechnical stability of the embankment. The underdrainage system comprises a network of finger drains and collector drains. The toe drain and underdrainage system drain by gravity to a collection sump located at the lowest point in the TSF.

Supernatant water will be removed from the TSF via a decant system located adjacent to the supernatant pond over the course of operation. The supernatant pond will be maintained in the northern valley within the TSF basin. Solution recovered from the decant system will be pumped back to the plant for recycle in the process circuits.

An emergency spillway will be available at all times during TSF operation, constructed in an embankment abutment in order to protect the integrity of the embankments in the event of emergency overflow. A closure spillway will be located at the eastern extent of the facility discharging into the existing open pit, and will be constructed to ensure all rainfall runoff from the TSF will safely discharge after operation ceases, thus forming a fully water-shedding structure.

A HDPE lined pipeline containment trench will be constructed for Stage 1 to provide secondary containment of the decant return and tailings delivery pipelines between the Plant Site and the TSF. An event pond will also be constructed along the TDRT alignment so that in the event that the tailings cannot be re-mobilised, the pipeline can be flushed and drained by manual valves into the event pond or TSF. An indicative alignment for the TDRT is shown on Drg. No. 801-102-A3001-101.

8.2 EMBANKMENT CONSTRUCTION

The TSF embankment will be constructed in annual raises to suit storage requirements and the availability of suitable mine waste. The Stage 1 TSF will provide 16 months of storage capacity, in order to allow Stage 2 construction to be carried out during the subsequent dry season.

The TSF embankment will be raised utilising downstream construction methods, however centreline or modified centreline raises may be considered subject to further technical assessment during operation. It is noted that downstream construction results in improved embankment stability with higher factors of safety against embankment failure.

Embankment crest elevations and storage details for each stage are shown in Table 8.1.

Table 8.1: Staged embankment construction

Stage	Crest Elevation (mRL)	Spillway Inlet Elevation (mRL)	Maximum Embank-ment Height (m)	Tailings Capacity (months)	Cumulative Tailings Storage Capacity (Mt)
1	70.0	68.2	16.0	16	4.1
2	72.2	70.4	18.2	12	8.6
3	74.2	72.4	20.2	12	13.0
4	76.0	74.2	22.0	12	17.5
5	77.9	76.1	23.9	12	22.0
6	79.7	77.9	25.7	12	26.4
7	81.4	79.6	27.4	12	30.9
8	83.0	81.2	29.0	12	35.4
9	84.7	82.9	30.7	12	39.8
10	86.2	84.4	32.2	12	44.3
11	87.4	85.6	33.4	10	48.0

Staged embankment crest elevations were determined based on the stage storage curve for the facility, shown on Figure 8.1. The TSF embankment will have an upstream slope of 2H:1V, an operating downstream slope of 3H:1V and a crest width of 10 m. The embankment upstream face will be lined with textured HDPE geomembrane liner, to allow safe egress from the TSF. The final downstream embankment profile will consist of 3H:1V slopes with 5 m wide benches at 10 m height intervals, producing an overall slope of 3.5H:1V for ease of rehabilitation.

The northern part of the facility comprises Annie's Dam which holds a waterbody of approximately 9.5 ha. Annie's Dam will need to be dewatered and decommissioned and allowed sufficient time for the basin material to dry prior to Stage 1 construction. The extent of saturation of the basin material is unknown and may take some time to dry, therefore it may not be practicable to line the entire footprint of Annie's Dam with HDPE. The basin material will be inspected following dewatering and drying, and free draining areas will be lined with HDPE. Saturated areas unsuitable for the installation of HDPE will be left unlined. The saturated areas are expected to be finer material of low permeability.

The Water Storage Dam will be constructed in the northern most valley of the TSF basin. The WSD embankment will be inundated by the progression of tailings in Year 9 of TSF operation. The WSD basin will comprise compacted soil subgrade overlain by HDPE Geomembrane liner. Basin underdrainage will be incorporated throughout the WSD basin ahead of tailings deposition in Year 9. The WSD is discussed in greater detail in Section 10.

The zones in the embankment will consist primarily of a low permeability zone (Zone A) and a downstream bulk fill zone (Zone C/C1). A transition structural zone (Zone B) may be required between the low permeability zone (Zone A) and a downstream bulk fill zone (Zone C/C1) which will be confirmed during subsequent design phases. It is noted that efforts will be made to source material (if available) from the existing Heap leach facility and TSF basin, particularly during Stage 1 construction.

Typical specifications are summarised as follows:

- Zone A material shall be won from borrow to form the low permeability zone of the embankments. The material will need to have a sufficiently high fines content and plasticity to ensure that a suitable low permeability can be achieved after conditioning and compaction. Zone A material will be sourced and placed by a civil contractor.
- Zone B material shall be won from borrow to provide sufficient transition between the finer Zone A material and coarser Zone C1 material after conditioning and compaction. Zone B material will be sourced and placed by a civil contractor.
- Zone C/C1 material shall generally be run of mine waste sourced from the Open Pit(s) to form the structural fill zone of the embankments. Zone C will be delivered to the embankment by the mining operation, moisture conditioned and compacted in layers by a civil contractor. Zone C1 material will be run of mine waste sourced from the Open Pit(s) that is placed progressively throughout operation as part of mining operations. Zone C1 material will be placed, spread and traffic compacted (by loaded haul trucks) as part of the mining operation. If coarse rockfill is available from the Open Pit(s), Zone C1 may be placed from a tip head (subject to assessment and approval by KP).
- Zone F1/F2 shall be clean sand/gravel drainage material supplied to a stockpile adjacent to the works for use by the civil contractor. The Zone F1 material will be sourced from local borrow (if available) or imported from off-site.

It is envisaged that the mining fleet will place the embankment bulk fill material (Zone C1) on a continuous basis throughout operation, hauling directly from the Open Pit (s). It is noted that the specification for the Zone C layer is more stringent and is assumed to be placed by a civil contractor (the material would be delivered to the embankment by the mining operation). A minimum structural fill profile (Zone C1) is required at the commencement of the construction period each year to facilitate the Zone A, Zone B and

Zone C material placement. It is envisaged that a civil contractor will place Zone A, Zone B and Zone C materials during each raise construction as space will be limited.

A cut-off trench will be located beneath the low permeability zone of the embankment and will be excavated to a depth of nominally 1.5 m (depending on ground conditions) to extend through to weathered rock or competent low permeability foundation material. The cut-off trench will be constructed continuously along the embankment and backfilled with low permeability fill (Zone A). The excavated material will be placed in the embankment (as Zone A or Zone C) if suitable, or else hauled to waste.

Typical embankment cross sections and details are shown on Drg. Nos. 801-102-A3001-201 to 801-102-A3001-203.

8.3 SEEPAGE CONTROL AND UNDERDRAINAGE COLLECTION

A number of seepage control and underdrainage collection features have been integrated into the TSF design in order to reduce seepage losses through the base of the TSF and increase the settled density of the deposited tailings. These consist of the following components:

- Cut-off trench.
- Compacted soil subgrade.
- HDPE geomembrane liner.
- Basin underdrainage collection system.
- Embankment toe drain.
- Leachate collection and recovery system (LCRS).

The above are at the higher end of TSF design features for the region as a whole and are considered to be appropriate for the operational phase. Post closure the cover system required to manage the elemental enrichment and acid generating potential of the tailings will reduce infiltration into the facility thereby further reducing the seepage potential post closure.

8.3.1 Cut-Off Trench

One of the primary seepage controls from the TSF will comprise a cut-off trench excavated in the foundation soils and backfilled with low permeability fill (Zone A) to reduce seepage loss under the embankment foundations. The cut-off trench will be located beneath the central low permeability core to a nominal depth of 1.5 m (depending on ground conditions). The cut-off trench will be constructed continuously along the embankment to the full deposition elevation in order to reduce potential seepage at any level. Low permeability material (Zone A) will be used to backfill the cut-off trench. If the cut material is suitable as fill, it may be placed in the TSF embankment in compacted layers (or reused as cut-off trench backfill).

The location and details of the embankment cut-off trench are shown on Drg. Nos 801-102-A3001-201 to 801-102-A3001-202.

8.3.2 Compacted Soil Subgrade

A compacted soil subgrade will be constructed within the TSF basin area as subgrade for the basin HDPE geomembrane liner, comprising either reworked in situ material (200 mm depth) or imported Zone A material (300 mm depth).

The construction methodology for the compacted soil subgrade will be as follows:

- The TSF basin area will be cleared, grubbed and the topsoil stripped.
- Borrow areas within the TSF basin will be shaped to facilitate full gravity drainage into the TSF.
- Where in situ material is suitable (classified as Zone A material) - scarify, moisture condition and compact in situ material to achieve target density (depth 200 mm).
- Where in situ material is not suitable (too coarse for classification as Zone A material or low plasticity to non-plastic) – win suitable material from borrow, place, spread, moisture condition and compact to achieve target density (thickness 300 mm).

The compacted soil subgrade surface shall be free from angular gravels and depressions, drain positively and be finished with a smooth drum vibratory roller. It must be ensured that compacted soil subgrade properties (moisture content, dry density ratio and thickness) are preserved after compaction until the compacted soil subgrade is covered by the installation of HDPE liner.

8.3.3 HDPE Geomembrane Liner

A geomembrane basin liner will be installed over the compacted soil subgrade. The geomembrane liner will comprise 1.5 mm smooth HDPE overlying the compacted soil surface. The HDPE will be anchored within a rectangular trench around the TSF perimeter, including on the TSF embankment crest. The TSF embankment upstream face will be lined with 1.5 mm textured HDPE liner, to facilitate ease of ingress and egress during construction and operation.

8.3.4 Basin Underdrainage System

The underdrainage system is installed over the full TSF basin area (including the WSD) and is designed to reduce the phreatic surface within the tailings mass, and subsequently the TSF embankment. The underdrainage system has several benefits, as follows:

- Reduces seepage through the basin and under/through the embankment. This is beneficial to the environment and promotes increased embankment stability.
- Drains the tailings mass, thus increasing the density of the tailings and providing a more efficient TSF in terms of constructed storage capacity.
- Increases the strength of the tailings mass immediately adjacent to the embankment.

The design of the underdrainage system takes advantage of the natural fall of the ground and thus minimal re-shaping of the basin will be required. The underdrainage system will consist of two interconnected drainage networks, namely the collector drains and the finger drains.

The collector drains will consist of a 100 mm draincoil pipe contained within a 400 mm deep trench, backfilled with drainage sand (Zone F1) and double-wrapped in geotextile. The collector drains will be located either side of a shaped drainage trench, approximately 8 m wide, to convey the peak sheet flows prior to inundation of the drains with tailings. The collector drains will be constructed so that the top surface of the drains is flush with the surrounding ground surface to reduce erosion damage to the drains from tailings supernatant and rainfall runoff. The collector drains will feed directly into the underdrainage collection sump.

Finger drains will be installed at approximately 100 m centres over the TSF basin area. The finger drains will consist of a 63 mm draincoil pipe within a 300 mm excavation backfilled with drainage sand (Zone F1) and double-wrapped in geotextile. The finger drains will connect into the collector drains or the embankment toe drain.

Basin underdrainage system plan, sections and details are shown on Drg Nos. 801-102-A3001-400 to 801-102-A3001-404.

8.3.5 Embankment Toe Drain

A toe drain will be constructed along the upstream toe of the embankment. The purpose of the toe drain is to increase the stability of the embankment by providing drainage of the tailings located at the embankment and covering the phreatic surface.

The toe drain is similar in design to the collector drains and comprises a 160 mm draincoil pipe within a 400 mm deep ‘v-ditch’ at the embankment toe, backfilled with drainage sand (Zone F1) and double-wrapped in geotextile. The toe drain will flow into the underdrainage collection sump. To achieve gravity drainage of the toe drain, in some areas the toe drain will be situated at the base of a trench at the embankment toe.

Details of the embankment toe drain are shown on Drg. No. 801-102-A3001-202 and Drg. No. 801-102-A3001-401.

8.3.6 Underdrainage Collection Sump

An underdrainage collection sump will be excavated at the lowest point in the TSF basin, adjacent to the groundwater drain sump.

The underdrainage sump will collect solution from the underdrainage network and collected solution will be pumped back onto the tailings beach, with flows reporting to the supernatant pond for recycling back to the Plant Site. The underdrainage sump will consist of the following components:

- An excavation nominally 2 m deep (minimum), 6 m by 3 m at the base. The sump will be backfilled with clean gravel material (Zone F2), overlain with drainage sand/gravel material (Zone F1) and wrapped in geotextile.
- Two 630 mm diameter HDPE riser pipes fixed into the centre of the sump and extending at a constant grade to the embankment crest elevation. The bottom 3 m of each riser pipe located within the sump will be slotted. The riser pipes will be situated on the embankment face and ballasted with a steel brace structure.
- The riser pipe will act as a guide for a submersible pump. Underdrainage system pumps, pipelines and associated infrastructure will be designed by others.
- The pump will operate within the slotted section of the riser pipe, drawing any seepage water build-up out of the sump.
- The riser pipe will be flange-coupled to allow the pump to slide up and down without jamming or snagging.
- The pump will have steel cables attached to it, to help locate it at the bottom of the riser and to retrieve it if required.

The location, sections and details of the underdrainage sump are shown on Drg. Nos. 801-102-A3001-400 and 801-102-A3001-402.

8.3.7 Leachate Collection and Recovery System (LCRS)

Seepage from the existing drainage courses within the TSF basin, beneath the composite liner system, will be collected by a Leachate Collection and Recovery System (LCRS). The LCRS is independent of all other seepage control components. The LCRS drains will consist of 100 mm diameter draincoil pipes contained within a 1,000 mm deep trench, backfilled with drainage gravel (Zone F2) to 700 mm depth (wrapped in geotextile), overlain by a 300 mm low permeability (Zone A) material cap. The LCRS drains will feed directly into the LCRS sump.

As well as providing a secondary drainage system beneath the TSF basin liner during operation, the LCRS has the following benefits:

- Improves accessibility of basin work areas during construction by helping to dewater the drainage course alluvial material.
- Reduces the upward hydrostatic pressure from the alluvial material after construction of the basin liner.

The LCRS will report to a collection sump at the lowest point in the TSF basin, adjacent to the underdrainage collection sump. The LCRS sump will lie beneath the compacted soil subgrade and consists of the following components:

- An excavation nominally 2 m deep, 6 m by 3 m at the base, filled with selected clean gravel material (Zone F2) encapsulated in geotextile. The sump is covered with compacted soil subgrade and HDPE geomembrane liner (so that the sump sits beneath the basin liner).
- Two 630 mm diameter HDPE riser pipes fixed into the centre of the sump and extending at a constant grade to the embankment crest elevation. The bottom 3 m of each riser pipe located within the sump is slotted.
- The riser pipe will act as a guide for a submersible pump. The LCRS pumps, pipelines and associated infrastructure will be designed by others.
- The pump will operate within the slotted section of the riser pipe drawing any seepage build-up out of the sump.
- The riser pipe will be flange-coupled to allow the pump to freely run up and down without jamming or snagging.
- The pump will have steel cables attached to it, to help locate it at the bottom of the riser and to retrieve if required.

The location, sections and details of the groundwater collector system and groundwater collection sump are shown on Drg Nos. 801-102-A3001-400 and 801-102-A3001-403.

8.4 DECANT SYSTEM

The TSF will operate with a turret decant which will be constructed, operated and subsequently de-commissioned to suit the staged development of the facility and the tailings beach. A decant trench will be constructed along the planned supernatant pond migration path, alongside an access causeway to facilitate access to the turret and relocation as required during the operation.

The decant system will consist of the following components:

- A decant trench within the natural drainage courses of the TSF basin (the planned supernatant pond migration path).
- An access causeway constructed of Zone D material (generally comprising excavated material from the decant trench).
- A floating polyethylene decant turret unit, with associated piped connections (See Appendix E for details).
- A pump affixed to the decant turret unit (pumping system designed by others).
- A mobile standing pump unit on the decant access causeway, to pump water abstracted by the turret pump to the process plant (via the decant water return pipeline).

The decant turret unit(s) will be relocated along the decant access causeway on a regular basis throughout operation to locate the turret at the supernatant pond location, and to ensure that no tailings enter the pump intake. Turret system pumps, pipelines, pump controls, electrical supply and associated infrastructure will be designed by others. The Turret pump(s) will operate automatically, reclaiming water from the TSF and pumping it via a pipeline to the process plant.

The proposed system general arrangement is shown on Drg. Nos. 801-102-A3001-101, 801-102-A3001-108 and 801-102-A3001-301, and typical sections and details are shown on Drg. Nos. 801-102-A3001-301 to 801-102-A3001-303.

8.5 EMERGENCY SPILLWAY

The TSF is designed to contain a range of design storm events, as listed in Table 1.1. In the event that a storm event greater than the TSF design criteria occurs, rainfall and supernatant water which cannot be stored within the supernatant pond will discharge from the TSF in a controlled manner via an engineered emergency spillway.

The emergency spillway will be constructed as part of each embankment raise. The spillway inlet will be completely in cut into an abutment of the TSF embankment. The emergency spillway channel will be lined with rock erosion protection (Zone E). The spillway channel is designed to discharge downstream of the embankment toe into a natural drainage channel.

The emergency spillway system is designed on the basis that attenuation of the storm event occurs within the supernatant pond. The attenuation on the TSF and spillway design will allow single storm events with an average recurrence interval of up to the Probable Maximum Flood (PMF) to be safely discharged from the TSF whilst protecting the embankment from overtopping.

The location and details of the Stage 1 emergency spillway are shown on Drg. No. 801-102-A3001-505.

The closure spillway will be excavated through the waste dump to the north east of the TSF towards the open pit and will allow conveyance of PMP storm events without any attenuation in the TSF. Deposition during the final stage of operation will be managed to push the supernatant pond to the eastern side of the TSF to reduce the required closure spillway excavation.

8.6 TAILINGS DEPOSITION SYSTEM

Tailings will be discharged into the TSF from the embankment by sub-aerial deposition methods, using a combination of spigots at regularly spaced intervals. Deposition will occur from multiple spigots inserted along the tailings distribution line.

The deposition location(s) will be moved progressively along the distribution line, as required, to control the location of the supernatant pond in the northern valley within the TSF basin, at the operating turret. After initial establishment of the tailings beaches, a suitable cycle time will be determined in order to evenly deposit the tailings around the TSF, thereby maintaining the supernatant pond at a suitable location and maintaining the formation of the tailings beach. During the final stages of operation, the deposition will be managed to push the supernatant pond to the north eastern area of the TSF basin to reduce the required excavation of the closure spillway.

Spigot off-take (and spigot clamp) sections and details are shown on Drg. Nos. 801-102-A3001-551 and 801-102-A3001-552.

8.7 TSF OPERATION

8.7.1 Deposition Objectives

The tailings deposition strategy was designed and will be managed throughout the life of the TSF to meet the following objectives:

- Deposition of a basin lining within the inundation area.
- Maintenance of freeboard against the upstream embankment face.
- Deposition to improve sub-aerial drying and consolidation of tailings.
- Deposition to effectively utilise the net available storage capacity.
- Effective management of the size and location of the supernatant pond.
- Reduce the volume of water stored on the TSF at any time.
- Reduce the operating costs of the tailings distribution system.
- Reduce down time by providing operational flexibility.
- Facilitate the implementation of the storage closure strategy.
- Reduce potential for dust generation.

8.7.2 Deposition Technique

The deposition of tailings into the TSF will be sub-aerially from the embankment. The tailings delivery pipeline will run from the Plant Site to the embankment crest in a HDPE lined pipeline corridor.

The TSF deposition extents are indicated on Drg. Nos. 801-102-A3001-101 and 801 102-A3001-108. The tailings will initially be deposited into the TSF from the TSF embankment at the low point of the TSF basin (along the eastern embankment), in such a way as to encourage the formation of beaches over which the slurry will flow in a laminar non-turbulent manner, and allow the supernatant pond to migrate up the valley.

A degree of segregation of the tailings will occur against the embankment, promoting dewatering of the tailings through the embankment toe drain and thus promoting stability, consolidation and reducing basin drainage. Tailings deposition will then be moved either side of this initial point to line the basin area whilst controlling the location of the supernatant pond.

Deposition will occur from multiple spigots inserted along the tailings distribution line. The deposition location(s) will be moved progressively along the distribution line as required to control the location of the supernatant pond. After initial establishment of the tailings beaches, a suitable cycle time will be determined in order to evenly deposit the tailings around the southern extent of the TSF basin, thereby maintaining the supernatant pond at a suitable location and maintaining the formation of tailings beaches.

The proposed tailings deposition method is the sub-aerial technique, as opposed to the sub-aqueous technique. Sub-aerial deposition allows for the maximum amount of water removal from the TSF by the formation of a large beach for drying and draining. Together with keeping the supernatant pond size to a minimum, sub-aerial deposition should increase the settled density of the tailings, and hence improve the storage potential and efficiency of the TSF.

The tailings will generally be deposited from along the embankment in such a way as to encourage the formation of beaches over which the slurry will flow in a laminar non-turbulent manner. The solids will settle as deposition continues and water will be released to form a thin film on the surface of the tailings. This water will flow to the supernatant pond from where it will be removed from the TSF by means of the turret system.

Deposition of the tailings will be conducted on a cyclic basis with the tailings being deposited over one area of the storage until the required layer thickness has been built up. Deposition will then be moved to an adjacent part of the storage to allow the deposition layer to dry and consolidate. This will facilitate more efficient storage to be achieved over the entire area.

After deposition on a particular area of beach ceases and settling of the tailings has been completed, further dewatering will take place due partly to drainage into the underdrainage system but mainly due to evaporation.

As water evaporates and the moisture content drops, the volume of tailings will reduce to maintain a condition of full saturation within the tailings. This process will continue until interaction between the tailings particles hinders volume reduction.

8.8 SEEPAGE ASSESSMENT

Seepage analyses were undertaken for the TSF embankment and basin to determine the following:

- Estimate the position of the phreatic surface within the embankment for both Stage 1 and final configurations.
- Estimate the total seepage losses from the TSF.
- Estimate the effect of the basin underdrainage system within the TSF.

The seepage model was developed in the analysis program SEEP/W (Ref. 10). The seepage assessment is reported in detail in Appendix F, and summarised herein.

Based on the seepage assessment of Stage 1 and Stage Final of the proposed TSF configuration, the following conclusions are made:

- Phreatic surface in the embankment would be expected to be relatively low, due to the HDPE geomembrane liner and other seepage control measures outlined in Section 8.3.
- The seepage loss is considered small for both Stage 1 and Stage Final with both average and storm ponds.

8.9 STABILITY ASSESSMENT

The stability of the proposed Stage 1 and final TSF embankment sections were assessed under static and seismic loading conditions using limit equilibrium methods. 'SLOPE/W' (Ref. 11), is a limit equilibrium program that was used for the analysis. The slope stability analysis was performed using the Morgenstern-Price method.

The stability of the TSF was assessed in order to confirm the factors of safety against shear failure considering long-term drained conditions, short-term undrained conditions and post seismic conditions. The effect of pore water pressures on embankment stability was modelled during the stability assessment.

The minimum stability criteria based on ANCOLD guidelines (Ref. 1) are provided in Table 1.1. The stability assessment is reported in detail in Appendix G and summarised below.

Based on the slope stability assessment, the Rustlers Roost TSF will have satisfactory factors of safety based on the recommended minimum factors of safety by ANCOLD (Ref. 1), and therefore should be stable as designed.

The stability analyses indicate that during operation the embankment profile satisfies all requirements for operational minimum factors of safety. All stability models were completed with the minimum embankment profiling.

9. TAILINGS STORAGE FACILITY DAM BREACH ASSESSMENT

9.1 INTRODUCTION

A dam breach assessment based on ANCOLD guidelines (Ref. 1) was carried out for the Rustlers Roost TSF to estimate the Population at Risk (PAR), business risk and environmental impact in the event of a dam failure. The likelihood of failure is not considered in the ANCOLD Consequence Category Assessment.

It is noted that the Dam break assessment was completed based on a total tonnage of 40 Mt. Subsequent to this assessment the total tonnage was increased from 40 Mt to 48 Mt. The Population at Risk (PAR) and impact area are expected to be similar and therefore will not change the ANCOLD Consequence Category assigned to the Rustlers Roost TSF.

A summary of the Dam Breach assessment is provided in the sections below, the detailed Dam Breach Assessment is provided in Appendix H.

9.2 DAM BREACH CONSEQUENCE ASSESSMENT

The key design parameters relating to the dam break assessment are as follows:

- The final TSF configuration (40.0 Mt stored tailings) was assessed for each option.
- An emergency spillway exists as part of the TSF design.
- The supernatant pond will be located remote from the TSF embankment under normal operating conditions.
- It was assumed that failure occurs at the highest section of each embankment and where the potential Population at Risk (PAR) will be the highest. Two dam breach scenarios were considered, breaching on the western and eastern sides of the TSF embankment.

9.3 CONCEPTUAL APPROACH

A consequence assessment was completed for the TSF in accordance with the requirements of the ANCOLD "Guidelines on the Consequence Categories for Dams" (Ref. 1). The severity rating of a facility is derived by considering the potential impacts of a significant embankment breach and resulting release of tailings slurry in terms of safety, environmental and economic factors.

The assessment is intended to be an initial assessment in accordance with the definition provided in Clause 2.1 of the ANCOLD guidelines (Ref. 1) as it is based on low quality topography and limited information relating to the population and communities close to and downstream of the project site. As such the assessment is intended to provide order of magnitude impacts only so as to define the consequence category of the facility for preliminary design. A more detailed and rigorous assessment should be carried out during subsequent design phases once detailed topography is available and further design details are available.

A dam breach assessment was conducted for potential dam break scenarios for both the Eastern and Western embankments assuming significant loss of containment. Dam breach modelling was based on the impact should a failure occur and does not consider the likelihood of such a failure occurring. The identified flow paths were used to determine the Population at Risk (PAR), the severity of damage and loss, and hence the consequence category of the facility.

A significant failure of any of the TSF embankments would result in a release of tailings and/or water, though the extent and magnitude of the release would depend on the location of the breach, its size and the cause. For this assessment, the possible breach flow paths for each embankment at final height (when the facility is at its maximum tailings storage volume) were assessed. The critical locations were identified as the Eastern and Western walls of the TSF embankment due to the amount of the tailings capable of mobilising in the event of failure.

9.4 POPULATION AT RISK ASSESSMENT

As part of the estimation of the hazard/consequence category for the TSF, an assessment of the indicative Population at Risk (PAR) was undertaken. It is not anticipated that all people will be downstream of the TSF at the same time; hence a percentage estimate of each role was approximated. A total PAR was then calculated, as shown in Table 9.1 for the critical dam breach scenario (eastern breach).

Table 9.1: Indicative Population at Risk (PAR) – Eastern Breach

Population	Number	Affected (%)	PAR
Processing Personnel[1]	50	0%	-
TSF Operation Personnel[1]	2	5%	0.1
TSF Construction Personnel[1,2]	25	5%	1.25
Mine Personnel[1]	20	0%	-
Public / Site Roads[1]	5	5%	0.25
Agricultural Fields	5	5%	0.25
Camping	5	5%	0.25
Unclassified Buildings	20	50%	10
Unidentified (5% Contingency)	-	-	0.6
Total	132		12.8

Notes:

1 The number of personnel has been estimated based on experience on similar projects within the region. This should be reviewed by Hanking and amended if the actual number of personnel differ significantly from those stated above.

2 TSF Construction Personnel only operational during TSF construction raises.

Based on the above estimate, a PAR of ≥10 to 100' is recommended for the TSF.

The PAR due to an environmental spill would be limited, and on this basis a PAR of '<1' was adopted for the Environmental Spill Consequence Category.

9.5 DAM FAILURE SEVERITY LEVEL

An assessment to determine the severity level of impacts from a large-scale failure of the facility (Dam Failure Severity Level) and a spillway flow or other water release (Environmental Spill Severity Level) was conducted.

The Severity Level Impact of a breach of the facility is rated as "Catastrophic". This rating was adopted as any significant breach of either embankment would be expected to flow into the Adelaide River or Mary River, which flows through a number of National Parks and wildlife conservation areas which are home to a number of threatened and endangered species. Additionally, if tailings solids were to enter these waterways, they are likely to be transported as sediment to the ocean and the potential impact area could be in excess of 20 km^2.

It is likely that there are a considerable number of communities downstream of the project site that rely on the aforementioned rivers for water supply, agriculture, tourism and other activities, which could be severely impacted due to contamination of the river resulting from a significant breach of the TSF.

The severity level of an environmental spill would be considered 'Major' due to the potential impact on the natural environment downstream of the TSF.

9.6 CONSEQUENCE CATEGORY

Based on the PAR calculation and Dam Failure Severity Level review summarised in sections 9.4 and 9.5, the ANCOLD (Ref. 1) consequence categories for the Rustlers Roost TSF are provided in tables 9.2 and 9.3, for dam failure and environmental spill respectively.

Table 9.2: ANCOLD Consequence Category – Dam failure

Stage	PAR	Severity of Damage or Loss	ANCOLD Consequence Category
Final	≥10 to <100	Catastrophic	High A

Table 9.3: ANCOLD Consequence Category – Environmental spill

Stage	PAR	Severity of Damage or Loss	ANCOLD Consequence Category
Final	<1	Major	Significant

9.7 DESIGN REQUIREMENTS FOR EXTREME CONSEQUENCE CATEGORY

Based on ANCOLD guidelines (Ref. 1), the recommended design criteria for the TSF are summarised in Table 9.4.

Table 9.4: Design criteria for 'High A' consequence category

Dam Failure Consequence Category	High A
Dam Spill Consequence Category	Significant
Design Storage Allowance Parameters	
Design Storage allowance Extreme Storm Storage Contingency Freeboard (Wave Run-up) Contingency Freeboard (Additional Freeboard)	10% AEP notional wet season runoff[1] 1% AEP, 72-hr flood 1:10 AEP wind 0.3 m
Emergency Spillway Design Parameters	
Design Flood Wave Freeboard Allowance	PMF Nil for given design flood
Design Earthquake Loadings	
Operating Basis Earthquake (OBE) Safety Evaluation Earthquake (SEE)	0.1% AEP (1 in 1,000) 0.01% AEP (1 in 10,000)
Factors of Safety	
Long-term drained Short-term undrained (potential loss of containment) Short-term undrained (no potential loss of containment) Post-seismic	1.5 (Effective strength) 1.5 (Consolidated Undrained Strength) 1.3 (Consolidated Undrained Strength) 1.0-1.2 (Post seismic Shear Strength)

Notes:
1 Assuming no evaporation and 100% runoff coefficient.

The Rustlers Roost TSF consequence category is governed by both impact area, impact on the natural environment and PAR. The assumptions noted in this section should be reviewed and considered by Hanking prior to subsequent design phases. The Rustlers Roost TSF design is characterised by downstream embankment construction throughout operation, a composite basin liner system and an underdrainage network in low-lying areas of the basin.

10. WATER STORAGE DAM

10.1 GENERAL

The Water Storage Dam (WSD) is the primary storage pond for clean process water on site, and is able to store sufficient makeup water at its maximum operating level. The WSD is located within the northern TSF footprint and will eventually be inundated with tailings. The WSD general arrangement is shown on Figure 10.1.

The WSD is intended to be recharged by water abstracted from pit dewatering, rainfall runoff and make-up water from the bore field. Water will be discharged via pumping from the WSD during the wet season into the Mount Bundey Creek. Pit dewatering will initially be pumped to a turkey's nest where dust suppression water will be sourced with the remaining water pumped to the WSD.

The water collected in the WSD will be pumped back to the process water dam to supply plant raw water requirements and process make-up water requirements. Water will be removed from the WSD by a floating pump (designed by others).

The WSD embankment comprises a homogeneous low permeability material (Zone A). The upstream embankment face, crest and downstream embankment face will be lined with textured HDPE geomembrane liner for erosion and seepage protection. Typical specifications for material types are summarised as follows:

- Zone A material shall be won from borrow to form the low permeability zone of the embankments. The material will need to have a sufficiently high fines content and plasticity to ensure that a suitable low permeability can be achieved after conditioning and compaction. Zone A material will be sourced and placed by a civil contractor.

The WSD basin area will be cleared, grubbed and topsoil stripped to ensure that the process water supply remains free of organic material. A compact soil subgrade within the WSD basin will be constructed as described in Section 8.3.2. The compact soil subgrade will be overlain with HDPE geomembrane liner as described in Section 8.3.3.

During the latter stages of operation tailings will be deposited into the WSD, therefore a network of finger, collector and LCRS drains reporting to either an underdrainage sump or LCRS sump (as described in Section 8.3) will be constructed throughout the WSD basin.

Discharge from the WSD will occur in a controlled manner via an engineered spillway, in order to protect the integrity of the embankments from overtopping failure. The WSD spillway will be excavated into the western ridgeline of the WSD, and discharge off-site. The emergency spillway will be lined with erosion protection material (Zone E). As the WSD is expected to fill during each year of operation, it is anticipated that the spillway will flow, and discharged water will report to the existing stream bed, each wet season.

The WSD embankment section is shown on Figure 10.2.

11. MONITORING

11.2 INTRODUCTION

A monitoring programme for the TSF will be developed to monitor for any potential issues which may arise during operations. The monitoring will include:

- Monitoring bores and surface water sampling stations downstream of the TSF embankment.
- Standpipe piezometers in the TSF embankment to monitor the phreatic surface.
- Vibrating Wire piezometers in the TSF embankment to monitor the phreatic surface.
- Survey pins to check for embankment movement.

The piezometers and monitoring bores will be checked monthly for water levels and quarterly for water quality.

Locations and typical details of the instrumentation are shown on Drg. Nos. 801-102-A3001-600 and 301–102-A3001-601.

If the monitoring programme indicates that potential problems are developing, an increase in monitoring frequency will be implemented and a response plan developed.

11.3 SEEPAGE MONITORING

The TSF design incorporates a number of measures to reduce the amount of seepage that will occur from the TSF, in order to mitigate the extent of any effects on the downstream environment.

A total of 6 No. groundwater monitoring stations will be installed downstream of the TSF embankment to facilitate early detection of changes in groundwater level and/or quality, both during operation and following decommissioning. Proposed monitoring bore locations are shown on Drg. No. 801-102-A3001-600.

The monitoring bore station consists of one shallow bore 5 to 10 m deep, and one deep bore approximately 60 m deep. The shallow bore is intended to detect any seepage from the TSF flowing within the surface soils, whilst the deep bore will monitor the chemical composition of the groundwater. Each borehole will be cased and screened over an interval set in the field during installation and sealed back to surface with low permeability grout. The PVC tube for the monitoring bores will be 100 mm diameter. Typical details of a monitoring bore are shown in Drg. No. 801-102-A3001-601. It is recommended that the boreholes are constructed before commissioning of the TSF in order to accumulate baseline data specific to the TSF location.

11.4 STABILITY MONITORING

Pore water pressures will be monitored at a number of locations within the embankments to ensure that performance and stability of the embankment are in line with design assumptions. Standpipe and Vibrating Wire piezometers will be installed in the TSF embankment, as shown on Drg. No. 801-102-A3001-600.

11.4.1 Vibrating Wire Piezometers

Vibrating wire piezometers (VWP) will be installed at thirteen (13) locations (pairs) beneath the Stage 1 embankment footprint as shown on Drg. No. 801-102-A3001-600. The VWPs will be connected to a telemetry network which can be read online.

Each piezometer location will consist of a 50 mm diameter PVC tube which will contain two nested instruments. The instruments will be placed at different depths and the hole will be sealed with a bentonite/cement grout, surrounding the cable that leads out to a monitoring station on the downstream side of the facility. A typical detail of a vibrating wire piezometer is shown in Drg. No. 801-102-A3001-600.

The piezometers will be monitored at regular intervals and any rises in water level noted. Increases of greater than 10% of the embankment height should be referred to a qualified geotechnical engineer for further investigation. The piezometer levels should be monitored to ensure that the phreatic surface does not reduce the overall stability of the embankments below acceptable levels. Remedial action will be undertaken if increases in pore water pressure of concern.

Additional vibrating wire piezometers will also be installed during subsequent stages.

11.4.2 Standpipe Piezometers

Each standpipe will consist of a 50 mm diameter PVC tube slotted at the base or supplied with a filter tip. The slotted section will be surrounded by sand, and bentonite pellets will be placed above the sand to provide a seal. The remainder of the hole will be sealed with a bentonite/cement grout. The top of the piezometer will be provided with a lockable cap to prevent tampering or vandalism. The base of each piezometer will be located within the embankment fill (approximately 0.5 m above the stripped foundation level) to ensure that the phreatic surface within the embankment, as opposed to natural groundwater level, is being measured. A typical detail of a standpipe piezometer is shown in Drg. No. 801-102-A3001-601.

The piezometers will be monitored at regular intervals and any rises in water level noted. Any significant increases between readings should be referred to a qualified geotechnical engineer for further investigation. The piezometer levels should be monitored to ensure that the phreatic surface does not reduce the overall stability of the embankments below acceptable levels.

Additional piezometers will be installed as the TSF embankments are raised, to monitor the development of the phreatic surface in the embankments. During each TSF embankment raise, existing piezometers will be sealed with cement/bentonite grout mix via tremie pipe and grout pump, and new piezometers installed on the raise embankment crest. Alternatively, once the base of piezometers is beneath the embankment phreatic surface (i.e. returning water level readings), vibrating wire piezometers may be installed in the existing standpipes and cables extended with each raise. This would remove the requirement to decommission and install new standpipes during each raise.

11.5 SURVEY PINS

Survey pins will be installed at regular intervals along the TSF embankment crest in order to monitor embankment movements and assess effects of any such movement on the embankment. The as-installed details of each pin (date of installation, survey pin ID, Northing, Easting and RL) will be recorded on installation. The locations of survey pins are shown on Drg. 801-102-A3001-600, and a typical detail of a survey pin is shown in Drg. 801-102-A3001-601.

Each pin will be monitored for movement at regular intervals. Any displacement of the embankment that is considered excessive or ongoing will require investigation by a qualified geotechnical engineer.

11.6 OPERATIONAL AUDITS

The TSF will undergo annual audits by the Engineer of Record (the Designer) to ensure that the facilities are operating in a safe and efficient manner.

As the TSF ANCOLD consequence category is ‘High A’, an additional third-party audit should be conducted by a Dams Specialist (independent of the Designer) on a biennial basis (starting in Year 1), as per ANCOLD guidelines (Ref. 1).

12. CLOSURE AND REHABILITATION

12.1 GENERAL

Appropriate closure design is essential in order to mitigate seepage by reducing infiltration through the de-commissioned TSF. Hence, the control of seepage through the TSF by means of appropriate closure design will be one of the primary objectives of the rehabilitation process. At this stage, a low permeability, engineered fill cover is proposed for the TSF as the most suitable long-term solution.

At the end of the TSF operation, the downstream faces of the embankment will have a slope of 3H:1V, with 5 m wide benches located at 10 m height intervals, for an overall slope profile of 3.5H:1V. The profile will be inherently stable under both normal and seismic loading conditions, will provide a stable drainage system, and will allow for revegetation.

Prior to rehabilitation of the embankment faces, temporary vegetation and geotextile silt fences can be used to limit erosion and sediment run-off from the embankment slopes.

Prior to commencing the earthworks component of the rehabilitation, the tailings delivery and distribution pipework will be removed from the facility, and the decant system and associated infrastructure will be removed.

During the final stages of operation, deposition should be managed to locate the final supernatant pond to the north eastern side of the TSF. The supernatant pond remaining on the surface of the TSF may need to be returned to the Plant Site for treatment until the supernatant water in the TSF can be shown to be suitable for discharge. After removal of the supernatant pond, drying of the tailings to a sufficient degree to facilitate trafficking is expected to take over a year. The underdrainage system will continue to operate for some time after completion of capping and re-vegetation to drain excess water from the tailings deposit. The returned water will be evaporated on the tailings surface. Once the water from the underdrainage is shown to be suitable for release, it can be discharged off-site in a manner to prevent erosion of natural ground. The quantity of water recovered from the underdrainage system will reduce with time and experience with similar facilities suggests that water recovery may continue for a period of up to 2-3 years following decommissioning. After the flow ceases, the underdrainage pumps will be removed and the underdrainage risers backfilled and sealed as part of the rehabilitation process.

After the water in the TSF has been proven to be benign, runoff can be allowed to discharge via the closure spillway.

The TSF closure spillway will be excavated during rehabilitation of the tailings surface subsequent to decommissioning. The closure spillway will be excavated through the waste dump located to the north east, discharging into the adjacent open pit downstream of the TSF. The closure spillway will be constructed in such a manner as to allow rainfall runoff from the surface of the rehabilitated TSF to discharge into the surrounding natural drainage system downstream of the TSF embankment.

Rehabilitation of the tailings surface will commence upon termination of deposition into the TSF. At closure, the TSF should be fully water shedding. The final profile of the tailings surface will slope gently from the embankments towards the closure spillway and the low spot on the tailings surface will be adjacent to the closure spillway, so that limited re-shaping of the tailings surface will be required. It is anticipated that a low permeability layer will be required on the final tailings surface to reduce rainfall infiltration into the tailings mass. The following capping layers are currently proposed:

- 0.5 m capillary break, comprising mine waste rockfill material.
- 0.3 m thick low permeability layer.
- 0.2 m thick topsoil as growth medium.

The finished surface will be shallow ripped and seeded with shrubs and grasses. The final closure capping profile provided above will be subject to future geochemical assessment completed throughout operation.

Other aspects of the rehabilitation programme will be re-vegetation, erosion control and stormwater management. Establishing a surface cover of verdant vegetation will reduce the potential for adverse environmental impacts such as dust generation and rainfall erosion, as well as improving aesthetics. To this end, rehabilitation trials will be undertaken during operation to determine the most efficient method to provide an effective cap and rehabilitate the surface of the TSF. The results of these trials will be used to design the most suitable cover which will be placed over the tailings surface.

13. CONSTRUCTION QUANTITIES

13.1 QUANTITIES

Detailed construction quantities on the basis of the design and the parameters presented in the sections above for the TSF are presented below. The quantities provided are to an overall accuracy of ± 15%.

The following should be noted regarding the quantities:

- The Water Storage Dam construction is not included in the quantities below.
- It was assumed that the structural fill zone for the TSF will be placed and traffic compacted (using loaded haul trucks) by the mining operation. A change to this methodology will result in cost increases.
- Unit rates provided are indicative based on similar projects within the Eastern Goldfields region and no escalation is included. It is recommended that project specific rates should be obtained during Q2 or 2022;
- Preliminary and General costs of 25% were assumed and included.
- No contingency was included in the cost estimate and this should be added by Hanking as necessary.
- All items and costs relating to mechanical and electrical equipment and instrumentation shall be determined by others.

The following exclusions are noted from the quantity estimates contained herein, however allowance should be made for these items in the overall cost estimates for the Feasibility Study:

- Crop compensation and re-settlement (if applicable).
- Security measures at the TSF.
- Surveying during construction.
- EPCM during construction.
- Engineering (design).
- Power supply.
- Permitting costs and associated fees.
- Supply and installation of pumping systems and associated infrastructure.
- Site access road earthworks (other than an access road alongside the TDRT and decant causeway).
- Contingency.

Quantities for major cost items were determined based on the following assumptions:

- Average topsoil depth of 200 mm.
- Cut off trench depth of 1.5 m.
- Allowance for wastage, overlap and anchoring of HDPE liner of 10%.
- Allowance for wastage, overlap and anchoring of geotextile liner of 10%.
- For the items where fill is to be sourced by the civil contractor, it was assumed that material would be won from borrow or stockpile within 1 km of the TSF or works area (no overhaul costs).
- Drainage sand and gravel material will require importing from a local commercial supplier. The material will be delivered to stockpile by the supplier.
- Erosion protection rockfill will be won from existing site stockpiles. The material will be delivered to stockpile by the supplier.
- Unsuitable foundation material will be present to an average 1.0 m depth in natural drainage courses within TSF basin areas and embankment footprints.

Table 13.1: Tailings Storage Facility – Preliminary Cost Estimate

Item	Description	Unit	Rate	Stage 1		Stage 2+		Closure		Total
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Cost
1	**PRELIMINARY AND GENERAL COSTS**									
1.1	**Preliminary and General**									
1.1.1	Preliminary and general costs (including mobilization and demobilization)	Item	25%	1	$ 7,862,595	1	$ 15,033,876	1	$ 4,370,933	$ 27,267,405
	Sub Total				$ 7,862,595		$ 15,033,876		$ 4,370,933	$ 27,267,405
2	**TSF SITE PREPARATION AND MATERIAL SUPPLY**									
2.1	**Site Preparation**									
2.1.1	Clear and grub embankment footprints, haul vegetation to designated stockpiles	m2	$ 0.13	212,000	$ 26,500	590,000	$ 73,750	-	$ -	$ 100,250
2.1.2	Clear and grub area of TSF basin, haul vegetation to designated stockpiles	m2	$ 0.13	1,278,000	$ 159,750	377,000	$ 47,125	-	$ -	$ 206,875
2.1.3	Strip topsoil from embankment footprints, haul to designated stockpiles (200mm)	m3	$ 1.36	43,000	$ 58,480	121,000	$ 164,560	-	$ -	$ 223,040
2.1.4	Strip topsoil from TSF basin area, haul to designated stockpiles (200mm)	m3	$ 1.36	256,000	$ 348,160	79,000	$ 107,440	-	$ -	$ 455,600
2.1.5	Excavate unsuitable material from the TSF embankment footprints and basin, haul to designated stockpile (nominal allowance)	m3	$ 4.50	149,000	$ 670,500	101,000	$ 454,500	-	$ -	$ 1,125,000
2.1.6	Decommission Annie's Dam (including dewatering and removal of embankment)	Item	By Others	1	$ -	-	$ -	-	$ -	$ -
2.2	**Stockpiles & Borrow Areas**									
2.2.1	Clear designated stockpiles, push material to perimeter (2m high)	m2	$ 0.13	493,000	$ 61,625	339,000	$ 42,375	1,000	$ 125	$ 104,125
2.2.2	Clear designated borrow areas, push material to perimeter (4m deep)	m2	$ 0.13	150,000	$ 18,750	329,000	$ 41,125	137,000	$ 17,125	$ 77,000
2.2.3	Strip topsoil from stockpile and borrow areas, haul to designated stockpiles (200mm)	m3	$ 1.36	129,000	$ 175,440	137,000	$ 186,320	28,000	$ 38,080	$ 399,840
2.3	**Material Supply**									
2.3.1	Supply suitable Zone E erosion protection material to stockpile (includes win, haul and place in stockpile)	m3	$ 12.50	20,600	$ 257,500	57,500	$ 718,750	-	$ -	$ 976,250
2.3.2	Supply suitable Zone F1 sand material to stockpile (includes win, haul and place in stockpile)	m3	$ 18.00	9,500	$ 171,000	1,400	$ 25,200	-	$ -	$ 196,200
2.3.3	Supply suitable Zone F2 gravel material to stockpile (includes win, haul and place in stockpile)	m3	$ 18.00	5,800	$ 104,400	-	$ -	-	$ -	$ 104,400
2.3.4	Supply 1.5 mm textured HDPE liner (including 10% allowance for wasteage and overlap)	m2	$ 3.00	121,000	$ 363,000	428,000	$ 1,284,000	-	$ -	$ 1,647,000
2.3.5	Supply 1.5 mm smooth HDPE liner (including 10% allowance for wasteage and overlap)	m2	$ 3.00	1,406,900	$ 4,220,700	454,300	$ 1,362,900	-	$ -	$ 5,583,600
	Sub Total				$ 6,635,805		$ 4,508,045		$ 55,330	$ 11,199,180
3	**TSF EMBANKMENT CONSTRUCTION**									
3.1	**Main Embankment**									
3.1.1	Excavate embankment cut off trench, haul and place in Zone C of embankment or designated stockpile	m3	$ 3.00	32,600	$ 97,800	16,700	$ 50,100	-	$ -	$ 147,900
3.1.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	1,700	$ 51,000	1,300	$ 39,000	-	$ -	$ 90,000
3.1.3	Win from borrow, load, haul, spread, condition and compact Zone A material in cut off trench	m3	$ 6.67	34,300	$ 228,781	18,000	$ 120,060	-	$ -	$ 348,841
3.1.4	Scarify, condition and compact suitable insitu subgrade (200 mm depth) within embankment footprint area	m2	$ 0.60	185,000	$ 111,000	575,000	$ 345,000	-	$ -	$ 456,000
3.1.5	Win from stockpile, load, haul, spread, condition and compact Zone C material in embankment	m3	$ 4.50	131,000	$ 589,500	1,753,000	$ 7,888,500	-	$ -	$ 8,478,000
3.1.6	Overhaul, place , spread, condition and compact Zone C1 material in embankment (MINE FLEET)	m3	$ 3.00	740,000	$ 2,220,000	5,513,000	$ 16,539,000	-	$ -	$ 18,759,000
3.1.7	Win from borrow, load, haul, spread, condition and compact Zone A material in embankment	m3	$ 6.67	221,000	$ 1,474,070	589,000	$ 3,928,630	-	$ -	$ 5,402,700
3.1.8	Win from borrow, load, haul, spread, condition and compact Zone B material in embankment	m3	$ 6.67	168,000	$ 1,120,560	532,000	$ 3,548,440	-	$ -	$ 4,669,000
3.1.9	Trim upstream face of Zone A material in preparation for placement of HDPE geomembrane liner	m2	$ 2.50	84,000	$ 210,000	246,000	$ 615,000	-	$ -	$ 825,000
3.1.10	Excavate and backfill HDPE geomembrane anchor trench in two layers	m3	$ 5.00	1,700	$ 8,500	22,600	$ 113,000	-	$ -	$ 121,500
3.1.11	Install 1.5 mm textured HDPE geomembrane liner to upstream embankment face	m2	$ 5.00	102,000	$ 510,000	387,000	$ 1,935,000	-	$ -	$ 2,445,000
3.1.12	Win from borrow, load, haul, place, spread, condition and compact wearing course on embankment crest	m3	$ 8.31	5,300	$ 44,043	69,100	$ 574,221	-	$ -	$ 618,264
3.1.13	Win from borrow or stockpile, load, haul, place, spread and shape Zone D safety bund on embankment crest	m3	$ 3.50	2,600	$ 9,100	33,700	$ 117,950	-	$ -	$ 127,050
3.1.14	Remove wearing course and safety bund from embankment, haul to stockpile	m3	$ 4.00	-	$ -	98,900	$ 395,600	11,800	$ 47,200	$ 442,800
	Sub Total				$ 6,674,354		$ 36,209,501		$ 47,200	$ 42,931,055
4	**BASIN LINER CONSTRUCTION**									
4.1	**Low Permeability Liner**									
4.1.1	Scarify, condition and compact suitable insitu subgrade (200mm depth) as compacted subgrade (where suitable)	m2	$ 0.60	767,000	$ 460,200	230,000	$ 138,000	-	$ -	$ 598,200
4.1.2	Prepare in-situ subgrade for imported compacted soil subgrade (200mm depth)	m2	$ 0.25	512,000	$ 128,000	153,000	$ 38,250	-	$ -	$ 166,250
4.1.3	Win from borrow, load, haul, spread, condition and compact Zone A material (300 mm depth) as compacted subgrade (where in situ soils unsuitable)	m3	$ 6.64	154,000	$ 1,022,560	51,000	$ 338,640	-	$ -	$ 1,361,200
4.1.4	Excavate and backfill HDPE geomembrane anchor trench in two layers	m3	$ 5.00	2,300	$ 11,500	11,200	$ 56,000	-	$ -	$ 67,500
4.1.5	Install 1.5 mm smooth HDPE geomembrane liner to basin area	m2	$ 5.00	1,279,000	$ 6,395,000	413,000	$ 2,065,000	-	$ -	$ 8,460,000
	Sub Total				$ 8,017,260		$ 2,635,890		$ -	$ 10,653,150
5	**UNDERDRAINAGE RETURN**									
5.1	**Upstream Toe Drain**									
5.1.1	Supply and install A24 Bidim geotextile inner cover in upstream toe drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	17,400	$ 60,030	10,100	$ 34,845	-	$ -	$ 94,875
5.1.2	Supply and install Textel 600R non-woven geotextile outer cover in upstream toe drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	17,400	$ 60,030	10,100	$ 34,845	-	$ -	$ 94,875
5.1.3	Supply and install 160mm draincoil with all tees, bends and jointing complete in toe drain (including filter sock)	lin m	$ 16.44	3,200	$ 52,608	2,400	$ 39,456	-	$ -	$ 92,064
5.1.4	Win from stockpile, load, haul, place and spread Zone F1 drainage medium in toe drain	m3	$ 6.50	1,600	$ 10,400	1,400	$ 9,100	-	$ -	$ 19,500
5.1.5	Win from stockpile, load, haul, place and spread 200mm Zone E erosion material within toe drain	m3	$ 7.65	2,300	$ 17,595	1,900	$ 14,535	-	$ -	$ 32,130
5.2	**Downstream Toe Drain**									
5.2.1	Excavate and shape downstream toe drain, haul to stockpile	m3	$ 5.00	5,500	$ 27,500	77,400	$ 387,000	-	$ -	$ 414,500
5.2.3	Win from supplied stockpile, load, haul, place and spread 200mm Zone E erosion protection in toe drain and outlet trench	m3	$ 6.50	2,900	$ 18,850	40,600	$ 263,900	-	$ -	$ 282,750
5.2.4	Excavate and shape outlet trench, haul to stockpile (nominal allowance)	m3	$ 5.00	150	$ 750	1,500	$ 7,500	150	$ 750	$ 9,000
5.3	**Finger Drain**									
5.3.1	Excavate and shape finger drains, haul to stockpile	m3	$ 3.00	900	$ 2,700	-	$ -	-	$ -	$ 2,700
5.3.2	Supply and install 63 mm draincoil groundwater drain, with all tees, bends and joints complete (including filter sock), in finger drain	lin m	$ 7.44	5,000	$ 37,200	-	$ -	-	$ -	$ 37,200
5.3.3	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in central groundwater drain	m3	$ 6.50	900	$ 5,850	-	$ -	-	$ -	$ 5,850
5.3.4	Supply and install A24 Bidim geotextile inner wrap in finger drains (including 10% allowance for overlap and wasteage)	m2	$ 3.45	13,800	$ 47,610	-	$ -	-	$ -	$ 47,610
5.3.5	Supply and install Textel 600R non-woven geotextile outer cover in finger drains (including 10% allowance for overlap and wasteage)	m2	$ 3.45	13,800	$ 47,610	-	$ -	-	$ -	$ 47,610
5.4	**Collector drain**									
5.4.1	Excavate and shape collector drains (including LCRS drain) and channel, haul to stockpile	m3	$ 3.00	30,000	$ 90,000	-	$ -	-	$ -	$ 90,000
5.4.2	Supply and install 160mm draincoil with all tees, bends and joints complete and geotextile wrapped, in LCRS drain	lin m	$ 16.44	6,500	$ 106,860	-	$ -	-	$ -	$ 106,860
5.4.3	Supply and install A14 Bidim geotextile inner cover in LCRS drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	24,300	$ 83,835	-	$ -	-	$ -	$ 83,835
5.4.4	Win from supplied stockpile, load, haul, place and spread Zone F2 drainage medium in LCRS drain	m3	$ 6.50	4,600	$ 29,900	-	$ -	-	$ -	$ 29,900
5.4.5	Supply and install 160mm draincoil with all tees, bends and joints complete and geotextile wrapped, in collector drain	lin m	$ 16.44	13,000	$ 213,720	-	$ -	-	$ -	$ 213,720
5.4.6	Supply and install A24 Bidim geotextile inner cover in collector drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	71,000	$ 244,950	-	$ -	-	$ -	$ 244,950
5.4.7	Supply and install Textel 600R non-woven geotextile outer cover in collector drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	71,000	$ 244,950	-	$ -	-	$ -	$ 244,950
5.4.8	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in collector drain	m3	$ 6.50	6,300	$ 40,950	-	$ -	-	$ -	$ 40,950
5.5	**Toe / Collector drain**									
5.5.1	Excavate and shape toe/collector drains (including LCRS drain) and channel, haul to stockpile	m3	$ 3.00	18,000	$ 54,000	-	$ -	-	$ -	$ 54,000
5.5.2	Supply and install 160mm draincoil with all tees, bends and joints complete and geotextile wrapped, in LCRS drain	lin m	$ 16.44	500	$ 8,220	-	$ -	-	$ -	$ 8,220
5.5.3	Supply and install A14 Bidim geotextile inner cover in LCRS drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	1,700	$ 5,865	-	$ -	-	$ -	$ 5,865
5.5.4	Win from supplied stockpile, load, haul, place and spread Zone F2 drainage medium in LCRS drain	m3	$ 6.50	400	$ 2,600	-	$ -	-	$ -	$ 2,600
5.5.5	Supply and install 160mm draincoil with all tees, bends and joints complete and geotextile wrapped, in toe/collector drain	lin m	$ 16.44	1,000	$ 16,440	-	$ -	-	$ -	$ 16,440
5.5.6	Supply and install A24 Bidim geotextile inner cover in toe/collector drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	3,600	$ 12,420	-	$ -	-	$ -	$ 12,420
5.5.7	Supply and install Textel 600R non-woven geotextile outer cover in collector drain (including 10% allowance for overlap and wasteage)	m2	$ 3.45	3,600	$ 12,420	-	$ -	-	$ -	$ 12,420
5.5.8	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in toe/collector drain	m3	$ 6.50	400	$ 2,600	-	$ -	-	$ -	$ 2,600
5.5.9	Win from stockpile, load, haul, place and spread 200mm Zone E erosion material within toe drain	m3	$ 7.65	2,600	$ 19,890	-	$ -	-	$ -	$ 19,890
5.6	**Underdrainage Collection Sump and Riser Pipe**									
5.6.1	Excavate and shape underdrainage collection sump, haul to stockpile	m3	$ 3.00	500	$ 1,500	-	$ -	-	$ -	$ 1,500
5.6.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	50	$ 1,500	-	$ -	-	$ -	$ 1,500
5.6.3	Supply and install DN630mm PN20 SDR9 PE100 slotted HDPE pipe, including all fittings	Lin m	$ 150.00	12	$ 1,800	-	$ -	-	$ -	$ 1,800
5.6.4	Supply and install DN630mm PN20 SDR9 PE100 solid HDPE pipe, including all fittings	Lin m	$ 150.00	60	$ 9,000	73	$ 10,950	-	$ -	$ 19,950
5.6.5	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in underdrainage collection sump	m3	$ 6.50	240	$ 1,560	-	$ -	-	$ -	$ 1,560
5.6.6	Win from supplied stockpile, load, haul, place and spread Zone F2 drainage medium in underdrainage collection sump	m3	$ 6.50	260	$ 1,690	-	$ -	-	$ -	$ 1,690
5.6.7	Supply and install A24 Bidim geotextile in underdrainage sump (including 10% allowance for overlap and wasteage)	m2	$ 3.45	1,700	$ 5,865	-	$ -	-	$ -	$ 5,865
5.6.8	Supply and install HDPE geomembrane wear sheet beneath underdrainage riser pipe	m2	By Others	70	$ -	100	$ -	-	$ -	$ -
5.6.9	Supply and install concrete filled Solid HDPE ballast pipes including 316 stainless steel plate straps (1000mm c/c)	m3	$ 500.00	19	$ 9,500	28	$ 14,000	-	$ -	$ 23,500
5.6.10	Supply and install submersible underdrainage pump (and associated infrastructure)	Item	By Others	2	$ -	-	$ -	-	$ -	$ -
5.7	**LCRS Collection Sump and Riser Pipe**									
5.7.1	Excavate and shape LCRS collection sump, haul to stockpile	m3	$ 3.00	500	$ 1,500	-	$ -	-	$ -	$ 1,500
5.7.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	50	$ 1,500	-	$ -	-	$ -	$ 1,500
5.7.3	Excavate and shape LCRS riser trench, haul to stockpile	m3	$ 3.00	80	$ 240	150	$ 450	-	$ -	$ 690
5.7.4	Supply and install DN630mm PN20 SDR9 PE100 solid HDPE pipe, including all fittings	lin m	$ 150.00	60	$ 9,000	73	$ 10,950	-	$ -	$ 19,950
5.7.5	Supply and install DN630mm PN20 SDR9 PE100 slotted HDPE pipe, including all fittings	lin m	$ 150.00	12	$ 1,800	-	$ -	-	$ -	$ 1,800
5.7.6	Win from supplied stockpile, load, haul, place and spread Zone F2 drainage medium in LCRS sump	m3	$ 6.50	500	$ 3,250	-	$ -	-	$ -	$ 3,250
5.7.7	Supply and install cement stabilised sand around LCRS riser pipe	m3	$ 35.00	70	$ 2,450	150	$ 5,250	-	$ -	$ 7,700
	Sub Total				$ 1,630,508		$ 832,781		$ 750	$ 2,464,039

Table 13.1 (Cont'd): Tailings Storage Facility – Preliminary Cost Estimate

Item	Description	Unit	Rate	Stage 1		Stage 2+		Closure		Total
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Cost
6	**TURRET SYSTEM**									
6.1	**Turret Inlet Channel**									
6.1.1	Excavate decant turret trench, haul and place in Zone D of Turret causeway or designated stockpile	m3	$ 3.00	38,000	$ 114,000	-	$ -	-	$ -	$ 114,000
6.1.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	1,900	$ 57,000	-	$ -	-	$ -	$ 57,000
6.2	**Turret Causeway**									
6.2.1	Supply and Install turret (and associated infrastructure)	Item	By Others	1	$ -	-	$ -	-	$ -	$ -
6.2.2	Supply and install pump (and associated infrastructure)	Item	By Others	1	$ -	-	$ -	-	$ -	$ -
6.2.3	Relocate existing pump along causeway	Item	By Others	1	$ -	10	$ -	1	$ -	$ -
6.2.4	Win from borrow or stockpile, load, haul, place, spread, condition and compact Zone C material (MINE FLEET)	m3	$ 4.50	2,800	$ 12,600	-	$ -	-	$ -	$ 12,600
6.2.5	Win from borrow or stockpile, load, haul, place, spread, condition and compact wearing course along access road and bunded corridor	m3	$ 8.31	3,000	$ 24,930	-	$ -	-	$ -	$ 24,930
6.2.6	Win from supplied stockpile, load, haul, place and spread Zone E erosion protection over inlet trench and causeway batters	m3	$ 7.65	12,500	$ 95,625	-	$ -	-	$ -	$ 95,625
6.2.7	Win from borrow or stockpile, haul and place Zone D safety bund along access road	m3	$ 3.50	1,300	$ 4,550	-	$ -	-	$ -	$ 4,550
	Sub Total				$ 308,705		$ -		$ -	$ 308,705
7	**EMERGENCY SPILLWAY**									
7.1	**Spillway**									
7.1.1	Clear and grub, emergency spillway haul to designated stockpile	m2	$ 0.13	2,000	$ 250	39,700	$ 4,963	-	$ -	$ 5,213
7.1.2	Strip topsoil from emergeny spillway, haul to designated stockpiles (200mm)	m3	$ 1.36	400	$ 544	8,300	$ 11,288	-	$ -	$ 11,832
7.1.3	Excavate and shape emergency spillway, haul and place in Zone C of embankment or designated stockpile	m3	$ 3.00	2,300	$ 6,900	48,300	$ 144,900	-	$ -	$ 151,800
7.1.4	Scarify, condition and compact base of spillway channel (200 mm depth)	m2	$ 0.60	700	$ 420	34,600	$ 20,760	-	$ -	$ 21,180
7.1.5	Win from supplied stockpile, load, haul, place and spread Zone E erosion protection (200 mm) to spillway channel	m3	$ 6.50	300	$ 1,950	15,000	$ 97,500	-	$ -	$ 99,450
	Sub Total				$ 10,064		$ 279,411		$ -	$ 289,475
8	**TAILINGS & DECANT PIPELINE**									
8.1	**Tailings Delivery Pipeline**									
8.1.1	Supply and install tailings delivery pipeline, including sleepers, sand bags, tees, valves and horizontal restraints	lin m	By Others	2,000	$ -	500	$ -	50	$ -	$ -
8.1.2	Supply and install tailings distribution pipeline along crest, including all tees and valves	lin m	By Others	3,200	$ -	-	$ -	-	$ -	$ -
8.1.3	Supply and install spigot offtakes, including reducing tees, high pressure rubber hose, clamps and signage	Item	By Others	128	$ -	-	$ -	-	$ -	$ -
8.1.4	Supply and install spigot droppers	lin m	By Others	2,700	$ -	5,500	$ -	-	$ -	$ -
8.1.5	Supply and install Bidim A14 wear sheet beneath spigot droppers (including 10% allowance for overlap and wasteage)	m2	By Others	3,000	$ -	6,500	$ -	-	$ -	$ -
8.2	**Decant Return Pipeline**									
8.2.1	Supply and install decant return pipeline, including sleepers, sand bags, tees, valves and horizontal restraints	lin m	By Others	3,500	$ -	-	$ -	-	$ -	$ -
8.3	**Tailings Decant Return Trench**									
8.3.1	Clear and grub, TDRT haul to designated stockpile	m2	$ 0.13	3,500	$ 438	-	$ -	-	$ -	$ 438
8.3.2	Strip topsoil from TDRT, haul to designated stockpiles (200mm)	m3	$ 1.36	700	$ 952	-	$ -	-	$ -	$ 952
8.3.3	Excavate TDRT, haul and place in Zone D of TDRT or designated stockpile	m3	$ 3.00	700	$ 2,100	-	$ -	-	$ -	$ 2,100
8.3.4	Win from borrow, load, haul, spread, condition and compact Zone A material in TDRT	m3	$ 6.64	2,300	$ 15,272	-	$ -	-	$ -	$ 15,272
8.3.5	Win from borrow, load, haul, spread, condition and compact Zone A material (300 mm depth) as low permeability soil liner (where in situ soils unsuitable) with TDRT	m3	$ 6.64	1,100	$ 7,304	-	$ -	-	$ -	$ 7,304
8.3.6	Supply and Install 1.5mm textured HDPE Geomembrane liner to TDRT	m2	$ 7.20	6,300	$ 45,360	-	$ -	-	$ -	$ 45,360
8.3.7	Excavate and backfill in two layers the HDPE Geomembrane Anchor trench	m3	$ 5.00	300	$ 1,500	-	$ -	-	$ -	$ 1,500
8.4	**Event Pond**									
8.4.1	Clear and grub, event pond haul to designated stockpile	m2	$ 0.13	1,300	$ 163	-	$ -	-	$ -	$ 163
8.4.2	Strip topsoil from event pond, haul to designated stockpiles (200mm)	m3	$ 1.36	300	$ 408	-	$ -	-	$ -	$ 408
8.4.3	Excavate event pond, haul and place in Zone D of event pond or designated stockpile	m3	$ 8.31	1,400	$ 11,634	-	$ -	-	$ -	$ 11,634
8.4.4	Win from borrow, load, haul, spread, condition and compact Zone A material in event pond	m3	$ 6.64	500	$ 3,320	-	$ -	-	$ -	$ 3,320
8.4.5	Win from borrow, load, haul, spread, condition and compact Zone A material (300 mm depth) as low permeability soil liner (where in situ soils unsuitable) with event pond	m3	$ 6.50	400	$ 2,600	-	$ -	-	$ -	$ 2,600
8.4.6	Supply and Install 1.5mm textured HDPE Geomembrane liner to event pond	m2	$ 7.20	1,700	$ 12,240	-	$ -	-	$ -	$ 12,240
8.4.7	Excavate and backfill in two layers the HDPE Geomembrane Anchor trench	m3	$ 5.00	60	$ 300	-	$ -	-	$ -	$ 300
	Sub Total				$ 103,590		$ -		$ -	$ 103,590
9	**MONITORING & INSTRUMENTATION**									
9.1	**Instrumentation**									
9.1.1	Install survey pins complete in TSF embankments	Item	$ 500.00	16	$ 8,000	216	$ 108,000	-	$ -	$ 116,000
9.1.2	Install standpipe piezometers complete in TSF embankments	Item	$ 1,500.00	13	$ 19,500	216	$ 324,000	-	$ -	$ 343,500
9.1.3	Decomission standpipe piezometers on previous TSF embankment raise	Item	$ 1,000.00	-	$ -	204	$ 204,000	25	$ 25,000	$ 229,000
9.1.4	Supply and install Vibrating Wire Piezometers including readout station other associated infrastructure	Item	$ 10,000.00	8	$ 80,000	-	$ -	-	$ -	$ 80,000
9.1.6	Install shallow monitoring bores complete (5 - 10 m depth)	Item	$ 5,000.00	5	$ 25,000	-	$ -	-	$ -	$ 25,000
9.1.7	Install deep monitoring bores complete (60 m depth)	Item	$ 15,000.00	5	$ 75,000	-	$ -	-	$ -	$ 75,000
	Sub Total				$ 207,500		$ 636,000		$ 25,000	$ 868,500
10	**TSF REHABILITATION**									
10.1	**Tailings Cap**									
10.1.1	Reshape and cut to fill capping surface	m2	$ 0.60	-	$ -	-	$ -	182,000	$ 109,200	$ 109,200
10.1.2	Win from adjacent wastedump, load, haul, place, spread, condition and compact Zone C fill over tailings surface (500mm) as capillary break	m3	$ 4.50	-	$ -	-	$ -	910,000	$ 4,095,000	$ 4,095,000
10.1.3	Win from borrow, load, haul, place, spread, condition and compact Zone A low permeability fill over tailings surface (300mm)	m3	$ 6.67	-	$ -	-	$ -	546,000	$ 3,641,820	$ 3,641,820
10.2	**Rehabilitation**									
10.2.1	Win from stockpile, load, haul, place and spread topsoil over tailings surface (200mm)	m3	$ 6.50	-	$ -	-	$ -	364,000	$ 2,366,000	$ 2,366,000
10.2.2	Win from stockpile, load, haul, place and spread topsoil along embankment downstream slope (200mm)	m3	$ 6.50	-	$ -	-	$ -	83,000	$ 539,500	$ 539,500
10.2.3	Revegetate tailings surface and embankment downstream slope, including hydroseeding, hand seeding, labour, etc	m2	$ 1.00	-	$ -	-	$ -	2,233,000	$ 2,233,000	$ 2,233,000
	Sub Total				$ -		$ -		$ 12,984,520	$ 12,984,520
11	**SUMMARY**									
1	PRELIMINARY AND GENERAL COSTS				$ 7,862,595		$ 15,033,876		$ 4,370,933	$ 27,267,405
2	TSF SITE PREPARATION AND MATERIAL SUPPLY				$ 6,635,805		$ 4,508,045		$ 55,330	$ 11,199,180
3	TSF EMBANKMENT CONSTRUCTION				$ 6,674,354		$ 36,209,501		$ 47,200	$ 42,931,055
4	BASIN LINER CONSTRUCTION				$ 8,017,260		$ 2,635,890		$ -	$ 10,653,150
5	UNDERDRAINAGE RETURN				$ 1,630,508		$ 832,781		$ 750	$ 2,464,039
6	TURRET SYSTEM				$ 308,705		$ -		$ -	$ 308,705
7	EMERGENCY SPILLWAY				$ 10,064		$ 279,411		$ -	$ 289,475
8	TAILINGS & DECANT PIPELINE				$ 103,590		$ -		$ -	$ 103,590
9	MONITORING & INSTRUMENTATION				$ 207,500		$ 636,000		$ 25,000	$ 868,500
10	TSF REHABILITATION				$ -		$ -		$ 12,984,520	$ 12,984,520
	Total				$ 31,450,381		$ 60,135,503		$ 17,483,733	$ 109,069,618

14. DESIGN RISKS AND OPPORTUNITIES

14.1 GENERAL

An evaluation of risks and opportunities for the project was conducted for the design presented in this report. The risks generally cover technical aspects of the work although some cost aspects are also addressed.

14.2 TAILINGS STORAGE FACILITY

14.2.1 Dam Break Assessment

It is recommended that the following information be reviewed and/or assessed by Hanking to confirm the consequence category of the TSF (based on ANCOLD guidelines, Ref. 1):

- Location and estimation of population of any local settlements downstream of the TSF, and details of any resettlement/relocation planning.
- Assumed manning levels for the process plant, TSF construction and mining operation (refer Section 9.4).
- Confirmation of the assumptions regarding the economic impacts of dam failure.

The Rustlers Roost TSF design presented in this document is considered to be at the higher end of TSF design features for the region as a whole, and as such it is noted that reducing the consequence category of the Rustlers Roost TSF will not result in significant cost reductions.

14.2.2 Beach Slope

The design is based on an average tailings beach slope of 0.6% (150H:1V). However, the beach slope is heavily dependent on the grind size and the ore blend of the tailings. Thus, small changes in plant performance or design, ore type, or the ore blend have the potential to change the tailings beach slope.

There are a number of approaches which can be used in response to measured beach slopes that are consistently different to the beach slope used for design. One of the major advantages to staging of construction on an annual basis is the ability to modify the design each year based on measured data obtained from the TSF. In these cases, the timing and height of the subsequent embankment raises would be modified to bring the schedule back into line with the design, and the subsequent lifts will be on an annual basis essentially as per the design raised heights.

14.2.2.1 Steeper Beach Slope

Deposition occurs from the TSF embankment only. If the measured beach slope is steeper than the design slope, the tailings rate of rise against the Stage 1 embankment will be faster than expected, and the Stage 1 TSF will reach capacity earlier than the design. The response to this would be to adjust the Stage 2 design elevations to accommodate (if possible) and/or bring Stage 2 construction forward, if necessary. Commencing the construction one or two months earlier would not have a significant impact as the construction would still be predominantly in the dry season. It should be noted Stage 1 capacity is 16 months, allowing for a controllable adjustment of the construction sequence. In addition, temporary deposition locations could be established away from the TSF embankment to provide additional storage capacity.

It should be noted that for steeper beach slopes the potential tailings storage would be reduced, but the storm water storage capacity would be increased accordingly.

14.2.2.2 Flatter Beach Slope

If the measured tailings beach slope is flatter than the design slope, the capacity of the Stage 1 TSF to store tailings would be increased. The overall TSF stormwater storage capacity will not be affected, unless Stage 2 construction is deferred beyond the original construction schedule.

14.2.3 Achieved Densities

The staged TSF embankment crest elevations are based on the ore blend and throughput used for the water balance modelling (refer Section 7). Changes in ore blend and/or throughput will result in changes in the achieved densities in the TSF. Similar to the variations in tailings beach slope, this may result in an adjusted construction schedule for Stage 2, either earlier or later than the design timing. It is recommended that monitoring of throughput, ore blend, rate of rise and achieved densities be undertaken (particularly in Stage 1) so that suitable planning and staging of the future embankment construction can occur.

14.2.4 Operating TSF Embankment Profile

If the TSF embankment Zone C1 material comprises coarse, clean rockfill of high strength sourced from the open pit, the stability of the TSF embankment downstream face using a steeper slope (2.5H:1V or even 2.25H:1V) should be considered during the next design phase to reduce costs. The final profile of 3.5H:1V (overall) is assumed to be required for rehabilitation purposes.

14.2.5 Availability of Mine Waste

Design of the TSF is based on structural fill material being sourced from the open pit mining operations. Based on initial review of the mining schedule, this should be suitable for Stage 1 and construction of future raises. If waste is not readily available during the Stage 1 construction, additional borrows will be required. It is noted that sufficient structural fill material will be available from the existing waste dumps. Although this is possible, the capital cost will increase.

Likewise, suitable low permeability fill material may be stockpiled by the mining operation at locations in close proximity to the TSF embankment, for use by civil contractors in future stages. This may reduce earthworks rates during future raise construction.

14.2.6 Life of Mine Planning

Any changes to the life of mine plan will impact upon the tailings requirements for the site. Issues to be considered are specific proportions of tailings types and blends, and TSF capacity, and construction timing. Any significant increases in total throughput may require an expansion of the current TSF, or an additional facility to be considered.

14.2.7 Wet Season Construction

The ability to construct earthworks during the wet season can be limited, so construction over the life of the project needs to be carefully planned and monitored so that approval, budgeting and logistics are in place to allow works to be completed promptly and prior to the onset of wet conditions.

14.2.8 Engineered Soil Cover

The current design for closure and decommissioning of the TSF includes an engineered fill cover constructed over the tailings beach as the most suitable long-term solution. The configuration of this cover has been assumed for this study. Ongoing tailings geochemistry characterisation testing (completed by others) during operation may indicate that it will be possible to grow plants on the final (drained) tailings surface subsequent to compaction. If this is the case, the costs for rehabilitation of the tailings surface could be significantly reduced.

Likewise, ongoing geochemistry testing may indicate that a more comprehensive cover system is required, which may result in increased costs for rehabilitation.

14.2.9 Zone F material

It may be possible to reduce Zone F supply costs if a suitable on-site quarry or mine waste stockpile can be established prior to construction of the Stage 1 TSF. For example, a power screen plant may produce suitable drainage material from the spent ore on the heap leach pad, however this should be confirmed with onsite trials to ensure conformance to the specification.

14.2.10 Annie's Dam Basin Saturation

Annie's Dam will need to be dewatered and decommissioned prior to stage 1 TSF construction. The extent of saturation of the basin material is unknown at this stage, and may take a long time to dry. If the material remains saturated it may not be practicable to HDPE liner the entire footprint of Annie's Dam. Subsequent to Annie's Dam being dewatered and left to dry the basin material will be inspected, free draining areas will have HDPE liner installed and the saturated areas unsuitable for the installation of HDPE liner will be left unlined. It is expected that the saturated areas will be comprised of finer material of low permeability.

14.2.11 Waste Rock Geochemistry

It is currently proposed to utilise mine waste from the open pit as the primary construction material for the TSF embankments. In the report completed by CDM Smith (Ref. 9) it is stated that all of the major lithologies present within the deposit were found to contain acid forming material. On this basis material from the open pit may not be suitable for use in the construction of the TSF embankment. Upon review this is not apparent from the data and material sampling appears to be biased towards sulfide bearing material rather than being representative of the range of waste rock to be mined.

Specific testing on material intended for construction is required to determine its acid forming and leaching characteristics. Given the variability and geochemical risk of the waste rock identified in the studies conducted to date, QA/QC geochemical testing of material will also be required as it is placed to verify that it is appropriate for use in the embankments.

If mine waste won from the open pit is not chemically benign and therefore unsuitable for use in the construction alternate borrows will need to be developed. This will increase earthworks rates and the overall capital cost significantly.

14.2.12 Tailings Solids and Supernatant Geochemistry

Geochemical testing was carried out on tailings solids and supernatant solution (refer Section 5).

A composite basin liner comprising a compacted soil subgrade and HDPE geomembrane liner has been adopted for the design.

Further geochemical and solids testing of the tailings should be continued at points throughout the life of the facility (nominally within the first year of operation and then every 2 years thereafter) to ensure that initial testing remains valid. Measurements will need to continue as part of ongoing operations to ensure information is available on the geochemical and physical behaviour of the tailings.

14.3 SURVEY

Inaccurate base survey is a common cause of variations between expected and actual quantities, particularly in reference to bulk fill earthworks volumes. Topographical contours at times can be generated with small amounts of survey pickup, and as such there may be significant interpolation.

Accurate basin pickup is required as this may have an impact on both bulk fill volumes and the storage capacity of the facility. If there is less storage capacity than currently designed, an earlier start to Stage 2 construction may be required in order to continue to provide the required stormwater storage capacity.

15. REFERENCES

1. Australian National Committee on Large Dams (ANCOLD), "Guidelines on Tailings Dams", 2019.

2. Australian National Committee on Large Dams (ANCOLD), "Guidelines for Design of Dams for Earthquakes", 1998.

3. Global Tailings Review, *"Global Industry Standard on Tailings Management"*, August 2020.

4. Australian National Committee on Large Dams (ANCOLD), "Guidelines on Selection of Acceptable Flood Capacity for Dams", March 2000.

5. GEM (2017), The openquake-engine User Instruction Manual.

6. Knight Piésold Australia, Report Ref. PE801-00102/03, "Definitive Feasibility Study Geotechnical Interpretative Report", December 2021.

7. CDM Smith, "*Appendix H – Water Balance and Updated Groundwater Modelling Report*", 2022.

8. HydroGeoLogic, "Rustlers Roost and Quest 29 Groundwater Peer Review", 28 July 2022.

9. CDM Smith, "*Appendix F – Materials Characterisation Study*", July 2022.

10. GEO-SLOPE International Ltd., "SEEP/W" (software), 2007.

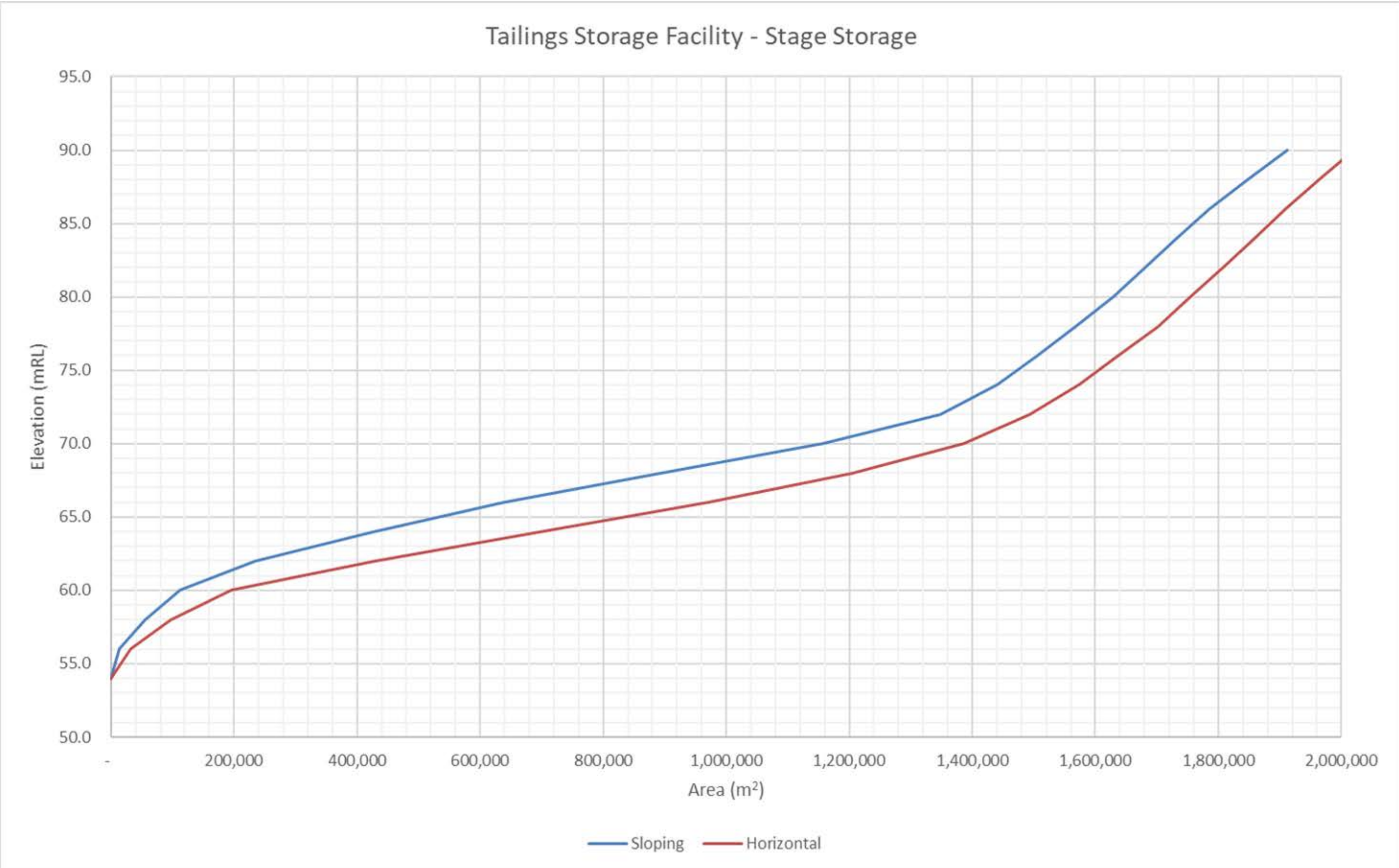
11. GEO-SLOPE International Ltd., "SLOPE/W" (software), 2007.

12. CDM Smith, "*Rustlers Roost Project – desktop geochemical assessment*", April 2019.

FIGURES

Knight Piésold CONSULTING

Tailings Storage Facility - Stage Storage
Elevation (mRL)
Volume (m³)
Sloping
Horizontal
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
-
5,000,000
10,000,000
15,000,000
20,000,000
25,000,000
30,000,000
35,000,000
40,000,000
45,000,000



Tailings Storage Facility - Stage Storage
Elevation (mRL)
Area (m²)
Sloping
Horizontal
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
-
200,000
400,000
600,000
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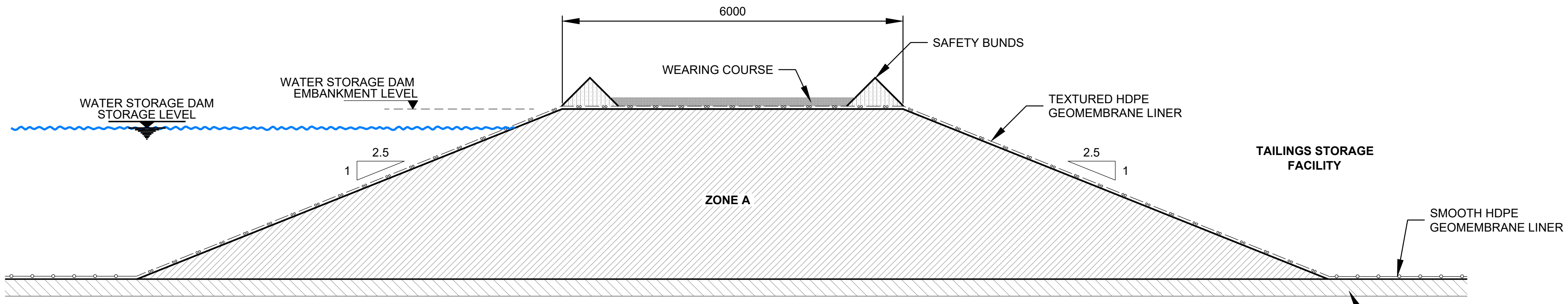
1,800,000
2,000,000

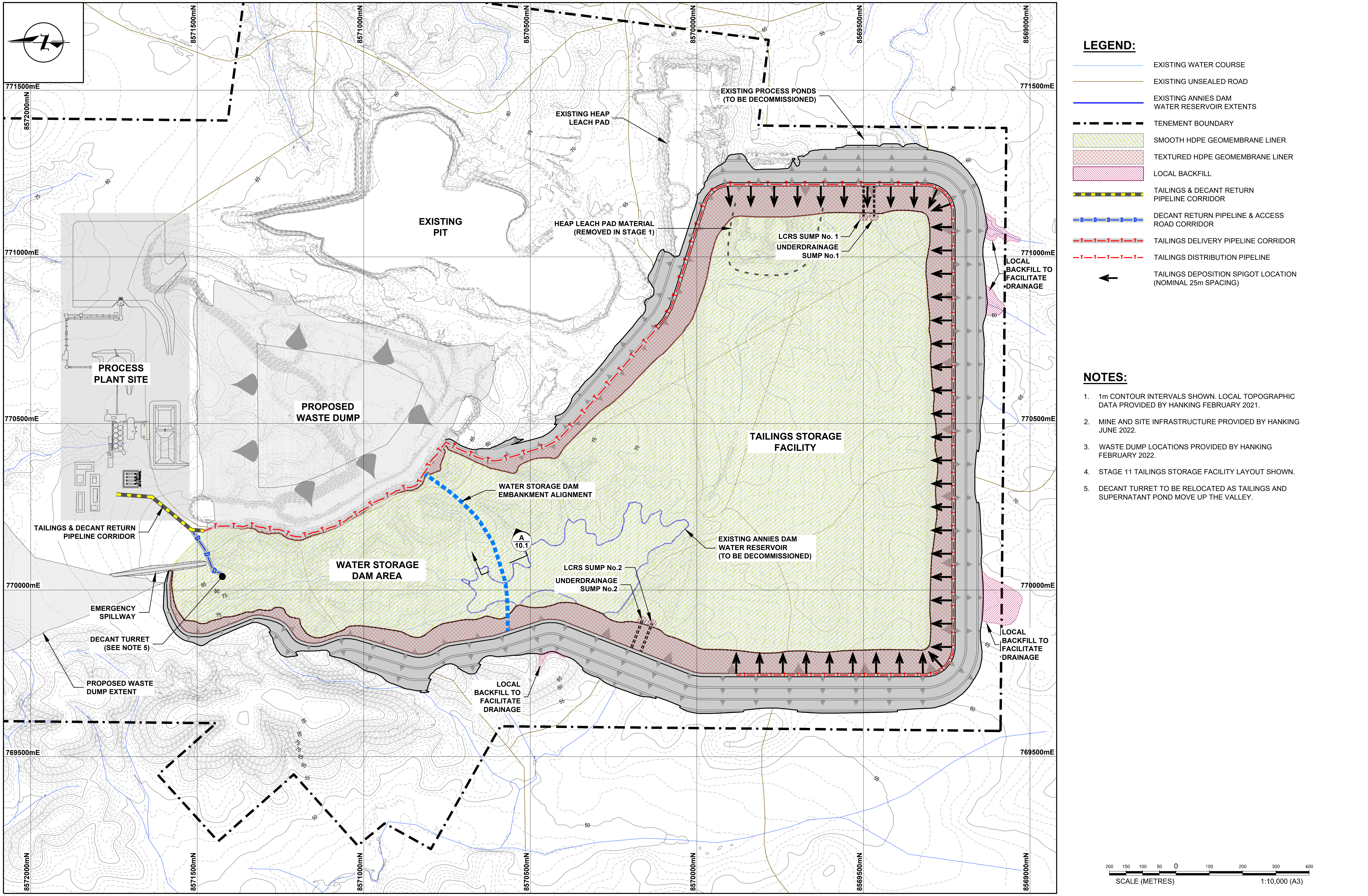


A
10.2

WATER STORAGE DAM EMBANKMENT SECTION

1:100

200 150 100 50 0 100 200 300 400
SCALE (METRES) 1:10,000 (A3)



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RUSTLERS ROOST GOLD PROJECT
FEASIBILITY DESIGN REPORT
GENERAL ARRANGEMENT PLAN - FINAL

PE801-00102/04
Figure 10.2

DRAWINGS

RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY

FEASIBILITY STUDY

FOR REVIEW
JULY, 2022

Prepared for:

HANKING AUSTRALIA INVESTMENT

Prepared by:

Knight Piésold CONSULTING

A.B.N. 67 001 040 419
A.C.N. 001 040 419

Knight Piésold Pty. Ltd.
Level 1, 184 Adelaide Terrace
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AUSTRALIA

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

DRAWING No.	DRAWING TITLE

SHEET SIZE A3 — REFERENCES

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
TITLE PAGE

SCALE N.T.S.
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-001**
REV: **C**

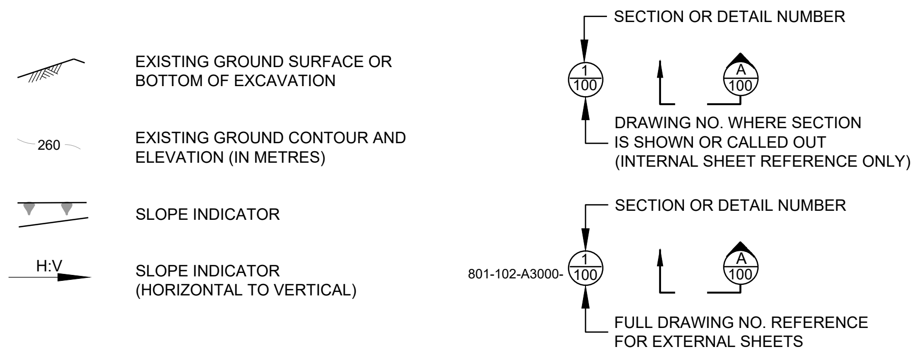
ABBREVIATIONS

C.M.	CONSTRUCTION MANAGER	NOM	NOMINAL
N.T.S.	NOT TO SCALE	OD	OUTSIDE DIAMETER
APPROX, ≈	APPROXIMATELY	OMC	OPTIMUM MOISTURE CONTENT
BOP	BOTTOM OF PIPE	PC	POINT OF CURVATURE
℄	CENTRELINE	PI	POINT OF INTERSECTION
CPT	CORRUGATED POLYETHYLENE TUBING	PT	POINT OF TANGENT
DIA , Ø	DIAMETER	PVC	POLYVINYL CHLORIDE
ELEV	ELEVATION	RC	REINFORCED CONCRETE
HLF	HEAP LEACH FACILITY	RCP	REINFORCED CONCRETE PIPE
HDPE	HIGH DENSITY POLYETHYLENE	REQ'D	REQUIRED
ID	INSIDE DIAMETER	R.L.	REDUCED LEVEL
IL	INVERT LEVEL	SDR	STANDARD DIMENSIONAL RATIO
LCRS	LEAKAGE COLLECTION & REMOVAL SYSTEM	SCH	SCHEDULE
LLDPE	LINEAR LOW DENSITY POLYETHYLENE	SMDD	STANDARD MAXIMUM DRY DENSITY
MAX	MAXIMUM	SOL	SETTING OUT LINE
MIN	MINIMUM	SOP	SETTING OUT POINT
		TSF	TAILINGS STORAGE FACILITY
		TYP	TYPICAL

INDEX OF DRAWINGS

DRAWING TITLE	REV.	DRAWING No.
TITLE PAGE	C	801-102-A3000-001
INDEX, COMMON LEGEND AND ABBREVIATIONS	C	801-102-A3000-002
SITE GENERAL ARRANGEMENT PLAN	C	801-102-A3000-050
GENERAL ARRANGEMENT PLAN - STARTER	C	801-102-A3000-100
GENERAL ARRANGEMENT PLAN - FINAL	C	801-102-A3000-150
TYPICAL SECTIONS AND DETAILS - SHEET 1	B	801-102-A3000-201
TYPICAL SECTIONS AND DETAILS - SHEET 2	B	801-102-A3000-202
TYPICAL SECTIONS AND DETAILS - SHEET 3	B	801-102-A3000-203
TYPICAL SECTIONS AND DETAILS - SHEET 4	B	801-102-A3000-204
TYPICAL SECTIONS AND DETAILS - SHEET 5	B	801-102-A3000-205
TYPICAL UNDERDRAINAGE SYSTEM LAYOUT	C	801-102-A3000-400
TYPICAL UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 1	B	801-102-A3000-401
TYPICAL UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 2	B	801-102-A3000-402
TYPICAL UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 3	B	801-102-A3000-403
TYPICAL UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 4	A	801-102-A3000-404
TYPICAL SPILLWAY PLAN SECTIONS AND DETAILS	B	801-102-A3000-610
TYPICAL SPIGOT PIPEWORK DETAILS	B	801-102-A3000-710
TYPICAL SPIGOT CLAMP DETAILS	B	801-102-A3000-720
MONITORING INSTRUMENTATION LAYOUT	C	801-102-A3000-800
TYPICAL MONITORING AND INSTRUMENTATION DETAILS	B	801-102-A3000-810

COMMON LEGEND



EXISTING GROUND SURFACE OR BOTTOM OF EXCAVATION

EXISTING GROUND CONTOUR AND ELEVATION (IN METRES)

SLOPE INDICATOR

SLOPE INDICATOR (HORIZONTAL TO VERTICAL)

GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL COORDINATES STATED IN GRID PROJECTION: MGA94 ZONE 52.
3. ALL ELEVATIONS IN METRES, RELATIVE TO MEAN SEA LEVEL.
4. DRAWINGS ARE NOT TO BE SCALED.
5. DRAWINGS TO BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS.

REFERENCES

DRAWING No.	DRAWING TITLE

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

SHEET SIZE A3

ORIGINAL STAMPED IN RED

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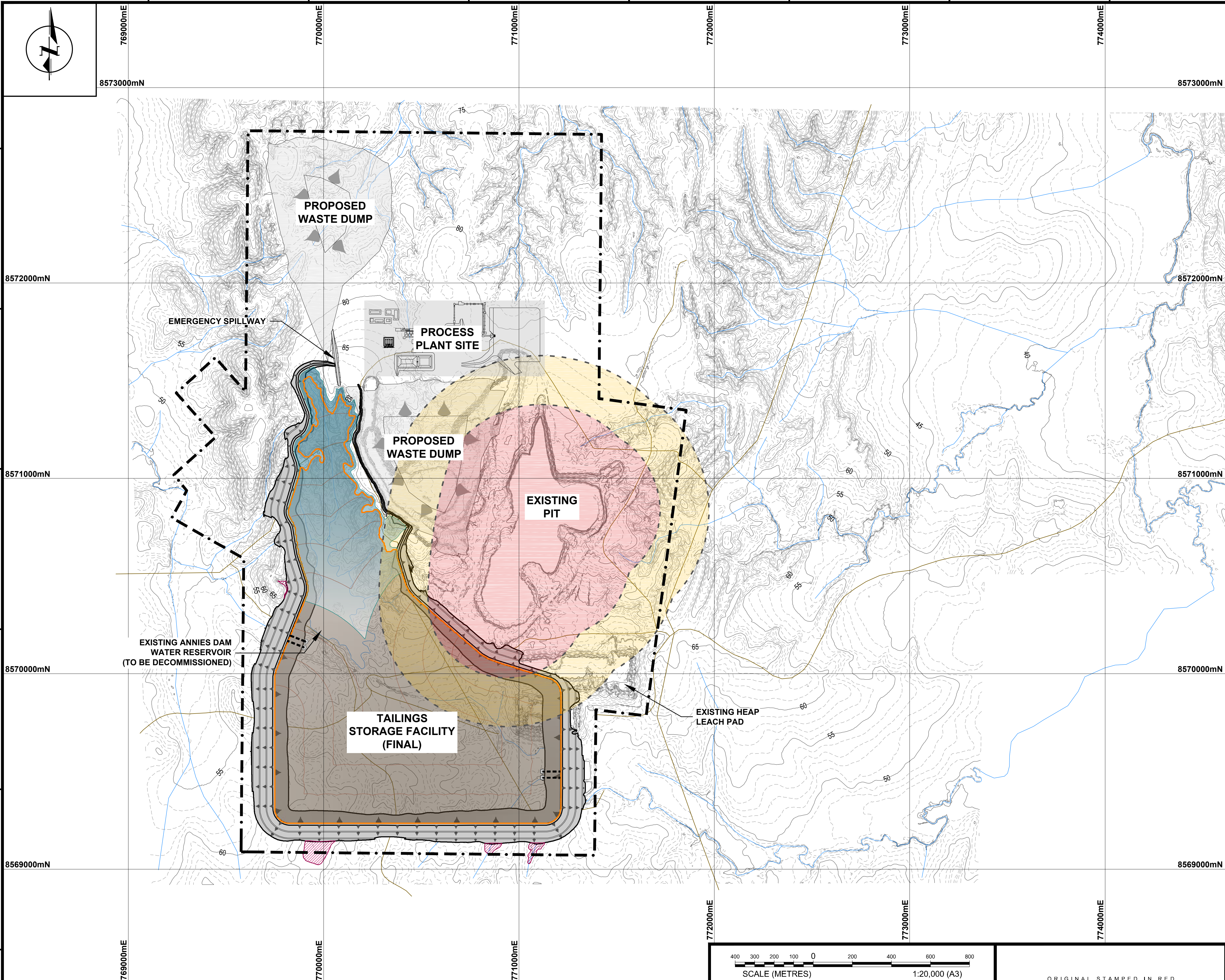
CONSULT AUSTRALIA Member Firm

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
INDEX, COMMON LEGEND AND ABBREVIATIONS

SCALE N.T.S.
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-002**
REV: **C**



LEGEND:

- EXISTING WATER COURSE
- EXISTING UNSEALED ROAD
- TENEMENT BOUNDARY
- BLAST ZONE - 250m
- BLAST ZONE - 500m
- TAILINGS EXTENT
- SUPERNATANT POND

NOTES:

1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. FINAL TAILINGS STORAGE FACILITY SHOWN.
3. MINE AND SITE INFRASTRUCTURE PROVIDED BY HANKING JUNE 2022.
4. WASTE DUMP LOCATIONS PROVIDED BY HANKING FEBRUARY 2022.
5. 1.1 Mm³ SUPERNATANT POND SHOWN.

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

SHEET SIZE A3 — REFERENCES — DRAWING No. — DRAWING TITLE

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DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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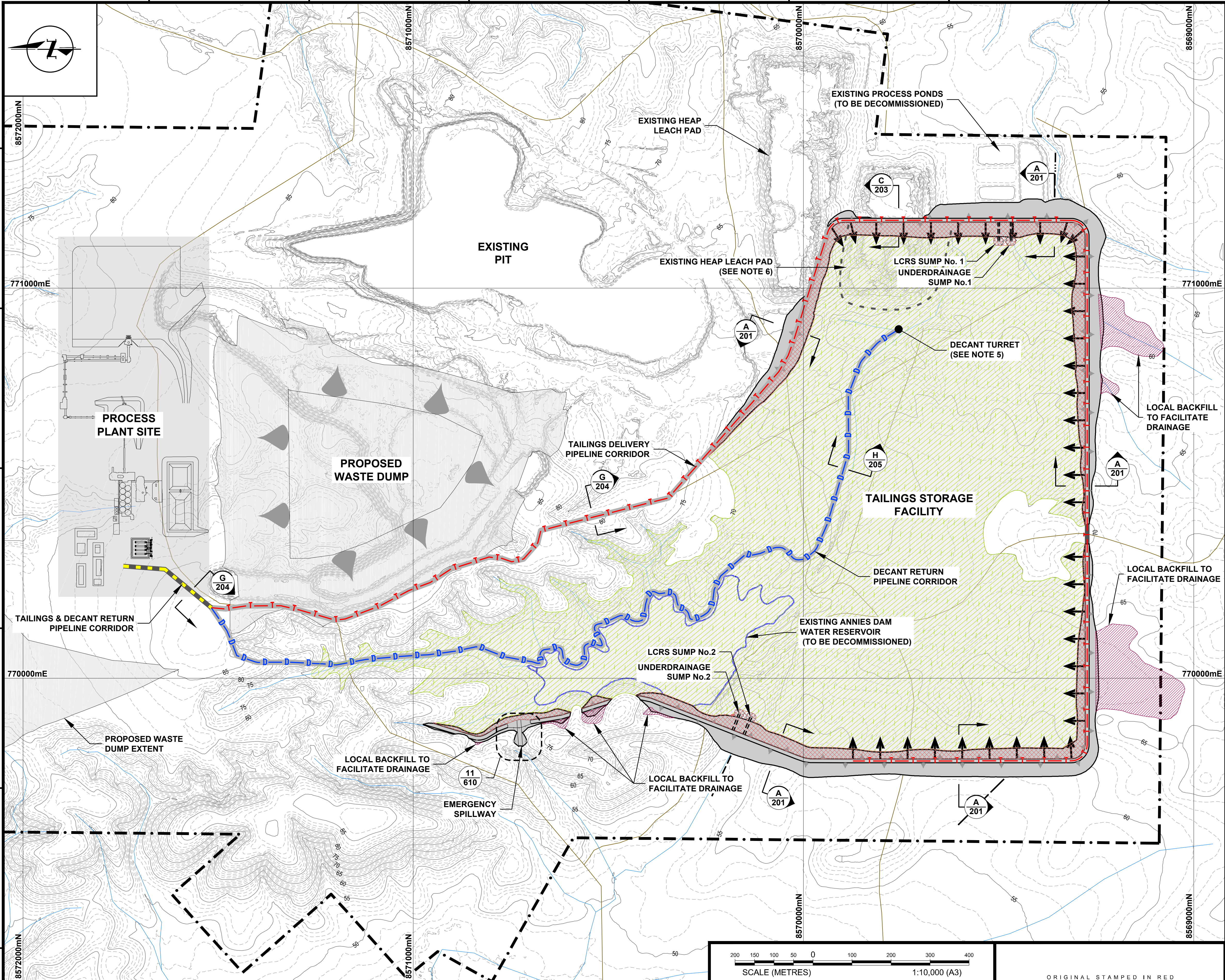
HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
SITE GENERAL ARRANGEMENT PLAN

SCALE 1:20,000
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-050**
REV: **C**



LEGEND:

- EXISTING WATER COURSE
- EXISTING UNSEALED ROAD
- EXISTING ANNIES DAM WATER RESERVOIR EXTENTS
- TENEMENT BOUNDARY
- SMOOTH HDPE GEOMEMBRANE LINER
- TEXTURED HDPE GEOMEMBRANE LINER
- LOCAL BACKFILL
- TAILINGS & DECANT RETURN PIPELINE CORRIDOR
- DECANT RETURN PIPELINE & ACCESS ROAD CORRIDOR
- TAILINGS DELIVERY PIPELINE CORRIDOR
- TAILINGS DISTRIBUTION PIPELINE
- TAILINGS DEPOSITION SPIGOT LOCATION (NOMINAL 25m SPACING)

NOTES:

1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. MINE AND SITE INFRASTRUCTURE PROVIDED BY HANKING JUNE 2022.
3. WASTE DUMP LOCATIONS PROVIDED BY HANKING FEBRUARY 2022.
4. STAGE 1 TAILINGS STORAGE FACILITY LAYOUT SHOWN.
5. DECANT TURRET TO BE RELOCATED AS TAILINGS AND SUPERNATANT POND MOVE UP THE VALLEY.
6. EXISTING HEAP LEACH PAD MATERIAL TO BE REMOVED FROM THE TAILINGS STORAGE FACILITY BASIN AND UTILISED IN EMBANKMENT CONSTRUCTION.

REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-201	TYPICAL SECTIONS & DETAILS -SHT 1
801-102-A3000-203	TYPICAL SECTIONS & DETAILS -SHT 3
801-102-A3000-204	TYPICAL SECTIONS & DETAILS -SHT 4
801-102-A3000-205	TYPICAL SECTIONS & DETAILS -SHT 5
801-102-A3000-610	SPILLWAY PLAN, SECTIONS & DETAILS

SHEET SIZE A3

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

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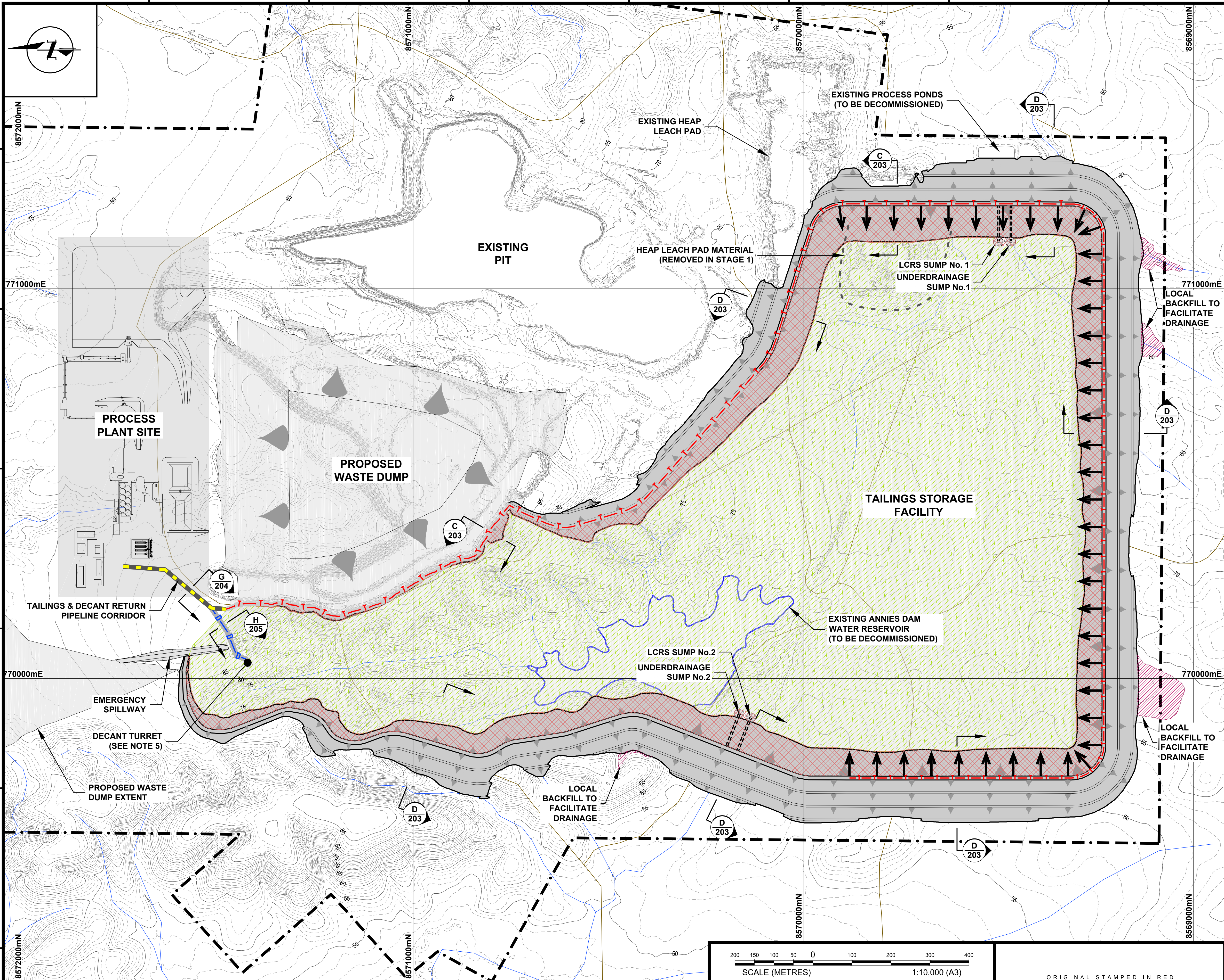
HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
GENERAL ARRANGEMENT PLAN - STARTER

SCALE 1: 10,000
STATUS: FOR REVIEW
DRAWING NUMBER: 801-102-A3000-100
REV: C



LEGEND:

- EXISTING WATER COURSE
- EXISTING UNSEALED ROAD
- EXISTING ANNIES DAM WATER RESERVOIR EXTENTS
- TENEMENT BOUNDARY
- SMOOTH HDPE GEOMEMBRANE LINER
- TEXTURED HDPE GEOMEMBRANE LINER
- LOCAL BACKFILL
- TAILINGS & DECANT RETURN PIPELINE CORRIDOR
- DECANT RETURN PIPELINE & ACCESS ROAD CORRIDOR
- TAILINGS DELIVERY PIPELINE CORRIDOR
- TAILINGS DISTRIBUTION PIPELINE
- TAILINGS DEPOSITION SPIGOT LOCATION (NOMINAL 25m SPACING)

NOTES:

1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. MINE AND SITE INFRASTRUCTURE PROVIDED BY HANKING JUNE 2022.
3. WASTE DUMP LOCATIONS PROVIDED BY HANKING FEBRUARY 2022.
4. STAGE 11 TAILINGS STORAGE FACILITY LAYOUT SHOWN.
5. DECANT TURRET TO BE RELOCATED AS TAILINGS AND SUPERNATANT POND MOVE UP THE VALLEY.

REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-203	TYPICAL SECTIONS & DETAILS -SHT 3
801-102-A3000-204	TYPICAL SECTIONS & DETAILS -SHT 4
801-102-A3000-205	TYPICAL SECTIONS & DETAILS -SHT 5

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

SHEET SIZE A3

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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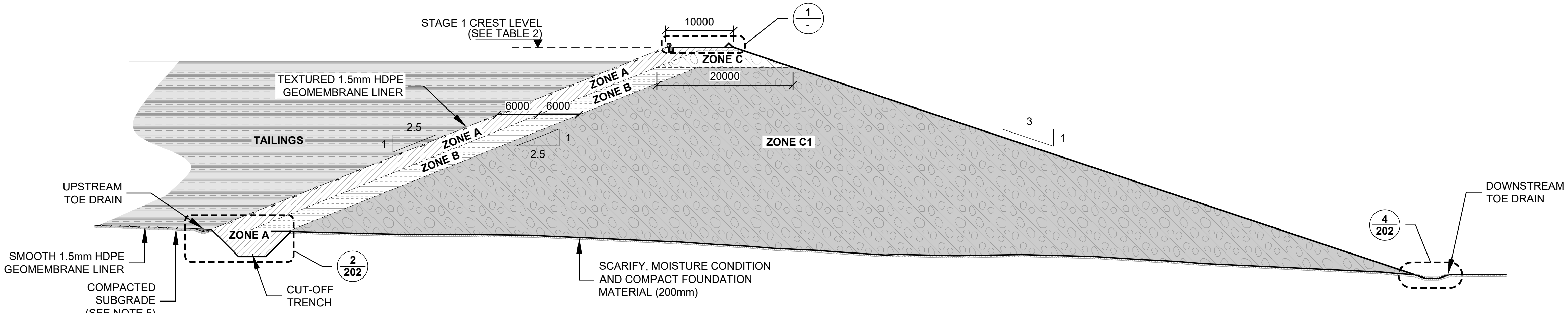
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
GENERAL ARRANGEMENT PLAN - FINAL

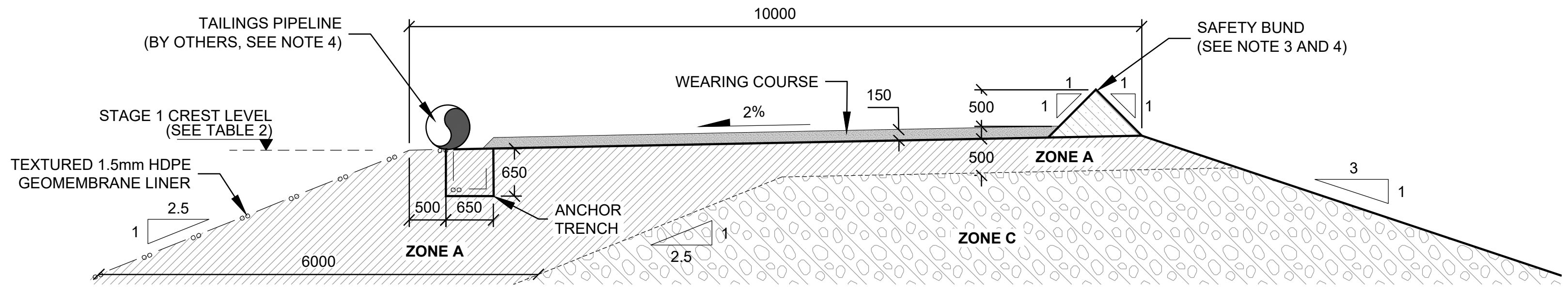
SCALE 1:10,000
STATUS: FOR REVIEW
DRAWING NUMBER 801-102-A3000-150
REV C



A / 100 **TYPICAL STAGE 1 EMBANKMENT CROSS SECTION**
1:750

NOTES:

1. EMBANKMENT FOUNDATION PREPARATION SHALL EXTEND 5000mm BEYOND THE TOE OF THE EMBANKMENT.
2. EMBANKMENT FOUNDATION IN THE VALLEY FLOOR WHICH IS DEEMED UNSUITABLE BY THE ENGINEER ON SITE IS TO BE REMOVED AND REPLACED BY ZONE A OR ZONE C MATERIAL.
3. SAFETY BUND MATERIAL TO BE PLACED, TRIMMED AND BUCKET TAMPED.
4. SAFETY BUNDS ARE TO BE INSTALLED (500mm HIGH MIN.) ON THE UPSTREAM CREST WHERE NO PIPELINE EXISTS. BREAKS IN UPSTREAM SAFETY BUNDS AT 50m INTERVALS TO ALLOW FOR DRAINAGE OF RAINFALL RUNOFF.
5. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).
6. ZONE B TRANSITION MATERIAL REQUIRED AS DIRECTED BY THE ENGINEER ON SITE.



1 / - **TYPICAL STARTER EMBANKMENT CREST DETAIL**
1:100

TABLE 1: ZONE SPECIFICATIONS SUMMARY

ZONE KEY	ZONE TYPE	DESCRIPTION	MAXIMUM LAYER THICKNESS	COMPACTION SPECIFICATION	GRADING
	ZONE A	LOW PERMEABILITY FILL	300mm	98% OF STANDARD MAXIMUM DRY DENSITY OMC -2% < MC < OMC +3%	D_{max}=150mm % FINES > 20 PI_{fines}>8
	ZONE B	TRANSITION ZONE	500mm	TRAFFIC COMPACTED 95% OF STANDARD MAXIMUM DRY DENSITY OMC -2% < MC < OMC +3%	D_{max}=300mm PI_{fines}>5
	ZONE C	MINE WASTE ROCK (BY CONTRACTOR)	500mm	UNIFORM DENSITY FREE OF VOIDS 95% OF STANDARD MAXIMUM DRY DENSITY	D_{max}=300mm PI_{fines}>5
	ZONE C1	MINE WASTE ROCK (BY MINING FLEET)	1500mm	UNIFORM DENSITY FREE OF VOIDS TRAFFIC COMPACTED BY LOADED TRUCKS	D_{max}=1000mm
	ZONE D	RANDOM FILL	500mm	92% OF STANDARD MAXIMUM DRY DENSITY OMC -0% < MC < OMC +3%	N/A
	ZONE E	EROSION PROTECTION (CLEAN ROCKFILL)	300mm	TAMPED WITH EXCAVATOR BUCKET	D_{max}=300mm % FINES < 5
	ZONE F1	DRAINAGE MEDIUM (SAND OR FINE GRAVEL)	N/A	UNIFORM DENSITY FREE FROM CAVITIES	D_{max}=19mm % FINES < 5
	ZONE F2	DRAINAGE MEDIUM (SAND OR FINE GRAVEL)	N/A	UNIFORM DENSITY FREE FROM CAVITIES	D_{max}=37.5mm % FINES < 5
	WEARING COURSE	GRAVEL	150mm	UNIFORM DENSITY FREE FROM CAVITIES	D_{max}=37.5mm % FINES 5-15
	EMBANKMENT FOUNDATION	IN-SITU MATERIAL (AS APPROVED BY THE ENGINEER)	200mm	98% OF STANDARD MAXIMUM DRY DENSITY OMC -3% < MC < OMC +3%	AS APPROVED BY ENGINEER
	COMPACTED SUBGRADE	RE-WORKED IN-SITU MATERIAL OR IMPORTED LOW PERMEABILITY FILL	300mm	98% OF STANDARD MAXIMUM DRY DENSITY OMC -3% < MC < OMC +3%	D_{max}=150mm % FINES > 20 PI_{fines}>8

TABLE 2: EMBANKMENT CREST ELEVATION

STAGE	RAISE HEIGHT (m)	ELEVATION (m R.L.)
1	VARIES (MAX. 18)	70.0
2	2.2	72.2
3	2.0	74.2
4	1.8	76.0
5	1.9	77.9
6	1.8	79.7
7	1.7	81.4
8	1.6	83.0
9	1.7	84.7
10	1.5	86.2
11	1.2	87.4

SHEET SIZE A3

REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-100	GENERAL ARRANGEMENT PLAN STARTER
801-102-A3000-202	TYPICAL SECTIONS & DETAILS-SHT 2

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

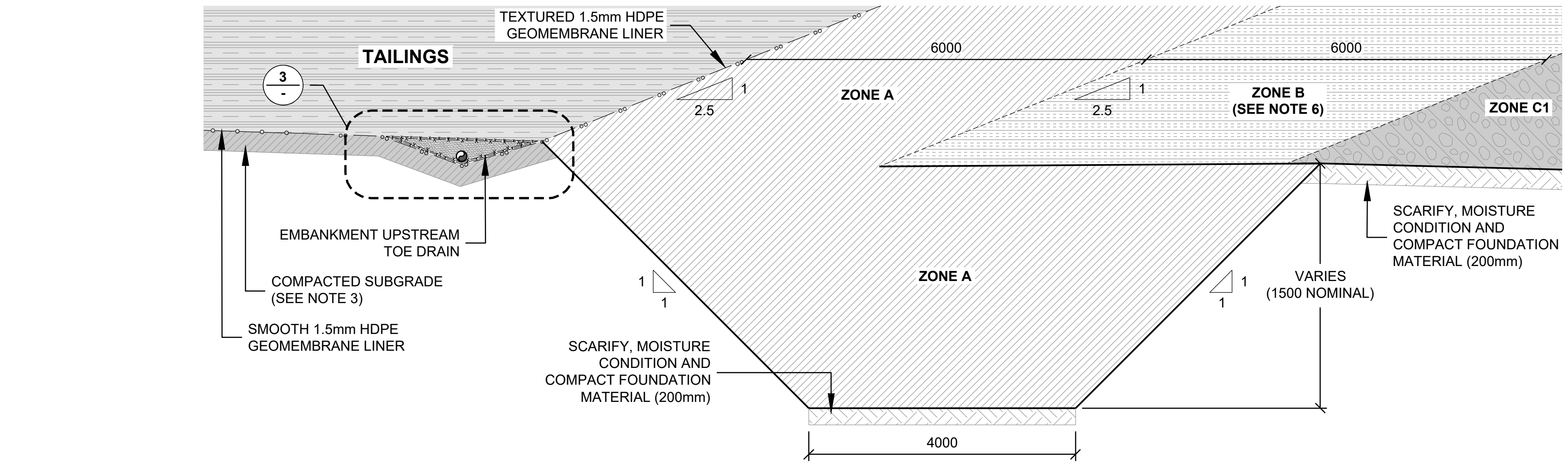
Knight Piésold CONSULTING

CONSULT AUSTRALIA Member Firm

HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS - SHEET 1

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-201**
REV: **B**

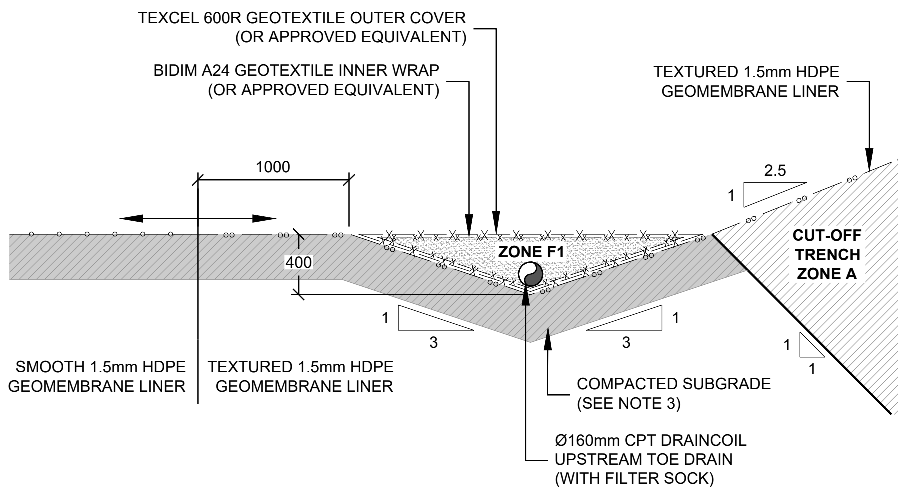
287
410



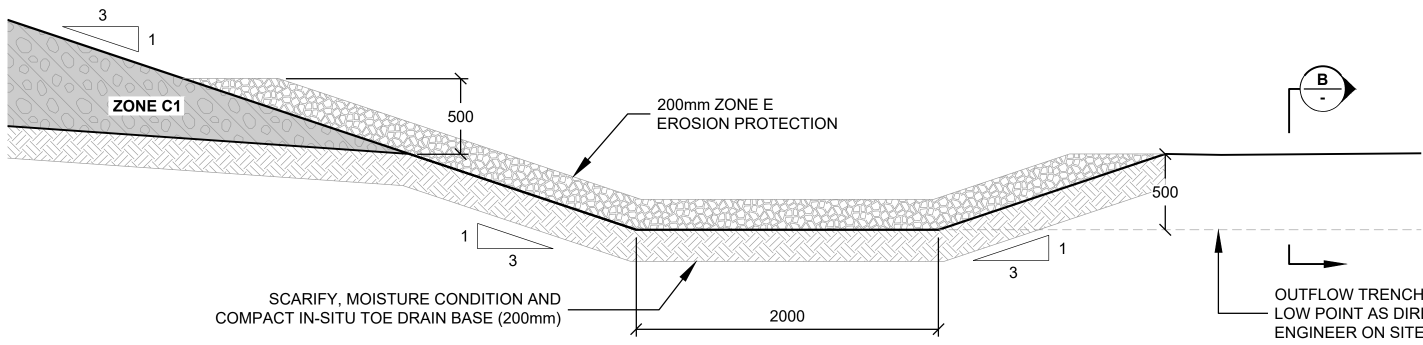
2 / 201 **TYPICAL TSF EMBANKMENT CUT-OFF TRENCH DETAIL**
1:100

NOTES:

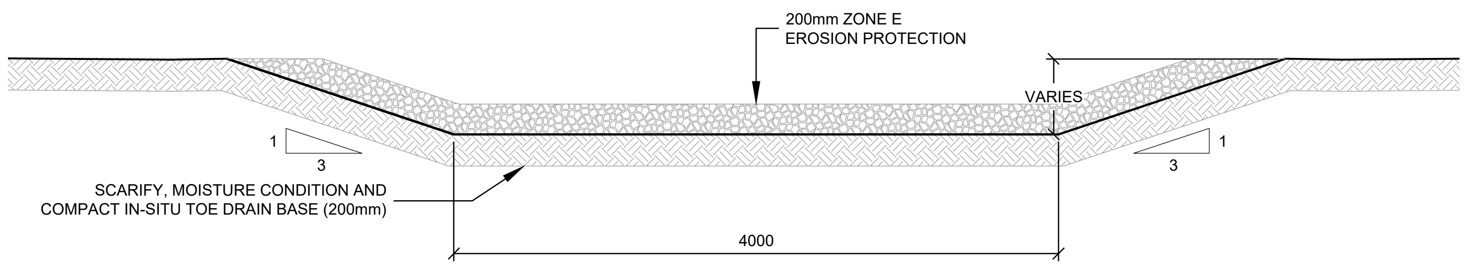
1. EMBANKMENT FOUNDATION PREPARATION SHALL EXTEND 5000mm BEYOND THE TOE OF THE EMBANKMENT.
2. EMBANKMENT FOUNDATION IN THE VALLEY FLOOR WHICH IS DEEMED UNSUITABLE BY THE ENGINEER ON SITE IS TO BE REMOVED AND REPLACED BY ZONE A OR ZONE C MATERIAL.
3. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).
4. FOR ZONE SPECIFICATIONS REFER TABLE 1 ON DRAWING 801-102-A3000-201.
5. FOR EMBANKMENT CREST LEVELS REFER TABLE 2 ON DRAWING 801-102-A3000-201.
6. ZONE B TRANSITION MATERIAL REQUIRED AS DIRECTED BY THE ENGINEER ON SITE.



3 / - **TYPICAL UPSTREAM TOE DRAIN DETAIL**
1:50



4 / 201 4 / 203 **TYPICAL DOWNSTREAM TOE DRAIN**
1:50



B / - **TYPICAL DOWNSTREAM TOE DRAIN OUTFLOW TRENCH SECTION**
1:50

DRAWING No.	DRAWING TITLE
801-102-A3000-201	TYPICAL SECTIONS & DETAILS - SHT 1
801-102-A3000-203	TYPICAL SECTIONS & DETAILS - SHT 3

REFERENCES — SHEET SIZE A3

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

REVISIONS

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

ORIGINAL STAMPED IN RED

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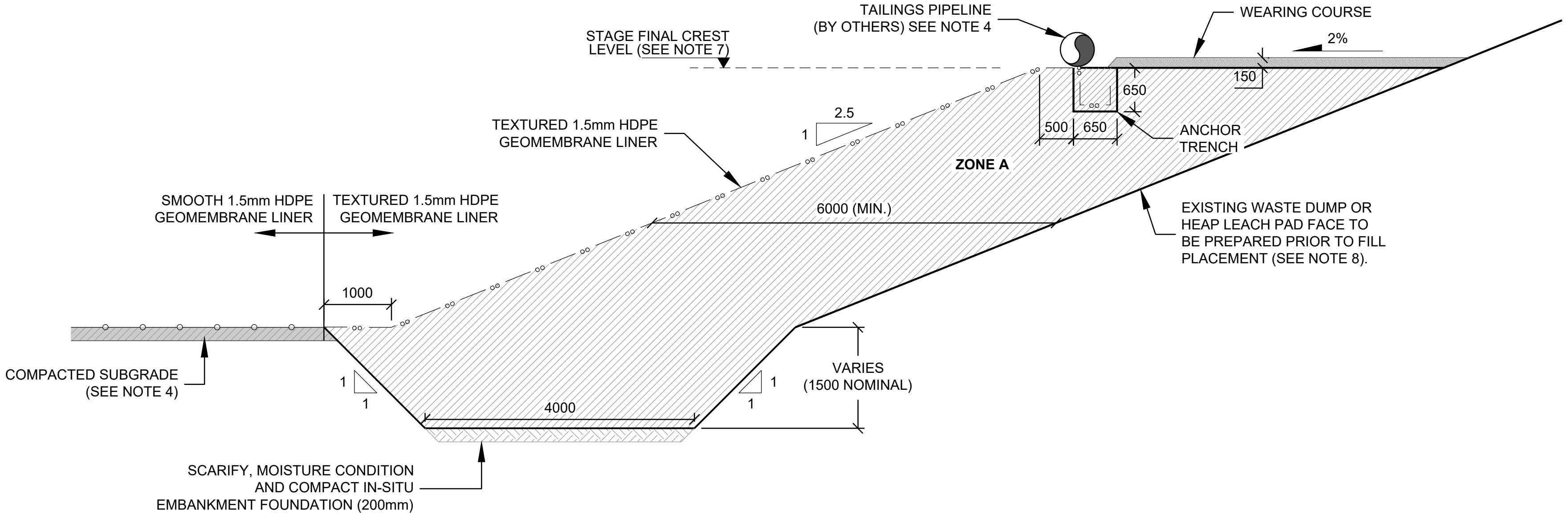
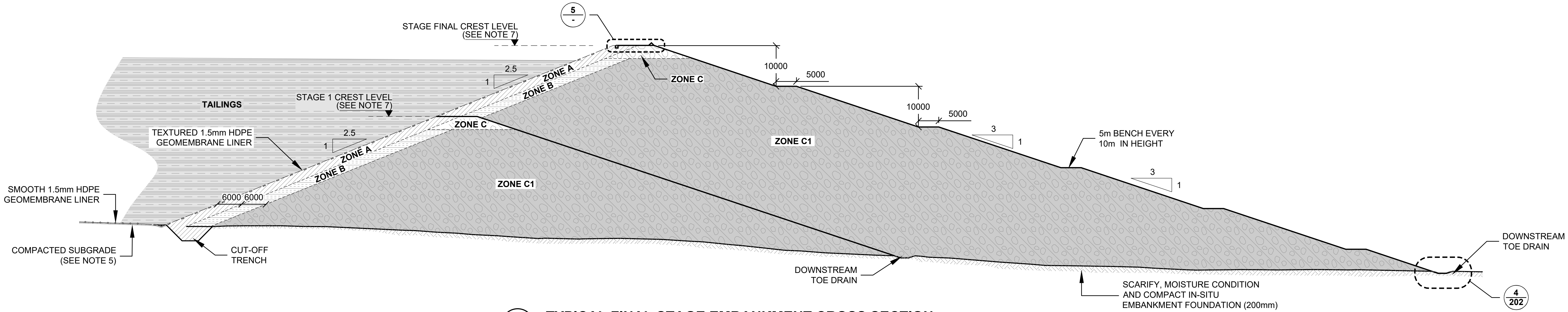
HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS - SHEET 2

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-202** REV **B**

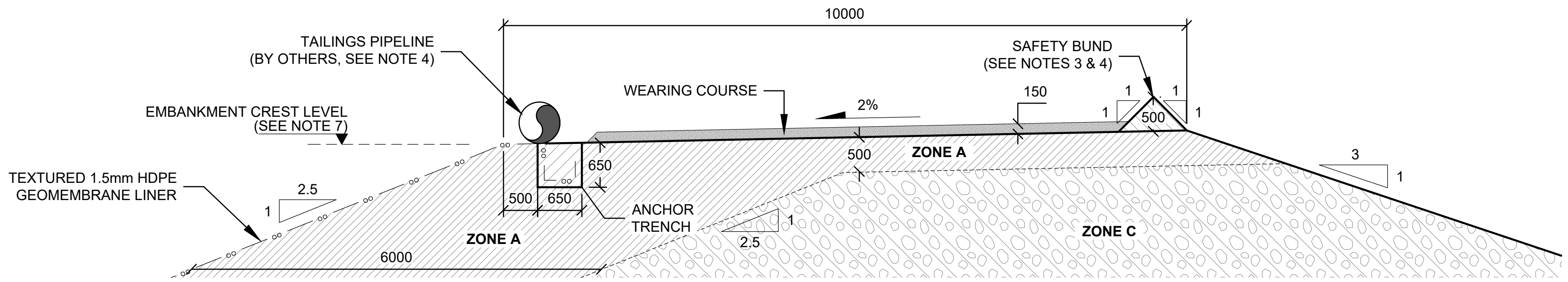
287
410



C/100 C/150 **TYPICAL EMBANKMENT SECTION AGAINST WASTE DUMP AND HEAP LEACH PAD**
1:100



D/150 **TYPICAL FINAL STAGE EMBANKMENT CROSS SECTION**
1:1,000



5/- **TYPICAL EMBANKMENT CREST DETAIL**
1:100

NOTES:

1. EMBANKMENT FOUNDATION PREPARATION SHALL EXTEND 5000mm BEYOND THE TOE OF THE EMBANKMENT.
2. EMBANKMENT FOUNDATION IN THE VALLEY FLOOR WHICH IS DEEMED UNSUITABLE BY THE ENGINEER ON SITE IS TO BE REMOVED AND REPLACED BY ZONE A OR ZONE C MATERIAL.
3. SAFETY BUND MATERIAL TO BE PLACED, TRIMMED AND BUCKET TAMPED.
4. SAFETY BUNDS ARE TO BE INSTALLED (500mm HIGH MIN.) ON THE UPSTREAM CREST WHERE NO PIPELINE EXISTS. BREAKS IN UPSTREAM SAFETY BUNDS AT 50m INTERVALS TO ALLOW FOR DRAINAGE OF RAINFALL RUNOFF.
5. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).
6. FOR ZONE SPECIFICATIONS REFER TABLE 1 ON DRAWING 801-102-A3000-201.
7. FOR EMBANKMENT CREST LEVELS REFER TABLE 2 ON DRAWING 801-102-A3000-201.
8. ZONE B TRANSITION MATERIAL REQUIRED AS DIRECTED BY THE ENGINEER ON SITE.

SHEET SIZE A3 — REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-100	GENERAL ARRANGEMENT PLAN - STARTER
801-102-A3000-150	GENERAL ARRANGEMENT PLAN-FINAL
801-102-A3000-201	TYPICAL SECTIONS & DETAILS-SHT 1
801-102-A3000-202	TYPICAL SECTIONS & DETAILS-SHT 3

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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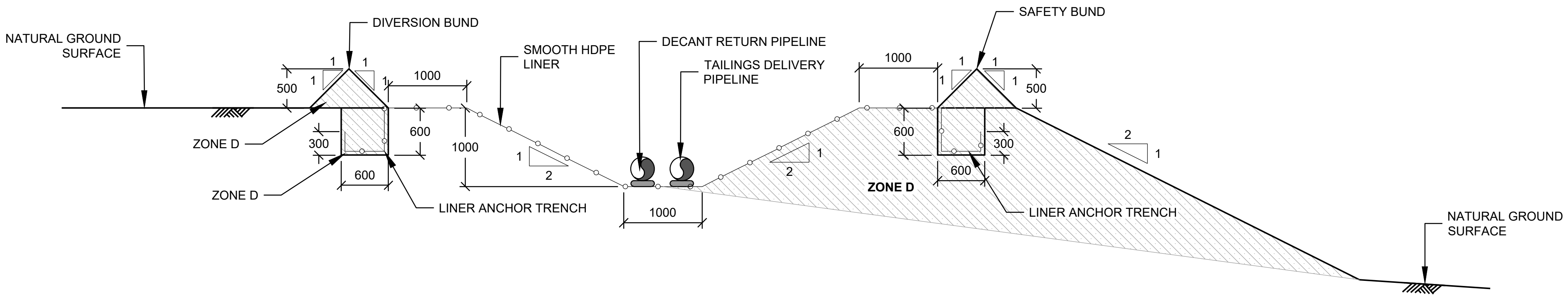
TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS - SHEET 3

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-203** REV **B**

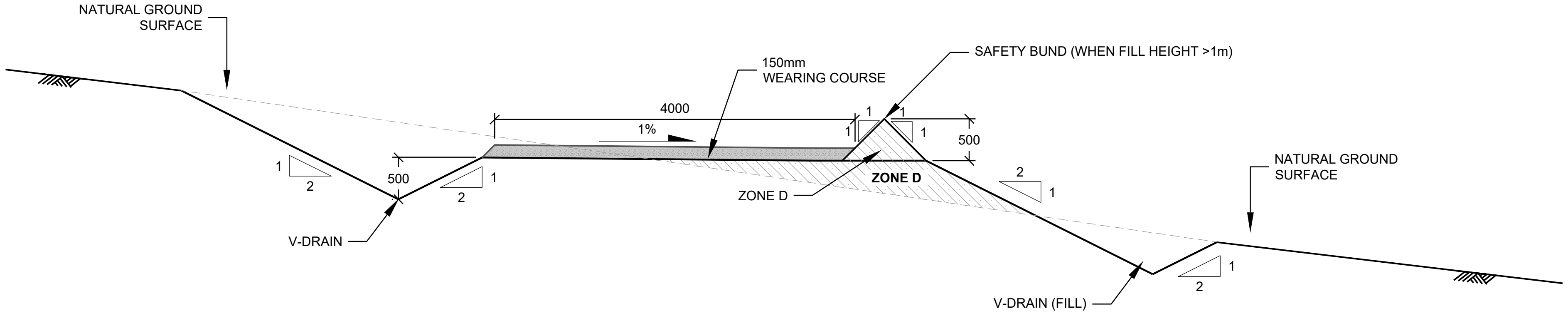
287 410

NOTES:

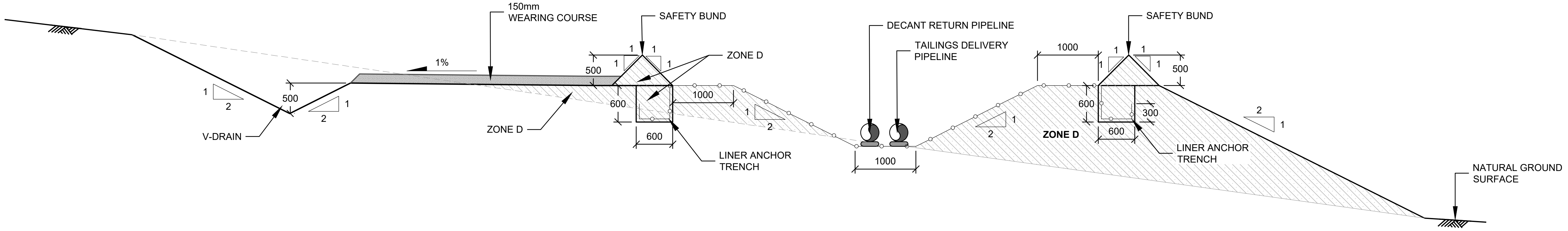
1. BREAKS IN SAFETY BUND AT 50m CENTRES (TO ALLOW DRAINAGE OF RAINFALL RUNOFF).
2. ANCHOR TRENCH BACKFILLED WITH ZONE D MATERIAL IN TWO LAYERS.
3. FOR EMBANKMENT ZONE SPECIFICATIONS, REFER TABLE 1 ON DRAWING 801-102-A3000-201.



E / - TYPICAL TAILINGS AND DECANT RETURN PIPELINE TRENCH SECTION (TDRT ONLY)
1:75



F / - TYPICAL TDRT ACCESS ROAD SECTION (ROAD ONLY)
1:75



G / - G / 100 TYPICAL TAILINGS AND DECANT RETURN PIPELINE TRENCH SECTION (TDRT AND ACCESS ROAD)
1:75

REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-201	TYPICAL SECTIONS & DETAILS-SHT 1

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

SHEET SIZE A3 — REVISIONS

ORIGINAL STAMPED IN RED

	DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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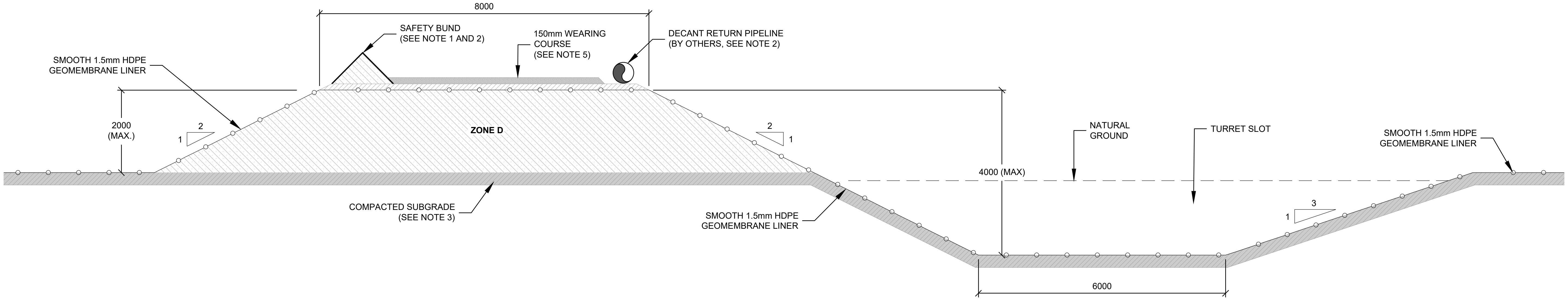
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS - SHEET 4

SCALE 1:75
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-204**
REV: **B**

287 410

NOTES:

1. SAFETY BUND MATERIAL TO BE PLACED, TRIMMED AND BUCKET TAMPED.
2. SAFETY BUNDS ARE TO BE INSTALLED (500mm HIGH MIN.) ON THE UPSTREAM CREST WHERE NO PIPELINE EXISTS. BREAKS IN UPSTREAM SAFETY BUNDS AT 50m INTERVALS TO ALLOW FOR DRAINAGE OF RAINFALL RUNOFF.
3. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).
4. FOR ZONE SPECIFICATIONS REFER TABLE 1 ON DRAWING 801-102-A3000-201.
5. 150mm ZONE A PROTECTION MATERIAL TO BE PLACED BETWEEN WEARING COURSE AND HDPE LINER.



H/100 H/150 **TYPICAL DECANT TURRET CAUSEWAY SECTION**

1:100

SHEET SIZE A3 REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-100	GENERAL ARRANGEMENT PLAN-STARTER
801-102-A3000-150	GENERAL ARRANGEMENT PLAN-FINAL
801-102-A3000-201	TYPICAL SECTIONS & DETAILS-SHT 1

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

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DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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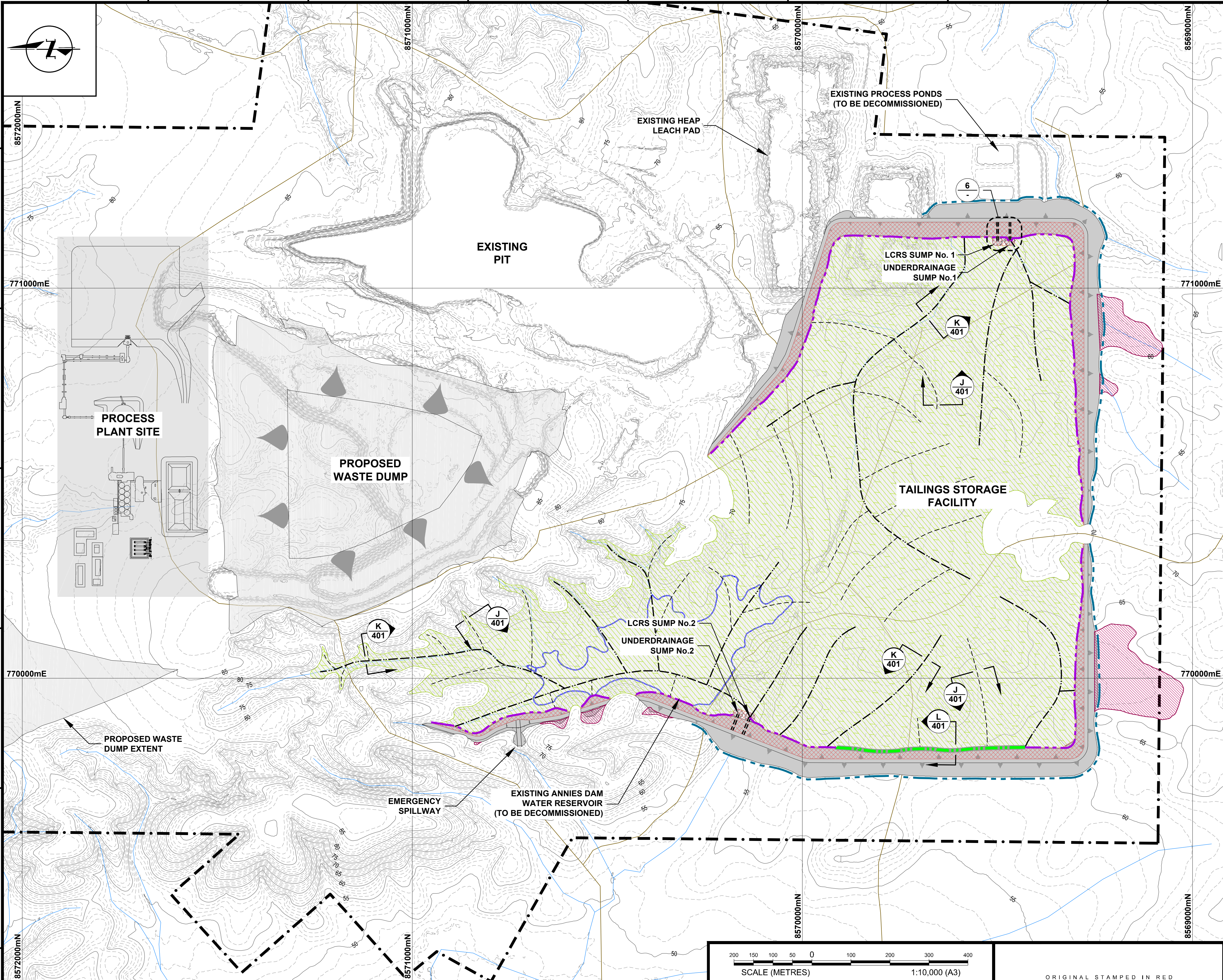
TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS - SHEET 5

SCALE 1:100
STATUS: FOR REVIEW
DRAWING NUMBER 801-102-A3000-205
REV B

287 410

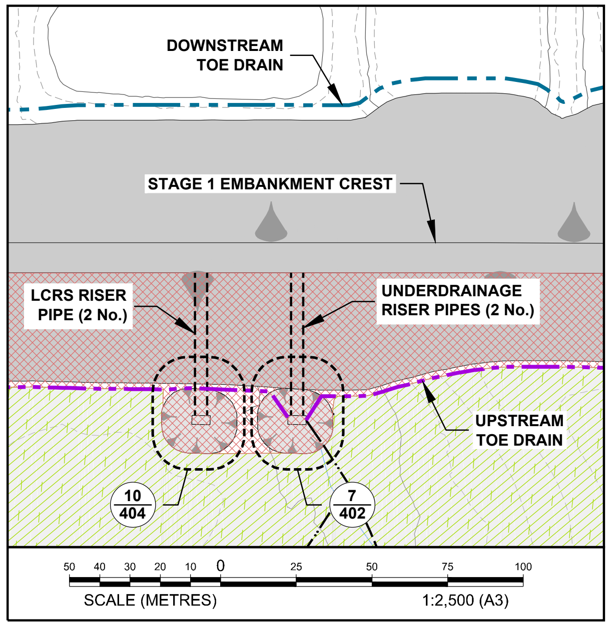


LEGEND:

- EXISTING WATER COURSE
- EXISTING UNSEALED ROAD
- EXISTING ANNIES DAM WATER RESERVOIR
- TENEMENT BOUNDARY
- SMOOTH HDPE GEOMEMBRANE LINER
- TEXTURED HDPE GEOMEMBRANE LINER
- LOCAL BACKFILL
- UPSTREAM EMBANKMENT TOE DRAIN
- DOWNSTREAM EMBANKMENT TOE DRAIN
- TOE/COLLECTOR DRAIN
- COLLECTOR DRAIN
- FINGER DRAIN

NOTES:

1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. MINE AND SITE INFRASTRUCTURE PROVIDED BY HANKING JUNE 2022.
3. WASTE DUMP LOCATIONS PROVIDED BY HANKING FEBRUARY 2022.
4. STAGE 1 TAILINGS STORAGE FACILITY LAYOUT SHOWN.
5. FOR UPSTREAM TOE DRAIN DETAILS REFER DETAIL 3 ON DRAWING 801-102-A3000-202.
6. FOR DOWNSTREAM TOE DRAIN DETAILS REFER DETAIL 4 ON DRAWING 801-102-A3000-202.



6 / - UNDERDRAINAGE AND LCRS COLLECTION SUMP PLAN DETAIL
1:2,500

SCALE (METRES) 1:10,000 (A3)

DRAWING No.	DRAWING TITLE
801-102-A3000-202	TYPICAL SECTIONS & DETAILS -SHT 2
801-102-A3000-401	UNDERDRAINAGE SECTIONS & DETAILS -SHT 1
801-102-A3000-402	UNDERDRAINAGE SECTIONS & DETAILS -SHT 2
801-102-A3000-404	UNDERDRAINAGE SECTIONS & DETAILS -SHT 4

SHEET SIZE A3 — REFERENCES

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

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DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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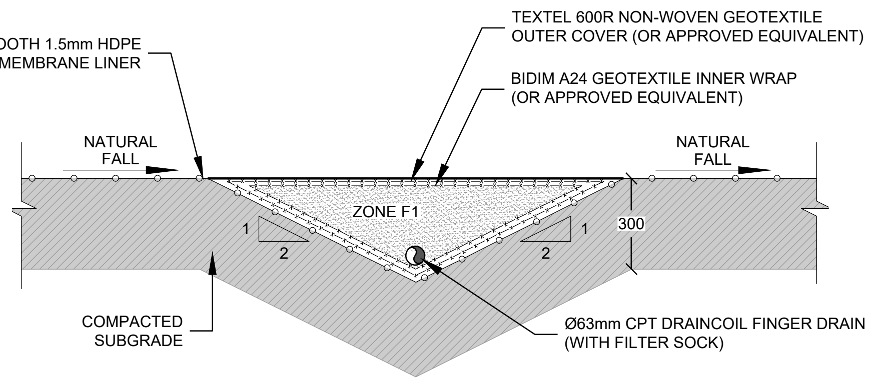
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
UNDERDRAINAGE SYSTEM LAYOUT

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: 801-102-A3000-400
REV: C

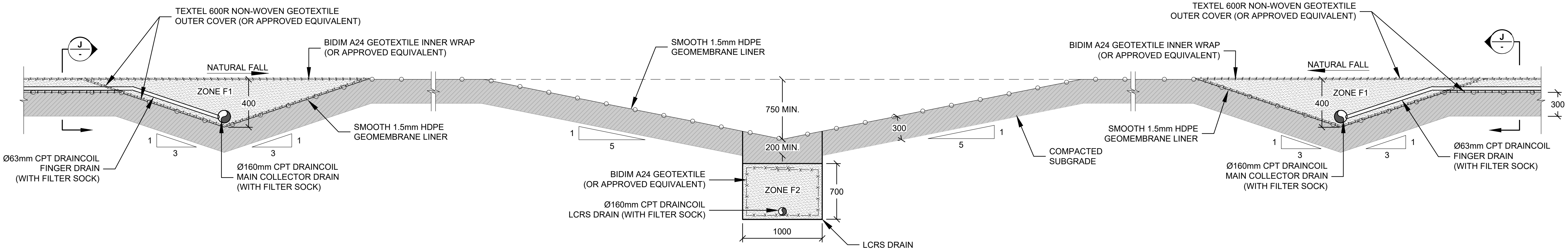


J/- J/400 TYPICAL FINGER DRAIN SECTION

1:25

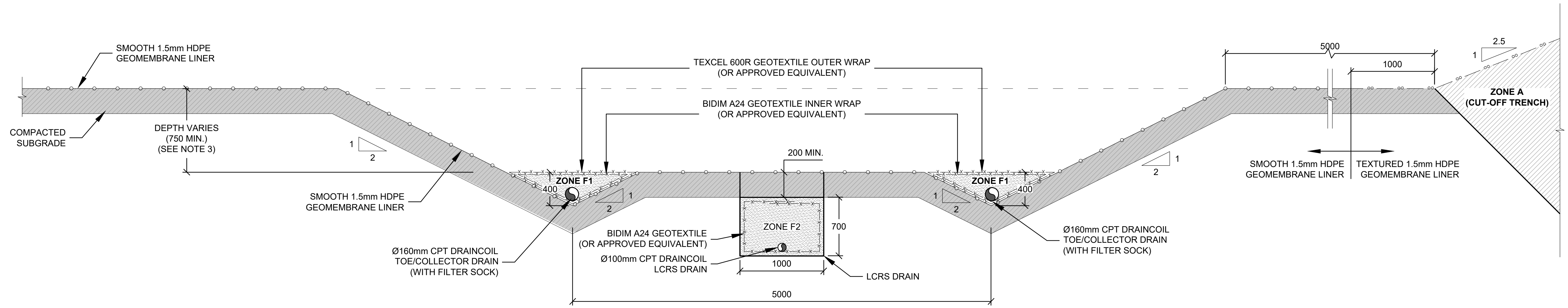
NOTES:

1. FOR ZONE SPECIFICATIONS REFER TO TABLE 1 ON DRAWING 801-102-A3000-201.
2. FINGER DRAINS TYPICALLY SPACED AT 100m c/c.
3. TOE/COLLECTOR DRAIN TO BE CONSTRUCTED TO MAINTAIN FALL OF 0.5% OR GREATER TOWARDS THE UNDERDRAINAGE SUMP.
4. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).



K/400 TYPICAL COLLECTION DRAIN SECTION

1:50



L/400 TYPICAL TOE/COLLECTOR DRAIN SECTION

1:50

REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-400	UNDERDRAINAGE SYSTEM LAYOUT
801-102-A3000-201	TYPICAL SECTIONS & DETAILS - SHT 1

SHEET SIZE A3

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

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DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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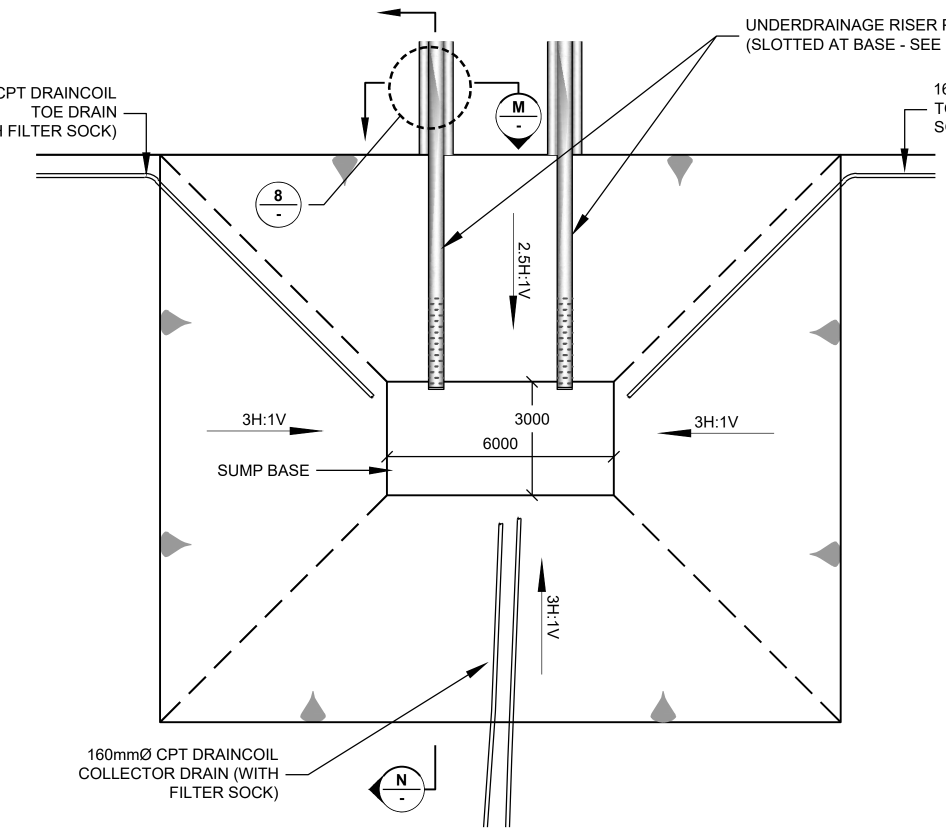
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 1

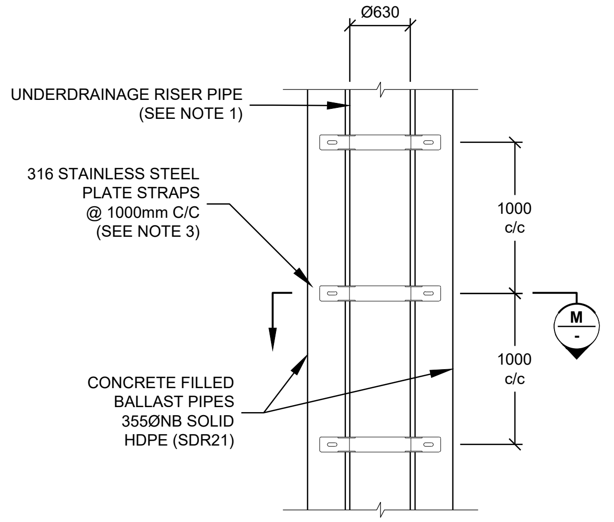
SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-401**
REV: **B**

NOTES:

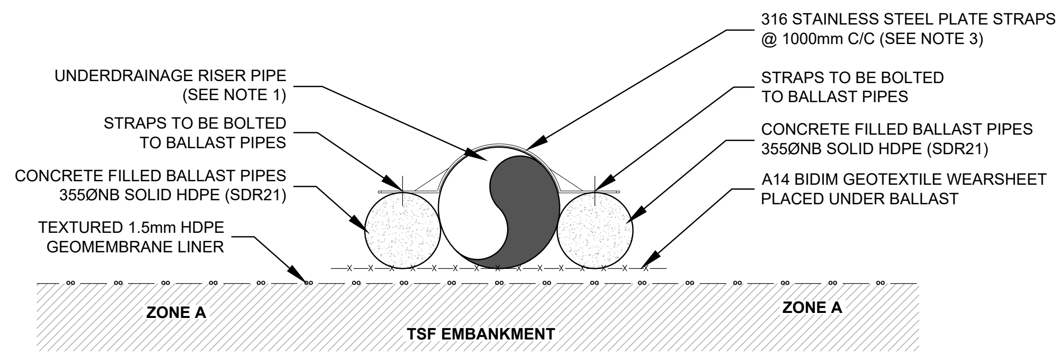
1. UNDERDRAINAGE RISER PIPES TO BE A DN630mm PN12.5 SOLID PE100 SDR 9 HDPE PIPE. ROWS OF THREE SLOTS SHALL BE EQUALLY SPACED AROUND THE BOTTOM OF THE PIPE. SLOTS TO BE 75mm x 6mm ON 150mm CENTRES.
2. UNDERDRAINAGE PUMPS AND ACCESSORIES TO BE DESIGNED AND SPECIFIED BY OTHERS.
3. RISER PIPES TO BE SECURED USING STEEL PLATE STRAPS AT 1000mm C/C. FOR STRAP MANUFACTURING DETAILS REFER DRAWING 801-102-A3000-403.
4. FOR ZONE SPECIFICATIONS REFER TO TABLE 1 ON DRAWING 801-102-A3000-201.
5. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).



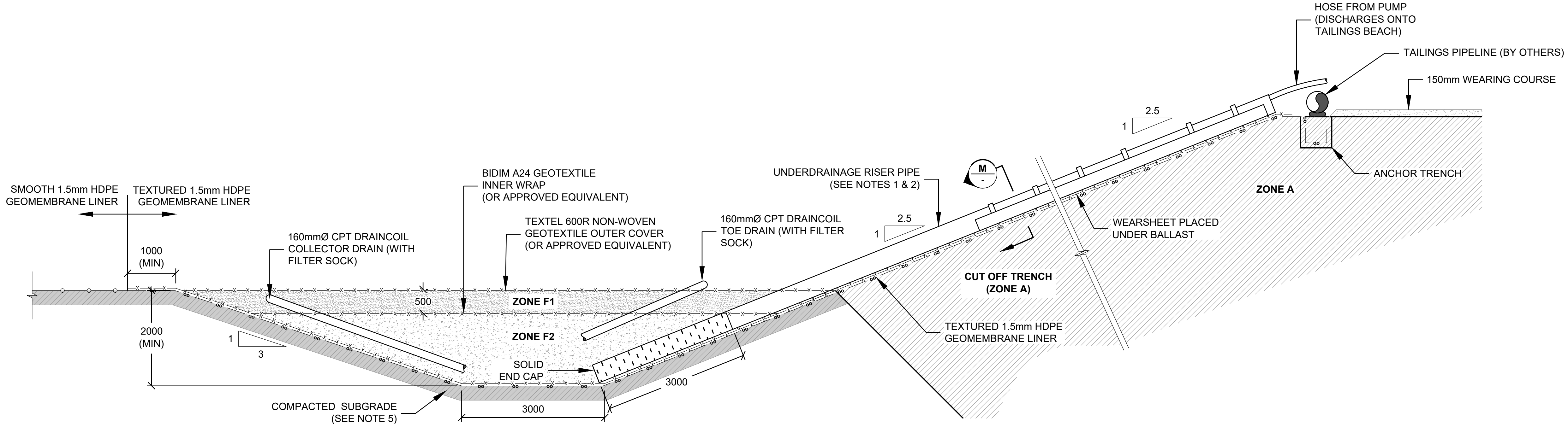
7 / 400 **UNDERDRAINAGE SUMP AND RISER PIPE LAYOUT DETAIL**
1:200



8 / - **TYPICAL UNDERDRAINAGE RISER PIPE BALLAST SYSTEM DETAIL**
1:50



M / - **TYPICAL UNDERDRAINAGE RISER PIPE SECTION**
1:50



N / - **UNDERDRAINAGE SUMP AND RISER PIPE SECTION**
1:100

DRAWING No.	DRAWING TITLE
801-102-A3000-201	TYPICAL SECTIONS AND DETAILS - SHT 1
801-102-A3000-400	UNDERDRAINAGE SYSTEM LAYOUT
801-102-A3000-403	UNDERDRAINAGE SECTIONS AND DETAILS - SHT 4

SHEET SIZE A3 — REFERENCES

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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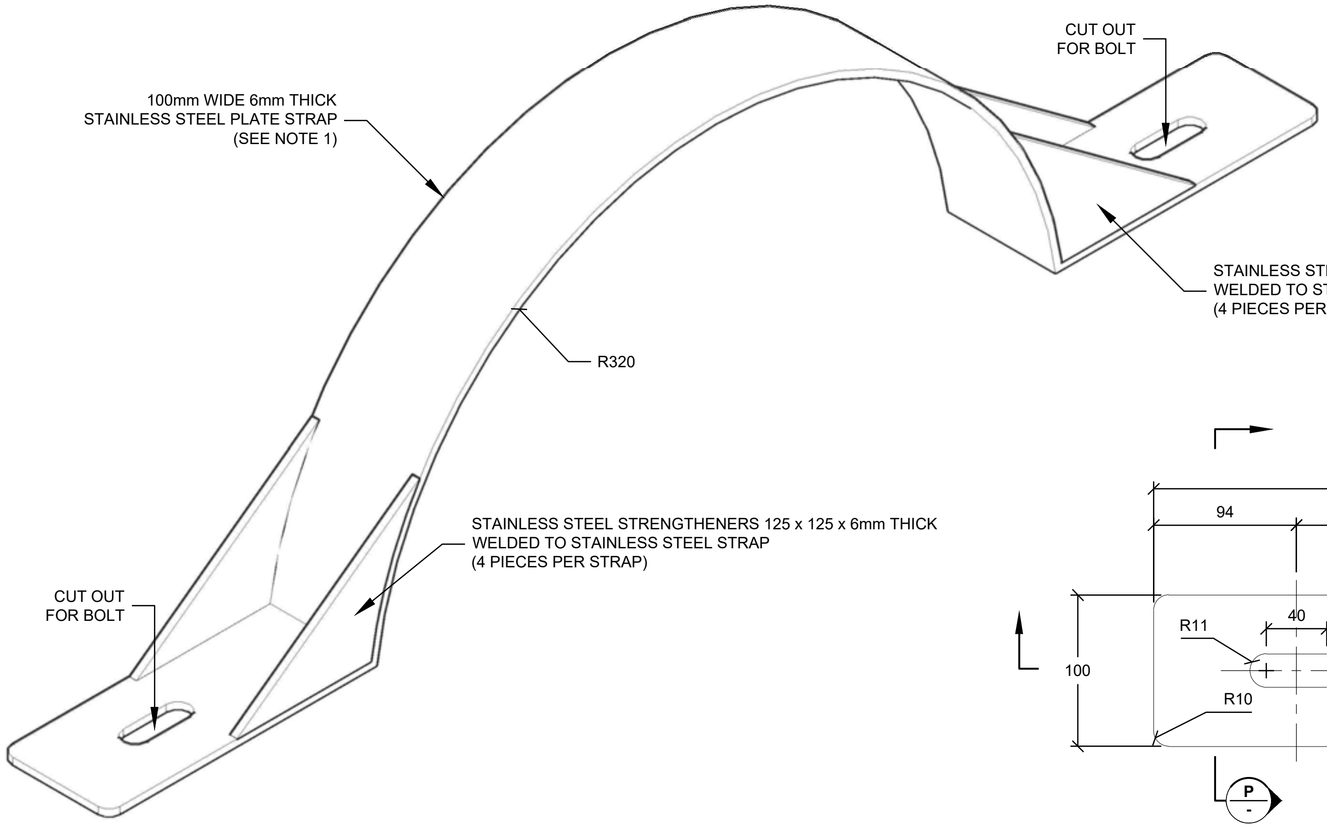
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 2

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-402**
REV: **B**

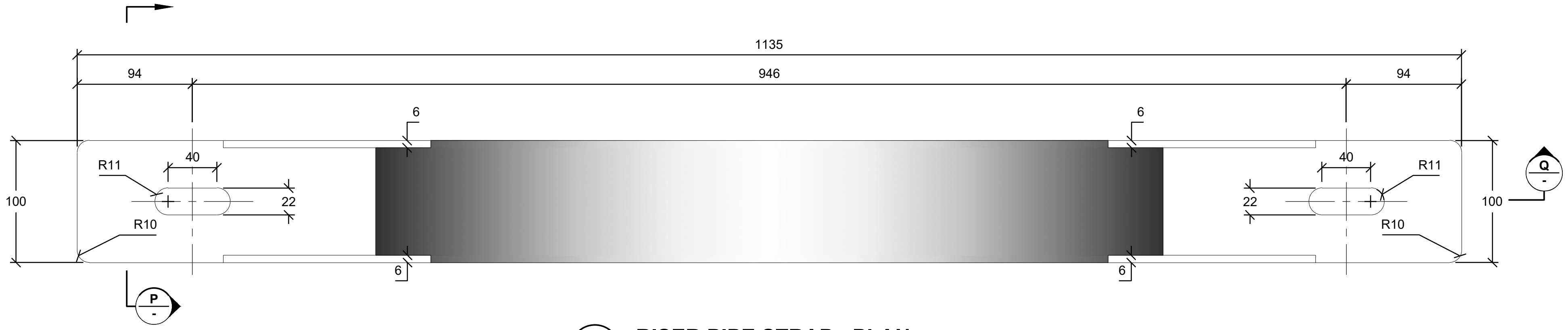
287 410

NOTES:

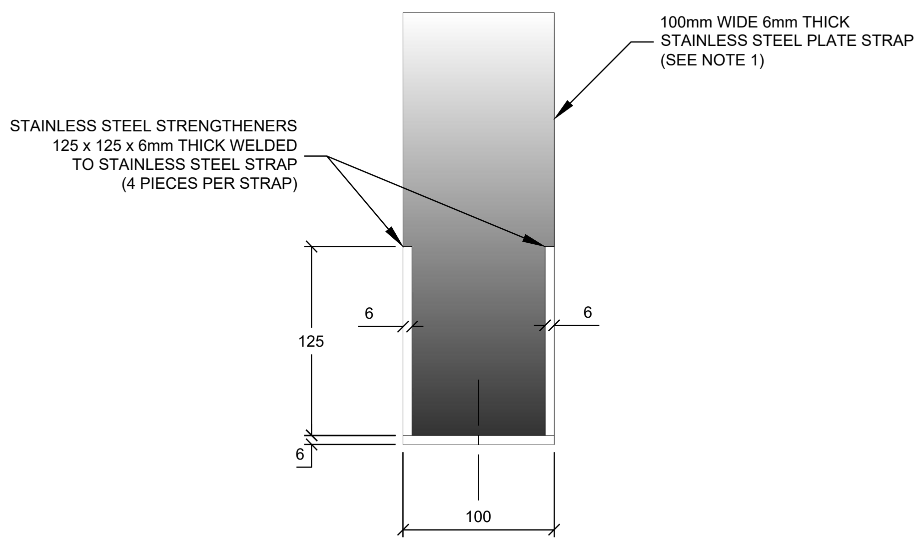
1. STAINLESS STEEL PLATE 316 (6mm THICK).
2. BOLT COMPRISES 12mmØ x 80mm SCREW.



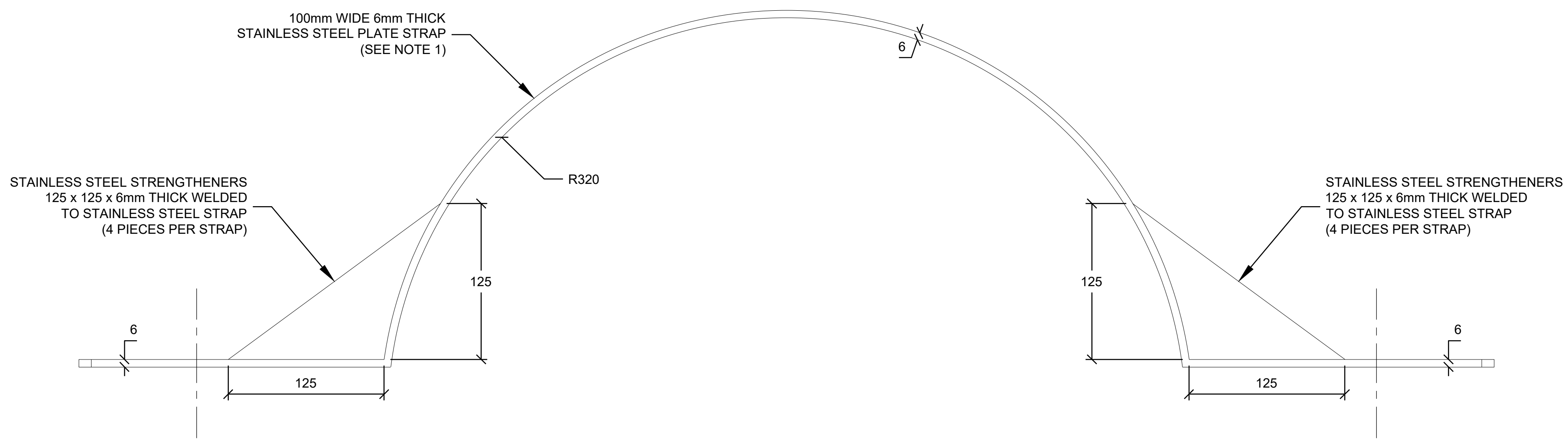
RISER PIPE STRAP - PERSPECTIVE
1:5



9 - **RISER PIPE STRAP - PLAN**
1:5



P - **RISER PIPE STRAP - SECTION SIDE VIEW**
1:5



Q - **RISER PIPE STRAP - SECTION FRONT VIEW**
1:5

SHEET SIZE A3

REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-400	UNDERDRAINAGE SYSTEM LAYOUT

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

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DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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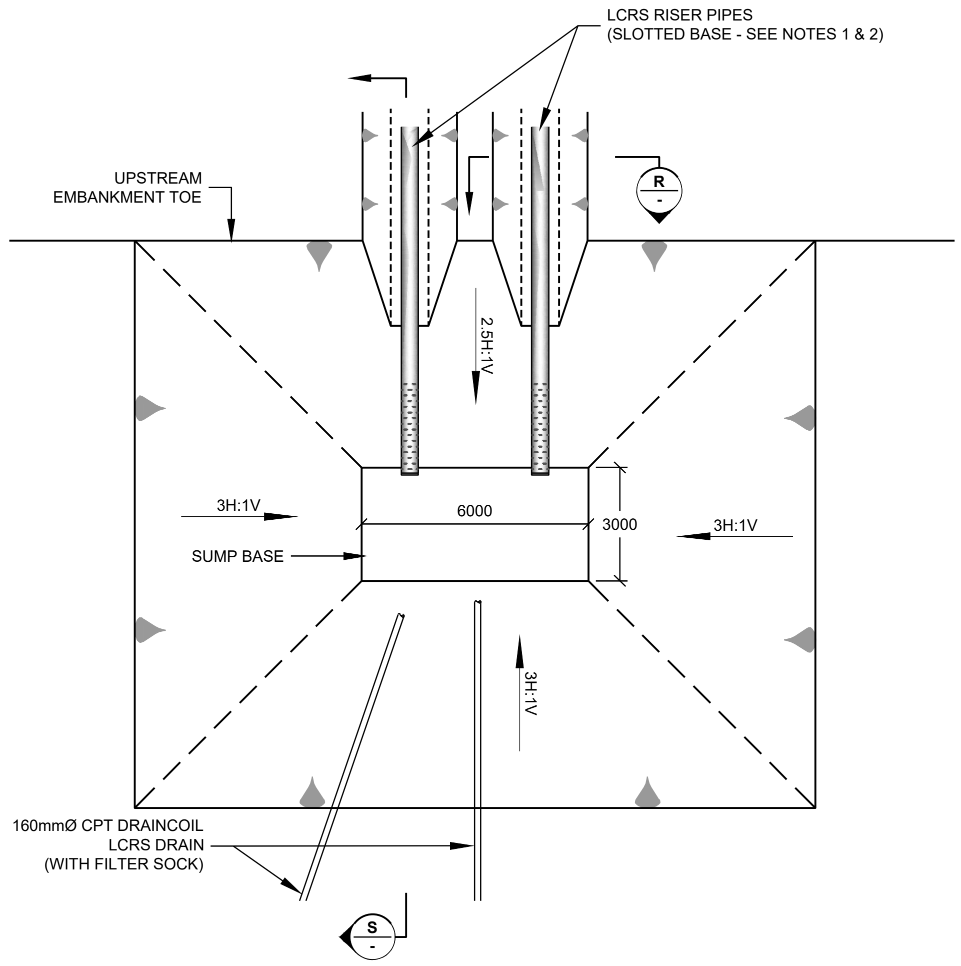
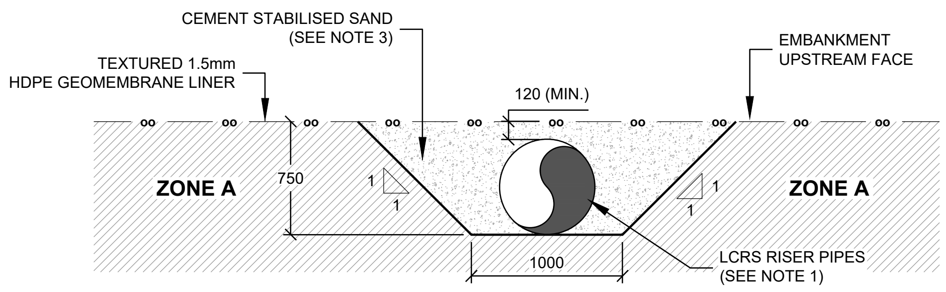
TAILINGS STORAGE FACILITY
UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 3

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-403**
REV: **B**

287
410



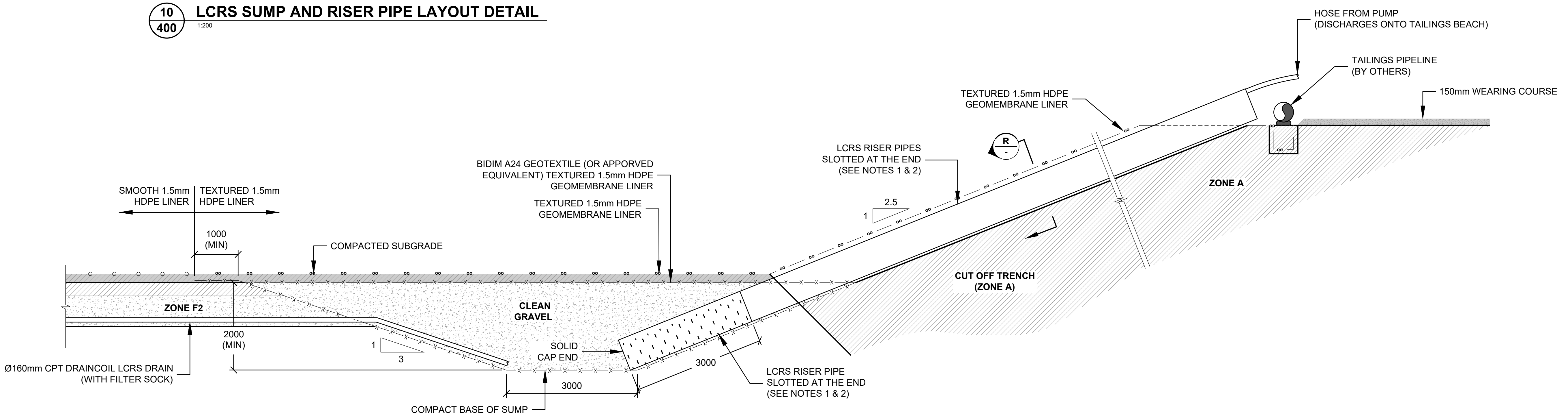
10 / 400 **LCRS SUMP AND RISER PIPE LAYOUT DETAIL**
1:200



R / - **TYPICAL LCRS RISER AND TRENCH SECTION**
1:50

NOTES:

1. LCRS RISER PIPE TO BE A DN630mm PN12.5 SDR 9 SOLID PE100 HDPE PIPE. ROWS OF THREE SLOTS SHALL BE EQUALLY SPACED AROUND THE BOTTOM OF THE PIPE. SLOTS TO BE 75mm x 6mm ON 150mm CENTRES.
2. LCRS PUMPS, PIPING, MECHANICAL AND ELECTRICAL, BY OTHERS AND SPECIFIED BY OTHERS.
3. TRENCH EXCAVATED FOR RISER PIPE TO BE BACKFILLED WITH CEMENT STABILISED SAND (10% CEMENT BY WEIGHT).
4. FOR ZONE SPECIFICATIONS REFER TO TABLE 1 ON DRAWING 301-102-A3000-201.
5. COMPACTED SUBGRADE IN TSF AS FOLLOWS:
   - WHERE IN-SITU MATERIAL IS UNSUITABLE AS COMPACTED SUBGRADE - 300mm IMPORTED SOIL ZONE A MATERIAL.
   - WHERE IN-SITU MATERIAL IS SUITABLE AS COMPACTED SUBGRADE - SCARIFY, MOISTURE CONDITION AND COMPACT IN-SITU MATERIAL (200mm).



S / - **LCRS SUMP AND RISER PIPE SECTION**
1:100

REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-201	TYPICAL SECTIONS & DETAILS - SHT 1
801-102-A3000-400	UNDERDRAINAGE SYSTEM LAYOUT

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

SHEET SIZE A3

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

Knight Piésold CONSULTING

CONSULT AUSTRALIA Member Firm

HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
UNDERDRAINAGE SECTIONS AND DETAILS - SHEET 4

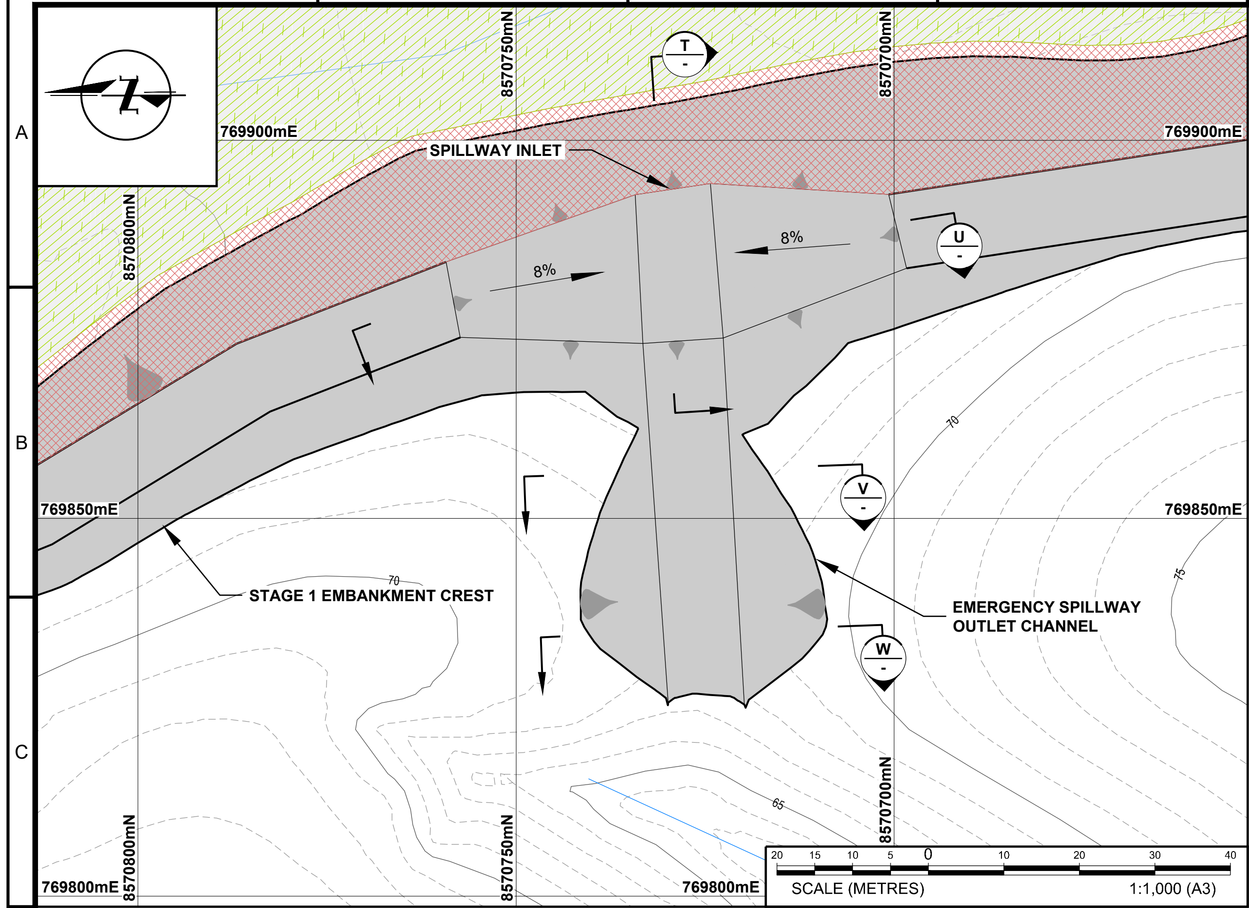
SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: 801-102-A3000-404
REV: A

LEGEND:

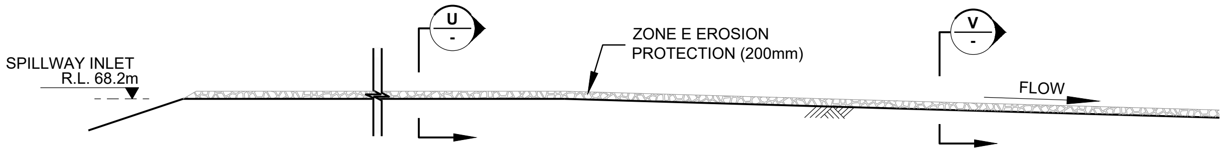
- EXISTING WATER COURSE
- SMOOTH HDPE GEOMEMBRANE LINER
- TEXTURED HDPE GEOMEMBRANE LINER

NOTES:

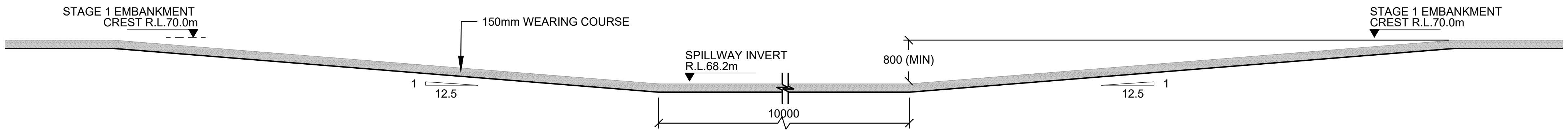
1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. STAGE 1 TAILINGS STORAGE FACILITY LAYOUT SHOWN.
3. FOR ZONE SPECIFICATIONS REFER TO TABLE 1 ON DRAWING 801-102-A3000-201.



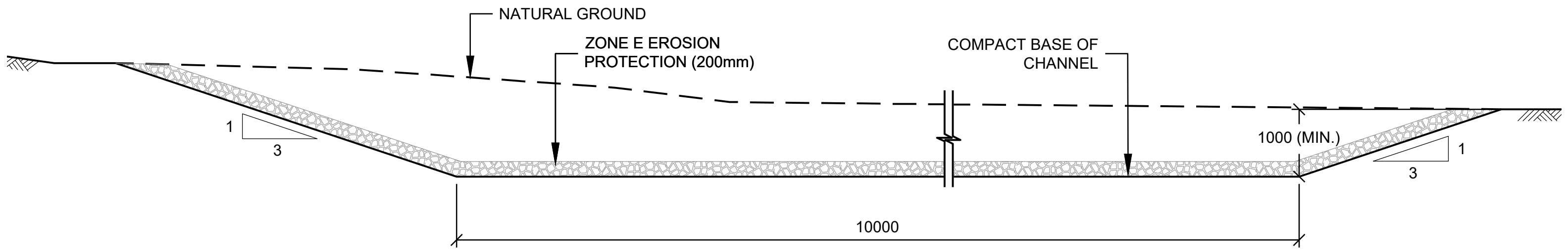
11/100 **STAGE 1 EMERGENCY SPILLWAY LAYOUT DETAIL**
1:1,000



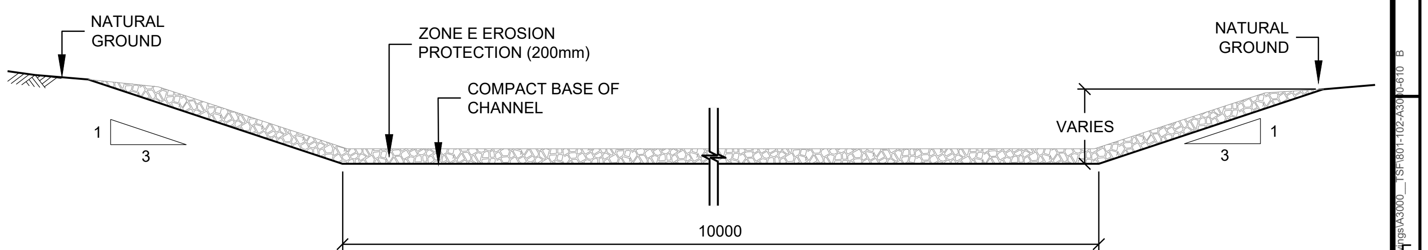
T/- **TYPICAL EMERGENCY SPILLWAY INLET SECTION**
1:200



U/- **TYPICAL SPILLWAY INLET/CROSSING SECTION**
1:100



V/- **TYPICAL EMERGENCY SPILLWAY SECTION**
1:100



W/- **TYPICAL EMERGENCY SPILLWAY OUTLET SECTION**
1:100

REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-100	GENERAL ARRANGEMENT PLAN-STARTER

SHEET SIZE A3

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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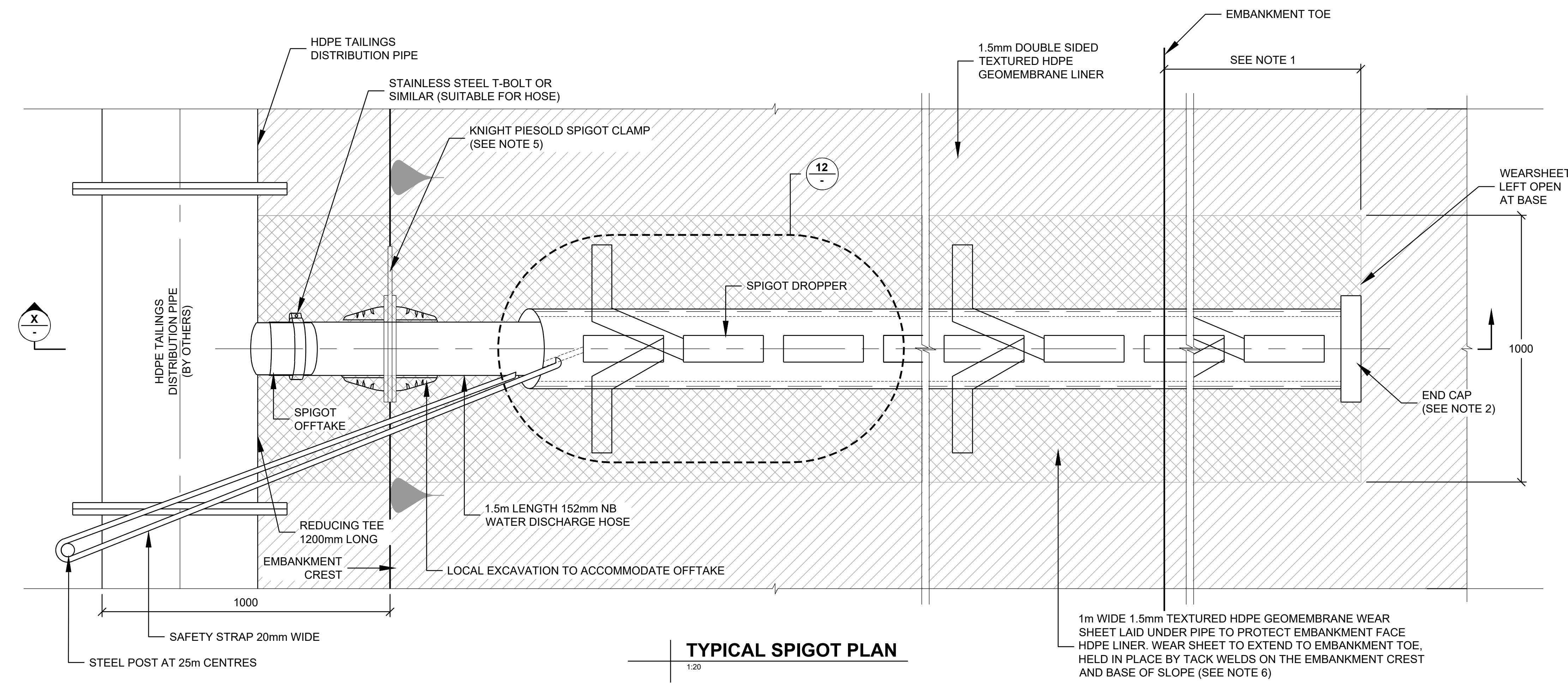
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
SPILLWAY PLAN, SECTIONS AND DETAILS

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-610**
REV: **B**

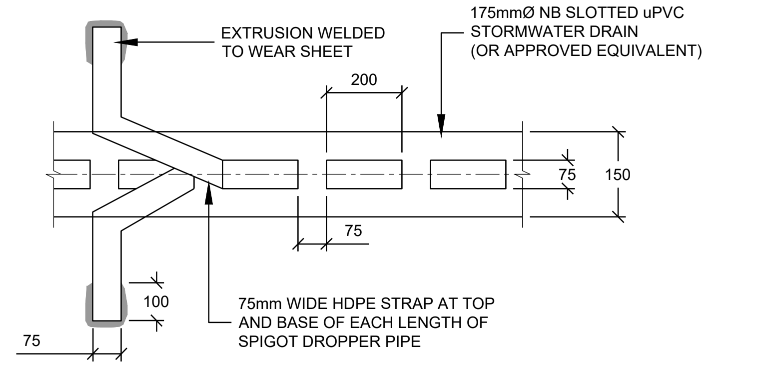


TYPICAL SPIGOT PLAN

1:20

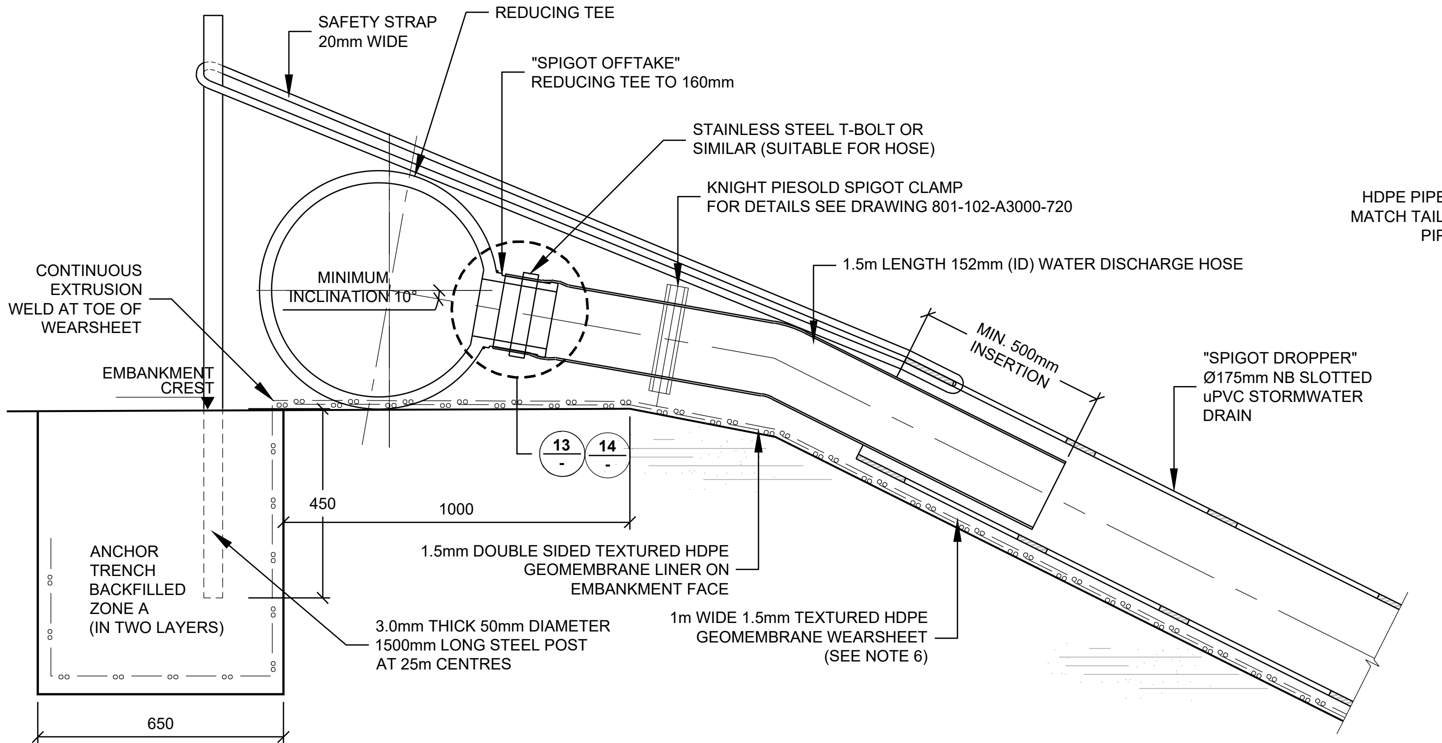
NOTES:

1. SPIGOT DROPPER TO EXTEND 2m BEYOND EMBANKMENT TOE DRAINS.
2. BOTTOM END OF SPIGOT DROPPER TO BE CAPPED, GLUED IN PLACE AND 6 NO. SELF TAPPING SCREWS 6mm DIAMETER.
3. TYPICAL OFFTAKE SPACING NOMINALLY 25m c/c.
4. TAILINGS DISTRIBUTION PIPELINE DESIGN BY OTHERS.
5. FOR SPIGOT CLAMP DETAILS, REFER TO DRG 801-102-A3000-720.
6. WEARSHEET TACK WELDS TO BE MINIMUM 200mm LENGTHS AT 2000mm INTERVALS, BOTH SIDES.



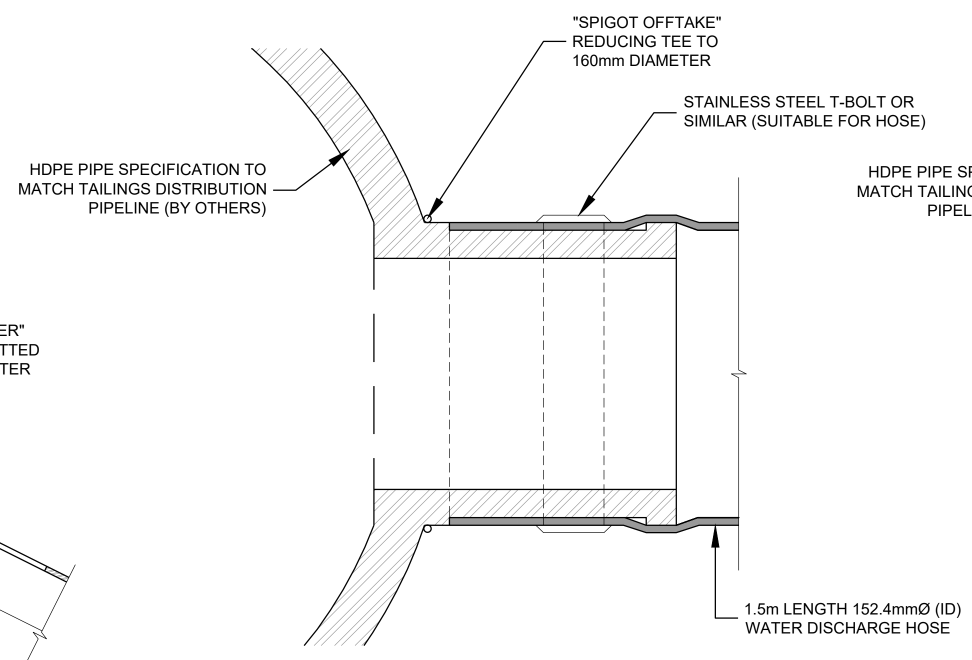
12 - SPIGOT DROPPER DETAIL

1:20



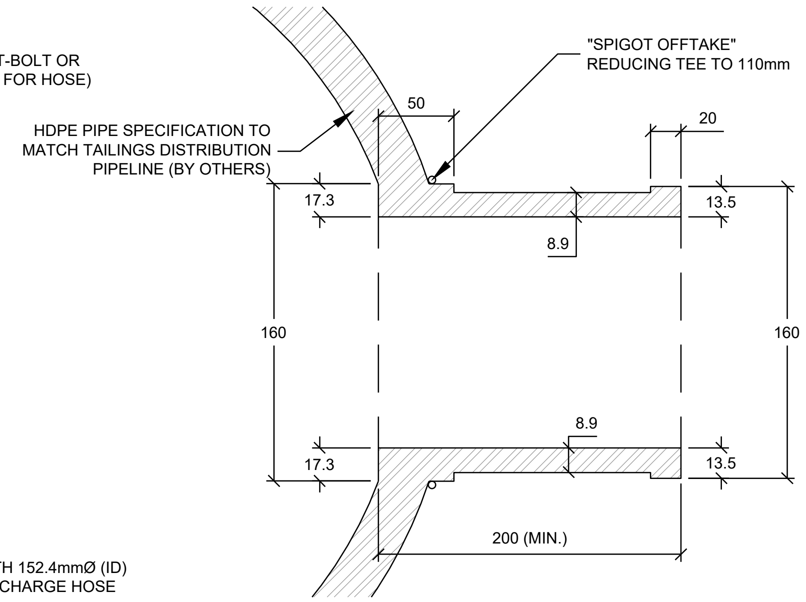
X - TYPICAL SPIGOT PIPEWORK SECTION

1:20



13 - SPIGOT OFFTAKE AND DISCHARGE HOSE DETAIL

1:5



14 - SPIGOT OFFTAKE DETAIL

1:5

REFERENCES	
DRAWING No.	DRAWING TITLE
801-102-A3000-100	GENERAL ARRANGEMENT PLAN-STARTER

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

SHEET SIZE A3

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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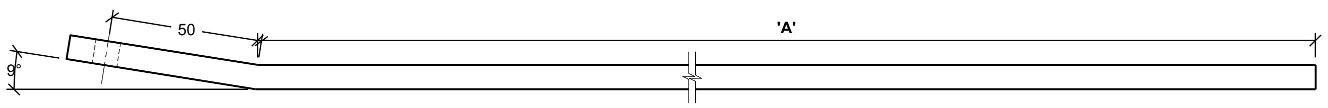
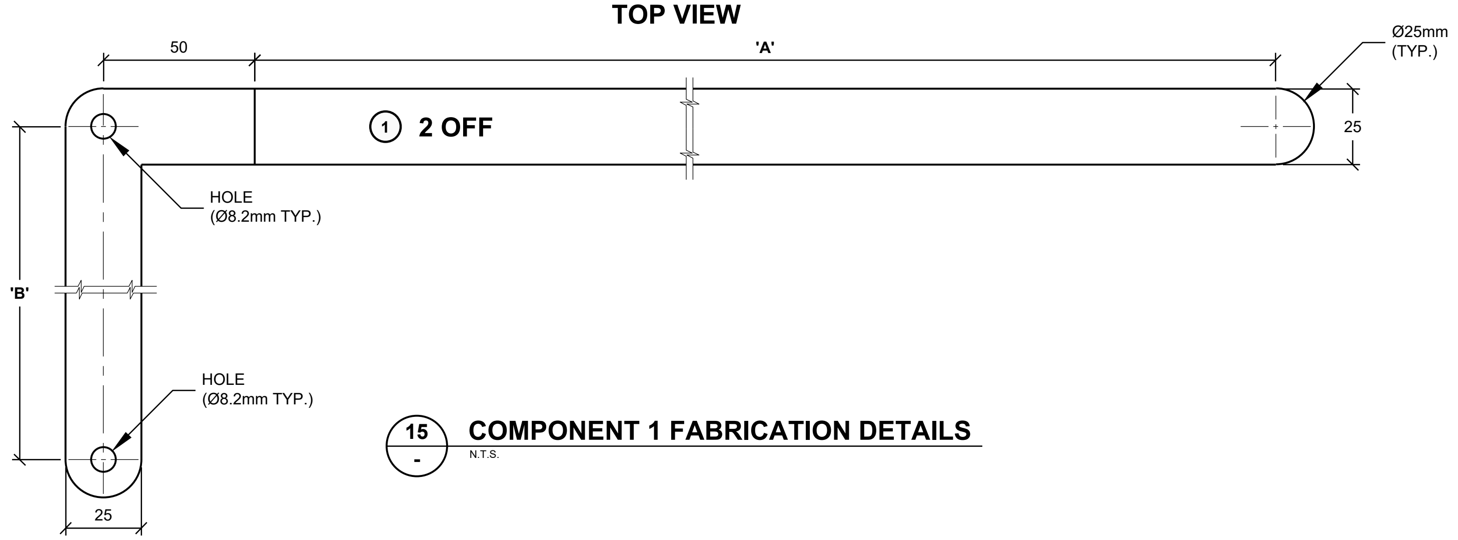
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
SPILLWAY PLAN, SECTIONS AND DETAILS

SCALE AS SHOWN
STATUS: FOR REVIEW

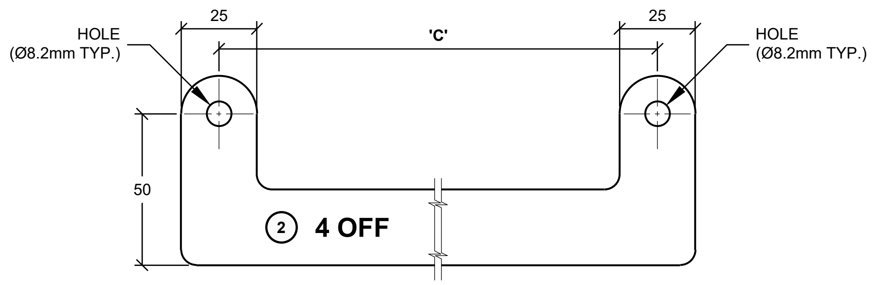
DRAWING NUMBER	REV
801-102-A3000-710	B



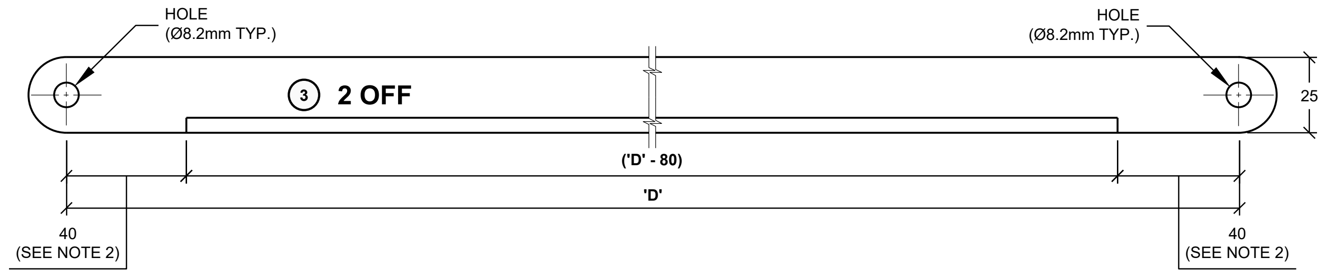
TOP VIEW

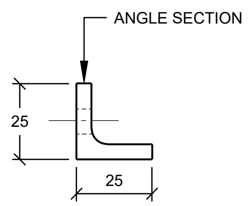


15 / - **COMPONENT 1 FABRICATION DETAILS**
N.T.S.

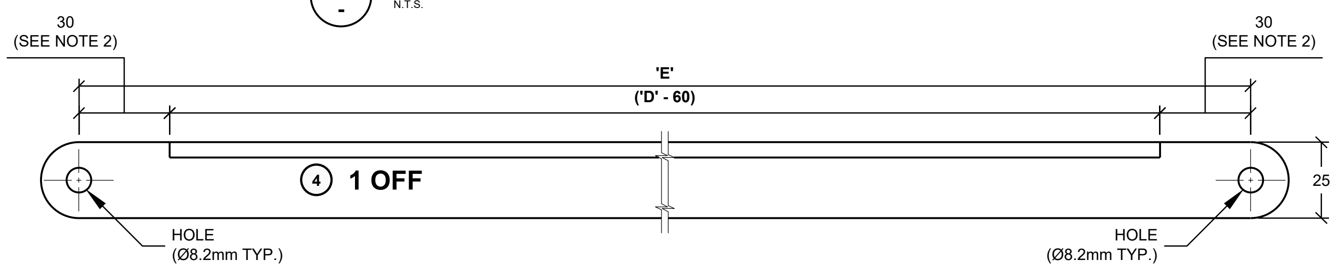


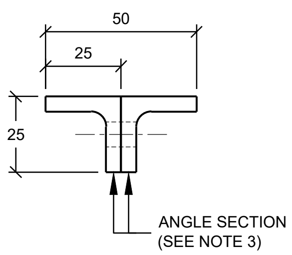
16 / - **COMPONENT 2 FABRICATION DETAILS**
N.T.S.





17 / - **COMPONENT 3 FABRICATION DETAILS**
N.T.S.





18 / - **COMPONENT 4 FABRICATION DETAILS**
N.T.S.

TABLE 4:
COMPONENT SIZING

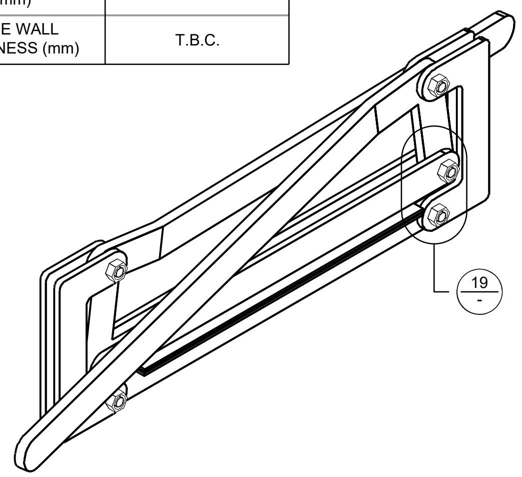
LENGTH I.D.	LENGTH (mm)
'A'	T.B.C
'B'	T.B.C
'C'	T.B.C
'D'	T.B.C
'E'	T.B.C
SUITABLE PIPE SIZE	
INTERNAL PIPE Ø (mm)	160
HOSE WALL THICKNESS (mm)	T.B.C.

LEGEND:

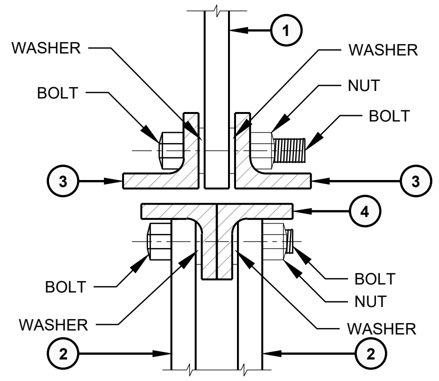
(1) (2) 25mm x 8mm STEEL PLATE
(3) (4) 25mm x 5mm STEEL PLATE

NOTES:

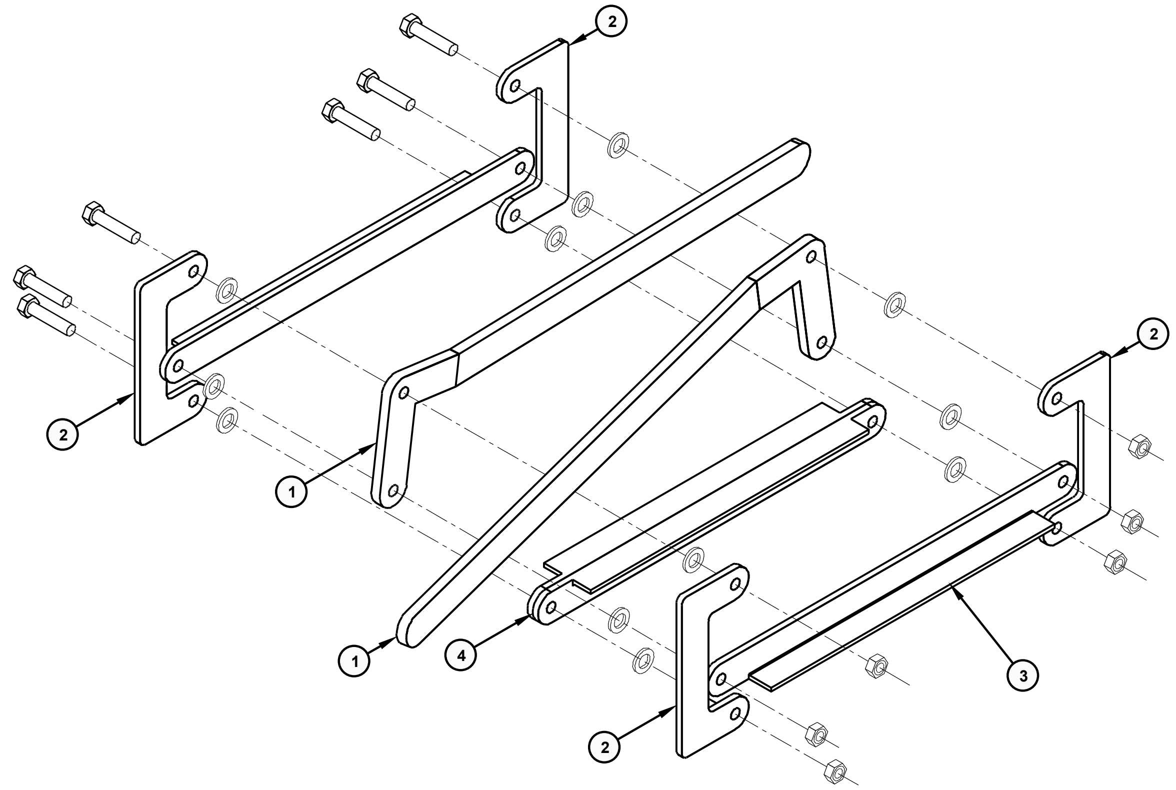
1. ASSEMBLE WITH 6 No. Ø8mm x 40mm LONG BOLTS EACH WITH 2 No. NYLON WASHERS AND ONE "LOCK ON" NUT
2. INDICATED AREAS OF THE ANGLE SECTIONS TO BE REMOVED TO ALLOW HANDLE OPERATION.
3. ANGLE SECTIONS ARE TO BE CONTINUOUSLY WELDED TOGETHER. TOP SURFACE TO BE GROUND FLAT.
4. COMPONENT SIZING TO BE CONFIRMED ONCE PIPEWORK DETAILS CONFIRMED.



SPIGOT CLAMP - ASSEMBLED VIEW
N.T.S.



19 / - **CLAMP ASSEMBLY DETAIL**
N.T.S.



SPIGOT CLAMP ASSEMBLY - EXPLODED VIEW
N.T.S.

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

REVISIONS

DRAWING No.	DRAWING TITLE

SHEET SIZE A3
REFERENCES

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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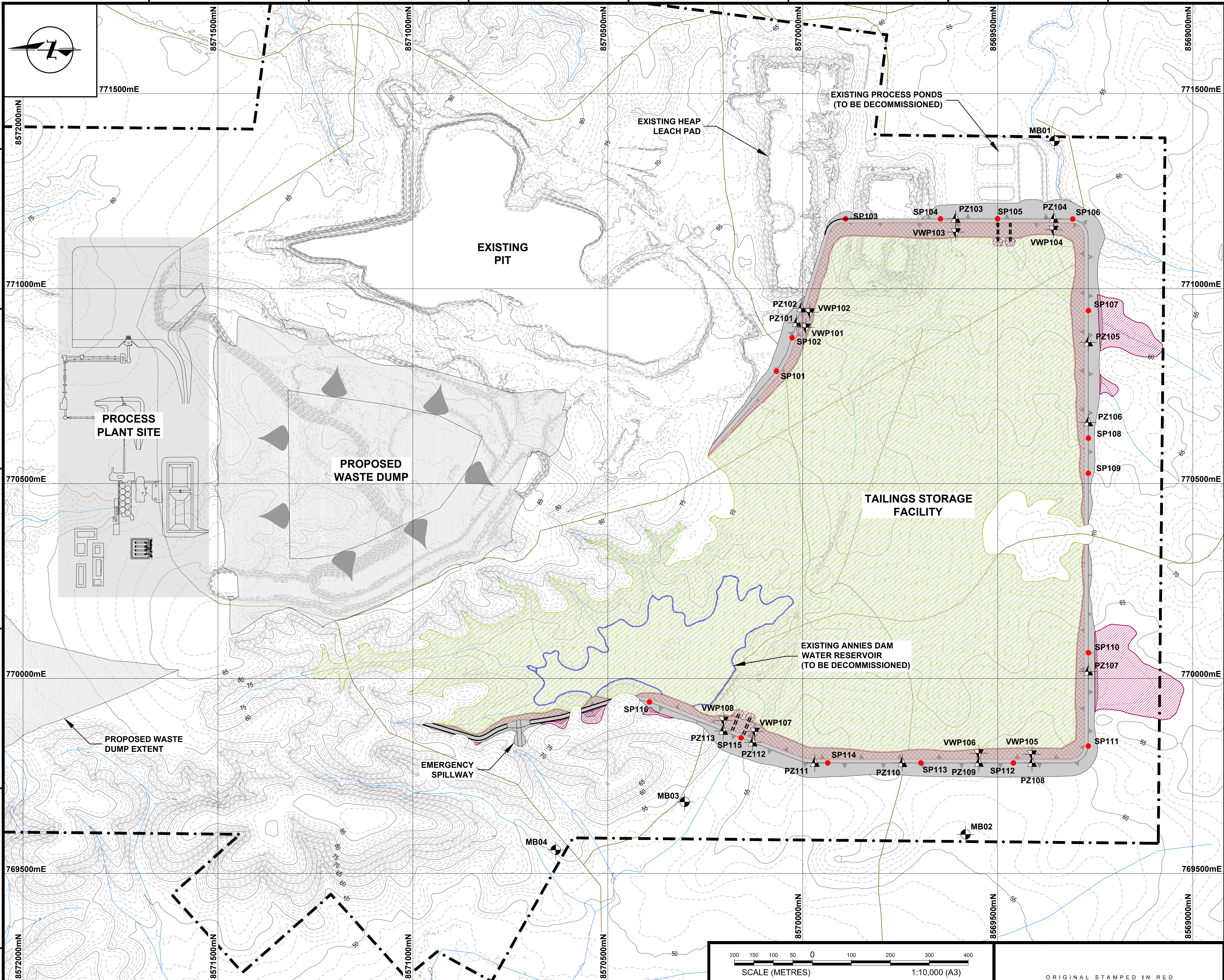
HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
SPIGOT CLAMP DETAILS

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-720**
REV: **B**



LEGEND:

- EXISTING WATER COURSE
- EXISTING UNSEALED ROAD
- EXISTING ANNIES DAM WATER RESERVOIR
- TENEMENT BOUNDARY
- SMOOTH HDPE GEOMEMBRANE LINER
- TEXTURED HDPE GEOMEMBRANE LINER
- LOCAL BACKFILL
- MONITORING BORE LOCATION
- STANDPIPE PIEZOMETER LOCATION
- VIBRATING WIRE PIEZOMETER
- SURVEY PIN LOCATION

NOTES:

1. 1m CONTOUR INTERVALS SHOWN. LOCAL TOPOGRAPHIC DATA PROVIDED BY HANKING FEBRUARY 2021.
2. MINE AND SITE INFRASTRUCTURE PROVIDED BY HANKING JUNE 2022.
3. WASTE DUMP LOCATIONS PROVIDED BY HANKING FEBRUARY 2022.
4. STAGE 1 TAILINGS STORAGE FACILITY LAYOUT SHOWN.
5. FOR MONITORING AND INSTRUMENTATION DETAILS REFER DRAWING 801-102-A3000-810.

SETTLEMENT PIN LOCATIONS

SP I.D.	EASTING	NORTHING
SP101	770788.1	8570067.8
SP102	770873.9	8570027.7
SP103	771178.8	8569890.3
SP104	771178.9	8569646.9
SP105	771178.9	8569500.8
SP106	771178.4	8569307.9
SP107	770943.7	8569267.9
SP108	770616.4	8569267.9
SP109	770526.4	8569267.9
SP110	770065.9	8569267.9
SP111	769826.3	8569268.2
SP112	769783.2	8569460.1
SP113	769783.2	8569697.4
SP114	769783.4	8569936.2
SP115	769847.5	8570158.3
SP116	769939.5	8570393.4

STANDPIPE PIEZOMETER LOCATIONS

PZ I.D.	EASTING	NORTHING
PZ101	770912.4	8570015.6
PZ102	770949.9	8570003.8
PZ103	771178.9	8569608.2
PZ104	771178.7	8569356.3
PZ105	770862.0	8569267.9
PZ106	770657.0	8569267.9
PZ107	770018.0	8569268.0
PZ108	769783.3	8569412.0
PZ109	769783.2	8569548.3
PZ110	769783.2	8569744.7
PZ111	769783.5	8569969.2
PZ112	769835.9	8570128.6
PZ113	769865.6	8570204.1

VIBRATING PIEZOMETER LOCATIONS

VWP I.D.	EASTING	NORTHING
VWP101	770900.3	8569991.9
VWP102	770939.5	8569981.8
VWP103	771145.0	8569607.7
VWP104	771151.1	8569356.7
VWP105	769805.8	8569412.0
VWP106	769808.2	8569548.6
VWP107	769863.9	8570122.7
VWP108	769892.7	8570202.5

MONITORING BORE LOCATIONS

BH I.D.	EASTING	NORTHING
MB01	771378.7	8569354.8
MB02	769599.9	8569582.8
MB03	769683.3	8570303.1
MB04	769560.1	8570633.8

REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-810	TYP. MONITORING & INSTRUMENTATION DETAILS

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	
C	04/07/2022	REVISED MINING INFRASTRUCTURE	SGM	AMM	AMM	BAS	

SHEET SIZE A3

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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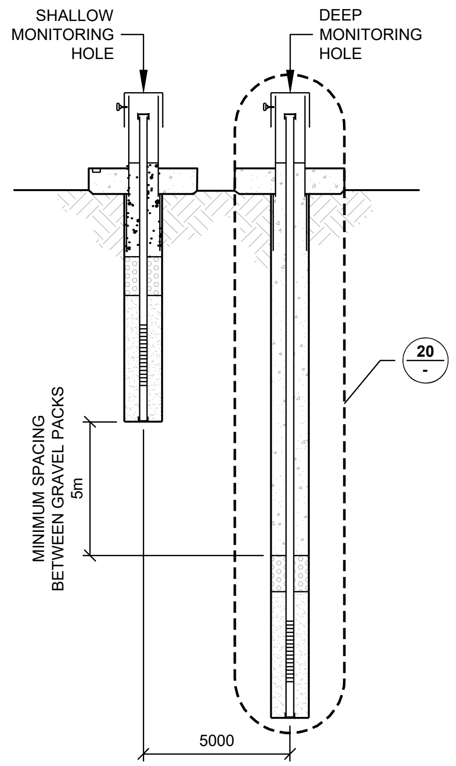
HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
MONITORING INSTRUMENTATION LAYOUT

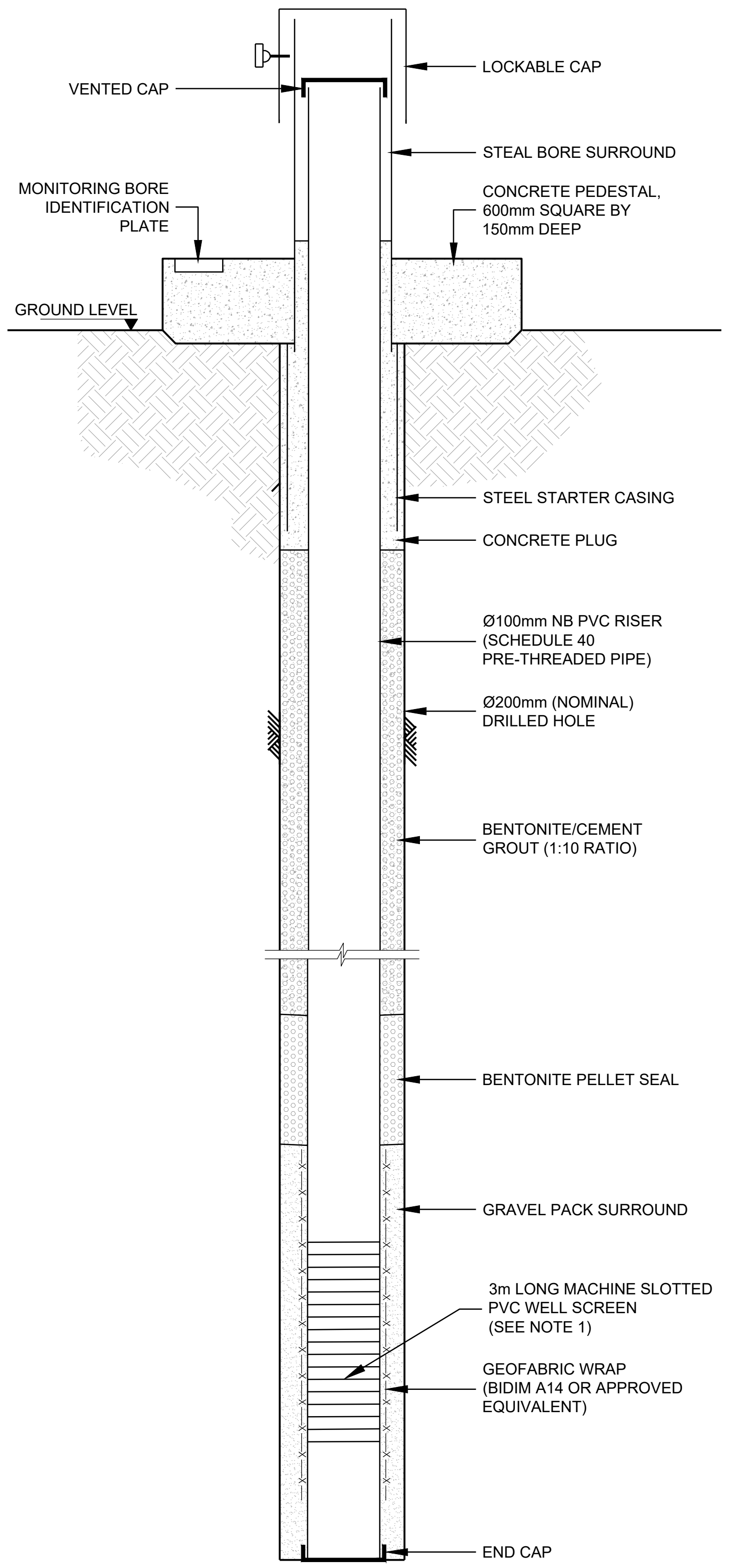
SCALE 1: 10,000
STATUS: FOR REVIEW
DRAWING NUMBER: 801-102-A3000-800
REV: C

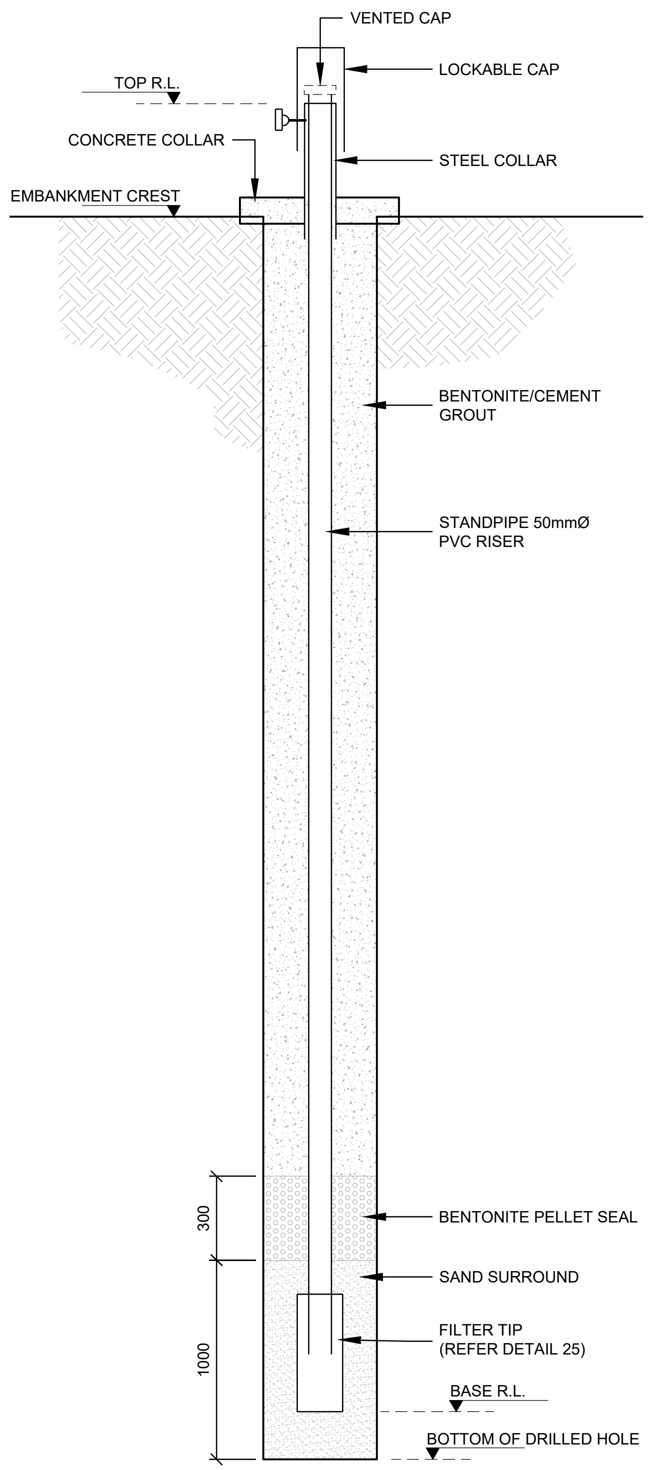
NOTES:

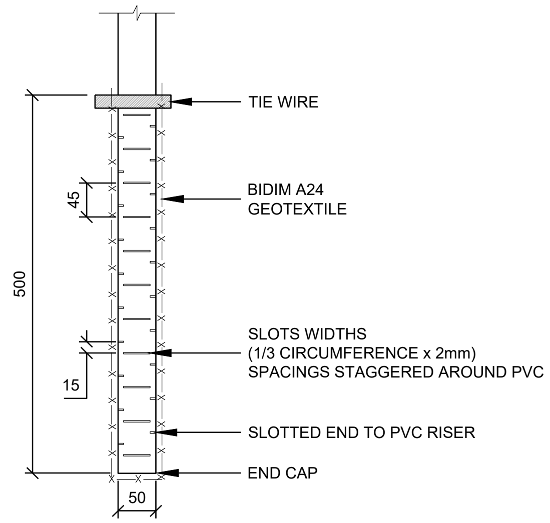
1. SLOTTED CASING TO BE FORMED BY CUTTING 1/3 WAY THROUGH THE PVC PIPE ON ALTERNATING SIDES. SLOTS TO BE PLACED AT 15mm SPACING, CENTRE TO CENTRE.
2. A REFERENCE "X" IS TO BE FILED OR CUT INTO TOP OF REBAR SETTLEMENT PIN PRIOR TO INSERTION INTO CONCRETE.



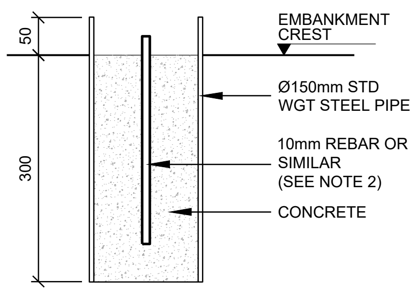
MONITORING BORE STATION
N.T.S



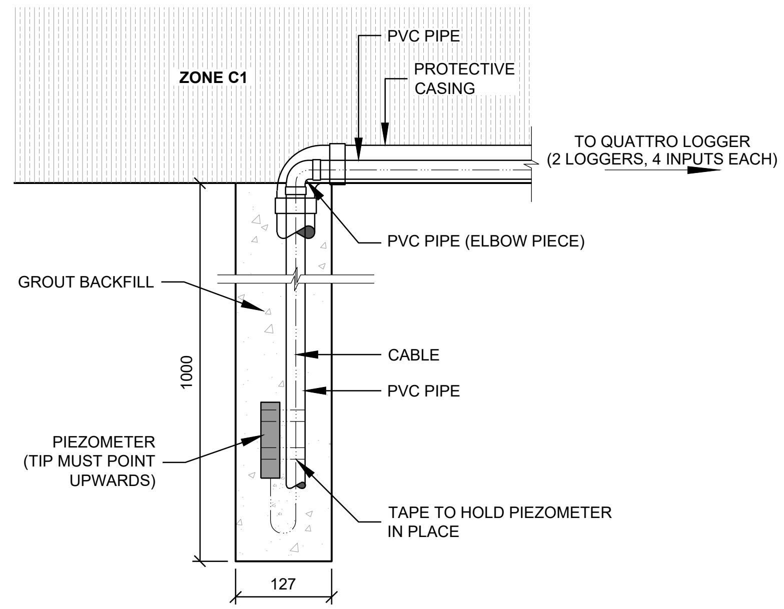




22 / - **FILTER TIP DETAIL**
1:10



SETTLEMENT PIN
1:10



20 / - **MONITORING BORE INSTALLATION DETAIL**
N.T.S

21 / - **STANDPIPE PIEZOMETER DETAIL**
N.T.S

INITIAL VIBRATING WIRE PIEZOMETER
1:10

SHEET SIZE A3 — REFERENCES

DRAWING No.	DRAWING TITLE
801-102-A3000-800	MONITORING INSTRUMENTATION LAYOUT

REVISIONS

REV	DATE	DESCRIPTION	DRN	DESIGN	CKD	APP	CLIENT APP
A	22/03/2022	ISSUED FOR CLIENT REVIEW	PRK	AMM	AMM	DJTM	
B	22/06/2022	ISSUED FOR REVIEW - JUNE 2022	SGM	AMM	AMM	BAS	

ORIGINAL STAMPED IN RED

DATE	DESIGNED	CHECKED	APPROVED	CLIENT APP'D

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RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
TYPICAL MONITORING AND INSTRUMENTATION DETAILS

SCALE AS SHOWN
STATUS: FOR REVIEW
DRAWING NUMBER: **801-102-A3000-810**
REV: **B**

287 410

APPENDIX A

Memorandum Ref. PE21-01333, *Rustlers Roost Gold Project - Design Climatology*

MEMORANDUM

To:	Hanking Australia Investment	**Date:**	20 October 2021
Attn:	John Zimmerman	**Our Ref:**	PE21-01333
		KP File Ref.:	PE801-00102/06-A acsb M21008
cc:	Charles Hastie	**From:**	Andrew Brown/Dave Morgan

RE: RUSTLERS ROOST GOLD PROJECT – DESIGN CLIMATOLOGY

EXECUTIVE SUMMARY

The Rustlers Roost Gold Project, developed by Hanking Australia Investment, is located approximately 90 km south-east of Darwin, in the Northern Territory. Knight Piésold (KP) is pleased to provide the following memorandum regarding design climatology that has been developed. The investigation and calculations discussed herein provide the hydrologic basis for the tailings storage facility Definitive Feasibility Study.

The site is located in a region with a Köppen climate classification of Tropical, savannah with distinctive wet and dry seasons. The critical design values generated in this memo are summarised in tables E.1 and E.2.

Table E.1: Monthly Climate Parameters

Month	10-yr ARI Wet Season (mm)	Annual Precipitation (mm)		Average Pan Evap. (mm)	Average Lake Evap. (mm)
		Average	100-yr ARI Dry		
Jul	0	0	0	193	139
Aug	0	0	0	212	151
Sep	26	26	3	222	157
Oct	62	62	0	236	165
Nov	93	93	232	204	145
Dec	338	338	66	186	134
Jan	336	241	222	170	123
Feb	550	410	266	150	109
Mar	508	252	131	170	123
Apr	56	56	65	177	127
May	0	0	23	190	137
Jun	3	3	0	181	130
1-year Totals	1,972	1,481	1,010	2,290	1,641

Table E.2: Storm Events (1 and 3 Day Totals)

Duration (hours)	1% AEP	0.1% AEP	1 in 10,000 AEP	PMP
24	293	457	669	1,200
72	441	648	906	2,180

1. DATA SOURCE / SUMMARY

Daily historic hydrologic data were obtained from the Scientific Information for Land Owners (SILO) database for use in deriving the baseline climatology. The SILO data are based on the available climatic records in the area of the site. There are 295 weather stations with daily precipitation data within 250 km of the site. Table 1.1 lists the ten closest stations to the Project site which recorded daily precipitation data. These stations are illustrated in Figure 1.1.

Table 1.1: Weather stations in the project area with daily precipitation data

Station Name	First Reading	Last Reading	Years of Data	Dataset Completeness	Distance from Site (km)
Rustlers Roost	Feb 1995	Nov 1997	2.4	83	3
Mount Bundy Mine	Jan 1968	Nov 1971	3.9	100	10
Toms Gully Gold Mine	Nov 1989	Jan 1995	3.8	69	10
Marrakai Springs	Mar 1995	Nov 2001	6.1	89	13
Corroboree Park	Oct 1992	Mar 2005	4.5	34	15
The Rose Gardens	Nov 1989	Jan 1991	1.1	87	17
Mount Ringwood	Jun 1968	Oct 2010	20.1	47	29
Ambrookville	Oct 1908	May 1909	0.7	82	30
Marrakai	Nov 1916	Jan 1942	21	83	31
Beatrice Hill	Jan 1884	Nov 2017	45.6	34	34

The SILO data integrates the available records to produce a daily climate data set. The data from SILO (extracted as a data drill down from the grid cell 12.90°S, 131.50°E) spanning the period January 1889 – October 2021 were analysed to obtain required design inputs for water balance modelling, namely:

- Typical variability of annual precipitation;
- Typical variability of monthly precipitation; and
- Synthetic monthly precipitation sequences for three climate scenarios:
  - 1% Average Exceedance Probability (AEP) Wet precipitation, 1 year duration;
  - Average precipitation, 1 year duration;
  - 1% AEP Dry precipitation, 1 year duration; and
  - 20% to 1 % Average Exceedance Probability (AEP) Wet precipitation, wet season duration.

Daily pan evaporation values were also sourced from the SILO dataset. While the SILO dataset starts in January 1889, the daily pan evaporation data pre-1970 are interpolated long term averages; as such this portion of the dataset was discarded. The dataset for January 1970 onwards is interpolated from daily observations and was assessed in this memorandum.

Design storms were developed using the BOM 2016 IFD generating tool. Probable Maximum Precipitation (PMP) was estimated using the methods developed by the BOM (Refs. 1, 2 & 3).

2. WATER BALANCE PRECIPITATION ANALYSIS

Precipitation data from SILO were reduced into a standardised format and then analysed on annual and monthly time scales to develop inputs for water balance modelling. The following sections detail the various analyses conducted and the results achieved. It is noted that as the wetter period of the year runs from December through to March, the annual data were analysed as "*Water Years*", spanning July through to June.

2.1 ANNUAL ANALYSIS

Daily precipitation records from the SILO dataset were summed to produce annual totals for the 134 years of record available. KP notes that water years of record (July through June) were excluded from the analyses if greater than 15% of the daily data from that year were missing (approximately 2 months); this was done to prevent missing records from introducing bias into computed climate statistics. On this basis, of the 134 water years of data, 2 years were excluded from the annual analysis. Sampling statistics were computed from the annual sums to provide a broad overview of the variability of annual climate at the project site, as given in Table 2.1. The stationarity of the data was assessed as outlined in Section 2.2 and as a result two sets of climatic data were generated, one for the full record and one for the last 30 years of the record.

Table 2.1: Annual precipitation statistics

Selected Statistic	Precipitation Value Full Record (mm)	Precipitation Value 30 Year Record (mm)
Average	1,356	1,481
Median	1,339	1,444
Std. Deviation	288	336
Minimum	690	1,075
Maximum	2,262	2,262
25^{th} Percentile	1,147	1,170
75^{th} Percentile	1,529	1,688

2.2 NON-STATIONARY CLIMATE ASSESSMENT

The annual precipitation totals for the Rustlers Roost Project for the period 1889 to 2021 were assessed looking for any long term trends. The complete annual rainfall dataset is shown in Figure 2.1. Also shown in Figure 2.1 is a linear trend line and a 10 year moving average. The trend lines indicate that the recent time period is slightly wetter than previous time periods. It is consistent with the Intergovernmental Panel on Climate Change (IPCC) assessment which identifies the region around the Rustlers Roost Project as having an increasing trend in annual rainfall (Ref. 4).

For the Rustlers Roost Project the long term mean rainfall (1889 to 2021) is 1,356 mm. The mean for the last 30 complete water years of record (1991-1992 to 2020-2021) is 1,481 mm, a 9.2% increase on the long term average. As this difference is significant enough, KP concluded that the analysis would assess only the past 30 complete water years of data.

2.3 MONTHLY ANALYSIS

Daily precipitation from the SILO dataset for 1991-1992 to 2020-2021 was summed in a manner similar to that described in Section 2.1 to produce monthly totals. KP notes that months of record were excluded from the analyses if greater than 25% of the daily data from that month were missing (approximately 1 week); for the same reason as given in Section 2.1. On this basis, of the 30 water years of data, 0 months were excluded from the monthly analysis. Sampling statistics were computed on the monthly sums to provide a broad overview of the variability of monthly climate at the project site, as given in Table 2.2.

Table 2.2: Monthly precipitation statistics

Month	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jul.	0	0	1	0	3	0	0
Aug.	1	0	2	0	11	0	0
Sep.	9	3	15	0	75	0	11
Oct.	57	41	47	0	180	20	83
Nov.	133	126	46	73	248	99	157
Dec.	267	286	97	70	434	206	331
Jan.	340	320	145	112	869	236	384
Feb.	311	305	125	114	576	205	395
Mar.	249	212	131	66	665	159	323
Apr.	101	62	141	0	725	32	102
May	12	1	23	0	100	0	21
Jun.	0	0	1	0	3	0	0

Note: all computed precipitation statistics are measured in (mm).

The sample statistics for monthly precipitation were also depicted as “box and whisker” plots to illustrate the variability of monthly values at the project site, as shown on Figure 2.2.

It is shown on Figure 2.2 that December to March is generally the wettest months of the year, with measurable precipitation occurring throughout the year with no other definite wet season trends observed.

2.4 SYNTHETIC WATER BALANCE SCENARIOS

KP performed frequency analysis on annual duration values (from the SILO dataset) to estimate the statistical likelihood of experiencing extremely “Wet” or “Dry” periods of weather at the project site. Exceedance and non-exceedance probabilities were assigned to various duration totals of daily precipitation values, by sorting the values in descending (for the “Wet” series) and ascending (for the “Dry” series) order.

A number (64) of different probability distributions, e.g.: Log-Pearson 3, Generalised Extreme Value, Wakeby, Inverse Gaussian, etc. were fitted to the various sums of daily precipitation data using EasyFit 5.4 Professional software. Three of the best fits were selected for comparison in each case, as shown in the following figures:

- Wet precipitation series, 1 year duration – Figure 2.3; and
- Dry precipitation series, 1 year duration – Figure 2.4.

Ideally, the distributions having the best weighted goodness-of-fit test ranking results will match across all scenarios, thereby providing consistent results. In this case, the goodness-of-fit test results indicated the Generalised Extreme Value distribution was statistically the best fit for a “Wet” scenario and Generalised Pareto distribution for a “Dry” scenario. The resulting estimated extreme wet and dry annual precipitation depths are shown in Table 2.3.

Table 2.3: Design annual precipitation - Wet and Dry scenarios

AEP	1 Year Precipitation Totals (mm)	
	Wet	Dry
20%	1,743	1,154
10%	1,941	1,076
5%	2,125	1,039
2%	2,354	1,017
1%	2,519	1,010

In order to apportion the statistically-computed climate series precipitation totals to monthly time series for use in water balance modelling, the following observed rainfall patterns were used:

- 1 year duration Wet scenarios: July 2010 – June 2011, the wettest observed water year of record;
- 1 year duration Average scenario: July 2020 – June 2021, one of the median observed water years of record; and
- 1 year duration Dry scenarios: July 1991 – June 1992, the driest observed water year of record.

Ratios of observed monthly to observed total precipitation were computed for each scenario. These ratios were then multiplied by the computed statistical totals (at the selected design frequency, 1% AEP) to form the desired synthetic climate scenarios for water balance modelling. The resulting climate scenarios are summarised (in monthly format) in Table 2.4.

Table 2.4: Annual synthetic climate scenarios

Month	Wet Scenarios (mm)			Average (mm)	Dry Scenarios (mm)		
	100-yr ARI	10-yr ARI	5-yr ARI		5-yr ARI	10-yr ARI	100-yr ARI
Jul	2	2	2	0	0	0	0
Aug	0	0	0	0	0	0	0
Sep	33	25	23	26	4	3	3
Oct	161	124	111	62	0	0	0
Nov	94	73	65	93	266	248	232
Dec	343	264	237	338	76	70	66
Jan	427	329	296	241	254	237	222
Feb	641	494	444	410	304	283	266
Mar	438	337	303	252	150	140	131
Apr	380	293	263	56	75	70	65
May	0	0	0	0	27	25	23
Jun	0	0	0	3	0	0	0
1-year Totals	2,519	1,941	1,743	1,481	1,154	1,076	1,010

It is noted that the 1% AEP Wet year may have months where the precipitation is less than the average or the 1% AEP dry year. Similarly, the 1% AEP Dry year may have months where the precipitation is greater than the average or the 1% AEP wet year. This is not an error and is due to the rainfall pattern within the specific year selected to develop the rainfall patterns.

2.5 ANCOLD WET SEASON ANALYSIS

In order to develop wet season precipitation patterns for modelling in compliance with ANCOLD 2012 the daily data were assessed to determine the average typical wet season duration. ANCOLD 2012 defines the wet season as the period in which, on average, 70% of the rainfall occurs. This was determined to be approximately 84 days. As the planned water balance modelling will be run on a monthly time step, this was conservatively rounded up to 90 days.

KP performed frequency analyses on the maximum 90 day precipitation values similar to the method described (with daily data) in Section 2.3. Exceedance and non-exceedance probabilities were assigned to the 90 day totals (rather than the annual daily maxima), by sorting the values in descending order. Probability distributions were fitted to the data and then plotted for comparison, as shown on Figure 2.5. KP selected the Johnson SB distribution for the wet season analysis. The results of these calculations are summarised in Table 2.5.

Table 2.5: Extreme long duration design precipitation

Annual Exceedance Probability (AEP)	90 Day Wet Precipitation Depth (mm)
20%	1,278
10%	1,394
5%	1,473
2%	1,543
1%	1,579

In order to apportion the statistically-computed 90 day totals to monthly time series for use in water balance modelling, the rainfall pattern observed during the wettest 3 month period (January 2011 to March 2011) was used. These monthly ratios were then multiplied by the computed statistical annual values to form the required synthetic scenarios. The results of this computation are provided in Table 2.6.

Table 2.6: 90 day duration synthetic precipitation scenarios

Month	90 day wet scenario depths (mm) for a given AEP				
	20%	10%	5%	2%	1%
Jan	308	336	355	372	380
Feb	504	550	581	609	623
Mar	466	508	537	562	576
Total	1,278	1,394	1,473	1,543	1,579

3. DESIGN STORMS

Aside from climate scenarios for water balance modelling, design storms were derived for surface water management design and storm containment.

3.1 PROBABLE MAXIMUM PRECIPITATION (PMP)

PMP was estimated using two different methods published by BOM, depending on the duration of the candidate storm. For storm durations of up to 6 hours, the Generalised Short Duration Method (GSDM) procedures (Ref. 1) is employed.

As the Project site is located in the Generalised Tropical Storm Method, Revised (GTSMR) Coastal Zone, GTSMR procedures (Ref. 2) were utilised for storm durations of 24 hours to 120 hours.

Results from estimating PMP with the various methods (and seasons) were plotted to determine which results in the largest (i.e. governing) values:

- Short duration (≤ 6 hour) PMP is determined by the GSDM method; and
- Long duration (≥ 24 hour) PMP is determined by the GTSMR Summer method.

Composite curve results for the Project site are summarised in Table 3.1.

Table 3.1: Composite depth-duration relationship for PMP

Estimation Procedure	Duration (hr)	Depth (mm)
GSDM	0.25	240
	0.50	280
	0.75	310
	1.0	340
	1.5	430
	2.0	500
	2.5	590
	3.0	670
	4.0	760
	5.0	880
	6.0	970
GTSMR Summer	24	1,200
	36	1,470
	48	1,730
	72	2,180
	96	2,440
	120	2,570

3.2 INTENSITY / FREQUENCY / DURATION

Intensity / Frequency / Duration (IFD) and corresponding Depth / Frequency / Duration (DFD) relationships for design storms (63.2% ≤ AEP ≤ 0.05%) were sourced from the BOM 2016 IFD tool (Ref. 3) for the grid cell (12.9125°S, 131.4875°E). The design storm information is summarised as storm depths in Table 3.2.

Table 3.2: Design storm depths

Duration (h)	Precipitation Depth (mm) for a given AEP							
	10%	5%	2%	1%	0.5%	0.2%	0.1%	0.05%
1	70.7	77.4	85.2	90.6	104.6	124.0	140.4	157.7
2	88.2	97.1	108.1	114.8	132.2	157.3	178.5	201.6
3	98.0	108.5	122.0	131.6	151.9	180.9	205.0	230.9
6	116.2	131.9	152.6	168.2	194.8	233.0	264.4	299.6
12	139.4	162.2	193.9	220.6	255.3	304.7	347.3	394.7
24	173.4	206.1	252.6	293.2	337.7	402.8	457.0	516.1
48	225.4	271.1	333.6	386.1	439.5	518.5	584.6	657.6
72	264.5	316.2	385.6	441.1	498.5	580.5	647.6	717.6
96	293.5	348.2	418.6	475.1	533.5	615.5	680.7	748.7
120	313.5	368.2	439.7	494.2	553.6	633.7	697.9	763.9
144	327.6	380.3	449.7	504.3	563.7	642.8	704.1	771.2
168	335.6	385.3	453.8	507.4	566.8	644.0	704.3	773.4

A summary of all of the estimated storm depths is provided as a DFD table and an IFD Table in Appendix A. This is also shown graphically on figures 3.1 to 3.3.

4. EVAPORATION

To be consistent with the precipitation analysis, only the last 30 complete water years of daily pan evaporation data were assessed. This decision was partially made as there is a relationship between annual rainfall and pan evaporation as shown on Figure 4.1.

Daily pan evaporation from the SILO dataset for 1991-1992 to 2020-2021 was summed in a manner similar to that described in Section 2.1 to produce monthly totals. KP notes that months of record were excluded from the analyses if greater than 25% of the daily data from that month were missing (approximately 1 week); for the same reason as given in Section 2.1. On this basis, of the 30 water years of data, 0 months were excluded from the monthly analysis. The average monthly pan evaporation values were calculated from the SILO pan evaporation dataset and are summarised in Table 4.1 below.

The resulting lake evaporation was determined using the relationship between monthly pan evaporation and monthly lake evaporation as described by Stanhill (Ref. 5). The average pan evaporation, average lake evaporation and pan factor are summarised in Table 4.1 below.

Table 4.1: Average monthly evaporation

Month	Average Pan Evaporation (mm)	Average Lake Evaporation (mm)	Pan Factor
Jul	193	139	0.72
Aug	212	151	0.71
Sep	222	157	0.70
Oct	236	165	0.70
Nov	204	145	0.71
Dec	186	134	0.72
Jan	170	123	0.73
Feb	150	109	0.73
Mar	170	123	0.73
Apr	177	127	0.72
May	190	137	0.72
Jun	181	130	0.72
Total	2,290	1,641	0.72

We trust that this memorandum is sufficient for your current needs. Please contact us if you have any queries.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

ANDREW BROWN
Project Engineer

DAVID MORGAN
Managing Director

REFERENCES

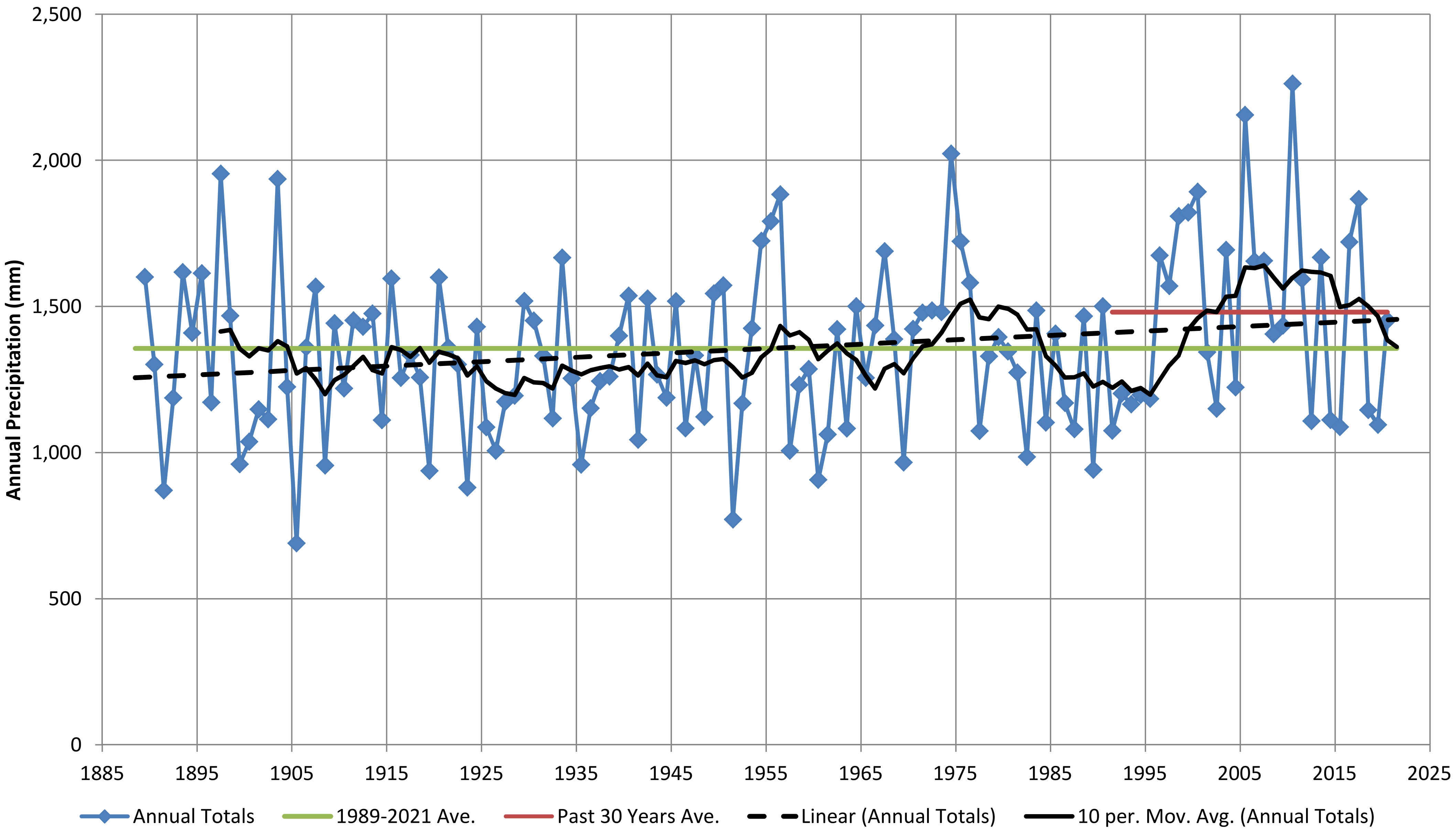
1. Australian Bureau of Meteorology. *"The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*", 2003. Melbourne, VIC. Australia.
2. Australian Bureau of Meteorology. "*Revision of the Generalised Tropical Storm Method for Estimating Probable Maximum Precipitation, HRS Report No. 8*", 2003. Melbourne, VIC. Australia.
3. Bureau of Meteorology, "*Design Rainfall Data System (2016)*", http://www.bom.gov.au/water/designRainfalls/revised-ifd/.
4. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller. "*IPCC Fourth Assessment Report: Climate Change 2007: Working Group I: The Physical Science Basis*", Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.
5. Stanhill, G. 1976. "*The CMO International Evaporimeter Comparisons.*" Publication 449 (World Meteorological Organisation, Geneva) 38pp.

FIGURES

Knight Piésold CONSULTING

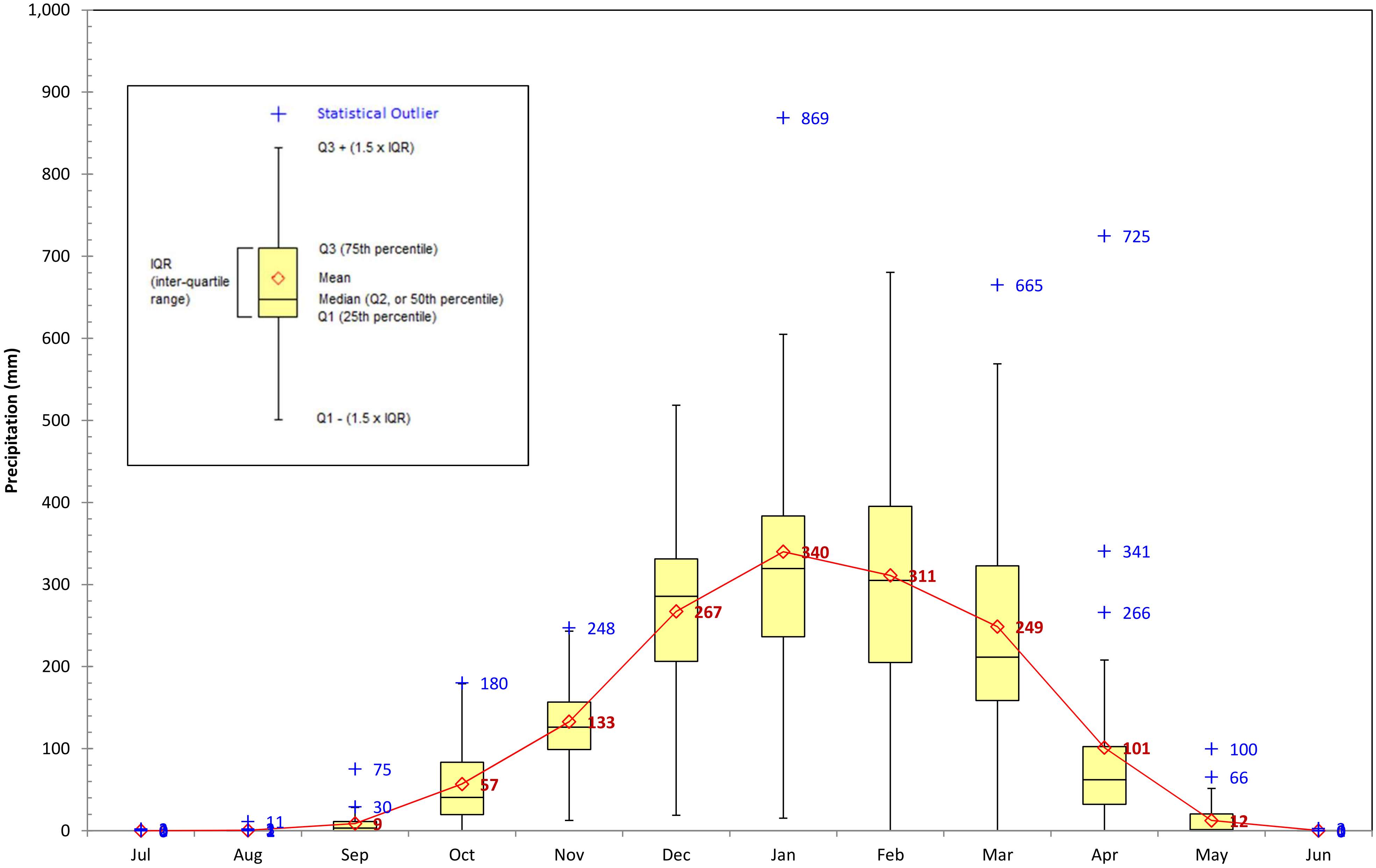
RUSTLERS ROOST PROJECT
DESIGN CLIMATOLOGY
PROJECT LOCATION AND NEARBY STATIONS

PE801-00102 M21008
Figure 1.1

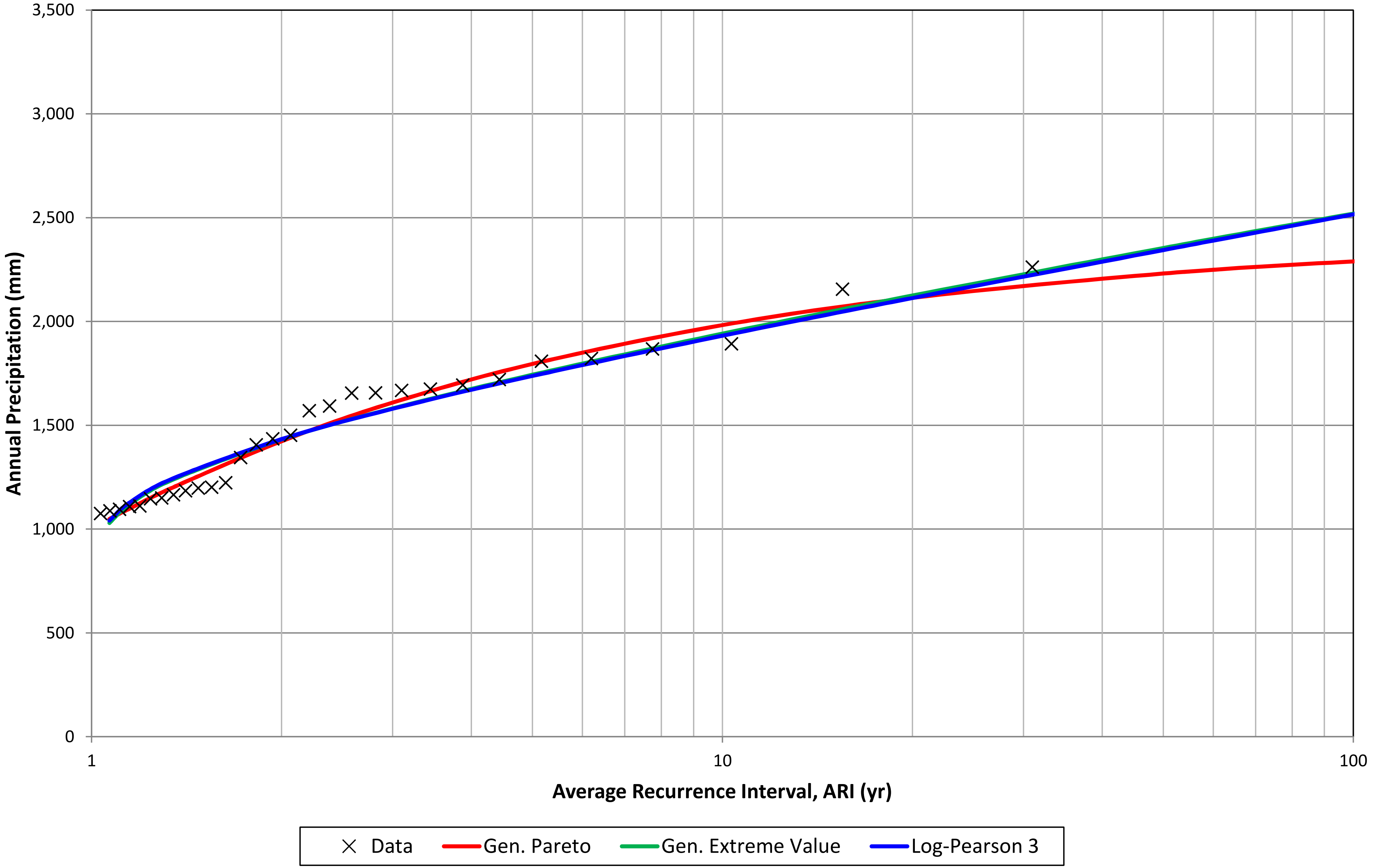


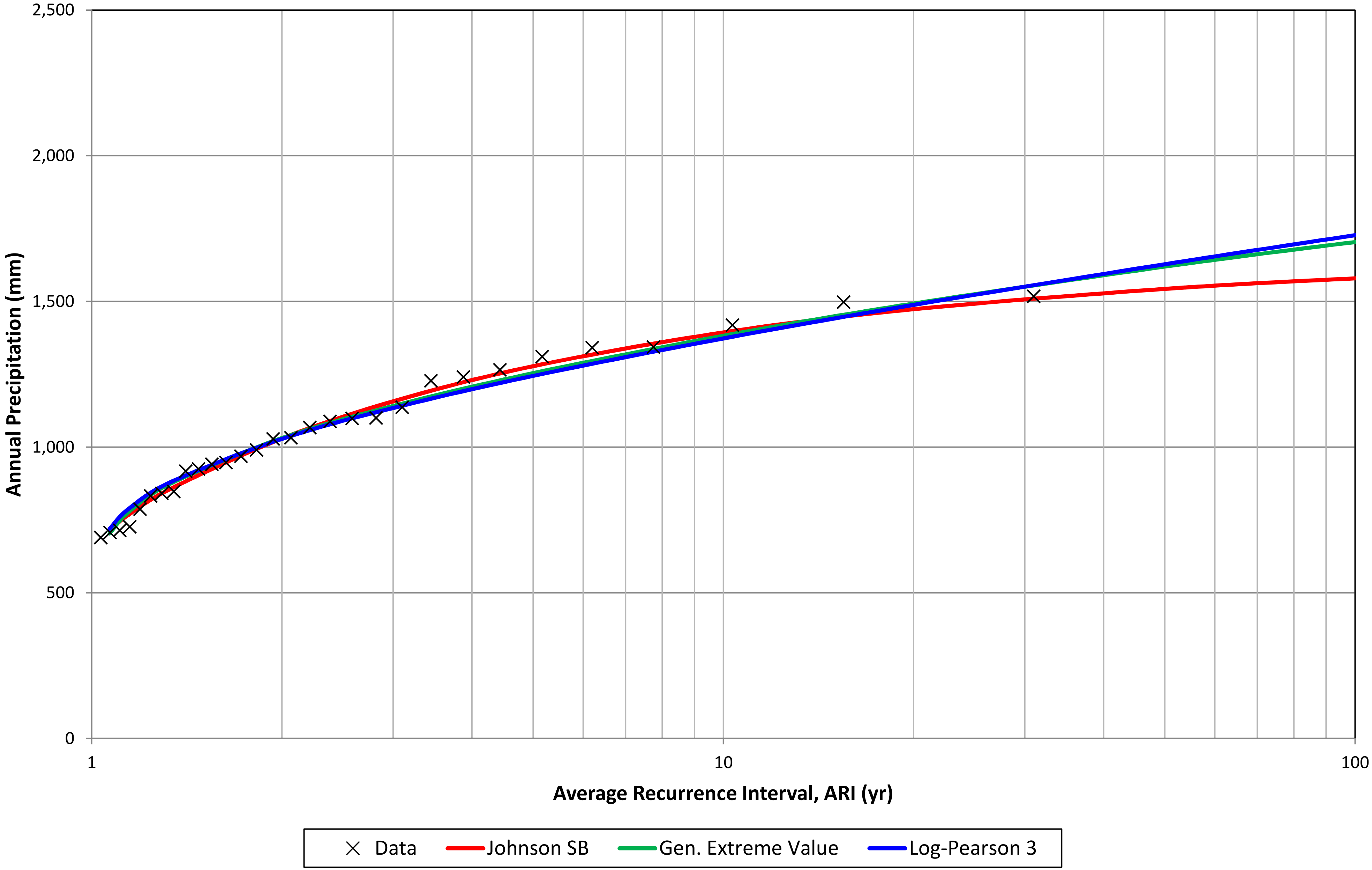
RUSTLERS ROOST PROJECT
DESIGN CLIMATOLOGY
ANNUAL PRECIPITATION TREND ANALYSIS - SILO DATASET

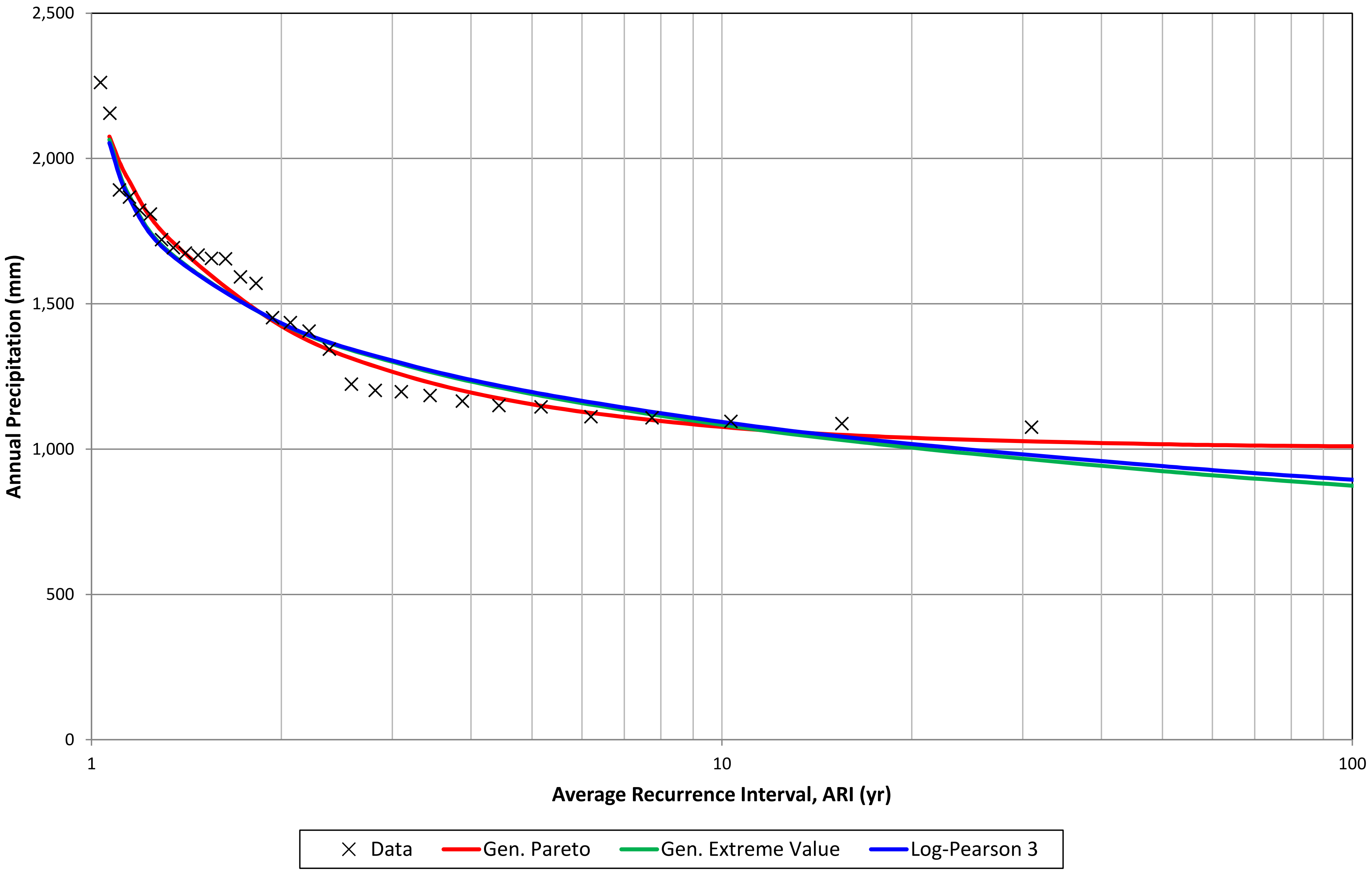
PE801-00102 M21008
Figure 2.1

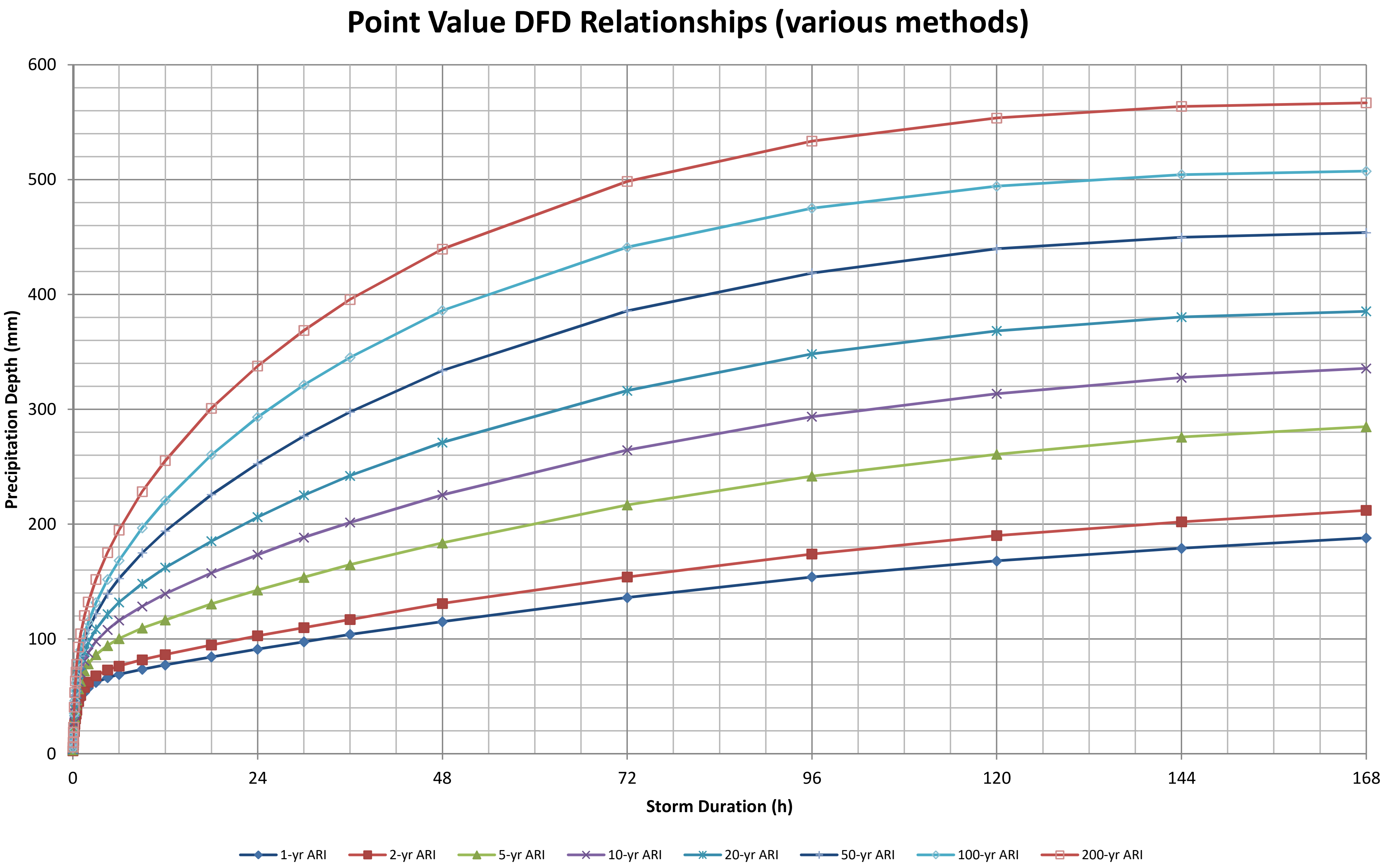


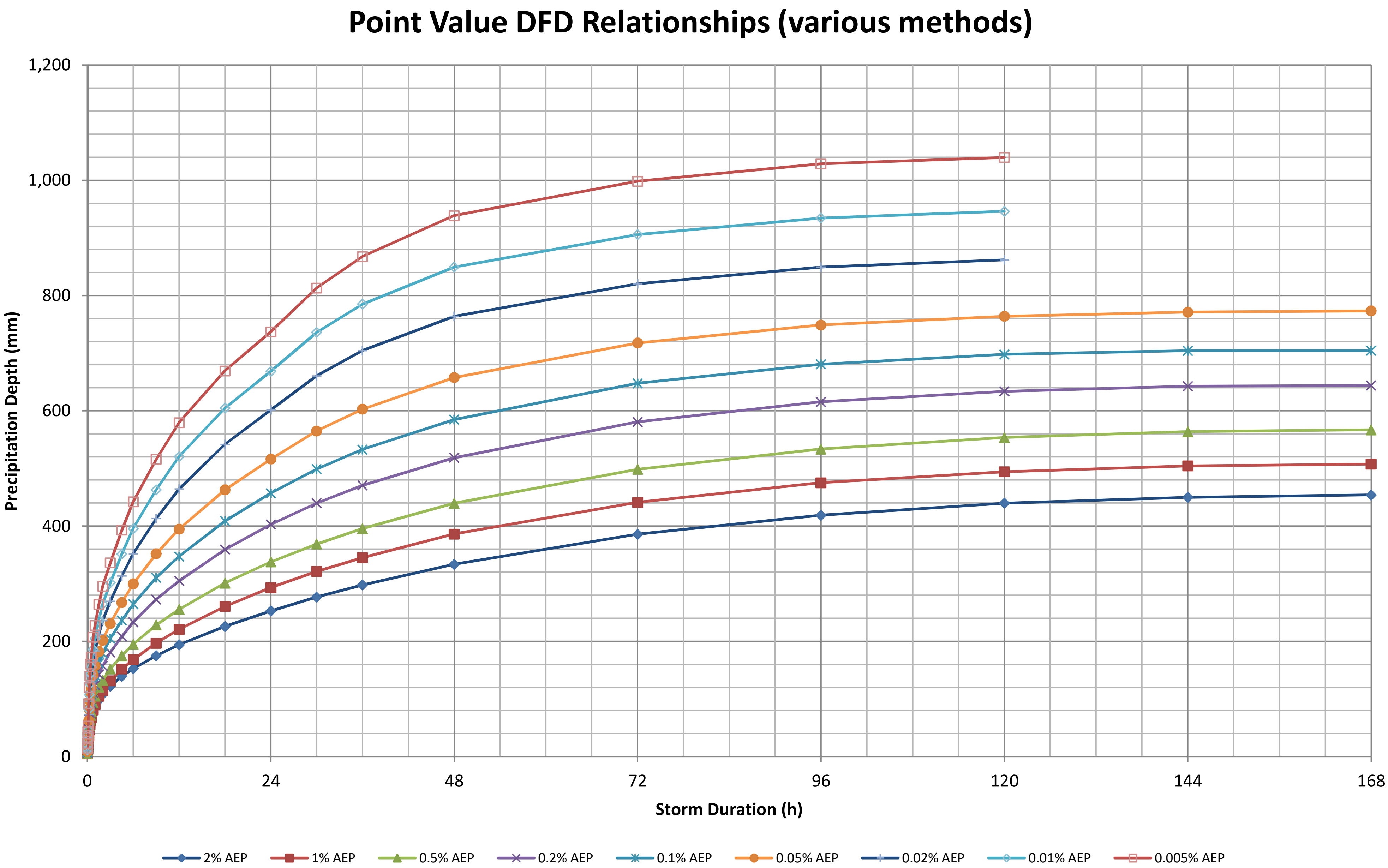
RUSTLERS ROOST PROJECT
DESIGN CLIMATOLOGY
MONTHLY PRECIPITATION STATISTICS: SILO POINT DATA (MOST RECENT 30 YEARS)


3,500
3,000
2,500
2,000
1,500
1,000
500
0
Annual Precipitation (mm)
1
10
100
Average Recurrence Interval, ARI (yr)
Data
Gen. Pareto
Gen. Extreme Value
Log-Pearson 3

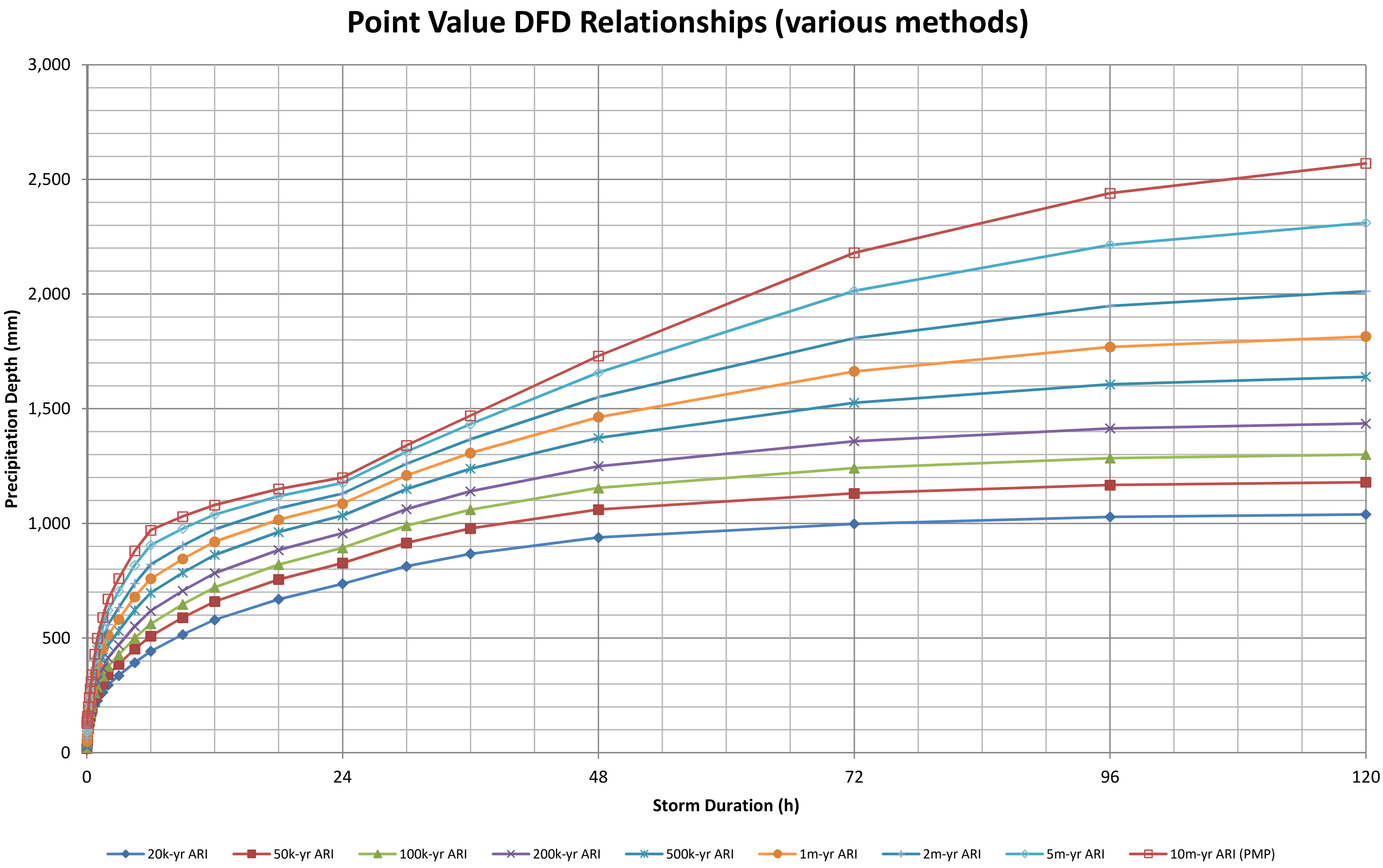

2,500
2,000
1,500
1,000
500
0
Annual Precipitation (mm)
1
10
100
Average Recurrence Interval, ARI (yr)
Data
Johnson SB
Gen. Extreme Value
Log-Pearson 3


2,500
2,000
1,500
1,000
500
0
Annual Precipitation (mm)
1
10
100
Average Recurrence Interval, ARI (yr)
Data
Gen. Pareto
Gen. Extreme Value
Log-Pearson 3

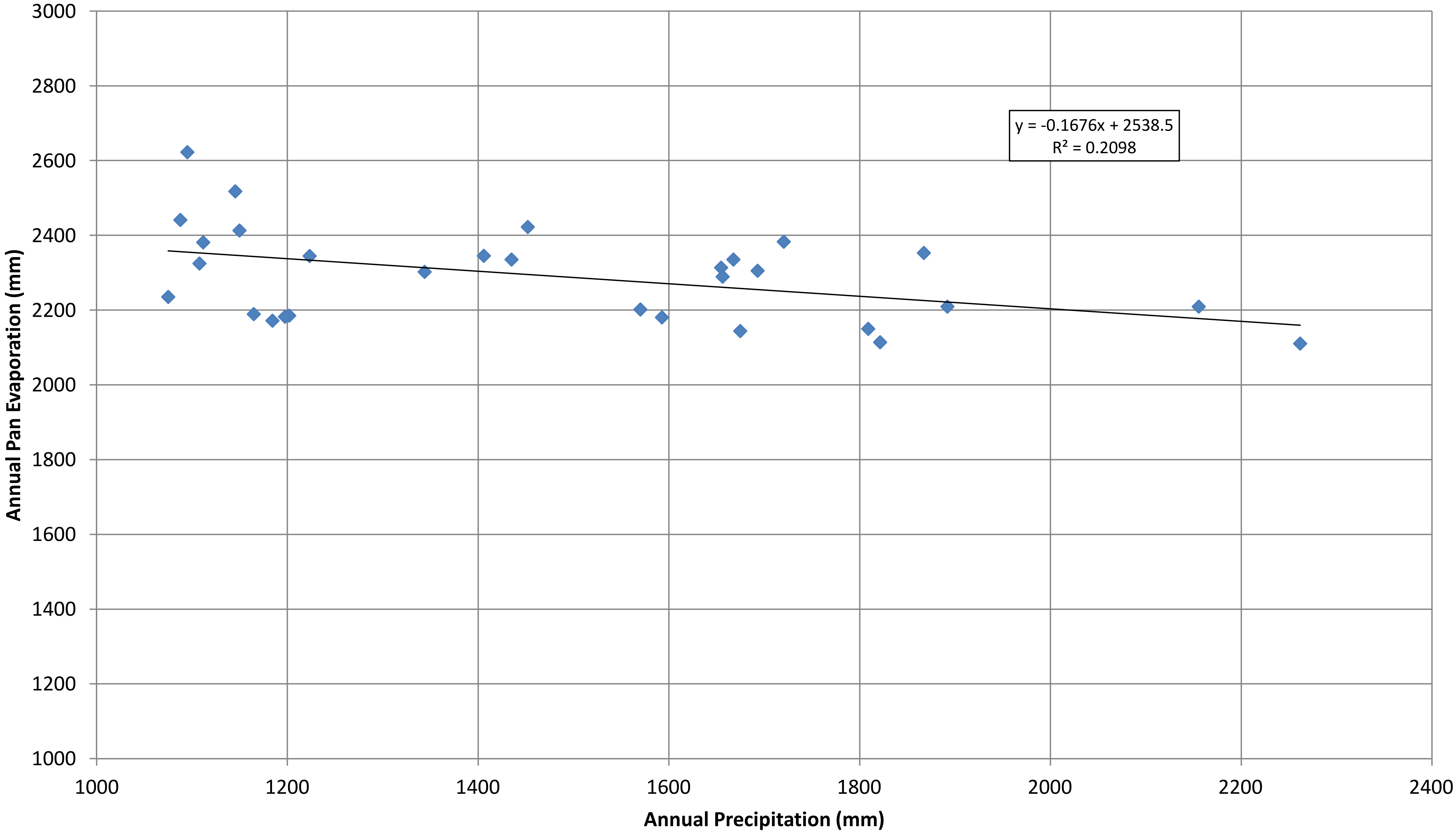

Point Value DFD Relationships (various methods)
600
500
400
300
200
100
0
Precipitation Depth (mm)
0
24
48
72
96
120
144
168
Storm Duration (h)
1-yr ARI
2-yr ARI
5-yr ARI
10-yr ARI
20-yr ARI
50-yr ARI
100-yr ARI
200-yr ARI



Point Value DFD Relationships (various methods)
Precipitation Depth (mm)
1,200
1,000
800
600
400
200
0
0
24
48
72
96
120
144
168
Storm Duration (h)
2% AEP
1% AEP
0.5% AEP
0.2% AEP
0.1% AEP
0.05% AEP
0.02% AEP
0.01% AEP
0.005% AEP



Point Value DFD Relationships (various methods)
3,000
2,500
2,000
1,500
1,000
500
0
Precipitation Depth (mm)
0
24
48
72
96
120
Storm Duration (h)
20k-yr ARI
50k-yr ARI
100k-yr ARI
200k-yr ARI
500k-yr ARI
1m-yr ARI
2m-yr ARI
5m-yr ARI
10m-yr ARI (PMP)


3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
Annual Pan Evaporation (mm)
y = -0.1676x + 2538.5
R² = 0.2098
1000
1200
1400
1600
1800
2000
2200
2400
Annual Precipitation (mm)

APPENDIX A
DFD and IFD Summary Tables

Subject: Hanking Australia	Made by: MBW	Job No.: PE801-00102
Rustlers Roost	Checked: ACSB	Date: 13/10/2021
Climate Assessment	Approved:	

Rustlers Roost: Depth (mm) / Frequency (AEP) / Duration (h) Table

The storm depths listed here have been adjusted assuming a total catchment area of 1.94 km^2

Storm Duration		Precipitation Depth (mm) for a given AEP (%) or ARI (yr)																					
		63.2%[1]	50%[2]	20%[3]	10%	5%	2%	1%	0.5%	0.2%	0.1%	0.05%	0.02%	0.01%	0.005%	0.002%	0.001%	0.0005%	0.0002%	0.0001%	0.00005%	0.00002%	PMP[4]
(min)	(h)	1.00	1.44	4.48	9.49	20	50	100	200	500	1,000	2,000	5,000	10,000	20,000	50,000	100,000	200,000	500,000	1,000,000	2,000,000	5,000,000	
1	0.017	2.8	2.8	3.4	3.8	4.2	4.6	4.9	5.7	6.8	7.7	8.7	10.4	12.1	14.3	18.2	22.3	27.8	38.0	49.0	64.3	94.2	128.0
2	0.033	5.2	5.2	6.4	7.1	7.8	8.4	8.7	10.0	11.8	13.4	14.9	17.4	19.9	22.9	28.1	33.2	39.8	51.3	63.1	78.5	106.5	136.0
3	0.050	7.3	7.5	9.2	10.2	11.1	12.1	12.7	14.5	17.2	19.5	21.9	25.7	29.2	33.3	40.1	46.5	54.2	66.9	79.1	94.1	119.4	144.0
4	0.067	9.3	9.5	11.8	13.1	14.3	15.6	16.6	19.0	22.6	25.6	28.8	33.7	38.0	43.1	51.1	58.3	66.8	80.3	92.6	107.1	130.5	152.0
5	0.083	11.0	11.4	14.1	15.8	17.3	19.0	20.2	23.3	27.7	31.3	35.4	41.5	46.9	52.9	62.2	70.3	79.5	93.6	105.9	119.9	141.3	160.0
10	0.167	18.5	19.4	24.1	27.0	29.5	32.9	35.2	40.7	48.5	55.0	62.4	73.2	82.2	91.9	105.6	116.7	128.3	144.4	156.9	169.8	187.0	200.0
15	0.25	24.2	25.5	31.6	35.4	38.8	43.1	46.3	53.5	63.7	72.3	81.9	96.0	107.5	119.7	136.7	150.1	163.8	182.2	196.1	209.9	227.4	240.0
20	0.33	28.7	30.5	37.7	42.1	46.3	51.3	54.9	63.4	75.5	85.7	96.6	112.7	125.8	139.7	159.1	174.4	190.2	211.5	227.7	243.9	264.8	280.0
25	0.42	32.5	34.5	42.7	47.7	52.3	57.8	61.8	71.3	85.0	96.4	109.4	128.5	144.0	160.3	182.8	200.3	218.1	241.4	258.7	275.3	295.9	310.0
30	0.50	35.6	38.0	47.0	52.4	57.4	63.4	67.6	77.9	92.8	105.8	119.3	139.1	155.2	172.2	195.8	214.4	233.5	259.1	278.5	297.7	322.3	340.0
45	0.75	42.6	45.6	56.5	63.1	69.1	76.0	80.9	93.1	111.1	125.6	142.0	166.2	186.1	207.3	237.0	260.8	285.4	318.9	344.8	370.7	404.8	430.0
60	1.0	47.4	51.0	63.2	70.7	77.4	85.2	90.6	104.6	124.0	140.4	157.7	183.4	204.7	227.6	260.4	287.1	315.4	355.0	386.6	419.6	464.7	500.0
90	1.5	53.5	57.9	72.3	81.1	88.9	98.2	104.9	120.4	142.7	162.0	182.2	212.2	237.1	264.0	302.7	334.2	367.8	415.0	452.9	492.5	547.1	590.0
120	2.0	57.4	62.4	78.4	88.2	97.1	108.1	114.8	132.2	157.3	178.5	201.6	236.0	264.6	295.5	340.0	376.4	415.0	469.5	513.0	558.5	621.1	670.0
180	3.0	62.2	68.0	86.3	98.0	108.5	122.0	131.6	151.9	180.9	205.0	230.9	269.4	301.5	336.2	386.1	426.9	470.4	531.8	581.0	632.6	703.9	760.0
270	4.5	66.3	73.0	94.2	108.0	121.6	139.2	151.8	175.1	208.2	236.3	267.2	313.3	351.6	392.9	452.2	500.3	551.3	622.6	679.3	738.0	818.1	880.0
360	6.0	69.2	76.4	100.4	116.2	131.9	152.6	168.2	194.8	233.0	264.4	299.6	352.0	395.4	442.1	508.6	562.3	618.7	696.9	758.3	821.2	905.7	970.0
540	9.0	73.6	81.9	109.5	128.3	148.2	174.9	196.7	228.3	272.8	310.3	351.8	413.0	462.9	515.7	589.2	647.0	706.1	785.1	844.6	903.1	977.3	1,030.0
720	12	77.4	86.4	116.5	139.4	162.2	193.9	220.6	255.3	304.7	347.3	394.7	464.4	520.6	579.3	659.6	721.3	782.8	862.4	919.9	973.8	1,038.1	1,080.0
1080	18	84.4	94.8	130.6	157.4	185.1	225.8	260.4	300.9	359.2	408.6	462.8	541.8	604.6	669.2	755.5	820.4	883.4	962.1	1,016.4	1,065.1	1,118.7	1,150.0
1440	24	91.1	102.8	142.6	173.4	206.1	252.6	293.2	337.7	402.8	457.0	516.1	601.5	668.7	737.0	827.1	893.6	957.1	1,034.3	1,085.9	1,130.3	1,176.1	1,200.0
1800	30	97.5	109.9	153.6	188.4	225.1	276.6	321.2	368.6	439.7	498.8	564.9	660.6	736.1	813.1	915.0	990.3	1,062.4	1,150.3	1,209.2	1,259.9	1,312.5	1,340.0
2160	36	104.0	116.9	164.7	201.4	242.1	297.6	345.1	395.6	470.6	532.7	602.7	704.4	785.0	867.6	977.8	1,060.1	1,139.9	1,238.8	1,306.7	1,366.9	1,432.5	1,470.0
2880	48	115.0	130.9	183.7	225.4	271.1	333.6	386.1	439.5	518.5	584.6	657.6	763.9	849.4	938.5	1,060.4	1,154.6	1,249.1	1,372.7	1,463.5	1,550.4	1,657.2	1,730.0
4320	72	136.0	154.0	216.7	264.5	316.2	385.6	441.1	498.5	580.5	647.6	717.6	820.4	905.8	998.1	1,131.3	1,240.8	1,358.3	1,526.1	1,662.8	1,808.2	2,014.0	2,180.0
5760	96	154.0	174.0	241.8	293.5	348.2	418.6	475.1	533.5	615.5	680.7	748.7	849.3	934.5	1,028.3	1,167.2	1,284.8	1,414.4	1,606.5	1,769.2	1,948.6	2,214.6	2,440.0
7200	120	168.0	190.0	260.8	313.5	368.2	439.7	494.2	553.6	633.7	697.9	763.9	862.0	946.0	1,039.5	1,179.9	1,300.6	1,435.5	1,639.0	1,814.7	2,012.0	2,310.8	2,570.0
8640	144	179.0	202.0	275.8	327.6	380.3	449.7	504.3	563.7	642.8	704.1	771.2											
10080	168	188.0	212.0	284.9	335.6	385.3	453.8	507.4	566.8	644.0	704.3	773.4											

- Estimated using the BOM IFD TOOL 2016

- Estimated by interpolation methodology as described in Section 3.5.2.2 of ARR 2016.

- Logarithmically interpolated for mid duration events

- Linearly extrapolated for short duration events

- Estimated using the procedures taken from "The Estimation of Probable Maximum Precipitation in Australia", June 2003 (GSDM)

- Estimated using the procedures taken from "Revision of the Generalised Tropical Storm Method for Estimating Probable Maximum Precipitation, HRS Report No. 8", August 2003 (GTSMR).

Notes:

1. 63% AEP is equivalent to 1 Exceedances per year (EY). This event of greater will occur once ever year.
2. The 50% AEP IFD does not correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
3. The 20% AEP IFD does not correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.
4. PMP is assumed to be equivalent to a 0.00001% AEP or 10,000,000 year ARI Event.

Knight Piésold CONSULTING	Subject Hanking Australia	Made by MBW	Job No. PE801-00102
	Rustlers Roost	Checked ACSB	Date 13/10/2021
	Climate Assessment	Approved	

Rustlers Roost: Intensity (mm/h) / Frequency (AEP) / Duration (h) Table

The storms intensities listed here have been adjusted assuming a total catchment area of 1.94 km^2

Storm Duration		Precipitation Intensity (mm/h) for a given AEP (%) or ARI (yr)																					
		63.2%[1]	50%[2]	20%[3]	10%	5%	2%	1%	0.5%	0.2%	0.1%	0.05%	0.02%	0.01%	0.005%	0.002%	0.001%	0.0005%	0.0002%	0.0001%	0.00005%	0.00002%	PMP[4]
(min)	(h)	1.00	1.44	4.48	9.49	20	50	100	200	500	1,000	2,000	5,000	10,000	20,000	50,000	100,000	200,000	500,000	1,000,000	2,000,000	5,000,000	
1	0.017	169.8	165.2	204.7	229.1	250.9	277.4	296.4	342.0	407.2	461.7	522.0	622.4	724.1	855.6	1,092.6	1,338.8	1,666.2	2,279.1	2,941.5	3,856.1	5,649.5	7,680.0
2	0.033	156.3	157.1	193.1	214.3	232.6	251.1	261.4	300.3	355.1	401.5	447.9	522.8	595.5	686.2	842.2	996.6	1,192.9	1,539.8	1,892.9	2,353.7	3,195.0	4,080.0
3	0.050	146.4	149.5	184.1	203.8	222.3	242.6	253.6	290.7	344.4	390.6	438.6	513.9	583.5	666.5	802.1	929.2	1,083.0	1,338.5	1,582.1	1,881.4	2,387.9	2,880.0
4	0.067	138.8	143.1	177.0	196.6	214.8	234.4	248.3	284.8	339.4	384.1	431.6	504.8	570.4	646.6	766.6	875.1	1,002.0	1,204.2	1,388.7	1,606.5	1,956.9	2,280.0
5	0.083	132.0	136.9	169.8	190.1	207.0	228.4	241.8	279.1	332.0	375.9	424.2	497.9	562.3	635.1	746.5	843.8	954.1	1,122.9	1,270.7	1,438.3	1,695.0	1,920.0
10	0.167	111.0	116.3	144.5	161.8	177.2	197.2	211.4	244.0	290.9	330.3	374.2	439.4	493.4	551.3	633.8	700.2	769.9	866.2	941.7	1,018.7	1,121.9	1,200.0
15	0.25	96.8	102.2	126.5	141.5	155.3	172.5	185.1	213.9	254.9	289.4	327.6	384.0	430.1	478.8	546.7	600.2	655.1	728.8	784.5	839.4	909.6	960.0
20	0.33	86.1	91.6	113.1	126.4	138.8	153.8	164.7	190.1	226.5	257.0	289.8	338.0	377.4	419.0	477.2	523.3	570.6	634.5	683.2	731.7	794.4	840.0
25	0.42	78.0	82.8	102.4	114.5	125.6	138.8	148.4	171.1	204.0	231.4	262.6	308.4	345.7	384.8	438.8	480.8	523.3	579.4	620.8	660.7	710.1	744.0
30	0.50	71.2	76.0	93.9	104.8	114.8	126.8	135.2	155.9	185.6	211.6	238.6	278.1	310.3	344.3	391.6	428.9	467.1	518.3	557.1	595.4	644.6	680.0
45	0.75	56.8	60.9	75.3	84.1	92.1	101.4	107.9	124.2	148.2	167.5	189.3	221.6	248.1	276.3	316.1	347.7	380.5	425.2	459.7	494.3	539.8	573.3
60	1.0	47.4	51.0	63.2	70.7	77.4	85.2	90.6	104.6	124.0	140.4	157.7	183.4	204.7	227.6	260.4	287.1	315.4	355.0	386.6	419.6	464.7	500.0
90	1.5	35.7	38.6	48.2	54.1	59.3	65.5	69.9	80.3	95.1	108.0	121.5	141.4	158.1	176.0	201.8	222.8	245.2	276.7	301.9	328.3	364.8	393.3
120	2.0	28.7	31.2	39.2	44.1	48.6	54.1	57.4	66.1	78.7	89.3	100.8	118.0	132.3	147.8	170.0	188.2	207.5	234.7	256.5	279.2	310.5	335.0
180	3.0	20.7	22.7	28.8	32.7	36.2	40.7	43.9	50.6	60.3	68.3	77.0	89.8	100.5	112.1	128.7	142.3	156.8	177.3	193.7	210.9	234.6	253.3
270	4.5	14.7	16.2	20.9	24.0	27.0	30.9	33.7	38.9	46.3	52.5	59.4	69.6	78.1	87.3	100.5	111.2	122.5	138.4	151.0	164.0	181.8	195.6
360	6.0	11.5	12.7	16.7	19.4	22.0	25.4	28.0	32.5	38.8	44.1	49.9	58.7	65.9	73.7	84.8	93.7	103.1	116.2	126.4	136.9	151.0	161.7
540	9.0	8.2	9.1	12.2	14.3	16.5	19.4	21.9	25.4	30.3	34.5	39.1	45.9	51.4	57.3	65.5	71.9	78.5	87.2	93.8	100.3	108.6	114.4
720	12	6.5	7.2	9.7	11.6	13.5	16.2	18.4	21.3	25.4	28.9	32.9	38.7	43.4	48.3	55.0	60.1	65.2	71.9	76.7	81.2	86.5	90.0
1080	18	4.7	5.3	7.3	8.7	10.3	12.5	14.5	16.7	20.0	22.7	25.7	30.1	33.6	37.2	42.0	45.6	49.1	53.4	56.5	59.2	62.1	63.9
1440	24	3.8	4.3	5.9	7.2	8.6	10.5	12.2	14.1	16.8	19.0	21.5	25.1	27.9	30.7	34.5	37.2	39.9	43.1	45.2	47.1	49.0	50.0
1800	30	3.3	3.7	5.1	6.3	7.5	9.2	10.7	12.3	14.7	16.6	18.8	22.0	24.5	27.1	30.5	33.0	35.4	38.3	40.3	42.0	43.8	44.7
2160	36	2.9	3.2	4.6	5.6	6.7	8.3	9.6	11.0	13.1	14.8	16.7	19.6	21.8	24.1	27.2	29.4	31.7	34.4	36.3	38.0	39.8	40.8
2880	48	2.4	2.7	3.8	4.7	5.6	6.9	8.0	9.2	10.8	12.2	13.7	15.9	17.7	19.6	22.1	24.1	26.0	28.6	30.5	32.3	34.5	36.0
4320	72	1.9	2.1	3.0	3.7	4.4	5.4	6.1	6.9	8.1	9.0	10.0	11.4	12.6	13.9	15.7	17.2	18.9	21.2	23.1	25.1	28.0	30.3
5760	96	1.6	1.8	2.5	3.1	3.6	4.4	4.9	5.6	6.4	7.1	7.8	8.8	9.7	10.7	12.2	13.4	14.7	16.7	18.4	20.3	23.1	25.4
7200	120	1.4	1.6	2.2	2.6	3.1	3.7	4.1	4.6	5.3	5.8	6.4	7.2	7.9	8.7	9.8	10.8	12.0	13.7	15.1	16.8	19.3	21.4
8640	144	1.2	1.4	1.9	2.3	2.6	3.1	3.5	3.9	4.5	4.9	5.4											
10080	168	1.1	1.3	1.7	2.0	2.3	2.7	3.0	3.4	3.8	4.2	4.6											

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