Capricorn Copper Pty Ltd

TEP Item 16 and 17 Rehabilitation Strategy

Old TSF and HLEP#2

March 2018

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1. Introduction

1.1 Background and context

In October 2015, Capricorn Copper Holdings Pty Ltd (CCPL) acquired 100% of the shares from Aditya Birla Pty Ltd. Following the acquisition, CCPL undertook a series of technical studies, which developed solutions to address past operating and environmental management challenges. The results of the studies improved the geological models and resource estimates for the known ore bodies at the Capricorn Copper Mine (CCM) and outlined the optimal restart strategy for the mine.

The business case to recommence operations at CCM reflects a combination of programs including the implementation of improvements in environmental practices to reduce risks as a basis for sustainable operations.

CCPL has recently engaged GHD to undertake a number of priority programs to facilitate mine restart. Programs undertaken to date include:

- Transitional Environmental Program (TEP) amendment application to defer earthworks for Old (Mammoth) TSF (Old TSF) and HLEP#2 (Figure 1) final landform and cover.
- Environmental Authority (EA) amendment application for change of methodology and recommencement of underground mining of the Esperanza South (ESS) Ore Body, deposition of tailings into Esperanza Pit, and paste fill plant operation to facilitate placements of tailings underground.
- Review and update of Esperanza Pit design storage allowance (DSA).
- Long-term concept tailings management plan.

As part of the TEP amendment application, CCPL committed to undertaking a program of works to review rehabilitations strategies for the Old TSF and HLEP#2 and implement the most suitable strategy by 1 March 2019.

CCPL have subsequently requested that GHD undertake a review of the technical feasibility of a range of rehabilitation strategies on which CCPL can make an informed decision and progress through to implementation.

1.2 Purpose of this report

The purpose of this report is to document the findings of work completed to date inclusive of the following:

- Old TSF and HLEP#2 geochemical and geotechnical investigation results.
- Separated tailings [i.e. Low Sulfur tailings (LST) and High Sulfur tailings (HST)] geochemical and geotechnical results.
- Alternative rehabilitation / cover strategies considered for Old TSF and HLEP#2.
- Seepage analysis (quality and quantity) assessments for Old TSF and HLEP#2.

1.3 Scope and limitations

The scope of works completed for this assessment is summarised as follows:

1. Undertake the following site and alternative strategy(ies) investigative works concurrently:
   - (a) Site investigations for Old TSF and HLEP#2. This will confirm if “do nothing” approach would be a reasonable option. This should include suitable program of works to inform removal and / or capping options if “do nothing” is not suitable and to establish baseline from which the efficacy of any rehabilitation option can be measured.
   - (b) Investigate alternative management strategy(ies) including LST / HST separation (geochemical and geotechnical analysis, pump / pipe requirements, etc.), artificial liners, removal and placement underground.
2. Undertake feasibility assessment of options accounting for costs to execute and environmental performance.

This report does not include detailed engineered design and project implementation plans for selected rehabilitation strategy. This will be developed on confirmation by CCM on the selected rehabilitation options and on receiving outstanding geotechnical analysis results which were not available at time of issue of this report and are expected to be received in early May 2018.

1.4 Assumptions

The following assumptions were made in the development of this report:

- Environmental values as established through readily available desktop information are correct and reflect current site conditions.
- Appropriate quality assurance and quality control processes were adopted by third parties with respect to data integrity of rely upon information during sample collection, transport, and analysis, and subsequent reporting.

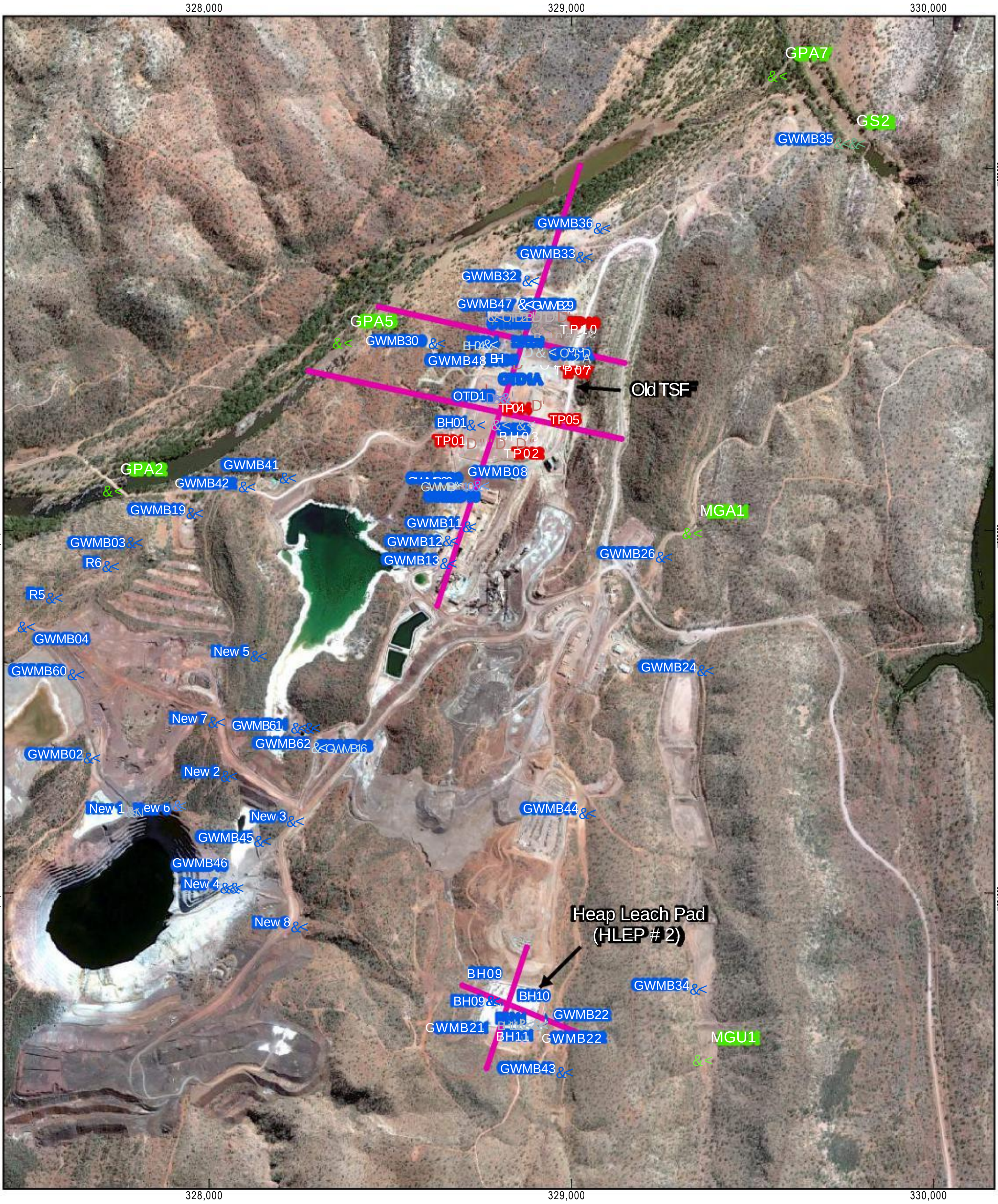
Other assumptions have been made in relation to specific work items. These are detailed within the relevant sections of this report.

This report: has been prepared by GHD for Capricorn Copper Pty Ltd and may only be used and relied on by Capricorn Copper Pty Ltd for the purpose agreed between GHD and the Capricorn Copper Pty Ltd as set out in section 1.2 of this report. GHD otherwise disclaims responsibility to any person other than Capricorn Copper Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.4 and other relevant sections *of this report). GHD disclaims liability arising from any of the assumptions being incorrect.*

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

GHD has prepared the preliminary cost estimates set out in section 5.2.1 of this report ("Cost Estimate) " using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD as listed in section 5.2.1. The Cost Estimate has been prepared for the purpose of comparative assessment of alternate waste storage facilities landform capping methods and must not be used for any other purpose. The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the capping works can or will be undertaken at a cost which is the same or less than the Cost Estimate. Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report. Site conditions (including the presence of hazardous substances and for site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.



LEGEND

- Surface water monitoring sites
- Section Lines
- Groundwater Monitoring Bores
- Test Pits

Paper Size A3

0 40 80 160 240 320 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

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GHD

Capricorn Copper Pty Ltd
Rehabilitation Plan & Financial Assurance Review

Location Map

Job Number	42-20321
Revision	B
Date	20 Mar 2018

Figure 1

2. Old TSF and HLEP#2 geochemical and geotechnical investigation

2.1 Scope of site investigation

A site investigation was undertaken by GHD Hydrogeologist Tim Murphy, between 23 and 26 of January 2018, which comprised of:

- Excavating and sampling of ten test pits at the Mammoth Tailings Storage Facility (Old TSF) for laboratory analysis.
- Undertaking constant head permeability tests into hand augured holes to make an approximate assessment of the permeability of tailings at the Old TSF.
- Drilling of six boreholes at the Old TSF to investigate depth of tailings and collect samples for laboratory geotechnical and geochemical analysis.
- Drilling of three boreholes at the HLEP#2 to investigate depth of waste rocks and collect samples for laboratory geochemical analysis.
- Installing two groundwater wells to allow monitoring of groundwater levels and sample collection for laboratory analysis of Old TSF seepage to inform seepage assessments.
- Logging and recording of observations during field investigations, including taking photos.

The drilling works were carried out by Proactive Drilling Services Pty Ltd using a hollow flight auger operated by a Hydrapower Scout V rig at the Old TSF, while using air hammer drilling at the HLEP#2 where larger and harder materials were expected. CCM provided a backhoe on the 26 January and a 20 tonne excavator on the 27 January 2018 for test pitting at the Old TSF. The samples collected were sent to ALS laboratory for geotechnical and geochemical analysis, as detailed in section 2.5.

2.2 Field activities

The field investigation program was undertaken as follows:

- 23 and 24 January 2018

  – Drilling of six boreholes at the Old TSF to full depth

  – Collecting samples for laboratory analysis

  – Converting two boreholes (BH02 and BH05) to groundwater wells.
- 25 January 2018

  – Drilling of two boreholes at the HLEP#2 as planned and one additional borehole at the HLEP#2 due to unexpectedly shallow depths of waste before hitting natural ground (4 m instead of 20 m as expected initially) to confirm the findings.

  – Collecting samples for laboratory analysis.
- 26 and 27 January 2018

  – Excavating and sampling of ten test pits at the Old TSF for laboratory analysis –

  Conducting constant head permeability tests at the Old TSF.

A geotechnical plan showing the locations of the test pits and boreholes can be found in Appendix A. The geotechnical observations are discussed in the sections below. All depth measurements are from local ground surface.

2.3 Site observations

2.3.1 Old TSF

Ten test pits were excavated to a depth of approximately 3.0 m at the Old TSF. It was observed that the materials encountered at the top 0.9 m of the test pits are mostly loamy sand with gravels and some cobbles overlaid on soils that appeared to be silty clay or clayey silt with sands above the tailings.

Some coarse gravels and large cobbles were found in TP01 (distinctive 200 mm thick layer) and TP05 above the tailings, as can be seen in the photo log in Appendix B. This is consistent with the findings from the previous investigation (EMM, 2015) where gravels were encountered in some of the pits particularly in the southern cell in the area shown in the geotechnical plan. The gravelly layer doesn't appear to be a modern engineered capillary break as based on visual assessment it has a high fines content. It is possible that during the rehabilitation, this more granular material was placed over softer tailings in this area to create a trafficable platform for the construction of the cover.

The cover is estimated to be 900 mm thick in most areas, but can be up to 2 m in some places, particularly in the laydown area (BH03).

A total of six boreholes were drilled in the Old TSF. Two valley profiles plotted using the depths and subsurface information obtained from the boreholes in Table 1 are shown in Figure 2 and Figure 3, confirming the Old TSF lies between two north-south aligned ridges. Based on these cross sections and estimated upstream embankment slopes of 2H:1V at the north and south ends of the storage, the total volume of the fill and tailings in the Old TSF is estimated to be approximately 1.4 Mm^3. The tailings appeared to be clayey silt or silty clay with sand in some areas. It was found that the tailings at 10 m below ground are either damp or wet. All of the boreholes were terminated due to hitting natural ground (siltstone) except for BH05 where it was very wet and auger reached its extent to continue without borehole collapse. Two groundwater wells had been installed at the two deepest holes at BH02 and BH05. The borehole logs can be found in Appendix C.

Table 1 Subsurface summary of boreholes at Old TSF

BH ID	Total depth (m)	Subsurface summary
BH01	9.8	0.9 – 1.2 m Silty Gravel with cobbles (Fill), dry 1.2 – 9.0 m Sandy Silt, dry (tailings) 9.0 – 9.8 m Siltstone (tailings)
BH02	18.0	0.0 – 0.9 m Silty Gravel with cobbles (Fill), dry 0.9 – 7.0 m Clay, damp (tailings) 7.0 – 8.5 m Silt, dry (tailings) 8.5 – 18.0 m Clay, damp (tailings)
BH03	13.7	0.0 – 2.0 m Silty Gravel with cobbles (Fill), dry 2.0 – 13.7 m Clayey Silt, damp (tailings)
BH04	16.0	0.0 – 0.9 m Silty Gravel with cobbles (Fill), dry 0.9 – 5.0 m Clayey Silt, dry (tailings) 5.0 – 10.0 m Silty Clay, dry – damp (tailings) 10.0 – 16.0 m Silty Clay, wet (tailings)
BH05	23.7	0.0 – 0.9 m Silty Gravel with cobbles (Fill), dry 0.9 – 16.5 m Clayey Silt, dry – damp (tailings) 16.5 – 23.0 m Silt with sand, wet (tailings) 23.0 – 23.7 m Sandy Silt, very wet (tailings)
BH06	10.7	0.0 – 0.9 m Silty Gravel with cobbles (Fill), dry 0.9 – 5.0 m Clay, damp (tailings) 5.0 – 10.7 m Silty Clay, damp (tailings)

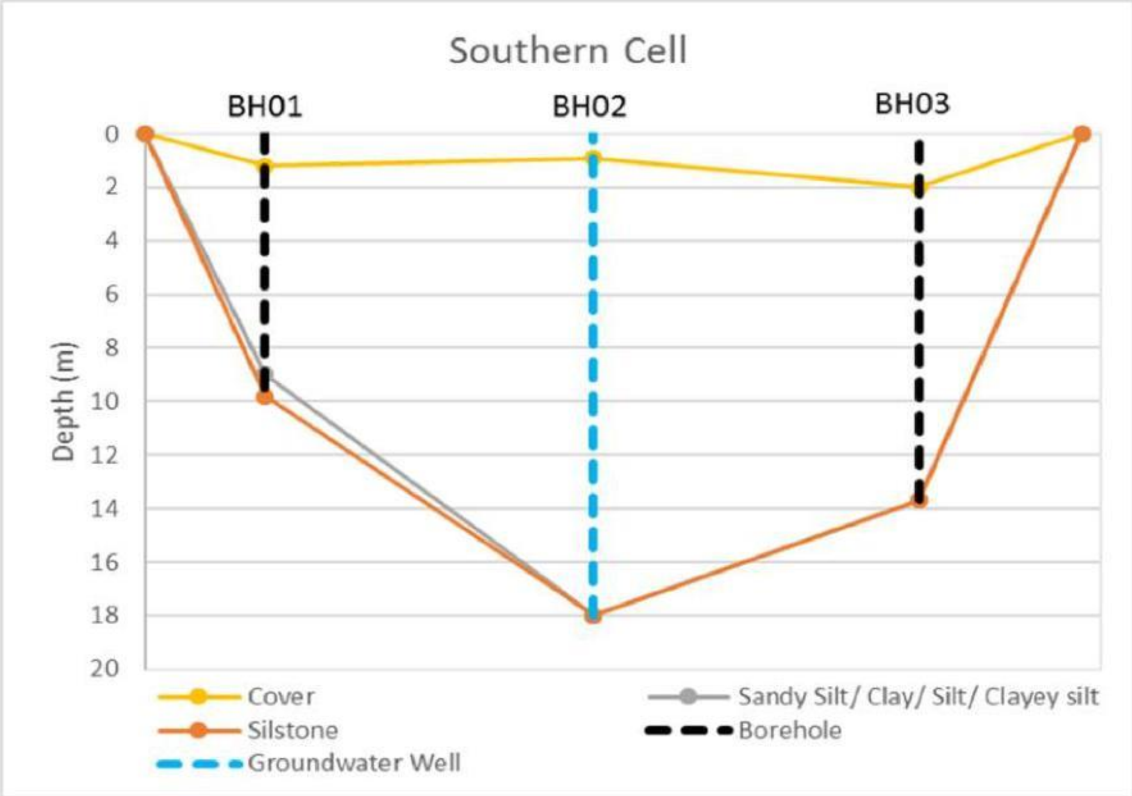


Figure 2 Soil profile of southern cell based on BH01 – BH03 (Section A-A)

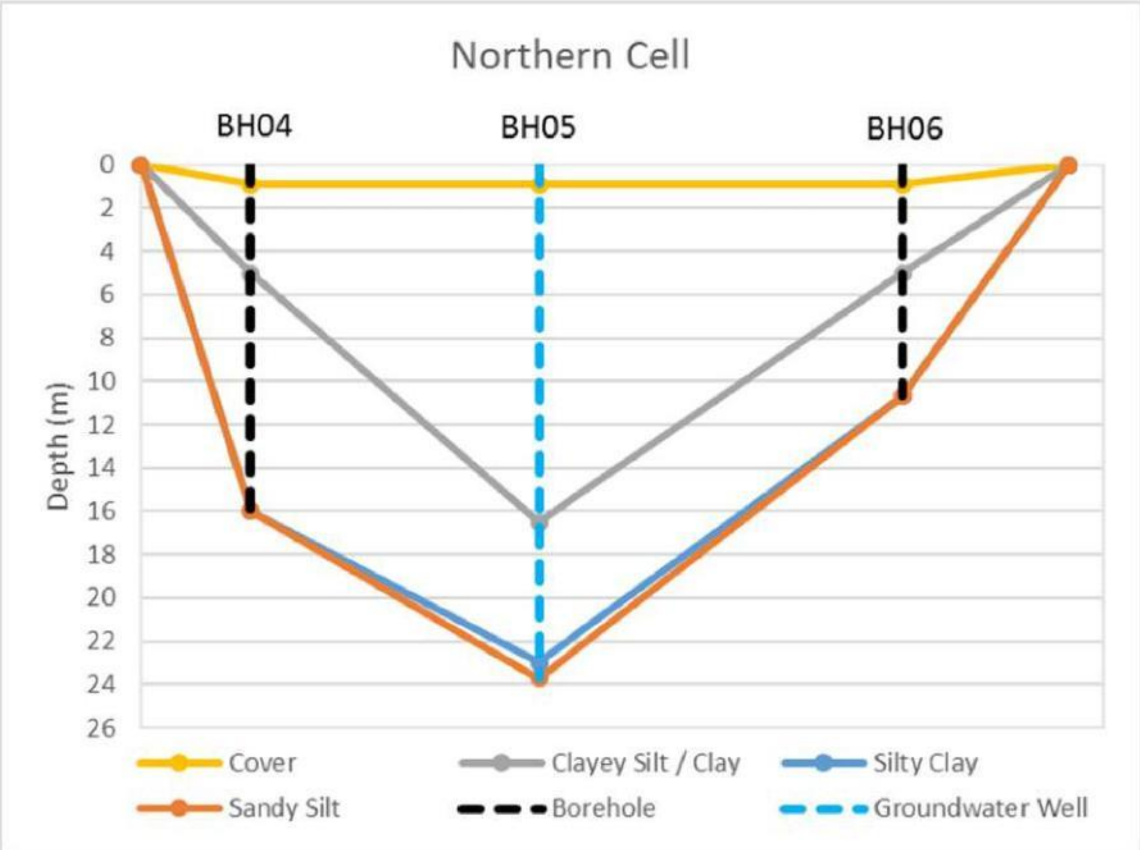


Figure 3 Soil profile of northern cell based on BH04 – BH06 (Section B-B)

2.3.2 HLEP#2

A total of three boreholes were drilled in the HLEP#2. Two boreholes hit natural ground at 3 and 4 m. One additional borehole was drilled near the Eastern embankment which was thought to be the deepest section but hit natural ground at 0.5 m. This indicates the loose materials on the eastern face of the HLEP#2 is likely shallow material which has rilled / spilled over the natural ground as opposed to a deeper batter of HLEP#2 waste material.

The maximum particle size or indications of chemically cemented materials was not able to be confirmed from the investigation given that the boreholes were drilled using air hammer. However, from the spoil retrieved from the boreholes, the material appeared to be silts with gravels (15-20 mm) and cobbles (60-70 mm) with size up to 100 mm. There were large boulders found at the Eastern embankment, however these were not encountered in the boreholes, and as discussed above these could be larger material spilled over the slope.

The state map with 10 m contours provided limited information of the original ground surface at the HLEP#2 but indicated that it might be situated on a ridge, hence the low fill depth. Assuming the average depth of the HLEP#2 waste is 3.5 m over an area of 1.77 HA, the volume of waste is estimated to be 62,000 m^3.

2.4 Insitu testing

2.4.1 Old TSF insitu permeability test

Two insitu permeability tests were carried out using a Cromer constant head permeameter at the base of TP01 and TP07.

The tests were carried out on a bench cut at 1.5 m depth to reduce risk of engulfment. The other pits were backfilled as soon as possible for safety reasons. Based on the field testing average permeability of the tailings is estimated to be 2.1 x 10^{-7} m/s and 7.8 x 10^{-6} m/s at TP01 and TP07 respectively. The assessed values are typical for fine tailings consisting of consolidated sandy clayey silt.

2.5 Laboratory analysis

A total of 64 samples were collected from the field investigation, with 35 from the boreholes and 10 grab samples and 20 bulk samples from the test pits. Selected samples were sent to ALS Laboratory on 29 January 2018 for geotechnical and geochemical analysis as follows (refer also Table 2):

- Geochemical suite comprising Total Metals (ICP / MS Full Suite), Net Acid Generation (NAG), Net Acid Production Potential (NAPP), Soluble sulfate sulfur (SHCl) and Chromium Reducible Sulfur (SCr);
- Geotechnical suite (short) comprising particle size distribution with hydrometer and Emerson Class; and
- Geotechnical suite (long) comprising particle size distribution with hydrometer, Atterberg limits, Emerson Class, compaction, permeability and soil water characteristic curves (SWCC).

Table 2 Laboratory analysis suite

Sample ID	Geochemical suite	Geotechnical suite (short)	Geotechnical suite (long)
Old TSF			
TP02-T	X		X
TP04-T	X		X
TP05-T	X		
TP06-T	X		
TP07-T	X		X
TP08-T			X
TP09-T	X		X
BH01-6.5	X		
BH02-10	X	X	
BH02-15	X		
BH03-5	X		
BH03-10	X		
BH04-5	X		
BH04-10	X	X	
BH05-20	X		
BH06-5	X		
BH06-10	X	X	
HLEP#2			
BH09-1.0	X		
BH09-2.0	X		
BH09-3.0	X		
BH09-4.0	X		
BH10-2.0	X		
BH10-3.0	X		

3. Seepage analysis (Old TSF and HLEP#2)

3.1 Previous work

GHD (2011) presented a 2D numerical seepage model along the axis of the Old TSF (approximately North-South). Works have been completed since this time to improve the surface capping of the Old TSF as described in Capricorn Copper (2017). The model attempted to quantify seepage rates along the northern wall of the Old TSF and from the up gradient influence (Mill Creek Dam), as well as rainfall and percolation through the Old TSF. It was estimated in the modelled scenario (upper value) that a total of 1.77 L/s was being discharged as seepage (Mill Creek Dam plus rainfall on Old TSF influence). GHD (2011) used a hydraulic conductivity (K) of 1 x 10^{-7} m/s as the input value of permeability through the Old TSF.

The conceptual model remains the same (Figure 4) with seepage discharging (and being intercepted) to the north (right) with recharge from above and from the south (left).

GHD, 2012 and GHD, 2013 provided hydraulic conductivity (K) values and a 3D Numerical model of the site however, neither the Old TSF nor the HLEP#2 were a focus of these works. GHD (2012) stated that:

- "Only one measured permeability value, of 2 x 10^{-8} m/s (0.002 m / day) is available for tailings material at Mt Gordon, tested by GHD in 2008."
- "This is within the range of 5 x 10^{-8} to 5 x 10^{-9} m/s estimated by Woodward Clyde (1999) base on grainsize analyses."

GHD (2013) determined that 1 L/s UG corresponded to a deep bedrock horizontal hydraulic conductivity (K) 1 x 10^{-7} m/sec. Adopted material hydraulic properties (GHD, 2013) are provided in Table 3.

Capricorn Copper (2017) provided a conceptual model for Sump 6 (Figure 4), discussion of the improvements to the surface features and water flows in the Old TSF area and commentary on surface water quality improvements overtime.

Capricorn Copper (2017) determined that the volume and poor quality of seepage could be significantly contributed to through other contaminated catchment influences (i.e. Mill Creek Dam) and historical observations of site based runoff of poor quality (approximately pH 2.5 and 2000 ppm copper) originating from areas south of the TSF and ponding and soaking through its southern wall.

Capricorn Copper (2017) concluded that the nature of these risk had been significantly reduced through measures implemented since the commencement of the TEP however, considering potential contaminated catchment influences and limited geotechnical and geochemical information within the Old TSF cover and tailings the current and future risk profile was not clear and required further investigation.

The following provides further information with respect to the conceptual model and seepage analysis with consideration to the geochemical and geotechnical investigation described in section 2.

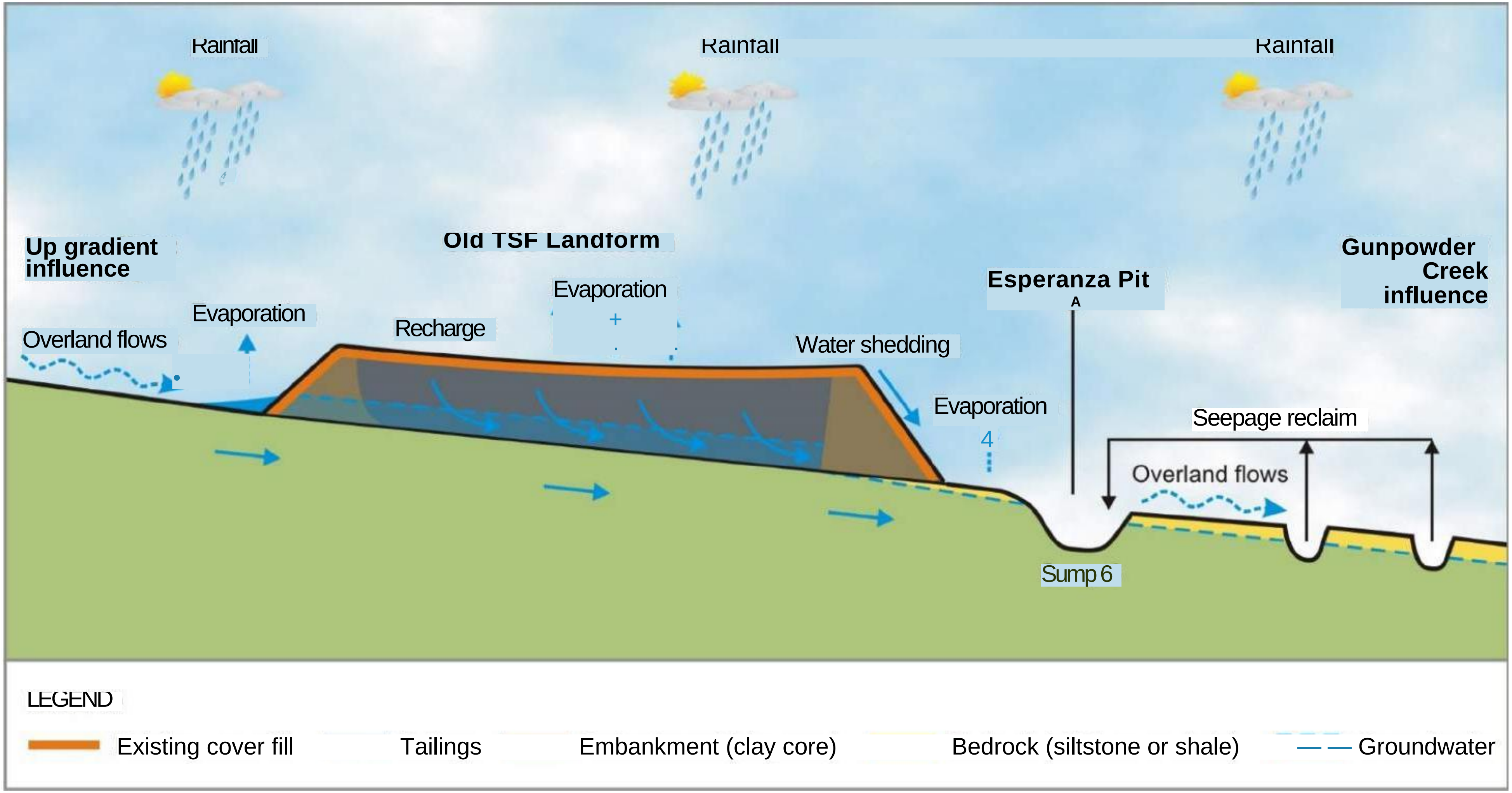


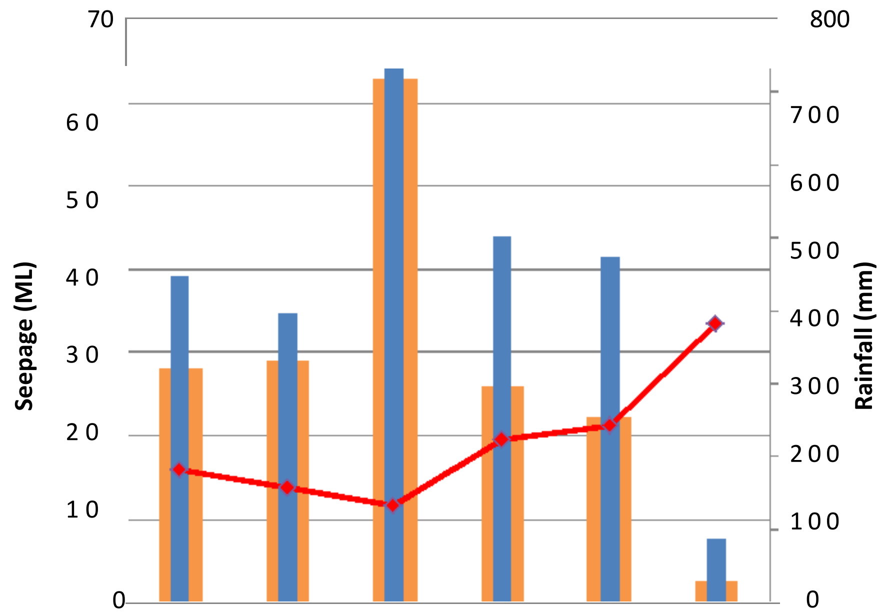
Figure 4 Conceptual model from south (left) to north (right) after Capricorn Copper (2017)

Table 3 Site material hydraulic properties (GHD, 2013)

Material	Kh (m / day)	Kh/Kv
Coarse Tails	1	3
Fine Tails	0.1	3
Alluvial SandGrav	1	3
Alluvial Clayey	0.01	3
L1 Qtzite soil	0.5	3
L2 Qtzite Wd Frac	0.5	3
L3 Qtzite Int Frac	0.01	3
L4 Qtzite Low Frac	0.005	3
L5 Qtzite	0.001	3
Wd Metavolc	0.1	3
Fract Metavolc	0.01	3
Deep Metavolc	0.001	3
Waste rock	10	3

3.2 Quantification of seepage flow to Sump 6 (Old TSF)

Seepage rates at Sump 6 have been presented relative to rainfall (Figure 5). Assuming that no changes have occurred onsite in connection with water management, then it would be expected that the relationship between variables such as the amount of rainfall (mm) on the TSF catchment, when plotted against seepage volumes (ML) reclaimed from Sump 6, would remain relatively constant. However, it is considered that the increases in this ratio in recent years generally reflects a reduction of seepage expression through the Old TSF consistent with Capricorn Copper (2017) findings.



	2013	2014	2015	2016	2017	2018
Seepage (ML)	28	29	63	25.8	22.34	2.61
Rainfall (mm)	448	397	734	501	474.77	87.6
Rainfall (mm):1ML seepage	16.0	13.7	11.7	19.4	21.3	33.6

Figure 5 Seepage flow at Sump 6 (Old TSF)

To put the above reported seepage rates into context, a sensitivity analysis using three areas of recharge were considered as likely catchments above Sump 6. The following also assumes that all seepage through the Old TSF is collected at Sump 6.

The three recharge areas considered are:

1. The original 170,000 m^2 considered in GHD (2011).
2. An extended area of 240,800 m^2 which considered the immediate catchment of the Old TSF (Figure 6).
3. A further extended area of 396,000 m^2 which includes the area to the south as inward flow up to the decant point near Mill Creek Dam (Figure 7).

The later reflects the previous suggested Capricorn Copper (2017) conceptual model that the Old TSF may also be being recharged from waters in the south. The percentages presented in Table 4 demonstrate seepage collected at Sump 6 approximates likely / plausible recharge rates relative to rainfall.

Table 4 Sump 6 recharge area sensitivity analysis

Year	Sump 6 (ML / year)	Rainfall (mm / year)	Required Recharge % Area_1	Required Recharge % Area_2	Required Recharge % Area_3
2013	28	448	37%	26%	16%
2014	29	397	43%	30%	18%
2015	63	734	50%	36%	22%
2016	25.8	501	30%	21%	13%
2017	22.34	475	28%	20%	12%

3.3 Quantification travel times seepage flow to Sump 6 (Old TSF)

Quantification of maximum travel times for seepage flow to Sump 6 through the saturated Old TSF (and potentially shallow basement rocks) were undertaken to put the previous modelling into context. It is recognised that travel times for seepage paths can be shorter (i.e. recharge that occurs near the downstream end of the Old TSF will obviously take less time to reach Sump 6 than the maximum travel time of recharge at the upstream end of the Old TSF). Based on the GHD (2011) 2D seepage modelling, two scenarios were presented for seepage which resulted in flows of 4.56E-03 m^3 / s (144 ML / year) and 2.80E-04 m^3 / s (9 ML / year). Given that the observed flows (Table 4) are well within this range, the above flows were used to provide a broad estimate of maximum travel times for waters within the Old TSF. Maximum travel times for the above two flows are 3 and 47 years respectively, given the following assumptions:

- A maximum flow path length of 600 m.
- A nominal flow path width of 230 m.
- A nominal saturated thickness of 10 m.
- A nominal effective porosity of 0.3.

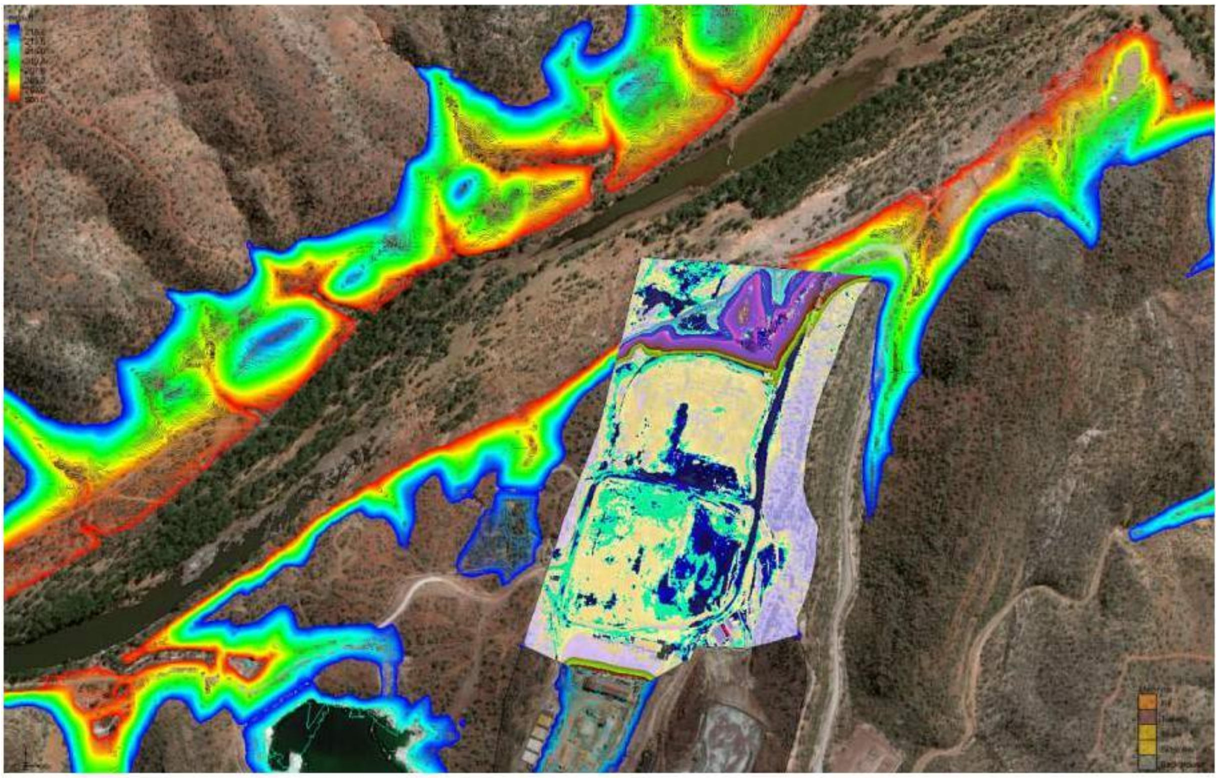


Figure 6 Sensitivity analysis recharge area 2

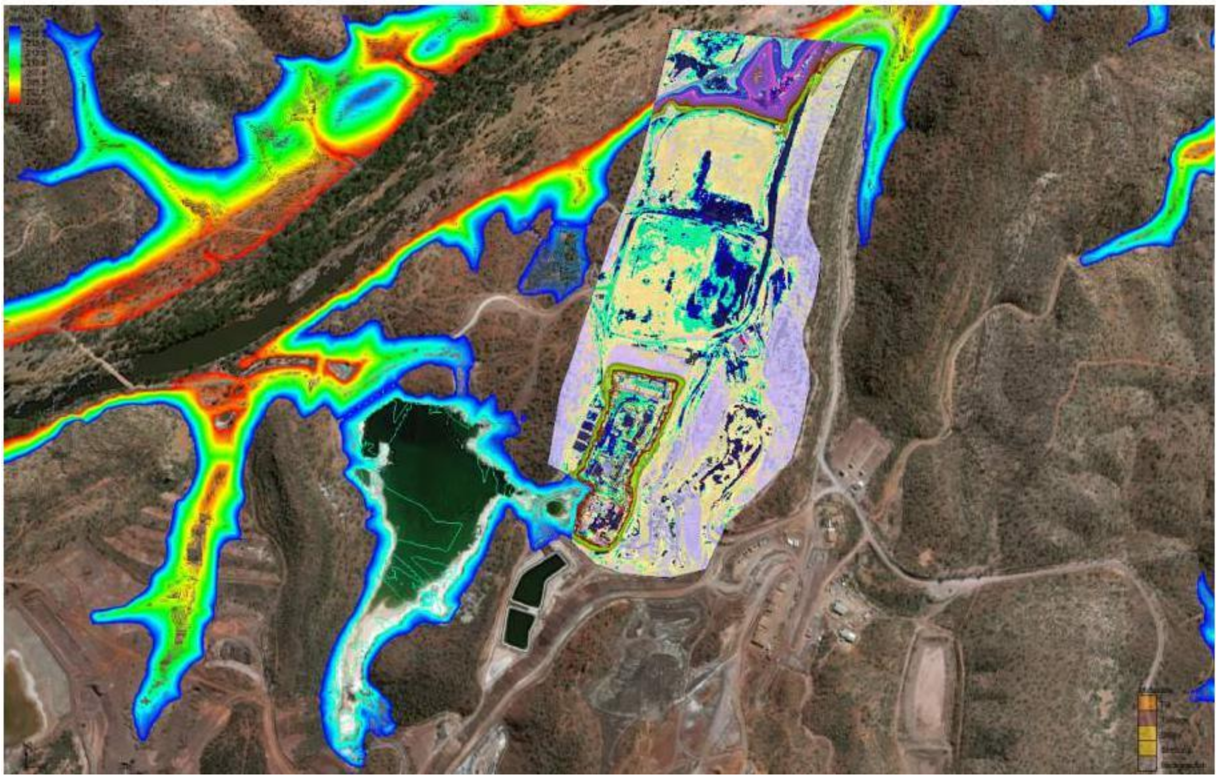


Figure 7 Sensitivity analysis recharge 3

3.4 AMD classification (Old TSF and HLEP#2)

Acid and metalliferous drainage (AMD) classification of materials with the Old TSF and HLEP#2 has been undertaken (Figure 8 Figure 9, Figure 10 and Table 5). In summary the sample results indicated that:

- The tailings materials are all PAF (potentially acid forming, 14 samples) having an MPA greater than ANC, resulting in appositive NAPP, and a NAG pH of less than 4.5, with one uncertain sample (UC) having a positive NAPP but a NAG pH above 4.5; and
- The heap leach materials are all NAF (non-acid forming, 4 samples) having an ANC more than twice MPA giving a negative NAPP and a NAG pH above 4.5, other than two UC samples with NAGpH above 4.5 but a positive NAPP.

3.5 Metal contents (HLEP#2)

Total metal contents are considered relative to global abundance induces (GAI). An assay GAI value greater than 3 is considered enriched (Table 6). Given that the HLEP#2 material is already intentionally leached, metal and sulfur are as expected, not enriched. HLEP#2 materials are only slightly enriched in arsenic and in one sample, sodium, antimony, selenium. This contrasts the tailings materials discussed later. No groundwater was intercepted during the investigation and GWMB21 is consistently dry over recent years. The leached nature of the HLEP#2 material (and the sulfur and metal contents) indicated that ongoing oxidation of the material is no longer a risk to the receiving environment. Past leaching / and or oxidation at HLEP#2) has resulted in historical local contamination (low pH, elevated sulfate and metals) at the adjacent GWMB22.

3.6 Metal contents (Old TSF)

Total metal contents (Table 7) are considered relative to GAI. An assay GAI value greater than 3 is considered enriched (Table 11). All tailings samples within the Old TSF are considered enriched in silver, arsenic, bismuth, copper, sulfur, antimony, selenium and thallium. Two of the twelve samples were also considered enriched with cobalt. Likewise, all of the samples are above the QLD EPA environmental trigger values (QLD EPA, 1995) for numerous metals and metalloids (orange values in Table 7).

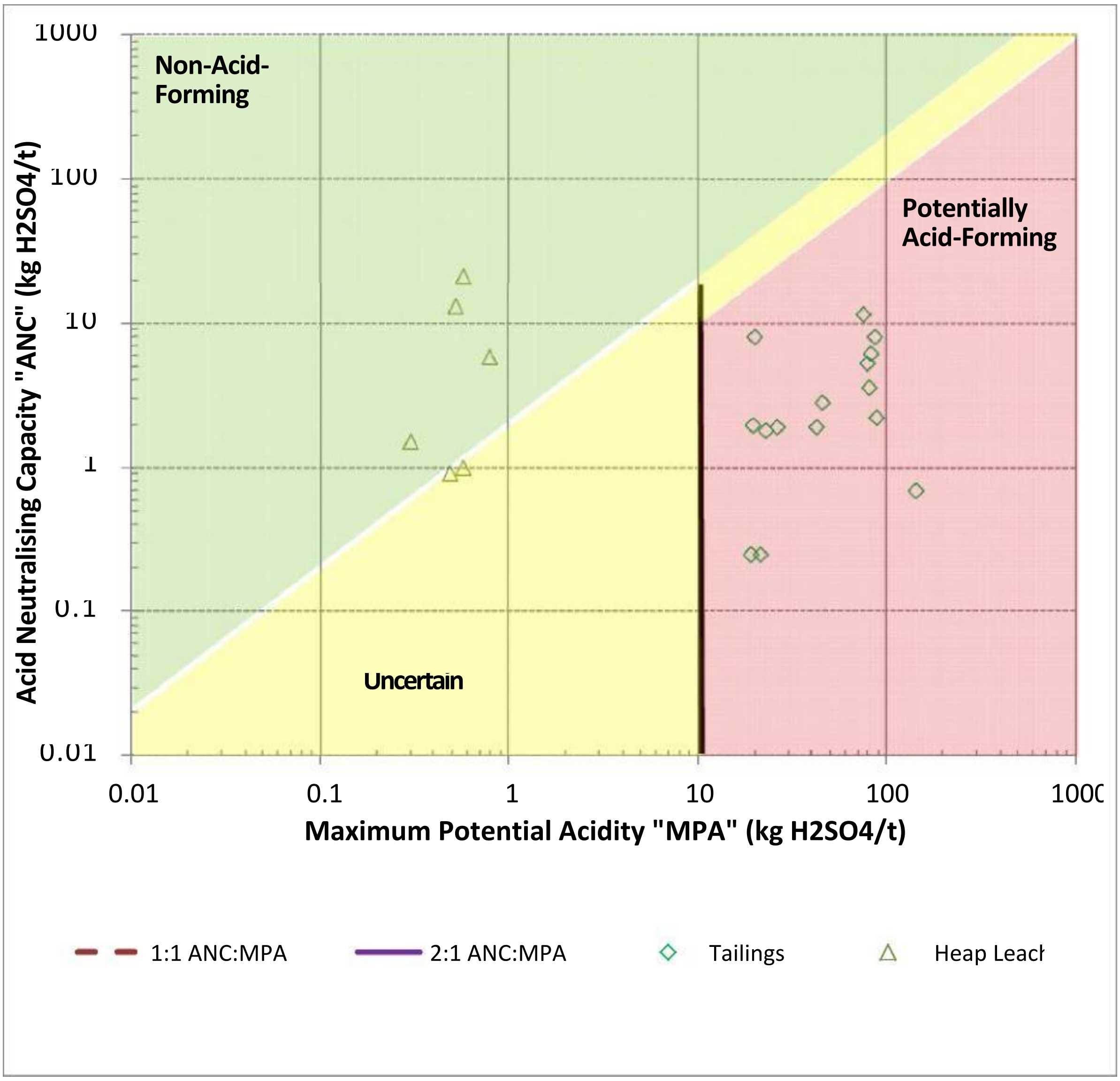


Figure 8 ANC vs MPA (Old TSF and HLEP#2)

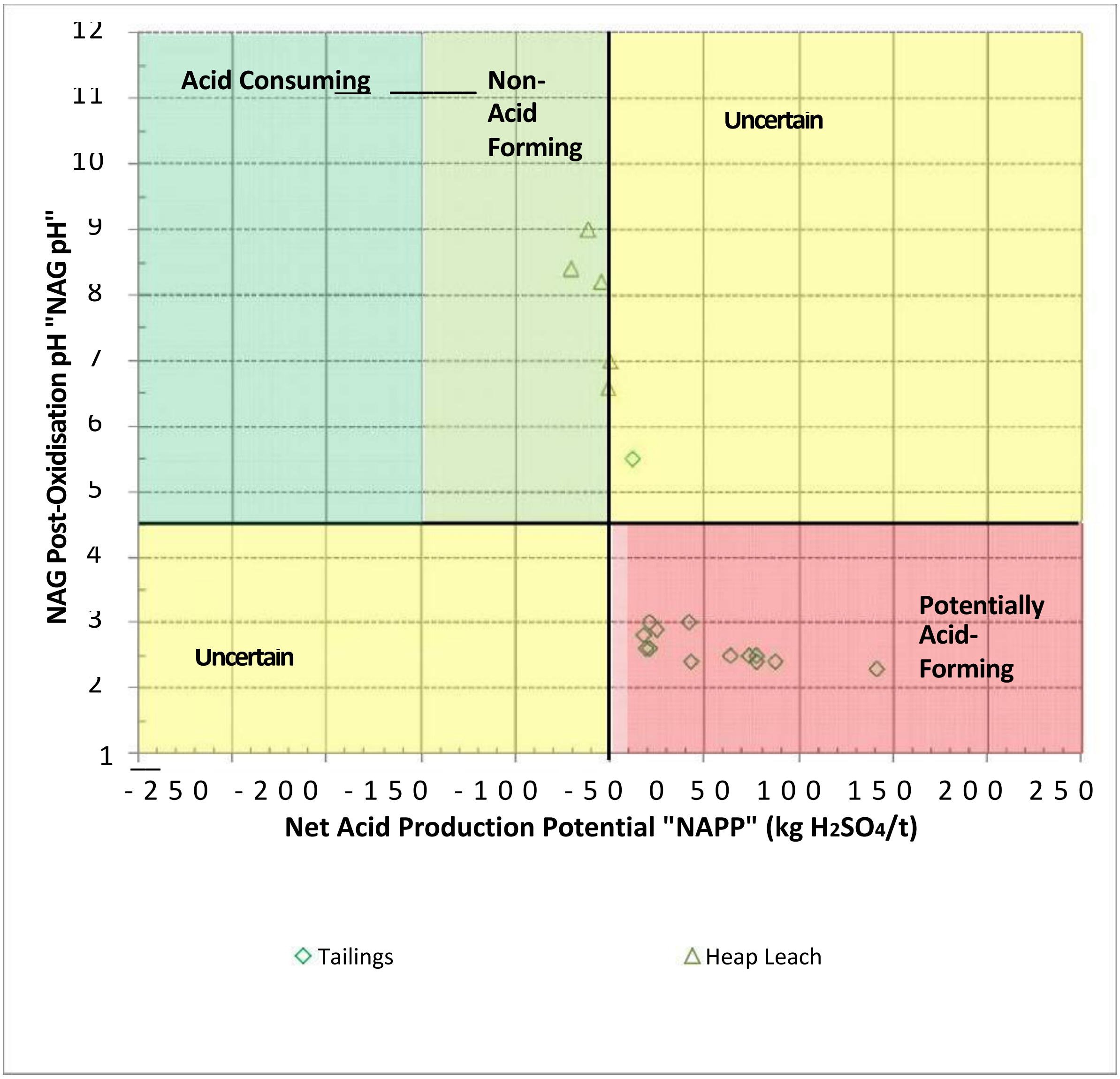


Figure 9 NAGpH vs NAPP (Old TSF and HLEP#2)

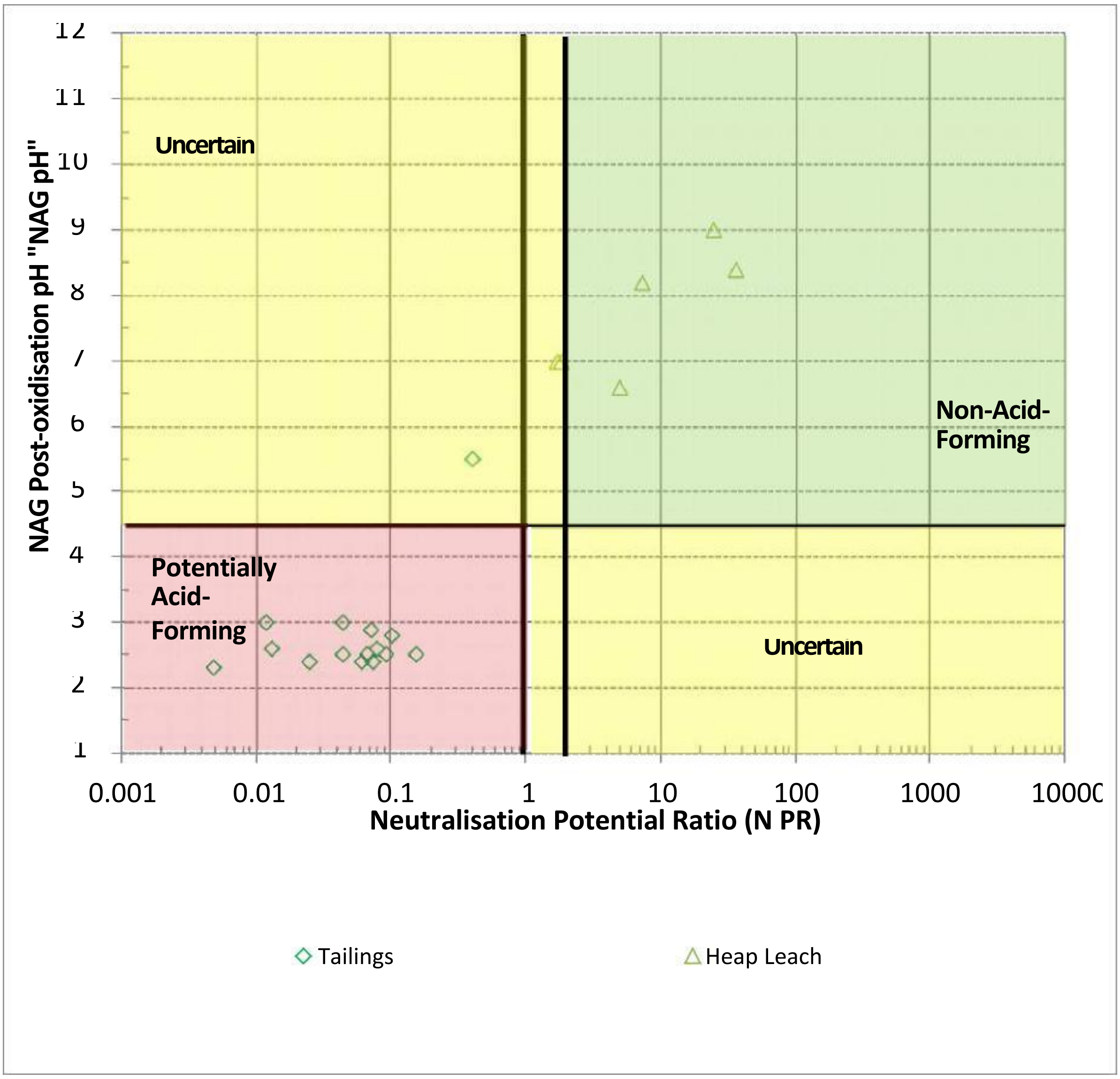


Figure 10 NAGpH vs NPR (Old TSF and HLEP#2)

Table 5 AMD classification summary table summary table (Old TSF and HLEP#2)

Sample ID	Location	Waste Rock Class	NAG pH/ pHox	NAG pH4.5 (kg/t H_2SO_4)	NAG pH7 (kg/t H_2SO_4)	ANC (kg/t H_2SO_4)	Total Sulfur (%S)	Sulfate Sulfur (%S)	Sulfide Sulfur (%S)	Calc MPA (kg/t H_2SO_4) (%S*30.6)	NAPP (kg/t H_2SO_4)	NPR (ANC/ MPA)	NAG pH7as %S	NAG pH7 as Mol Equiv H^+/t	AMD Class	ANC (%H_2SO_4 or %$CaCO_3$)
LOR			**0.1**	**0.1**	**0.1**	**0.10**			**0.010**	**0.1**	**0.1**	**0.1**	**0.01**	**1**		**0.10**
BH10_2.0	Heap Leach	Heap Leach	8.2	0.1	0.1	5.80	0.08	0.054	0.026	0.8	-5.0	7.3	0.00	1	NAF	0.19
BH10_3.0	Heap Leach	Bedrock	6.6	0.1	1.2	1.50	0.02	0.010	0.010	0.3	-1.2	4.9	0.04	24	NAF	0.05
BH09_1.0	Heap Leach	Heap Leach	8.4	0.1	0.1	21.20	0.09	0.071	0.019	0.6	-20.6	36.5	0.00	1	NAF	0.69
BH09_2.0	Heap Leach	Heap Leach	9.0	0.1	0.1	13.00	0.03	0.013	0.017	0.5	-12.5	25.0	0.00	1	NAF	0.42
BH09_3.0	Heap Leach	Heap Leach	7.0	0.1	0.1	1.00	0.02	0.001	0.019	0.6	-0.4	1.7	0.00	1	UC	0.03
BH09_4.0	Heap Leach	Bedrock	7.0	0.1	0.1	0.90	0.02	0.004	0.016	0.5	-0.4	1.8	0.00	1	UC	0.03
BH05_20	Old Tailings Dam	Tailings	2.4	49.8	60.3	2.20	3.47	0.540	2.930	89.7	87.5	0.0	1.97	1229	PAF-HC	0.07
BH06_5	Old Tailings Dam	Tailings	2.5	41.2	56.1	3.60	3.46	0.820	2.640	80.8	77.2	0.0	1.83	1144	PAF-HC	0.12
BH04_5	Old Tailings Dam	Tailings	2.4	27.2	41.0	2.80	2.50	1.020	1.480	45.3	42.5	0.1	1.34	836	PAF-HC	0.09
BH03_5	Old Tailings Dam	Tailings	5.5	0.1	5.1	8.10	0.90	0.242	0.658	20.1	12.0	0.4	0.17	104	UC	0.26
BH02_15	Old Tailings Dam	Tailings	2.5	40.6	59.5	11.50	3.55	1.090	2.460	75.3	63.8	0.2	1.95	1213	PAF-HC	0.38
BH01_6.5	Old Tailings Dam	Tailings	2.3	58.6	79.0	0.70	5.77	1.120	4.650	142.3	141.6	0.0	2.58	1611	PAF-HC	0.02
TP02_T	Old Tailings Dam	Tailings	2.8	9.5	17.3	2.00	1.07	0.428	0.642	19.6	17.6	0.1	0.57	353	PAF-HC	0.07
TP04_T	Old Tailings Dam	Tailings	3.0	17.1	31.4	1.90	2.76	1.350	1.410	43.1	41.2	0.0	1.03	640	PAF-HC	0.06
TP05_T	Old Tailings Dam	Tailings	2.6	15.7	21.2	0.25	1.43	0.798	0.632	19.3	19.1	0.0	0.69	432	PAF-HC	0.01
TP06_T	Old Tailings Dam	Tailings	2.9	8.8	18.6	1.90	1.49	0.632	0.858	26.3	24.4	0.1	0.61	379	PAF-HC	0.06
TP07_T	Old Tailings Dam	Tailings	2.6	14.0	19.7	1.80	1.14	0.390	0.750	23.0	21.2	0.1	0.64	402	PAF-HC	0.06
TP09_T	Old Tailings Dam	Tailings	3.0	7.9	15.3	0.25	1.15	0.455	0.695	21.3	21.0	0.0	0.50	312	PAF-HC	0.01
BH02_10	Old Tailings Dam	Tailings	2.4	53.4	65.7	6.20	3.43	0.690	2.740	83.8	77.6	0.1	2.15	1340	PAF-HC	0.20
BH04_10	Old Tailings Dam	Tailings	2.5	48.2	61.9	5.30	3.50	0.910	2.590	79.3	74.0	0.1	2.02	1262	PAF-HC	0.17
BH03_10	Old Tailings Dam	Tailings	2.5	51.6	66.4	8.00	3.68	0.870	2.810	86.0	78.0	0.1	2.17	1354	PAF-HC	0.26

Table 6 Metal (and metalloid) contents relative to GAI values (GAI > 3 are red values) and QLD EPA Env trigger value (exceedances are orange values)

Metal	Units	QLD EPA Env Trigger Value	Avg Shale / Crustal Abundance	Contents	Contents	Contents	Contents	Contents	Contents	GAI	GAI	GAI	GAI	GAI	GAI
				BH10_ 2.0	BH10_ 3.0	BH09_ 1.0	BH09_ 2.0	BH09_ 3.0	BH09_ 4.0	BH10_ 2.0	BH10_ 3.0	BH09_ 1.0	BH09_ 2.0	BH09_ 3.0	BH09_ 4.0
				(Bedrock)	Heap Leach	Heap Leach	Heap Leach	Heap Leach	Heap Leach	Heap Leach	Heap Leach	Heap Leach	Heap Leach (Bedrock)	Heap Leach	Heap Leach (Bedrock)
Ag	ppm	20	0.07	0.21	0.1	0.39	0.07	0.02	0.02	0.9	-0.1	1.8	-0.7	-2.5	-2.5
Al	%		8.23	3.84	3.13	3.29	3.08	2.82	2.55	-1.8	-2.1	-2.0	-2.1	-2.2	-2.4
As	ppm	20	1.8	45.8	18.9	61.1	38.6	16	18.3	4.0	2.7	4.4	3.8		2.7
Ba	ppm		425	420	320	340	390	140	210	-0.7	-1.1	-1.0	-0.8	-2.3	-1.7
Be	ppm	15	3	1.24	0.65	0.8	0.82	0.53	0.48	-1.9	-2.9	-2.6	-2.5	-3.2	-3.3
Bi	ppm		0.17	0.78	0.36	1.64	0.63	0.39	0.36	1.5	0.4	2.6	1.2	0.5	0.4
Ca	%		4.2	0.19	0.08	0.5	0.22	0.04	0.05	-5.1	-6.4	-3.7	-4.9	-7.4	-7.1
Cd	ppm	3	0.2	0.03	<0.02	0.02	0.03	<0.02	<0.02	-3.4		-4.0	-3.4		
Ce	ppm		60	45.5	39	42.6	43.7	39.5	38.3	-1.1	-1.3	-1.2	-1.1	-1.3	-1.3
Co	ppm	50	25	45.3	7.9	33.5	41.9	6.5	5.2	0.2	-2.3	-0.2	0.1	-2.6	-2.9
Cr	ppm	50	100	65	63	45	58	43	29	-1.3	-1.3	-1.8	-1.4	-1.9	-2.4
Cs	ppm		3	1.21	1.11	0.91	0.85	0.64	0.62	-2.0	-2.1	-2.4	-2.5	-2.9	-2.9
Cu	ppm	60	55	337	108	382	381	157	75	2.0	0.3	2.1	2.1	0.9	-0.2
Fe	%		20	3.37	2.29	1.86	1.54	0.99	0.64	-3.2	-3.8	-4.1	-4.4	-5.0	-5.6
Ga	ppm		15	8.8	7.24	6.76	6.55	6.21	5.35	-1.4	-1.7	-1.8	-1.9	-1.9	-2.1
Ge	ppm		1.5	0.08	0.08	0.08	0.08	0.07	0.06	-4.9	-4.9	-4.9	-4.9	-5.1	-5.3
Hf	ppm		3	3.3	2.9	3.6	3.3	2.4	2.2	-0.5	-0.7	-0.4	-0.5	-1.0	-1.1
In	ppm		0.1	0.04	0.027	0.033	0.028	0.017	0.008	-2.0	-2.5	-2.3	-2.5	-3.2	-4.3
K	%		2.1	2.35	2.37	1.97	1.69	0.7	1.31	-0.5	-0.5	-0.8	-1.0	-2.2	-1.3
La	ppm		30	19.6	22.1	21.5	22.7	19.8	19.8	-1.3	-1.1	-1.1	-1.1	-1.3	-1.3
Li	ppm		20	9.4	4	8.4	7.6	5.1	3	-1.7	-3.0	-1.9	-2.1	-2.6	-3.4
Mg	%		23000	0.3	0.12	0.47	0.17	0.06	0.08	-3.6	-4.9	-3.0	-4.4	-5.9	-5.5
Mn	ppm	500	950	448	81	402	365	53	42	-1.7	-4.2	-1.9	-2.0	-4.8	-5.2
Mo	ppm	4	1.5	0.68	0.36	0.53	0.47	0.55	0.3	-1.8	-2.7	-2.2	-2.3	-2.1	-3.0
Na	%		2.4	0.04	0.05	0.04	0.03	0.03	0.04	4.0	-6.2	-6.6	-7.0	-7.0	-6.6
Nb	ppm		20	5.7	3.6	4.2	3.8	3.6	2.9	-2.5	-3.1	-2.9	-3.1	-3.1	-3.4
Ni	ppm	60	75	30.4	6.2	26.1	22.4	9	6.1	-2.0	-4.3	-2.2	-2.4	-3.7	-4.3
P	ppm		1050	230	130	250	150	90	90	-2.9	-3.7	-2.7	-3.5	-4.2	-4.2
Pb	ppm	300	12.5	10.7	7.6	12.3	9.5	4.5	4.2	-0.9	-1.4	-0.7	-1.1	-2.1	-2.2
Rb	ppm		90	74.2	74.7	61	52.4	28	44	-0.9	-0.9	-1.2	-1.4	-2.3	-1.7
Re	ppm		0.0005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002						
S	%		0.035	0.09	0.02	0.1	0.03	0.02	0.01	0.7	-1.5	0.9	-0.9	-1.5	-2.5
Sb	ppm	20	0.2	1.58	0.83	2.55	1.09	0.55	0.57	2.3	1.4	3.0	1.8	0.8	0.9
Sc	ppm		16	9.3	5.5	5.2	4.1	4	3	-1.4	-2.2	-2.3	-2.6	-2.7	-3.1
Se	ppm	3	0.05	1	<1	<1	<1	<1	<1	3.7					
Sn	ppm	50	6	1.1	0.9	0.9	0.9	0.9	0.8	-3.1	-3.4	-3.4	-3.4	-3.4	-3.6
Sr	ppm		375	32.3	39.2	42.4	36.1	43.6	47.9	-4.2	-3.9	-3.8	-4.0	-3.8	-3.6
Ta	ppm		2	0.4	0.32	0.31	0.32	0.31	0.26	-3.0	-3.3	-3.3	-3.3	-3.3	-3.6

Metal	Units	QLD EPA Env Trigger Value	Avg Shale / Crustal Abundance	Contents	Contents	Contents	Contents	Contents	Contents	GAI	GAI	GAI	GAI	GAI	GAI
Te	ppm		0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05						
Th	ppm		10	6.28	7.19	6.22	6.21	5.97	5.6	-1.3	-1.1	-1.3	-1.3	-1.4	-1.5
Ti	%		0.57	0.297	0.107	0.159	0.105	0.124	0.066	-1.6	-3.1	-2.5	-3.1	-2.9	-3.8
Tl	ppm		0.45	0.79	0.45	1	0.52	0.21	0.29	0.2	-0.7	0.5	-0.5	-1.8	-1.3
U	ppm		2.7	1.8	1	1.7	1.5	1	0.8	-1.2	-2.1	-1.3	-1.5	-2.1	-2.4
V	ppm	70	135	86	58	48	32	32	21	-1.3	-1.9	-2.2	-2.7	-2.7	-3.3
W	ppm		1.5	5.4	2.7	1.3	1.2	1.2	1.9	1.2	0.2	-0.9	-1.0	-1.0	-0.3
Y	ppm		30	31.9	8.8	10.4	9.4	7	6.2	-0.6	-2.4	-2.2	-2.3	-2.8	-2.9
Zn	ppm	200	70	14	4	10	9	6	2	-3.0	-4.8	-3.5	-3.6	-4.2	-5.8
Zr	ppm		165	126	106	134	116	91.2	79.2	-1.0	-1.3	-1.0	-1.2	-1.5	-1.7
Hg	ppm	1	0.08	0.018	0.006	0.019	0.005	0.008	<0.005	-2.8	-4.4	-2.7	-4.7	-4.0	

Table 7 **Metal (and metalloid) contents relative QLD EPA env trigger (exceedances are orange values)**

Metal	Unit	QLD EPA Env Trigger	Avg Shale / Crustal Abundance	BH05_20	BH06_5	BH04_5	BH03_5	BH02_15	BH01_6.5	TP02_T	TP04_T	TP05_T	TP06_T	TP07_T	TP09_T
				Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings
Ag	ppm	20	0.07	2.92	2.89	2.6	9.93	3.11	4.67	1.76	3.8	3.29	2.86	2.44	2.77
Al	%		8.23	2.91	5.24	4.97	4.08	6.44	3.77	5.65	5.29	3.73	5.5	4.53	3.4
As	ppm	20	1.8	823	1025	818	522	1110	1590	367	814	771	613	423	697
Ba	ppm		425	170	250	210	190	430	260	190	230	340	270	160	160
Be	ppm	15	3	0.36	0.71	0.77	1.51	0.89	0.41	0.71	0.69	0.47	0.75	0.58	0.4
Bi	ppm		0.17	22.7	30.3	24.5	24	32.2	25.1	14	32	17.2	21.6	15.8	19
Ca	%		4.2	0.18	0.38	0.34	0.18	0.47	0.19	0.2	0.27	0.24	0.3	0.2	0.19
Cd	ppm	3	0.2	0.03	0.04	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.04
Ce	ppm		60	46.2	78.8	77.3	56.3	99.9	59.4	89.1	80.5	66.8	86.5	68	55.4
Co	ppm	50	25	106	317	329	109.5	373	269	171.5	136.5	60.9	174	146	77
Cr	ppm	50	100	38	48	48	37	49	44	47	48	41	57	50	52
Cs	ppm		3	0.65	1.18	1.07	1.53	2.33	0.8	1.37	1.24	0.99	1.35	1.16	0.88
Cu	ppm	60	55	5170	5520	5620	11200	6540	7230	3710	12300	1350	6850	5030	1810
Fe	%		20	4.71	7.53	7.23	5.59	7.53	6.72	4.99	6.45	4.36	6.12	4.67	4.7
Ga	ppm		15	6.15	11.2	10.85	10.15	14.6	8.34	12.05	11.05	8.97	11.75	9.61	7.82
Ge	ppm		1.5	0.09	0.13	0.12	0.11	0.22	0.11	0.13	0.13	0.1	0.11	0.12	0.1
Hf	ppm		3	2.9	3.3	3.3	3.8	3.8	3	3.8	3.3	3.3	3.7	3.3	3.1
In	ppm		0.1	0.078	0.113	0.117	0.255	0.162	0.098	0.111	0.116	0.08	0.114	0.095	0.079
K	%		2.1	1.34	1.8	1.66	1.77	2.67	2.05	2.09	1.92	2.24	2.22	1.54	1.31
La	ppm		30	24.1	40.3	39.4	28.9	52	32	47.1	41.1	34.6	44.9	35.4	29.5
Li	ppm		20	8.4	19.6	21.8	15	19.8	11.4	27.6	20.9	9.3	23.7	23	13.7
Mg	%		23000	0.21	1.05	1.16	0.36	1	0.3	1.02	0.89	0.36	1.14	0.95	0.51
Mn	ppm	500	950	57	476	458	126	407	77	331	227	88	330	329	164
Mo	ppm	4	1.5	2.21	2.25	1.99	3.31	3.41	3.93	1.6	1.64	3.62	1.56	1.58	1.46
Na	%		2.4	0.02	0.02	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.02	0.03
Nb	ppm		20	3.6	5.8	6.2	7.4	7.3	5.1	6.7	6.3	5.3	7	5.9	5
Ni	ppm	60	75	66	182	208	50.3	223	153.5	145	118	60.6	131	110	65.8
P	ppm		1050	200	430	460	610	580	400	320	480	320	550	420	320
Pb	ppm	300	12.5	55	67.7	51.8	48.6	70.1	87.3	28.6	51.4	52.7	41.4	30.9	42.3
Rb	ppm		90	37.9	51.5	49	58	81.7	56.6	63	58.3	66.9	66.1	47.5	39.6
Re	ppm		0.0005	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
S	%		0.035	3.32	3.17	2.42	1.01	3.33	5.44	1.09	2.49	1.47	1.82	1.18	1.16
Sb	ppm	20	0.2	13.3	21	20.9	28.7	19.05	19.45	13.4	22.2	14	18.55	13.5	18.4
Sc	ppm		16	2.5	5.6	6.2	6.4	6.7	2.8	8	6.3	3.7	6.2	5.8	4.7
Se	ppm	3	0.05	1	1	1	1	1	1	<1	1	<1	<1	<1	1
Sn	ppm	50	6	1.2	2.4	2	2.1	3.1	1.7	2.3	2.5	1.7	2.3	1.8	1.6
Sr	ppm		375	54.5	96.1	75.7	216	164	101.5	69.4	74.4	109.5	85.1	51.9	52.3
Ta	ppm		2	0.32	0.5	0.51	0.62	0.63	0.44	0.57	0.54	0.42	0.58	0.5	0.41
Te	ppm		0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Th	ppm		10	6.86	13.35	12.85	9.88	16.15	9.59	15.65	15	9.96	16.05	14.8	10.05
Ti	%		0.57	0.097	0.154	0.161	0.189	0.196	0.126	0.17	0.159	0.131	0.174	0.152	0.133

Metal	Unit	QLD EPA Env Trigger	Avg Shale / Crustal Abundance	BH05_20	BH06_5	BH04_5	BH03_5	BH02_15	BH01_6.5	TP02_T	TP04_T	TP05_T	TP06_T	TP07_T	TP09_T
Tl	ppm		0.45	32.7	34.4	21.5	7.92	33.6	44.5	5.97	20.9	18.2	14.15	7.32	15.55
U	ppm		2.7	4.3	8.8	7.8	6	8.6	4.8	9.2	9.5	4.5	10	7.6	4.8
V	ppm	70	135	33	65	66	56	78	40	65	63	46	65	50	46
W	ppm		1.5	1.1	1.7	1.8	1.6	2.6	1.3	1.6	1.4	1.4	1.6	1.4	1.2
Y	ppm		30	9.4	17.6	16	16.2	15.7	10.4	16.8	15.9	10.9	19.3	14	12.8
Zn	ppm	200	70	11	39	39	19	42	15	27	25	14	32	28	27
Zr	ppm		165	100	118.5	119	142	136	103	133.5	120	115.5	136.5	119	110
Hg	ppm	1	0.08	0.205	0.24	0.162	0.101	0.274	0.358	0.086	0.239	0.232	0.136	0.111	0.142

Table 8 GAI values, GAI > 3 are red values (Old TSF)

Metal	BH05_20	BH06_5	BH04_5	BH03_5	BH02_15	BH01_6.5	TP02_T	TP04_T	TP05_T	TP06_T	TP07_T	TP09_T
	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings
Ag	4.7	4.7	4.6	6.5	4.8	5.4	4.0	5.1	4.9	4.7	4.5	4.6
Al	-2.2	-1.3	-1.4	-1.7	-1.0	-1.8	-1.2	-1.3	-1.8	-1.2	-1.5	-1.9
As	8.2	8.5	8.2	7.5	8.6	9.1	7.0	8.2	8.1	7.8	7.2	7.9
Ba	-2.0	-1.4	-1.7	-1.8	-0.6	-1.4	-1.8	-1.5	-1.0	-1.3	-2.1	-2.1
Be	-3.7	-2.7	-2.6	-1.7	-2.4	-3.5	-2.7	-2.8	-3.3	-2.7	-3.0	-3.6
Bi	6.4	6.8	6.5	6.5	6.9	6.5	5.7	6.9	6.0	6.3	5.9	6.1
Ca	-5.2	-4.1	-4.3	-5.2	-3.8	-5.1	-5.1	-4.6	-4.8	-4.5	-5.1	-5.1
Cd	-3.4	-3.0	-3.0	-3.0	-3.0	-3.4	-4.0	-4.0	-4.0	-3.4	-4.0	-3.0
Ce	-1.0	-0.3	-0.3	-0.8	0.1	-0.7	-0.1	-0.2	-0.5	-0.1	-0.5	-0.8
Co	1.4	3.0	3.1	1.5	3.2	2.8	2.1	1.8	0.6	2.1	1.9	1.0
Cr	-2.1	-1.7	-1.7	-2.1	-1.7	-1.8	-1.7	-1.7	-1.9	-1.5	-1.7	-1.6
Cs	-2.9	-2.0	-2.1	-1.6	-1.0	-2.6	-1.8	-1.9	-2.3	-1.8	-2.0	-2.4
Cu	5.9	6.0	6.0	7.0	6.2	6.4	5.4	7.1	4.0	6.3	5.9	4.4
Fe	-2.7	-2.1	-2.1	-2.5	-2.1	-2.2	-2.7	-2.3	-2.9	-2.4	-2.8	-2.7
Ga	-1.9	-1.1	-1.1	-1.2	-0.7	-1.5	-1.0	-1.1	-1.4	-1.0	-1.3	-1.6
Ge	-4.7	-4.2	-4.3	-4.4	-3.4	-4.4	-4.2	-4.2	-4.6	-4.4	-4.3	-4.6
Hf	-0.7	-0.5	-0.5	-0.3	-0.3	-0.7	-0.3	-0.5	-0.5	-0.4	-0.5	-0.6
In	-1.0	-0.5	-0.4	0.7	0.0	-0.7	-0.5	-0.4	-1.0	-0.5	-0.7	-1.0
K	-1.3	-0.9	-1.0	-0.9	-0.3	-0.7	-0.7	-0.8	-0.6	-0.6	-1.1	-1.3
La	-1.0	-0.2	-0.3	-0.7	0.1	-0.6	0.0	-0.2	-0.5	-0.1	-0.4	-0.7
Li	-1.9	-0.7	-0.5	-1.1	-0.7	-1.5	-0.2	-0.6	-1.8	-0.4	-0.5	-1.2
Mg	-4.1	-1.8	-1.6	-3.3	-1.9	-3.6	-1.8	-2.0	-3.3	-1.7	-1.9	-2.8
Mn	-4.7	-1.7	-1.7	-3.6	-1.9	-4.3	-2.2	-2.7	-4.1	-2.2	-2.2	-3.2
Mo	-0.1	-0.1	-0.3	0.5	0.5	0.7	-0.6	-0.5	0.6	-0.6	-0.6	-0.7
Na	-7.6	-7.6	-7.0	-7.0	-7.0	-7.6	-7.0	-7.6	-7.0	-7.0	-7.6	-7.0
Nb	-3.1	-2.4	-2.3	-2.1	-2.1	-2.6	-2.2	-2.3	-2.6	-2.2	-2.4	-2.7
Ni	-0.8	0.6	0.8	-1.2	0.9	0.4	0.3	0.0	-1.0	0.1	-0.1	-0.8
P	-3.1	-1.9	-1.9	-1.4	-1.5	-2.1	-2.4	-1.8	-2.4	-1.6	-2.0	-2.4
Pb	1.5	1.8	1.4	1.3	1.8	2.1	0.5	1.4	1.4	1.1	0.6	1.1
Rb	-1.9	-1.5	-1.5	-1.3	-0.8	-1.3	-1.2	-1.3	-1.1	-1.1	-1.6	-1.8
Re						1.3	1.3					

Metal	BH05_20	BH06_5	BH04_5	BH03_5	BH02_15	BH01_6.5	TP02_T	TP04_T	TP05_T	TP06_T	TP07_T	TP09_T
S	5.9	5.8	5.5	4.2	5.9	6.6	4.3	5.5	4.7	5.0	4.4	4.4
Sb	5.4	6.1	6.0	6.5	5.9	5.9	5.4	6.1	5.5	5.9	5.4	5.9
Sc	-3.3	-2.2	-2.0	-2.0	-1.9	-3.2	-1.7	-2.0	-2.8	-2.0	-2.1	-2.4
Se	3.7	3.7	3.7	3.7	3.7	3.7		3.7				3.7
Sn	-3.0	-2.0	-2.2	-2.2	-1.6	-2.5	-2.0	-1.9	-2.5	-2.0	-2.4	-2.6
Sr	-3.4	-2.6	-3.0	-1.5	-1.9	-2.5	-3.1	-3.0	-2.4	-2.8	-3.5	-3.5
Ta	-3.3	-2.7	-2.6	-2.3	-2.3	-2.8	-2.5	-2.5	-2.9	-2.4	-2.7	-2.9
Te												
Th	-1.2	-0.2	-0.3	-0.7	0.0	-0.7	0.0	-0.1	-0.7	0.0	-0.1	-0.7
Ti	-3.2	-2.5	-2.5	-2.3	-2.2	-2.8	-2.4	-2.5	-2.8	-2.4	-2.6	-2.8
Tl	5.5	5.6	4.9	3.5	5.6	6.0	3.1	4.9	4.7	4.3	3.4	4.5
U	0.0	1.0	0.9	0.5	1.0	0.2	1.1	1.2	0.1	1.2	0.8	0.2
V	-2.7	-1.7	-1.7	-1.9	-1.5	-2.4	-1.7	-1.8	-2.2	-1.7	-2.1	-2.2
W	-1.1	-0.5	-0.4	-0.6	0.1	-0.9	-0.6	-0.8	-0.8	-0.6	-0.8	-1.0
Y	-2.3	-1.4	-1.6	-1.5	-1.6	-2.2	-1.5	-1.6	-2.1	-1.3	-1.8	-1.9
Zn	-3.3	-1.5	-1.5	-2.5	-1.4	-2.9	-2.0	-2.1	-3.0	-1.8	-2.0	-2.0
Zr	-1.4	-1.1	-1.1	-0.9	-0.9	-1.3	-1.0	-1.1	-1.2	-0.9	-1.1	-1.2
Hg	0.7	0.9	0.4	-0.3	1.1	1.5	-0.6	0.9	0.9	0.1	-0.2	0.2

3.7 Groundwater chemistry (Old TSF)

Recent (early 2018 and late 2017) groundwater chemistry in key bores (Figure 14) are presented on a piper diagram (Figure 11). For reference recent surface water chemistry in the Sump 6 and Gunpowder Creek (GPA5 and GPA7) are also included in this dataset. Dissolved copper is also included as an example metal. Of note Sump 6 is significantly higher in dissolved copper (Figure 12) and sulfate (Figure 13) than all bores, with GWMB32 the next highest elevated.

Table 9 Recent major ions and dissolved copper in key locations

Sample ID (year of sample)	Na	K	Ca	Mg	s	Carbonate as $CaCO_3$ (0.5 = <LOR)	Cl	SO_4	Cu
Units	(mg / L)	(mg / L)	(mg / L)	(mg / L)	(mg / L)	(mg / L)	(mg / L)	(mg / L)	(mg / L)
LOR	1	1	1	1	0.4	0.5	1	1	
BH05(18)	52	74	505	848	330	0.5	26	3050	0.459
BH02(18)	167	51	572	287	156	0.5	80	2040	2.14
GWMB08(18)	72	100	437	287	207	0.5	33	1980	1.33
GWMB09(18)	48	87	444	259	203	0.5	26	1960	6.63
GWMB30(18)	29	10	355	149	324	0.5	20	1130	0.285
GWMB31(18)	48	31	495	661	327	0.5	23	3280	3.29
GWMB32(18)	59	20	484	725	520	0.5	36	3800	21.9
GWMB33(18)	259	288	210	486	189	0.5	37	2720	0.072
GWMB08(17)	62	62	396	272	199	0.5	28	2120	1.19
GWMB09(17)	56	56	484	308	239	0.5	25	2430	3.67
GWMB30(17)	34	34	341	142	289	0.5	12	1020	0.016
GWMB31(17)	273	273	212	527	319	0.5	45	3080	0.027
GWMB32(17)	57	57	488	731	269	0.5	34	4230	99.1
GWMB33(17)	50	50	498	673	321	0.5	6	3630	1.68
SUMP 6 (18)	63	26	451	486	0.4	0.5	39	4670	759
SUMP 6 (17)	63	25	439	491	0.4	0.5	32	5010	389
GPA5(17)	2	4	8	4	30	0.5	3	9	0.007
GPA5(18)	5	6	21	20	45	0.5	5	78	0.007
GPA7(17)	10	8	40	38	57	0.5	10	183	0.014
GPA7(17)	4	6	17	15	34	0.5	6	72	0.013

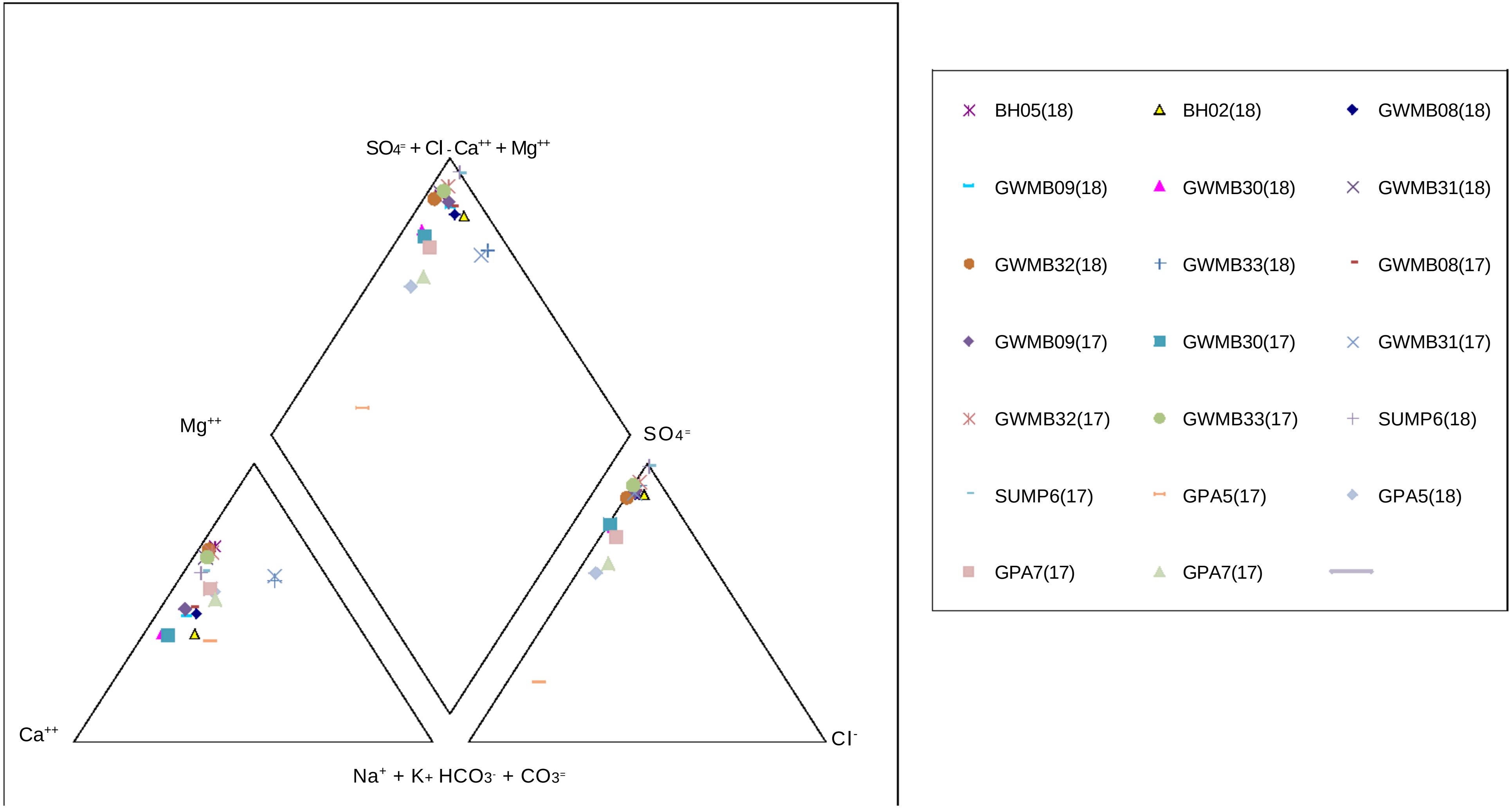


Figure 11 Piper plot of recent groundwater chemistry

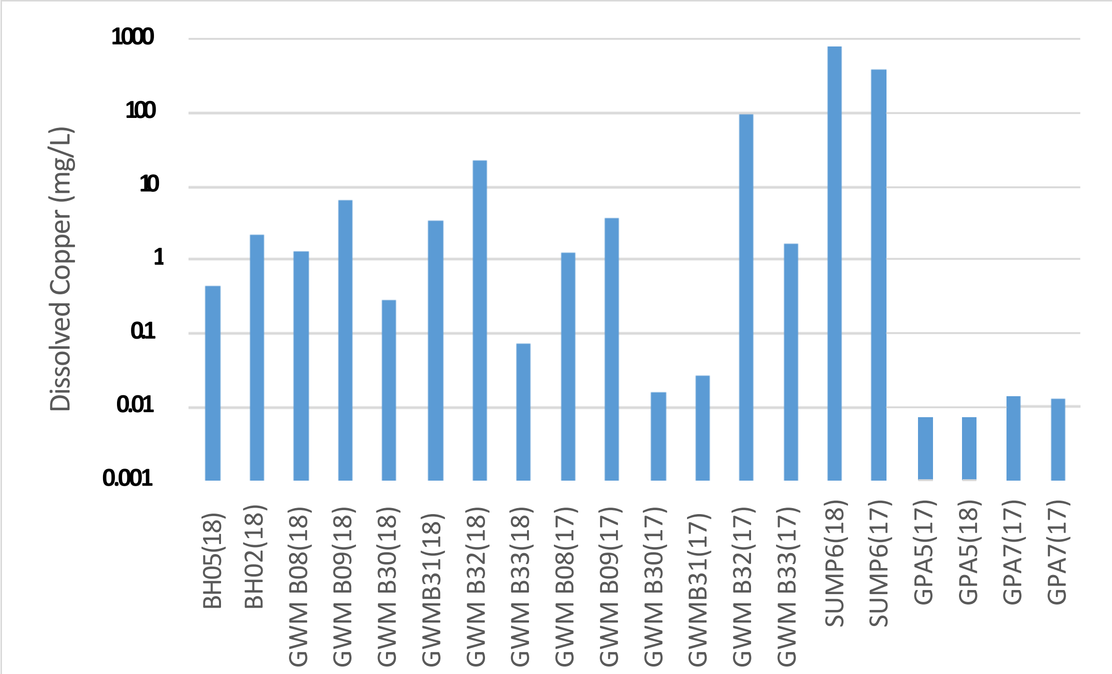


Figure 12 Recent dissolved copper results in key locations

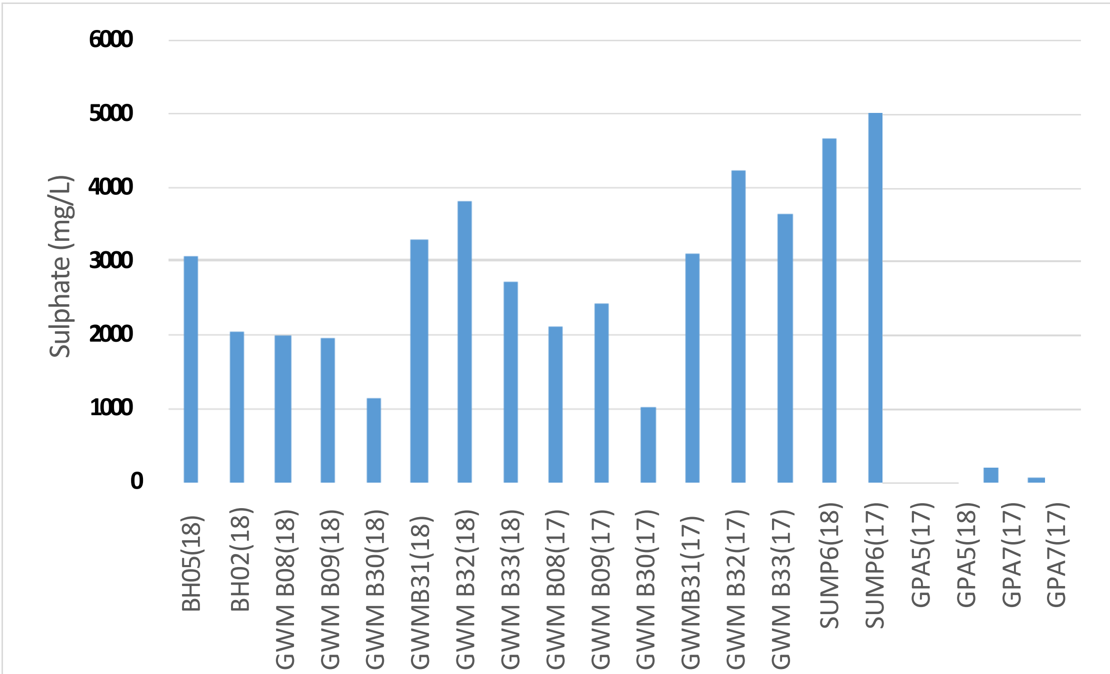


Figure 13 Recent sulfate results in key locations

3.8 Groundwater levels and cross-sections (Old TSF)

To build on the conceptual hydrogeological model of the Old TSF, groundwater levels in key bores (Table 10) are considered in the context. This puts the likely flow directions into a 3D context and confirms the receiving environments. For the purpose of this report, the receiving environment is considered the Gunpowder Creek which has an approximate stage (creek water level) elevation of 196 mAHD (Figure 14). Likewise, Sump 6 is at the northern toe of the Old TSF and is at an approximate elevation of 201 mAHD (Figure 14).

Table 10 Standing water levels (SWL) in key bores

Bore	Count	Min SWL (m)	Max SWL (m)	Average SWL (m)	Collar (mAHD)	SWL Average (mAHD)
GWMB09	67	0.67	4.90	2.42	215.15	212.73
GWMB11	73	0.29	4.26	1.66	215.80	214.14
GWMB12	80	0.28	7.27	1.88	215.02	213.14
GWMB13	75	0.07	4.43	1.49	215.23	213.74
GWMB30	82	2.27	8.00	6.31	202.39	196.08
GWMB31	75	15.81	28.39	21.13	222.95	201.82
GWMB32	84	0.00	2.20	1.68	198.97	197.29
GWMB33	84	2.82	6.35	4.64	199.90	195.26
GWMB36	84	0.47	4.54	2.87	196.78	193.91
BH05	1	13.55	13.55	13.55	225.60	212.05
BH02	1	16.43	16.43	16.43	224.55	208.12
Old TSF1A	73	12.51	16.29	14.20	224.55	210.35
Old TSF1B	58	4.26	9.74	9.49	224.55	215.06
Old TSF2A	73	11.60	20.10	18.42	226.43	208.01
Old TSF2B	64	8.87	13.84	13.08	226.34	213.26

Where bore logs are available, hydrogeological units have been included on cross and long sections through the Old TSF (Figure 14 to Figure 19) along with average water levels. The hydrogeological units are simplified as:

- Fill
- Tailings
- Bedrock (shale or siltstone).

Figure 14 Old TSF bores and section lines

Figure 15 Orthogonal view of the Old TSF looking north at a dip of 45 degrees, bores, section lines in white, vertical exaggeration at 3

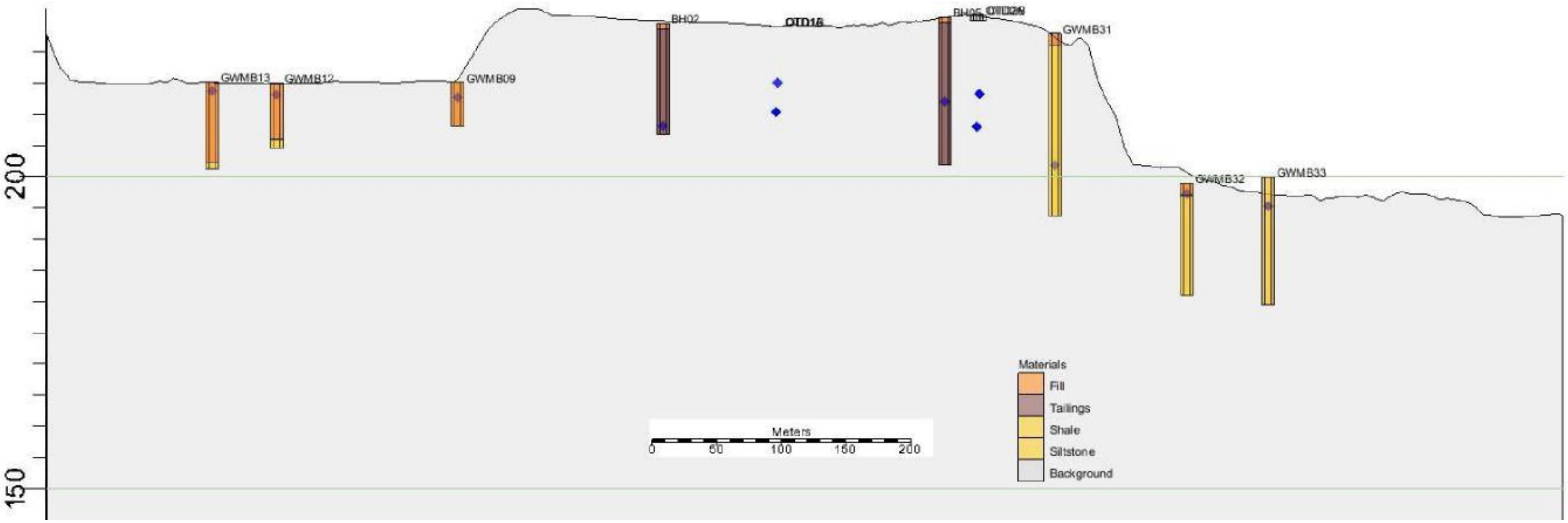


Figure 16 Long section 1 looking west with, topography, key boreholes, average standing water levels (blue diamonds at (GWMB13, GWMB12, GWMB9, BH02, Old TSF1A, Old TSF1B, BH5, Old TSF2A, Old TSF2B, GWMB31, GWMB32 and GWMB33) vertical exaggeration at 5

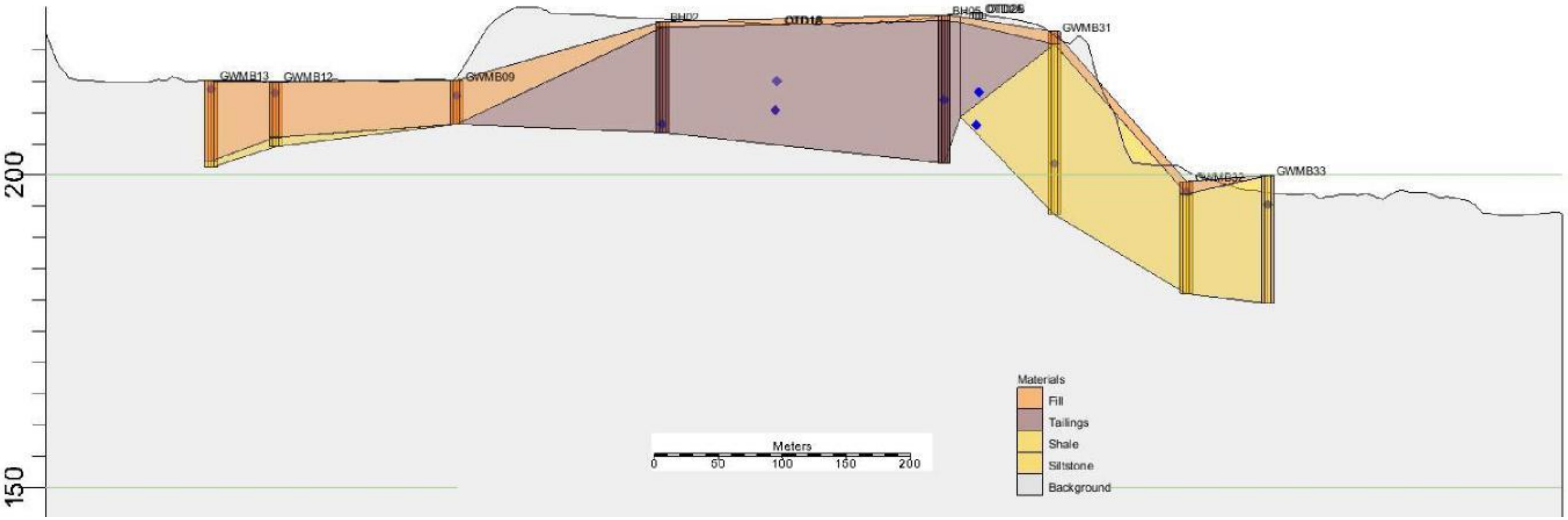


Figure 17 Long section 1 looking west with, topography (mAHD), key boreholes, average standing water levels (blue diamonds) and fence diagram, vertical exaggeration at 5

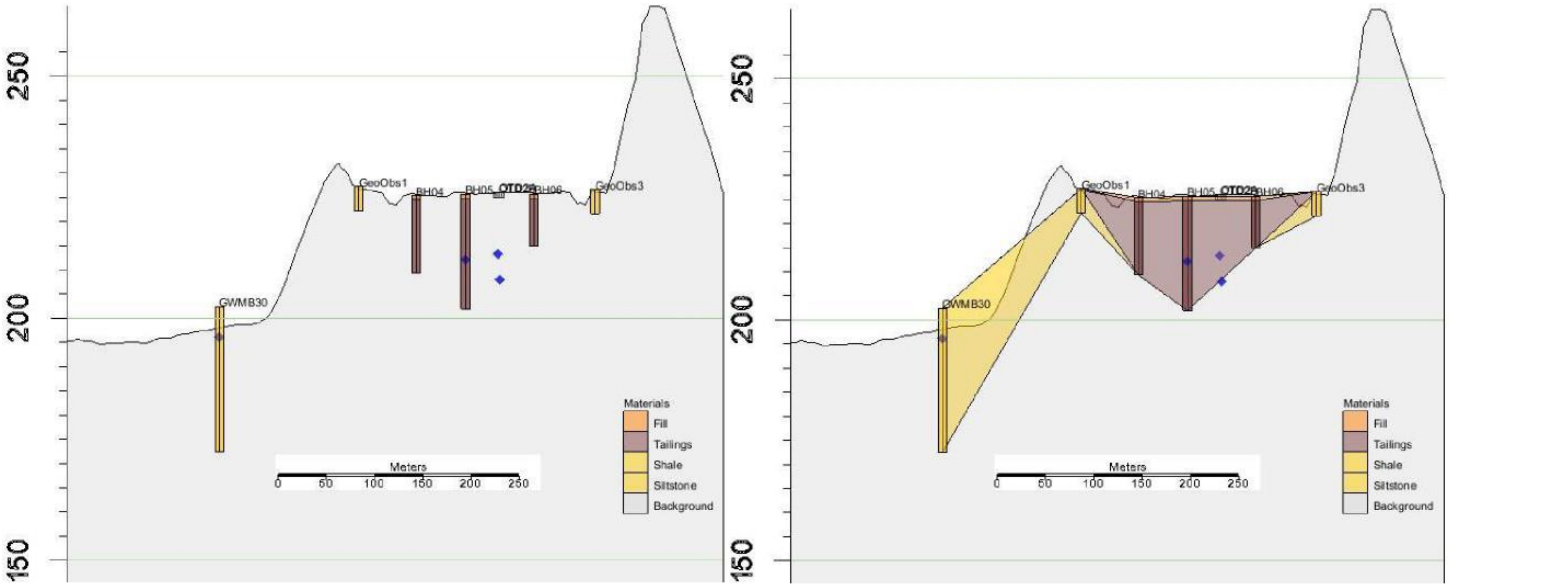


Figure 18 Cross section 1 Looking north with topography (mAHD), key boreholes, average standing water levels (blue diamonds at GWMB30, BH5 Old TSF2A, Old TSF2B) and fence diagram, vertical exaggeration at 5

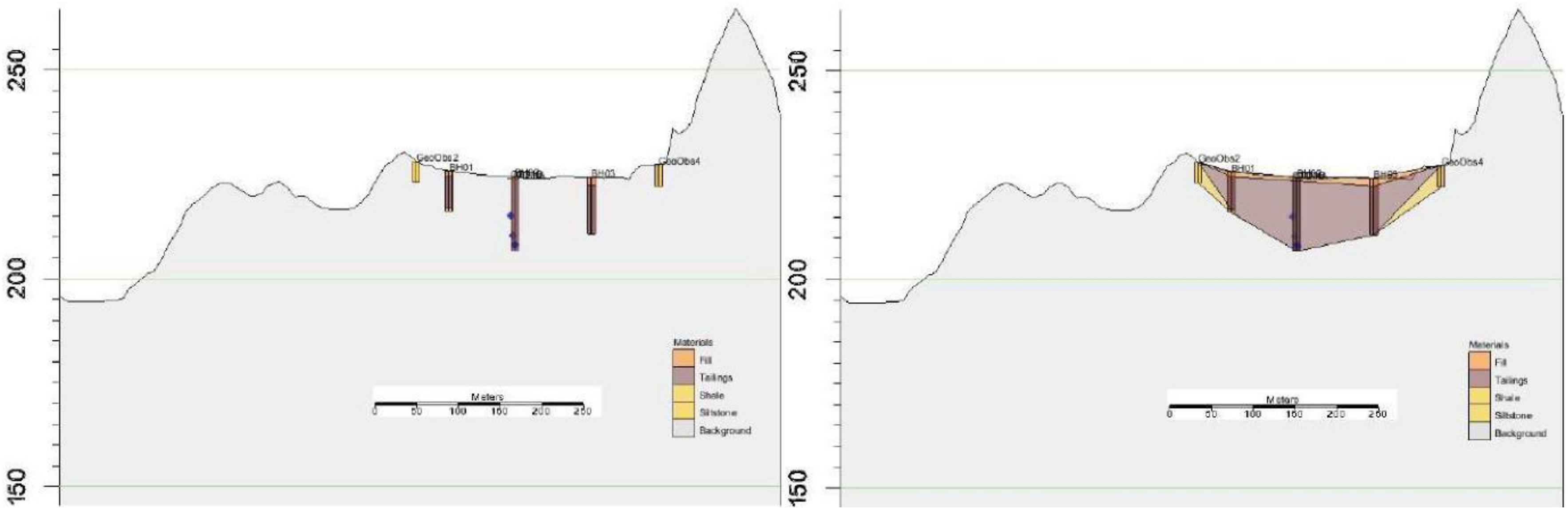


Figure 19 Cross section 2 looking north with topography (mAHD) key boreholes, average standing water levels (blue diamonds at BH02, Old TSF1A and Old TSF1B) and fence diagram, vertical exaggeration at 5

3.9 Summary of the flow regime (Old TSF)

The conceptual hydrogeological model for the Old TSF is summarised as follows:

- The primary shallow groundwater flow direction is highly likely to be along the axis of the Old TSF (NNE) following the pre-mining topography to Gunpowder Creek.
- The majority of groundwater flow is likely to be within tailings, waste rock and shallow fractured bedrock.
- A clay core within the northern embankment is likely to limit this northward flow occurring directly out of the face / toe of the Old TSF.
- Flow (most likely beneath the aforementioned clay core) results in a significant quantity of this groundwater seepage being intercepted and reporting to Sump 6.
- Groundwater seepage intercepted and reporting to Sump 6 is elevated in sulfate and metals relative to all other waters in the Old TSF.
- Relative to the above, deep groundwater flow is hypothesised to be negligible, like elsewhere on site.
- A minor (as yet unquantified) portion of groundwater flow could conceptually flow radially from the high groundwater points within the TSF. Such flow is considered:
    1. Likely the west (as indicated by low groundwater levels within the Old TSF of ~208 to 210 mAHD at BH05, Old TSF1A and Old TSF2A) through the basement / embankment which has low points of 222 mAHD and 227 mAHD discharging to Gunpowder Creek at 196 mAHD or below, but likely to be at very low rates as indicated by the chemistry at the bore GWMB30 and the receiving environment GPA5.
    2. Highly unlikely through the topographical high to the east of the Old TSF which is significantly higher at 252 mAHD at its low point (although this is not yet demonstrated).
    3. Unlikely southwards due to slightly elevated groundwater levels in GWMB09, GWMB11, GWMB12, and GWMB13 all at ~213 mAHD.

3.10 Summary of the geochemical results and hydrogeological information (Old TSF)

Old TSF tailings are geochemically classified as PAF and not considered an appropriate material for use as closure materials elsewhere.

Given the chemistry of Sump 6 is significantly elevated with respect to sulfate and metals (copper provided herein as an example), it is likely to be the result of oxidation (and potentially hydrolysis) of tailings within the Old TSF. That it is elevated even higher than observed elsewhere (including within the bores in the tailings), could suggest that:

- Water quality is deteriorating along the flow path (i.e. not just shallow oxidation is occurring, but iron hydrolysis at low pH is occurring without the need for oxygen); and / or
- Water reporting to the sump now still reflects quality associated with previous practices within and on the Old TSF (i.e. other contaminated catchment influences as discussed in section 3.1), due to travel times through the Old TSF which are anticipated to be in the order of years to decades.

3.11 Recommendations (Old TSF)

Ongoing management of Sump 6 is recommended as a priority for management of the seepage from the Old TSF as previously identified and being undertaken by CCM. Surface water management as discussed in Capricorn Copper (2017) should be maintained to prevent pooling and infiltration.

A more modern cover design with increased thickness of growth medium with a reduced permeability layer and capillary break e.g. EMM (2015) or alternatives as discussed in section 5) is highly likely to decrease the net mass loading of contaminants to Sump 6 as a result of rainfall infiltration in the long term. Given the chemistry of the Old TSF groundwater and tailings material and likely travel times within the Old TSF, an inert cover system (non-acid forming) is not likely to result in significantly improved conditions within the Old TSF in the short to medium term (years to decades) or address potential seepage generated from other contaminated catchment influences as discussed in section 3.1. Likewise, even an acid consuming cover system may not result in immediate leaching of neutralising material through the system nor significantly improved conditions within the Old TSF in the short to medium term (years to decades).

This supports the option of adopting an adequate cover material /solution that could result in a net benefit in seepage rates as a result of rainfall infiltration being achieved without the need to disturb additional areas to source natural low permeability materials. Such alternates are discussed in section 5.2.

3.12 Summary of the geochemical results and hydrogeological information (HLEP#2)

HLEP#2 materials are currently above water table (unsaturated). The HLEP#2 material is overlain by a High Density Polyethylene (HDPE) liner (albeit requiring minor repair) which is likely to limit infiltration to the underlying material. HLEP#2 materials may be considered an appropriate material for use as closure materials elsewhere given that they have already been leached, and contain relatively low sulfur and metals compared with other site materials. Given the leaching that has already occurred, they pose a relatively low risk of further oxidation in their current state. HLEP#2 is not seen as a risk of causing additional environmental harm.

3.13 Recommendations (HLEP#2)

Further consideration of the material properties / chemistry could result in these materials becoming a useful closure material (e.g. as rockfill for alternate Old TSF LST filtration and dry stacking discussed in section 5). If left in-situ, the HDPE liner could be repaired and maintained to prevent infiltration until the HLEP#2 is rehabilitated.

However, given its small surface area, and the requirement for capping under the TEP by 1 March 2019, any cover material /solution as preferred by CCM e.g. EMM (2015) or alternatives discussed in section 5.2 would be suitable.

4. HST and LST geochemical and geotechnical results

A single sample each of HST and LST were provided by CCM for laboratory testing to provide indicative results to aid design decisions for alternative cover systems. The following presents the results from these two samples.

4.1 AMD classification (HST and LST)

AMD classifications for HST and LST are presented in Figure 20, Figure 21, Figure 22 and Table 11. As anticipated, HST were classified as potentially acid forming (PAF) and LST as uncertain (UC). It should be noted that the LST represent a significantly lower risk of AMD generation than HST and other tailings on site (i.e. those at the Old TSF discussed above).

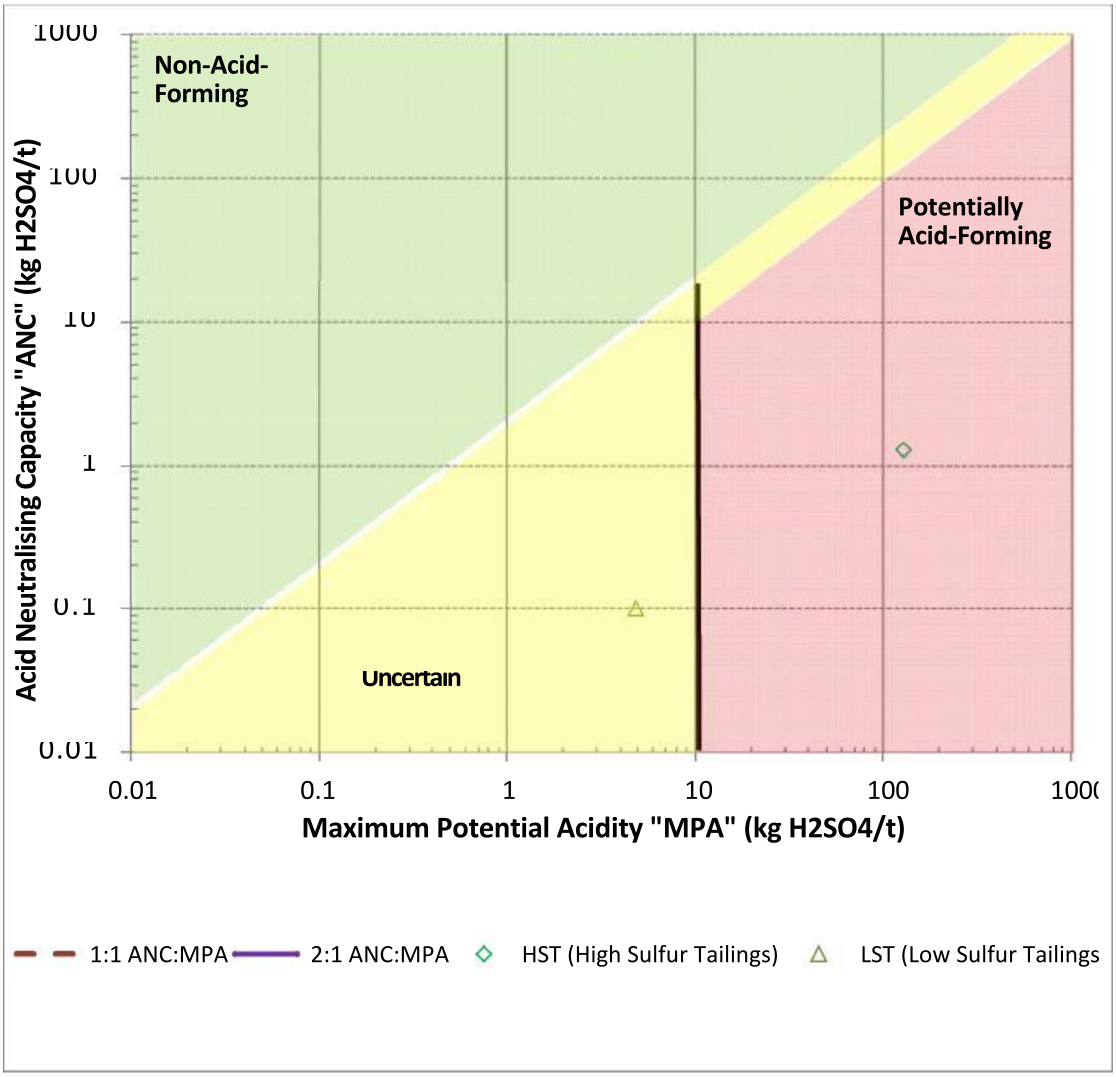


Figure 20 ANC vs MPA (HST and LST)

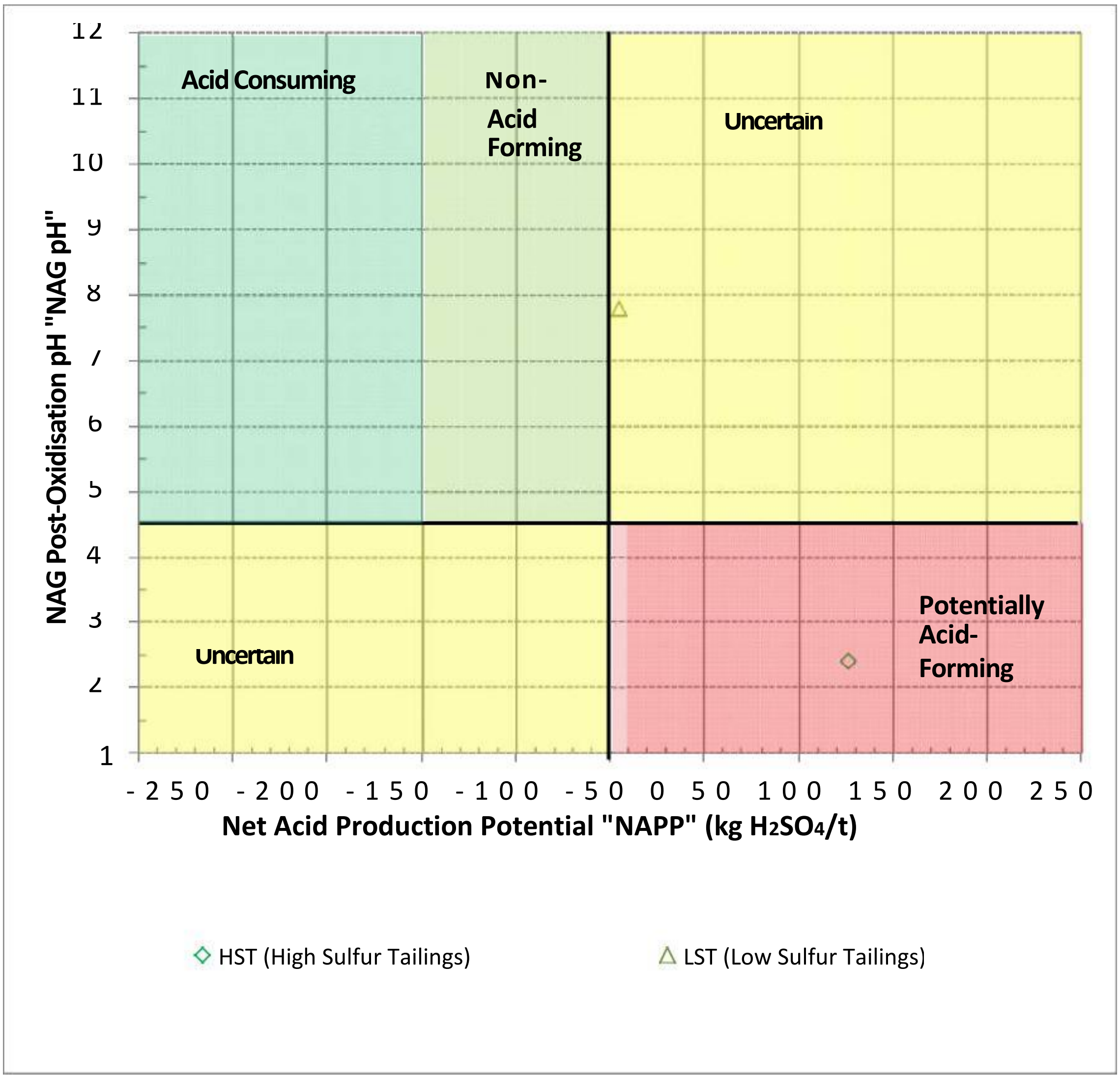


Figure 21 NAG pH vs NAPP (HST and LST)

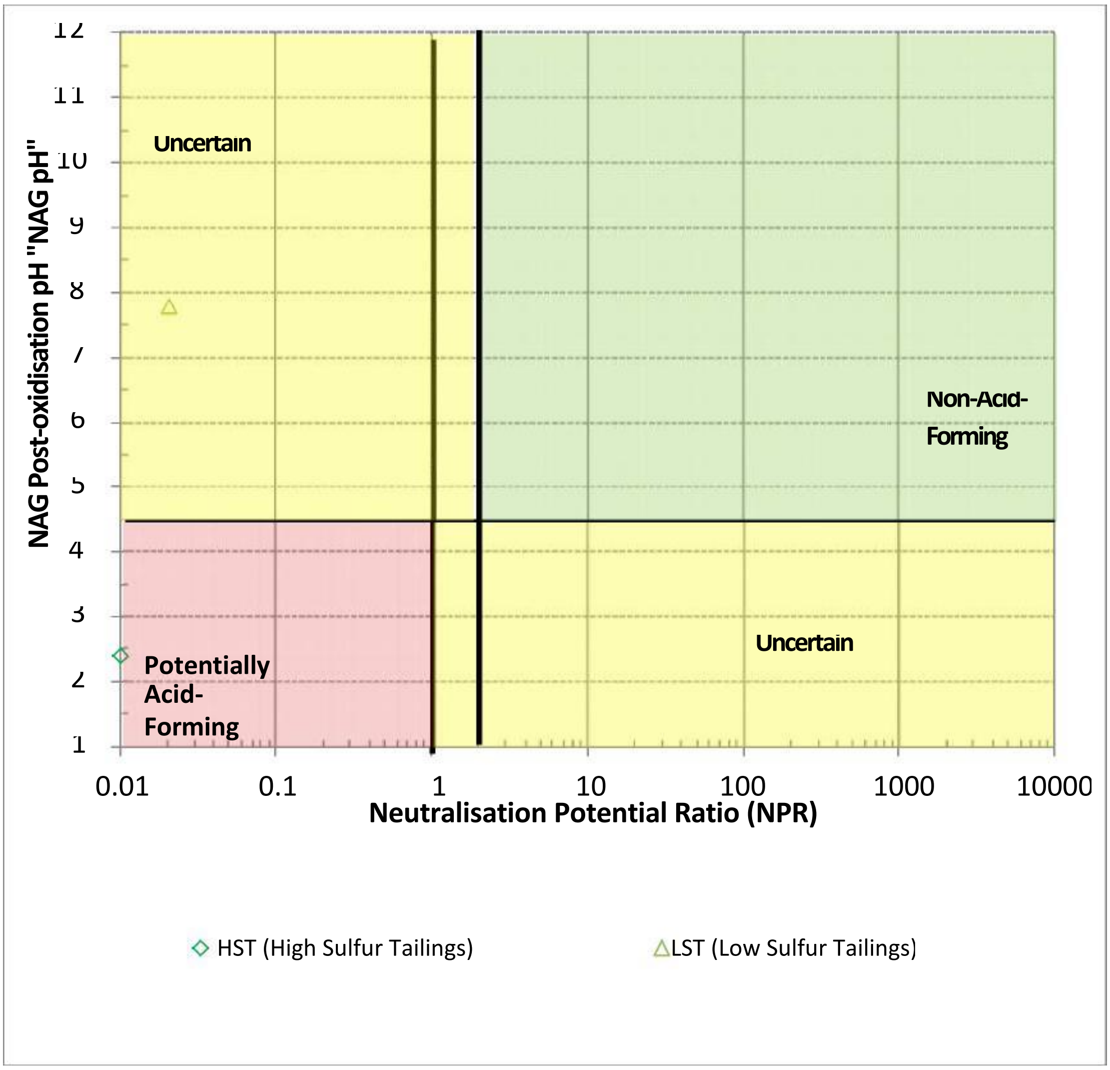


Figure 22 NAG pH vs NPR (HST and LST)

Table 11 AMD classification summary table (HST and LST)

Sample ID	Location	Waste Rock Class	NAG pH/ pHox	NAG pH4.5 (kg/t H_2SO_4)	NAG pH7 (kg/t H_2SO_4)	ANC (kg/t H_2SO_4)	Total Sulfur (%S)	Sulfate Sulfur (%S)	Sulfide Sulfur (%S)	Calc MPA (kg/t H_2SO_4) (%S*30.6)	NAPP (kg/t H_2SO_4)	NPR (ANC / MPA)	NAG pH7as %S Equiv	NAG pH7 as Mol H^+/t	AMD Class	ANC (%H_2SO_4 or %$CaCO_3$)
LOR			0.1	0.1	0.1	0.10			0.010	0.1	0.1		0.01	1		0.1(
HST	HST	HST	2.4	30.0	56.0	1.30	4.70	0.530	4.170	127.6	126.3	0.0	1.83	1142	PAF-HC	0.04
LST	LST	LST	7.8	0.3	0.3	0.10	0.22	0.062	0.158	4.8	4.7	0.0	0.01	5	UC	0.00

4.2 Metal contents (HST and LST)

Total metal contents are considered relative to GAI. An assay GAI value greater than 3 is considered enriched (Table 12). LST are considered enriched in copper and arsenic, although at a significantly lower concentration than the HST. HST are considered enriched in silver, arsenic, cadmium, copper, sulfur, antimony, and thallium. It is noted that the Capricorn Copper Post Land Use Plan indicates that previous soil surveys completed by NRA in 1995 suggested that naturally occurring soils exist with high copper and arsenic, with concentrations of 120 mg/kg and 58 mg/kg respectively.

Table 12 Metal contents relative to GAI values (GAI > 3 are red values) and QLD EPA Env Trigger Values (exceedances are orange values)

Metal	Unit	QLD EPA Env Trigger Value	HST	LST	Avg Shale / Crustal Abundance)	GAI HST	GAI LST
Ag	ppm	20	6.1	0.2	0.07	5.8	0.9
Al	ppm		2100	2400	82300	-6.0	-5.8
As	ppm	20	1400	58	1.8	8.9	4.4
B	ppm		22	5.3	10	0.5	-1.6
Ba	ppm	400	52	24	425	-3.7	-4.8
Be	ppm	15	<0.05	0.16	3		-4.9
Ca	ppm		2600	3700	42000	-4.7	-4.2
Cd	ppm	3	8.5	0.2	0.2	4.7	-0.7
Co	ppm	50	90	12	25	1.2	-1.7
Cr	ppm	50	47	50	100	-1.7	-1.7
Cu	ppm	60	6100	850	55	6.1	3.3
Fe	ppm		49000	9900	200000	-2.7	-5.0
K	ppm		540	620	21000	-5.9	-5.7
Li	ppm		1.8	1.8	20	-4.1	-4.1
Mg	ppm		1200	3500	23000	-4.9	-3.4
Mn	ppm	500	82	270	950	-4.2	-2.5
Mo	ppm	4	2.2	1.2	1.5	-0.1	-1.0
Na	ppm		37	45	24000	-10.0	-9.7
Ni	ppm	60	60	13	75	-1.0	-3.2
P	ppm		180	180	1050	-3.2	-3.2
Pb	ppm	300	130	6.9	12.5	2.7	-1.5
S	ppm		50000	1900	350	6.5	1.8
Sb	ppm	20	23	2	0.2	6.2	2.7
Se	ppm	3	<1	<1	0.05		
Sn	ppm	50	7	1.2	6	-0.4	-3.0
Sr	ppm		7	2.5	375	-6.4	-7.9
Ti	ppm		13	22	5700	-9.4	-8.7
Tl	ppm		27	0.8	0.45	5.2	0.2
V	ppm	70	5	7.4	135	-5.4	-4.8
Zn	ppm	200	17	8.6	70	-2.7	-3.7
Hg	ppm	1	0.34	0.09	0.08	1.4	-0.5

4.3 Summary of the geochemical results (HST and LST)

The LST material presents a significantly lower risk than the HST material due to, not only their low sulfur contents but also their low metal contents. This highlights the potential for LST to be used as a closure material across the site. That it is considered enriched and above QLD EPA Env Trigger values requires further consideration, however, the same document (QLD EPA, 1995) states: “The indicative remediation levels for metals do not take into account potentially elevated levels which may be encountered in naturally mineralised areas. Under these circumstances higher levels may be acceptable for a specific tenure.” Consideration of the above, in conjunction with ongoing sampling to validate the actual content of the LST applied to any features is recommended if LST is used as closure materials.

4.1 HST and LST geotechnical results and summary

Geotechnical testing HST and LST comprised particle size analysis and Emerson Class dispersion testing with results shown in Table 13 and Table 14 .

Table 13 Particle size analysis

Grain Size	HST % passing	LST % passing
600 µm	100	100
300 µm	99	100
212 µm	98	98
63 µm	71	66

Table 14 Emerson class

	HST	LST
Emerson Class Number	4	4

Based on the geotechnical test results the LST material has sufficiently high fines content to form a low permeability cover material.

The LST with Emerson Class 4 is considered potentially dispersive (Emerson Class 1-4 being dispersive and 8 non- dispersive). However, similar material is used in dam construction and other earthworks successfully. In the case of LST use as a low permeability layer this would be protected from erosion by the overlying growth medium. If LST was also used as a growth medium (upper exposed layer) this would still be feasible given the flat slopes of the cover limiting surface runoff velocities and even more so if LST mixed with granular material (potentially NAF waste, sourced from North WRD). In should LST be considered a risk for being dispersive if used as part of the growth medium, a small quantity of lime or gypsum can be mixed in to the soil to render the material non-dispersive (typically 1%-3% by weight).

5. Alternative rehabilitation / cover strategies

Following the site investigation at the Old TSF and HLEP#2 alternative management strategies to assist with the review of alternative strategies and comparison with current cover systems (EMM, 2015).

5.1 Current waste cover design

The approved waste cover design for CCM is specified in Table 5 of Capricorn Copper Post Mine Land Use Plan (NRA, 2015), which is summarised in Figure 23 below. This differs to the recommended cover design presented in the Final Cover Design Report (EMM, 2015).

It is noted that the EMM (2015) cover system has no drainage and root protection layer (Layer 2) as it has a thicker plant growth medium of 2 m and low permeability layer of 0.5 m above the 0.6 m thick bridging / capillary break layer. The cover had been modelled using Vadose / w software developed by Geoslope International and found that provided the low permeability layer is built to the design standard, the capillary break will never become saturated and will effectively close down percolation to the underlying tailings because it will create a permanent air entry value break between the overlying low permeability layer and underlying tailings. Percolation is expected to be limited to 0.025% and is not expected to exceed 2% if there is poor establishment vegetation, provided there is an air entry value break (EMM, 2015).

The cover was designed for Old TSF and HLEP#2 only, however it is considered appropriate to be adopted by the waste rock dumps (WRDs) at the mine. The capillary break layer can be left out provided that the waste rocks at the WRDs and HLEP are free draining.

A thicker trafficable layer is likely to be required for Esperanza TSF particularly on the decant pond. Although the Esperanza TSF has been decommissioned for 5 years it is likely that the tailings in the decant pond area are still soft and a thicker trafficable layer will be required as per the cover design. This should be confirmed by either by visual inspection and shear vane testing on the tailings to estimate soil bearing capacity.

The low permeability layer can be constructed using clayey material sources from the downstream toe of North WRD. The EMM (2015) report shows there is a sufficient materials balance for low permeability and growth materials to meet the design profile, however mining this materials will result in a significant area to rehabilitate. The plant growth medium and rocks for the bridging / capillary break layer can be sought from the Old TSF, Northern WRD or North Rock Quarry.

It is understood that a significant cover trial was conducted by CCM on Esperanza TSF previously including construction of multi-layers covers, vegetation and specific monitoring, however no details of the trial methodology or results was recorded (NRA, 2015).

Cover trials are recommended to be carried out as described in section 5.5 to allow data collection to assess the effectiveness of this cover. HLEP#2 may provide an opportunity for cover trials using conventional clay capping i.e. EMM (2015) for future consideration given its low environmental risk, small footprint and requirement for capping by 1 March 2019.

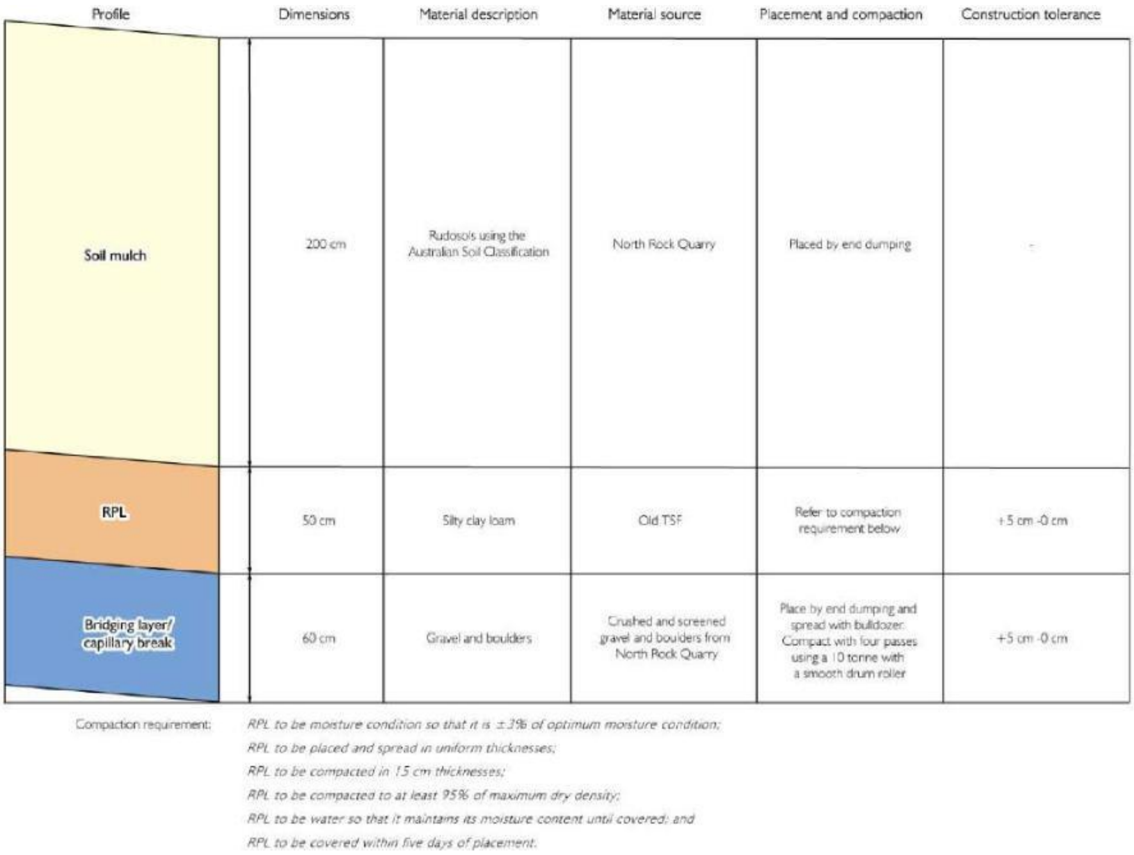


Figure 23 Cover design (EMM, 2015)

5.2 Assessment of alternative strategies

The following alternative strategies have been considered:

- HLEP#2 total removal of materials for use in capping other areas, this material could be used as a bridging layer over tailings or as a growth medium.
- Use of LST as a low permeability capping material and growth medium. There are a number of strategies considered to deliver the LST which include slurry form (A) or paste / dry stack form (B). These are compared at a high level in Table 15 and the associated technology discussed below.

Table 15 Alternative strategies for LST capping comparison

Item	Slurry	Paste / Dry Stack
	1A - Discharge LST tailings onto waste facilities using conventional tailings deposition method with cyclones where required	1B - Cap waste facilities using thickened paste / dry stacked tailings
LST Tailings Deposition	LST tailings being delivered by pipeline in slurry form to TSF for deposition to form cover materials. Typically 50% solids by weight. Could be operated all year round.	LST tailings will be pumped from the Mill in a slurry to a centrally located paste / filtration plant. Paste / Filter cake would be hauled, placed, spread and compacted to form unsaturated, dense and stable tailings “stack”.

Item	Slurry 1A - Discharge LST tailings onto waste facilities using conventional tailings deposition method with cyclones where required	Paste / Dry Stack 1B - Cap waste facilities using thickened paste / dry stacked tailings
		Typically 70-80% solids by weight. Paste / dry stack cover materials are assumed to only operate 6 months / year during dry season when materials can be placed and compacted.
Water Management	TSF's: Maintain a 100 m minimum tailings beach, return water to plant for reuse where possible to keep the decant pond as low as practical. Residual pond left to evaporate after achieving the required cover thickness after accounting for settlement / consolidation. Re-work dried LST as required to achieve cover system design. WRDs / Heap Leach Pads: Given there would be significant water losses through coarse WRD's and possible containment issues, a conventional slurry would not be suited for deposition directly on WRD's, however cyclones could be placed on WRD's to extract a drier product (70% solids) with the fines and water returned via pipeline to the process plant.	Paste and filtered tailings would have negligible to no bleed water. Surface water runoff collection and diversion would be required to divert surface runoff away from the filtered materials prior to and post placement.
Costs	CAPEX for tailings deposition pipelines is minimal as this is mostly already in place. OPEX would be considered negligible as there is no change from conventional operations. Costs for the HST separation and paste plant for HST deposition are already accounted for in current operations. Additional CAPEX / OPEX for the cyclones for use on the WRD's only would be required.	CAPEX and OPEX for paste thickener and filtration plants are extra over current conventional tailings slurry deposition and have been discussed and costed below. CAPEX / OPEX for these options are thus higher than conventional deposition and higher than using cyclones. However, this does not consider whole of mine life operations with respect to future tailings management and is therefore not directly comparable.
Time	Time consuming for tailings to dry on TSF's, can only deposit tailings in thin layers and allow them to dry over the dry season. Cyclones could only be used in dry season when materials can be spread and compacted as required. Likely that this option would take up to 2 years to complete and would not be completed within TEP timeframe of 1 March 2019.	Will take less time than conventional tailings discharge as filter cake can be trucked, spread and compacted readily as soon as it is produced or can be stacked / stored at a place and move as needed. Capillary break and plant growth medium (possibly also modified LST) can be laid immediately on the dry stacked tailings. Works could be completed within TEP timeframe of 1 March 2019.

Item	Slurry	Paste / Dry Stack
	1A - Discharge LST tailings onto waste facilities using conventional tailings deposition method with cyclones where required	1B - Cap waste facilities using thickened paste / dry stacked tailings
Risks / Limitations	Not feasible if LST tailings are not available. Depending on weather for the drying of tailings. May require major EA amendment for raise of dam wall and placement of LST slurry.	
Advantages	Reduces the storage capacity of the TSF required to store LST tailings. Save 5000 m3 / ha of clay to construct the low permeability layer (0.55 Mm3). Potential use as growth medium.	Reduces the storage capacity of the TSF required to store LST tailings; Save 5000 m3 / ha of clay to construct the low permeability layer (0.55 Mm3). Potential use as growth medium Minimum water loss.

5.2.1 Thickening and filtration options

Cycloning, paste thickening and filtration options to produce a dried LST product for use as cover materials are discussed further below. The assumptions and basis for the work presented herein is shown below. Paste and filtration laboratory testing is being undertaken to confirm assumptions which would allow vendor pricing and refinement of the CAPEX / OPEX.

Table 16 LST thickening and filtration parameters

Parameter	Units
Total tailings production	1.6
HST production	0.16 Mtpa
LST production	1.44 Mtpa
Tails feed solids	min 45-50% w/w
Grading	finer than 63 um 75%
SG	2.7
Solids required for dry stacking	75
Availably	80%
Solids Concentration %	75 % w/w
% of year in operation (dry season)	50%
Hours / 6 months	8,760
Tonnes dry stacked materials	262,800 t / annum
Assumed dry density cover materials placed	1.6 t / m^3
Cover material produced / placed	164,250 m^3
Cover material produced / placed	32.9 HA at 0.5 m thick

General

The estimate for thickening of the LST to cap the waste rock dumps is based on historical data and information provided by vendors. As no particle size distribution apart from the 75% passing 63 micrometre is available the equipment is generic and based on rules of thumb to some extent. Laboratory testing currently ongoing will confirm viability of paste and filtration facilitating refinement of costs.

The determination of the 75 tph of dry solids is based on a 6 month dry season operation with continuous operation, this could effectively enable placement of 32.9 HA of 0.5 m thick low permeability LST capping over a facility in a dry season (less if the LST was also used as the growth medium). This is considered a workable placement volume to progressively cap facilities during mine operation, however the throughput could be increased should this be deemed required.

CCM has confirmed that the Greenstone Ore is non-acid generating and can be a source of low sulphur tailings without additional flotation cells. Based on current operations, CCM expect to generate up to 1 million tonnes of LST material with 40% of this be treated over the 2018 / 2019 period. This is sufficient capacity for capping of Old TSF and HLEP#2.

Belt filters

Belt filters have a discharge rate that is limited to around 10 $m^3/h/m2$ of active belt filter area. This is optimistic as removal of liquid in the filter cake interstices with fine cakes is sometimes a problem and so a 5 $m^3/h/m^2$ rate has been used to size the belt filter required and the estimate based on a 2 m wide belt with a 7 m long filtering section as a realistic sizing.

The costing summary presented below is based on similar filters with ancillaries from historical data bases updated to present day costs.

Recessed plate filters

Based on previous projects which have Recessed Plate Filters installed it is expected to discharge a filter cake that is approximately 70% w/w at a rate per filter of approximately 15 tph for a large filter. For CCM a 75 tph filter cake discharge rate is required and so 5 filters of the same size will be required.

Paste thickening

Paste thickening may achieve an underflow density of 75% however this depends on confirmation testing of tailings samples.

Paste tailings would have negligible bleed water so would be suitable for discharge onto a flat sections of a WRD or tailings landform. However, due to the steeper beach angle than conventional tailings the paste discharge would require regular moving and dozing or the material to form the final landform.

Cyclones

Cyclones have a maximum expected underflow from a thickening cyclone of around 70% for the LST but this depends on the particle size distribution (PSD) which is not currently available (results outstanding). Weir have carried out a preliminary analysis based on passing 75% of particles sized at 62 um and expect that 70% will be the likely maximum underflow but such would depend on actual tests. The slime fraction and water would be returned back for reuse in the process plant.

The benefit of cyclones are that they can be moved to each waste facility to be covered to reduce the need to truck and haul, unlike other fixed filtration and paste plant.

5.3 Alternate cover cost estimates compared to EMM (2015)

The scope of the CAPEX / OPEX cost estimate includes:

- A pump set at the plant to pump the required LST to the thickening plant located in the field.
- A 100 m^3 agitated tank is allowed for at the site of the new thickening equipment from which a pump will feed the thickening plant. For the option of a paste thickener an underflow pump is required to stack out. For cyclones and belt filters there will be sufficient elevation to deposit onto a pad. For the plate and frame option there will be a set of collector and elevating screws.
- The thickening equipment as covered in the options delineated above would be located at a position approximately central to the WRDs. For the larger equipment this cannot be skid mounted with the exception being the cyclones.
- The paste thickened discharge will be deposited on a pad and loaded by front end loader (FEL) onto trucks, this has been costed opposed to pumping to paste to each facility to remove the difficultly with high paste pumping costs and continual movement of the discharge point. It has been assumed that a 25 t payload is to be carried and that the round trip to the WRD / TSF's will be 20 minutes to match the production rate. The pad will have push wall for the FEL.
- The filtrate / overflow will be piped to an adjacent TSF as this stream is likely to be around 50 m3 / hr. It is expected that this can be a gravity discharge.
- The power is provided by diesel generator which have been allowed at sized at 100 kW to meet peak demand although this will vary with the type of equipment and for an average output at 75% maximum the diesel consumption will be 33 l / hr requiring a 1 kl tank to cover a 40 hour run time which allows for refilling daily.
- The cost of a dozer has been included which could be used for a day shift once a week which is thought to be able to spread the deposited tails at a rate of 1,000 tph with the trucks having deposited the load in discrete smaller piles. A week production would equate to 12,600 t (7,875 m3, or 15,750 m2 at 0.5 m thick, 50,000 m2). Placing in 0.15 m thick layers would require towards 70 hr week compaction with a sheepsfoot roller.
- Control is local by PLC or similar as included in a vendor package.
- The scope of the estimate excludes:
- Buildings over the field equipment. It is expected that although occasional rain events may occur that the additional expense is not warranted.
- Operational costs have been allowed as the cost of 2 x 12 hour shifts with an operator off shift i.e. 3 plant operators. There will be a similar requirement for the truck drivers and FEL drivers.

At this stage only belt filtration has been costed. Other costs are likely to be similar, with the exception of cycloning which is expected to be less CAPEX and slightly less OPEX.

Table 17 LST belt filtration CAPEX belt filtration CAPEX

CAPEX	$ ex GST
CIVILS and BUILDING WORK Civils & building work	157,800
Belt filter	914,000
TANK, PUMPS and PIPING Tank, pumps & piping	445,000
Electrical / control	325,000
ENGINEERING and PROJECT MANAGEMENT 0 Engineering & project management	276,00
Basic total	1,841,800
Contingency @ 20%	368,200
Total estimated cost of project	$2,210,000
PER m3 LST for 0.56 Mm^3 low permeability capping*	$3.98 / m3

Note; equivalent LST capping CAPEX rate decreases if LST also used for growth medium.

Table 18 LST belt filtration OPEX belt filtration OPEX

Item	Cost per annum	Comments
Maintenance	$100,000	Replacement / repairs to belt filter pumps and ancillaries at 6% of capital cost.
Diesel generator fuel	$290,400	Based on fuel at $2 / l 100 kw 33 l / hr
Personnel cost Plant	$352,000	Based on an operator at the plant continuously
Truck hire cost with operator	$660,000	Based on $150 / hr for truck including driver hire
FEL hire cost with operator	$880,000	Based on $200 / hr for FEL including driver hire
Dozer	$396,000	Based on $180 / hr for roller including driver hire full time day shift
Roller	$286,000	Based on $130 / hr for dozer including driver hire full time day shift
Total	$2,678,400	Equivalent to $16.31 / m^3 low permeability cap based on 164,250 m^3/ annum placed.

Based on the direct cost comparison of use of LST as an alternate to a low permeability capping material placed over the required landforms of 112 HA at 0.5 m thick are shown below. Conventional clay rates are based on a recently quote from QCrush 28 March 2018. However, this does not consider whole of mine life operations with respect to future tailings management and is therefore not directly comparable.

Table 19 LST Alternate cost comparison alternate cost comparison

Low Permeability Cover 0.5 m thick	CAPEX $	OPEX $ / m3	Volume m3	Total $
LST Alternate	$2,210,000	$16.31	559,900	$11,340,205
Conventional Clay	-	$6.86	559,900	$3,840,914

5.4 Discussion

Costs are presented for the use of filtered LST as an alternate to conventional clay for a low permeability capping layer. The comparative cost results show the filtering the LST material are higher than costs for conventional clay capping. However, this does not consider whole of mine life operations with respect to future tailings management and is therefore not directly comparable.

While the filtration costs are not favourable there are potential other beneficial uses such as disposing of tailings to save capacity elsewhere onsite. Filter tailings could also be used in the proposed upper Esperanza TSF to make a compacted low permeability upstream face on the existing WRD and or to bulk fill landforms to the desired profiles.

Further, filtration and dry stacking will take less time than conventional tailings discharge (i.e. slurry form) as filter cake can be trucked, spread and compacted readily as soon as it is produced or can be stacked / stored at a place and move as needed. The LST would form the low permeability layer and growth medium, the LST cover could be a similar in design to the EMM (2015) proposal. A capillary break would not be necessary on the WRD's due to their coarse nature per EMM (2015) and if a thick enough LST layer is placed a capillary break may not be required on the TSF's. Works could be feasibly completed within TEP timeframe of 1 March 2019.

Given the conventional clay placing is significantly lower comparative cost it would be feasible to reduce the total volume required of filtered LST and use slurry deposition over the Esperanza TSF and Old TSF (total 36 HA). This results in a reduction in required area / volume low permeability LST capping, but even still total LST cost would be $8.4 M which is well above the conventional clay capping.

Costs shown assume LST must be filtered prior to use. However, given the cost for filtration a lower cost alternate could be to use conventional LST slurry deposition to cap the Esperanza TSF and Old TSF which are suited to this and utilise conventional capping for the WRD landforms where slurry deposition is not practicable. This would essentially save a $1.23 M (36 HA of 0.5 m thick capping at $6.86 / m^3 based on rates from QCrush). This saving could be further increased should the LST be used as a growth medium for say 1.5 m of the total 2 m design thickness, resulting in a further $1.91 M (36 HA of 1.5 m thick capping at $3.54 / m_3 based on rates from QCrush). This would represent a total saving of $3.14 M in capping the TSF's over conventional clay and growth medium use. However, it is time consuming for tailings to dry on TSF's and LST in slurry form can only be deposited in thin layers with time to dry over the dry season. It is likely that this option would take up to 2 years to complete and would not be completed within TEP timeframe of 1 March 2019. It may also require an amendment to the Environmental Authority (EA) for raise of dam wall and placement of LST slurry.

5.5 Recommendations

The following actions are recommended to support the cover design with respect to the TEP completion date 1 March 2019:

- Continue with LST separation and reduce the cover requirements for future landforms i.e. proposed Upper Esperanza TSF.
- Conduct a series of cover trials by constructing covers with different thicknesses and layers on a 10 m x 10 m area of Old TSF. Install instrumentation including oxygen sensors, volumetric moisture content sensors, temperature sensors and lysimeters, etc. to provide data for the assessment of the effectiveness of different covers.
- Progress filtration and dry stacking as the cover option for Old TSF.
  Continue engineering design and finalise supplier arrangements.

- Develop detailed program of works / implementation plan for design, procurement and construction in line with relevant TEP dates being 1 November 2018 (CAPEX) and 1 March 2019 (project completion). Concept plans for this option are provided in section 5.6.

5.6 Concept filtration and dry stack implementation plan (Old TSF)

The following provides a concept implementation plan for LST filtration and dry stacking at the Old TSF (and other facilities).

Construction of filtration plant at central location to the landforms to be covered, most likely this would be on the North WRD. Tailings would be thickened at the Mill utilising existing equipment and pumped to the filtration plant, this may require an upgrade to the existing pumping system. The filtration plant would be sized to enable full capping of the Old TSF in the required timeframe. Adopting 2.5 m thick cover comprising a low permeability compacted LST layer 0.5 m thick, underlying a growth medium 2 m thick comprising of 1.5 m LST with 0.5 m of NAF gravel rockfill mixed into the upper surface to provide a stable material. This requires a total 220,000 m3 or 330,000 tonnes LST, at 1.5 t/m^3 average placed dry density for the 11 Ha Old TSF cover. Over a 4 month period this would require an annual production rate of 990,000 tonnes. This is within the total production mill production rate of 1.6 Mtpa of which 1.44 Mtpa is expected to be LST with the remaining 10% being HST placed as underground paste backfill. It is therefore envisaged the filtration plant will be sized indicatively to suit 1 Mtpa-1.44 Mtpa pending assessment of total project requirements. The sizing of the filtration plant will also consider the life of mine tailings management requirements.

It is envisaged a FEL would remove the filtered LST from the stockpile and load it to articulated dump trucks for hauling to the Old TSF (and other landforms for future capping). Once the surface area was prepared, which for the Old TSF would include stripping and stockpiling the current cover material, filtered LST would be dumped on surface and dozed to suit the profile of the final landform profile. A low permeability LST layer (0.5 m) would be placed in thin lifts and compacted, then a thicker layer (1.5 m) of LST would be placed to form the growth medium, this would likely only require track rolling, a granular material (NAF gravel rockfill) sourced from the North WRD) would then be placed and ripped into the LST to form a stable surface on the growth medium. Final grading, fertilisation and seeding would then be applied for cover revegetation. The landform would be gently graded to minimise surface erosion. The growth medium would require sufficient thickness to retain rainfall within the cover allowing maximum evapotranspiration to minimise infiltration through to the underlying landform similar to the EMM (2015) store and release cover.

The LST could also be used as bulk filling above existing landforms to achieved desired profiles and suit the life of mine tailings storage requirements, this also progressively de-risks the landforms in that a significant thickness of LST is placed which reduces infiltration during operations and reduces further oxidisation from the surface. During capping the placed LST materials would require progressive covering with the growth medium / rock to minimise the open area susceptible to erosion. Runoff off from the placed LST could be controlled relatively easily as most of the landforms are bunded or could have sediment control structures built at runoff locations.

A storage shed at the filter plant would likely be required to suit filtered LST production should there be heavy rainfall preventing placement of LST (2,740 tonnes filtered LST /day at nominal 1 Mtpa throughput). However, during prolonged rainfall periods there could be contingency for reverting to conventional slurry deposition in Esperanza Pit or alternatively placement of dry stacked LST able to be done in wet weather, for example a lower compacted zone within a dry stack facility encapsulated with compacted material.

A conceptual model of the Old TSF with LST cover is shown in Figure 24, which could be applied to other landforms. Conceptual cover profile for Old TSF with LST cover is provided as Figure 25.

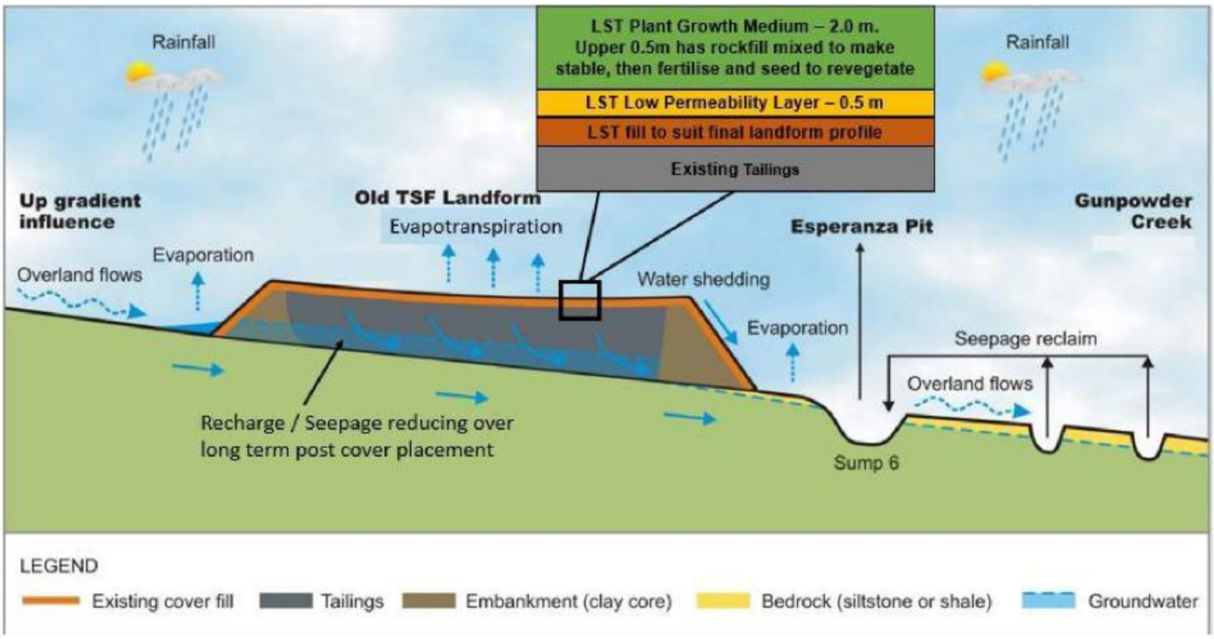


Figure 24 Conceptual model with LST capping

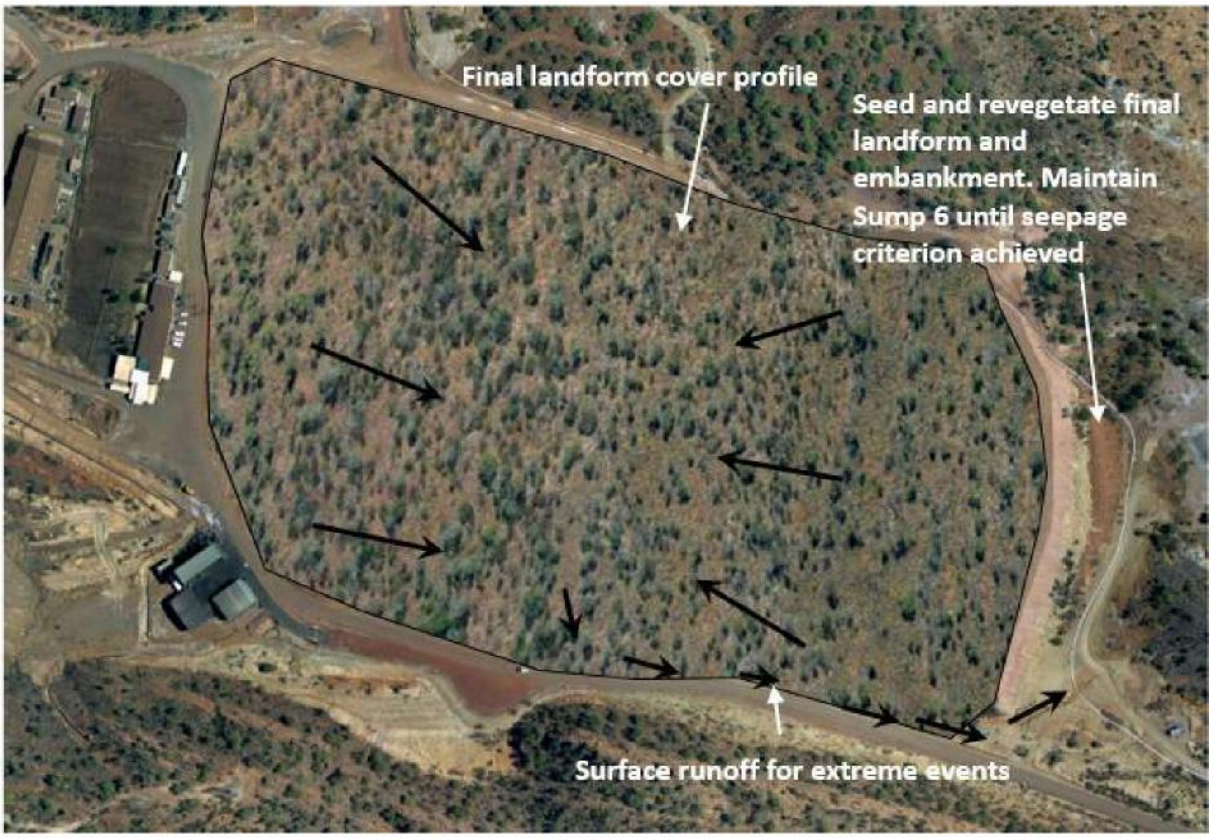


Figure 25 Conceptual final cover profile

5.7 Concept conventional clay capping implementation plan (HLEP#2) (if selected)

EMM (2015) provides recommendations on how to construct the final landform for the conventional clay capping at the Old TSF and HLEP#2. This also discussed in section 5.1 of this report. A scope of works and bill of quantities have been developed inclusive of the following requirements:

- Reshaping landform with a dozer to design levels prior to capping works
- Winning, carting, spreading and compacting rock bridging layer / capillary break
- Winning, carting, spreading and compacting reduced permeability layer
- Winning, carting, spreading and track rolling growth medium.

CCM have initiated discussions with local Contractor for these works.

5.8 Compliance with DES notice Decision to approve TEP amendment

In accordance with the DES Notice Decision to approve an amendment to a transitional environmental program (101/0008746; CA44550; TEP MAN17560) dated 24 July 2017, Schedule 1 – Condition of transitional environmental program MAN17650, the TEP amendment must be undertaken in accordance with the following conditions of approval:

1. The preferred rehabilitation strategies' for the Old TSF and HELP#2 landforms must be consistent with best practice monument in accordance with s21 of the Environmental Protection Act 1994

Reports on the 'preferred rehabilitation strategies; must be provided to the administering authority by close of business on 1 March 2018. The reports must include, but not be limited to:

a. Technical feasibility, engineering designs and project implementation plans

b. A description of the mythology and principles used to evaluate the preferred strategy

c. A description of how the preferred strategy is determined to be superior to alternative strategies and consistent with best practice management in accordance with S21 of the Environmental Protection Act 19994.

The following extract is from s21 of the *Environment Protection Act 1994*.

21 Best practice environmental management

(1) The "best practice environmental management" of an activity is the management of the activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the measures currently used nationally and internationally for the activity.

(2) In deciding the "best practice environmental management" of an activity, regard must be had to the following measures—

(a) strategic planning by the person carrying out, or proposing to carry out, the activity;

(b) administrative systems put into effect by the person, including staff training and monitoring and review of the systems;

(c) public consultation carried out by the person;

(d) product and process design;

(e) waste prevention, treatment and disposal.

(3) Subsection (2) does not limit the measures to which regard may be had in deciding the "best practice environmental management" of an activity.

The following provides an overview of how the requirements of how the proposed capping options address the TEP amendment notice conditions and s21 of the *Environment Protection Act 1994*:

a. *Technical feasibility, engineering designs and project implementation plans*

Dry stacked LST of the Old TSF is considered technically feasible. Conceptual LST usage and designs are provided and will be developed as per the detailed program of works / implementation plan for design, procurement and construction in line with relevant TEP dates being 1 November 2018 (CAPEX) and 1 March 2019 (project completion) in the cover letter accompanying this report on submission to DES.

Conventional clay capping of the HLEP#2 is considered technically feasible. EMM (2015) cover design is suitable and will be developed per the detailed program of works / implementation plan for design and construction in line with relevant TEP dates being 1 March 2019 (project completion) in the cover letter accompanying this report on submission to DES.

b. *A description of the methodology and principles used to evaluate the preferred strategy*

Assessment of alternative strategies is provided in section 5 of this report. Key considerations in the assessment have included technical feasibility (i.e. geochemical and geotechnical analysis of insitu material and proposed LST cover material) water management (i.e. existing OLD TSF leachate conditions, ongoing SUMP 6 operational requirements, surface water run-off and collection), costs (CAPEX and OPEX), timing relation to TEP completion dates, risks / limitations (i.e. inclement weather, legislative implications / EA amendment requirements) and advantages (i.e. implications for future operations through life of mine and rehabilitation disturbance footprints).

c. *A description of how the preferred strategy is determined to be superior to alternative strategies and consistent with best practice management in accordance with S21 of the Environmental Protection Act 19994.*

Use of LST is considered to be a superior alternative to conventional landform capping. The use of LST will minimise the need for disturbance of natural borrow materials (which subsequently require revegetation). The *Tailings Management Leading Practice Sustainable Development Program (LPSDP) for the Mining Industry, Commonwealth Australia Department of Foreign Affairs and Trade*, (September 2016) considered best practice tailings management strategies and states that:

'The desulphurisation (or depyritisation) of tailings, where possible, involves the separation of the non-economic sulphide minerals into a low-volume stream, leaving most of the tailings with a low sulphur content that will be less reactive and preferably non-acid-generating. The two tailings streams can be managed separately and differently. The high-sulphur material can be selectively deposited beneath the tailings pond to remain submerged during operations, and possibly after closure, or be covered by low-sulphur tailings after closure to maintain saturation of the underlying high-sulphur tailings.'

In the case of CCM the separation of sulphides to form both LST and HST streams will provide a lower risk tailings discharge management for the site during operations through environmentally safe disposal of the HST as paste backfill to the underground.

The Tailings Management LPSDP (DFAT, 2016) also states:

'Desulphurised tailings with non-acid-generating or acid-consuming characteristics may be co-disposed with waste rock in dumps or used as a cover material. The cost of tailings desulphurisation may be offset by the production of a low-sulphur tailings stream that can potentially be used to provide a final cover material, rather than having to mine cover material or import it from elsewhere.'

In conclusions, the recommended proposal for filtered LST used as a cover material is in line with best practice management in accordance with the LPSDP (DFAT, 2016). Despite the perceived higher initial cost, the overall project benefits as described include LST as a cover material, prevention of additional disturbance for insitu capping materials, reduced risk during operations allowing progressive landform encapsulation and rehabilitation, minimising the need for additional slurry tailings disposal footprints and reducing seepage risk from such facilities.

6. Conclusions and recommendations

Based on the findings in the study the following conclusions and recommendations are made;

6.1 Old TSF

- Old TSF tailings are geochemically classified as PAF and not considered an appropriate material for use as closure materials elsewhere.
- Given the chemistry of Sump 6 is significantly elevated with respect to sulfate and metals (copper provided herein as an example), it is likely to be the result of oxidation (and potentially hydrolysis) of tailings within the Old TSF. That it is elevated even higher than observed elsewhere (including within the bores in the tailings), could suggest that:
  - Water quality is deteriorating along the flow path (i.e. not just shallow oxidation is occurring, but iron hydrolysis at low pH is occurring without the need for oxygen); and / or
  - Water reporting to the sump now still reflects quality associated with previous practices within and on the Old TSF (i.e. other contaminated catchment influences as discussed in section 3.1), due to travel times through the Old TSF which are anticipated to be in the order of years to decades.
- Ongoing management of Sump 6 is recommended as a priority for management of the seepage from the Old TSF as previously identified and being undertaken by CCM. Surface water management as discussed in Capricorn Copper (2017) should be maintained to prevent pooling and infiltration.
- A more modern cover design with increased thickness of growth medium with a reduced permeability layer and capillary break e.g. EMM (2015) or alternatives as discussed in section 6.3 is likely to decrease the net mass loading of contaminants to Sump 6 in the long term as a result of rainfall infiltration. Given the chemistry of the Old TSF groundwater and tailings material and likely travel times within the Old TSF, an inert cover system (non-acid forming) is not likely to result in significantly improved conditions within the Old TSF in the short to medium term (years to decades) or address potential seepage generated from other contaminated catchment influences as discussed in section 3.1. Likewise, even an acid consuming cover system may not result in immediate leaching of neutralising material through the system nor significantly improved conditions within the Old TSF in the short to medium term (years to decades).

6.2 HLEP#2

- HLEP#2 materials are currently above water table (unsaturated). The HLEP#2 material is overlain by a HDPE liner (albeit requiring minor repair) which is likely to limit infiltration to the underlying material.
- HLEP#2 materials may be considered an appropriate material for use as closure materials elsewhere given that they have already been leached, and contain relatively low sulfur and metals compared with other site materials (e.g. as rockfill for alternate Old TSF LST filtration and dry stacking discussed in section 6.3). Given the leaching that has already occurred, they pose a relatively low risk of further oxidation in their current state. If left in-situ, the HDPE liner could be repaired and maintained to prevent infiltration until the HLEP#2 is rehabilitated.
- Given its small surface area, low environmental risk and the requirement for capping under the TEP by 1 March 2019, any cover material / solution as preferred by CCM e.g. EMM

(2015) or alternatives discussed in section 6.3 would be suitable. HLEP#2 may provide an opportunity for cover trials (refer section 6.3) using conventional clay capping i.e. EMM (2015) for future consideration.

6.3 Alternate cover materials

- LST / HST separation and use of LST as closure material across the site is technically feasible.
- Alternative options considered included LST slurry deposition (with cyclones where required) and LST paste / dry stacking.
- The LST material presents a significantly lower risk than the HST material due to, not only their low sulfur contents but also their low metal contents. This highlights the potential for LST to be used as a closure material across the site.
- Geotechnical testwork received to date shows LST gradings are suited to filtration / thickening. LST material has sufficient fines content to for a low permeability material when compacted. LST is slightly dispersive therefore will require some form of erosion protection when used as a growth medium (rock mixed with LST).
- Costs for filtration and dry stacking of LST material are higher than costs for conventional clay capping and LST slurry deposition however, this does not consider whole of mine life operations with respect to future tailings management and is therefore not directly comparable.
- Filtration and dry stacking will result in potential other beneficial uses such as disposing of tailings to save capacity elsewhere onsite. Filtered tailings could also be used in the potential upper Esperanza TSF to make a compacted low permeability upstream face on the existing WRD and or to bulk fill landforms to the desired profiles.
- Filtration and dry stacking will take less time than conventional tailings discharge (i.e. slurry form) as filter cake can be trucked, spread and compacted readily as soon as it is produced or can be stacked / stored at a place and move as needed. The LST would form the low permeability layer and growth medium, the LST cover could be a similar in design to the EMM (2015) proposal. A capillary break would not be necessary on the WRD’s due to their coarse nature per EMM (2015) and if a thick enough LST layer is placed a capillary break may not be required on the TSF’s. Works could be feasibly completed within TEP timeframe of 1 March 2019.
- LST slurry deposition is suited as a cover for Esperanza TSF and Old TSF and would be cost effective however, it is time consuming for tailings to dry on TSF’s and LST in slurry form can only be deposited in thin layers to control the rise rate and with time to dry over the dry season before suitable for trafficking. It is likely that this option would take up to 2 years to complete and would not be completed within TEP timeframe of 1 March 2019. It may also require an amendment to the Environmental Authority (EA) for raise of dam wall and placement of LST slurry.
- Assessment of and recommendations for alternative cover material complies with the conditions of DES Notice of Decision to approve the TEP amendment (101/0008746; CA44550; TEP MAN17560) and the recommended proposal for filtered LST used as a cover material is in line with best practice management prescribed under s21 the *Environmental Protection Act 1994*.

The following actions are recommended to support the alternate cover design:

- Continue with LST separation and reduce the cover requirements for future landforms i.e. proposed Upper Esperanza TSF.

- Conduct a series of cover trials by constructing covers with different thicknesses and layers on a 10 m x 10 m area of Old TSF. Install instrumentation including oxygen sensors, volumetric moisture content sensors, temperature sensors and lysimeters, etc. to provide data for the assessment of the effectiveness of different covers.
- Progress filtration and dry stacking as the cover option for Old TSF. Continue engineering design and finalise supplier arrangements.
- Develop detailed program of works / implementation plan for design, procurement and construction in line with relevant TEP dates being 1 November 2018 (CAPEX) and 1 March 2019 (project completion).

7. References

EMM, 2015 Final Cover Design Report Old Tailings Facility and Heap Leach Pad Number 2, Mt Gordon Mine.

Capricorn Copper, 2017 Transitional environmental program – amendment application (3rd submission) 17 July 2017

GHD 2011. Report for Esperanza TSF Upgrade, Stage 1 Seepage Assessment. Report Ref

32 / 15847 / 54791 for Birla Mount Gordon

GHD, 2012 32 / 15847 / 56738 Esperanza Tailings Dam Raise 79 for Birla Mount Gordon. Master Seepage Report

GHD, 2013 Esperanza Pit DSA and MRL Revision Hydrogeological Response to DEHP Notice of Decision

QLD EPA (1995) January 1995 Assessment and Management of Acid Drainage

Commonwealth Australia Department of Foreign Affairs and Trade (September 2016), Tailings Management Leading Practice Sustainable Development Program (LPSDP) for the Mining Industry.

Appendices

Appendix A – Geotechnical plan

APPENDIX A - Geotechnical Plan

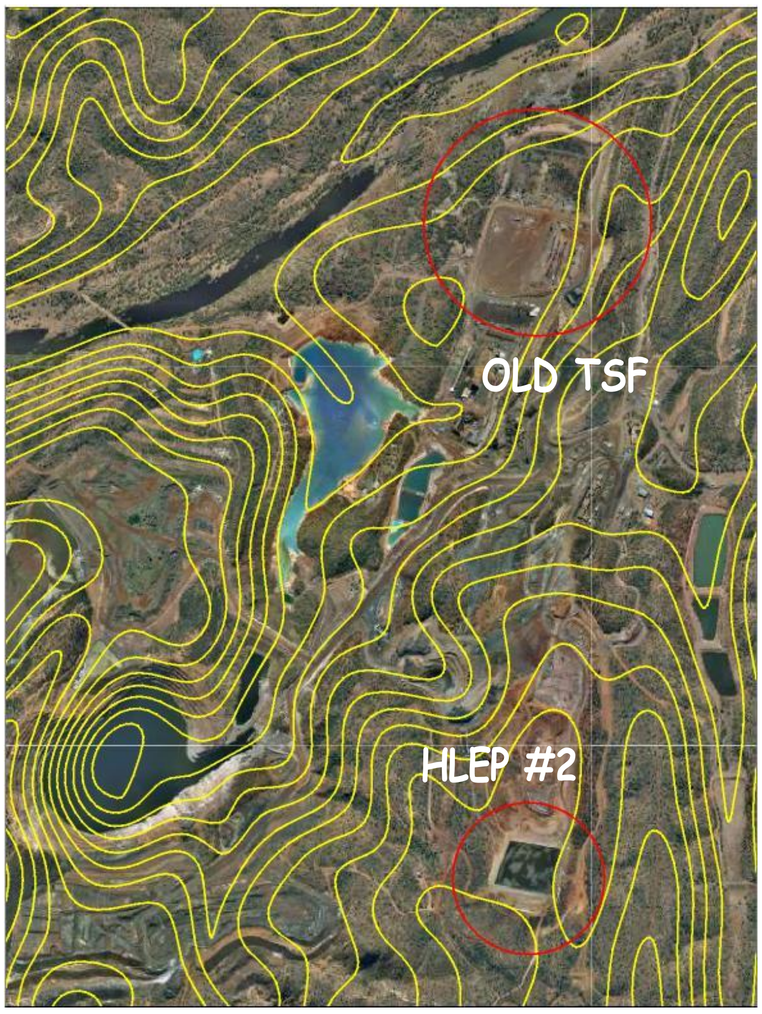


FIGURE 1: GENERAL SITE MAP

FIGURE 2: HEAP LEACH PAD No.2 (HLEP #2)

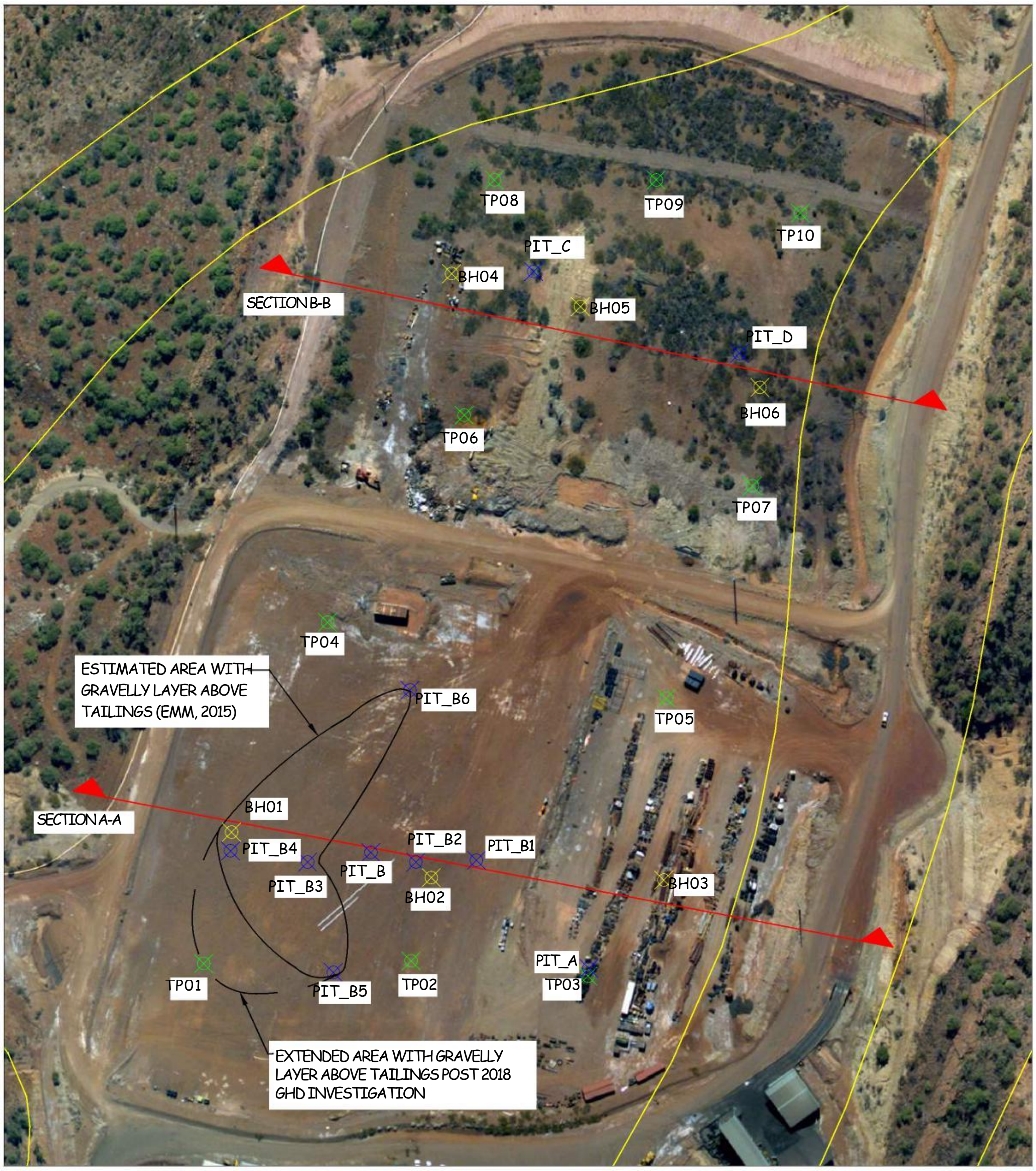


FIGURE 3: OLD TSF

LEGEND:

- State Contours
- 2018 Test Pits (GHD)
- 2018 Boreholes (GHD)
- 2015 Test Pits (EMM)

Appendix B – Photographic log

Appendix B – Photo Logs

Photo 1 TP01 at Old TSF– note gravelly layer above tailings

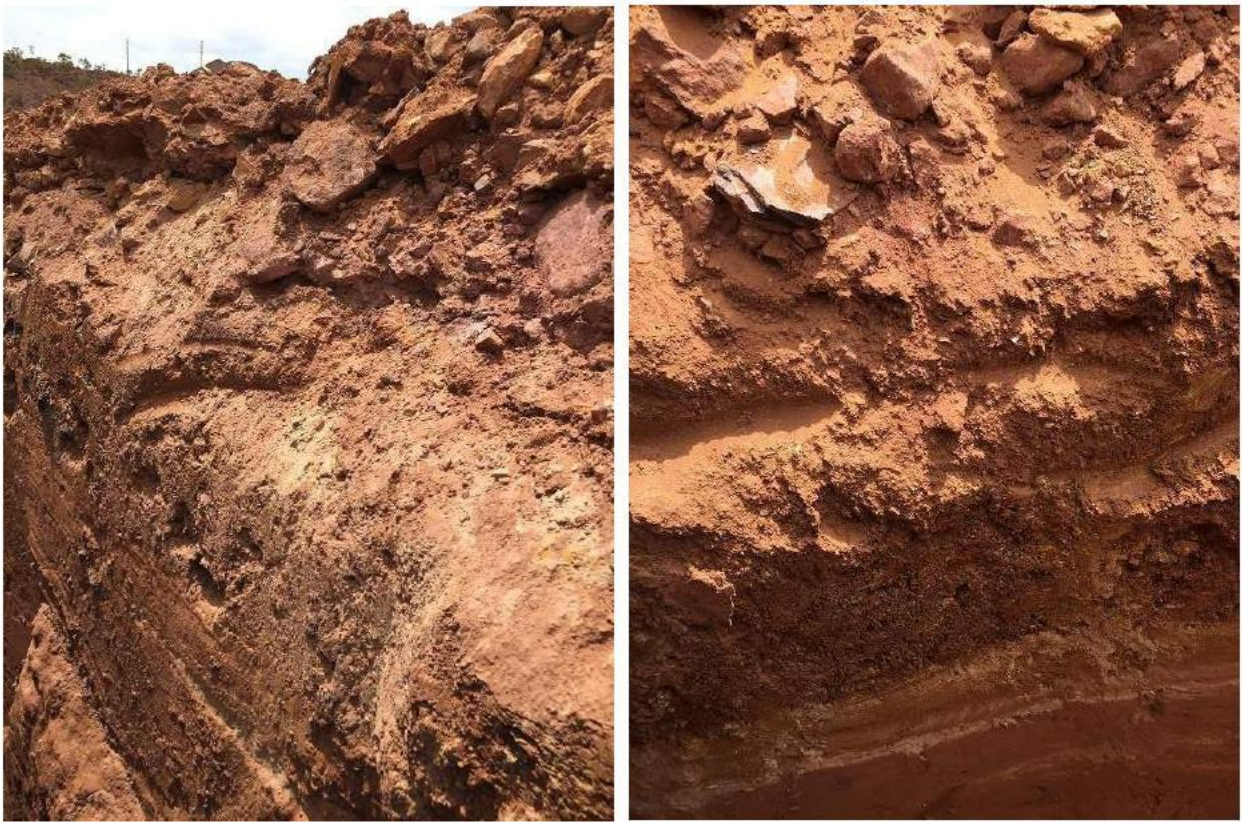


Photo 2 TP02 at Old TSF

Photo 3 TP03 at Old TSF

Photo 4 TP05 at Old TSF – note gravels above the tailings

Photo 5 TP06 at Old TSF

Photo 6 TP07 at Old TSF

Photo 7 TP08 at Old TSF

Photo 8 TP09 at Old TSF

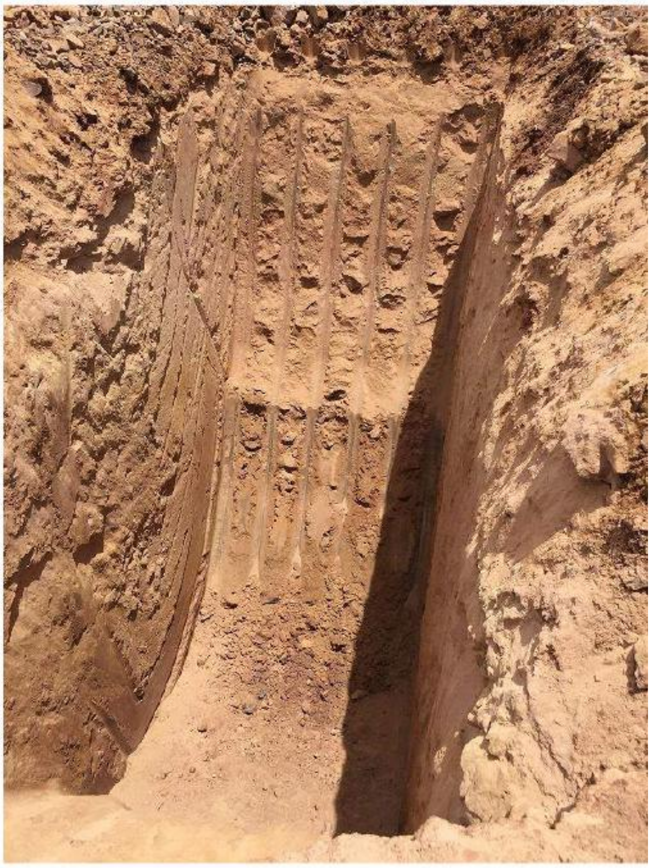


Photo 9 TP10 at Old TSF

Photo 10 BH02 at Old TSF

Photo 11 BH03 at Old TSF

Photo 12 BH04 at Old TSF

Photo 13 BH05 at Old TSF

Photo 14 BH06 at Old TSF

Photo 15 BH10 at HLEP #2

Photo 16 Eastern Embankment of HLEP #2 near BH11

Appendix C – Borehole log

BOREHOLE LOG

MONITORING WELLBH01

ENVIRONMENTAL-GROUNDWATER

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)9.8	Logged By TM
Date Drilled 24/01/2018 - 24/01/2018	Diameter (mm)150	Checked By

B.C.L No. | Casing | Screen | Surface Completion

Depth (m)	Drilling Method	Sample ID	Dell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type _Classification Croup Symbola; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Auger		Backfilled with cover material (fill)						
0.5									-0.5
1					FILL: Redish brown Silty Gravel with rocks, dry	D			-1
1.5		BH01_1.5	Grout plug at top of hole		SANDY SILT: Dark brown sandy silt, powdery, dry	D			-1.5
2									-2
2.5									-2.5
3									-3
3.5									-3.5
4									-4
4.5									-4.5
5		BH01_5.0							-5
5.5			backfilled with cutting from bore						-5.5
6					SANDY SILT: Dark blackish brown sandy silt, powdery, dry	D			-6
6.5		BH01_6.5			SANDY S)LT: Dark brown sandy silt, powdery, dry	D			-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9		BH01_9.0			SILTSTONE: Pale grey siltstone, hard, dry	D			-9
9.5			Bentonite holeplug						-9.5
10					Termination Depth at:9.8 m				-10
10.5									-10.5
11									-11
11.5									-11.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

MONITORING WELLBH02

ENVIRONMENTAL-GROUNDWATER

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)17.75	Logged By TM
Date Drilled 24/01/2018 - 24/01/2018	Diameter (mm)150	Checked By

B.C.L No. Casing Screen Surface Completion

XK]M^_`a	XOJIIJL[=KM^PY	UV`]IK @X	Dell Details		COV]^JR FP[		HPLbJbMKLR\	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	ElKeVMJPL_`a
	Auger		cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1					Grout plug at top of hole CLAY: Dark moderate plasticity, firm, damp	Dm			-1
1.5		BH02_ 1.5							-1.5
2									-2
2.5									-2.5
3									-3
3.5									-3.5
4									-4
4.5									-4.5
5		BH02_ 5.0							-5
5.5									-5.5
6									-6
6.5			backfilled with cuttings from bore						-6.5
7					SILT: Dark brown Silt, powdery, dry	D			-7
7.5									-7.5
8									-8
8.5					CLAY: Dark brown clay, moderate plasticity, firm, damp	Dm			-8.5
9									-9
9.5									-9.5
10		BH02_ 10							-10
10.5									-10.5
11									-11
11.5									-11.5
12									12

Notes

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

Depth (m)	Drilling Method	Sample ID	@ell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil =ype IClassification ?roup Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICA=O>S Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
					12.5				-12.5
13			backfilled with cuttings from bore						-13
13.5									-13.5
14			Bentonite plug above gravel filter pack		CLAY: Dark blackish brown clay, moderate plasticity, firm, damp	Dm			-14
14.5									-14.5
15		BH02_ 15			CLAY: Dark blackish brown clay, moderate plasticity, firm, wet	W			-15
15.5			Gravel filter pack around screen to 0.5m above screen						-15.5
16									-16
16.5									-16.5
17									-17
17.5									-17.5
18					Termination Depth at:17.75 m				-18
18.5									-18.5
19									-19
19.5									-19.5
20									-20
20.5									-20.5
21									-21
21.5									-21.5
22									-22
22.5									-22.5
23									-23
23.5									-23.5
24									-24
24.5									-24.5
25									-25
25.5									-25.5
26									-26

Notes

GHD Soil ClassificationsThe GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH03

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)13.7	Logged By TM
Date Drilled 24/01/2018 - 24/01/2018	Diameter (mm)150	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Dell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type _Classification Croup Symbola; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
0	Auger		Backfilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5			Grout plug at top of hole						-0.5
1									-1
1.5									-1.5
2		BH03_ 2.2			CLAYEY SILT: Dark brown clayey silt, moderate plasticity, soft-firm, damp	Dm			-2
2.5									-2.5
3									-3
3.5									-3.5
4									-4
4.5									-4.5
5		BH03_ 5.0			CLAYEY SILT: Dark brown clayey silt, moderate plasticity, dense, damp	Dm			-5
5.5									-5.5
6									-6
6.5			backfilled with cuttings from bore						-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5									-9.5
10		BH03_ 10							-10
10.5									-10.5
11									-11
11.5									-11.5
12									12

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

Depth (m)	Drilling Method	Sample ID	;ell Details		Graphic Log	LITHOLOGICAL DESCRIPTION Soil 8VAe DClassification :rouA SVmYolF; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICA8O9S Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
		12.5backfilled		with cuttings from bore						-12.5
13										-13
13.5		BH03_13.7		Bentonite holeplug						-13.5
14						Termination Depth at&13.7 m				-14
14.5										-14.5
15										-15
15.5										-15.5
16										-16
16.5										-16.5
17										-17
17.5										-17.5
18										-18
18.5										-18.5
19										-19
19.5										-19.5
20										-20
20.5										-20.5
21										-21
21.5										-21.5
22										-22
22.5										-22.5
23										-23
23.5										-23.5
24										-24
24.5										-24.5
25										-25
25.5										-25.5
26										-26

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH04

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)16	Logged By TM
Date Drilled 24/01/2018 - 24/01/2018	Diameter (mm)150	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Dell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type _Classification Croup Symbola; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT @ND@CATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Auger		Backfilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1			Grout plug at top of hole		CLAYEY SILT: Dark brown mottled light grey clayey silt, loose, dry	D			-1
1.5		BH04_1.5							-1.5
2									-2
2.5									-2.5
3									-3
3.5									-3.5
4									-4
4.5									-4.5
5		BH04_5.0			SILTY CLAY: Dark brown silty clay, moderate plasticity, soft-firm, dry	D			-5
5.5									-5.5
6					SILTY CLAY: Dark brown silty clay, moderate plasticity, soft, damp	Dm			-6
6.5									-6.5
7			backfilled with cuttings from bore						-7
7.5									-7.5
8					SILTY CLAY: Dark brown silty clay, moderate plasticity, soft, dry	D			-8
8.5									-8.5
9									-9
9.5					SILTY CLAY: Dark brown silty clay with gravel, moderate plasticity, soft, dry	D			-9.5
10		BH04_10			SILTY CLAY: Dark brown silty clay, moderate plasticity, soft, sticky, wet	W			-10
10.5									-10.5
11									-11
11.5									-11.5
12									12

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH04

Depth (m)	Drilling Method	Sample ID	;ell Details		Graphic Log	LITHOLOGICAL DESCRIPTION Soil 8VAe DClassification :rouA SVmYolF; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICA8O9S Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
						12.5				-12.5
13										-13
13.5				backfilled with cuttings from bore						-13.5
14										-14
14.5										-14.5
15										-15
15.5				Bentonite holeplug						-15.5
16		BH04_ 16				Termination Depth at:16 m				16
16.5										-16.5
17										-17
17.5										-17.5
18										-18
18.5										-18.5
19										-19
19.5										-19.5
20										-20
20.5										-20.5
21										-21
21.5										-21.5
22										-22
22.5										-22.5
23										-23
23.5										-23.5
24										-24
24.5										-24.5
25										-25
25.5										-25.5
26										-26

Notes

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

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BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)23.7	Logged By TM
Date Drilled 23/01/2018 - 23/01/2018	Diameter (mm)150	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Dell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type _Classification Croup Symbola; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Auger		cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1			Grout plug at top of hole		CLAYEY SILT: Dark brown clayey silt, plastic, soft, dry	D			-1
1.5		BH05_ 1.5							-1.5
2									-2
2.5									-2.5
3									-3
3.5		BH05_ 3.5			CLAYEY SILT: Dark brown clayey silt, plastic, soft, damp	Dm			-3.5
4									-4
4.5									-4.5
5									-5
5.5									-5.5
6									-6
6.5		BH05_ 6.5	backfilled with cuttings from bore						-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5									-9.5
10		BH05_ 10			CLAYEY SILT: Dark brown clayey silt, plastic, soft, dry	D			-10
10.5									-10.5
11									-11
11.5									-11.5
12									12

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

EFGHI JKL	EMNOONPQ :FHIRS	TUKGOF =E	Well Details		C>XC@=YZCEBTY?	YRPVNVHFPWI	COMMENTS/ CONTAMINANT I<DICATO?S Odours, staining, waste materials,separate phase liquids, imported fill, ash.	BOFgUHNRP JKL
				12.5				-12.5
13			backfilled with cuttings from bore					-13
13.5								-13.5
14			Bentonite hole plug					-14
14.5								-14.5
15		BH05_ 15						-15
15.5								-15.5
16			Hole colapsed around installation					-16
16.5		BH05_ 16.5		SILT WITH SAND: Dark brown Silt with sand, soft, wet	W			-16.5
17								-17
17.5								-17.5
18								-18
18.5								-18.5
19								-19
19.5								-19.5
20		BH05_ 20						-20
20.5			Hole colapsed while installing					-20.5
21								-21
21.5								-21.5
22								-22
22.5								-22.5
23		BH05_ 23		SANDY SILT: Dark brown Fine sandy silt, very soft, very wet	VW			-23
23.5								-23.5
24				Termination Depth at:23.7 m				-24
24.5								-24.5
25								-25
25.5								-25.5
26								-26

Notes

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH06

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)10.7	Logged By TM
Date Drilled 24/01/2018 - 24/01/2018	Diameter (mm)150	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Dell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type _Classification Croup Symbola; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Auger		Backfilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1					Grout plug at top of hole CLAY: Dark brown clay, moderate plasticity, soft, damp	Dm			-1
1.5		BH06_ 1.5							-1.5
2									-2
2.5									-2.5
3									-3
3.5									-3.5
4									-4
4.5									-4.5
5		BH06_ 5.0			SILTY CLAY: Dark brown fine silty clay, moderate plasticity, soft, damp	Dm			-5
5.5			backfilled with cuttings from bore						-5.5
6									-6
6.5									-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5					SILTY CLAY: Dark brown Silty clay with sand, damp	Dm			-9.5
10		BH06_ 10							-10
10.5			Bentonite holeplug						-10.5
11					Termination Depth at:10.7 m				-11
11.5									-11.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH09

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Air hammer	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)4.3	Logged By TM
Date Drilled 25/01/2018 - 25/01/2018	Diameter (mm)115	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Cell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type ^Classification Broup Symbol`; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Air hamm		Backfilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1		BH09_1.0	Grout plug at top of hole		FILL: Redish brown Silty Gravel with trace rocks, dry	D			-1
1.5									-1.5
2		BH09_2.0			FILL: Redish brown Silty Gravel, dry	D			-2
2.5			backfilled with cuttings from bore						-2.5
3		BH09_3.0			FILL: Pale redish grey Silty Gravel, becoming hard, dry	D			-3
3.5									-3.5
4		BH09_4.0			SILTSTONE: Pale redish grey siltstone, hard, dry	D			-4
4.5					Termination Depth at:4.3 m				-4.5
5									-5
5.5									-5.5
6									-6
6.5									-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5									-9.5
10									-10
10.5									-10.5
11									-11
11.5									-11.5

Notes

GHD Soil Classifications The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH10

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Auger/Air hammer	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)3.7	Logged By TM
Date Drilled 25/01/2018 - 25/01/2018	Diameter (mm)115	Checked By

B.C.L No. | Casing | Screen | Surface Completion

Depth (m)	Drilling Method	Sample ID	Cell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type ^Classification Broup Symjol`; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Auger		Bacifilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks, dry	D			
0.5									-0.5
1			Grout plug at top of hole						-1
1.5									-1.5
2		BH10_2.0							-2
	Air hamm								
2.5			backfilled with cuttings from bore						-2.5
3		BH10_3.0			SILTSTONE: Pale grey siltstone, hard, dry	D			-3
3.5									-3.5
					Termination Depth at:3.7 m				
4									-4
4.5									-4.5
5									-5
5.5									-5.5
6									-6
6.5									-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5									-9.5
10									-10
10.5									-10.5
11									-11
11.5									-11.5

Notes

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete Coring, DC-Diamond Core, FH-F oam Hammer, HA-Hand Auger, HE-Hand Excavation (shovel), HFA-H ollow Flight Auger, NDD-N on Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-S olid Flight Auger, SS-Split Spoon, WB-Wash WS-Window Sampler	D-Dry, SM-Slightly Moist, M-M oist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-S oft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

BOREHOLE LOG

ENVIRONMENTAL-GROUNDWATER

MONITORING WELLBH11

ClientCapricorn Copper Pty Ltd	Drill Co.Proactive Drilling Services	Easting, Northing ,
ProjectRehabilitation Plan & Financial Assurance Review	DrillerMarcus	Grid Ref
Project No.4220321	Rig Type	Elevation
Site Capricorn Copper Mine	Drill Method Air hammer	Collar RL
Location Capricorn Copper Mine, Gunpowder Rd, QLD	Total Depth (m)3	Logged By TM
Date Drilled 25/01/2018 - 25/01/2018	Diameter (mm)115	Checked By

B.C.L No.	Casing	Screen	Surface Completion

Depth (m)	Drilling Method	Sample ID	Cell Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type ^Classification Broup Symjol`; Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials,separate phase liquids, imported fill, ash.	Elevation (m)
	Air hamm		Bacifilled with cover material (fill)		FILL: Redish brown Silty Gravel with rocks (large), dry	D			
0.5					SILTSTONE: Pale grey siltstone, hard, dry	D			-0.5
1			Grout plug at top of hole						-1
1.5									-1.5
2		BH11_ 2.0	backfilled with cuttings from bore						-2
2.5									-2.5
3					Termination Depth at:3 m				3
3.5									-3.5
4									-4
4.5									-4.5
5									-5
5.5									-5.5
6									-6
6.5									-6.5
7									-7
7.5									-7.5
8									-8
8.5									-8.5
9									-9
9.5									-9.5
10									-10
10.5									-10.5
11									-11
11.5									-11.5

Notes

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Drilling Abbreviations	Moisture Abbreviations	Consistency Abbreviations	
AH-Air Hammer, AR-Air Rotary, BE-Bucket Excavation, CC-Concrete DC-Diamond Core, FH-Foam Hammer, HA-Hand Auger, HE-Hand (shovel), HFA-Hollow Flight Auger, NDD-Non Destructive Drilling, PT-Pushtube, SD-Sonic Drilling, SFA-Solid Flight Auger, SS-Split Spoon, WB-Wash Bore, WS-Window Sampler	D-Dry, SM-Slightly Moist, M-Moist, VM-Very Moist, W-Wet, S-Saturated	Granular Soils VL-Very Loose, L-Loose, MD-Medium Dense, D-Dense,VD - Very Dense	Cohesive Soils VS-Very Soft, S-Soft, F-Firm, ST-Stiff, VST-Very Stiff, H-Hard

GHD

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4220321-20724/https://projects.ghd.com/oc/nqoc/pmluppcm previewupdat/Delivery/Documents/4220321-REP-Old TSF and HLEP_2 Rehabilitation Strategy.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	Kieran Kerr and Lee Evans	Robert Virtue and Robert Longey				

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