Appendix G - TSF Design Documentation

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Volume 3

Contents

HANKING AUSTRALIA INVESTMENT
RUSTLERS ROOST GOLD PROJECT



FEASIBILITY DESIGN REPORT

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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				22/12/2021
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B	Modified Basin	AMM	DJTM	DJTM	20/05/2022
		AMM	DJTM	DJTM	
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APPENDIX G

Stability Assessment

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CONSULTING

G.1. APPENDIX G – TSF STABILITY ASSESSMENT

A stability assessment of the TSF embankment was conducted under both static and post-seismic loading conditions using limit equilibrium methods.

G.1.1 STABILITY ASSESSMENT

G.1.1.1 Methodology

SLOPE/W (Ref. G1), developed by GEO-SLOPE International Ltd. in Canada, is a limit equilibrium program that was used for the analysis. The analysis was carried out using the Morgenstern-Price method.

The program calculates the magnitude of the destabilising forces in the embankment slope and compares this to the total available strength of the soil structure. The ratio of these two parameters is given as the factor of safety. When the destabilising forces are equal to the strength of the structure, this ratio (the factor of safety) is equal to one and the embankment is said to be "just stable". As the factor of safety increases, the probability of an embankment failure is reduced.

G.1.1.2 Assumptions

The following assumptions were made as part of the stability modelling:

- TSF embankment is constructed as a homogeneous earth-fill embankment that will generally be equivalent to the modelled typical cross section.
- The construction materials for the embankment used for Zones A will be compacted to specification as provided on the design drawings and specifications.
- Zone B is heap leach material and will be compacted to 95%SMDD.
- Zone C is mine waste with high permeability and will be compacted to 95%SMDD.
- No strain softening materials present within the TSF embankment.
- Material index and strength properties will be confirmed during the construction phases.
- The beach slope is 150H:1V
- The basin and toe drains will function effectively to maintain the phreatic surfaces low near the embankment.

G.1.1.3 Modelling details

The stability of the embankment sections (Figure G.1) at Stage 1 and final were analysed. Due to the similar embankment profile and the ground conditions, only the north embankment was assessed according to ANCOLD guidelines (Ref. G2).

Table G.1 lists the recommended factors of safety under different loading conditions. As per ANCOLD guidelines. Critical failure surfaces are defined as those that give the lowest factor of safety and represent a failure surface that would likely cause significant damage if sliding were to occur. Shallow failure surface that gives low factors of safety, but do not represent a critical breaching of the embankment have not been included.

Table G.1: Recommended minimum factors of safety for design

Loading Condition	Minimum FOS
Long-term drained stability	1.5
Short-term undrained (potential loss of containment)	1.5
Short-term undrained (no potential loss of containment)	1.3
Post-seismic	1.0-1.2

G.1.1.4 Material properties

The shear strength parameters of the embankment and foundation materials are based on the findings from site investigations presented in the geotechnical report (Ref. G3) and typical values for similar materials published in literature.

There are no available strength testing programmes conducted in tailings. The shear strength parameters of tailings are therefore estimated based on the typical values for similar materials published in literature.

The post-seismic undrained shear strengths of the foundation materials with low permeability are reduced to 80% of their static strengths due to the potential build-up of excess pore pressures during the cyclic loading (Ref. G4).

The parameters adopted are summarised in Table G.2.

Table G.2: Adopted strength parameters

Material	Depth (m)	Unit Weight (kN/m3)	Strength Properties			
			c' (kPa)	Φ' (degs)	su/σ'v	sumin (kPa)
Transported and residual soil[1]	0-4.5	19	5	30	0.35	50
Extremely weathered material, coarse grained	4.5-5	20	10	32	-	-
Highly weathered interbedded sandstone and siltstone	5-16	22	50	32	-	-
Bedrock	Below 16	22	100	32	-	-
Zone A (selected clayey sand compacted to 98% SMDD)	-	19	5-15	30	-	-
Zone B (assumed to be sourced from heap leach material and compacted to 95% SMDD)	-	18	1	34	-	-
Zone C (assumed to be sourced from mine waste compacted to 95% SMDD)	-	21	0	34	-	-
Tailings	-	16	0	25	-	-

1: The post-seismic undrained shear strengths of the foundation materials with low permeability are reduced to 80% of their static strengths

G.1.1.5 Phreatic surface

The phreatic surface in the TSF is based on the seepage analysis results reported in Appendix F. The results indicate that the phreatic surface in the embankment is low.

G.1.1.6 Embankment profiles

The Stage 1 and final embankment sections were based on the following parameters

- Stage 1
  - Embankment crest level: RL 70.0m
  - Downstream embankment slope: 3H:1V
  - Upstream embankment slope: 2.5H:1V
- Stage final
  - Embankment crest level: RL 87.4m
  - Downstream embankment slope: 3H:1V with 5m bench every 10m in height
  - Upstream embankment slope: 2.5H:1V

G.1.1.7 Stability assessment results

The slope stability models for Stages 1 and final are shown in figures G.2 and G.3.

The results of the stability analyses are summarized in Table G.3 and shown in figures G.4 to G.11.

Table G.3: Summary of stability analysis results

Stages	Loading Conditions	Factor of Safety	Figure
Stage 1	Drained	2.24	G.4
	Undrained (potential loss of containment)	1.78	G.5
	Undrained (no potential loss of containment)	1.60	G.6
	Post-Seismic	1.56	G.7
Stage Final	Drained	2.32	G.8
	Undrained (potential loss of containment)	1.80	G.9
	Undrained (no potential loss of containment)	1.72	G.10
	Post-Seismic	1.64	G.11

G.1.2 CONCLUSIONS AND RECOMMENDATIONS

Based on assumptions and available information, the stability assessment indicates that the proposed embankment has adequate factors of safety under all loading conditions according to ANCOLD.

The following recommendations are made:

- To implement a comprehensive instrumentation monitoring program to monitor the phreatic levels within the embankment during construction and operation.
- To maintain an effective drainage system to ensure that the phreatic surface be below the design levels in the embankment.

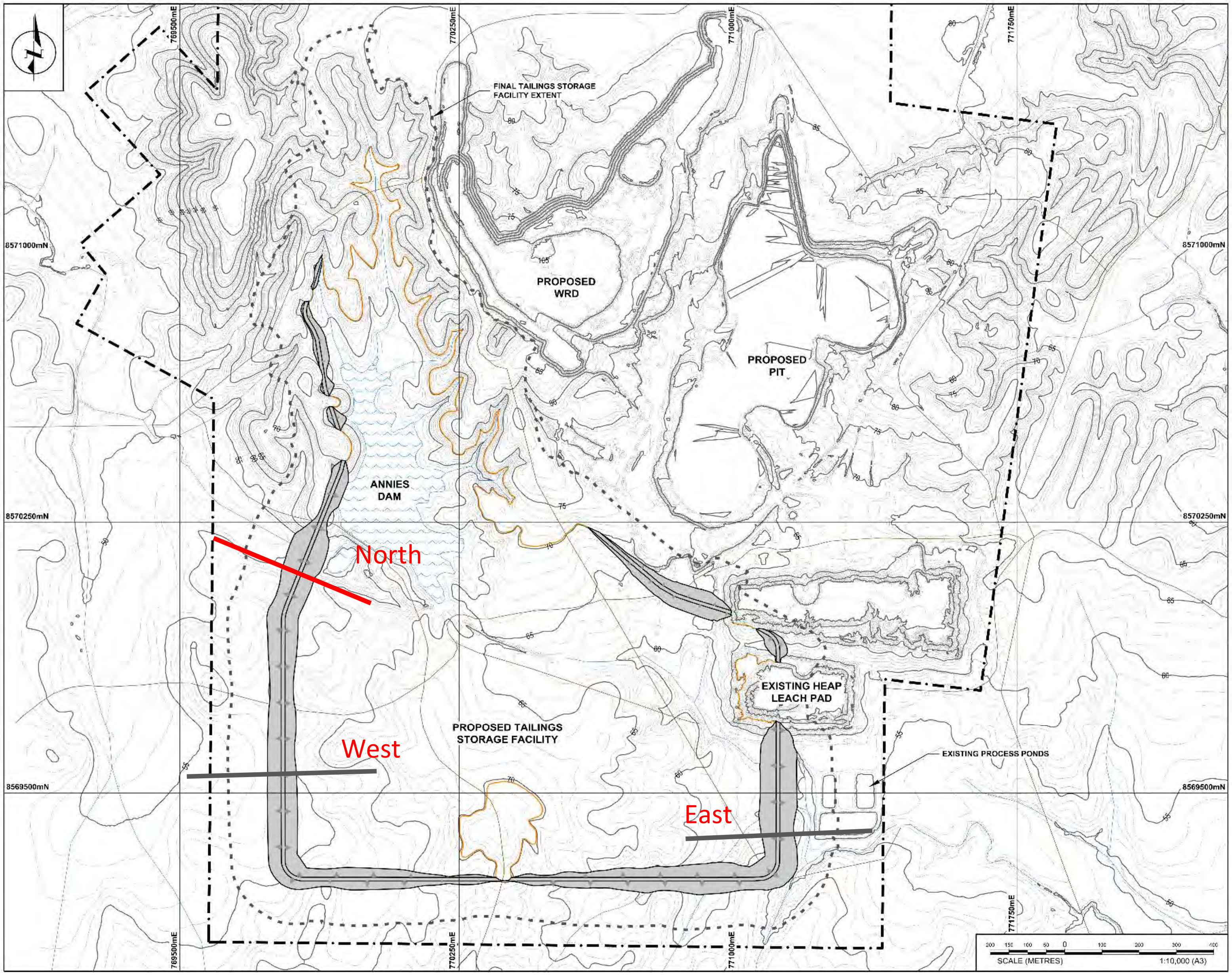
G.1.3 REFERENCES

1. GEO-SLOPE International Ltd., *“SLOPE/W”*, 2018.
2. Australian National Committee on Large Dams (ANCOLD), *“Guidelines on Tailings Dams”,* May 2012.

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

4. Makdisi, E.I. and Seed, H.B., 1977, December. Simplified procedure for estimating dam and embankment earthquake-induced deformations. In ASAE Publication No. 4-77. Proceedings of the National Symposium on Soil Erosion and Sediment by Water, Chicago, Illinois, December 12-13, 1977

APPENDIX G – FIGURES



LEGEND:

- EXISTING WATER COURSE
- EXISTING RESERVOIR
- EXISTING ACCESS TRACK
- MINING TITLE

NOTES:

1. ALL COORDINATES SHOWN IN GRID PROJECTION MGA94 ZONE 52.
2. 1m CONTOUR INTERVALS SHOWN.
3. STAGE 1 EMBANKMENT SHOWN.

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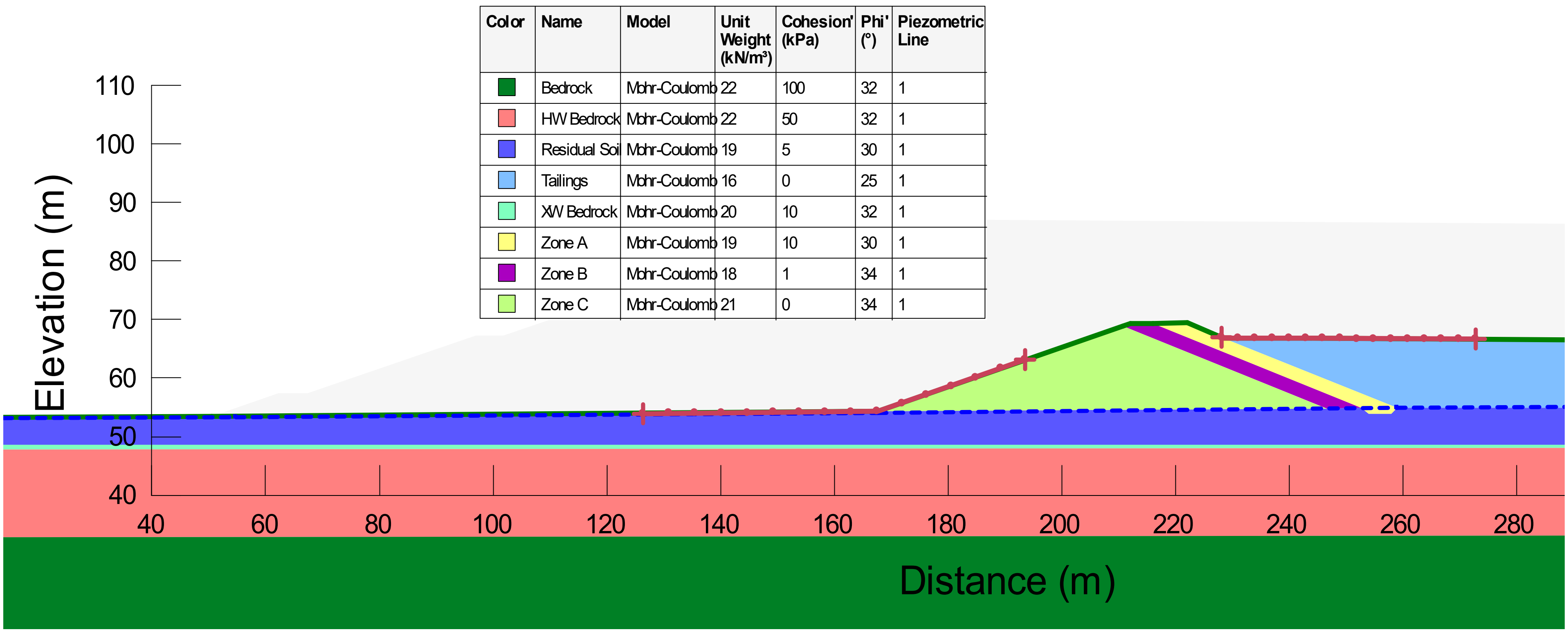
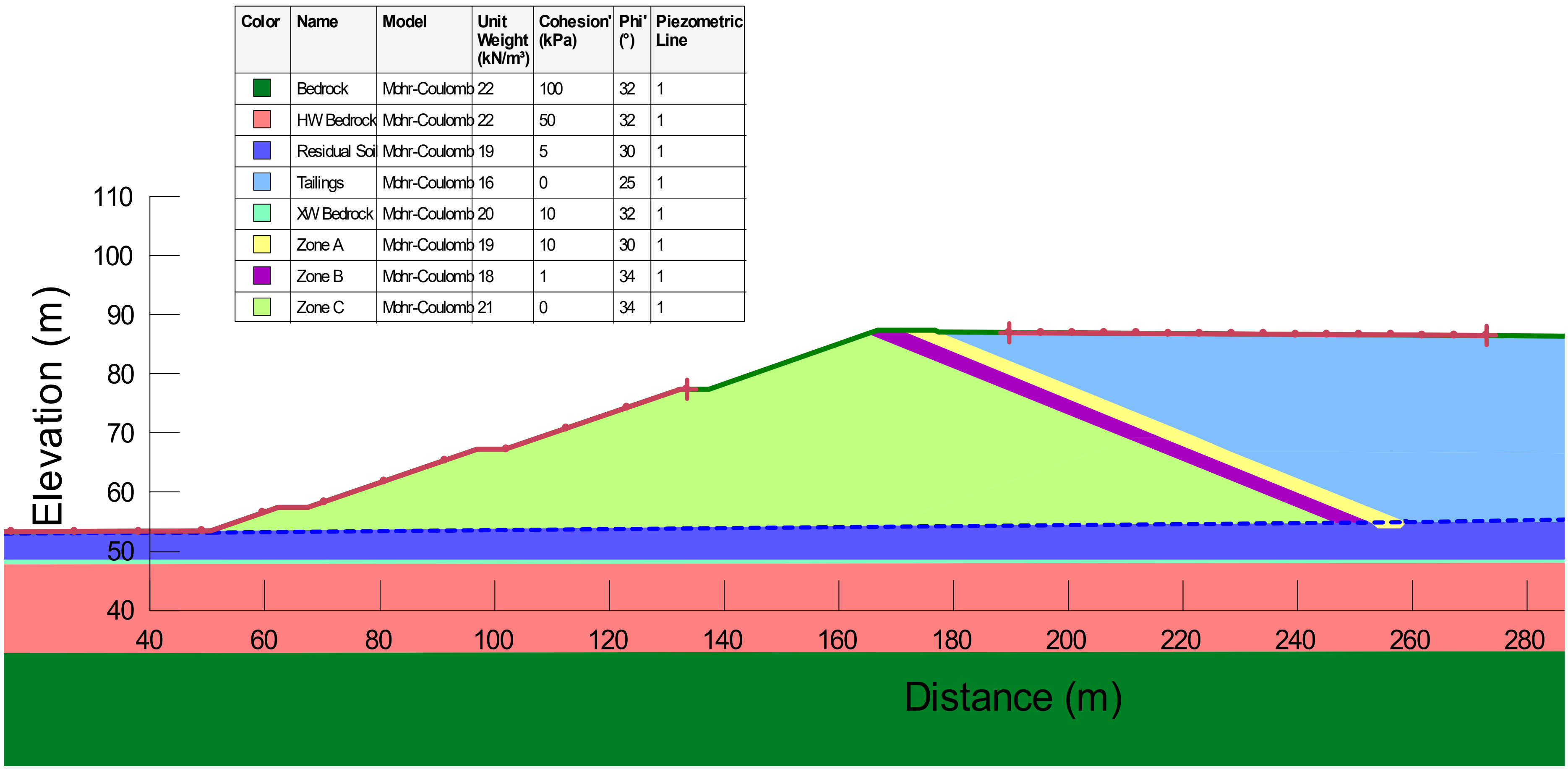
RUSTLERS ROOST GOLD MINE
TSF STAGE 1 AND FINAL STABILITY ASSESSMENT
LOCATION OF SECTIONS

PE801-00102/04
Figure G.1

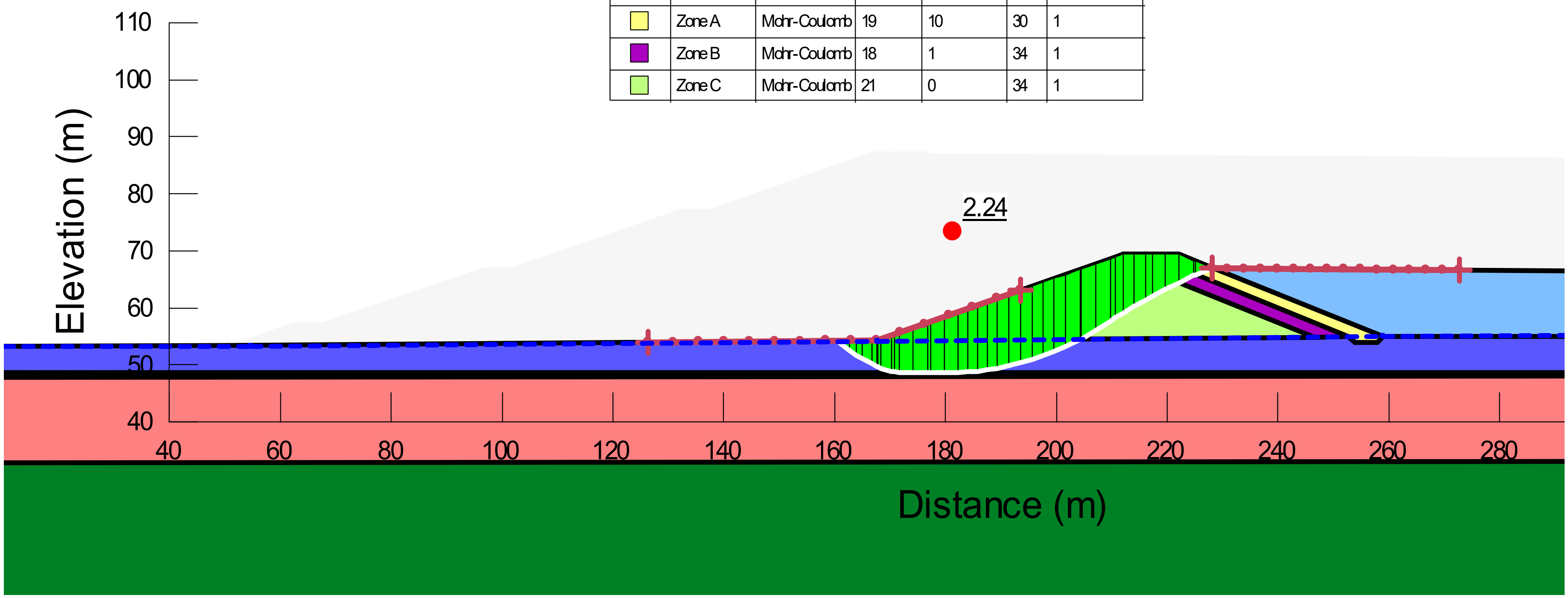


Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22	100	32	1
	HW Bedrock	Mohr-Coulomb	22	50	32	1
	Residual Soi	Mohr-Coulomb	19	5	30	1
	Tailings	Mohr-Coulomb	16	0	25	1
	XW Bedrock	Mohr-Coulomb	20	10	32	1
	Zone A	Mohr-Coulomb	19	10	30	1
	Zone B	Mohr-Coulomb	18	1	34	1
	Zone C	Mohr-Coulomb	21	0	34	1

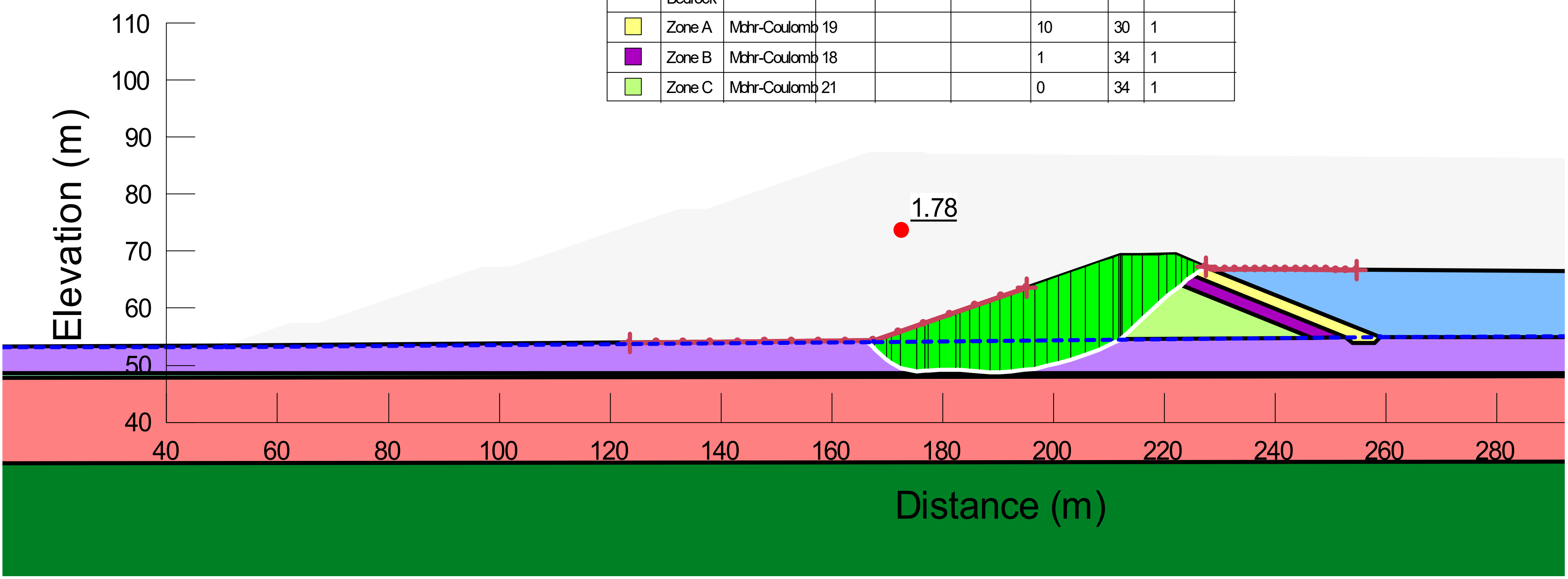


Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22	100	32	1
	HW Bedrock	Mohr-Coulomb	22	50	32	1
	Residual Soi	Mohr-Coulomb	19	5	30	1
	Tailings	Mohr-Coulomb	16	0	25	1
	XW Bedrock	Mohr-Coulomb	20	10	32	1
	Zone A	Mohr-Coulomb	19	10	30	1
	Zone B	Mohr-Coulomb	18	1	34	1
	Zone C	Mohr-Coulomb	21	0	34	1

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22	100	32	1
	HW Bedrock	Mohr-Coulomb	22	50	32	1
	Residual Soil	Mohr-Coulomb	19	5	30	1
	Tailings	Mohr-Coulomb	16	0	25	1
	XW Bedrock	Mohr-Coulomb	20	10	32	1
	Zone A	Mohr-Coulomb	19	10	30	1
	Zone B	Mohr-Coulomb	18	1	34	1
	Zone C	Mohr-Coulomb	21	0	34	1



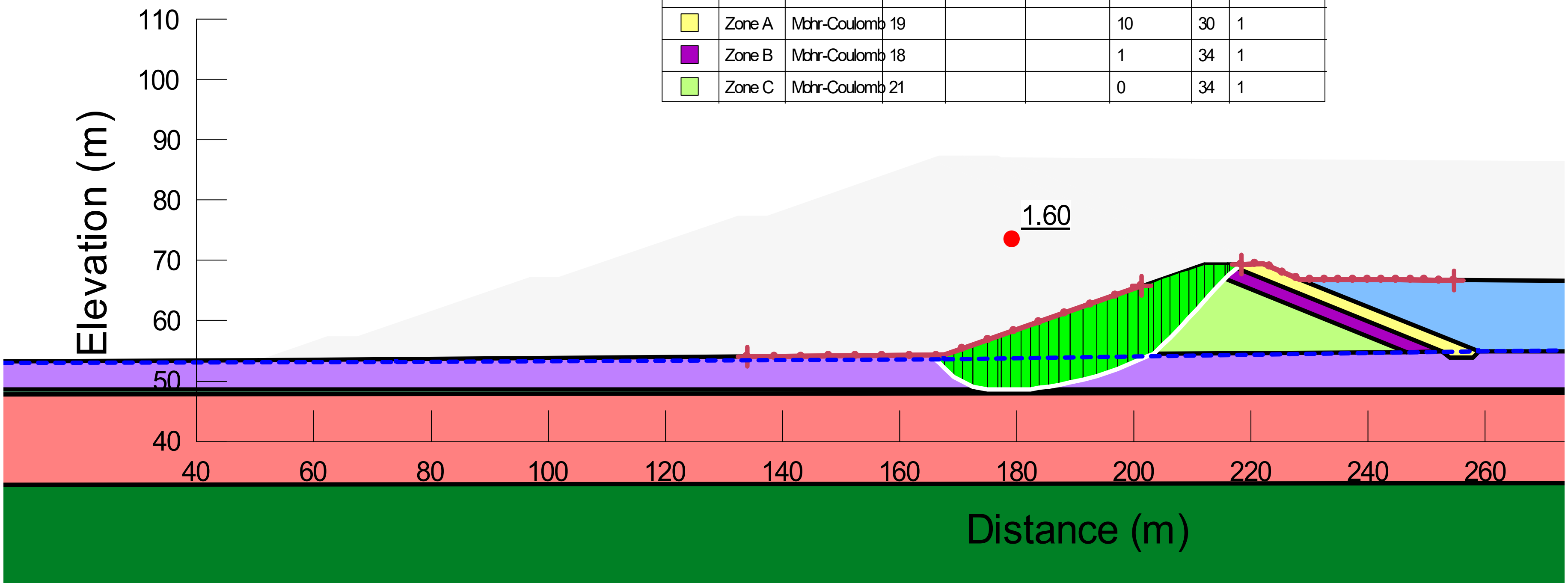
Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22			100	32	1
	HW Bedrock	Mohr-Coulomb	22			50	32	1
	Residual Soil-UD	SHANSEP	19	50	0.35			1
	Tailings	Mohr-Coulomb	16			0	25	1
	XW Bedrock	Mohr-Coulomb	20			10	32	1
	Zone A	Mohr-Coulomb	19			10	30	1
	Zone B	Mohr-Coulomb	18			1	34	1
	Zone C	Mohr-Coulomb	21			0	34	1



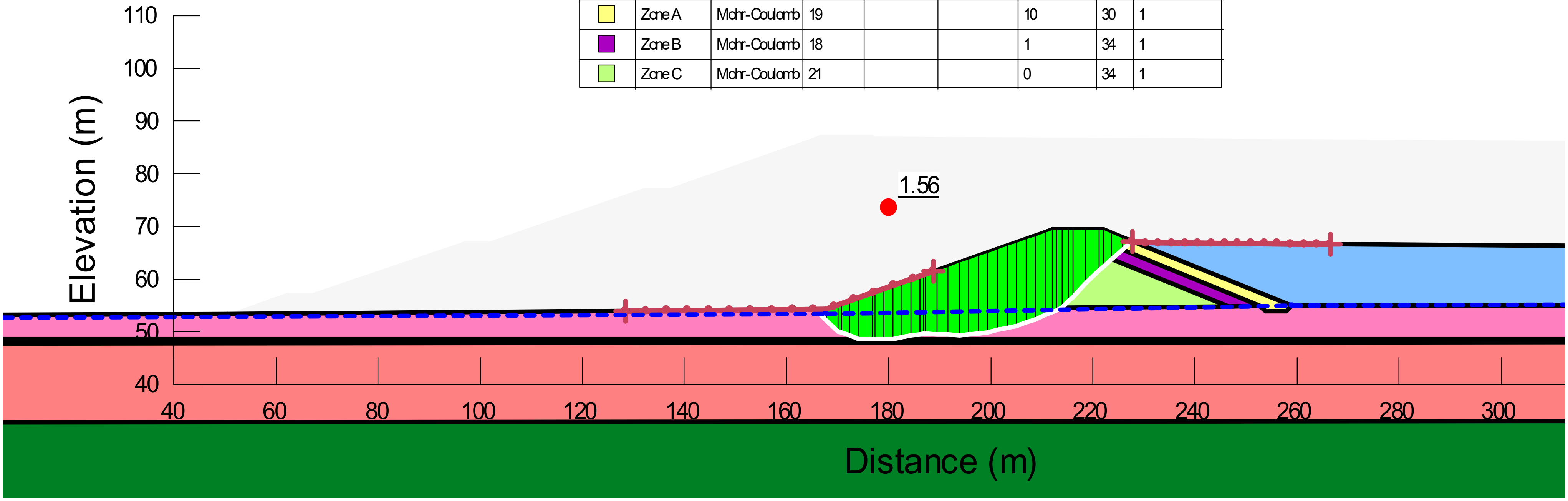
RUSTLERS ROOST GOLD MINE
TSF STAGE 1 AND FINAL STABILITY ASSESSMENT
SLOPE/W RESULT - STAGE 1 (AVERAGE/FLOOD POND) - UNDRAINED

PE801-00102/04
Figure G.5

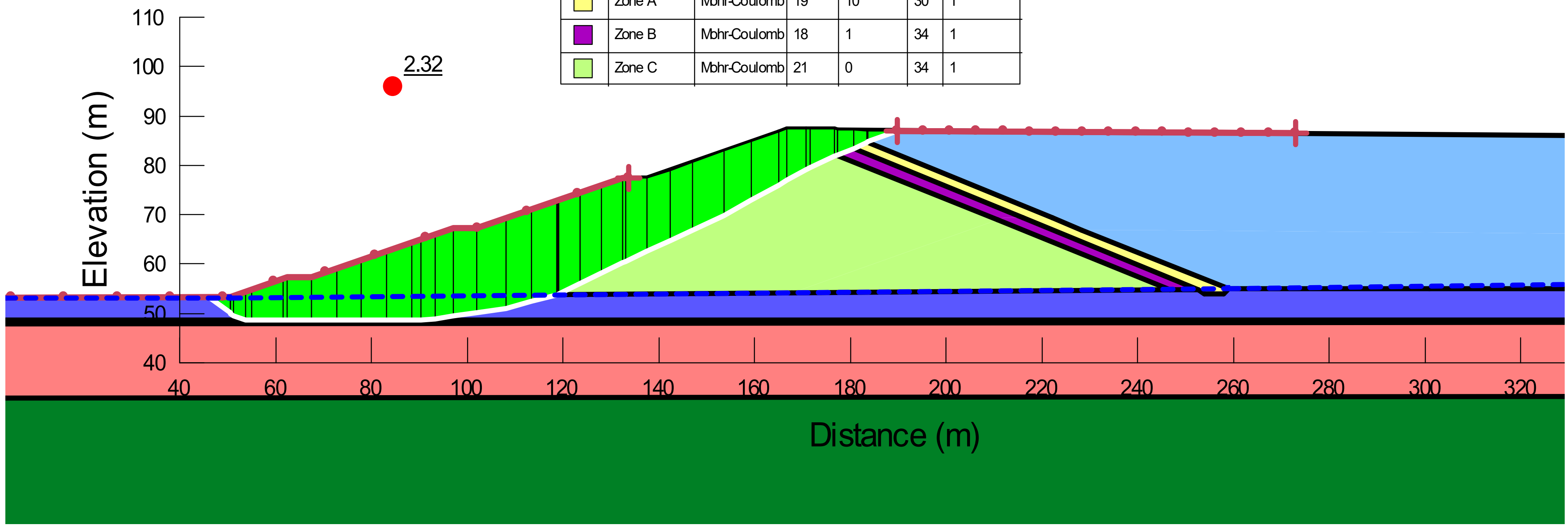
Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
(dark green)	Bedrock	Mohr-Coulomb	22			100	32	1
(salmon)	HW Bedrock	Mohr-Coulomb	22			50	32	1
(lilac)	Residual Soil-UD	SHANSEP	19	50	0.35			1
(light blue)	Tailings	Mohr-Coulomb	16			0	25	1
(mint)	XW Bedrock	Mohr-Coulomb	20			10	32	1
(yellow)	Zone A	Mohr-Coulomb	19			10	30	1
(purple)	Zone B	Mohr-Coulomb	18			1	34	1
(light green)	Zone C	Mohr-Coulomb	21			0	34	1



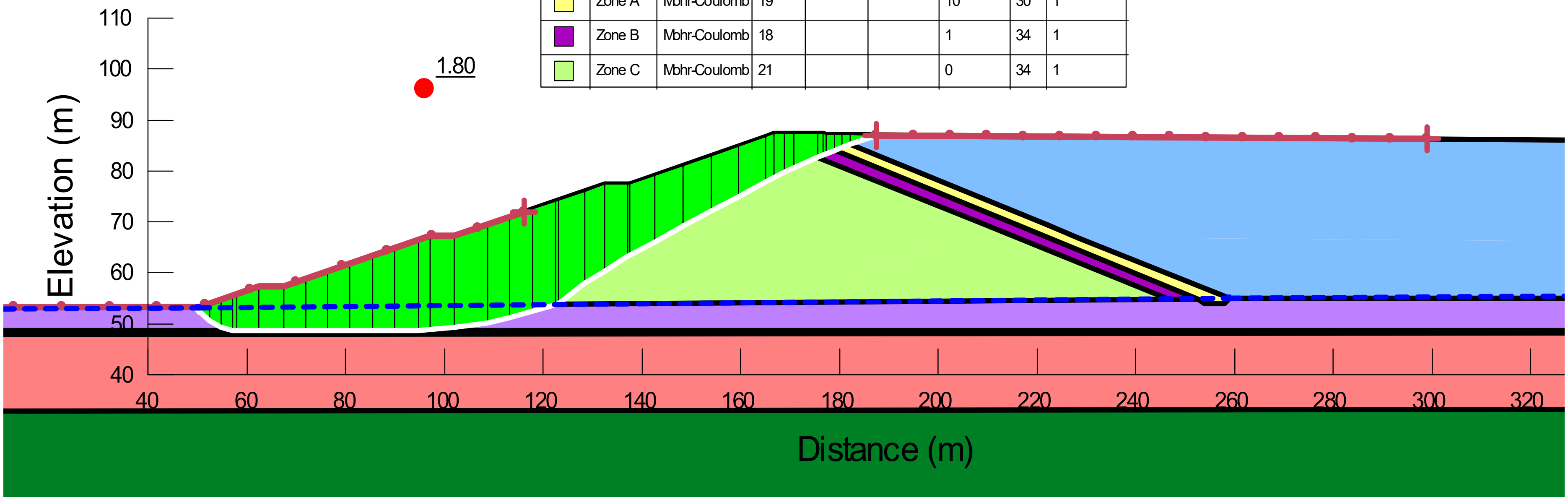
Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
(dark green)	Bedrock	Mohr-Coulomb	22			100	32	1
(salmon)	HW Bedrock	Mohr-Coulomb	22			50	32	1
(pink)	Residual Soil-PS(UD)	SHANSEP	19	40	0.28			1
(light blue)	Tailings	Mohr-Coulomb	16			0	25	1
(aqua)	XW Bedrock	Mohr-Coulomb	20			10	32	1
(yellow)	Zone A	Mohr-Coulomb	19			10	30	1
(purple)	Zone B	Mohr-Coulomb	18			1	34	1
(light green)	Zone C	Mohr-Coulomb	21			0	34	1



Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22	100	32	1
	HW Bedrock	Mohr-Coulomb	22	50	32	1
	Residual Soil	Mohr-Coulomb	19	5	30	1
	Tailings	Mohr-Coulomb	16	0	25	1
	XW Bedrock	Mohr-Coulomb	20	10	32	1
	Zone A	Mohr-Coulomb	19	10	30	1
	Zone B	Mohr-Coulomb	18	1	34	1
	Zone C	Mohr-Coulomb	21	0	34	1



Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22			100	32	1
	HW Bedrock	Mohr-Coulomb	22			50	32	1
	Residual Soil-UD	SHANSEP	19	50	0.35			1
	Tailings	Mohr-Coulomb	16			0	25	1
	XW Bedrock	Mohr-Coulomb	20			10	32	1
	Zone A	Mohr-Coulomb	19			10	30	1
	Zone B	Mohr-Coulomb	18			1	34	1
	Zone C	Mohr-Coulomb	21			0	34	1



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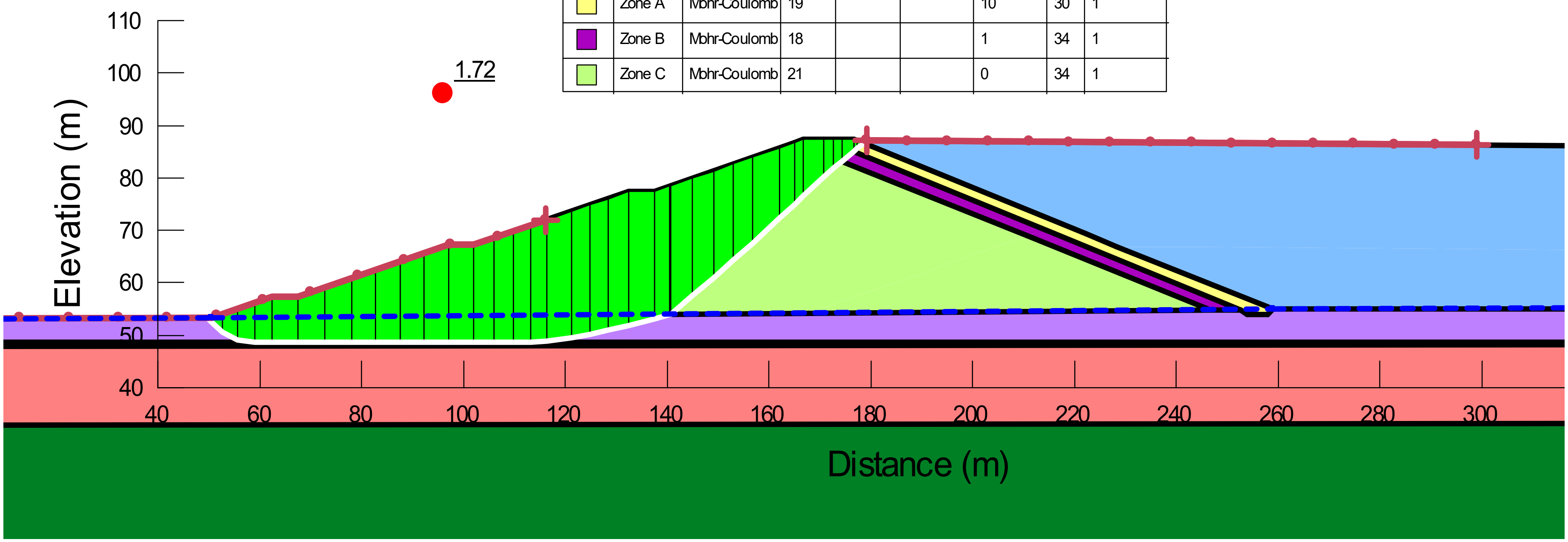
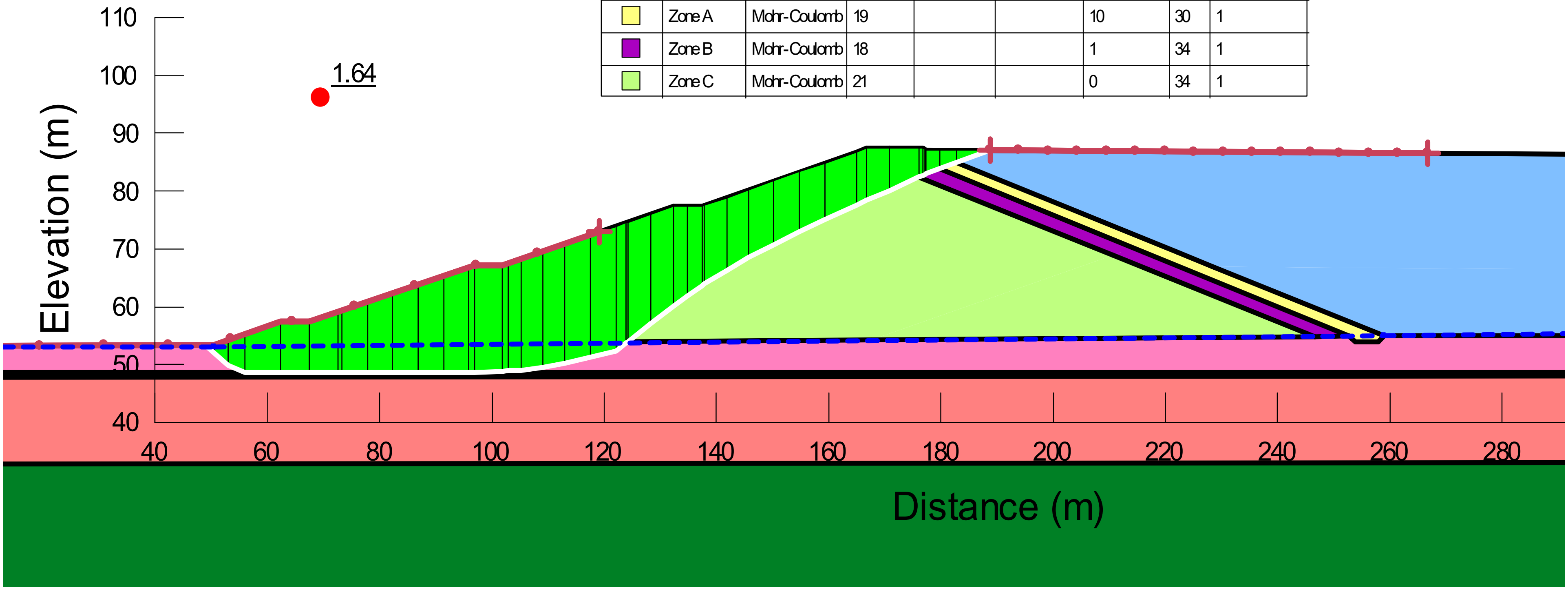
RUSTLERS ROOST GOLD MINE
TSF STAGE 1 AND FINAL STABILITY ASSESSMENT
SLOPE/W RESULT - STAGE FINAL (AVERAGE/FLOOD POND) - UNDRAINED

PE801-00102/04
Figure G.9



Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22			100	32	1
	HW Bedrock	Mohr-Coulomb	22			50	32	1
	Residual Soil-UD	SHANSEP	19	50	0.35			1
	Tailings	Mohr-Coulomb	16			0	25	1
	XW Bedrock	Mohr-Coulomb	20			10	32	1
	Zone A	Mohr-Coulomb	19			10	30	1
	Zone B	Mohr-Coulomb	18			1	34	1
	Zone C	Mohr-Coulomb	21			0	34	1

Color	Name	Model	Unit Weight (kN/m³)	Minimum Strength (kPa)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Bedrock	Mohr-Coulomb	22			100	32	1
	HW Bedrock	Mohr-Coulomb	22			50	32	1
	Residual Soil-PS(UD)	SHANSEP	19	40	0.28			1
	Tailings	Mohr-Coulomb	16			0	25	1
	XW Bedrock	Mohr-Coulomb	20			10	32	1
	Zone A	Mohr-Coulomb	19			10	30	1
	Zone B	Mohr-Coulomb	18			1	34	1
	Zone C	Mohr-Coulomb	21			0	34	1



APPENDIX H

Memorandum Ref. PE21-00859 Rustlers Roost Gold Project – Tailings Storage Facility Dam Break and Consequence Assessment Rev 1

MEMORANDUM

To:	Hanking Australia Investment	**Date:**	08 July 2021
Attn:	John Zimmerman	**Our Ref:**	PE21-00859
		KP File Ref.:	PE801-00102/04-A djtm M21005
cc:	Charles Hastie	**From:**	Dave Morgan

RE: RUSTLERS ROOST – TSF DAM BREAK AND CONSEQUENCE ASSESSMENT REV 1

Knight Piésold Pty Ltd (KP) has been engaged by Hanking Australia Investment (Hanking) to complete a dam break assessment for the Tailings Storage Facility (TSF), to be included as part of the pre-feasibility study for the Rustlers Roost Gold Project. As part of the assessment, the TSF consequence assessment was carried out for the facility, in order to establish severity of impact and population at risk in the event of a dam failure, and to assign minimum design criteria for the facility.

Based on Google Earth imagery and topography, there is risk of a tailings breach impacting the Adelaide River or Mary River, significant national parks, local agriculture and large environmentally sensitive floodplains. A number of sites and local access roads are at risk of being cut off and a number of unclassified buildings are located downstream of the TSF. The ANCOLD 2019 Dam Failure Consequence Category is 'High A'.

A detailed LIDAR survey will need to be conducted to model more accurately inundation mapping downstream. In addition, further design details (water balance, tailings characteristics etc.) will be required to conduct detailed dam breach modelling to establish dam breach formation and discharge flood wave modelling.

This memorandum supersedes memorandum Ref. PE21-00825 issued June 2021.

1. BACKGROUND

Rustlers Roost is a brownfields project located in the Mount Bundey region of the Northern Territory, 100 km south east of Darwin. The redevelopment will include expansion of existing pits, waste rock landforms, water storage dams and internal roads; construction of new infrastructure including an onsite processing facility, a tailings storage facility and groundwater bores for water supply.

The latest design (KP Memorandum PE21-00451) consists of a new TSF with the following characteristics:

- Total tonnage stored of 40 Mt over 10 years;
- Inundation area of approximately 292 Ha;
- Three perimeter embankments designed using the downstream method with a maximum height of 31 m; and
- Foundation geology siltstone underlying the surficial soils throughout the facility.

The site has an average rainfall of 1,455 mm and is in a low seismic zone.

2. 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 must be carried out during subsequent design phases once detailed topography is available and further design details (water balance, tailings characteristics etc.) 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. The layout of the facility is shown in Figure 2.1. Dam breach modelling is 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.

The potential breach flow paths for location are shown on Figure 2.2. The red line within the figure indicates the flow path 60 km downstream (based on ANCOLD guidance) due to loss of containment. Google Earth was used to identify any significant infrastructure or items of conservation along this 60 km flow path.

3. ASSESSMENT OF DAM BREAK IMPACTS

3.1 WESTERN BREACH

In the event of failure of the Western embankment of the TSF, tailings have the potential to progress down the valley towards Marrakai Creek (40 km downstream) before entering Adelaide River (47 km downstream). The following impacts may occur (based on review of available topographical survey data and aerial photography) as shown in Figure 3.1:

- Based on Google Earth imagery, there is evidence of farming and agriculture along the lower lying areas of the valley downstream of the TSF and these areas are at risk of inundation by tailings solids;

- It is likely that the tailings solids (suspended in liquor flow) will enter the Adelaide River (47 km downstream) via the existing natural drainage pathways;
- A significant environmental impact is anticipated if tailings were to reach the Adelaide River, the following items have been identified further downstream utilising the Integrated Biodiversity Assessment Tool (ref. 7):
  - Djukbinj National Park;
  - Harrison Dam Conversation Area;
  - Melacca Swamp Conservation Area; and
  - Floodplains of Adelaide and Mary River.
- Some impact to tourism and commerce along the Adelaide River is anticipated especially in the short-term if tailings were to enter the Adelaide River;
- Tailings solids and supernatant water may have adverse impacts on the groundwater quality within the immediate area, and remediation will be required;
- A number of site and local access roads are at risk of being cut off in the event of failure;
- Both tailings solids and contaminated water are likely to be released from the current mining lease; and
- If failure was to occur during a TSF raise, construction workers will be at risk.

At this stage it is not expected that the plant site or accommodation for the project will be affected by a western breach.

3.2 EASTERN BREACH

In the event of failure of the Eastern embankment of the TSF, tailings have the potential to progress down the valley towards Mary River (58 km downstream). The following impacts may occur (based on review of available topographical survey data and aerial photography) as shown in Figure 3.2:

- Based on Google Earth imagery, there is evidence of farming and agriculture along the lower lying areas of the valley downstream of the TSF and these areas are at risk of inundation by tailings solids;
- It is likely that the tailings solids (suspended in liquor flow) will enter the Mary River (58 km downstream) via the existing natural drainage pathways;
- A significant environmental impact is anticipated if tailings were to reach the Mary River with the Mary River National Park and floodplains at risk;
- Some impact to tourism and commerce along the Mary River is anticipated especially in the short-term if tailings were to enter the river system;
- Tailings solids and supernatant water may have adverse impacts on the groundwater quality within the immediate area, and remediation will be required;
- A number of site and local access roads are at risk of being cut off in the event of failure, including the existing site access road;
- The flow path travels close to an existing mine site before crossing the Arnhem Highway at a bridge crossing 21km downstream;
- There is evidence of unclassified buildings located approximately 22 km downstream of the TSF as shown on Figure 3.3. These are located on higher ground typically 100 m away from the flow path. It is assumed conservatively that these buildings will be impacted by the potential flow;
- Both tailings solids and contaminated water are likely to be released from the current mining lease; and

- If failure was to occur during a TSF raise, construction workers will be at risk.

At this stage it is not expected that the plant site or accommodation for the project will be affected by a western breach.

4. POPULATION AT RISK

As part of the estimation of the consequence category as per ANCOLD guidelines, an assessment of the indicative Population at Risk (PAR) was undertaken. There are a number of factors impacting the PAR calculation as follows:

- A number of local and site access roads are located downstream of the TSF and will be accessed daily by locals and staff;
- Once per shift, inspections by Processing Department are expected at the TSF which requires access along the embankment crest and pipeline access road;
- The process site and mine services areas are assumed to be located upstream of the TSF and will be accessed by process and mining personnel hence not impacted;
- There is evidence of camping and tourism along the Adelaide and Mary Rivers;
- A number of unclassified buildings are located along the eastern flow path and are at risk;
- The TSF construction contractor(s) are assumed to be based upstream of the TSF, however it is assumed that some workers may be present at the failure location. It is noted that these workers will only be present for a limited time, during TSF construction phases.

A breakdown of people estimated within the impact area as a whole was based on experience on similar projects within the region, and should be reviewed by Hanking to confirm suitability of the assumptions. 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 for each dam breach location, and provides an indication of the potential PAR.

4.1 WESTERN BREACH

The indicative population at risk for the western embankment failure is summarised in Table 2.1.

Table 2.1: Indicative Population at Risk (PAR) –Western 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 [1]	5	5%	0.25
Camping [1]	5	5%	0.25
Unidentified (5% Contingency)	-	-	0.1
Total	**112**		**2.2**

Notes:
[1] The number of personnel has been estimated based on experience on similar projects within the region;
[2] TSF Construction Personnel only operational during TSF construction raises.

For the purposes of the hazard assessment a Population at Risk (PAR) of '≥1 to <10' was adopted for this scenario.

4.2 EASTERN BREACH

The indicative population at risk for the eastern embankment failure is summarised in Table 2.2.

Table 2.2: 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 [1]	5	5%	0.25
Unclassified Buildings [1]	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;
[2] TSF Construction Personnel only operational during TSF construction raises.

For the purposes of the hazard assessment a Population at Risk (PAR) of '≥10 to <100' was adopted for this scenario.

5. SEVERITY LEVEL AND CONSEQUENCE ASSESSMENT

An assessment was conducted to determine the severity level of impacts based on ANCOLD 2019 (Ref. 2). 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 likelihood of failure is not considered in the ANCOLD Consequence Category Assessment. The Dam Failure Severity Levels for the Western and Eastern embankments failure scenarios are presented in tables 2.3 and 2.4. The environmental spill failure scenario for the eastern and western failures are considered to be similar and are presented in Table 2.5.

Table 2.3: Severity Level – Dam Failure (Western Embankment)

Damage Type	Dam Failure Severity Level
Infrastructure (dam, houses, commerce, farms, community)	**Medium**
Damage to the TSF itself is expected to be repairable relatively quickly but at a cost for earthworks. Site and public roads, pipework and power supply cables may be inundated but repairs are expected to be minor. Local access tracks and farms downstream may be impacted but repairs are expected to be minor. Some impact to local tourism along the Adelaide River is anticipated with some reparations likely. The overall cost is assumed to be Moderate ($10M - $100M)	
Business Importance	**Major**
Hanking Investment Australia is a subsidiary of China Hanking Holdings Limited (CHHL). CHHL has Iron and Gold mining assets in China and Australia, with a current market cap of less than US$1BN. As such, it is considered that failure of the TSF would be crippling to the business, therefore bankruptcy is considered possible in the event of failure.	
Extreme discontent due to environmental impact. There would likely be severe reaction from the community and some loss of business credibility hence “crippling to business” was selected.	
Interim loss of revenue due to suspension of processing.	
Public Health	**Minor**
It has been assumed that dust arising from tailings solids following the breach will pose a short term and/or long-term health risk to populations in the immediate vicinity of the inundation extents (to be confirmed by geochemical testing); The supernatant water and tailings area assumed to contain environmentally significant contaminants (to be confirmed during geochemical testing). It is assumed less than 100 people will be affected.	
Social Dislocation	**Minor**
Minor social dislocation (<100 people) would be anticipated for locals whose land may have been impacted by failure.	
Impact Area	**Catastrophic**
The embankment solids breach inundation has the potential to be greater than 5 km^2 but smaller than 20 km^2. It is noted that if solids were to enter water ways downstream containment would be difficult and the impact area would exceed 20 km^2 due to the flat low lying areas.	
Impact Duration	**Medium**
Impact is not expected to exceed 5 years in duration.	
Impact on Natural Environment	**Catastrophic**
Remediation expected to be difficult due to the high expected runout distance and impact area.	
Significant effects are expected on the Adelaide River system located 47 km downstream of the TSF.	
A number of threatened and endangered species are located within the Adelaide River system and some impact is anticipated.	
Djukbinj National Park, Harrison Dam Conversation Area, Melacca Swamp Conservation Area and Adelaide and Mary River Floodplains are at risk if failure was to occur.	

Table 2.4: Severity Level – Dam Failure (Eastern Embankment)

Damage Type	Dam Failure Severity Level
Infrastructure (dam, houses, commerce, farms, community)	**Medium**
Damage to the TSF itself is expected to be repairable relatively quickly but at a cost for earthworks. Site and public roads, pipework and power supply cables may be inundated but repairs are expected to be minor. Local access tracks and farms downstream may be impacted but repairs are expected to be minor. Some impact to local tourism along the Mary River is anticipated with some reparations likely. The overall cost is assumed to be Moderate ($10M - $100M).	
Business Importance	**Major**
Hanking Investment Australia is a subsidiary of China Hanking Holdings Limited (CHHL). CHHL has Iron and Gold mining assets in China and Australia, with a current market cap of less than US$1BN. As such, it is considered that failure of the TSF would be crippling to the business, therefore bankruptcy is considered possible in the event of failure.	
Extreme discontent due to loss of life and environmental impact. There would likely be severe reaction from the community and some loss of business credibility hence “crippling to business” was selected.	
Interim loss of revenue due to suspension of processing.	
Public Health	**Minor**
It has been assumed that dust arising from tailings solids following the breach will pose a short term and/or long-term health risk to populations in the immediate vicinity of the inundation extents (to be confirmed by geochemical testing); The supernatant water and tailings area assumed to contain environmentally significant contaminants (to be confirmed during geochemical testing). It is assumed less than 100 people will be affected.	
Social Dislocation	**Minor**
Minor social dislocation (<100 people) would be anticipated for locals whose land may have been impacted by failure.	
Impact Area	**Catastrophic**
The embankment solids breach inundation has the potential to be greater than 5 km^2 but smaller than 20 km^2. It is noted that if solids were to enter water ways downstream containment would be difficult and the impact area would exceed 20 km^2 due to the flat low lying areas.	
Impact Duration	**Medium**
Impact is not expected to exceed 5 years in duration.	
Impact on Natural Environment	**Catastrophic**
Remediation expected to be difficult due to the high expected runout distance and impact area.	
Significant effects are expected on the Mary River system located 58 km downstream of the TSF.	
An endangered species is located within the Mary River system and some impact is anticipated.	
The Adelaide River and Mary River Floodplains are at risk if failure was to occur.	

Table 2.5: Severity Level – Environmental Spill (Western/Eastern Embankment)

Damage Type	Dam Failure Severity Level
Infrastructure (dam, houses, commerce, farms, community)	**Minor**
Damage to the TSF itself is expected to be repairable relatively quickly but at a cost for earthworks and limited to the emergency spillway. Some impact to local tourism along the Mary River is anticipated with some reparations likely. The overall cost is assumed to be Minor (<$10M).	
Business Importance	**Medium**
Hanking Investment Australia is a subsidiary of China Hanking Holdings Limited (CHHL). CHHL has Iron and Gold mining assets in China and Australia, with a current market cap of less than US$1BN. As such, it is considered that an environmental spill failure of the TSF would have significant impacts on the business, however bankruptcy is not considered possible.	
Some discontent due to environmental impact. There would likely be some reaction from the community and some loss of business credibility hence “significant impact business” was selected.	
Discharge into the facility may need be ceased in the short term until the pond can be sufficiently dewatered (if required) and special inspection completed by a Dams Engineer. Duration is anticipated to be relatively short.	
Public Health	**Minor**
The supernatant water and tailings area assumed to contain environmentally significant contaminants (to be confirmed during geochemical testing). It is assumed less than 100 people will be affected.	
Social Dislocation	**Minor**
Minor social dislocation (<100 people) would be anticipated for locals whose land may have been impacted by failure.	
Impact Area	**Medium**
It is expected that the impact area will be limited to the streams and creeks immediately downstream of the TSF, some impact on the immediate area is anticipated. The embankment solids breach inundation has the potential to be greater than 1 km^2 but smaller than 5 km^2.	
Impact Duration	**Minor**
Impact is not expected to exceed 1 years in duration.	
Impact on Natural Environment	**Major**
Remediation expected to be achieved relatively easily due to the limited impact area.	
For the purpose of this assessment the supernatant is assumed conservatively to have elevated environmentally significant elements (to be confirmed in the next design phase) which may have some impact on the Adelaide River and Mary River systems downstream.	
A number of National parks, Wildlife reserves and conservation areas are located downstream and may be impacted by an environmental spill.	

It is noted that 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 are 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. A summary of the results and derivation of the facility consequence categories are shown in Table 2.6.

Table 2.6: Assessment of consequence category (ANCOLD 2019)

Embankment (Table Ref.)	Population at Risk (PAR)	Severity of Damage and Loss	ANCOLD Consequence Category
Western Embankment (Table 2.3)	≥1 to <10	Catastrophic	**High B**
Eastern Embankment (Table 2.4)	≥10 to <100	Catastrophic	**High A**
Environmental Impact* (Table 2.5)	<1	Major	**Significant**

*Eastern and Western environmental impact expected to be similar therefore a single ANCOLD Consequence Category assigned.

Based on a PAR of ≥10 to <100 and Catastrophic severity of impact, a consequence category of 'High A' was adopted for the design of the TSF. In accordance with the ANCOLD "Guidelines on Tailings Dams" (Ref. 2) the minimum design criteria for this consequence category are summarised in Table 2.6.

Table 2.6: ANCOLD (2019) design parameters (minimum)

Dam Failure Consequence Category	High A
Dam Spill Consequence Category	Significant
Design Storage Allowance Parameters	
Design Storage allowance	10% AEP notional wet season runoff [1] (1 in 10)
Extreme Storm Storage	1% AEP, 72-hr flood (1 in 100)
Contingency Freeboard (Wave Run-up)	10% AEP Wind
Contingency Freeboard (Additional Freeboard)	0.3
Emergency Spillway Design Parameters	
Design Flood	PMF
Wave Freeboard Allowance	Nil for given design flood
Design Earthquake Loadings	
Operating Basis Earthquake (OBE)	0.1% AEP (1 in 1,000)
Safety Evaluation Earthquake (SEE)	0.01% AEP (Median 50th Fractile 1 in 10,000)
Maximum Credible Earthquake (MCE) for post closure	Ground motion from known active faults calculated deterministically or Probabilistically 1 in 10,000 AEP
Factors of Safety	
Long-term drained	1.5 (Effective strength)
Short-term undrained (potential loss of containment)	1.5 (Consolidated Undrained Strength)
Short-term undrained (no potential loss of containment)	1.3 (Consolidated Undrained Strength)
Post-seismic	1.0-1.2 (Post seismic Shear Strength)
Dam Safety / Inspection Frequency	
Comprehensive inspection	By Dams Engineer and Specialist (where relevant) after first year of operation then every 5 years.
Intermediate inspection	By Dams Engineer annually
Routine Inspection	Weekly to twice weekly inspection by operations personnel/ inspector.

[1] Assuming no evaporation and 100% runoff coefficient

These design criteria will be used to develop the design, construction and verification requirements for Rustlers Roost TSF.

6. CONCLUSIONS AND RECOMENDATIONS

The key conclusions from the Dam Breach Assessment for the Rustlers Roost TSF are summarised as follows:

- Based on Google Earth imagery there is evidence of farming and agriculture along the lower lying areas of the valley downstream of the TSF and these areas are at risk of inundation by tailings solids;
- It is likely that the tailings solids (suspended in liquor flow) will enter either the Adelaide River or Mary River via the existing natural drainage pathways;

- Some impact to tourism and commerce along these rivers is anticipated;
- Tailings solids and supernatant water may have adverse impacts on the groundwater quality within the immediate impact area;
- A number of site and local access roads are at risk of being cut off in the event of failure;
- A number of unclassified buildings are located downstream of the TSF, it is assumed conservatively that these buildings will be impacted by the potential flow;
- Both tailings solids and contaminated water are likely to be released from the current mining lease;
- If failure was to occur during a TSF raise, construction workers will be at risk;
- A PAR of '≥10 to <100' is expected for the assumed failure case;
- On the basis of significant impact on the environment the Severity Level would be 'Catastrophic';
- The ANCOLD 2019 Dam Failure Consequence Category is 'High A'; and
- The ANCOLD 2019 Environmental Spill Consequence Category is 'Significant'.

It may be possible to reduce the PAR from '≥10 to <100' to '≥1 to <10' if detailed modelling is completed to confirm that the unclassified buildings identified downstream are not affected. If the PAR were to reduce to '≥1 to <10' the ANCOLD Consequence Category classification would change from 'High A' to 'High B'.

The key recommendations from the Dam Breach Assessment for future work are summarised as follows:

- Dam break assessment to be revisited in subsequent design when geochemical characterisation assessment has been completed;
- Assumptions made in regards to infrastructure locations and number of personnel to be reviewed by Hanking and dam break updated to reflect any significant changes;
- Detailed dam breach modelling will be required to establish dam breach formation and discharge flood wave modelling and should be completed once further design details (water balance, tailings characteristics etc.) are available; and
- A detailed LIDAR survey will need to be conducted within the drainage corridors to the east and west of the TSF, and a hydraulically accurate Digital Terrain Model provided to model accurate inundation mapping.

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 MOLLAN
Project Engineer

DAVID MORGAN
Managing Director

REFERENCES

1. Australian National Committee on Large Dams, ANCOLD (2012). *"Guidelines on the Consequence Categories for Dams"*, October 2012.
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5. Joint Research Centre of the European Commission, (2021). *"Digital Observatory for Protected Areas – Melacca Swamp"*, accessed 14 June 2021, https://dopa-explorer.jrc.ec.europa.eu/wdpa/23767
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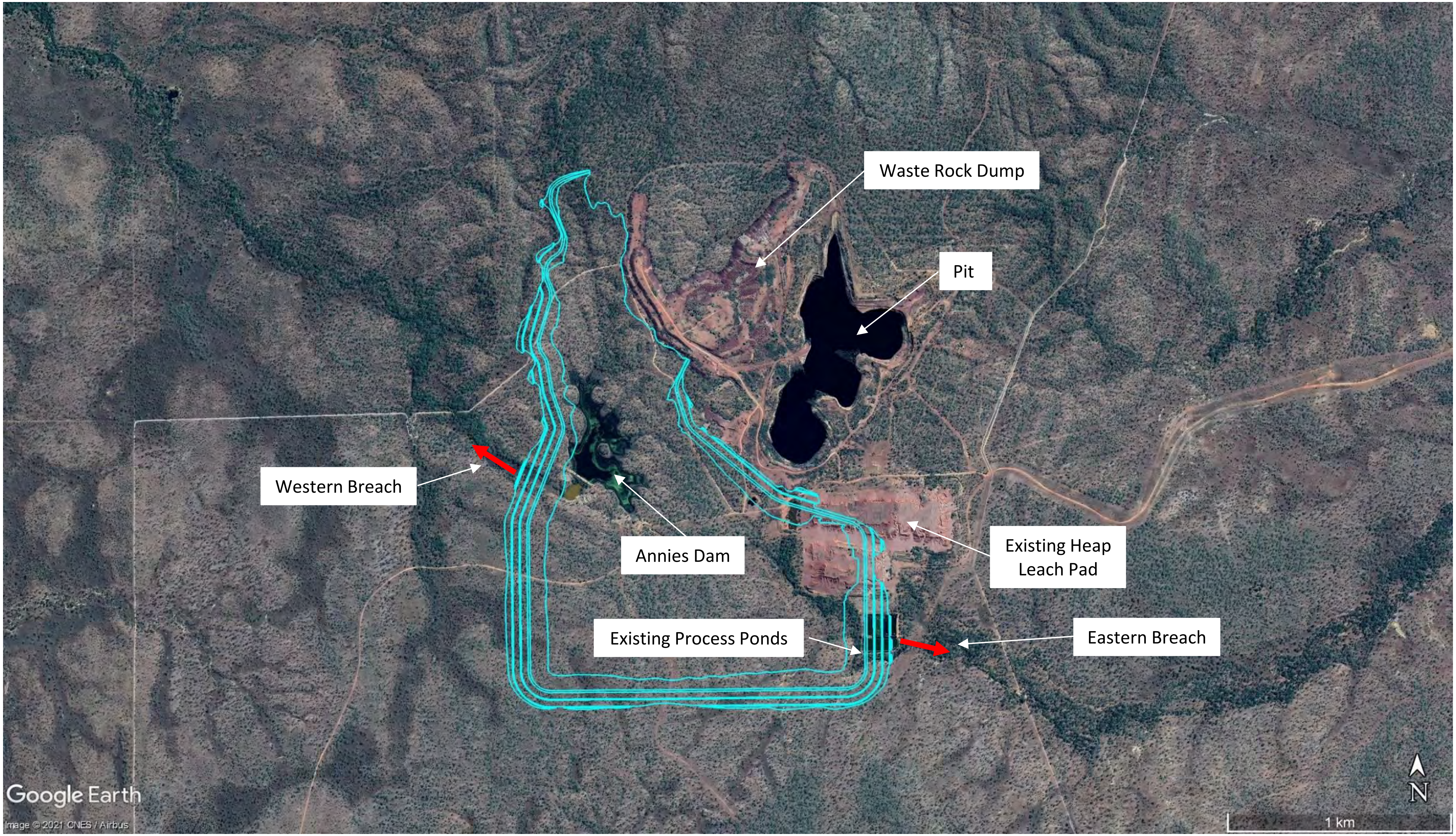
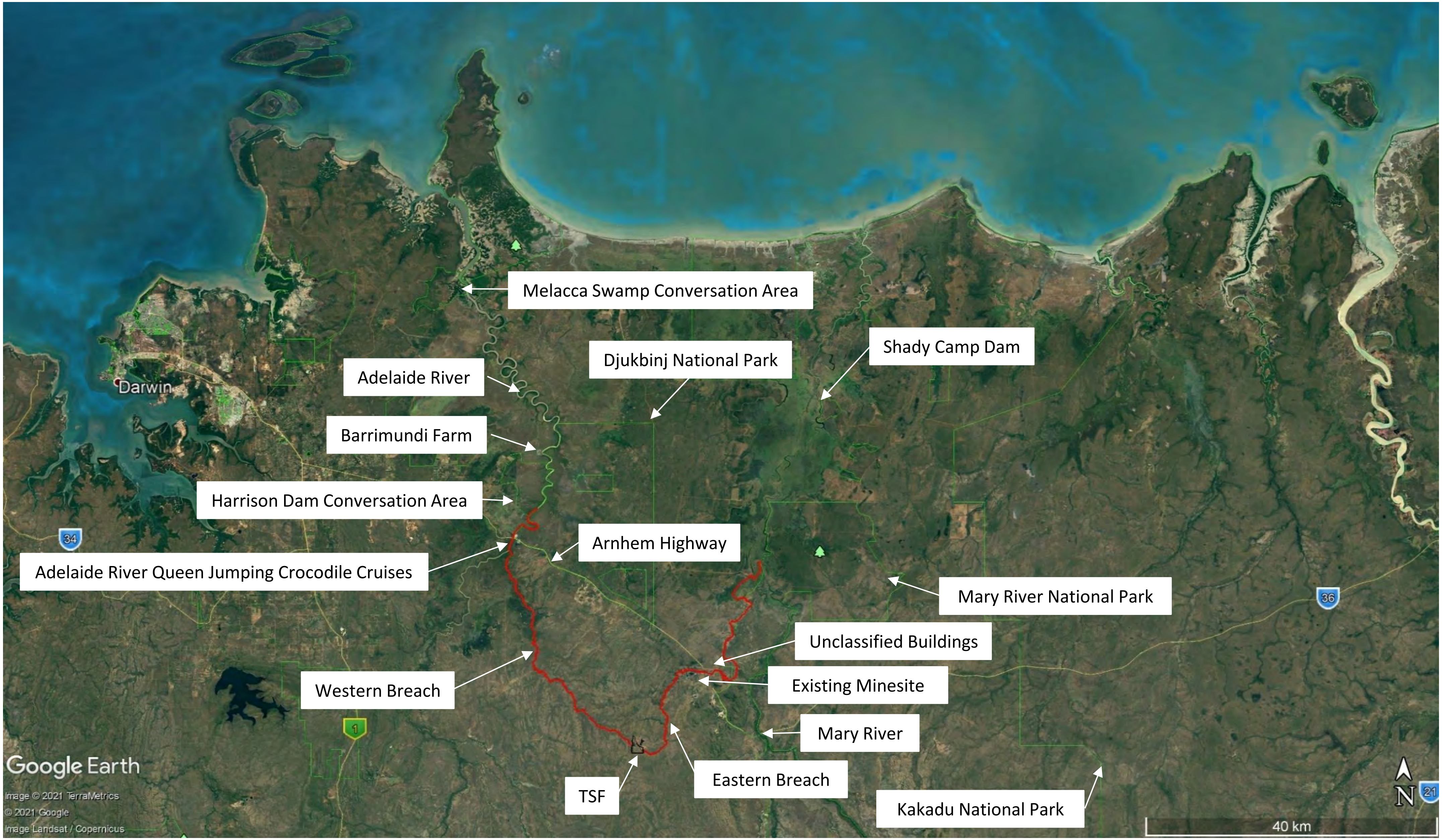
7. Integrated Biodiversity Assessment Tool (2021). "Integrated Biodiversity Assessment Tool", accessed 15 June 2021, https://www.ibat-alliance.org/

FIGURES

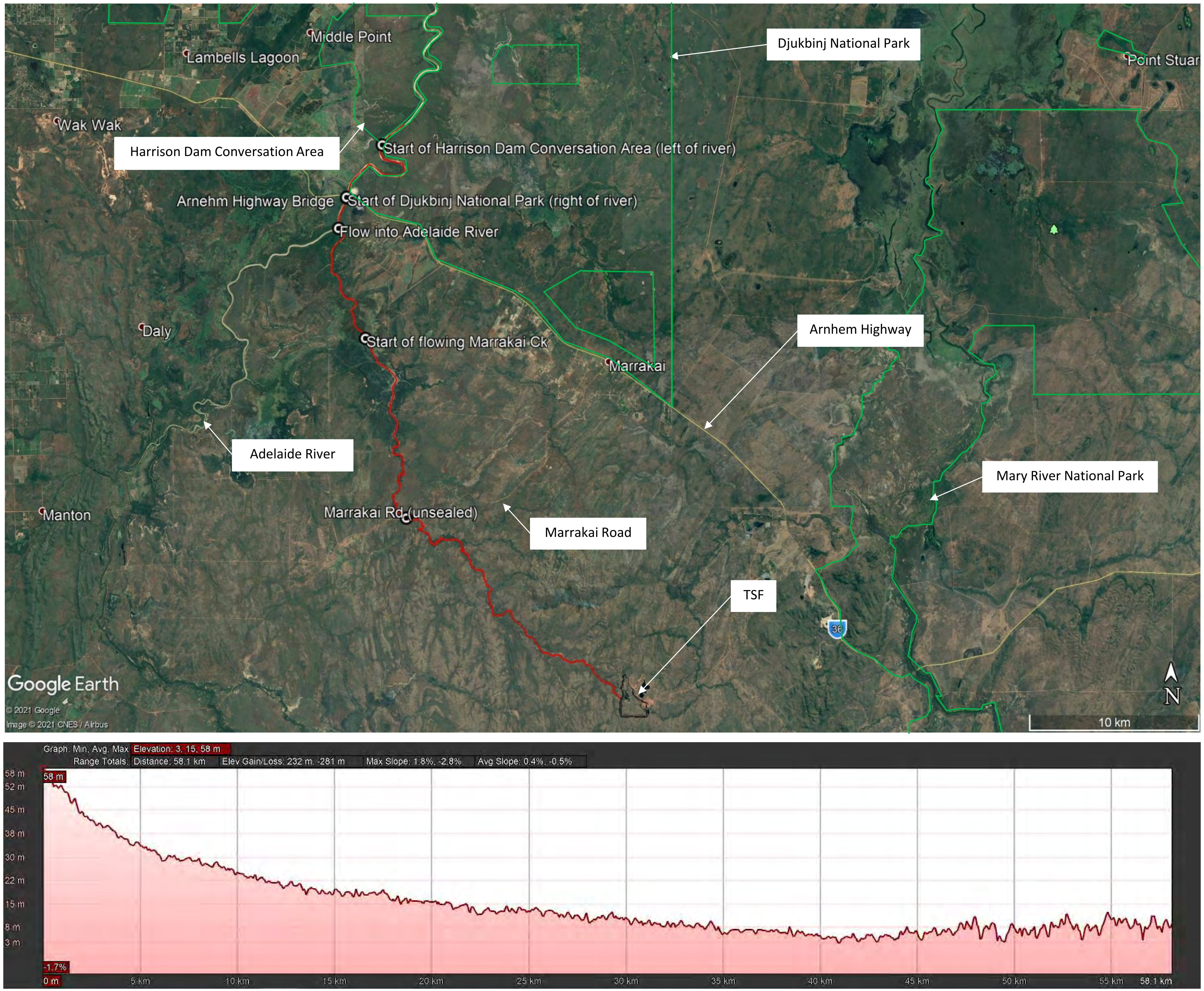

Waste Rock Dump
Pit
Western Breach
Annies Dam
Existing Heap Leach Pad
Existing Process Ponds
Eastern Breach
Google Earth
Image © 2021 CNES / Airbus
N
1 km



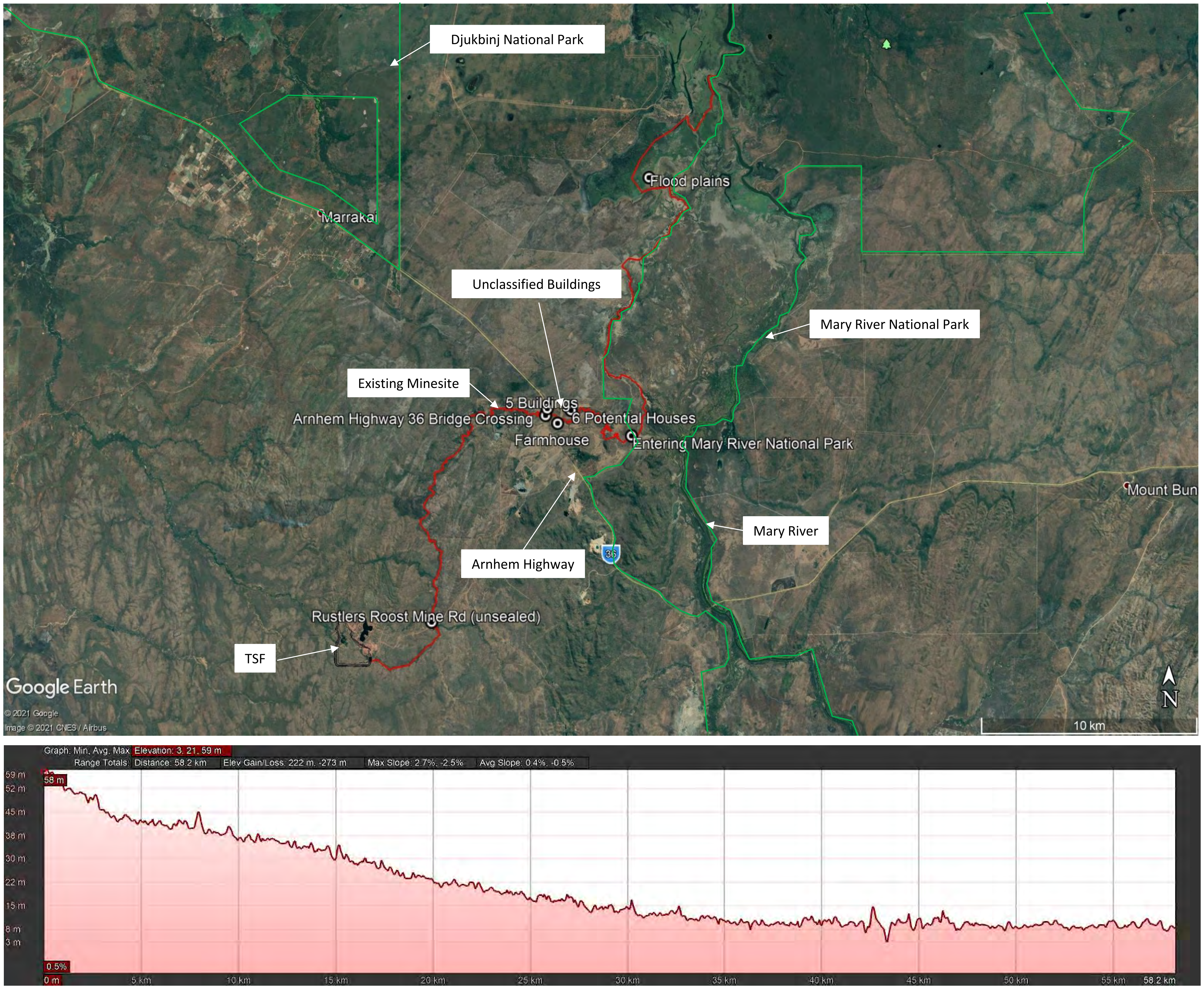
Knight Piésold CONSULTING

RUSTLERS ROOST GOLD PROJECT
DAM BREACH ASSESSMENT
EXTENTS OF DAM BREACHES

PE801-00102 M21005
Figure 2.2



Middle Point
Lambells Lagoon
Djukbinj National Park
Point Stuart
Wak Wak
Harrison Dam Conversation Area
Start of Harrison Dam Conversation Area (left of river)
Arnehm Highway Bridge
Start of Djukbinj National Park (right of river)
Flow into Adelaide River
Daly
Start of flowing Marrakai Ck
Marrakai
Arnhem Highway
Adelaide River
Mary River National Park
Manton
Marrakai Rd (unsealed)
Marrakai Road
TSF
Google Earth
© 2021 Google
Image © 2021 CNES / Airbus
N
10 km
Graph: Min, Avg, Max Elevation: 3, 15, 58 m
Range Totals: Distance: 58.1 km Elev Gain/Loss: 232 m, -281 m Max Slope: 1.8%, -2.8% Avg Slope: 0.4%, -0.5%
58 m
52 m
45 m
38 m
30 m
22 m
15 m
8 m
3 m
-1.7%
0 m
5 km
10 km
15 km
20 km
25 km
30 km
35 km
40 km
45 km
50 km
55 km
58.1 km


Djukbinj National Park
Flood plains
Marrakai
Unclassified Buildings
Mary River National Park
Existing Minesite
5 Buildings
Arnhem Highway 36 Bridge Crossing
6 Potential Houses
Farmhouse
Entering Mary River National Park
Mount Bun
Mary River
Arnhem Highway
36
Rustlers Roost Mine Rd (unsealed)
TSF
Google Earth
© 2021 Google
Image © 2021 CNES / Airbus
N
10 km
Graph: Min, Avg, Max Elevation: 3, 21, 59 m
Range Totals Distance: 58.2 km Elev Gain/Loss: 222 m, -273 m Max Slope: 2.7%, -2.5% Avg Slope: 0.4%, -0.5%
59 m
52 m
45 m
38 m
30 m
22 m
15 m
8 m
3 m
58 m
0.5%
0 m
5 km
10 km
15 km
20 km
25 km
30 km
35 km
40 km
45 km
50 km
55 km
58.2 km

Arnhem Hwy
36
Mt Bundey Creek
Bridge Crossing
Structures
Exisiting Minesite
Arnhem Highway
Farmhouse
Google Earth
Image © 2021 CNES / Airbus
© 2021 Google
1 km
N

APPENDIX I

Memorandum Ref. PE21-01135 *Rustlers Roost Gold Project – TSF Layout and Construction Quantities Rev 1*

MEMORANDUM

To:	Hanking Australia Investment	**Date:**	03 September 2021
Attn:	John Zimmerman	**Our Ref:**	PE21-01135
		KP File Ref.:	PE801-00102/05-A djtm M21007
cc:	Charles Hastie	**From:**	Dave Morgan

RE: RUSTLERS ROOST GOLD PROJECT – TSF LAYOUT AND CONSTRUCTION QUANTITIES REV 1

The Rustlers Roost Gold Project (Rustlers Roost) is a brownfields project being redeveloped by Hanking Australia Investment (Hanking). Knight Piésold Pty Ltd (KP) were engaged by Hanking to conduct a PFS level TSF design based on current project information. KP were previously involved with the project in 1996/97 for previous owners and conducted a TSF locations assessment in 2018. Previous knowledge utilised to complete this TSF layout review and construction quantities is summarised as follows:

The following work had been conducted previously by KP for Rustlers Roost:

- Tailings testing (Report Ref. 522/1, September 1996).
- TSF Option Study and design memo (Memorandum Ref. PE18-00378).
- Site Investigation (Report Ref. 522/4, January 1997).
- Waste rock storage design (Report Ref. 522/5, January 1997).

This memorandum supersedes memorandum KP Ref. PE21-00451 issued in April 2021, updated for an increased total tonnage of 48 Mt.

1. PRELIMINARY TSF DESIGN

1.1 GENERAL

The proposed site for tailings was designated by Hanking. KP evaluated 3 No. options for the TSF layout, as shown on figures 1.1 to 1.3. At a meeting on 25 March 2021, the three options were presented to Hanking (Messrs John Zimmerman and Charles Hastie). It was agreed that Option 2 should be used for the PFS on the basis of the smaller embankment volume. Furthermore, it was agreed that mine waste should be available for embankment construction and therefore downstream raise configuration should be utilised based on simplifying constructability.

The embankment alignment is designed to take advantage of natural topography (ridge lines) to reduce the volume of embankment construction materials required. The TSF is designed to encapsulate the existing Annie's Dam during Stage 1 of operation. The design parameters adopted for the preliminary design are summarised in Table 1.1. The TSF footprint was limited to provide a 50 m corridor between the downstream toe of the embankment and the site boundary.

At a meeting on 26 August 2021 Hanking (Messrs John Zimmerman and Charles Hastie) advised that the TSF would need to be designed to store a total of 48 Mt of tailings (up from 40 Mt). The required stormwater storage capacity will be confirmed during the subsequent design phase, based on the ANCOLD consequence category of the TSF determined from a TSF dam break assessment. The embankment will be constructed in stages, with the upstream low permeability zone and any transitional material zones being constructed by a specialised earthworks contractor and the downstream structural fill zones being progressively constructed by the mining fleet as part of the mine operations.

A compacted soil liner, comprising primarily reworked in situ soils, will be constructed over the full TSF basin, with the exception of the Annie's Dam reservoir area. The design incorporates an underdrainage system to reduce pressure head acting on the compacted soil liner, reduce seepage, increase tailings densities, and improve the geotechnical stability of the embankments. The underdrainage system comprises a network of finger drains and collector drains. The underdrainage system drains by gravity to a collection sump located at the lowest point in the basin. Solution recovered from the underdrainage system will be pumped back to the plant for re-use in the process circuit.

A decant turret system (comprising floating pump/s attached to a HDPE 'turret') will recycle water from the TSF supernatant pond for use in the process throughout operation (typical details of the turret system are provided in Appendix A). An emergency spillway will be constructed for each raise to discharge flows which result from storm events in excess of the design criteria.

The general arrangement of the TSF (Stage 1 and final arrangements) is shown on figures 1.4 and 1.5.

1.2 TAILINGS DEPOSITION SYSTEM

Tailings will be discharged into the facility by sub-aerial deposition methods, using banks of spigots at regular intervals predominantly from the main embankments for supernatant pond location control. The active tailings beach will be regularly rotated around the facility so as to maximise tailings density and control the supernatant pond.

Deposition will be managed from eastern, southern and western embankments to ensure that the supernatant pond will be located in the northern valley of the TSF. During the later stages of operation, deposition will be relocated to the head of the northern valley to push the supernatant pond further south towards the proposed closure spillway location.

Table 1.1: TSF design parameters

Throughput Storage Capacity - Stage 1 - Stage 10 (Final)	4.0 Mtpa 5.33 Mt (16 months) 48 Mt (12 years)
Tailings density [1] - Stage 1 - Final	 1.0 t/m³ 1.4 t/m³
Tailings beach slope[1]	150H:1V
Cut-off Trench	Upstream toe cut-off through residual/transported material.
Embankment	Multi-zoned earthfill embankment, with upstream low permeability zone and downstream structural zone.
Raise technique	Downstream raise construction methods for all raises
Basin treatment	Compacted Soil Liner (CSL) over entire TSF basin area.
Underdrainage	System of finger and collector drains within low lying areas of the TSF basin.
Decant system	A Turret system connected to an access causeway located with the TSF basin and will be used to draw water from the supernatant pond and will be relocated as required (nominally every 2-3 months during early stages of operation, reducing to annually) as the supernatant pond migrates up the valleys. The Turret system will be located initially within the eastern valley of the TSF, before being relocated to the western valley in approximately month 8 of operation. The Turret will be moved along the causeway to in the latter stages of Stage 1, before being lifted into Annie's Dam reservoir, where the Turret will remain during subsequent operation (with some migration further up slope as required).
Construction materials Low permeability fill (Zone A) Structural fill (Zone C)	 Selected low permeability borrow material or selected mine waste stockpile for use by civil contractor fleet. Mine waste (placed by the mining operations) and traffic compacted by loaded haul trucks.
Embankment slopes - Intermediate - Closure	 3H:1V Downstream 2H:1V Upstream 3.5H:1V downstream (overall), with 5 m horizontal benches at 10 m height increments.
Cover profile	Generally shaped to achieve dry closure with no ponding (water shedding).
Capping	Coarse rockfill over tailings (nominal 0.5 m thickness), Low permeability mine waste (nominal 0.3 m thickness), Covered with topsoil (0.2 m), re-vegetation.

[1] Assumed tailings parameters to be confirmed during subsequent design.

1.3 EMBANKMENT CONSTRUCTION

The TSF embankments will be constructed in stages to suit storage requirements. Staged embankment crest elevations are presented in Table 1.2.

Table 1.2: Embankment construction schedule

Stage	Storage Capacity (Mt)	Tailings Volume (Mm^3)	Crest Elevation (RL m)
1[*1]	5.3	5.3	70.2
2	9.3	6.7	71.4
3	13.3	9.5	73.6
4	17.3	12.4	75.5
5	21.3	15.2	77.4
6	25.3	18.1	79.2
7	29.3	21.0	80.9
8	33.3	23.8	82.6
9	37.3	26.7	84.3
10	41.3	29.5	85.9
11	45.3	32.4	87.4
12	48.0	34.3	88.4

[*1] Stage 1 TSF designed to provide 16 months capacity.

The embankments will consist of an upstream low permeability zone (Zone A) with a downstream structural zone (Zone C). The embankment will have an upstream slope of 2H:1V, a downstream slope of 3H:1V during operation and a crest width of 10 m. Low permeability material will be required along the existing waste dump.

Construction of the staged raises will occur during the dry season before the current stage is full, so that there is adequate storage volume available throughout the life of mine and to reduce construction delays.

1.4 SEEPAGE CONTROL

In order to reduce seepage losses through the TSF basin area, maximise water return to the plant and increase the settled densities of deposited tailings as much as practicable; a number of seepage control and underdrainage collection features have been integrated into the design.

The seepage control and underdrainage collection systems will consist of the components as follows:

- Cut-off trench;
- Compacted soil liner (CSL);
- Basin underdrainage collection system overlying the CSL, including collectors (in drainage courses) and finger drains (30 m spacing over TSF basin area);
- Underdrainage collection sump; and
- Embankment toe drain.

1.5 DECANT AND RETURN WATER SYSTEM

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

The decant turret system will consist of the following components:

- A decant turret trench within the natural drainage courses within the TSF basin (the planned supernatant pond migration paths);
- An access causeway constructed of Zone D material (generally comprising excavated material from the decant turret trench);
- A floating polyethylene decant turret unit, with associated piped connections;
- A pump affixed to the decant turret unit (pumping system designed by others); and
- 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) (as shown in Appendix A) 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.

1.6 EMERGENCY SPILLWAY

The TSF will be designed to contain a range of design storm and rainfall sequences events up to and greater than the required design criteria. The design criteria for the TSF will be governed by the ANCOLD consequence category, to be determined during the subsequent design phase based on a TSF dam break assessment.

In the event that a storm event greater than the TSF design criteria occurs rainfall and supernatant water which cannot be stored will discharge from the TSF in a controlled manner via an engineered spillway. The operational emergency spillway will be constructed as part of each embankment raise.

1.7 TAILINGS PERFORMANCE MONITORING

Tailings performance monitoring will include monitoring of the following variables on a continuous basis:

- Solids tonnage to the TSF;
- Water volume to the TSF;
- Rainfall and evaporation at TSF;
- Water return from the TSF; and
- Collection efficiency of the underdrainage system.

Monitoring of tailings moisture contents and densities, and survey of the tailings beach and supernatant pond locations should be conducted four times a year.

1.8 TSF MONITORING

A comprehensive monitoring programme for the TSF will be required to ensure that any potential problems are discovered early in order to initiate contingency plans.

The monitoring systems will include the following items:

- Regular inspections of all TSF infrastructure;
- Survey pins to monitor embankment displacement;
- Piezometers to measure pore water pressure within the embankment;
- Boreholes to monitor water quality and seepage levels downstream of the TSF;
- Surface water monitoring stations to monitor water quality in surface flows downstream of the TSF; and
- Ongoing operational monitoring and water balance calibration for the TSF.

Any problems identified will result in an increase in monitoring frequency and the Engineer of Record (EoR) will be notified immediately to assess the situation. It is recommended that the boreholes are constructed before commissioning the TSF to accumulate baseline data specific to the storage location. Survey pins will be installed along the downstream batter to monitor for movement.

1.9 EMERGENCY CONTROLS

Under normal operating conditions the following systems should be in place:

- The tailings pipeline will be located on the upstream crest of the embankment, which will have a minimum cross fall to the tailings beaches of 2%. Any leakage from the pipeline should therefore flow towards the TSF;
- The facility is protected by a spillway so that in the unlikely event of an overflow situation, water will be discharged and the embankment will not be overtopped; and
- Between the plant site and the TSF, the tailings pipeline, and water return lines will be contained within a bunded corridor.

These systems should reduce the risk of uncontrolled spillages occurring from the TSF or pipelines outside of the TSF.

1.10 REHABILITATION

The main focus of the rehabilitation programme will be re-vegetation, erosion control and stormwater management.

At the end of the mining operation, the embankment will have a downstream slope of 3H:1V with 5 m benches at 10 m intervals for erosion and drainage control. The adopted downstream profile will allow for re-vegetation.

The surplus water on the TSF will need to be disposed of when processing operations are ceased. When the geochemical properties of the tailings supernatant become available, a strategy for the disposal of the surplus water will be determined. The rehabilitation plans will be confirmed during the operation via routine geochemical testing.

During the later stages of operation, deposition will be relocated to the head of the northern valley to push the supernatant pond further south towards an existing drainage course in the east of the Annie’s Dam basin. The TSF closure spillway will be excavated from this valley, running around the waste dump and discharging into the Open Pit.

Rehabilitation of the tailings surface will commence upon termination of tailings deposition. At this stage, soil fill covers are proposed for the TSF as the most appropriate long-term solution. This is subject to ongoing geochemistry testing during operation.

2. CONSTRUCTION QUANTITIES

On the basis of the preliminary design presented, construction quantities were determined and are presented in Table 2.1 (appended) and summarised in Table 2.2. The quantities are estimated with an overall accuracy of ± 25 - 30%.

It should be noted that:

- Unit rates provided are indicative based on similar projects within the Western Australia goldfields and no escalation is included. Project specific rates should be determined during the subsequent design phase;
- Preliminary and General costs of 35% were assumed and included;
- No contingency was included in the cost estimate and this should be added by Hanking as necessary;

No allowance was made for:

- EPCM during the construction;
- Mechanical, piping, instrument and pumping systems;
- Power supply; and
- Design items noted as ‘by others’ in the tables.

Table 2.2: Summary of capital costs

Stage	Total Tonnage (Mt)	Incremental Tonnage (Mt)	Cost	
			(AU$M)	(AU$/tonne)
TSF Stage 1 construction	5.3	5.3	$ 21.6	$4.04/t
TSF Stage 2+ construction	48	42.7	$ 54.3	$1.27/t
TSF Closure	48	-	$ 15.5	$0.32/t
TOTAL			**$ 91.3**	**$1.90/t**

2.11 CENTRELINE CONSTRUCTION

For the purposes of a capital cost comparison, centreline construction has been assessed for stages subsequent to Stage 1, with a view to reduce overall earthworks volumes. It is noted that all design parameters, as presented in Table 1.1, have been assumed for the centreline modelling. The viability of constructing using centreline methods for + Stage 2 construction requires further technical assessment.

The modelling is summarised in Table 2.3.

Table 2.3: Downstream and Centreline Comparison

Raise Methodology	Stage 1		Final	
	Volume (m^3)	Embankment Footprint (Ha)	Volume (m^3)	Embankment Footprint (Ha)
Downstream	1,177,000	21.4	9,647,000	78.3
Centreline	1,177,000	21.4	7,645,000	50.4

* The embankment levels have been assumed to be the same for the purpose of this assessment.

Stage 1 costs will remain the same regardless of which construction methodology is adopted, with the exception of some minor increases for construction of an underdrainage tower and access causeway (as the current riser pipe configuration is not suitable). Based on the above a reduction in earthworks in the range of 22% (2,003,000 m^3) would be anticipated over the period of operation. This equates to an estimated cost reduction of $9.4 M over the operation ($0.22/t for stages 2+). It is noted that the viability of centreline construction will require further technical assessment prior to adoption.

We trust this is sufficient information for your current requirements, however please contact us if you require any additional detail.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

ANDREW MOLLAN
Project Engineer

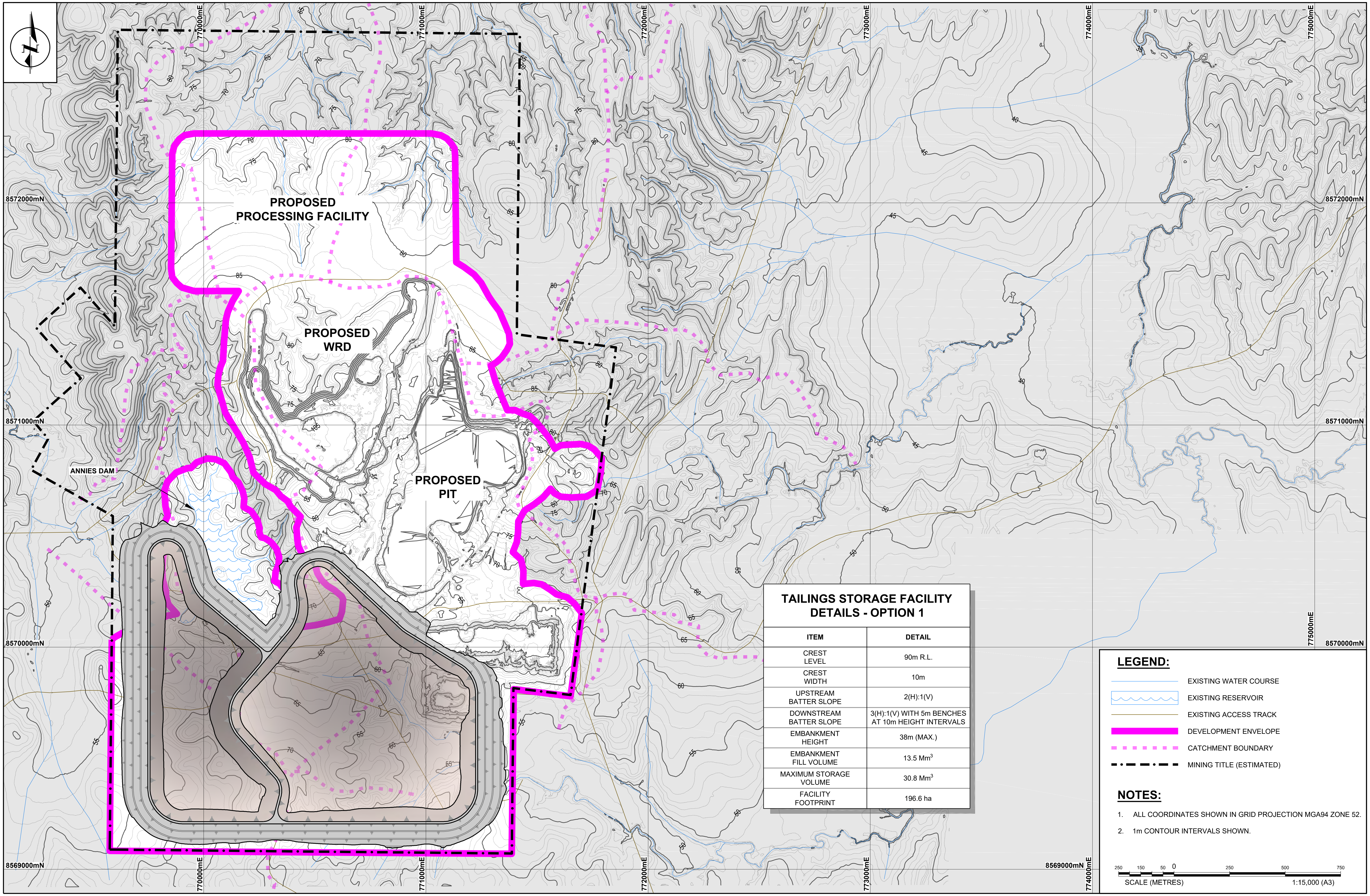
DAVID MORGAN
Managing Director

TABLE

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	35%	1	$ 7,545,869	1	$ 19,005,510	1	$ 5,410,659	$ 31,962,038
	Sub Total				$ 7,545,869		$ 19,005,510		$ 5,410,659	$ 31,962,038
2	**TSF SITE PREPARATION**									
2.1	**Site Preparation**									
2.1.1	Clear and grub embankment footprints, haul vegetation to designated stockpiles	m2	$ 0.13	213,000	$ 26,625	571,000	$ 71,375	-	$ -	$ 98,000
2.1.2	Clear and grub area of TSF basin, haul vegetation to designated stockpiles	m2	$ 0.13	1,312,000	$ 164,000	599,000	$ 74,875	-	$ -	$ 238,875
2.1.3	Strip topsoil from embankment footprints, haul to designated stockpiles (200mm)	m3	$ 1.36	42,600	$ 57,936	114,200	$ 155,312	-	$ -	$ 213,248
2.1.4	Strip topsoil from TSF basin area, haul to designated stockpiles (200mm)	m3	$ 1.36	262,400	$ 356,864	119,800	$ 162,928	-	$ -	$ 519,792
2.1.5	Excavate unsuitable material from the TSF embankment footprints and basin, haul to designated stockpile (nominal allowance)	m3	$ 4.50	21,300	$ 95,850	57,100	$ 256,950	-	$ -	$ 352,800
2.2	**Stockpiles & Borrow Areas**									
2.2.1	Clear designated stockpiles, push material to perimeter (2m high)	m2	$ 0.13	430,000	$ 53,750	395,000	$ 49,375	11,000	$ 1,375	$ 104,500
2.2.2	Clear designated borrow areas, push material to perimeter (4m deep)	m2	$ 0.13	102,000	$ 12,750	200,000	$ 25,000	132,000	$ 16,500	$ 54,250
2.2.3	Strip topsoil from stockpile and borrow areas, haul to designated stockpiles (200mm)	m3	$ 1.36	106,400	$ 144,704	119,000	$ 161,840	28,600	$ 38,896	$ 345,440
2.2.4	Supply suitable Zone E erosion protection material to stockpile (includes win, haul and place in stockpile)	m3	$ 12.50	14,800	$ 185,000	15,600	$ 195,000	4,600	$ 57,500	$ 437,500
2.2.5	Supply suitable Zone F1 sand material to stockpile (includes win, haul and place in stockpile)	m3	$ 18.00	40,700	$ 732,600	8,800	$ 158,400	-	$ -	$ 891,000
2.2.6	Supply suitable Zone F2 gravel material to stockpile (includes win, haul and place in stockpile)	m3	$ 18.00	600	$ 10,800	-	$ -	-	$ -	$ 10,800
	Sub Total				$ 1,840,879		$ 1,311,055		$ 114,271	$ 3,266,205
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	47,400	$ 142,200	30,400	$ 91,200	-	$ -	$ 233,400
3.1.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	4,800	$ 144,000	3,100	$ 93,000	-	$ -	$ 237,000
3.1.3	Win from borrow, load, haul, spread, condition and compact Zone A material in cutoff trench	m3	$ 6.67	52,200	$ 348,174	33,500	$ 223,445	-	$ -	$ 571,619
3.1.4	Scarify, condition and compact suitable insitu subgrade (200 mm depth) within embankment footprint area	m2	$ 0.60	213,000	$ 127,800	571,000	$ 342,600	-	$ -	$ 470,400
3.1.5	Win from borrow, load, haul, spread, condition and compact Zone C material in embankment (MINE FLEET)	m3	$ 3.00	871,000	$ 2,613,000	7,781,000	$ 23,343,000	-	$ -	$ 25,956,000
3.1.6	Win from borrow, load, haul, spread, condition and compact Zone A material in embankment	m3	$ 6.67	215,000	$ 1,434,050	596,000	$ 3,975,320	-	$ -	$ 5,409,370
3.1.7	Win from stockpile, load, haul, place and spread Zone F1 drainage medium in chimney and blanket drain	m3	$ 6.50	28,000	$ 182,000	-	$ -	-	$ -	$ 182,000
3.1.8	Win from borrow, load, haul, place, spread, condition and compact wearing course on embankment crest	m3	$ 8.31	5,900	$ 49,029	92,300	$ 767,013	-	$ -	$ 816,042
3.1.9	Win from borrow or stockpile, load, haul, place, spread and shape Zone D safety bund on embankment crest	m3	$ 3.50	1,500	$ 5,250	23,100	$ 80,850	-	$ -	$ 86,100
3.1.10	Remove wearing course and safety bund from embankment, haul to stockpile	m3	$ 4.00	-	$ -	115,400	$ 461,600	12,822	$ 51,289	$ 512,889
	Sub Total				$ 5,045,503		$ 29,378,028		$ 51,289	$ 34,474,820
4	**BASIN LINER CONSTRUCTION**									
4.1	**Low Permeability Liner**									
4.1.1	Scarify, condition and compact suitable insitu subgrade (200mm depth) as low permeability soil liner (where suitable)	m2	$ 0.60	919,000	$ 551,400	419,000	$ 251,400	-	$ -	$ 802,800
4.1.2	Prepare in-situ subgrade for imported low permeability soil liner (200mm depth)	m2	$ 0.25	424,000	$ 106,000	180,000	$ 45,000	-	$ -	$ 151,000
4.1.3	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)	m3	$ 6.64	128,000	$ 849,920	54,000	$ 358,560	-	$ -	$ 1,208,480
	Sub Total				$ 1,507,320		$ 654,960		$ -	$ 2,162,280
5	**UNDERDRAINAGE RETURN**									
5.1	**Upstream Toe Drain**									
5.1.1	Supply and install A14 Bidim geotextile inner cover in upstream toe drain	m2	$ 3.45	19,800	$ 68,310	12,700	$ 43,815	-	$ -	$ 112,125
5.1.2	Supply and install Textel 600R non-woven geotextile outer cover in upstream toe drain	m2	$ 3.45	19,800	$ 68,310	12,700	$ 43,815	-	$ -	$ 112,125
5.1.3	Supply and install 160mm draincoil with all tees, bends and jointing complete in toe drain	lin m	$ 16.44	3,949	$ 64,922	2,526	$ 41,527	-	$ -	$ 106,449
5.1.4	Win from stockpile, load, haul, place and spread Zone F1 drainage medium in toe drain	m3	$ 6.50	4,000	$ 26,000	2,600	$ 16,900	-	$ -	$ 42,900
5.2	**Downstream Toe Drain**									
5.2.1	Supply and install 160mm draincoil with all tees, bends and jointing complete in toe drain	lin m	$ 16.44	4,107	$ 67,519	2,929	$ 48,153	-	$ -	$ 115,672
5.2.2	Win from stockpile, load, haul, place and spread Zone F1 drainage medium in toe drain	m3	$ 6.50	4,200	$ 27,300	3,000	$ 19,500	-	$ -	$ 46,800
5.2.3	Win from supplied stockpile, load, haul, place and spread Zone E erosion protection in toe drain	m3	$ 6.50	3,100	$ 20,150	2,200	$ 14,300	-	$ -	$ 34,450
5.3	**Seepage Collection Sump**									
5.3.1	Excavate downstream seepage collection outflow trench, haul to stockpile	m3	$ 3.00	700	$ 2,100	-	$ -	-	$ -	$ 2,100
5.3.2	Win from stockpile, load, haul, place and spread Zone F1 bedding material in base of outflow trench	m3	$ 6.50	10	$ 65	-	$ -	-	$ -	$ 65
5.3.3	Supply and install 160mm solid HDPE pipe with all tees, bends and jointing complete in outflow trench	lin m	$ 16.44	490	$ 8,056	-	$ -	-	$ -	$ 8,056
5.3.4	Backfill downstream seepage collection outflow trench with Zone D material	m3	$ 3.00	700	$ 2,100	-	$ -	-	$ -	$ 2,100
5.3.5	Excavate downstream seepage collection sump, haul to stockpile	m3	$ 3.00	25	$ 75	-	$ -	-	$ -	$ 75
5.3.6	Supply and install 25MPa reinforced concrete tower base for seepage collection sump	lin m	$ 6,500.00	3	$ 19,500	-	$ -	-	$ -	$ 19,500
5.3.7	Supply and install 1200mm diameter slotted concrete pipe for seepage collection sump	lin m	$ 4,189.00	6	$ 25,134	-	$ -	-	$ -	$ 25,134
5.3.8	Backfill downstream seepage collection sump with Zone A material	m3	$ 3.00	25	$ 75	-	$ -	-	$ -	$ 75
5.4	**Finger Drain**									
5.4.1	Supply and install 100mm draincoil groundwater drain, with all tees, bends and joints complete (including filter sock), in finger drain	lin m	$ 7.44	23,505	$ 174,874	-	$ -	-	$ -	$ 174,874
5.4.2	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in central groundwater drain	m3	$ 6.50	2,200	$ 14,300	-	$ -	-	$ -	$ 14,300
5.4.3	Supply and install A14 Bidim geotextile inner wrap in finger drains (including smooth HDPE erosion protection sheet)	m2	$ 3.45	34,100	$ 117,645	-	$ -	-	$ -	$ 117,645
5.4.4	Supply and install Textel 600R non-woven geotextile outer cover in finger drains	m2	$ 3.45	34,100	$ 117,645	-	$ -	-	$ -	$ 117,645
5.5	**Collector drain**									
5.5.1	Excavate and shape collector drains and channel, haul to stockpile	m3	$ 3.00	13,100	$ 39,300	21,400	$ 64,200	-	$ -	$ 103,500
5.5.2	Supply and install 100mm draincoil with all tees, bends and joints complete and geotextile wrapped, in collector drain	lin m	$ 16.44	3,949	$ 64,916	6,474	$ 106,433	-	$ -	$ 171,349
5.5.3	Supply and install A14 Bidim geotextile inner cover in collector drain	m2	$ 3.45	39,000	$ 134,550	63,900	$ 220,455	-	$ -	$ 355,005
5.5.4	Supply and install Textel 600R non-woven geotextile outer cover in collector drain	m2	$ 3.45	39,000	$ 134,550	63,900	$ 220,455	-	$ -	$ 355,005
5.5.5	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in collector drain	m3	$ 6.50	1,900	$ 12,350	3,200	$ 20,800	-	$ -	$ 33,150
5.6	**Underdrainage Collection Sump and Riser Pipe**									
5.6.1	Excavate and shape underdrainage collection sump, haul to stockpile	m3	$ 3.00	900	$ 2,700	-	$ -	-	$ -	$ 2,700
5.6.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	90	$ 2,700	-	$ -	-	$ -	$ 2,700
5.6.3	Supply 630 mm diameter HDPE underdrainage riser pipe (slotted), including all fittings	Lin m	$ 150.00	133	$ 19,950	58	$ 8,700	-	$ -	$ 28,650
5.6.4	Supply 630 mm diameter HDPE underdrainage riser pipe (solid), including all fittings	Lin m	$ 150.00	18	$ 2,700	-	$ -	-	$ -	$ 2,700
5.6.5	Win from supplied stockpile, load, haul, place and spread Zone F1 drainage medium in underdrainage collection sump	m3	$ 6.50	300	$ 1,950	-	$ -	-	$ -	$ 1,950
5.6.6	Win from supplied stockpile, load, haul, place and spread Zone F2 drainage medium in underdrainage collection sump	m3	$ 6.50	600	$ 3,900	-	$ -	-	$ -	$ 3,900
5.6.7	Supply and install A14 Bidim geotextile in underdrainage sump	m2	$ 3.45	2,400	$ 8,280	-	$ -	-	$ -	$ 8,280
5.6.8	Install HDPE wear sheet beneath underdrainage riser pipe	m2	$ 8.00	133	$ 1,064	58	$ 464	-	$ -	$ 1,528
5.6.9	Supply and install concrete filled Solid HDPE ballast pipes including 316 stainless steel plate straps (1000mm c/c)	m3	$ 285.00	266	$ 75,810	116	$ 33,060	-	$ -	$ 108,870
5.6.10	Supply and install submersible underdrainage pump (and associated infrastructure)	Item	By Others	3	$ -	-	$ -	-	$ -	$ -
	Sub Total				$ 1,328,799		$ 902,577		$ -	$ 2,231,377
6	**TURRET SYSTEM**									
6.1	**Turret Inlet Channel**									
6.1.1	Excavate decant turret trench, haul and place in Zone C of causeway or designated stockpile	m3	$ 3.00	27,000	$ 81,000	8,000	$ 24,000	-	$ -	$ 105,000
6.1.2	Extra over for breaking hard rock material (nominal allowance)	m3	$ 30.00	1,400	$ 42,000	400	$ 12,000	-	$ -	$ 54,000
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	5	$ -	9	$ -	-	$ -	$ -
6.2.4	Win from borrow or stockpile, load, haul, place, spread, condition and compact Zone C material (MINE FLEET)	m3	$ 4.50	-	$ -	-	$ -	-	$ -	$ -
6.2.5	Win from borrow or stockpile, haul, place, spread, condition and compact wearing course along access road and bunded corridor	m3	$ 8.31	2,100	$ 17,451	400	$ 3,324	-	$ -	$ 20,775
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	10,600	$ 81,090	2,000	$ 15,300	-	$ -	$ 96,390
6.2.7	Win from borrow or stockpile, haul and place Zone D safety bund along access road	m3	$ 3.50	700	$ 2,450	200	$ 700	-	$ -	$ 3,150
	Sub Total				$ 223,991		$ 55,324		$ -	$ 279,315
7	**EMERGENCY SPILLWAY**									
7.1	**Spillway**									
7.1.1	Clear and grub, emergency spillway haul to designated stockpile	m2	$ 0.13	4,000	$ 500	37,929	$ 4,741	15,265	$ 1,908	$ 7,149
7.1.2	Strip topsoil from emergeny spillway to 150mm depth, haul to designated stockpiles	m3	$ 1.36	800	$ 1,088	7,600	$ 10,336	3,100	$ 4,216	$ 15,640
7.1.3	Excavate and shape emergency spillway, haul and place in Zone C of embankment or designated stockpile	m3	$ 3.00	3,800	$ 11,400	40,800	$ 122,400	62,300	$ 186,900	$ 320,700
7.1.4	Scarify, condition and compact base of spillway channel (200 mm depth)	m2	$ 0.60	2,900	$ 1,740	30,900	$ 18,540	8,100	$ 4,860	$ 25,140
7.1.5	Win from supplied stockpile, load, haul, place and spread Zone E erosion protection to spillway channel	m3	$ 6.50	1,100	$ 7,150	11,400	$ 74,100	4,600	$ 29,900	$ 111,150
	Sub Total				$ 21,878		$ 230,117		$ 227,784	$ 479,779
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	$ 300.00	2,100	$ 630,000	550	$ 165,000	-	$ -	$ 795,000
8.1.2	Supply and install tailings distribution pipeline along crest, including all tees and valves	lin m	$ 300.00	2,700	$ 810,000	70	$ 21,000	-	$ -	$ 831,000
8.1.3	Supply and install spigot offtakes, including reducing tees, high pressure rubber hose, clamps and signage	Item	$ 6,717.15	158	$ 1,061,310	117	$ 785,907	-	$ -	$ 1,847,216
8.1.4	Supply and install spigot droppers	lin m	$ 112.00	2,730	$ 305,760	8,954	$ 1,002,848	-	$ -	$ 1,308,608
8.1.5	Supply and install HDPE wear sheet beneath spigot droppers	m2	$ 8.00	2,730	$ 21,840	8,954	$ 71,632	-	$ -	$ 93,472
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	$ 300.00	3,300	$ 990,000	-	$ -	-	$ -	$ 990,000
8.3	**Tailings Decant Return Trench**									
8.3.1	Clear and grub, TDRT haul to designated stockpile	m2	$ 0.13	34,400	$ 4,300	-	$ -	-	$ -	$ 4,300
8.3.2	Strip topsoil from TDRT to 150mm depth, haul to designated stockpiles	m3	$ 1.36	6,900	$ 9,384	-	$ -	-	$ -	$ 9,384
8.3.3	Excavate and TDRT, haul and place in Zone D of TDRT or designated stockpile	m3	$ 3.00	-	$ -	-	$ -	-	$ -	$ -
8.3.4	Win from borrow, load, haul, spread, condition and compact Zone C material in TDRT (MINE FLEET)	m3	$ 3.00	26,600	$ 79,800	-	$ -	-	$ -	$ 79,800
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 Trench	m3	$ 6.64	300	$ 1,992	-	$ -	-	$ -	$ 1,992
	Sub Total				$ 3,914,386		$ 2,046,387		$ -	$ 5,960,772

Item	Description	Unit	Rate	Stage 1		Stage 2+		Closure		Total
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Cost
9	**MONITORING & INSTRUMENTATION**									
9.1	**Instrumentation**									
9.1.1	Install survey pins complete in TSF embankments	Item	$ 500.00	14	$ 7,000	205	$ 102,500	-	$ -	$ 109,500
9.1.2	Install standpipe piezometers complete in TSF embankments	Item	$ 1,500.00	16	$ 24,000	246	$ 369,000	-	$ -	$ 393,000
9.1.3	Decomission standpipe piezometers on previous TSF embankment raise	Item	$ 1,000.00	-	$ -	246	$ 246,000	27	$ 27,333	$ 273,333
9.1.4	Install monitoring bores complete (shallow)	Item	$ 5,000.00	5	$ 25,000	-	$ -	-	$ -	$ 25,000
9.1.5	Install monitoring bores complete (deeph)	Item	$ 15,000.00	5	$ 75,000	-	$ -	-	$ -	$ 75,000
	Sub Total				$ 131,000		$ 717,500		$ 27,333	$ 875,833
10	**TSF REHABILITATION**									
10.1	**Tailings Cap**									
10.1.1	Reshape and cut to fill capping surface	m2	$ 0.60	-	$ -	-	$ -	176,000	$ 105,600	$ 105,600
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	$ 3.00	-	$ -	-	$ -	878,000	$ 2,634,000	$ 2,634,000
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	-	$ -	-	$ -	527,000	$ 3,515,090	$ 3,515,090
10.2	**Rehabilitation**									
10.2.1	Win from stockpile, load, haul, place and spread topsoil over tailings surface (200mm)	m3	$ 6.50	-	$ -	-	$ -	351,000	$ 2,281,500	$ 2,281,500
10.2.2	Win from stockpile, load, haul, place and spread topsoil along embankment downstream slope (200mm)	m3	$ 6.50	-	$ -	-	$ -	95,000	$ 617,500	$ 617,500
10.2.3	Revegetate tailings surface and embankment downstream slope, including hydroseeding, hand seeding, labour, etc	m2	$ 1.00	-	$ -	-	$ -	474,000	$ 474,000	$ 474,000
	Sub Total				$ -		$ -		$ 9,627,690	$ 9,627,690
11	**SUMMARY**									
1	PRELIMINARY AND GENERAL COSTS				$ 7,545,869		$ 19,005,510		$ 5,410,659	$ 31,962,038
2	TSF SITE PREPARATION				$ 1,840,879		$ 1,311,055		$ 114,271	$ 3,266,205
3	TSF EMBANKMENT CONSTRUCTION				$ 5,045,503		$ 29,378,028		$ 51,289	$ 34,474,820
4	BASIN LINER CONSTRUCTION				$ 1,507,320		$ 654,960		$ -	$ 2,162,280
5	UNDERDRAINAGE RETURN				$ 1,328,799		$ 902,577		$ -	$ 2,231,377
6	TURRET SYSTEM				$ 223,991		$ 55,324		$ -	$ 279,315
7	EMERGENCY SPILLWAY				$ 21,878		$ 230,117		$ 227,784	$ 479,779
8	TAILINGS & DECANT PIPELINE				$ 3,914,386		$ 2,046,387		$ -	$ 5,960,772
9	MONITORING & INSTRUMENTATION				$ 131,000		$ 717,500		$ 27,333	$ 875,833
10	TSF REHABILITATION				$ -		$ -		$ 9,627,690	$ 9,627,690
										$ -
	Total				$ 21,559,625		$ 54,301,458		$ 15,459,027	$ 91,320,110

FIGURES



TAILINGS STORAGE FACILITY DETAILS - OPTION 1

ITEM	DETAIL
CREST LEVEL	90m R.L.
CREST WIDTH	10m
UPSTREAM BATTER SLOPE	2(H):1(V)
DOWNSTREAM BATTER SLOPE	3(H):1(V) WITH 5m BENCHES AT 10m HEIGHT INTERVALS
EMBANKMENT HEIGHT	38m (MAX.)
EMBANKMENT FILL VOLUME	13.5 Mm^3
MAXIMUM STORAGE VOLUME	30.8 Mm^3
FACILITY FOOTPRINT	196.6 ha

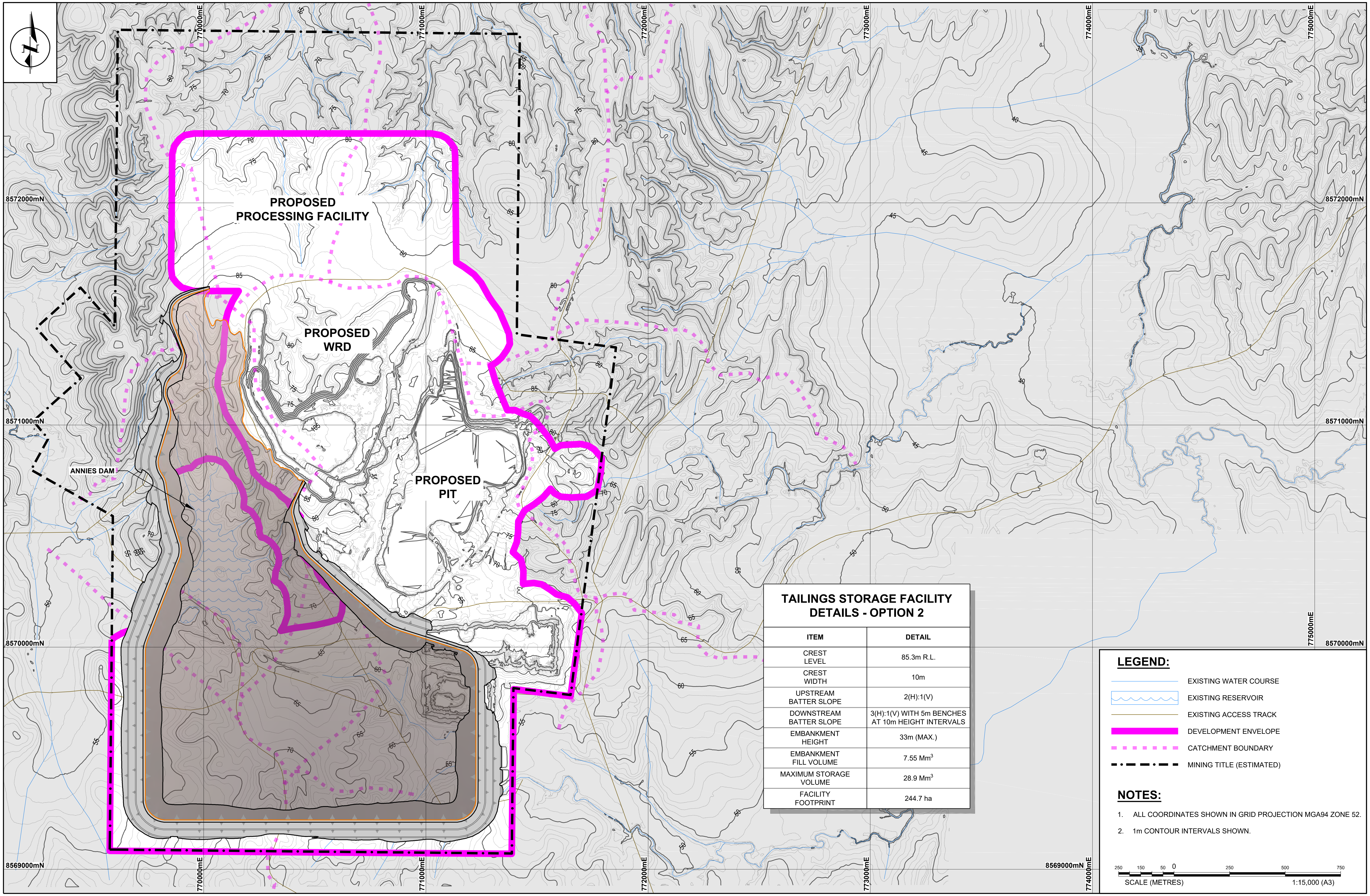
NOTES:

1. ALL COORDINATES SHOWN IN GRID PROJECTION MGA94 ZONE 52.
2. 1m CONTOUR INTERVALS SHOWN.

Knight Piésold CONSULTING

RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY OPTIONS
OPTION 1 GENERAL ARRANGEMENT PLAN

PE801-00102 M21007
Figure 1.1



TAILINGS STORAGE FACILITY DETAILS - OPTION 2

ITEM	DETAIL
CREST LEVEL	85.3m R.L.
CREST WIDTH	10m
UPSTREAM BATTER SLOPE	2(H):1(V)
DOWNSTREAM BATTER SLOPE	3(H):1(V) WITH 5m BENCHES AT 10m HEIGHT INTERVALS
EMBANKMENT HEIGHT	33m (MAX.)
EMBANKMENT FILL VOLUME	7.55 Mm^3
MAXIMUM STORAGE VOLUME	28.9 Mm^3
FACILITY FOOTPRINT	244.7 ha

LEGEND:

- EXISTING WATER COURSE
- EXISTING RESERVOIR
- EXISTING ACCESS TRACK
- DEVELOPMENT ENVELOPE
- CATCHMENT BOUNDARY
- MINING TITLE (ESTIMATED)

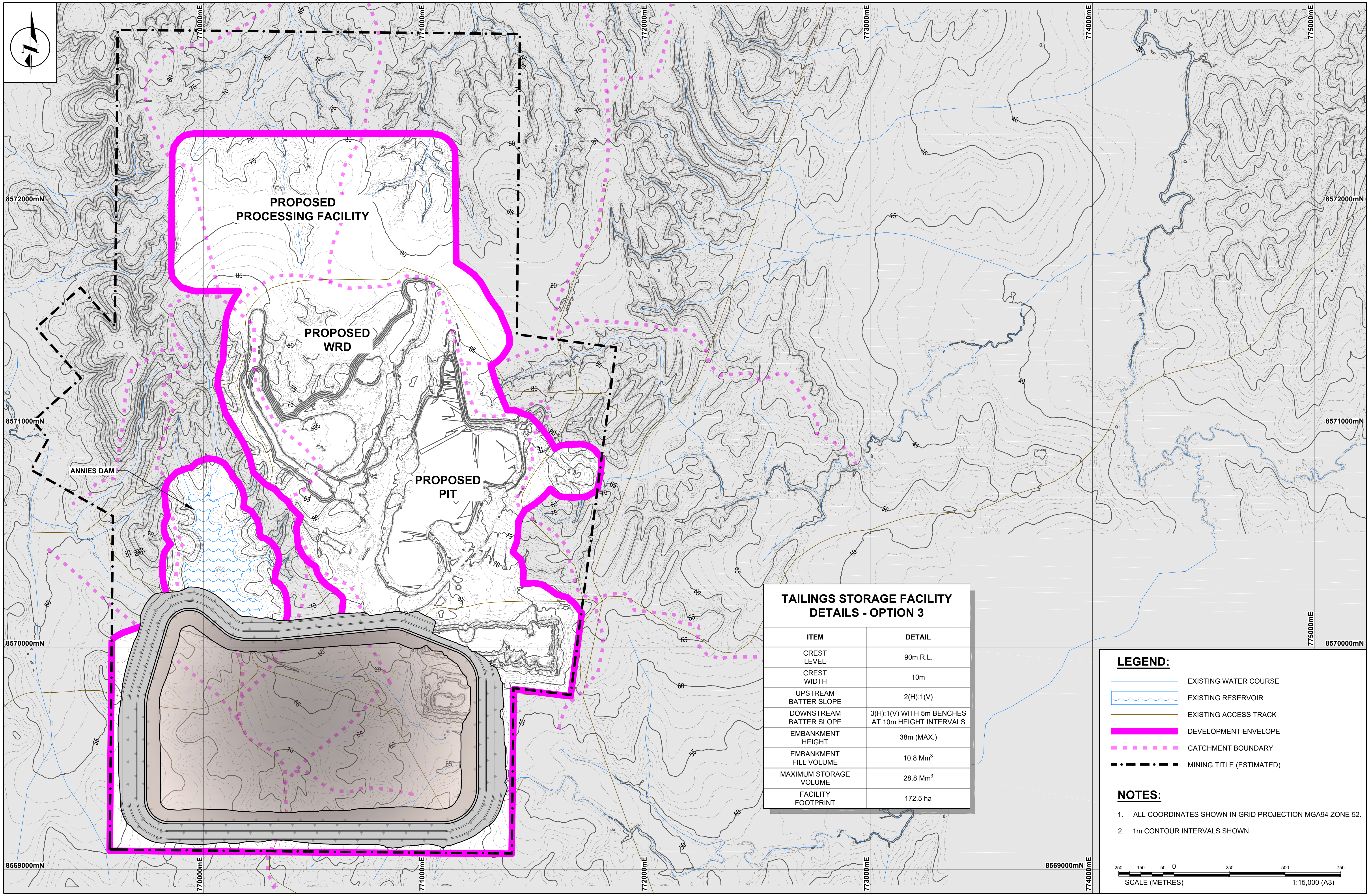
NOTES:

1. ALL COORDINATES SHOWN IN GRID PROJECTION MGA94 ZONE 52.
2. 1m CONTOUR INTERVALS SHOWN.

Knight Piésold CONSULTING

RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY OPTIONS
OPTION 2 GENERAL ARRANGEMENT PLAN

PE801-00102 M21007
Figure 1.2



TAILINGS STORAGE FACILITY DETAILS - OPTION 3

ITEM	DETAIL
CREST LEVEL	90m R.L.
CREST WIDTH	10m
UPSTREAM BATTER SLOPE	2(H):1(V)
DOWNSTREAM BATTER SLOPE	3(H):1(V) WITH 5m BENCHES AT 10m HEIGHT INTERVALS
EMBANKMENT HEIGHT	38m (MAX.)
EMBANKMENT FILL VOLUME	10.8 Mm^3
MAXIMUM STORAGE VOLUME	28.8 Mm^3
FACILITY FOOTPRINT	172.5 ha

LEGEND:

- EXISTING WATER COURSE
- EXISTING RESERVOIR
- EXISTING ACCESS TRACK
- DEVELOPMENT ENVELOPE
- CATCHMENT BOUNDARY
- MINING TITLE (ESTIMATED)

NOTES:

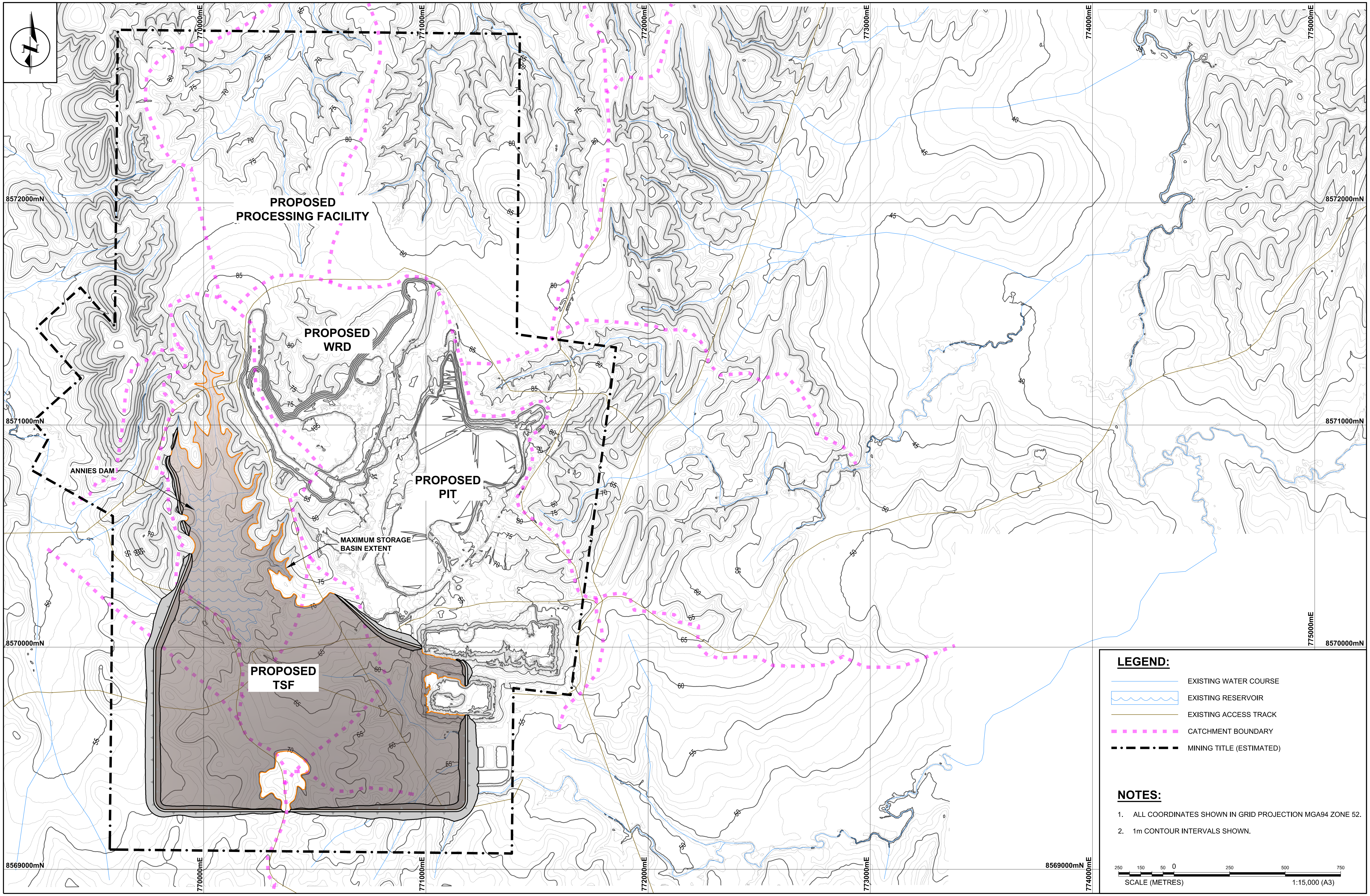
1. ALL COORDINATES SHOWN IN GRID PROJECTION MGA94 ZONE 52.
2. 1m CONTOUR INTERVALS SHOWN.

250 150 50 0 250 500 750
SCALE (METRES) 1:15,000 (A3)

Knight Piésold CONSULTING

RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY OPTIONS
OPTION 3 GENERAL ARRANGEMENT PLAN

PE801-00102 M21007
Figure 1.3



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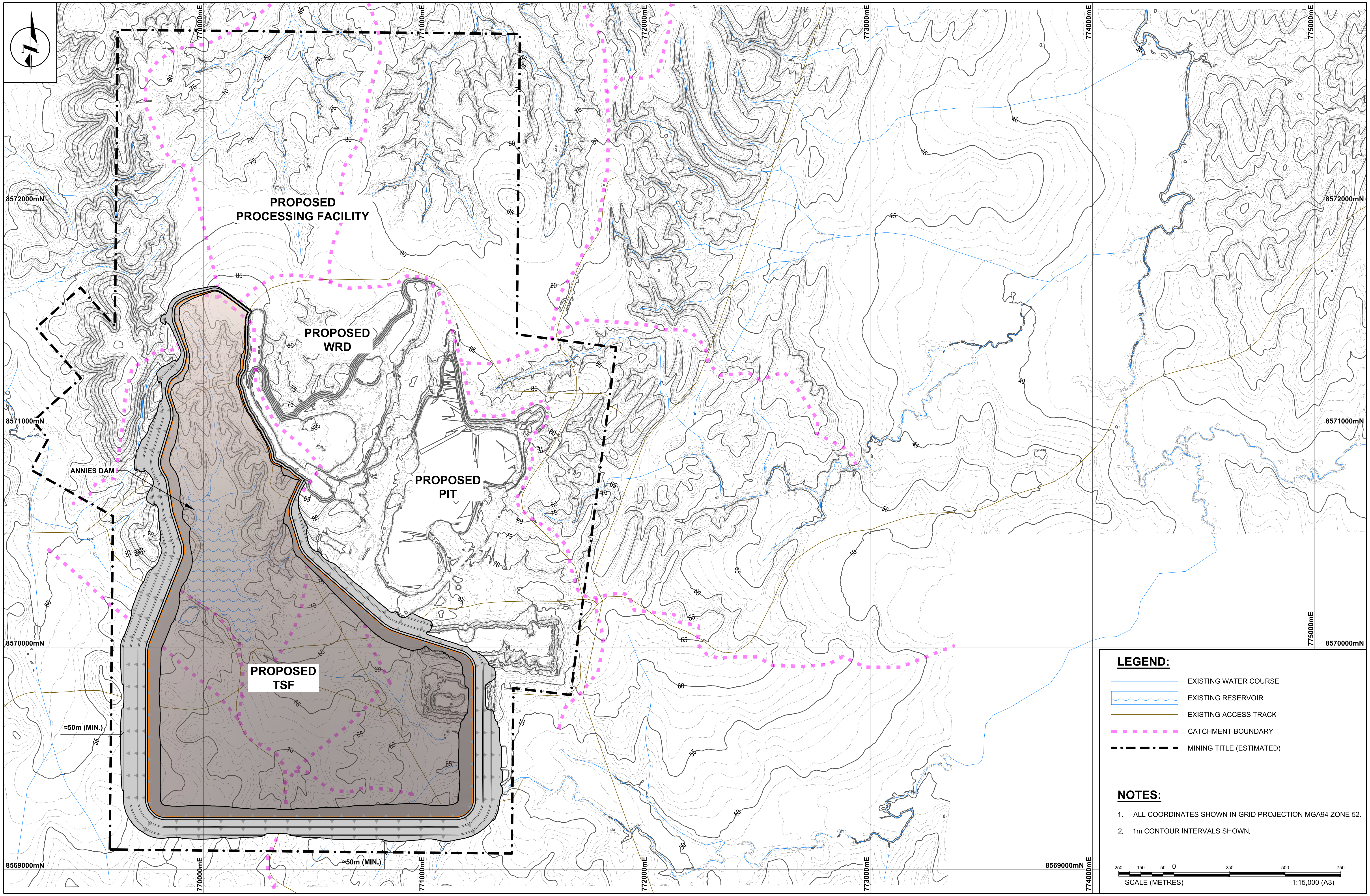
RUSTLERS ROOST GOLD PROJECT
TAILINGS STORAGE FACILITY
GENERAL ARRANGEMENT PLAN - STAGE 1

PE801-00102 M21007
Figure 1.4



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

PE801-00102 M21007
Figure 1.5

APPENDIX A

THE TURRET

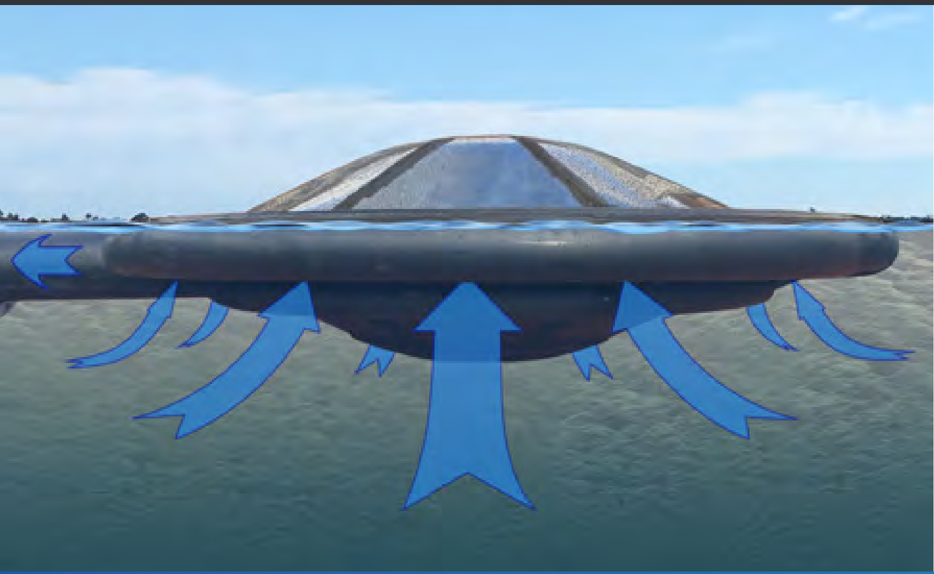
SHALLOW WATER? NO PROBLEM.

A floating water intake device for shallow water.

PRODUCT DESCRIPTION

RBH ENGINEERING

RBH ENGINEERING



INTRODUCING THE TURRET

The Turret is a floating water intake device that solves the problems of vortexing, pump cavitation and drawing from shallow water with its patented radial geometric design.

- Shallower tailings dams: The Turret can draw water from a depth of only 400mm. This means tailings dams can be much shallower and have much less surface area. This can result in lower evaporation losses, increased drying of tailings, improved tailings densities and reduced frequency of embankment raises.

SPACE-AGE SHAPE – LEGENDARY PERFORMANCE

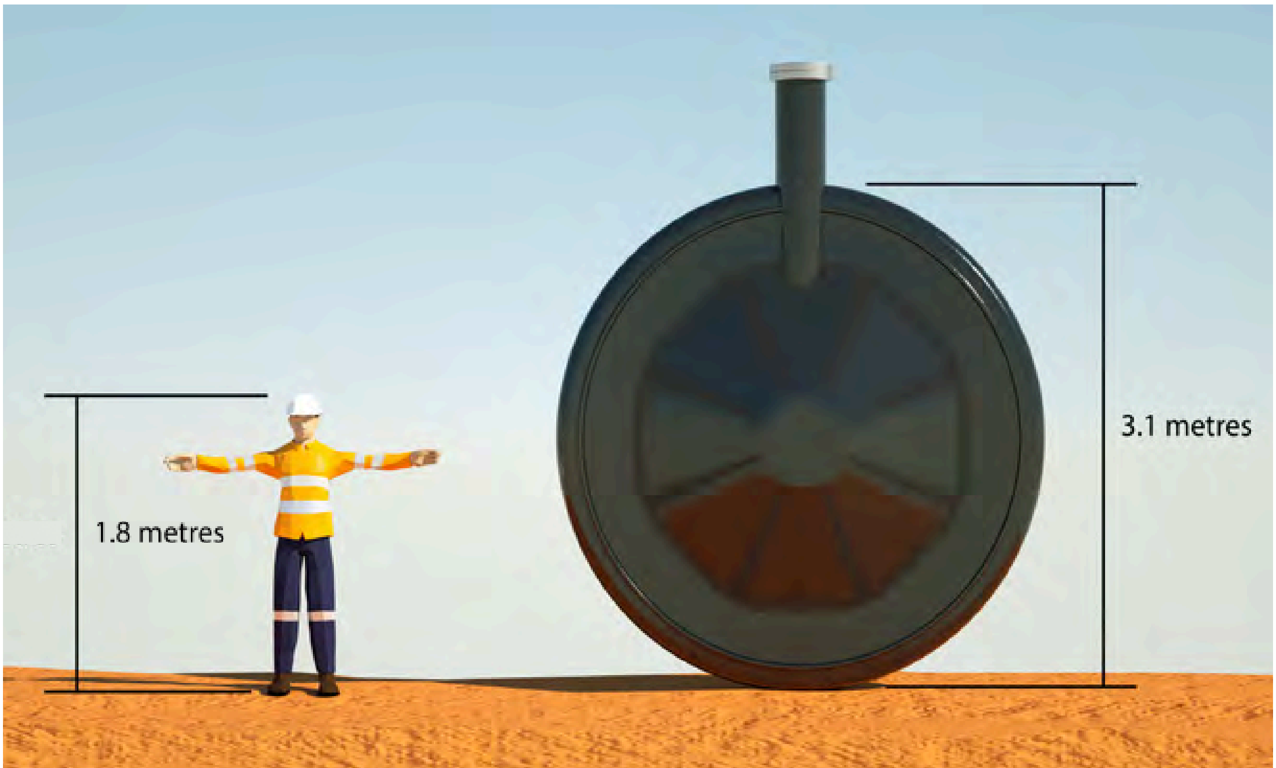
The Turret creates a barrier against vortexing and is a water intake solution for dewatering, tailings dams, decant ponds and raw water dams. It is an all-round solution for shallow water bodies:

- Mobile decanting: The Turret is a replacement for water intakes on existing decant barges and siphon decant systems. Because it takes water from just under the surface, the Turret permits much shallower decant ponds without the need to change the existing decant structure.
- Fixed decanting: When combined with a skid-mounted pump, the Turret is also a land-based, movable, lower capex and safer alternative to fixed decant systems such as cascade decant towers, seepage decant towers and embankment drains.

TOUGH, SAFE AND SIMPLE

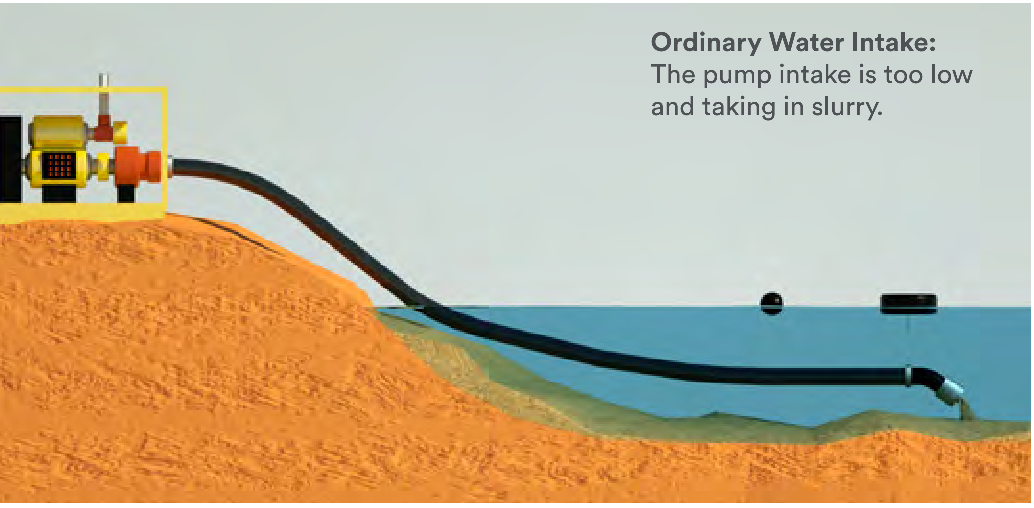
- The Turret is built tough. It is constructed of 10mm thick polyethylene and has been tested in the unforgiving environment of Australia's gold mines. Because of its futuristic design, only the Turret:
- Draws water down to 400mm.
- Creates a barrier against vortexing.
- Can be easily relocated with minimal equipment and human intervention.
- Is scalable – so you can add as many Turrets as you need to the one pump, depending on pump capacity and suction size.

Bottom View



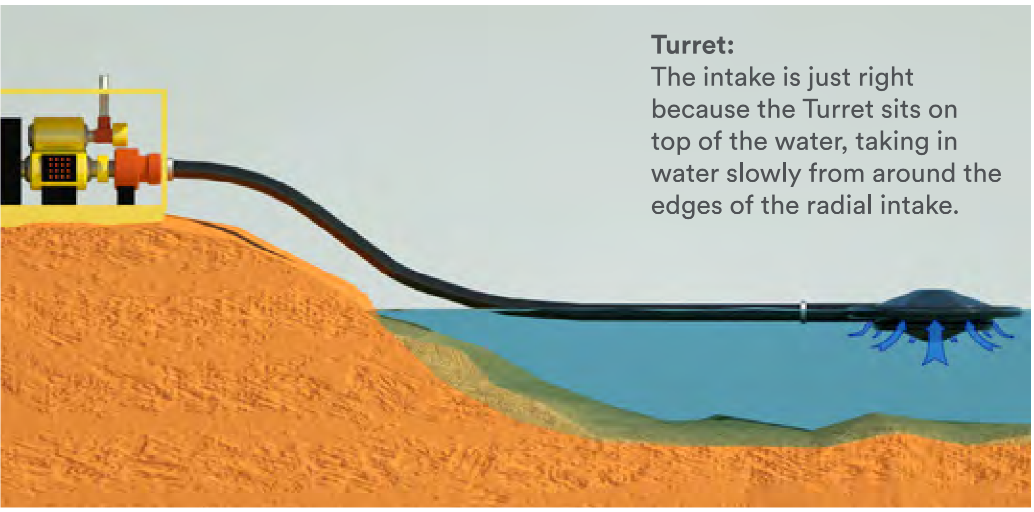
Side View

HOW DOES THE TURRET WORK?



Ordinary Water Intake: The pump intake is too low and taking in slurry.

Ordinary Water Intake: The pump intake is too high causing a vortex.



Turret: The intake is just right because the Turret sits on top of the water, taking in water slowly from around the edges of the radial intake.

THE GOLDEN RULE

The golden rule is that the pump suction must be:

- Sufficiently above the bottom of a dam to avoid slurry, sand or mud being drawn into the pump, and
- Sufficiently submerged to avoid the formation of vortexes on the water surface.

The damage that slurry, silt and debris can do to a pump is well known. The damage a vortex can do is more insidious. A vortex causes air to enter the pump through the suction line, which leads to reduced efficiency and may lead to pump damage. A vortex can also cause cavitation damage to pumps.

THE TURRET ADVANTAGE

The Turret floats on the surface, away from slurry, sand or mud.

The slow speed of water intake around the wide radial intake means slurry, sand and mud are not stirred up. Taking water from around the surface prevents vortexing, which damages pumps and creates downtime.

RUGGEDNESS WITH PLENTY OF PERFORMANCE

Specification	3m Turret
Diameter	3110mm (122 inches)
Height	839mm (33 inches)
Weight	350kg (771 pounds)
Minimum operational depth	400mm (15.7 inches)
Maximum flow	1,000m³ per hr (588 cubic feet per minute)
Minimum flow	10m³ per hr (5.88 cubic feet per minute)
Intake pipe diameter	315mm (12.6 inches) OD or 355mm (14.2 inches) OD
Material	10mm (0.39 inches) high density polyethylene
Colour	Black
Construction method	Polywelded

CRITICAL SUBMERGENCE

There is a relationship between the depth of the submerged suction intake and the intake velocity of the water. The "critical submergence" is the minimum submergence needed to prevent the formation of vortexes.

YOU CAN CALCULATE THE CRITICAL SUBMERGENCE OF YOUR INTAKE WITH FORMULAS...

CRITICAL SUBMERGENCE CALCULATION FORMULAS

Author / Origin	Date	Formula
Hydraulic Institute	1998	$D \cdot (1 + 2.3 \cdot Fr)$
Pumping System Manual		$(V^2/2g) + 0.5$
Prosser	1977	1.5* D
Paterson & Noble	1982	$D \cdot (1 + 2.5 \cdot Fr)$
Hecker	1987	$D \cdot (1 + 2.3 \cdot Fr)$
Knauss	1987	$D \cdot (0.5 + 2 \cdot Fr)$
Flyght	2002	$1.7 \cdot Fr$
Werth & Frizzell	2009	$D \cdot (2.1 + 1.33 \cdot Fr^{0.67})$

...OR YOU CAN USE THE TURRET

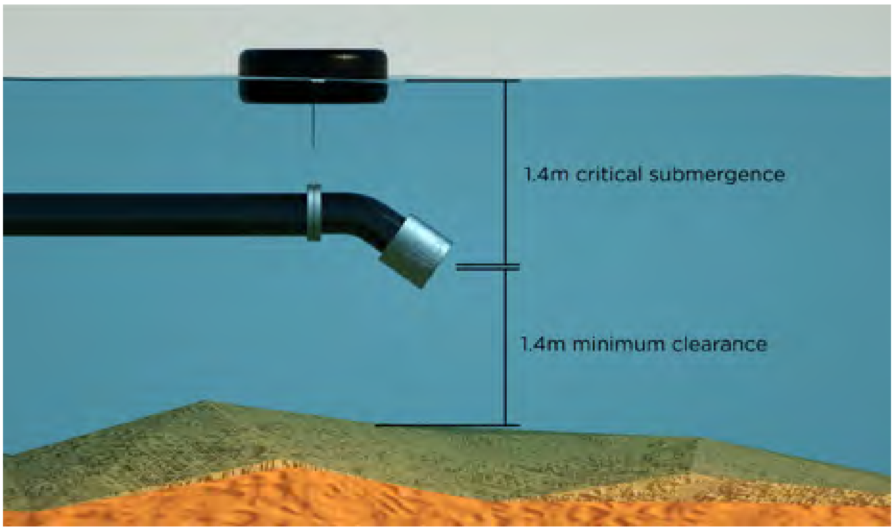
The Turret floats on the surface and automatically keeps the correct critical submergence in water as shallow as 400mm.

THE PRINCIPAL OF FALSIFICATION

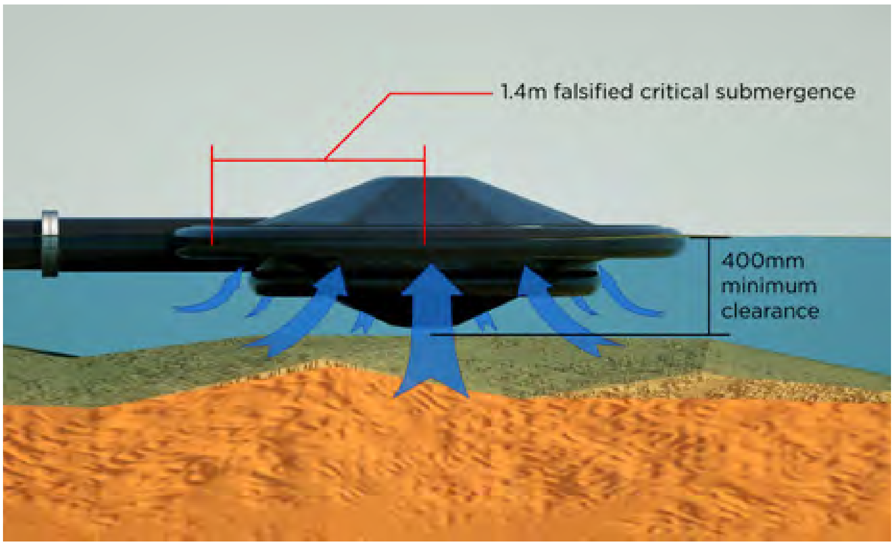
The Turret works on the Principle of Falsification. This principle calculates the critical submergence – and turns it sideways by using a vacuum. Instead of requiring critical submergence *from above* the suction intake, the Turret draws water *from the side* of the intake. The radius of the Turret is equal to the height of the critical submergence.

For example:

- If a pump drawing 1,000m^3/hr of water through a 315mm diameter intake had a critical submergence of 1.4m, this means that the suction intake must be 1.4m below the surface.
- By using the Principle of Falsification, however, the Turret draws the water from 1.4m to the side of the water intake.
- The Turret has falsified the critical submergence by using a vacuum inside the Turret to take water *from the side* of the suction intake, not above it.
- In this example, the pump could draw water from a depth of as shallow as 400mm instead of 1.4m needed for ordinary intakes.

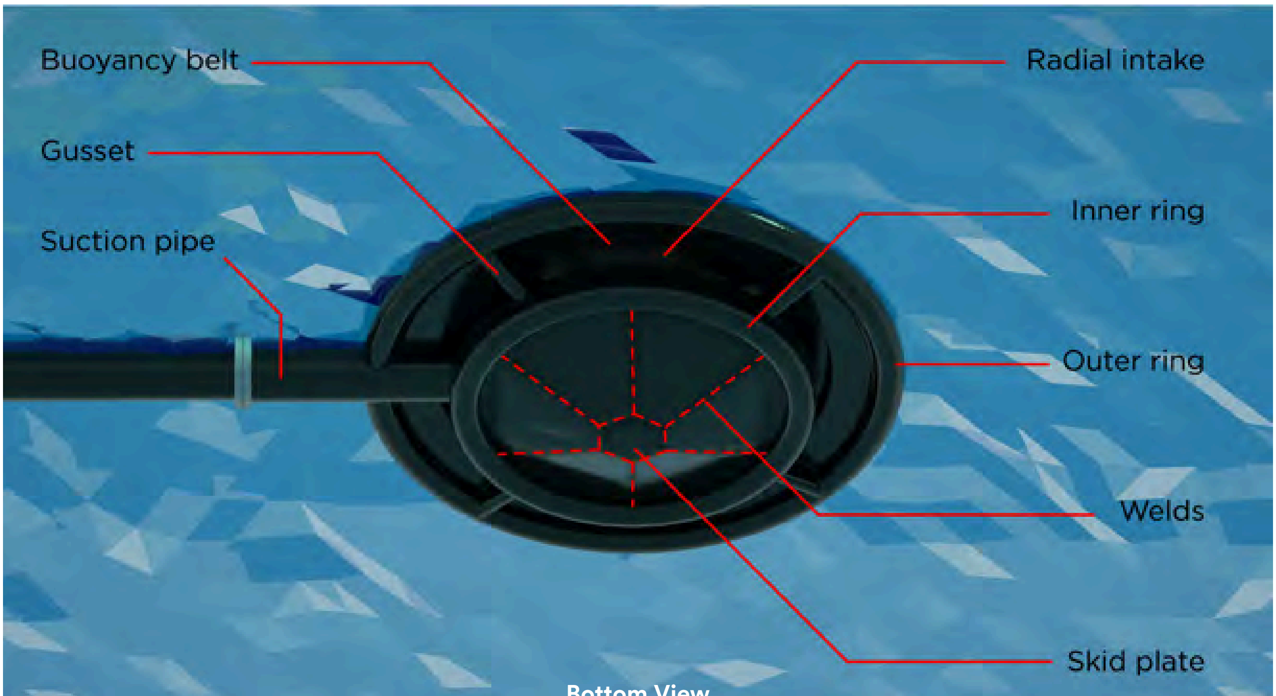


Pump intake in water with example critical submergence of 1.4m

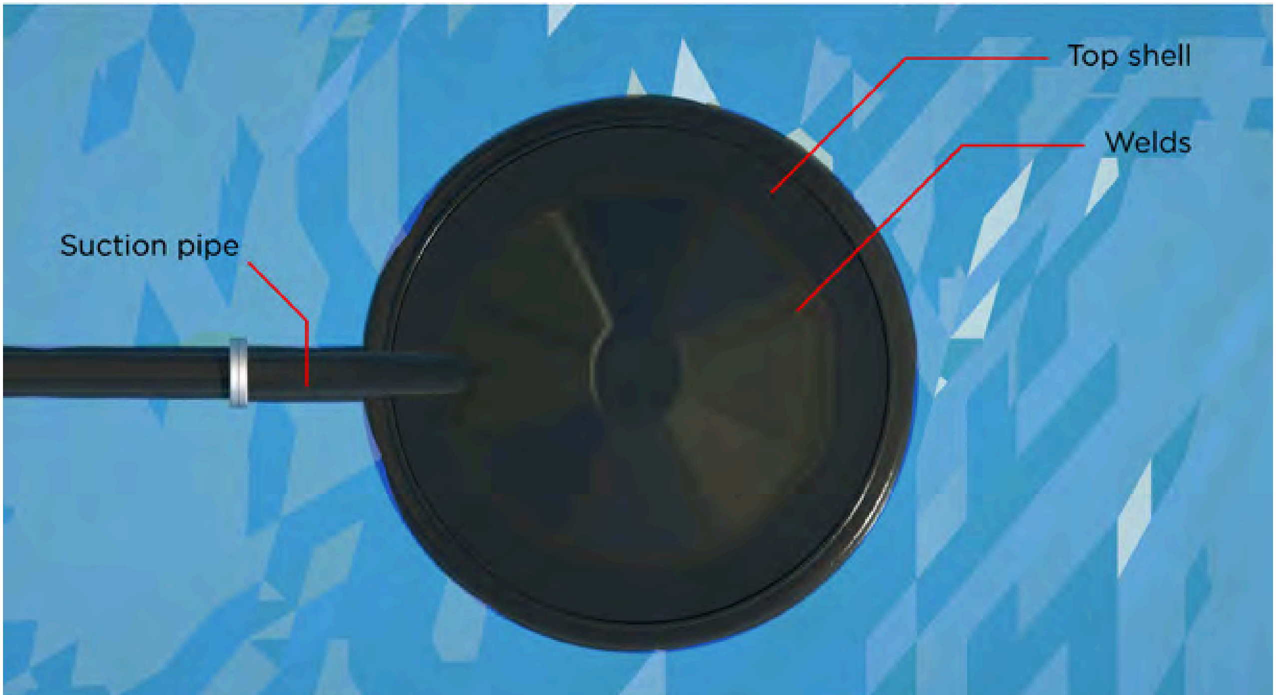


Turret floating on top of water, operating in only 400mm of water.

TURRET
DESIGN FEATURES



Bottom View



Top View

SMART THINKING ALL THE WAY

The Turret gives priority to increased safety, reduced costs and reliability. The design was field tested at Newmont Boddington Gold Mine for more than two years. The Turret gives you a long-life, safe and reliable water intake for your mining pumps with a barrier against vortexing.

Outer Ring

The tough 160mm PN16 polyethylene Outer Ring provides the seal around the water so that air can't get into the Turret. This Outer Ring is filled with air and sealed to provide buoyancy and flotation for the Turret.

Radial Water Intake

The wide diameter of the Radial Water Intake means that even though your pump might be drawing 1,000 cubic metres per hour, the velocity of the water at the outside of the Turret is much, much lower than the velocity at the main intake of the suction line. The benefit of this is that even at depths of only 400mm, a 1,000 cubic metre an hour pump can operate without the danger of vortexing or getting air into your pump.

Buoyancy Belt

Between the Outer Ring and the Inner Ring is the Buoyancy Belt filled with extruded polyurethane foam. The advantage of this is that the Turret will sit level in water at the right depth.

Inner Ring

The 110mm PN16 Inner Ring is also filled with air and sealed. The Inner Ring is poly welded to the Top and Bottom Shells. It has eight polyethylene gussets welded at equal distances around it and onto the Outer Ring. This provides strength and torsional stiffness.

Top and Bottom Shells

The Top Shell and Bottom Shell are made of high density 10mm polyethylene. Each Shell has eight equidistant poly welds that provide ribs of strength through the Shell. Poly welding of the Top Shell to the Bottom Shell and the Inner Ring minimises the risk of failure inherent in mechanical fixings such as nuts and bolts. The round shape of the Bottom Shell makes the Turret easy to slide in or out of the water in muddy or rocky conditions. The round shape also helps the Turret slide easily over a polyethylene tailings dam liner without ripping the liner.

Skid Plate

An additional 10mm polyethylene skid plate is poly welded to the Bottom Shell. This means that dragging the Turret around a mine site simply ablates the Skid Plate and this minimises the risk of damage to the Bottom Shell itself.

Suction Pipe

There is a choice between 355mm or 315mm diameter polyethylene PNIO Suction Pipe. Both are designed to maximise the flow up to 1,000 cubic metres an hour. The 355mm Suction Pipe is used to minimise line loss when the Turret is further out into the water body, whilst the 315mm Suction Pipe is used closer to the shore. The Suction Pipe is poly welded between the Top Shell and the Bottom Shell for structural integrity.

Stub End

Both the 355mm and 315mm polyethylene Stub Ends are butt welded to the Suction Pipe. Special care is taken to grind out the butt weld line on the inside of the Intake Pipe so that there is low-to-zero turbulence as water passes over the weld line.

Backing Ring

A high quality 355mm or 315mm Table E Backing Ring is fitted up against Stub End so that the Turret can be connected to a suction line by bolting up to mining hose or poly pipe.

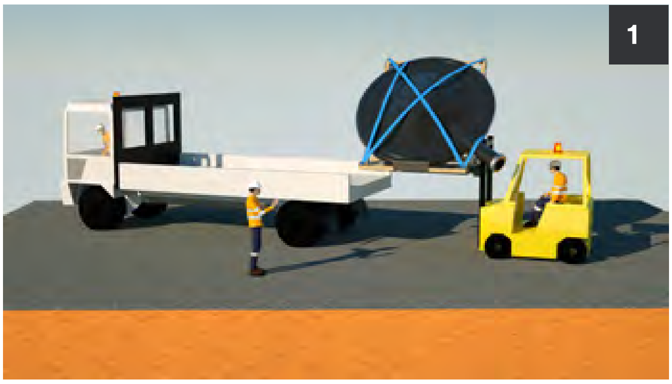
Optional Screen

The Turrent has an optional Filter Screen. The width of the Outer Ring means the water approaching the Radial Water Intake is so slow that foreign objects often just drift past – and those that don't are more often than not caught in the Filter Screen before they have a chance to enter the Turret and the pumping system.

Optional Floating Coupling

The optional snap-on Floating Coupling from RBH makes connecting the Turret to the pump Suction Line a breeze – taking only minutes to snap together.

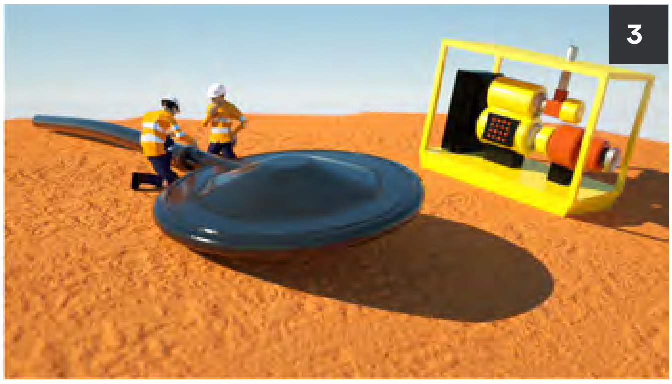
HOW TO USE THE TURRET



1. Take the Turret to site on a light work truck – the biggest Turret is only 350kg.

a) The Turret comes with a carry frame so that it can be strapped into a standard 2.4m wide truck tray at 45-degree angle so it does not protrude over the sides of the truck.

2. Remove the Turret from the vehicle in its frame with a telehandler or forklift.



3. Unbox the Turret, lay it level on the ground and connect it to the suction line.

a) If using a flood prime system, fit a non-return valve between the suction line and the Turret.

b) If using a vacuum system, a non-return valve is not required.

4. Fix floats to your suction pipe if necessary.

a) Heavy mining hose or heavy wall polyethylene (PN11 or above) needs a half float or a full float to keep the suction pipe level with the top of the water.

b) Lighter polyethylene (PN10 and below) usually doesn't need a float.

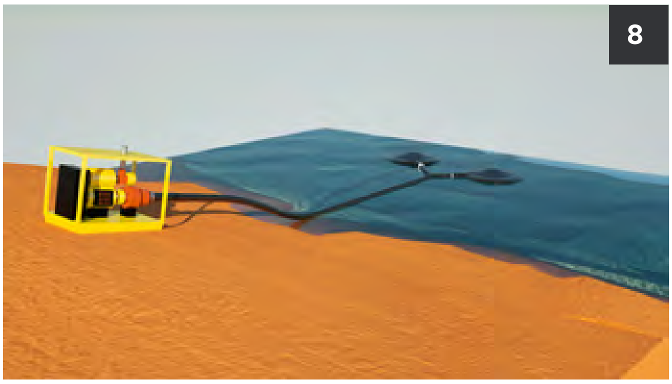
Combining patented smart design, tough polyethylene construction and zero moving parts, the Turret provides a safe and cost-effective water intake solution for the demands of tailings dams, decant ponds and raw water dams. The Turret is easily moveable and can operate in as little as 400mm of water. All this means you get uninterrupted production, lower costs and higher safety.

5. Slide the Turret and the suction pipe into the water keeping them both level.

6. Connect the suction pipe to the pump. Wait five minutes for the bottom of the Turret to fill with water and allow the Outer Ring of the Turret to touch the water level.

7. Prime the pump.

a) Once primed, there will be slight air turbulence coming through pump for two to three minutes which is the last of the air in the Turret. Then water will flow normally.



8. To increase water intake more than 1,000m^3 per hour, put a Y piece or Christmas Tree manifold in the suction line connect more Turrets. This is dependent on pump capacity and suction size.

HOW THE TURRET DRAMATICALLY IMPROVES TAILINGS DAM EFFICIENCIES

In this article by Dr Ross De Kretser, formerly Rio Tinto Technology and Innovation's Principal Advisor for Water, Waste and Tailings, you can read how the Turret can:

- Significantly reduce water loss through evaporation.
- Dramatically:
  - increase the drying of tailings,
  - improve tailings densities, and
  - reduce the frequency of embankment raises.
- Reduce the risk of seepage-related tailings embankment stability risks.

POTENTIAL OPERATING BENEFITS OF THE TURRET IN A TAILINGS STORAGE FACILITY

By Dr Ross De Kretser, B. Eng (Chem); Ph.D.

Former Principal Advisor, Water, Waste and Tailings with Rio Tinto Technology and Innovation Pty Ltd.

Operating a tailings storage facility (TSF) with as small a decant pond as is practically possible can deliver the following benefits:

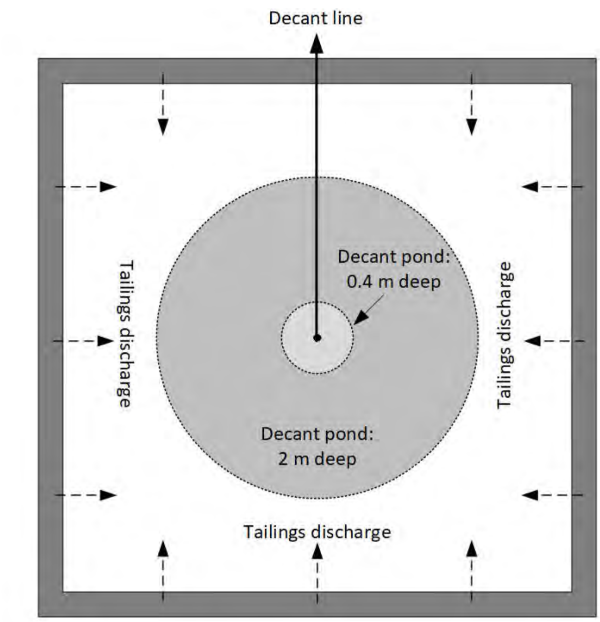
- **Water efficiency:** Evaporative losses from the decant pond are directly proportional to its area. A reduction in decant pond size will directly reduce water losses from it, positively impacting site fresh water demand.
- **Tailings management costs:** A smaller decant pond exposes a greater proportion of the tailings to evaporative drying and gravity drainage effects. This promotes improved tailings densities, efficient storage utilisation and a reduced frequency of embankment raises.
- **Tailings management risk:** A greater buffer can be maintained between the decant pond and embankments, reducing seepage-related embankment stability risks. Alternatively, design constraints (e.g. TSF size, embankment construction method) relating to seepage risk can be positively impacted, with associated cost reduction implications.

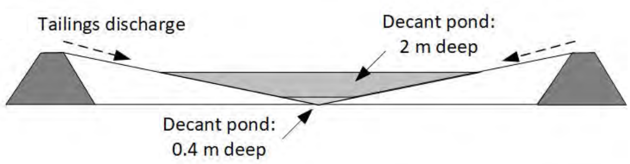
Through its ability to draw water from a much shallower depth than ordinary decant water intakes, the Turret can allow operation of a TSF with dramatically reduced decant pond sizes resulting in the potential to realise all of the above operational benefits. Importantly, these benefits do not necessarily require the complete reconfiguration of a decant system design (e.g. replacement of a floating pontoon with a shore-based system), rather only the replacement of a traditional pump intake with a Turret to allow shallow decant pond operation, as is illustrated in the following conceptual scenario.

1 Calculations and numbers quoted are conceptual and indicative. They are based on simplistic calculations that, for instance, do not account for all aspects of the water balance around a TSF. Actual benefits will be highly site-specific, and other factors (e.g. suspended fine solids) may also impact the practical minimum operating depth of the TSF.

COMPARISON OF A STANDARD 2M DEEP WATER INTAKE COMPARED TO A TURRET'S 400MM DEEP RADIAL WATER INTAKE

The benefits of the Turret can be demonstrated for a conceptual square, 500m x 500m TSF operating with perimeter discharge designed to maintain a central decant pond (see illustration).





Schematic of conceptual perimeter discharge TSF operating with conventional 2m deep and Turret, 0.4m deep decant ponds (not to scale).

The conceptual pond will therefore be circular and decant removal is from a central, deepest point. Tailings beach angles vary, but a beach angle of 1.5% is considered reasonably common, and used in this example (i.e. for every 100m of tailings beach horizontally from the discharge point, the beach elevation decreases by 1.5m).

Using this information, the required radius and resultant area of decant pond and exposed tailings beach area were determined for two scenarios:

- a standard decant intake requiring a minimum 2m pond depth, and
- a Turret requiring only 0.4m minimum pond depth.

The comparison between the two scenarios is:

1. Standard intake, 2m pond depth:
   a. Required minimum pond radius around the decant intake: 133m
   b. Resultant decant pond surface area: ~70,500m^2
   c. Exposed beach area: ~179,500m^2 or 72% of total TSF area.
2. Turret intake, 0.4m pond depth:
   a. Required minimum pond radius around the decant station intake: 27m
   b. Decant pond surface area: ~2,300m^2
   c. Exposed beach area: ~247,700m^2 or 99% of total TSF area.

For this conceptual scenario, the use of Turret allows the potential for[1]:

1. 96% reduction in the decant pond area, which also reduces evaporative losses from the pond itself by 96%.
2. At an example daily mean evaporation rate of 10mm per day, this equates to a reduction in evaporative losses of 247 megalitres per year from the decant pond.
3. 38% increase in exposed tailings beach area, enhancing tailings drying with potential improvement in deposited density resulting in less frequent embankment raises and lower associated costs.

Whilst indicative in nature, and specific to the square TSF configuration depicted, the conceptual scenario presented illustrates the potential magnitude of the benefit delivered by the Turret to an operation from environmental, reputational, risk management and economic perspectives. Similar benefits would also be evident in deployment of the Turret into other TSF configurations.

Ross de Kretser, B. Eng (Chem), Ph.D., director, Acclarium Tailings and Solid Liquid Separation Consulting, formerly Principal Advisor, Water, Waste and Tailings Rio Tinto Technology and Innovation Pty Limited

TOUGH. RELIABLE. SMART. SAFE. SCALABLE.

THE BENEFITS OF THE TURRET

	Decant Barge, Decant Tower etc.	Turret
Minimum pond radius	133m	27m
Decant pond surface area	~70,500m²	~2,300m²
Reduction in pond surface area	0%	96%
Exposed beach area	~179,500m²	~247,700m²
Exposed beach percentage	72% of total TSF area	99% of total TSF area
Increase in exposed beach area	0%	38%
Yearly evaporation saving	0 megalitres pa	247 megalitres pa

FEATURES, ADVANTAGES AND BENEFITS OF THE TURRET

Tailings Dams, Decant Ponds and Raw Water Dams

RECLAIMING WATER FROM SHALLOW DEPTHS

- Can draw water down lower than other conventional systems, thus returning more of your reclaimed water to processing.
- Can keep production going when other systems can't operate at low levels.
- Can operate down to 400mm.

SAFETY ISSUES

- The Turret can deal with large increments in tide and water level before it has to be moved, cutting down human involvement in operations.
- Moving the Turret in and out is easy because it slides across the ground and floats on the surface of the water.
- There is minimal interaction of humans with heavy equipment to install or move Turret.

SIMPLICITY OF TASK

- The work can be carried out on the roadway, tailings beach or side of the dam and doesn't have to be done close to the water.
- Installation is easy: take the Turret off the work vehicle with a telehandler or forklift lay it level on the ground and connect it to the suction line - minimal need for heavy equipment.
- Low-to-zero risk of tearing poly-lined tailings dams because of the dish shape design.

REPAIRS TO TURRET

- Low-to-zero repairs because there are no moving parts.
- The Turret is long-lasting because it is made from polyethylene and is UV resistant.
- Resists corrosion in tailings dams because it is made of polyethylene.

PRODUCTION

- Can extract greater volume of water because it draws water down to a lower depth.
- Draws water from just beneath the surface which has the least number of suspended particles, meaning fewer solids go into returned water.
- Less reliance on raw water because more reclaimed water from tailings dams is available.

COST

- Low-to-zero maintenance to Turret because there are no moving parts.
- Less damage to pumps because Turret draws from just beneath the surface where there are fewer contaminants and solids, thus fewer solids and corrosive chemicals in the pumps.
- Design creates a barrier to vortexing and therefore cavitation damage from vortexing when used as directed.

THE TURRET ADVANTAGE

The Turret floats on the surface, away from slurry, sand or mud.

The slow speed of water intake around the wide radial intake means slurry, sand and mud are not stirred up. Taking water from around the surface prevents vortexes forming, damaging pumps and creating downtime.

SHALLOW WATER? NO PROBLEM.

Are you ready to take charge? Then order your Turrets today.

ENQUIRIES AND ORDERS:

RBH Engineering, 39 Farmers Avenue,
Boddington, Western Australia 6390
T: +61 8 9883 8206
E: robh@rbhmechanical.com.au

RBH ENGINEERING

APPENDIX J

Memorandum Ref PE22-00888 Rustlers Roost Gold Project – Tailings Geochemistry Testing

Knight Piésold CONSULTING

Knight Piésold CONSULTING

MEMORANDUM

To:	Primary Gold Ltd	**Date:**	16 September 2022
Attn:	John Zimmerman	**Our Ref:**	PE22-00888
		KP File Ref.:	PE801-00102/06-A djtm M22002
cc:	Charles Hastie	**From:**	Dave Morgan

RE: RUSTLERS ROOST GOLD PROJECT – TAILINGS GEOCHEMISTRY SUMMARY

Knight Piésold (KP) was requested by Primary Gold Ltd (Primary Gold) to provide a summary of the tailings testing completed to date, the implications for tailings management and recommendations for further work.

1. GENERAL

A preliminary assessment of the tailings geochemistry was conducted by CDM Smith (Ref. 1). 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 geochemical testing was undertaken by Primary Gold in 2022 which included multi-element analysis of the tailings solids, water quality analysis of the supernatant and acid base accounting.

2. PREVIOUS STUDIES

2.1 ACID BASE ACCOUNTING

A previous assessment was conducted by CDM Smith initially in 2021 and updated in 2022 to include the results of the kinetic testing programme (Ref. 1). The scope of work comprised acid base accounting (ABA) and distilled water extract (DWE) of the tailing solids.

The results of the study recorded a high total sulfur content of 1.76%, of which the vast majority was indicated to be present as sulfide. Although not reported by CDM Smith, the sulfide content can be used to determine the maximum potential acidity (MPA). KP has calculated the MPA to be 46 kg H2SO4/t, which is high.

Carbon speciation testing indicated a total carbon content of 0.92%, of which over half was present as organic carbon. The acid neutralising capacity (ANC) of the sample was determined as 27 kg H2SO4/t which is high, albeit 40% less than the MPA.

Although not reported by CDM Smith, KP prefers to use the carbon speciation results to estimate the carbonate content and associated ANC which may be available from carbonate minerals. This can be compared to the measured ANC value to estimate the contribution of ANC from carbonates and other non-carbonate minerals. Samples where the majority of ANC is derived from non-carbonate minerals tend to be less reactive and may only be available to buffer acid under low pH conditions. The estimated ANC available from carbonates was estimated as 33 kg H2SO4/t, which is similar to the measured ANC and indicates that the ANC is essentially entirely derived from carbonate minerals and should be readily available to buffer acid.

Although not reported by CDM Smith, the MPA and ANC are typically used to determine the NAPP and ANC/MPA ratio. The tailings sample has a positive NAPP of 19 kg H2SO4/t and ANC/MPA ratio of 0.59, indicating excess acid forming potential.

2.2 NET ACID GENERATION

A net acid generation (NAG) test was conducted which indicated that the sample produced 30 kg H_2SO_4/t (i.e. 30 kg of sulfuric acid per tonne of oxidised tailings) with a final pH of 2.4.

2.3 ACID FORMING POTENTIAL

On the basis of this test work, the tailings are classified as Potentially Acid Forming (PAF). Given the circum-neutral paste pH and ANC of 27 kg H_2SO_4/t, it is likely that the tailings have a reasonable lag time prior to acid generation, however, this should be confirmed initially by kinetic NAG testing followed by column leach or humidity cell testing to determine whether operational controls are required to manage the pH in the TSF.

2.4 MULTI-ELEMENT RESULTS

No multi-element analysis of the tailings solids was conducted during the previous test work. Therefore, multi-element analysis of the tailings solids has been incorporated into the updated testing suite to assess element enrichments and potential implications for tailings management.

2.5 SUPERNATANT WATER QUALITY

Similarly, no supernatant testing was conducted in the previous study. Therefore, supernatant water quality analysis has been incorporated into the updated testing suite to assess element enrichments and potential implications for tailings management.

3. CURRENT GEOCHEMICAL CHARACTERISATION

Acid Base Accounting was conducted in September 2022 on a metallurgical sample of tailings (HPGR Comp-Leach Residue JR322) by ALS Metallurgy. The laboratory testing results are provided in Appendix A.

3.1 ACID BASE ACCOUNTING

The tailings sample recorded a high total sulfur content of 0.96% with a calculated Maximum Potential Acidity (MPA) of 29.3 kg H_2SO_4/t, which is high. No sulfur speciation was conducted so, based on previous testing, it was conservatively assumed that the sulfur is present as sulfide.

The acid neutralising capacity (ANC) of the sample was determined as 24 kg H_2SO_4/t which is high. The resulting Net Acid Producing Potential of the samples was calculated as 5.28 kg H_2SO_4/t which indicate excess acidity over neutralisation potential.

3.2 NET ACID GENERATION

A net acid generation (NAG) test was conducted which indicated that the sample produced 2 kg H_2SO_4/t (i.e. 2 kg of sulfuric acid per tonne of oxidised tailings) with a final pH of 4.5.

3.3 ACID FORMING POTENTIAL

On the basis of this test work, the tailings are classified as Potentially Acid Forming – Low Content (PAF-LC) with the acid base accounting results provided in Table 3.1:

Table 3.1: Acid Base Accounting Results

Sample	Total S	ANC	NAG (pH 4.5)	NAG (pH 7)	NAG pH	MPA	NAPP	AFP
	%	kg/t H_2SO_4	kg/t H_2SO_4	kg/t H_2SO_4		kg/t H_2SO_4	kg/t H_2SO_4	
JR7322	0.96	24	<2	2	4.5	29.3	5.3	PAF-LC

3.4 MULTI-ELEMENT RESULTS

3.4.1 Element Enrichments

Whole rock multi-element analysis of the tailings was conducted to assess element enrichments. The analysis results were compared to average crustal abundances (ACAs) to calculate the geochemical abundance indices (GAIs). The GAI quantifies an assay result for a particular element in terms of ACA. The assay results along with the ACA and GAIs are provided in Table 3.3.

The results of the Multi element analysis indicate that the 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.

3.4.2 Preliminary Soil Quality Screening

The results of the multi-element analysis have also been compared to a set of soil quality screening guidelines for human health, ecology and intervention values for site contamination. 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.

Summarised assay results compared to the assessment criteria are presented in tables 3.4 to 3.6 with the implications for tailings management provided in Section 4.

Table 3.3: Element Enrichment Results

Element	Unit	Assay Results	ACA	GAI
Ag	ppm	<2	0.07	4
Al	ppm	70400	82000	0
As	ppm	420	1.5	6
Ba	ppm	0.12	500	0
Bi	ppm	0.13	0.048	6
Ca	ppm	440	41000	0
Cd	ppm	<5	0.11	4
Co	ppm	<10	20	0
Cr	ppm	6850	100	1
Cu	ppm	<5	50	1
Fe	ppm	82200	41000	0
K	ppm	27000	21000	0
Mg	ppm	17200	23000	0
Mn	ppm	8.22	950	0
Mo	ppm	2.70	1.5	4
Na	ppm	1.72	23000	0
Ni	ppm	2600	80	0
P	ppm	40	1000	0
Pb	ppm	3140	14	2
S	ppm	9600	260	4
Sr	ppm	1300	370	0
V	ppm	85	160	0
Zn	ppm	0.96	75	0

Legend:

Not Enriched	0 - 1
Slightly Enriched	2
Significantly Enriched	3 - 4
Highly Enriched	5 - 6

Table 3.4: Assay Results and Soil Quality Screening – Human Health Guidelines

Element	Human Health-Based Investigation Levels [1] (ppm)	Rustlers Roost Tailings (ppm)
Ag	N/G	2
As	300	**420**
Ba	N/G	440
Cd[2]	90	5
Co	300	25
Cr	N/G	340
Cu	17000	170
Mn	19000	2600
Mo	N/G	40
Ni	1200	145
P	N/G	1300
Pb	600	85
S	N/G	0.96
V	N/G	60
Zn	30000	100

Notes:

Values in red bold indicate where a guideline value has been exceeded.

[1] National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1). Health Investigation Levels for Soil Contaminants, Generic Land Use HIL C – Recreational.

[2]Detection limits higher than exceedance levels.

Table 3.5: Assay Results and Soil Quality Screening – Ecological Soil Guidelines

Element	Ecological Soil Screening Levels [1,2] (ppm)	Rustlers Roost Tailings (ppm)
Ag	14	2
As	46	**420**
Ba	2000	440
Cd[3]	0.36	**5**
Co	230	25
Cr	34	**340**
Cu	49	**170**
Mn	4000	2600
Mo	N/G	40
Ni	130	**145**
P	2000	1300
Pb	56	**85**
S	600	0.96
V	280	60
Zn	79	**100**

Notes:

Values in red bold indicate where a guideline value has been exceeded.

[1] United States Environmental Protection Agency (U.S. EPA) Ecological Soil Screening Levels (Eco-SSLs), http://www.epa.gov/ecotox/ecossl/ (mammalian wildlife).

[2] Ecological guideline values for phosphorous, sulfur and sulfate are based on National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999). These former Australian ecological investigation levels for urban areas have been included for reference purposes in the absence of other more applicable ecological assessment criteria.

[3] Detection limits higher than exceedance levels.

Table 3.6: Assay Results and Soil Quality Screening – Soil Intervention Values

Element	Soil Remediation Intervention Values [1] (ppm)	Rustlers Roost Tailings (ppm)
Ag	15	2
As	55	**420**
Ba	625	440
Cd[2]	12	5
Co	240	25
Cr	380	340
Cu	190	170
Mn	N/G	2600
Mo	200	40
Ni	210	145
P	N/G	1300
Pb	530	85
S	N/G	0.96
V	250	60
Zn	720	100

Notes:

Values in red bold indicate where a guideline value has been exceeded.

[1]Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM) 2000. Circular on Target Values and Intervention Values for Soil Remediation, Reference DBO/1999226863. Soil remediation intervention values. In the absence of intervention values for beryllium, selenium, silver, tin and vanadium, “indicative levels for serious soil contamination” have been applied.

[2]Detection limits higher than exceedance levels.

3.5 SUPERNATANT WATER QUALITY

The supernatant water quality was assessed to examine the solubility of various elements during processing. The results of the testing give an indication of the water quality at the point of tailings discharge.

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. The Assay results and reference guidelines are provided in Table 3.7a and 3.7b.

The test work results unfortunately employed high detection limits which makes true assessment of the quality of the supernatant challenging. For Silver, Aluminium, Arsenic, Cadmium, Chromium, Iron, Manganese, Molybdenum, Nickel, Lead, Antimony and Selenium the detection limit was greater than at least one of the guidelines.

Mercury, copper, WAD cyanide and pH were the only parameters (excluding those with high testing limits), that exceeded the reference release guidelines.

Copper, Sodium, Mercury and pH were the only parameters (excluding those with high testing limits), that exceeded the drinking guidelines.

It is understood that prior to discharge the tailings will be subjected to cyanide destruction, which has not been conducted on the sample, and therefore it would be expected that both the cyanide concentration and also some metals would be lower in the actual discharge, however this will need to be assessed when a detoxified sample is available.

Table 3.7a: Supernatant Results Compared to Reference Release Guidelines

Parameter	Units	Release Water Guidelines	Supernatant Results
Silver	mg/l	0.5	<0.2
Aluminium	mg/l	5	<2.0
Arsenic	mg/l	0.1	<1.0
Barium	mg/l	N/G	<0.5
Beryllium	mg/l	N/G	<0.5
Bismuth	mg/l	N/G	<1.0
Calcium	mg/l	1000	15
Cadmium	mg/l	0.01	<0.5
Cobalt	mg/l	1	<0.5
Chromium	mg/l	1	<1.0
Copper	mg/l	0.3	**0.8**
Iron	mg/l	2	<1.0
Mercury	mg/l	0.002	**0.01**
Potassium	mg/l	N/G	30
Lithium	mg/l	2.5	<0.5
Magnesium	mg/l	2000	<2.0
Manganese	mg/l	N/G	<0.5
Molybdenum	mg/l	0.15	<0.5
Sodium	mg/l	N/G	238
Nickel	mg/l	0.5	<0.5
Phosphorus	mg/l	N/G	<10
Lead	mg/l	0.1	<0.5
Sulfate	mg/l	1000	40
Antimony	mg/l	N/G	<0.5
Selenium	mg/l	0.02	<0.5
Tin	mg/l	N/G	<0.02
Strontium	mg/l	N/G	<0.2
Thorium	mg/l	N/G	<0.005
Titanium	mg/l	N/G	<1.0
Uranium	mg/l	N/G	<0.005
Vanadium	mg/l	N/G	<0.2
Yttrium	mg/l	N/G	<0.1
Zinc	mg/l	0.5	0.4
Zirconium	mg/l	N/G	<0.5
pH	-	6 to 9	**9.94**
NaCN	%	N/G	0.005
WAD CN	mg/l	0.5	**27.85**

Notes:
N/G = No guideline.
Values in red bold indicate where the assay value exceeds the guideline value.
Values in shaded yellow indicated detection limit above guideline value therefore comparison not possible

Table 3.7b: Supernatant Results Compared to Drinking Water Guidelines

Parameter	Units	Drinking Water Guidelines	Supernatant Results
Silver	mg/l	0.1	<0.2
Aluminium	mg/l	0.2	<2.0
Arsenic	mg/l	0.01	<1.0
Barium	mg/l	0.7	<0.5
Beryllium	mg/l	N/G	<0.5
Bismuth	mg/l	N/G	<1.0
Calcium	mg/l	N/G	15
Cadmium	mg/l	0.003	<0.5
Cobalt	mg/l	N/G	<0.5
Chromium	mg/l	0.05	<1.0
Copper	mg/l	2	0.8
Iron	mg/l	0.3	<1.0
Mercury	mg/l	0.006	**0.01**
Potassium	mg/l	N/G	30
Lithium	mg/l	N/G	<0.5
Magnesium	mg/l	N/G	<2.0
Manganese	mg/l	0.1	<0.5
Molybdenum	mg/l	0.05	<0.5
Sodium	mg/l	180	**238**
Nickel	mg/l	0.07	<0.5
Phosphorus	mg/l	N/G	<10
Lead	mg/l	0.01	<0.5
Sulfate	mg/l	250	40
Antimony	mg/l	0.02	<0.5
Selenium	mg/l	0.04	<0.5
Tin	mg/l	N/G	<0.02
Strontium	mg/l	N/G	<0.2
Thorium	mg/l	N/G	<0.005
Titanium	mg/l	N/G	<1.0
Uranium	mg/l	0.03	<0.005
Vanadium	mg/l	N/G	<0.2
Yttrium	mg/l	N/G	<0.1
Zinc	mg/l	3	0.4
Zirconium	mg/l	N/G	<0.5
pH	-	6.5 to 8.5	**9.94**
NaCN	%	N/G	0.005
WAD CN	mg/l	N/G	27.85

4. IMPLICATIONS FOR TAILINGS MANAGEMENT

4.1 ACID FORMING POTENTIAL

The two tailings samples tested (CMD Smith and current) 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.

4.2 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 (as discussed in Section 4.1). 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.

4.3 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.

We trust the information provided is sufficient at this stage, however, please contact us should you require any additional detail.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

ANDREW MOLLAN
Project Engineer

DAVID MORGAN
Managing Director

REFERENCES

1. *CDM Smith, "Appendix D – Materials Characterisation Study", July 2022.*

APPENDIX A

Laboratory Testing Results

JOB	A23352
PROJECT:	Rusters Roost
CLIENT:	Primary Gold Ltd
DATE:	Sep-22

Metallurgy

ACID MINE DRAINAGE PREDICTION ANALYSIS

SAMPLE ID	Total Sulphur (%)	ANC (kg/t H_2SO_4)	NAG (pH 4.5) (kg/t H_2SO_4)	NAG (pH 7.0) (kg/t H_2SO_4)	TAPP (kg/t H_2SO_4)	NAPP (kg/t H_2SO_4)	pH	Conductivity (ms/cm)
HPGR COMP -LEACH RESIDUE JR7322 (p80 106um)	0.96	24	<2	2.00	29.30	5.28	4.5	0.495

a) ANC- Acid Neutralizing Capacity. A measurement of the capacity (if any) of the ore to neutralize sulphuric acid. Units are in kg H_2SO_4 per tonne of ore.

b) NAG- Net Acid Generation. A measurement of the actual net acid produced by the ore under oxidizing conditions. The ore is oxidized by the addition of Hydrogen Peroxide with heat. ANC figure would have reduced the acid produced hence the "Net"AG Units as above.

c) TAPP- Total Acid Production Potential. A calculated figure based on the total sulphur assay. (Some laboratories use only the sulphide sulphur figure). Units as above.

d) NAPP- Net Acid Production Potential. Sort of a worst case scenario of TAPP – ANC. Units as above.

PROJECT	A23352
CLIENT:	RUSTLERS ROOST GOLD PROJECT
TEST DESCRIPTION:	TAILINGS SOLUTION ASSAY
DATE:	SEP 2022

ANALYTE	JR7322 (36 HR Leach Filtrate)
Ag(mg/l)	<0.2
Al(mg/l)	<2.0
As(mg/l)	<1.0
Ba(mg/l)	<0.5
Be(mg/l)	<0.5
Bi(mg/l)	<1.0
Ca(mg/l)	15.0
Cd(mg/l)	<0.5
Co(mg/l)	<0.5
Cr(mg/l)	<1.0
Cu(mg/l)	0.8
Fe(mg/l)	<1.0
Hg(mg/l)	0.010
K(mg/l)	30
Li(mg/l)	<0.5
Mg(mg/l)	<2.0
Mn(mg/l)	<0.5
Mo(mg/l)	<0.5
Na(mg/l)	238
Ni(mg/l)	<0.5
P(mg/l)	<10
Pb(mg/l)	<0.5
S(mg/l)	40
Sb(mg/l)	<0.5
Se(mg/l)	<0.5
Sn(mg/l)	<0.02
Sr(mg/l)	<0.2
Th(mg/l)	<0.005
Ti(mg/l)	<1.0
U(mg/l)	<0.005
V(mg/l)	<0.2
Y(mg/l)	<0.1
Zn(mg/l)	0.4
Zr(mg/l)	<0.5
Ph	9.94
NaCN(%)	0.005
WAD CN (mg/L)	27.85

Data is in mg/l unless otherwise stated

*Data is in mg/l CaCO3

** Data is in mS/cm

PROJECT	A23352
CLIENT:	RUSTLERS ROOST GOLD PROJECT
TEST DESCRIPTION:	TAILINGS SOLIDS ASSAY
DATE:	SEP 2022

ANALYTE	JR7322 (36 HR Leach Solids)
Ag(ppm)	<2
Al(%)	7.04
As(ppm)	420
Au(ppm)	0.12
Au(ppm)_rpt1	0.13
Ba(ppm)	440
Be(ppm)	<5
Bi(ppm)	<10
Ca(ppm)	6850
Cd(ppm)	<5
Co(ppm)	25
Cr(ppm)	340
Cu(ppm)	170
Fe(%)	8.22
K(%)	2.70
Mg(%)	1.72
Mn(ppm)	2600
Mo(ppm)	40
Na(ppm)	3140
Ni(ppm)	145
P(ppm)	1300
Pb(ppm)	85
S(%)	0.96
Sr(ppm)	32
V(ppm)	60
Zn(ppm)	100