Graphinex – Esmeralda Graphite Project

Environmental Impact Statement

Appendix W – Technical Report for Tailings Storage Facilities

GRAPHINEX

Soil & Rock Engineering Pty Ltd (SRE)
ABN 98 675 219 020

GRAPHINEX

Esmeralda Graphite Project

Technical Report for Tailings Storage Facilities

Final Rev (issued for use)

Ref: **Graphinex TSF Design Technical Report Rev 0**

Date: **15 May, 2026**

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15 May, 2026

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Attention: Blair Richardson

RE: Technical Report for Tailings Storage Facilities Esmeralda Project, Queensland

Soil & Rock Engineering Pty Ltd (SRE P/L) is pleased to provide the Final Tailings Storage Facility Design Technical Report (Rev 0) for the for Esmeralda Graphite Project, Queensland.

This Technical Report is based on the proposed 4 Cells for Tailings Storage as developed in the Prefeasibility Study.

Should you require further information or clarification of any details, please do not hesitate to contact this office.

Yours faithfully
pp SRE P/L

Christopher Lane
Principal Tailings Consultant

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Abbreviations and Terminology

The following abbreviations have been used in this document

AEP	Annual Exceedance Probability
ANCOLD	Australian National Committee on Large Dams
BOM	Bureau of Meteorology
CMW	CMW Geosciences Pty Ltd
DETSI	Department of the Environment, Tourism, Science and Innovation
DSA	Design Storm Allowance
EGP	Esmeralda Graphite Project
EIS	Environmental Impact Study
ESS	Extreme Storm Storage
FoS	Factor of Safety
GPL	Graphinex Pty Ltd
GTSF	Graphinex Tailings Storage Facilities
GPTSF	Graphinex Pit Tailings Storage Facilities (Tailings deposited into the Graphinex Pit prior to closure)
ha	hectare
hrspa	Hours per annum
H:V	Horizontal : Vertical
IAS	Initial Advice Statement
LoM	Life of Mine
m/a	metres per annum
mmpa	millimetres per annum
MB	Monitoring Bore
m^3/d	cubic metres per day
Mm^3	Million cubic metres
Mt	Million tonnes
Mdtpa	Million dry tonnes per annum
Mtpa	Million tonnes per annum
ML	Mine Lease
oh/a	operating hours per annum, assumed as 8,000
OM	Operations Manual(s)
pa	per annum
PSD	Particle Size Distribution
PP	Project Proposal, which is the documentation prepared by AARC Environmental Solutions
P_{80}	80% passing, and refers to a particular particle size as stated, i.e. a P_{80} of 75 microns means 80% of the total weight of materials is finer than 75 microns
RL	Reduced Level relative to a fixed datum
SP	Standpipe Piezometers
tpa	tonnes per annum
tpd	tonnes per day
t/m^3	tonnes per cubic metre
TDS	total dissolved solids
WAVE	WAVE International

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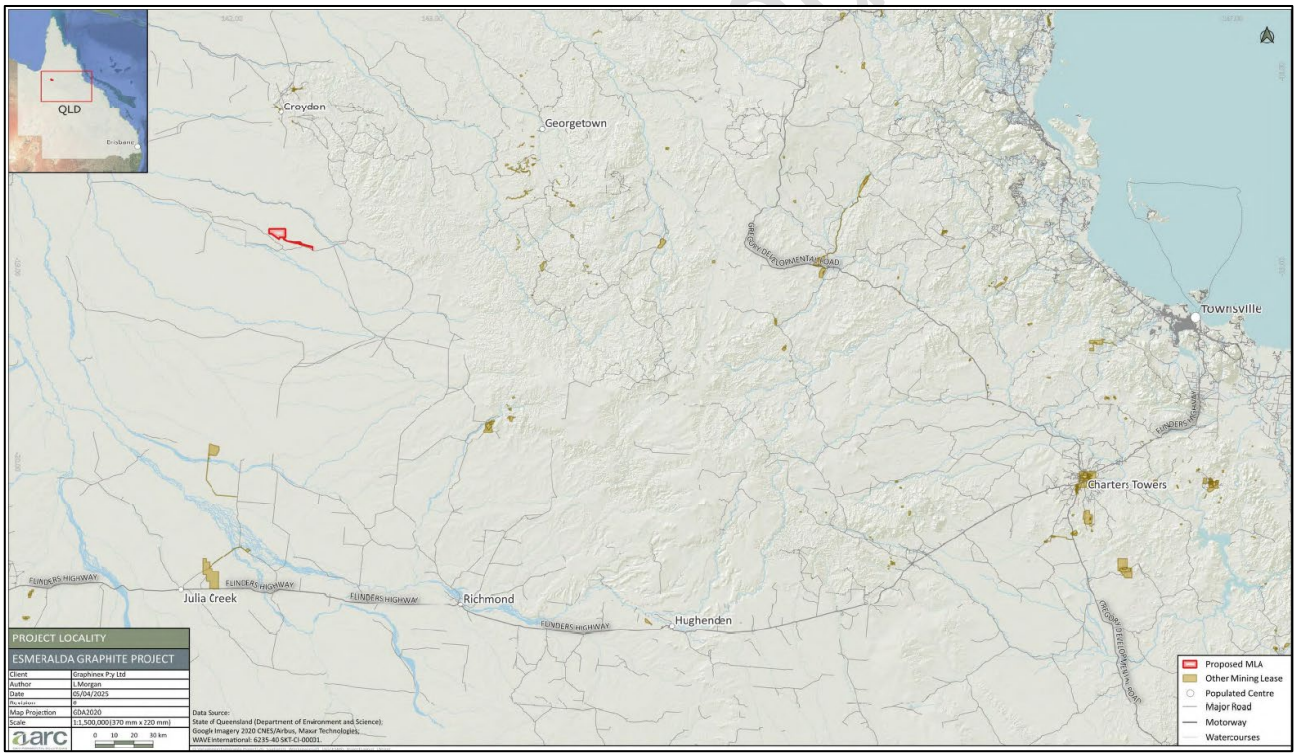
SUBJECT: TECHNICAL REPORT - TAILINGS STORAGE FACILITIES

1 INTRODUCTION

Soil & Rock Engineering Pty Ltd (SRE) has been commissioned by Graphinex Pty Ltd (GPL) to prepare the Technical Report for Tailings Storage Facilities Design, hereafter referred to as the Graphinex Tailings Storage Facilities (GTSF) for the Environmental Impact Statement (EIS) for the Esmeralda Graphite Project (EGP). This document presents the details required by the Department of the Environment, Tourism, Science and Innovation (DETSI) Queensland, for the regulatory approval of the GTSF.

Background information from the current Project Proposal (PP), prepared by AARC Environmental Solutions (AARC) and information from various studies by specialist consultants engaged for this project, have been used in the preparation of this document. According to the PP, the EGP is located within Queensland's North West Minerals Province (NWMP), approximately 70 km south of Croydon, on Exploration permits for Minerals (EPM) 28274 and is understood to be in the Prefeasibility Study Phase at this time, with the Definitive Feasibility Study (DFS) to follow. Figure 1.1, prepared by AARC Environmental, shows the location of the project.

Figure 1.1 - Project Location (source AARC)



The style of the TSF design was selected in the Prefeasibility Study (PFS), by WAVE International (WAVE). The intent of the downstream design, which comprises four (4) TSF Cells was to provide a safe, stable, non-polluting structure during its period of operation. At the completion of processing, it is understood that the TSF Cells 1, 2 and 3 will be deconstructed with the tailings and mine waste returned to the mine pit void. TSF Cell 4 will remain.

1.1 Attachments

The documents completing this document comprise:

i) Appendix 1 CVs of RPEQ Registered Design Personnel

ii) Appendix 2 Design Drawings, Scope of Works and Construction Specific Specifications

iii) Appendix 3 Geotechnical Assessment – Tailings Testwork

iv) Appendix 4 Preliminary Dam Break Assessment and Hydraulic Spillway Analyses

v) Appendix 5 Water Balance Cells 1 to 4

1.2 Background Information

Graphinex proposes to process an average of approximately 3.5 Million dry tonnes per annum (Mdtpa) of graphite ore, over its operational mine life of approximately 53 years. The expected graphite ore contains approximately 5 to 6% graphite, with approximately 3.25 Mdtpa of tailings being produced on site using the flotation process operation, which equates to an equivalent volume of approximately 2.097 Mm^3pa at the minimum insitu dry-density density of 1.55 t/m^3. Mining ceases at the end of Year 42 and processing ceases at the end of Year 48.

The above-ground tailings storage capacity as currently designed, can accommodate tailings to Year 48, including the required freeboard allowance requirements.

When the tailings are returned to the mine pit void, the minimum insitu dry density of the tailings would be in the range of 1.65 to 1.85 t/m^3, and with consolidation occurring as the mine void is backfilled, a higher insitu dry density of the tailings is possible.

The drawings in Appendix 2 were originally prepared by WAVE during the Prefeasibility Study (PFS) in March 2025 as a 3 Cell TSF arrangement and subsequently updated in February 2026 to the 4 Cell arrangement to accommodate additional tailings. The 4 cells are located between 1.2 km (TSF Cell 1) and 4.5 km (TSF Cell 4) to the southeast of the Mine Pit and 1.5 to 2.0 km south of the processing plant. The containment facilities are fully HDPE-lined (floor and upstream face of the containment embankments). These embankments comprise a traffic-compacted mine-waste downstream zone, with a crest width of 15 m, and roller-compacted clayey fill in the upstream zone to support the placement of the HDPE liner. The crest width of the upstream zone is 5 m. The containment embankments are to be raised in 4 stages by downstream construction, with the internal and external batter slopes being conservative, at 2.5:1 H:V (horizontal to vertical), approximately 22°. The internal containment area and storage volume capacity of each TSF Cell was provided by WAVE (10 Feb 2026).

The information provided by WAVE is presented in Table 1.1 and comprises the internal containment area at Crest RL 149.25 m and estimated useable storage volume for each cell. The maximum storage capacity of the HDPE-lined GTSF Cells 1 to 4 is based on the results of the tailings testing, which is presented in Section 2.5.1 and Appendix 3, using the minimum insitu dry-density of 1.55 t/m^3. The expected maximum depth of tailings is 16.8 m and the corresponding tailings surface elevation is RL 146.8 m for each cell. This was determined by SRE based on the ground elevation of approximately RL 130 m and considering the freeboard requirements, as detailed in Section 4.3. Table 1.2 presents the details of the embankment construction volumes for each Cell of the GTSF.

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Table 1.1 - Physical Characteristics GTSF Cells at Maximum Crest RL with maximum depth of Tailings

Cell No.	Internal Containment Area (ha) at crest RL 149.25	Estimated Maximum Depth of Tailings (m)	Estimated Useable Storage Volume (Mm^3)	Storage Capacity Mt @ 1.55 t/m^3 to RL 146.8 m
1	131.9	16.80	24.20	36.31
2	139.2	16.80	23.88	37.01
3	138.3	16.80	22.75	35.26
4	138.3	16.80	22.75	35.26
Total			**93.57**	**143.43**

Table 1.2 - Embankment Construction Volumes

Cell	Stage	Embankment Crest RL	Upstream Zone Embankment Volume (Mm^3)	Downstream Zone Embankment Volume (Mm^3)
1	1	133.50	0.11	0.77
1	2	138.75	0.12	1.48
1	3	144.00	0.12	2.30
1	4	149.25	0.12	3.17
2	1	133.50	0.11	0.44
2	2	138.75	0.12	0.93
2	3	144.00	0.12	1.48
2	4	149.25	0.12	2.15
3	1	133.50	0.11	0.33
3	2	138.75	0.12	0.93
3	3	144.00	0.12	1.43
3	4	149.25	0.12	2.13
4	1	133.50	0.11	0.33
4	2	138.75	0.12	0.93
4	3	144.00	0.12	1.43
4	4	149.25	0.12	2.13

The design concept for each Cell of the GTSF incorporates a pontoon-mounted return-water recovery system. Perimeter monitoring/recovery bores located around the GTSF as part of the hydrogeological studies executed by the GP Hydrogeologist (hydrogeologist.com.au), are assumed to have been located within the potential flow paths, which are controlled structurally and lithologically by fractured rock. These bores could be used for monitoring groundwater quality during the operation of the TSFs and could be supplemented with recovery bores, if required, in order to return any seepage water from the TSFs to the process plant.

Similar design concepts to the downstream-constructed TSF Cells proposed in this document, have been utilised successfully at other mines throughout Australia.

The design for the GTSF was selected by WAVE International (WAVE) during the Prefeasibility Study (PFS). SRE has executed a high-level analysis of alternative Tailings Storage Options, refer to Table 1.3. This analysis confirms that the proposed downstream construction of the TSF, presented in the PFS, is appropriate for this project.

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It should be noted that with the exception of Cell 4, all the tailings and the mine waste materials are to be returned to the pit at the completion of the project. With the potential to deposit tailings into the pit after the cessation of mining the TFS Design could be optimised to reduce construction costs.

A geotechnical information assessment of the materials proposed for the style of the TSF adopted is presented in Section 2.4.9 and the tailings geotechnical properties as currently known and expected from the tailings testing underway is presented in Section 2.5.1. Geochemical characterisation of the tailings and mine waste was completed by RGS[6] as part of their studies.

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Table 1.3 - Graphinex Project Possible TSF Options

TSF Option	Economic Ranking*	Risk Ranking+	Comment
Downstream raised TSF (Paddock, Valley, Integrated Waste landform)	2	1	Progressive rehabilitation of outer embankments of Cell 4 is possible where the embankments are constructed to the maximum width. For the EP, all the mine waste and tailings in Cells 1, 2 and 3 are to be returned to the pit at the end of processing.
Filtered Tailings	3	3	Filtered tailings are typically adopted where there is a shortage of water for processing, which is not the case with the Graphinex Project. The capital and operating cost of filtered is very high compared to other options such as thickened tailings. Given that the proposed processing rate, in terms of tonnes per day processed, is approximately 10,000 tpd net rainfall (rainfall minus evaporation) is negative, the project does fit within the envelope of successful filtered tailings operations. However, the plasticity index of the tailings does not meet the requirements for dry stacking. Some erosion of the filtered tailings stacks during the wet season is possible, in addition to fugitive dust emissions during the dry season which increases the operational risk of this option.
Co-Disposal with mine waste	3	3	This requires the tailings to be filtered and in addition to the high filtering cost the transportation and materials handling cost are also very high. To ensure stack stability the ratio of mine waste to tailings must be greater than 8:1.

Notes

Economic Ranking*
1 = low whole of life cost
2 = medium whole of life cost
3 = high whole of life cost

Risk Ranking+
1 = low risk both during operation and post operation
2 = medium risk both during operation and post operation
3 = high risk both during operation and post operation

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1.3 Design Considerations

Details contained in this Technical Report were generally compiled in accordance with the requirements of the following documents, as appropriate:

i) DETSI *'Regulated structures—EIS information guideline'*, dated June 2024[1].

ii) DETSI '*Manual for assessing consequence categories and hydraulic performance of structures'*, dated June 2024[2].

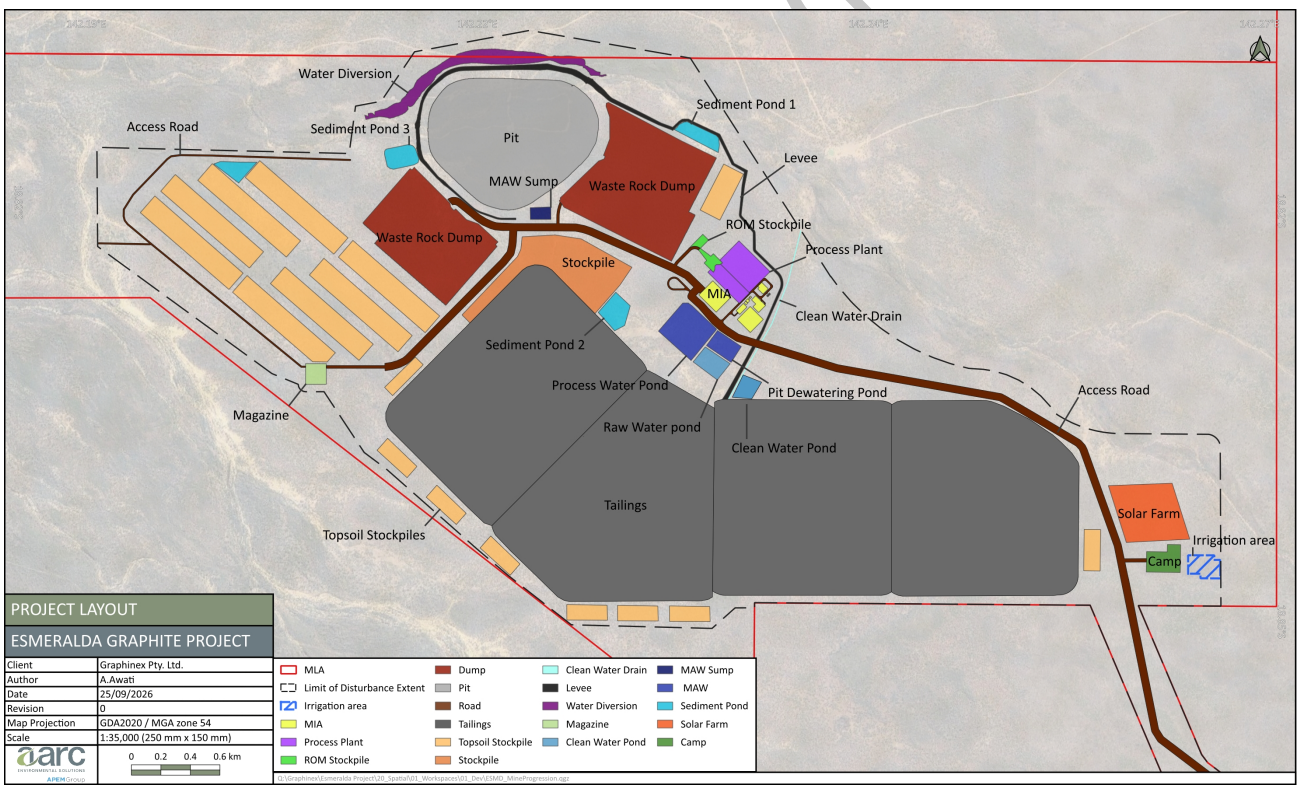
iii) Australian National Committee on Large Dams (ANCOLD) '*Guidelines on Tailings Dams - Planning, Design, Construction, Operation and Closure*', Rev 1 dated July 2019[3].

iv) Australian National Committee on Large Dams ANCOLD "Guidelines on the Consequence Categories for Dams", dated October 2012[4].

1.4 Location of Project

The EP is located at 18° 49.8' S and 142° 13.9' E, within Queensland's North West Minerals Province (NWMP), approximately 70 km south of Croydon and approximately 500 kilometres west of Townsville, refer to Figure 1.1. Figure 1.2 shows the infrastructure and tenement layout.

Figure 1.2 – Infrastructure and Tenement Layout (source AAARC)



1.5 Mining History

Historic gold mining activities have been undertaken at Croydon, 70 km to the north of the project. No historical mining has occurred in the area surrounding this Project.

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1.6 Rehabilitation and Closure Objectives

It is understood that the current requirements are that the GTSF Cells 1, 2 and 3 are to be deconstructed, with all the embankment construction materials and tailings returned to the mine pit. GTSF Cell 4 will remain and be rehabilitated as described in Section 8 of this report.

Cone Penetrometer Testing (CPT) investigations, with pore pressure dissipation testing of the deposited tailings within the GTSF, will be required prior to closure to extract the vital information (moisture content, density and shear strength of the tailings) for the deconstruction process.

1.7 Commitments

GPL makes the following commitments in respect of the GTSF:

i) Minimal disturbance of land will be performed in order to allow the project to proceed.

ii) Pipelines to and from the GTSF will be bunded with sumps in low-lying locations to prevent spillage of tailings or return water into the surrounding area in the event of pipeline failure.

iii) An adequate freeboard in accordance with the design requirements as detailed in Section 4.3 must be maintained.

iv) Existing monitoring will be utilised to monitor water levels and water quality. Baseline water levels and samples have been taken and additional work is programmed prior to tailings deposition, refer to Section 7 of the report titled *'Esmeralda Graphite Project – Groundwater Impact Assessment'* prepared by the GP Hydrogeologist (hydrogeologist.com.au).

v) To manage and operate the tailings storage in general accordance with the Operations Manuals (OM) prepared as part of the detailed design, with annual engineering reviews of the GTSF. Preliminary operating requirements are detailed in Section 7 of this document.

vi) Deconstruct the GTSF Cells 1, 2 and 3, with all the tailings returned to the mine pit first, followed by embankment construction materials. GTSF Cell 4 is to be rehabilitated in accordance with the project closure details in Section 8 and the rehabilitation plan to the final Post Mine Land Use (PMLU), grazing, as soon as practicable.

2 TSF DESIGN CONSIDERATIONS

2.1 Tenure

Table 2.1 details the site, mining lease number, area and grid co-ordinates for this facility.

Table 2.1 – Area of Disturbance

Facility	Mining Lease No	Total Area (Ha) of Final Tailings Surface	Latitude and Longitude (Decimal degrees)
GTSF	MLA100430/MLA100431	4,517	Lat -18.8125 (S), Long 142.2167 (E)

2.2 TSF Design Parameters

The TSF design parameters presented in Table 2.2 are based on the mining schedule and the approximate project timeframe provided by aarc.

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Table 2.2 – TSF Design Parameters

Annual Tailings Production (Mtpa)	GTSF Life (yrs)	Project Life (yrs)	LOM (MT)	Tailings Slurry Density % Solids	Operating hrspa
3.25	45	63	175	60	8,000

2.3 Storage Capacity

The internal storage capacity of the proposed TSF Cells is currently estimated to be 93.6 Mm^3, refer to Table 1.1.

2.4 Site Conditions

2.4.1 Climate

The project is located at approximately 37 km WNW of Esmeralda Station (BOM Station ID 029016) at 18.85° S and 142.57° E. The Project is in Climate Zone 1, which is characterised by high-humidity summers with significant rainfall (November to April) and warm, dry winters. The rainfall data used in the TSF design was sourced from Emerald Station, where rainfall data was collected from 1914 to 2024, with the mean annual rainfall of 686.4 mm. According to the Australian Climate Averages - Evaporation (Climatology 1975-2005), average annual evaporation is estimated to be approximately 2,500 mm/year. The evaporation data used in the TSF design is from Croydon Township (BOM Station 029012) where mean daily evaporation data for the period 1972 to 2014 is 2,476 mm. Potential evaporation is significantly greater than the annual rainfall. According to the Australian Government Bureau of Meteorology website https://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.030045.3pm.pdf, winds in the area are predominately from the east and south east. Rainfall intensity for a 1% AEP 72-hour storm event is 5.31 mm, according to the Australian Government Bureau of Meteorology website http://www.bom.gov.au/water/designRainfalls/ifd/. The most recent data is presented in Table 2.3 and Figure 2.1. The PMP 6 hr duration is 950 mm, based on the BOM GSDM method.

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Table 2.3 – Rainfall intensity data (mm/hr) Annual Exceedance Probability (%)

Duration	63.20%	50%	20%	10%	5%	2%	1%
1 min	145	163	217	252	284	326	356
2 min	125	142	190	221	248	278	299
3 min	118	133	178	207	233	263	283
4 min	112	127	170	197	222	251	273
5 min	108	121	162	188	212	242	263
10 min	90.3	101	135	156	177	203	223
15 min	78.2	87.8	117	135	153	176	193
20 min	69.2	77.7	103	120	136	156	171
25 min	62.3	69.9	93.1	108	122	140	154
30 min	56.7	63.7	84.9	98.7	112	128	140
45 min	45	50.7	67.9	78.9	89.2	102	111
1 hour	37.6	42.5	57	66.3	75	85.6	93.3
1.5 hour	28.6	32.4	43.7	50.9	57.7	65.9	71.9
2 hour	23.3	26.4	35.8	41.8	47.4	54.4	59.4
3 hour	17.2	19.6	26.7	31.3	35.6	41.1	45.1
4.5 hour	12.6	14.4	19.7	23.2	26.6	31	34.3
6 hour	10.1	11.5	15.9	18.8	21.6	25.3	28.2
9 hour	7.36	8.39	11.6	13.9	16.1	19.1	21.5
12 hour	5.89	6.72	9.37	11.2	13.1	15.7	17.7
18 hour	4.32	4.93	6.93	8.37	9.85	11.9	13.5
24 hour	3.48	3.97	5.62	6.83	8.09	9.8	11.2
30 hour	2.95	3.37	4.79	5.84	6.95	8.44	9.63
36 hour	2.58	2.95	4.21	5.15	6.15	7.47	8.52
48 hour	2.09	2.4	3.44	4.23	5.08	6.16	7.01
72 hour	1.57	1.8	2.6	3.22	3.87	4.68	5.31
96 hour	1.29	1.48	2.14	2.64	3.18	3.83	4.34
120 hour	1.1	1.27	1.83	2.26	2.72	3.28	3.71
144 hour	0.969	1.12	1.61	1.99	2.38	2.87	3.26
168 hour	0.87	1	1.44	1.77	2.12	2.57	2.93

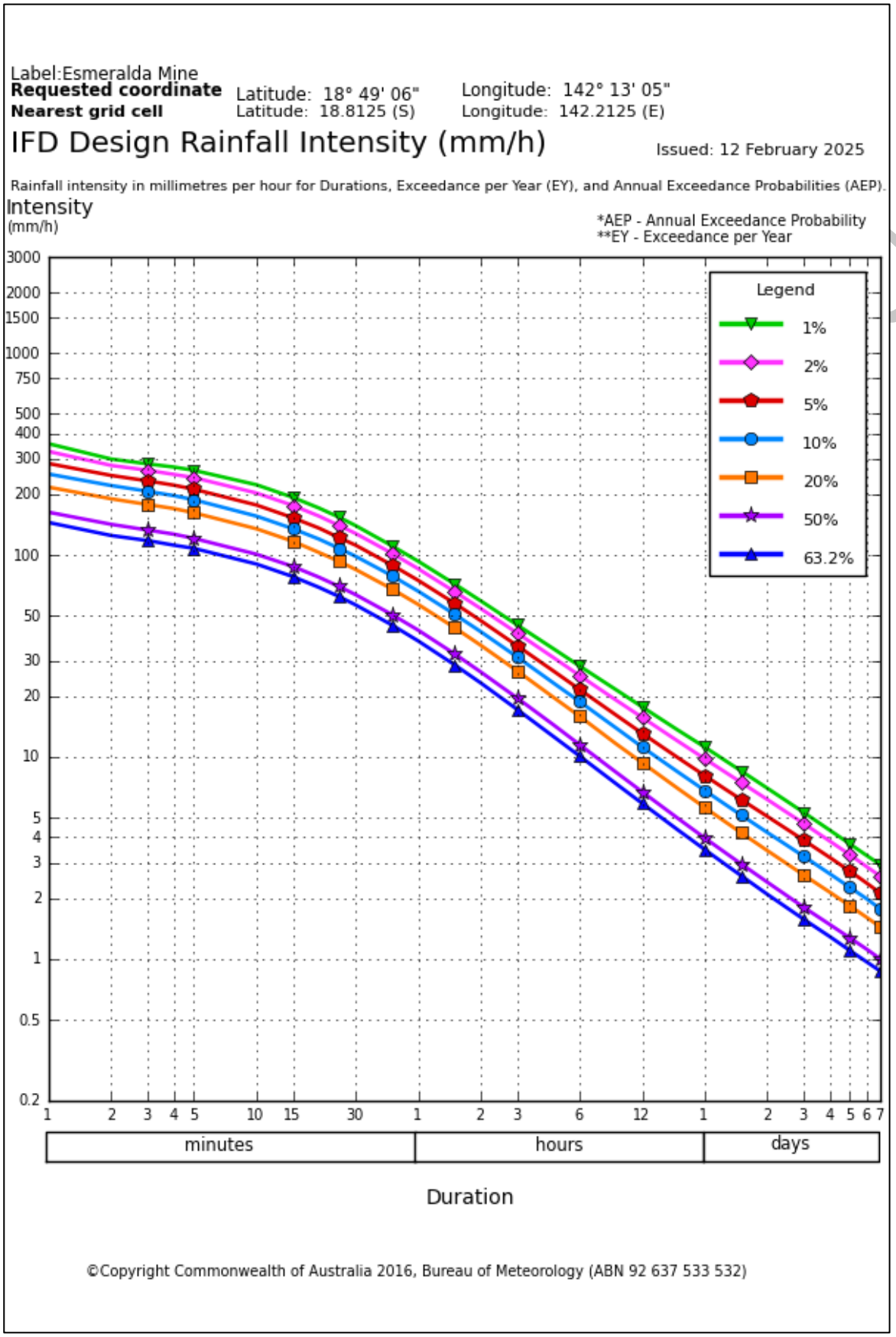
Note:

The 50% AEP IFD does not correspond to the 2-year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.

* The 20% AEP IFD does not correspond to the 5-year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

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Figure 2.1 - Rainfall Intensity Frequency Duration (source Commonwealth of Australia 2016 BOM)



2.4.2 Soils

The Atlas of Australian Soils (broadscale national mapping at 1:1,000,000 scale) describes the Project Area being majority deep sandy mottled yellow earths on very gently undulating alluvial plains. Numerous sandy rises and shallow sandy stream beds are also described from the southern area of the transport corridor, while the western edge of the mine area includes yellowish brown earthy sands on stream levees, small flood plains and infilled channels.

2.4.3 Geology

The entire Esmeralda project area is concealed under Cainozoic and Mesozoic cover sequences. These Cainozoic sediments are underlain by the Mesozoic sediments of the Carpentaria Basin consisting of sandstone, siltstones and shales of the Gilbert River Formation. A major unconformity exists between the Mesozoic sediments and Proterozoic basement. The Carpentaria Basin is comprised of Early Cretaceous to Middle Jurassic age, fluvial to shallow marine-dominated sediments. The basement is currently mapped as "unknown basement" and is interpreted to be the Esmeralda Supersuite granites. Previous drilling in the area suggests that the cover sequence consists of flat-laying laminated and cross-bedded siltstone, claystone, and coarse sandstones. Logging of drill core by Cartledge[5] indicates that these sediments had alternating porous and non-porous horizons and differing strengths. According to historic drill holes, this sequence is approximately 50 - 70 m thick across the project area.

The exploration target is a granitic pluton of undetermined size, interpreted as the Esmeralda Granite—part of the Proterozoic Esmeralda Supersuite within the Croydon Province. This pluton is generally believed to be free from significant local-scale structural disruptions (Graphinex, 2025). However, 2025 geotechnical core logging executed by Cartledge[5], identified alternating fault zones at approximately 100–110 m depth and a distinct fault zone between 115 and 120 m, based on observations from two geotechnical boreholes (25ESGT001 and 25ESGT002). Additionally, borehole 25ESGT005 exhibits frequent fragmentation, possibly associated with faulting and jointing. Chlorite–quartz veins and chlorite–carbonate infill are the most common mineralogical features recorded in the recovered core, as documented in the site geotechnical logs.

2.4.4 Geotechnical Conditions

The geotechnical site investigation (GSI) work by Cartledge[5], relevant to the mine pit and inferred to be relevant to the TSF, indicates that the ground conditions comprise:

i) Fine-grained sand - the predominant surface material observed across the project area with an indicated thickness of approximately 1.0 m.

ii) An underlying sedimentary sequence comprising flat-lying, laminated and interbedded layers of highly to extremely weathered sandstone, siltstone and claystone, which is approximately 60–70 m thick.

iii) A transition zone from the sedimentary sequence to granite, consisting of approximately 10–15 m of moderately weathered sandstone.

iv) Granite, which is the host rock for the graphite, was encountered at approximately 70 m.

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2.4.5 Seismicity

Australia has a low seismicity (rate of occurrence of earthquakes) when compared to countries located along tectonic plate boundaries, such as New Zealand or Indonesia. However, seismic risk is the combination of hazard, community exposure and infrastructure vulnerability. According to the Earthquake Hazard Map of Queensland, Figure 3.2 (F) of AS1170.4-2007, a horizontal Peak Ground Acceleration (PGA) of 0.03 g has a 10% probability of exceedance in 50 years (1:500 AEP).

2.4.6 Landuse

The Project area is located within the Gulf Savannah NRM region. The Project area is located within an existing pastoral property. Queensland Land Use Mapping classifies the study area as 'Grazing Native Vegetation' (DNRMMRRD 2024). Land within and surrounding the Project is designated 'Rural' zone under the Croydon Shire Planning Scheme 2019. The land in the study area is currently used for low-intensity cattle grazing of native vegetation. No historical mining has occurred in the underlying or surrounding Project area. The Project has an Agricultural Land Classification of Class C2 (Queensland Guidelines for agricultural land evaluation 2015). This land is considered suitable for grazing native pastures, with or without the introduction of pasture, and with lower fertility soils than C1. The Esmeralda Prospect Road is a local council road providing access to local properties and the southern boundary of the MLAs.

2.4.7 Landform

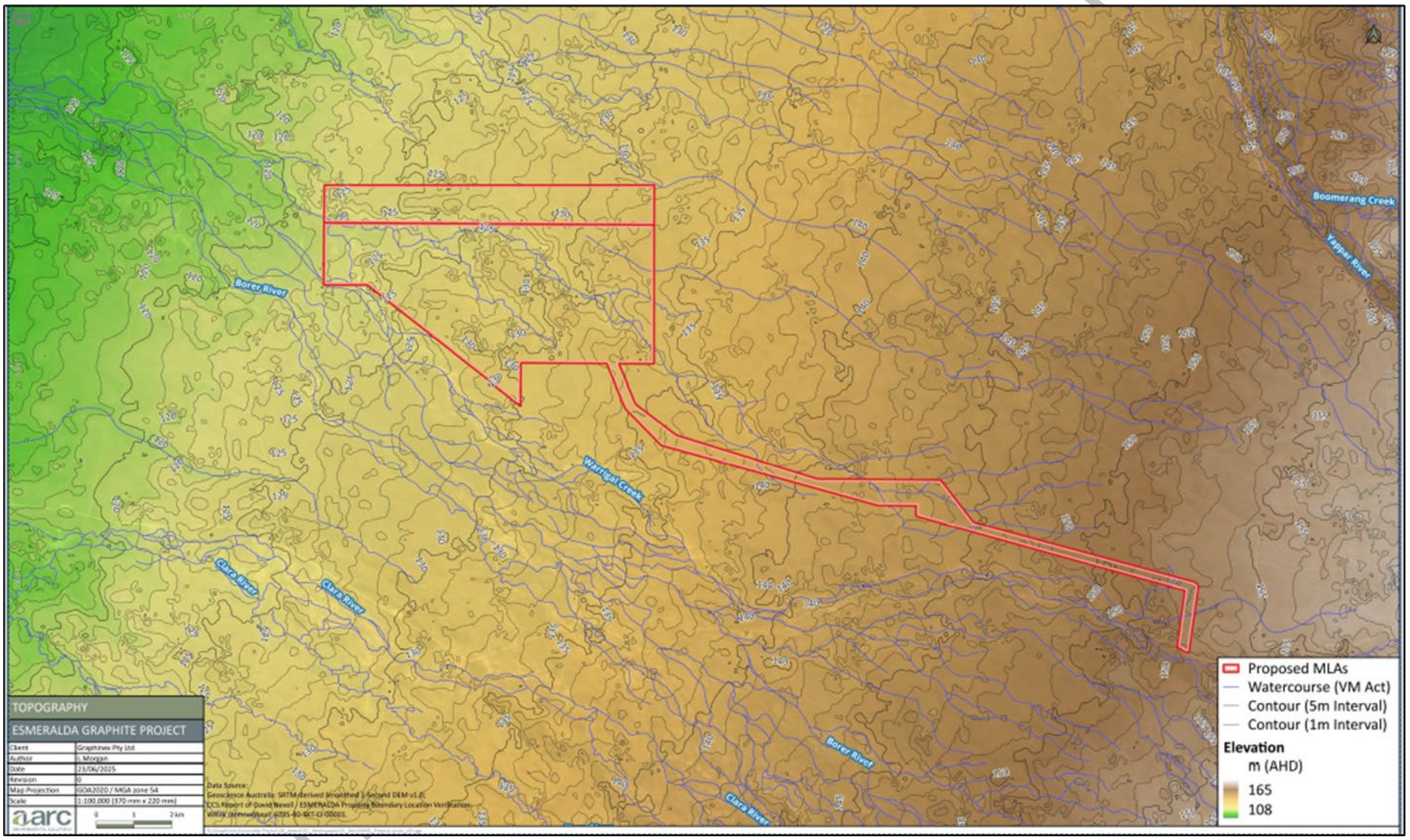
The topography of the Project area is generally flat to gently undulating, with elevations ranging between 120 m and 140 m Australian Height Datum (AHD). Braided river systems dissect plains of low woodland vegetation across the Project site, refer to Figure 2.2.

2.4.8 Hydrological Characteristics

The proposed GTSF is located on the top of a ridge and would only be subjected to rainfall runoff from the drainage divide, which falls within the catchment area upstream of the facilities. Some minor diversion may be required to divert flood waters away from the TSFs. Figure 2.2 shows the topography and we understand that flood modelling for the whole project is being executed by others. The estimated catchment area where rainfall runoff flows into each of the cells forming the GTSF, is 120.8 ha for Cell 1, 128.1 ha for Cell 2 and 127.7 ha for Cells 3 and 4.

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Figure 2.2 - Topography (source AARC)



2.4.9 Hydrogeology

The Cartledge[5] GSI data included groundwater level measurements at five (5) groundwater monitoring bores that Graphinex drilled, with the data indicating standing water levels varying between 7.66 m and 11.95 m below the existing ground surface.

According to the report by the GP Hydrogeologist (hydrogeologist.com.au)[6] the following details relevant to the design of the GTSF were noted:

i) *"Groundwater quality data has been obtained from multiple groundwater sampling events in September 2024 to November 2025. The field electrical conductivity (EC) is shown in Figure 4 12. Field EC ranges from 803 µS/cm to 3,250 µS/cm and is lowest in bore ESMB01D and highest in bore Rowe 1. Groundwater is considered too saline for crops at 8,100 µS/cm and water below 7,460 µS/cm is considered suitable for beef cattle (Queensland Government, 2018). Pelican bore, Rowe 1 bore and Rowe 2 bore show slightly higher EC concentrations (>2,000 µS/cm) when compared to the site-specific groundwater monitoring bores (between 800 µS/cm and 1,500 µS/cm)."*

ii) *"The maximum predicted drawdown in the Gilbert River Formation extends beyond the Project area, with drawdown extending approximately 1700 m beyond ML 100430 in the north and 1300 m beyond ML 100431 in the southwest. The maximum predicted drawdown in the Gilbert River Formation extends radially to a maximum distance of 3600 m from the open pit crest to the south and west, and up to 3100 m from the open pit crest to the north and east. The predicted maximum project drawdown in the Gilbert River Formation ranges from approximately 1 m to 50 m."* Figure 6.1 of their report is presented below as Figure

iii) *"Groundwater monitoring will be undertaken during mining operations to confirm the groundwater drawdown predictions and identify any unexpected changes in groundwater levels. Section 7* (in their report) *describes the proposed groundwater monitoring program and management measures."*

From the details contained in the report by the GP Hydrogeologist and the details of the design, it can be concluded that:

i) The geology of the site beneath the TSF has a low to very low permeability.

ii) Groundwater recharge from any fugitive seepage out of the deposited tailings in the GTSF is expected to be very low, given:

   a) The GTSF is fully HDPE-lined.

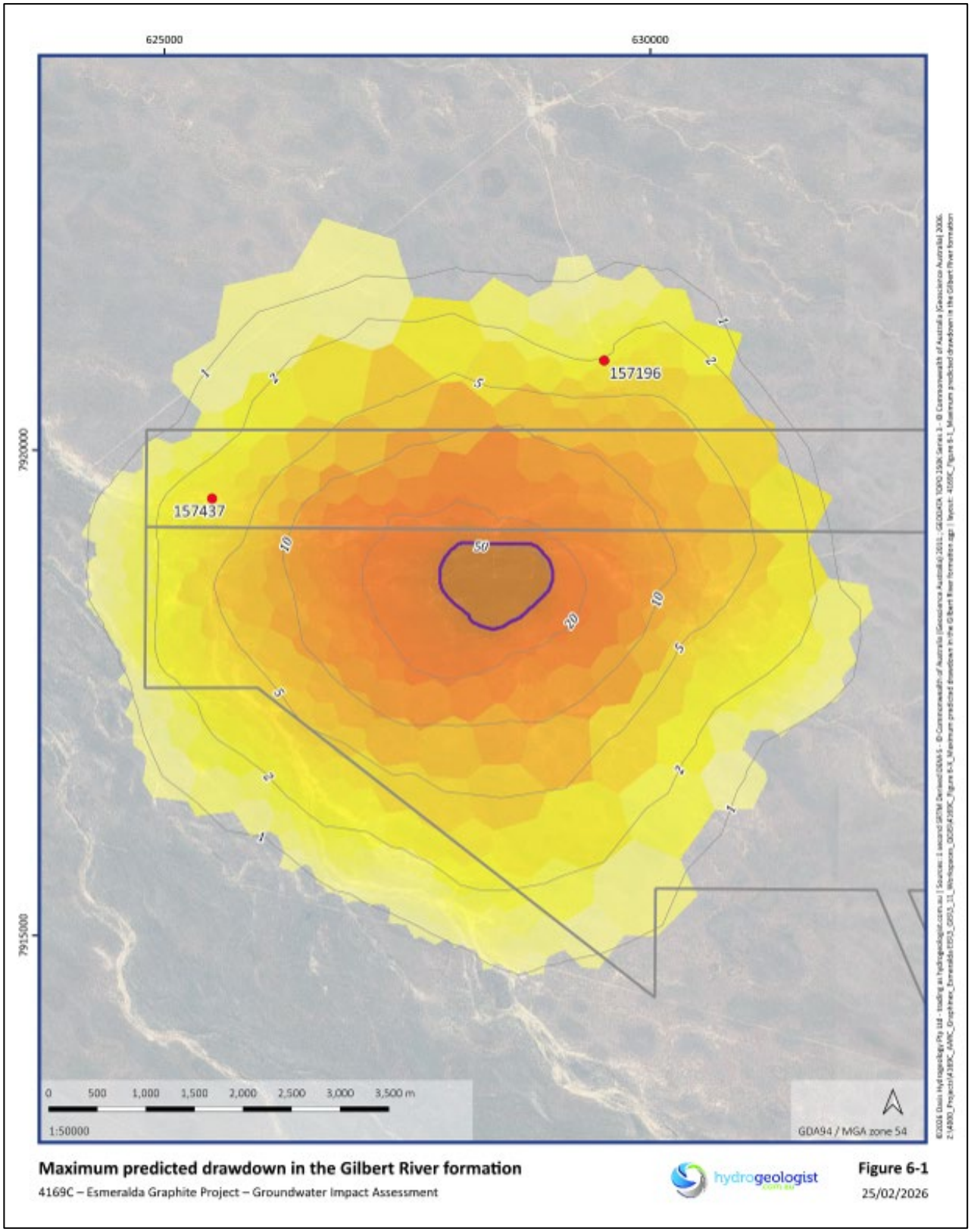
   b) The geotechnical properties of the tailings, determined from laboratory testing, refer to Section 2.5.1, demonstrate that the rapid settling characteristics of the tailings indicate that a high rate of supernatant water recovery is possible.

   c) The presence of the upstream toe drain over the HDPE liner in the base of each TSF Cell provides a preferential flow path to the external sump for water recovery and recycling.

iii) The cone of predicted drawdown from pit dewatering extends beneath the GTSF, refer to Figure 2.3, such that any seepage would be captured by the mine pit dewatering activities.

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Figure 2.3 - Predicted Drawdown (sourced from the GP Hydrogeologist Report)



2.5 Tailings Properties

2.5.1 Geotechnical Characteristics

Tailings testwork was executed by E-Precision Pty Ltd in late February, early March 2026. The tailings samples, received on 16 February 2026, were dry and remixed with Perth tap water to a slurry density of 60% solids. The laboratory testwork comprised:

i) One particle size distribution (PSD) and hydrometer with soil particle density (SPD) determination.

ii) One Atterberg Limits (AL) Test.

iii) One Air Drying Test (ADT).

iv) One Undrained Settling Test (UST).

v) One Drained Settling Test (DST).

vi) One Extended Height Consolidation Test (EHCT).

The results of the geotechnical tailings testing are contained in the Technical Memorandum in Appendix 3 of this document. The results of this testing and the implications for the operation of the TSFs are summarised as follows:

i) The results of the PSD and AL testing indicate that the tailings can be classified as a low plasticity sandy clay/sandy silt and are classified as CL-ML, according to Table 10, Classification of Fine-Grained Soils in AS 1726:2017, Geotechnical Site Investigations.

   Based on the results of the PSD and AL tests, the hydraulic conductivity for the settled, consolidated tailings is estimated to be in the range of 10^{-8} m/s to 10^{-10} m/s. The relevant geotechnical test results (PSD and AL testing) on which the screening for liquefaction is based, include moisture content, particle size distribution, clay content (defined as % passing the 0.002 mm sieve) and Atterberg limits. The screening implies that there is an overall tendency for the tailings materials which have a low plasticity clay fraction, to be susceptible to liquefaction under sufficiently adverse conditions of saturation, in-situ stress and cyclic loading. As the tailings will be contained within an above-ground facility raised by downstream construction and ultimately moved back into the mined pit, which is effectively an In-Pit TSF (IPTSF). It is highly unlikely that the deposited tailings would form a foundation for future embankment raises and therefore, apart from some settlement of the tailings in the pit as a result of any seismic activity, there are no adverse consequences if the tailings were to liquefy.

ii) The tailings have an SPD of 2.678 t/m^3.

iii) The ADT indicates that solar drying and desiccation (a function of the % solids, clay fraction and plasticity of the tailings) occur over a period of approximately 10.4 days, with the final estimated dry density peaking at approximately 1.32 t/m^3. This does not include the effects of consolidation which would occur within the tailings stack.

iv) The objective of the UST is to monitor the tailings settlement and the development of clear supernatant water in undrained conditions. By monitoring the percentage of supernatant with

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respect to the initial water volume, an indication of how much water will be available for recovery and the speed at which this water is released, can be assessed. The results show the available supernatant water with respect to the total water discharged to the tailings storage. The points to note from the laboratory results are:

a) Water available for recovery (approximately 54.07%) takes approximately 1.0 days under laboratory conditions.

b) The dry density of the tailings after 1.26 days is approximately 1.47 t/m^3 in the UST, which does not include the effects of consolidation, which would occur within the tailings stack.

v) The objective of the DST, which was top and bottom drained, is to monitor the tailings settlement and the development of clear supernatant water and underdrainage in drained conditions. By monitoring the percentage of supernatant and underdrainage with respect to the initial water volume, an indication of how much water will be available for recovery and the speed at which this water is released, can be assessed. The points to note from the laboratory results are:

a) The recovery of water from the top drainage, by decantation, is approximately 28% of the slurry water and is available 1.83 hours after tailings deposition. The recovery of water from the underdrainage is 30.1% of the slurry water, which is available 1.83 hours after tailings deposition. Total water recovery is 58.85%, under laboratory conditions, which does not include the effects of consolidation, which would occur within the tailings stack, increasing the total water available for recovery.

b) The dry density of the tailings after approximately 1 day is 1.57 t/m^3 in the drained settling test, which does not include the effects of consolidation, which would occur within the tailings stack.

vi) The objective of the Consolidation Test, which is undrained, is to determine the consolidation and permeability characteristics of the tailings. The points to note from the laboratory results are:

a) The tailings have good consolidation characteristics with Cv between 4.55 and 16.677 m^2/yr.

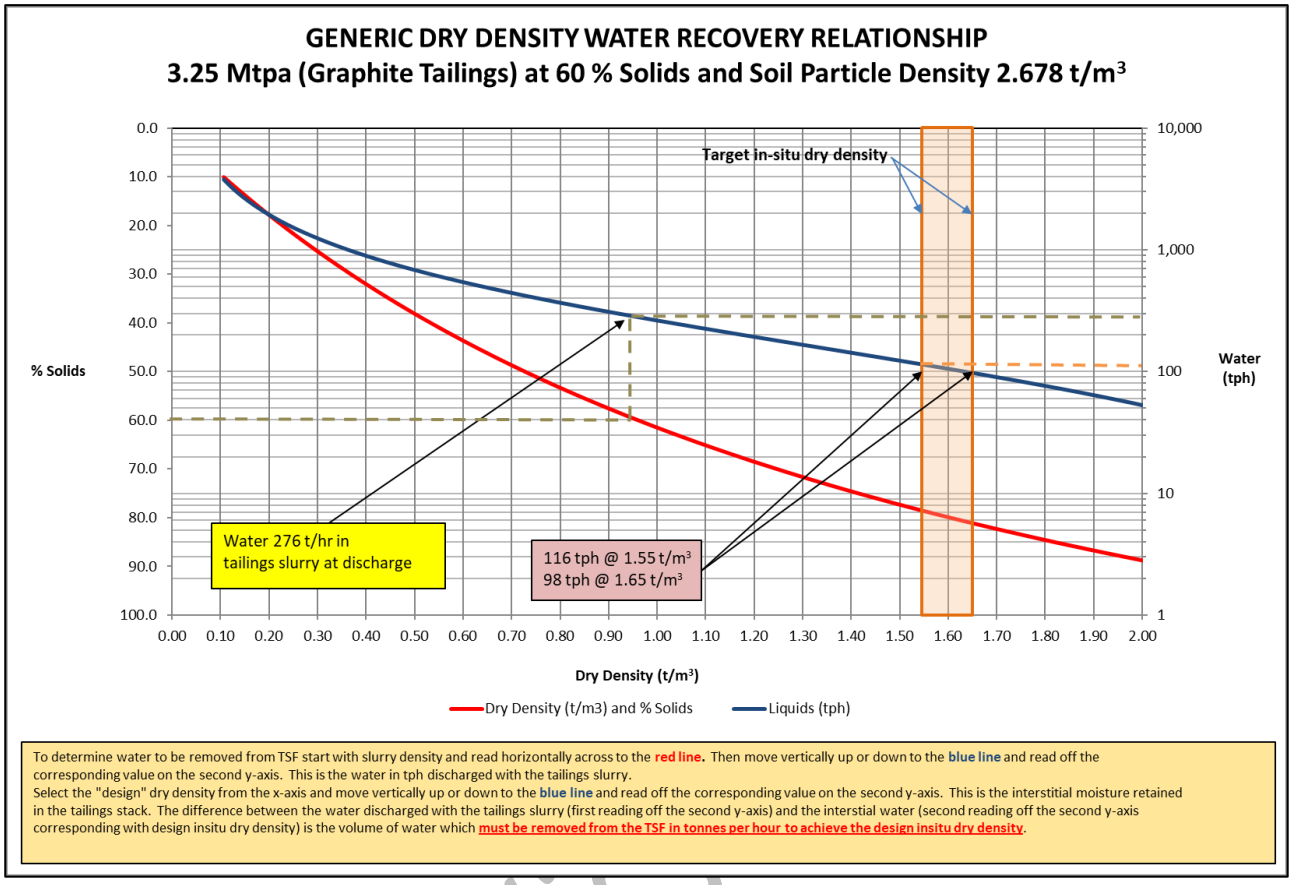
b) The hydraulic conductivity (k) for the tailings is in the range of 3.6 x 10^{-8} m/sec, at Stage 1 (12.5 kPa) to 5.7 x 10^{-11} m/sec, at Stage 8 (1600 kPa) under laboratory conditions, which does include the effects of consolidation, which would occur within the tailings stack in the above ground TSF, where an increased overburden loading combined with drainage through the underdrainage in the base of the tailings stack, would further reduce the hydraulic conductivity (k) for the tailings. A similar effect would occur where the tailings are deposited back into the mine pit at the end of processing.

From a review of the test results above and the performance of similar TSFs where fresh ores are discharged into the storage facility, the results of the consolidation testing indicate that the final in-situ dry densities of the tailings deposited into the above ground TSF are likely to be in the range of 1.55 to 1.65 t/m^3. The final in-situ dry densities of the tailings deposited back into the mine pit being in the range of 1.65 to 1.85 t/m^3. Figure 2.4 shows the Generic Moisture Density Curve.

The design must consider the inclusion of a rock ring decant filter for the above ground TSFs to maximise the water recovery/removal and explore the benefits of inclusion of an underdrainage system. A technical note on the rock ring filter and tailings deposition is attached as Appendix 2 in the Technical Memorandum.

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Figure 2.4 - Generic Moisture Density Curve



2.5.2 Geochemical Characteristics

According to RGS[7], "the tailings are typically alkaline with low salinity, and low acid neutralising capacity. The majority of tailings samples are classified as PAF. NAG testing also confirms that the tailings are likely to be PAF. The concentration of sulfide sulfur was relatively low in one sample classified as Uncertain, although the low neutralising capacity is consistent across all the samples. Based on the alkaline pH values, it is likely that some of the inherent sulfide sulfur is slow to react, or less reactive than those typically associated with pyrite minerals. An expert determined that the sulfur is in the form of pyrrhotite and elemental sulfur. Comparing the Batch 1 and Batch 2 tailings, all initially produce a neutral pH and are classified as PAF.

Seepage is moderately saline, which is typical for tailings. The newer tailings are slightly more saline and have higher ANC. The total carbon in the Batch 2 tailings is lower than in the Batch 1 tailings, which may indicate an improvement in graphite recovery. Initial contact water may contain slightly elevated concentrations of aluminium, although all other metal/metalloid concentrations are expected to be low. If the tailings are left unmanaged and allowed to oxidise, several metals/metalloids, including aluminium, boron, cadmium, copper, lead, manganese, nickel, and zinc can mobilise into pore water under weakly acidic conditions. Leachate produced under saturated (anoxic) conditions maintains a neutral pH and lower concentrations of metal/metalloids. Concentrations of soluble hydrocarbons (sourced from flotation reagents) in tailings are initially above background soil but then diminish rapidly. In terms of physical properties, the Batch 2 tailings have lower bulk density, and a higher proportion of clay and silt than the Batch 1 tailings. However, all of the tailings behave predominantly as a sand. They are likely to be permeable, to drain quickly, and have low water retention characteristics. The tailings are classified as Emerson Class 3 or 4 and are expected to have good structure and stability, with limited shrink/swell behaviour.

Classification: Moderate to high-risk material. Classified as PAF.

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Management: Disposal into the backfilled void with a waste rock cover and soil capping is the recommended. AMD management strategy. Preferably inundated with groundwater. Tailings are unsuitable as a bulk fill or surface layer without treatment.".

The tailings are to be contained within HDPE-lined Cells forming the TSF and as such, it is considered there is a very low risk of seepage with potential adverse consequences for the environment below the TSF. Nevertheless, monitoring bores are recommended, with standing water level measurements and water samples taken on at least a quarterly basis to monitor water quality adjacent to the TSF.

2.6 Mine Waste Geochemistry

According to RGS[6], "Soil, overburden, and waste rock mine materials typically have low total sulfur content, low to moderate ANC, and most are classified as NAF-Barren. These materials have a negligible risk of acid generation and a high factor of safety with respect to potential for acidic drainage. Overburden and waste rock materials are suitable to be disposed as backfill or in out-of-pit waste rock dumps and will not require management for acidic drainage.". On the basis of the foregoing, the mine waste is geochemically suitable for use in the construction of the containment embankments for the TSF Cells.

3 TSF DESIGN

3.1 General

The design of the TSF for the EGP was developed by WAVE as part of the PFS study. This PFS design was based on a 3 Cell arrangement which was subsequently increased to 4 Cells. The physical design storage parameters for each cell of the TSF are presented in Table 3.1 and comprise:

- TSF Cell number
- TSF Stage number
- Embankment Crest RL (m) for each Stage of each Cell
- Storage Volume (Mm^3) with Freeboard Allowance of 1.3 m below the spillway
- Tonnes of Tailings (Million - dry tonnes) to be stored in each Cell/Stage
- Operating Life (years) for each Cell/Stage @ 3.25 Mtpa
- Zone 1 Earthworks including the seepage cut-off (Mm^3) for each Cell/Stage; and
- Zone 2 Earthworks (Mm^3) for each Cell/Stage.

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Table 3.1 - Storage Volumes (Mm^3)/Capacity 1.55 t/m^3/Operating Life @3.35 Mtpa/Embankment Volumes (Mm^3)

TSF Cell	Stage	Embankment Crest RL	Storage Volumes (Mm3)	Tonnes @ 1.55 t/m^3	Operating Life @3.25 Mtpa	Upstream Zone Embankment Volume (Mm^3)	Downstream Zone Embankment Volume (Mm^3)
1	1	133.50	4.69	7.03	2.16	0.11	0.77
1	2	138.75	6.08	9.13	2.81	0.12	1.48
1	3	144.00	6.50	9.75	3.00	0.12	2.30
1	4	149.25	6.93	10.40	3.20	0.12	3.17
2	1	133.50	3.45	5.34	1.64	0.11	0.44
2	2	138.75	6.39	9.90	3.05	0.12	0.93
2	3	144.00	6.81	10.55	3.25	0.12	1.48
2	4	149.25	7.24	11.21	3.45	0.12	2.15
3	1	133.50	2.67	4.13	1.27	0.11	0.33
3	2	138.75	6.26	9.70	2.98	0.12	0.93
3	3	144.00	6.71	10.40	3.20	0.12	1.43
3	4	149.25	7.12	11.03	3.39	0.12	2.13
4	1	133.50	2.67	4.13	1.27	0.11	0.33
4	2	138.75	6.26	9.70	2.98	0.12	0.93
4	3	144.00	6.71	10.40	3.20	0.12	1.43
4	4	149.25	7.12	11.03	3.39	0.12	2.13
Total			**93.57**	**143.83**	**44.26**	**1.90**	**22.36**

3.2 Risk-Based Design

Section 1.3 lists the relevant Guidelines and Standards adopted for this design. The protocol followed for the preparation of this TSF Design Report commenced with the application of the ANCOLD Guidelines, which set the framework for Engineering Design of TSFs for the whole of Australia, with the Queensland Regulatory requirements also being addressed in the design process.

This tailings storage study commenced with a risk-based management process which considered alternative storage options, refer to Table 1.3. The option selected was based on:

i) The availability of the construction materials from the mining operation to construct a robust design.

ii) Reduction in the complexity of the containment structures, where downstream construction ultimately results in a robust structure, with a low likelihood of failure with a very low to no environmental consequence.

iii) Similar design concepts to that proposed in this document, have been utilised successfully at numerous mine sites in Australia. Provided the deposition of the tailings is cycled within each cell and supernatant water recovery is maximised, the overall settlement and formation of a surface crust will support the placement of a mine waste cover and topsoil if available, for both Cell 4 and the proposed In-Pit TSF.

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At this stage, it is understood that all the tailings and mine waste forming TSF Cells 1, 2 and 3 will be deconstructed and returned to the mine pit void. TSF Cell 4 will be rehabilitated and remain post closure.

A risk assessment will need to be executed as part of the approved mining Project Management Plan (PMP) prepared by PGL. As part of this risk assessment, it was clearly recognised that to minimise risk, the:

i) The TSF design concept presented in this document has to be fully understood by the project proponents.

ii) Construction, installation of the water recovery pump in each Cell and ultimately in the base of the pit must be executed in accordance with the intent of the design as presented in this document.

3.3 Geotechnical Assessment

The design concept adopted for the GTSF in the PFS was formulated to meet both the general requirements of the mine and the general parameters discussed in the previous sections.

The design is based on the available reports, testing and the experience of the author who has been involved in the development, operation and annual reviews of existing similar, downstream-constructed tailings storage facilities for various projects throughout Australia, for more than 38 years.

Based on the details presented in this report, together with the supporting documents provided by the GPL and considering the past performance of similar TSFs, the embankments of this facility are likely to be stable during the operation of the GTSF, provided that the:

i) Design concept presented in this document, which provides the details for the TSF Design, is fully understood by the operators.
ii) Construction work for pipeline corridors, bunding etc., is executed in accordance with the intent of the design.
iii) Management of tailings deposition and water recovery is in accordance with the intent of the design as presented in Section 7 of this document.

From a review of the geotechnical information for the site, refer to Section 2.4.4 and tailings testwork, refer to Section 2.5.1 and the performance of other similar storage facilities where mine waste has been used for downstream embankment construction and tailings derived from fresh rock is discharged, a final average in-situ dry density of not less than 1.55 t/m^3 could reasonably be achieved where consolidation of tailings and water recovery through the underdrainage and decant system is maximised. Given the surface area of the TSFs, it is recommended that the water recovery system (pumps and pipes) be sized for an operating capacity of not less than 70% of the slurry water volume at the maximum static head.

Care will have to be taken during tailings deposition to ensure that the spigotting does not damage the HDPE liner and water recovery will have to be efficient to avoid creation of large ponds and long-term ponding of supernatant water over a large area of each TSF Cell.

The geotechnical assessment of the GTSF design indicates the storage can be operated safely, provided the details in the OM are followed. Given the past performance of the majority of these styles of TSFs, it is unlikely that any slumping of the materials forming the containment embankment would affect the operation of the decant system and is unlikely to pose a risk to personnel servicing pumps etc. A major deep-seated embankment failure is not anticipated.

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3.4 Materials Placement and Embankment Geometry

3.4.1 Zone 1

The proposed TSF design concept comprises TSF Cell 1 to the west and TSF Cell 4 to the east. The TSF design is based on downstream construction techniques. The embankments of the TSF have upstream and downstream slopes of 2.5:1 (H:V) to form a robust structure.

The base of all the TSF Cells is to be lined with 1.5 mm HDPE, which will be placed over the compacted, highly to extremely weathered sandstone, siltstone, and claystone, with a minimum thickness of 500 mm to form a low-permeability zone beneath the HDPE liner.

The perimeter embankments, including the dividing embankment between Cells 1 and 2, 2 and 3, and 3 and 4 are to comprise 2 zones. A rolled compacted zone comprising *'select'* fill sourced from the upper layers of the sedimentary rock sequence (highly to extremely weathered sandstone, siltstone, and claystone). The seepage cutoff soil embankment with a cutoff trench on the upstream face, with a minimum crest width of 5 m comprises suitable materials sourced from mine waste (sedimentary rock sequence), which is to be moisture-conditioned and compacted to 95% SMDD. These requirements, materials selection and compaction will ensure the upstream zone of the TSF will comprise low-permeability zone beneath the HDPE liner.

The locally-sourced mine waste materials may require some screening to remove oversized materials to achieve the following requirements for placement and compaction in Zone 1:

i) The materials must have 100% by weight passing 19 mm.
ii) The materials must have a minimum of 15% by weight passing 0.075 mm.
iii) The material must be free of organic or any other deleterious inclusions.
iv) The material must have a liquid limit of not less than 30%.
v) The material must have a plasticity index of more than 10%.

Full details of the construction including drawings, Scope of Works and Technical Specifications are presented in Appendix 2.

The materials would be transported to the site of the TSF and placed in such a manner as to minimise segregation. The materials are to be moisture-conditioned and cured, to ensure the moisture is thoroughly mixed and evenly spread through all materials proposed for embankment construction, to within the range of -2%, +2% of the optimum moisture content, as determined from laboratory testing in accordance with the latest version of AS1289 5.1.1. All fill material destined for the upstream perimeter embankment is to be placed in homogeneous horizontal layers not exceeding 300 mm loose lift thickness. Each layer shall be compacted to achieve a minimum density ratio of not less than 95% of the standard maximum dry density (SMDD), as determined from laboratory test. Placement should be continuous. If a break in fill placement allows the exposed surface to dry, it should be lightly tyned, watered and compacted prior to fill placement recommencing. The upstream slope shall be relatively smooth and free of projections (e.g. cobbles, roots etc.). Field density testing will be executed to ensure compliance with the specification and QA/QC procedures.

The geotechnical investigations, executed by Cartledge, at the mine pit area and sterilisation drilling confirm the lithology beneath the TSF is low-permeability material, suitable for use in Zone 1 of the TSF construction.

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3.4.2 Zone 2

The downstream section of the embankment will have a minimum crest width of 15 m and comprises traffic-compacted mine waste also derived from the sedimentary rock sequence. Downstream construction by stages is to be implemented with the Stage 1 embankment crest being not less than RL 133.5 m. Further staged embankment raising is planned to RL 138.75 m, RL 144 m, and RL 149.25 m, which will also be executed by downstream construction. The actual construction stages and timing are to be prepared in the next stage of the study. Current indications are that adequate volumes of mine waste are available from pre-strip mining operations to meet the current LOM tailings storage embankment construction requirements. Full details of the construction including drawings, schedules of materials, Scope of Works and Specifications are presented in Appendix 2.

The maximum particle size for the downstream zone, Zone 2, is 500 mm. The construction methodology for the downstream embankment shall be as follows:

i) Spread a loose lift of Rock Fill Material with a maximum thickness not exceeding 750 mm.

ii) The Rock Fill Material shall be compacted using smooth-drum vibrating rollers of not less than 11 tonnes front module mass, in layers of loose-lift thickness not exceeding 750 mm. Where the front module mass is less than 11 tonnes, the loose-lift thickness of the Rock Fill shall be reduced.

The geotechnical investigations, executed by Cartledge, at the mine pit area and sterilisation drilling confirm the lithology beneath the TSF is suitable for use in Zone 2 of the TSF construction.

3.4.3 Liner Details

The design concept incorporates a single HDPE-lined floor of the TSF and upstream embankments to the embankment crest at RL 149.25 m.

The basal liner (1.5 mm thick) comprises a smooth HDPE liner, or approved equivalent, which is to be placed over a layer of compacted oxide mine waste or compacted in-situ low-permeability subgrade, free of gravel, cobbles and boulders, with minimum compacted thickness of 300 mm.

A single-sided textured 1.5 mm HDPE Liner (or approved equivalent) is to be applied to the upstream face of the embankments from Stages 1 to 4.

The HDPE liner requires stringent surface preparation of the underlying subgrade or deployment of a geotextile underlay where suitable material is not available. Extreme care is required during handling, placement and installation of the HDPE to avoid damage. The selected materials for the subgrade in the base of the TSF are also to be installed on the upstream embankment slopes of Stages 1 to 4.

3.5 TSF Embankment Construction

Construction of the TSF is to be undertaken in accordance with the Construction Specification for the facility, developed as part of the following phases of design works to cover both earthworks construction and liner installation. Typical construction requirements for the TSF implementation include the following:

i) Inspection of the seepage cut-off and the alignment of the embankment.

ii) Inspection of the compacted base of the TSF prior to liner construction.

iii) Compliance testing of the floor of the TSF, seepage cut-off and perimeter embankment, to ensure:

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a) Moisture curing of materials as required during the upstream embankment construction with content at the time of placement and compaction within -2%, +2% of the optimum moisture content. Compaction is to achieve a density ratio greater than 95% of standard maximum dry density as determined by laboratory compaction testing (AS 1289 5.1.1) and confirmed by field density testing (AS1289.5.8.4 or approved alternative).

b) Materials used in the upstream embankment construction shall comprise clayey material having a fines content (material finer than 75 microns) greater than 30% for the compacted clay liner.

c) Mine waste materials used in the downstream embankment shall be spread with a maximum loose thickness not exceeding 750 mm. This material shall be compacted using smooth drum vibrating rollers of not less than 11 tonnes front module mass, in layers of loose-lift thickness not exceeding 750 mm.

In accordance with ANCOLD (2019)[3], construction supervision for the TSF is to be undertaken on a full-time basis by an engineer who is suitably qualified in the design and construction of TSFs. ANCOLD (2019) recommends that the designer provides or coordinates the construction supervision and construction reporting.

Laboratory and field testing is to be implemented to ensure the construction materials, including the liner, are selected, placed, and in the case of the earthworks materials, compacted in accordance with the intent of the design. Test types and frequencies are to be addressed in the construction specifications. In addition to the specifications, a QA/QC Manual must be developed for use in the construction. The main objectives for the implementation of the QA/QC Manual are to:

i) Ensure that construction work adheres strictly to all requirements as defined in the technical specifications, supporting construction design documents, codes and standards, and regulatory requirements.

ii) Maintain quality and provide documentation to ensure that tasks performed will comply with project requirements.

iii) Prevent construction deficiencies through pre-construction quality coordination.

iv) Ensure non-conformances are reported and resolved through approved dispositions and follow-up actions to confirm acceptable results during the construction process.

v) Provide auditable records of all tests, inspections, noncompliance and corrections, and any other pertinent data as required.

vi) Ensure that construction subcontractors have appropriate quality systems that will ensure work activities will meet contractual, technical, and quality requirements.

vii) Comply with project requirements and specifications, using Project-approved Quality Plans, construction control procedures and Inspection and Test Plans.

viii) Ensure that the extent of inspections, verifications and assessments is commensurate with the risk, safety, cost, schedule and quality issues that may adversely impact the quality of the facility.

Address and coordinate resolution of quality issues identified during reviews, surveillance, audits and inspections.

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3.6 Seepage Analysis

3.6.1 Background

The current design includes a Megaflo underdrain along the upstream toe of the proposed Stage 1 starter TSF embankment for all 4 Cells. This drain is above the HDPE liner which covers the TSF basin as described in Section 3.6 of this report. The purpose of the underdrain is to recover water from the base of the tailings stack for re-circulation and re-use in the EP process plant.

3.6.2 Seepage Modelling

A numerical seepage assessment of the underdrainage system has been undertaken using the two-dimensional Finite Element (2D FE) numerical seepage flow assessment to estimate the volume of water seepage likely to be recovered from the underdrainage. This work was undertaken in parallel with the SLOPE/W analyses, utilising Geostudio SEEP/W 2012. The modelling is conservatively based on steady state flow conditions using the following approach:

i) SEEP/W only considered the basal liner and underdrainage system. Seepage, if any, passing through the liner beneath the TSF impoundment area was not included in the modelling.

ii) The tailings stack was deemed to be fully-saturated, with a fully-developed hydrostatic porewater pressure from the tailings beach.

iii) The Megaflo 300 underdrain is modelled as a nominally 2 m wide line element (i.e. underdrain overlain by filter sand that has a minimum 2 m wide contact interface with tailings) with zero hydraulic porewater pressure, i.e. Megaflo underdrain effectively removes water out of the TSF such that porewater pressure does not build up within the underdrain itself.

The permeability parameter, defined by the hydraulic conductivity coefficient 'k' of 1 x 10^{-8} m/s, was adopted from a combination of the testing results of the Graphinex tailings and other graphite projects which considered the sand fraction of the tailings. During deposition, the tailings will likely segregate and form highly permeable, preferential flow paths within the overall tailings mass.

3.6.4 Seepage Results

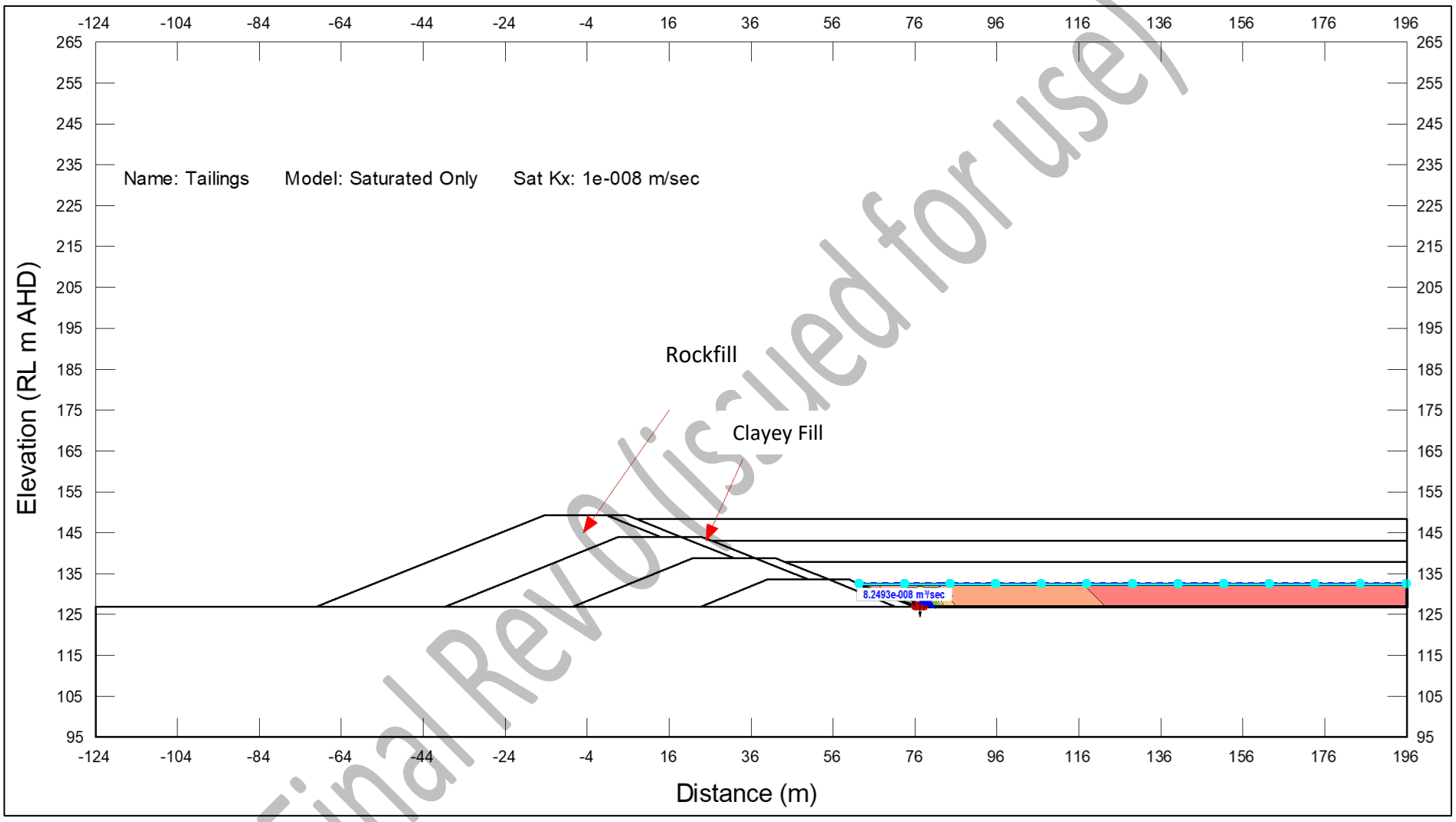
SEEP/W analysis was undertaken for each of the 4 stages proposed to progressively build the TSF. The summary of the predicted seepage flow into the proposed underdrainage system is presented in Table 3.2 below for Stages 1 to 4. The models for the analysis are presented as Figures 3.1 to 3.4 below. Please note that what appears to be mounding in Figures 3.1 to 3.4 is actually the impact of the flow into underdrainage at the embankment toe which has a higher permeability than the deposited tailings, hence the flow rates out of the TSF.

Table 3.2 - Predicted tailings liquor seepage flow rate into Megaflo underdrain

Tailings deposition stage	Tailings liquor seepage flow rate into Megaflo underdrain:	
	m^3/s per m length Megaflo underdrain	L/day per m length Megaflo underdrain
1	8.2 x 10^{-8}	7
2	1.2 x 10^{-7}	10
3	1.5 x 10^{-7}	13
4	1.9 x 10^{-7}	16

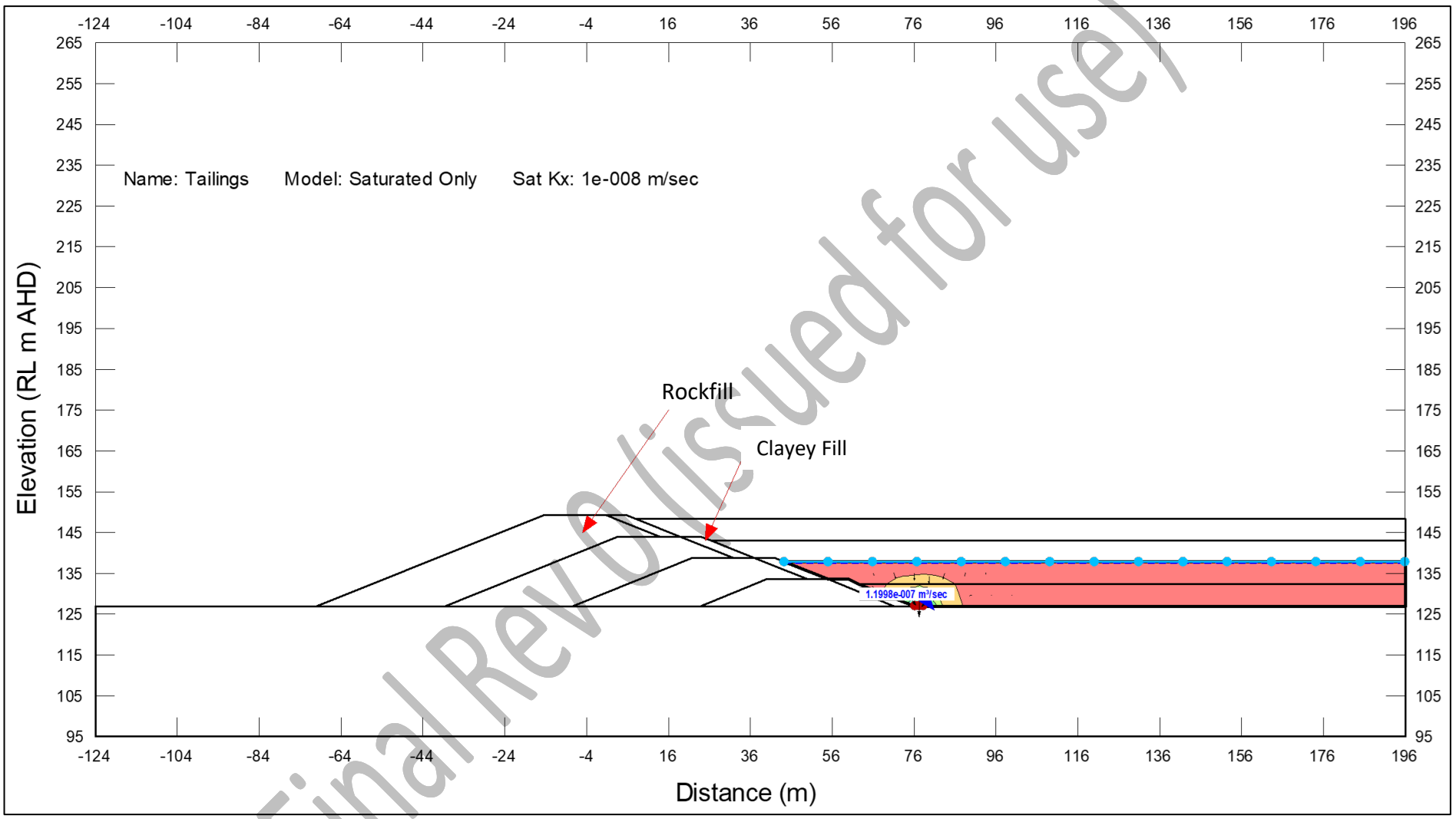
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Figure 3.1 – SEEP/W analysis output: TSF Stage 1



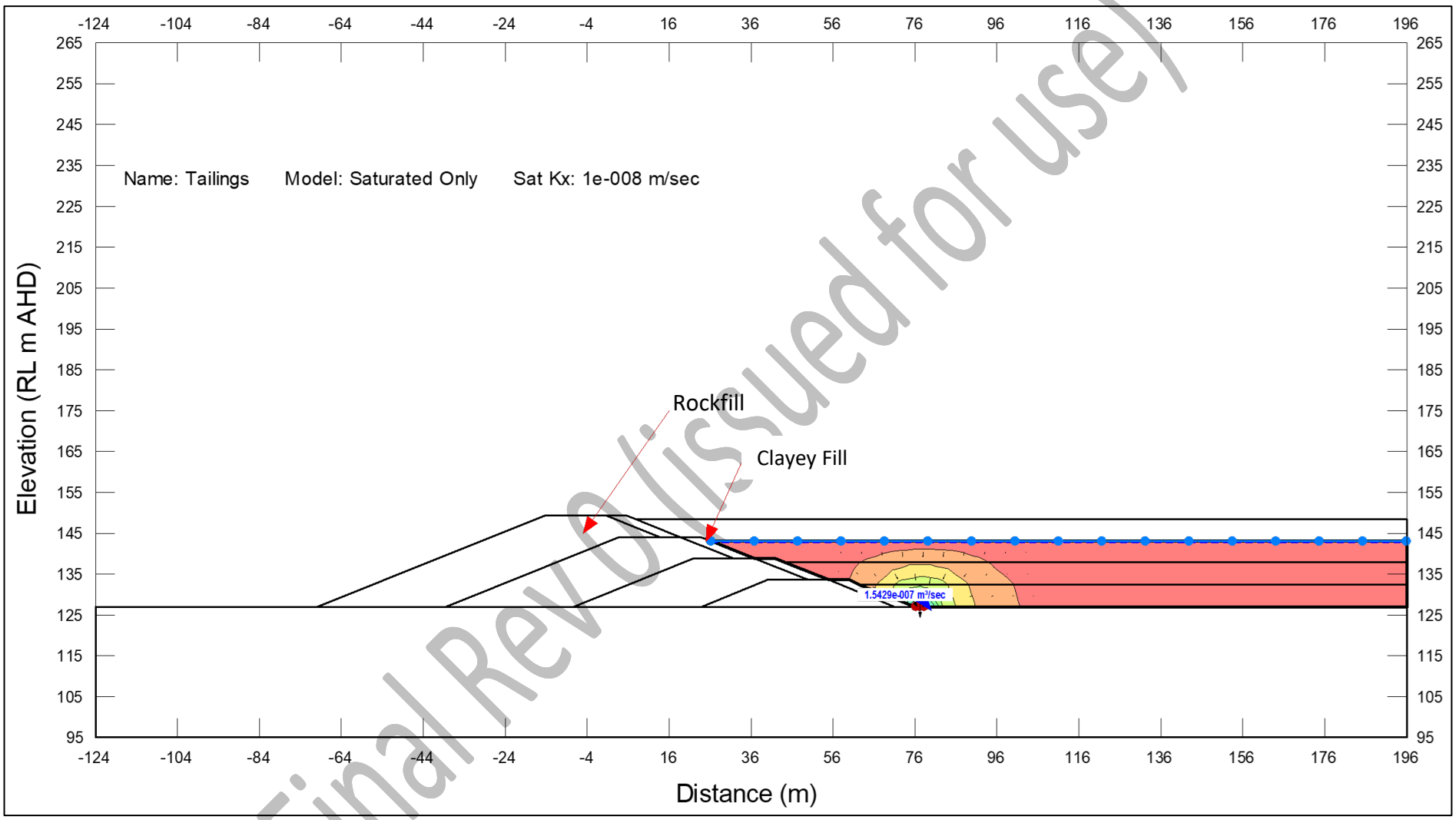
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Figure 3.2 - SEEP/W analysis output: TSF Stage 2



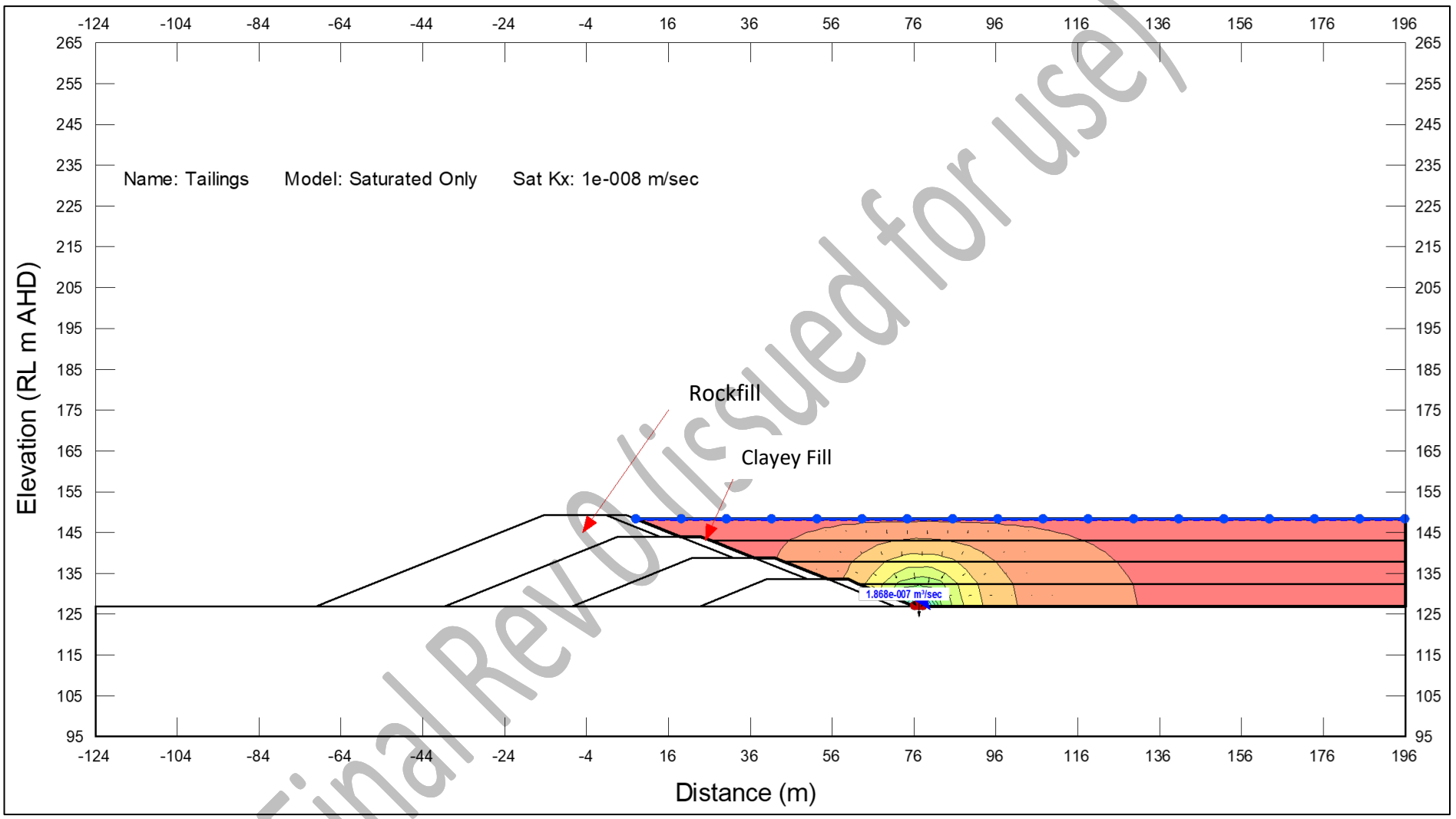
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Figure 3.3 - SEEP/W analysis output: TSF Stage 3



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Figure 3.4 - SEEP/W analysis output: TSF Stage 4



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3.7 Slope Stability Analysis

3.7.1 Background

The TSF concept was developed during the PFS by WAVE. SRE has executed a numerical geotechnical stability assessment of that design, to ensure compliance with minimum ANCOLD (2019) geotechnical stability requirements.

The geotechnical site investigation (GSI) executed by Cartledge[5] and described in Section 2.4.9, indicates the natural foundation within the TSF footprint, below the surficial surface sand of 1 m, is composed of sedimentary rock, placed under alluvial/fluvial processes, comprising interbedded layers of highly to extremely weathered sandstone, siltstone, and claystone, hereafter referred to as the sedimentary rock sequence, which at the proposed mine pit are approximately 60 to 70 m thick. This layer of sedimentary rock is underlain by granite and this granite is assumed to extend under the TSF. No geotechnical investigations have been completed within the proposed TSF footprint at this stage.

The surficial sands will be removed from the TSF footprint, and the TSF embankments and base will be constructed on the top of the sedimentary rock sequence, the foundation for the TSF. This sedimentary rock sequence is the main influence on the geotechnical stability of the TSF, relative to the full design height of the TSF embankment, 22 m at the Stage 4 crest at RL 149.25 m. Hence, the basement for the stability analysis model is limited to these materials, as the underlying granites at a depth of 60 to 70 m do not influence the stability of the TSF. The foundation materials are deemed to geotechnically shear in a dilatant and drained manner under all soil stress conditions. The drained shear strength sedimentary rock sequence can be defined via the Mohr-Coulomb failure criterion, as represented by the effective friction angle φ' and apparent cohesion c' parameter, and Cartledge has estimated $\varphi' = 31.5°$ and c' = 17.2 kPa to be representative of the sedimentary rock sequence. The construction of the TSF containment embankment will be executed using mine waste from the sedimentary rock sequence and granite, when and if available. The floor of each cell of the GTSF and upstream face of containment, Zone 1 of the TSF, will be HDPE-lined. Section 3.9.4.

The geotechnical slope stability assessment involves iteratively estimating the geotechnical slope stability Factors of Safety (FoS_{slope}) for different design TSF embankment geometry profiles, based on a two-dimensional Limit Equilibrium (2D LE) analysis approach for all 4 Stages of the proposed embankment geometry as detailed on the drawings prepared by Wave in Table 3.3. The commercial analysis software Geostudio SLOPE/W 2012, employing the Morgenstern-Price method of slices, has been utilised for this assessment to evaluate the following soil stress conditions as per geotechnical stability requirements set out in the referenced ANCOLD (2019) guideline:

3.7.2 Long-term static condition

All soils that form the TSF structure, natural foundation soil underlying the TSF embankment, the containment embankment, and the impounded tailings, are treated to geotechnically shear in a drained manner. The minimum ANCOLD FoS_{slope} requirement for this soil stress condition is ≥ 1.5. The results of the stability analysis in Figure 3.5 demonstrate compliance with this requirement.

3.7.3 Short-term static condition

The TSF embankment and underlying natural foundation soils supporting the embankment are treated to geotechnically shear in a drained manner. The impounded tailings are treated to geotechnically shear in a

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contractive undrained manner as generally expected of tailings which have been discharged as a slurry deposition. The minimum ANCOLD FoS_{slope} requirement for this soil stress condition is ≥ 1.5. The results of the stability analysis in Figures 3.6 and 3.7 demonstrate compliance with this requirement.

3.7.4 TSF Embankment

Considering that a HDPE lining is placed on the base and sides of the TSF, the entire embankment can be deemed to geotechnically shear in a drained manner under all soil stress conditions. The geotechnical stability of the TSF embankment is governed by the geotechnical shear strength of the sedimentary rock sequence, forming the foundation with the mine waste material used for embankment construction. Thes materials are represented by the Mohr-Coulomb failure criteria, and SRE has conservatively assigned a nominal $\varphi' = 35°$ and $c' = 0$ kPa for the slope stability analysis based the details in the Cartledge Report[5].

3.7.5 Tailings

The geotechnical characteristics of the tailings have been determined, refer to Section 2.5.1. Based on past project experience, these tailings are expected to geotechnically shear in a drained manner, and under long-term static operating conditions. The geotechnical testing indicates the tailings will achieve full primary consolidation as fast as they are deposited, primarily due to presence of a sand fraction, materials larger than 75 microns, and segregation at the time of deposition, which will create preferential drainage pathways near the embankments where tailings spigotting is executed. The tailings can also transition towards an undrained geotechnical shear state under short-term static soil stress conditions, as a result mine blasting activities, intense rainfall events, construction earthworks, etc.

The drained shear strength of the tailings can typically be represented by a Mohr-Coulomb effective friction angle $\varphi' = 30°$ and apparent cohesion $c' = 0$ kPa, whereas its undrained shear strength can be presented by the stress-normalised undrained shear strength ratio S_u/σ_v' ratio of 0.25 based on correlation to the above φ' via the MIT SHANSEP approach. These shear strength parameters have been adopted for the slope stability analysis.

3.7.6 Groundwater

The Cartledge[5] GSI data included groundwater level measurements at five (5) groundwater monitoring bores that Graphinex drilled, with the data indicating standing water level varying between 7.66 m and 11.95 m below the existing ground surface. A groundwater level of approximately 8 m (i.e. RL 122 m AHD) has been adopted for the slope stability analysis, although it is recognised that pit dewatering may, depending on the cone of depression formed as a result of pit watering lower the ground water table beneath the TSF. This change in groundwater elevation may not significantly change the results of the stability modelling.

3.7.7 Seismicity for Stability Assessment

The Geoscience Australia *2018 National Seismic Hazard Assessment for Australia* document (GA NSHA18), of which the national-scale seismic hazard maps presented within the document have been derived from the utilisation of modern ground motion models (GMMs) superseding methods adopted for the development of AS1170.4-2007). According to GA NSHA18, the EGP is in a seismically-quiet region of Australia, with a horizontal Peak Ground Acceleration (PGA) of 0.01 g, which has a 10% probability of exceedance in 500 years (1:500 AEP). The proposed design of the TSF, based on an HDPE-lined facility, which is based on downstream

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raising of all the perimeter embankments of TSF for Stages 1 to 4, has created a robust structure, which is unlikely to be impacted by a seismic event with Peak Ground Acceleration (PGA) of 0.01 g.

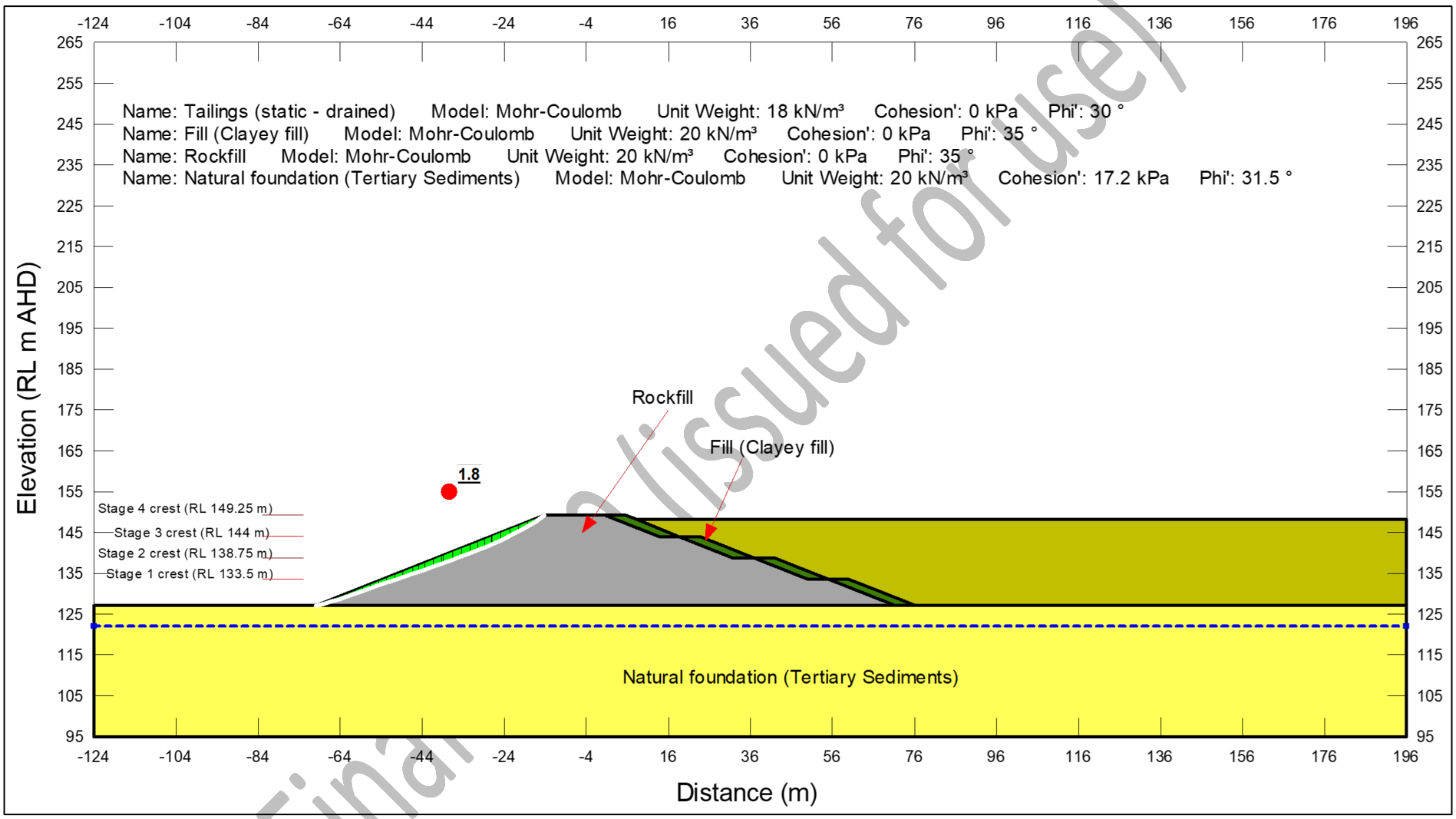
3.7.8 Stability Results

The stability assessment has been executed for the final Stage 4 of the proposed TSF development, with SLOPE/W analysis output presented in Figures 3.5 to 3.7 below.

This assessment confirms that the proposed TSF design is robust, with the Factors of Safety, FoSslope comfortably exceeding the minimum ANCOLD requirements, thus providing long-term environmental and structural stability. The results of this stability assessment also demonstrate the flexibility of the design concept, where the availability of mine waste for downstream embankment construction comfortably meets the design requirements. Furthermore, the assessment indicates the impounded tailings are only likely to have limited/negligible influence on the geotechnical stability of the TSF embankment.

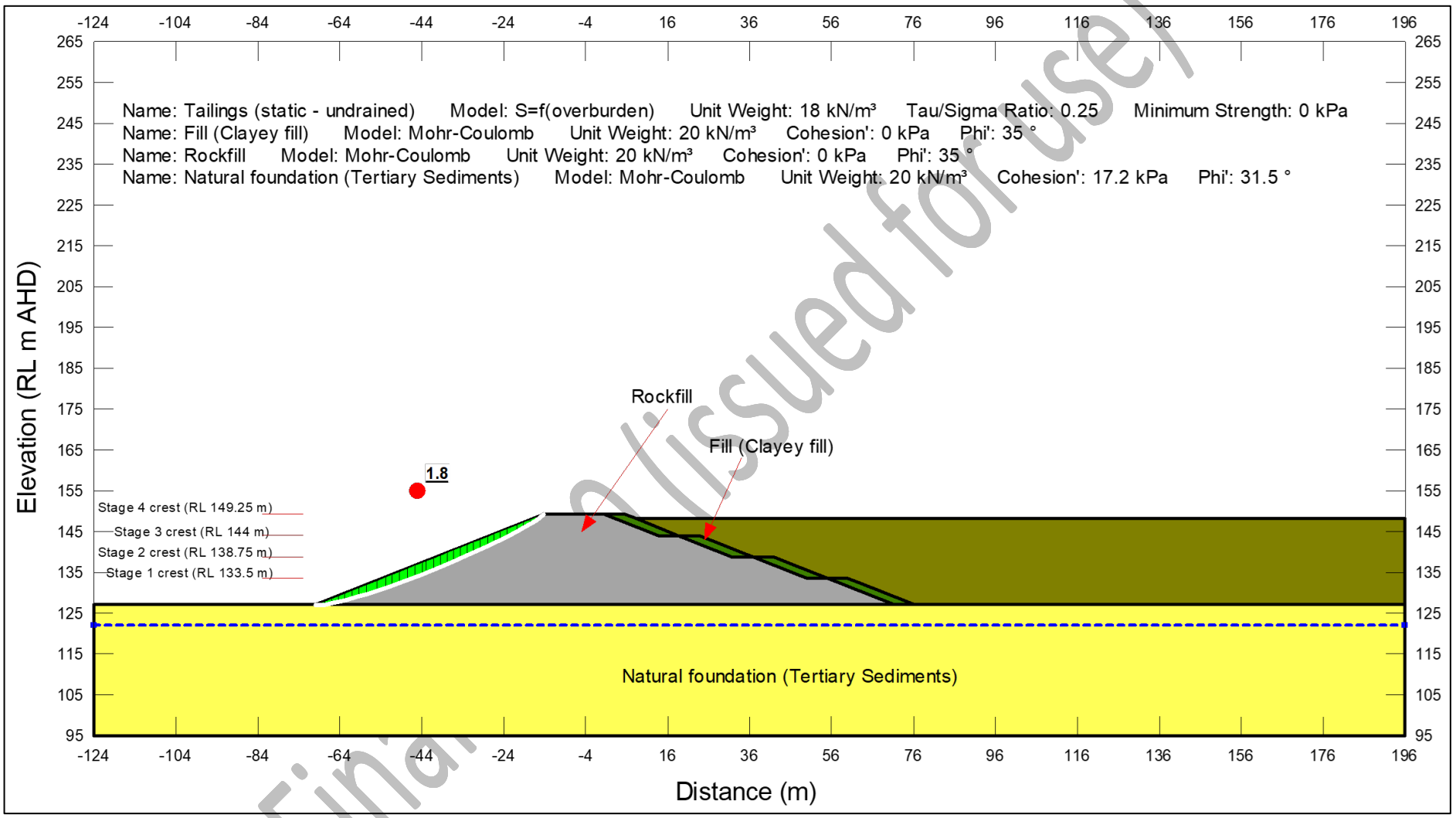
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Figure 3.5 - SLOPE/W analysis output (Static long-term operating conditions)



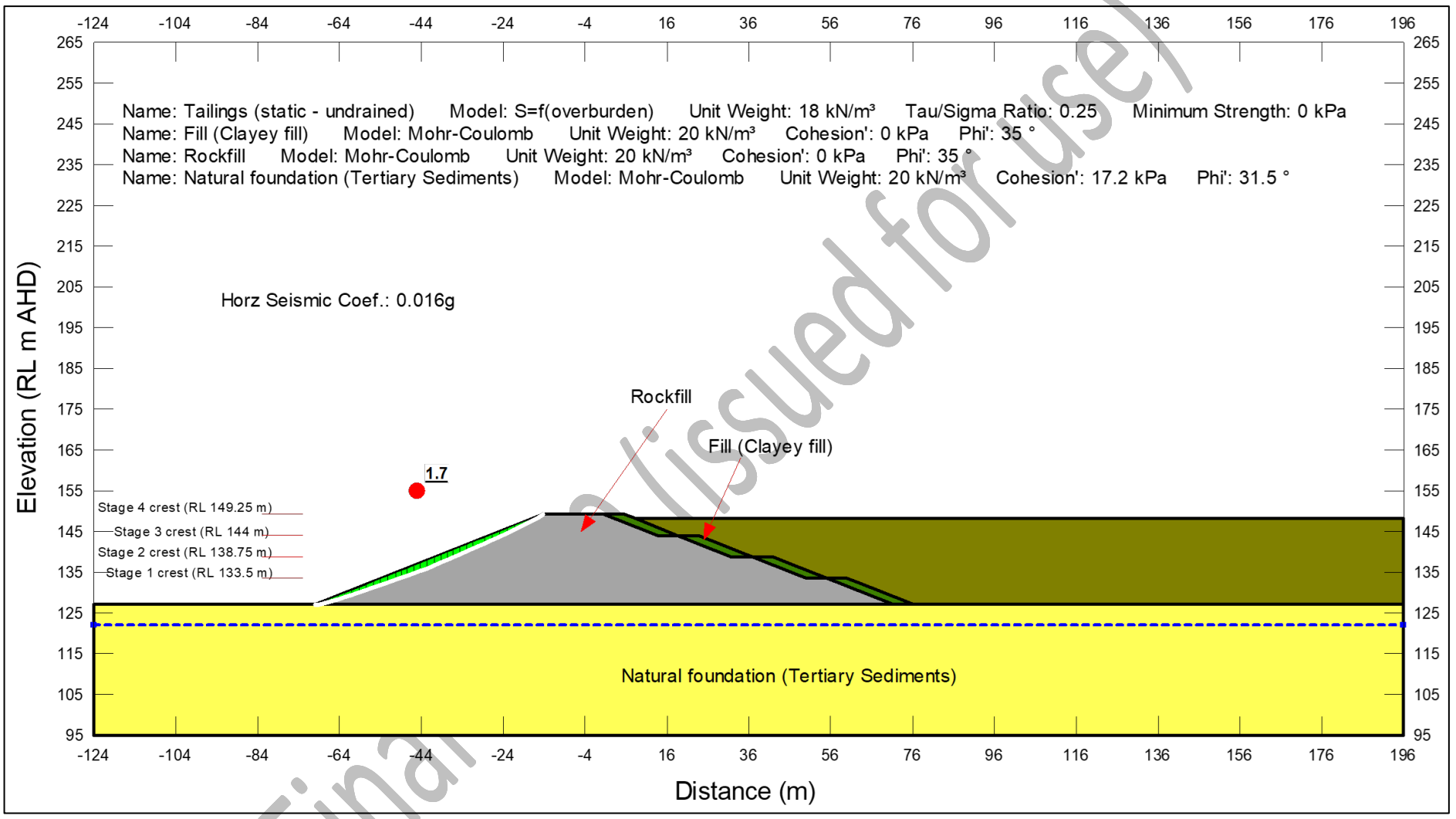
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Figure 3.6 - SLOPE/W analysis output (Short-term transient conditions)



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Figure 3.7 - SLOPE/W analysis output (Seismic condition)



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3.8 Drawings

Drawings prepared by WAVE show the plans and section details for the PFS TSF Design. The drawings for the design concept are listed in Table 3.3 and presented in Appendix 2. Details of embankment construction materials are presented in Table 1.2.

Table 3.3 – Drawings

Drawing No.	Title
6235-40-DWG-00020 Rev B	Mine Site General Arrangement Plan
6235-40-DWG-00030 Rev B	Site Wide Drainage Plan
6235-40-DWG-00031 Rev B	Mine Site Drainage Plan
6235-40-DWG-00040 Rev A	Tailings Storage Facility Plan
6235-40-DWG-00041 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
6235-40-DWG-00042 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

Pipeline bunding will need to be put in place from the process plant to the GTSF.

3.9 Dam Break Studies

A preliminary dam break and spillway hydraulic assessment for the Esmeralda Graphite Project TSF was performed by CMW Geosciences Pty Ltd (CMW), using Empirical Methods as part of the initial study. This work has been updated with modelling using HEC-RAS, refer to Section 3.12, and their updated Technical Memorandum is presented in Appendix 4.

3.9.1 Empirical Methods

The initial dam break assessment was performed using Empirical Methods for the TSF (Cell 1 being the most critical) at the final embankment crest levels of RL 149.25 m (maximum embankment height, 22 m). The scenarios examined were:

i) Sunny-day case.

ii) Worst case (i.e. with probable maximum precipitation (PMP) into TSF). The PMP 6 hr duration is 950 mm, based on the BOM GSDM method.

According to CMW, *"If a TSF embankment breach were to occur, tailings would only be partially released from the storage impoundment, as the majority of the tailings beaches would have dried back. In addition, remobilised tailings will behave as a thickened slurry and therefore will not be as free-flowing as water.*

The breach characteristics were estimated using T MacDonald and J Langridge - Monopolis (1984)[7], embankment breaches typically occur relatively quickly (typically 0.5 hour to 4 hours). The peak flows were then estimated using Rico M, Beniti G, Diez-Herrero G (2008)[8] and also by assuming a triangular hydrograph. The peak flows in Table 1 below are based on the Rico method and a triangular hydrograph, noting that the Rico method arrives at very peaked outflow hydrographs.

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The flood volumes for the TSF from the breach for the sunny day cases were estimated to be 33% of the storage volume. The flood volumes of TSF from the breach for the worst case were estimated to be 33% plus a PMP event (assessed to be 950 mm) over the TSF catchment (i.e. the tailings basin). The flow from TSF dam break will flow along a channel creek system to the north -northeast of the project. Based on Rico (2008) the dam break run-out could be up to nominally 50 km.".

The actual volume of materials released from the TSF would be a function of the volume of water on the TSF and the tailings rheology at the time of the breach. It should be noted that the Rico approach, which has been around for many years, was developed for water storage facilities. It is often used for these types of Empirical Analyses of tailings storage facilities, as it provides a *'worst case scenario'.* The limitations of the Rico method are that:

i) It does not consider the geotechnical shear strength properties of the contained tailings. When tailings are deposited and water is removed the deposited tailings, solids can achieve a reasonable in-situ dry density, typical greater than 1.5 t/m^3 and shear strength, which provides some resistance to mobilisation of materials in the event of an embankment failure.

ii) It is not applicable for impoundments with large surface areas.

The Rourke and Luppnow Method (ref: H Rourke, D Luppnow, 2015)[9] for estimating volume released from the TSF was also consulted to assess potential stored volume release. Table 3.4 presents a summary of case study data used in their analysis. It was noted from Rourke and Luppnow analyses of past TSF failures, that:

i) The release volume varies between 9 and 67 % of stored volume.

ii) The volume of tailings outflow is estimated under the assumption of a conical failure plane. Historical analyses of tailings dam failures by Rourke & Luppnow, 2015, indicate that the post-failure tailings slopes generally fall between 5 and 18%.

The Rourke and Luppnow Method demonstrates that in order to mitigate the consequence of a dam-break, the pond volume and area should be minimised by the adoption of good operating practices to minimise the supernatant pond on the TSF. Removal of excess water and maintaining the supernatant pond to the smallest practical minimum, significantly reduces the potential for an embankment breach and the volume of liquids and solids released in the event of an embankment breach.

Table 3.4 - Summary of case study data used in the analysis

Name	Impoundment Storage Volume (Mm3)	Release Volume (Mm3)	Ratio of release volume to storage volume (%)	Ratio of pool area to total area (%)
Merriesprui	7.0	0.6	9	14
Bafokeng	13.0	3.0	23	30
Mount Polley	50.0	24.4	29	72
Kolontar	1.2	0.7	58	88
Stava	0.3	0.2	67	100

It should be noted that the volumes of water in the natural channel to the southwest of the TSF at the time of the release could contribute to the distance the tailings solids and liquor might flow.

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3.9.2 HEC-RAS Modelling

HEC-RAS modelling has been undertaken by CMW Geosciences and the details of this work are presented in the Technical Memorandum included in Appendix 4. The following summarises the findings from the hydraulic analyses:

i) RDF and SDF breach scenarios originating from the southwest embankment of TSF Cell 1 are not expected to impact the mine infrastructure located to the west and north of the facility. It is also noted that the process plant is planned to be constructed at a higher elevation than TSF Cell 1.

ii) Runoff resulting from an SDF breach of the southwest embankment of TSF Cell 1 is expected to extend approximately 4.3 km to the northwest along the natural drainage line, as well as approximately 1.8 km northward from the southwest corner of the facility. In comparison, runoff associated with an RDF breach is anticipated to extend approximately 3.9 km to the northwest following the same natural drainage pathway.

iii) Inundation depths following both RDF and SDF scenarios are expected to be typically ≤1 m, except within approximately 100 m and 500–700 m of the breach location, respectively, and at low-lying areas along the natural drainage line.

iv) Estimated flow velocities associated with an RDF event are expected to be generally ≤1 m/s beyond approximately 200 m from the breach epicentre, whereas for an SDF event, similar velocities are anticipated beyond approximately 600–900 m from the breach location. Elevated flow velocities are expected to occur within low-lying sections of the drainage line located to the southwest and northwest of TSF Cell 1.

v) The estimated travel time for breach flows to reach the adjacent drainage line is approximately 0.3–0.4 hours for both the RDF and SDF scenarios.

vi) The SDF scenario may result in shallow inundation of the access road located northwest of TSF Cell 1, with estimated flow depths of up to approximately 0.5 m and flow velocities of around 0.7 m/s. The estimated arrival time at this location is greater than 1.3 hours following breach initiation.

4 HAZARD CATEGORY ASSESSMENT

4.1 ANCOLD

Hazard category assessments have been executed using the ANCOLD Standard, which provides the framework for the national standard applicable to TSFs and the details required by the Department of the Environment, Tourism, Science and Innovation (DETSI) Queensland, for the regulatory approval of the GTSF are presented in Section 4.

A preliminary hazard category assessment was undertaken for the GTSF using the criteria provided in Tables 1 and 2 of the ANCOLD Guidelines[3], presented as Tables 4.1 and 4.2 respectively, in this document. In accordance with ANCOLD Guidelines, the GTSF has a 'preliminary' Consequence Category Assessment (CCA) of 'Significant' in accordance with ANCOLD. The severity of damage and loss was assessed as Major, based on health, social and environmental impacts associated with a potential failure of the facility. The population at risk (PAR) includes all people who would be directly exposed to flood waters assuming they took no action to evacuate and is estimated to be >1 and < 10, primarily comprising itinerants, as the mine personnel would

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likely be aware of the risks and evacuation procedures through inductions and training. This GTSF has been assigned a Severity Level Medium and Consequence Category of High C in accordance with ANCOLD (2012) Guidelines.

Table 4.1 - (from ANCOLD 2019) Table 1 Severity Level impacts

DAMAGE TYPE	MINOR	MEDIUM	MAJOR	CATASTROPHIC
Infrastructure (dam, houses, commerce, farms, community)	<$10M	$10M-$100M	$100M-$1B	>$1B
Business importance	Some restrictions	Significant impacts	Severe to crippling	Business dissolution, bankruptcy
Public health	<100 people affected	100-1000 people affected	<1000 people affected for more than one month	>10,000 people affected for over one year
Social dislocation	<100 person or <20 business months	100-1000 person months or 20-200 business months	>1000 person months or >200 business months	>10,000 person months or numerous business failures
Impact Area	<1 km2	< 5km^2	< 20km^2	> 20km^2
Impact Duration	< 1 (wet) year	< 5 years	< 20 years	> 20 years
Impact on natural environment	Damage limited to items of low conservation value (e.g., degraded or cleared land, ephemeral streams, non-endangered flora and fauna). Remediation possible.	Significant effects on rural land and local flora & fauna. Limited effects on: A. Item(s) of local & state natural heritage. B. Native flora and fauna within forestry, aquatic and conservation reserves, or recognised habitat corridors, wetlands, or fish breeding areas.	Extensive rural effects. Significant effects on river system and areas A & B. Limited effects on: C. Item(s) of National or World natural heritage. D. Native flora and fauna within national parks, recognised wilderness areas, RAMSAR wetlands and nationally protected aquatic reserves. Remediation difficult	Extensively affects areas A & B. Significantly affects areas C & D. Remediation involves significantly altered ecosystems.

Table 4.2 - (from ANCOLD 2019) Table 2 Recommended Consequence Category

Population at Risk (PAR)	SEVERITY OF DAMAGE OR LOSS			
	MINOR	MEDIUM	MAJOR	CATASTROPHIC
<1	Very Low	Low	Significant	High C
>1 to 10	Significant	Significant	High C	High B
>10 to 100	High C	High C	High B	High A
>100 to 1000		High B	High A	Extreme
>1000			Extreme	Extreme

Regardless of the hazard ratings assigned to the GTSF, frequent inspections (once per shift, twice daily) must be made of the spigot, tailings lines, water return lines, pumps and related facilities, the position of the pond in relation to the water recovery pump and the pit walls. The return lines should be checked regularly for

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quantity and quality of water return. Full engineering inspections must be executed on an annual basis. The operational design objectives of the GPTSF are to:

i) Maximise the in-situ dry density of the tailings, which in turn maximises the storage capacity of the tailings facility.

ii) Maximise the return solution to the plant.

4.2 Queensland Regulatory Requirements

According to the DETSI Manuals[1, 2], all structures that are classified as dams or levees must have their consequence category assessed, based on the potential environmental harm that would result from controlled releases or uncontrolled discharges that might occur and failure event scenarios. A Hazard Consequence Assessment has been completed as part of this study by suitably qualified employees of SRE:

i) James Christopher Lane (RPEQ 13083) who is a Registered Professional Engineer of Queensland in the designated field of Geotechnical (mining) with more than 38 years of professional experience in the mining industry, specifically devoted to the design and auditing of tailings storage facilities.

ii) David Hsien Ta Yong – David Yong (RPEQ 28326) who is a Registered Professional Engineer of Queensland in the designated field of Geotechnical (mining) with more than 8 years of professional experience in the mining industry, specifically devoted to the design of tailings storage facilities.

The CVs of James Christopher Lane and David Yong are attached in Appendix 1.

The consequence category of 'High', 'Significant', or 'Low' will determine whether the structure is a 'regulated structure'. A structure is regulated if it has a 'High' or 'Significant' consequence classification. The consequence category of any structure is the highest consequence category determined under any of the assessment criteria set out in the DETSI *'Manual for assessing consequence categories and hydraulic performance of structures'* 2024 (the Manual). The consequence category of a structure must be assessed by a suitably qualified and experienced person and must account for each of the following failure events:

i) *'Failure to contain – seepage'* – spills or releases to ground and/or groundwater via seepage from the floor and/or structure sides.

ii) *'Failure to contain – overtopping'*– spills or releases from the structure that result from loss of containment due to overtopping.

iii) *'Dam break'* – collapse of the structure due to any possible cause.

Table 1 from the Manual has been summarised for the purpose of reference to the guideline requirements, for the Consequence Category Assessment; this is shown below in Table 4.3. The Consequence Category Assessment Criteria has been applied in relation to the design stages of the TSF, including the construction, mining operating conditions and final closure. Our assessment is Low for *'Harm to Humans',* but Significant for general economic loss based on the threshold values in DETSI Table 1.

In addition, the hydraulic performance must be assessed at each stage; the requirements are given in Table 2 of the Manual. These requirements are presented in Table 4.4 of this document. It should be noted that modelling of the seepage and stability of the GTSF has been performed, refer to Sections 3.6 and 3.7. These results confirm that the stability of the TSF meets and exceeds the current regulations/standards with respect to Factors of Safety. Furthermore, the maximum elevation of the tailings is estimated to be RL 146.8 m 2.45 m below the embankment crest and exceeds the freeboard requirements, refer to Tables 4.5 and 4.6.

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Table 4.3 - Consequence Category Assessment extracted from Table 1 in the "Manual for assessing consequence categories and hydraulic performance of structures" [2]

Environmental Harm	Consequence Category		
	High	**Significant**	**Low**
Harm to Humans	Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[8]. Note: The requirement to consider the location of people in the failure path is only relevant to the *'dam break'* scenario.	Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater, but less than 10 people is expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the *'dam break'* scenario.	Location such that people are not routinely present in the failure path and loss of life is not expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the *'dam break'* scenario.
	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 20 or more people being affected.	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected[9].	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of less than 10 people being affected.
General Environmental Harm	Location such that: a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and b) Adverse effects[11] on Significant Values are likely; and c) The adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $50,000,000; or ii) remediation of damage is likely to take 3 years or more; or iii) permanent alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 5 km^2 .	Location such that contaminants may be released so that adverse effects[10] (that are not already authorised to be disturbed to at least the same extent under other conditions of the authority subject to any applicable offset commitment) either: a) Would be likely to be caused to Significant Values but those adverse effects[10]effects[10] would not be likely to meet the thresholds for the High consequence category and instead would be likely to cause at least one of the following: i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or ii) remediation of damage is likely to take more than 6 months but less than 3 years; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 1km^2 but less than 5km^2; or b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[12], wetland of general ecological significance13, riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects10 are likely to cause at least one of the following:	Location such that either: a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or b) Contaminants are likely to be released to those areas, but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects[10]

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Environmental Harm	Consequence Category		
	High	Significant	Low
		i) loss or damage or remedial costs greater than $20,000,000; or ii) remediation of damage is likely to take more than 1 year; or iii) significant alteration to existing ecosystems; or v) the area of damage (including downstream effects) is likely to be at least 2 km^2	
General economic loss or property damage	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[14]	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[13].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[13]

Notes:

7 To be used for all failure event scenarios

8.'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

9 When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

10 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste, and which is unlikely to cause persons to become physically ill.

11 Adverse effects include chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

12 See Environmental Protection (Water and Wetland Biodiversity) Policy 2019for definitions

13 Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

14 This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

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Table 4.4 - Hydrological design criteria for 'failure to contain – seepage' scenario extracted from Table 2 in the *"Manual for assessing consequence categories and hydraulic performance of structures"* [2]

Design criteria	**Adequate containment and detection measures**		
Regulated structure classifications	**Containment**	**Leakage detection and/or monitoring**	**Rectification**
High Consequence	Designed with a floor and sides of material that will contain the wetting front and any entrained contaminates within the bounds of the containment system during its operational life	Have a system that will detect any passage of the wetting front or entrained contaminates through either the floor or sides of the dam	Either be capable of repair to rectify any passage of the wetting front through either the floor or sides of the dam, or else be decommissioned and rehabilitated.
Significant Consequence	Designed with a floor and sides of material that will minimise (or reduce) seepage to avoid the environmental harm in the significant consequence category in Table 1 (the Manual) and ensure that the environmental harm likely to occur is only as in the low consequence category of that table.	Have a system that is appropriate to demonstrate that significant harm as per Table 1 (the Manual) will not occur	N/A

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4.3 Potential Failure Mechanisms

The GTSF Cells 1 to 4 incorporate the following features that will minimise (or reduce) the potential for seepage to avoid environmental harm:

i) Initial operations will include the construction of the TSF embankments with a low permeability zone, (Zone 1) over which is placed an HDPE liner, which also extends across the entire floor of each cell to contain the wetting front.

ii) There are upstream toe drains constructed on top of this liner, at the interface of the embankment and floor to capture and contain liquor from the consolidation of the tailings.

iii) The tailings geotechnical characteristics, as detailed in Section 2.5.1, settle rapidly, which will facilitate the removal of supernatant water for return to the process plant and, when coupled with the liquor recovered from the underdrainage, will allow the tailings to achieve a high density and low residual moisture content, less than 20% gravimetric moisture content at a consolidated density of 1.75 t/m^3.

iv) The hydraulic conductivity of the tailings is very low 4.1 x 10^{-9} m/s with minimal consolidation pressure Vertical Pressure of 25 kPa, reducing to 9.4 x 10^{-10} m/sec as the consolidation pressure Vertical Pressure of 100 kPa.

v) Vibrating wire piezometers (VWPs) to be installed into the base of the facility to monitor and detect the development of phreatic surface and provide an indicator of seepage through the liner.

vi) Existing monitoring bores will be utilised to monitor water levels and water quality. Baseline water levels and samples have been taken and additional work is programmed prior to tailings deposition, refer to Section 7 of the report titled 'Esmeralda Graphite Project – Groundwater Impact Assessment' prepared by the GP Hydrogeologist (hydrogeologist.com.au). It should be noted that the existing water table is approximately 8 m below ground level and pit dewatering is likely to create a cone of depression which might extend beneath the GTSF.

The additional design information for the proposed facility is presented below for the operation of the GTSF, which has been assessed as a ***'significant'*** consequence structure which meets the requirements of Table 2 of DETSI[2].

Therefore, in addition to the low permeability of the deposited tailings, the presence of an HDPE liner and toe drainage system, indicates that any potential seepage is not likely to impact human health in terms of seepage.

Removal of excess water from the GTSF will promote high in-situ dry densities within the tailings stack, such that the majority of the consolidation of tailings will occur during operation, reducing the potential and the magnitude of any seepage.

4.4 Hydraulic Performance Objectives Failure to Contain Overtopping

The site is located in a climate which typically comprises high-humidity summers with significant rainfall (November to April) and warm, dry winters and is dependent on water return from the TSF for continuity of operations. Any rainfall runoff likely to collect within the impoundment area will be recovered for use in processing operations. The water balance in Section 5.1 demonstrates that the operation of the TSF in the

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wet season, December to March, does generate surplus water. The spillways are only likely to operate if the rainfall event exceeds the design storage requirements, refer to Table 4.3

For the GTSF, the water recovery system (pumps and pipes) must be sized for an operating capacity of not less than 70% of the slurry water volume at the maximum static head to achieve the target in-situ dry density of greater than 1.55 t/m^3. Higher in-situ dry densities, similar to those achieved elsewhere, can be obtained where supernatant water recovery is above the recommended target. The target minimum average in-situ dry density of 1.55 t/m^3 has been adopted for the design of the GTSF at this stage, in the absence of geotechnical tailings testing.

With respect to the discharge of water, if and when such an event which exceeds the design criteria occurs, the water quality is likely to be significantly diluted, given the size of event required to exceed the design rainfall which would result in the excess volume of water exiting the TSF via the spillway.

In addition, given that the TSF is at the head of the drainage catchment, dilution would take place downstream of the spillway as a result of mixing with waters from other catchments feeding into the same drainage system. Ultimately, this would result in water of a quality similar to that from other areas in the surrounding catchments. The actual volume of any discharge is a function of the available storage on the TSF at the time the event occurred and the volume of water from adjacent and downstream catchments.

An Operations Manual will be prepared as part of the definitive feasibility (DFS) design work. Implementation of the Operations Manual will assist in ensuring that the TSF is managed to meet the design requirements and minimise the risk of overtopping.

4.4.1 DSA Allowance

The climate data including the most recent Rainfall Intensity Data is presented in Section 2.4.2.

The wet season rainfall, selected as the period December to March for this project, is required for estimation of the Design Storage Allowance (DSA). The DSA of 1.23 m for each cell of the GTSF is based the Esmeralda Station (BOM Station ID 029016) data.

The GTSF Cells 1 to 4 are standalone facilities with no external catchment and no interconnecting spillways between each cell. The wet season storage volume requirements for various stages based on the Wet Season 1 in 100 AEP storm event scenarios is presented in Table 4.5.

Table 4.5 - Summary of DSA Storage Volume (Mm^3) for GTSF (Wet Season 1 in 100 AEP of 1,230 mm) at each Stage/Crest RL

Stage	Crest RL (m)	Cell 1 (Mm^3)	Cell 2 (Mm^3)	Cell 3 (Mm^3)	Cell 4 (Mm^3)
1	133.50	1.35	1.44	1.43	1.43
2	138.75	1.44	1.53	1.52	1.52
3	144.00	1.53	1.62	1.61	1.61
4	149.25	1.62	1.71	1.70	1.70

It should be noted that the estimated final beach elevation of the deposited tailings, RL 146.8 m, refer to Table 1.1, which is 2.45 m below the maximum Stage 4 design crest elevation of RL 149.25 m.

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4.4.2 ESS Allowance

The GTSF Cells 1 to 4 are standalone facilities with no external catchment and no spillways interconnecting the cells. The minimum recommended ESS freeboard for the GTSF by Stage is presented in Table 4.6.

The ESS volume must be observed at all times as the absolute minimum requirement which takes into consideration reasonably foreseeable scenarios including, but not limited to, climatic variability and pump or power failures during wet-weather events. All reasonable efforts must be made to ensure the ESS, 0.382 m plus an allowance of not less than 0.30 m below the spillway invert, say 0.75 m, is provided at all times for all stages of each cell.

Table 4.6 - ESS for GTSF (must be provided at all times)

Stage	Crest RL (m)	Recommended Freeboard (ESS 0.38 m plus allowance below spillway invert 0.3 m)
1	133.50	0.75
2	138.75	0.75
3	144.00	0.75
4	149.25	0.75

The details in Table 1.1 shows the physical characteristics of the GTSF Cells where the design embankment crest elevation is RL 149.25 and the maximum depth of tailings is 16.80 m, with the maximum elevation of the deposited tailings in each TSF, being RL 146.8 m, assuming TSFs will be operated to achieve the expected minimum in-situ dry density of 1.55 t/m^3, refer to Section 2.5.1. If the settled density is higher than 1.55 t/m^3, then the final surface of the deposited tailings will be lower than RL 146.8 m.

4.4.3 Storm Water Monitoring

It is recommended that after each raise, marker poles are established on the GTSF to clearly delineate the water levels, such that a visual estimate of the freeboard can be ascertained at any time.

4.4.4 Spillways

Each TSF cell will require a permanent spillway and temporary spillways at each stage. TSF cell spillways will be 25 m wide, with a depth of 1.0 m and approximately 80 m long, with an energy dissipator on the downstream side. The spillway has been designed based on a PMP rain event of 950 mm in 6 hours, with most of the rain occurring over a 4-hour period. Table 4.7 summarises the hydrology and hydraulic analyses for the TSF cell spillways.

Table 4.7 – Summary of Hydrology/Hydraulic Analyses of the TSF Spillways

Parameter	Details
Total catchment area	120 ha
Rainfall depth of a PMP 6 hr. storm event	950 mm
Peak inflow – from catchment area	125 m^3/s
Peak outflow – down spillway	28.5 m^3/s
Spillway dimensions	25 m width, 0.7 m flow depth

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4.5 Dam Break - loss of confinement embankment

4.5.1 Geotechnical Assessments

Geotechnical site investigations and geotechnical laboratory testing of the potential embankment construction materials for the GTSF have been executed by Cartledge to define the engineering characteristics of these materials.

The embankment design comprises a single-sided textured HDPE liner placed over a low permeability upstream zone (Zone 1), constructed from the sedimentary rock sequence (highly to extremely weathered sandstone, siltstone and claystone), with similar mine waste in the downstream zone (Zone 2). Perimeter embankment raising will be executed by downstream construction techniques as appropriate to the conditions at the time of construction. Geotechnical analyses (seepage and stability), refer to Sections 3.8 and 3.9, indicate adequate factors of safety for all stages of construction.

QA/QC testing during construction and periodic geotechnical investigations during the life of the facility are required to confirm that the design parameters are being achieved. Instrumentation in the form of vibrating wire piezometers is to be installed during construction to monitor the pore pressures over the life of the facility to ensure that the design requirement to provide a safe, stable, non-polluting structure during its period of operation is achieved. At the completion of processing, it is understood that the TSF will be deconstructed with the tailings and mine waste returned to the mine pit void. An Operations Manual must be prepared as part of the DFS design work, to ensure that the TSF is managed to meet the requirements of the intent of the design. All of these measures are designed to minimise the potential for loss of confinement, which results in a dam break. Nevertheless, dam breaks can occur. Table 4.8 below sets out the design criteria for the dam break scenario, which appears as Table 6 in the DETSI *"Manual for assessing consequence categories and hydraulic performance of structures"*. As noted in Section 4.1, the design and operation of the GTSF, has been assessed as a *"significant"* consequence structure which meets the requirements of Table 2 of DETSI[2].

Table 4.8 - Hydrological design criteria for 'dam break' scenario

Design criteria	Flood passage	Flood ingress prevention
Consequence Category for 'dam break'[17]	Spillway capacity[18]	Flood level for embankment crest levels[19]
Containment dams high consequence	1:1 000 AEP To 1:100 000 AEP	Spillway design flood peak level + wave run-up allowance for 1:10 AEP wind
Containment dams significant consequence	Containment dams significant consequence	Containment dams significant consequence

Notes

17 The design criteria identified in this table are relevant to a dam break scenario that is caused by the failure of the spillway to pass a flood of the identified probability or where flood ingress over the tops of the banks occurs. As such, they are not relevant to dam break failure modes where no inflows exist to the dam, such as failure caused by piping. Consideration by the suitably qualified and experienced person may need to be given to the appropriateness of the consequence category for the 'dam break' scenario and the correct application of the design criteria in this table if there is a significant difference in consequence between the different failure modes.

18 Spillway capacity selected by the certifier with rationale.

19 If spillway design flood is PMF, no wave run-up is required. Part of safety bunds of embankments may be used for waver run-ups if supported by a risk assessment.

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5 ENVIRONMENTAL CONSIDERATIONS

The following environmental considerations have been incorporated into the tailings storage design.

5.1 Tailings Management

Pipelines to and from the pits will have bunding to prevent spillage of tailings or return water into the surrounding area in the event of pipeline failure.

Tailings in the form of slurry will be discharged sub-aerially with the initial tailings discharge being from a multi-point discharge spigots placed around the upstream perimeter embankment the HDPE Lined GTSF, such that initial discharge allows deposition onto the floor of the GTSF and around the decant locations. Once the floor of the facility is covered. The objective is to force the supernatant pond to the decant pump location. Keeping the supernatant pond (surface water) to a small size will have the effect of reducing evaporation from the surface of the pond and hence will assist in optimising the water recovery and the density of the deposited tailings. In addition to the decant water recovery, the underdrainage system around the toe of the upstream embankment within each cell allows for recovery of interstitial water of the tailings to promoted consolidation of the tailings.

5.2 Groundwater Monitoring

Monitoring of groundwater will be undertaken from bores installed as part the hydrogeological assessment of the project. The details of these bores are presented in Table 5.1.

Table 5.1 – Monitoring bores installed as part of the hydrogeological studies (sourced from hydrogeologist.com.au)

Bore	Easting	Northing	Hydrostratigraphic unit	Elevation (mAHD)	Casing height (maGL)	Hole depth (mbGL)	Screen interval (mbGL)
ESMB01S	627798	7918997	Tertiary sediments	120.549	0.70	11.5	8.5 - 11.5
ESMB01D	627804	7918987	Gilbert River Formation	120.491	0.71	60	49 - 55
ESMB02S	629007	7918705	Tertiary sediments	122.37	0.57	12	6 - 12
ESMB02D	629007	7918702	Gilbert River Formation	122.367	0.75	60	49 - 55
ESMB03	627462	7918188	Tertiary sediments	121.755	0.69	10	7 - 10
ESMB04S	627861	7918550	Tertiary sediments	119.81	0.70	10	7 - 10
ESMB04D	627850	7918563	Gilbert River Formation	119.891	0.50	51.1	46 - 49
ESMB05S	628485	7918127	Tertiary sediments	120.747	0.62	10	7 - 10
ESMB05D	628499	7918142	Gilbert River Formation	120.382	0.47	53	49 - 52
ESMB06S	628552	7919064	Tertiary sediments	120.108	0.65	10	7 - 10
ESMB06D	628536	7919065	Gilbert River Formation	120.355	0.41	51	47 - 50
ESMB07S	628401	7918643	Gilbert River Formation	121.213	0.49	54	47 - 50
ESMB07D	628411	7918654	Basement rock	121.316	0.79	84	78 - 84
ESMB17	625543	7919486	Gilbert River Formation	117.183	0.66	52	46 - 49

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Any water recovered from the monitoring bores will be pumped to the process plant. Section 7 in the hydrogeological report details the proposed ground water monitoring methodology.

5.3 Water Balance

A preliminary water balance analysis was prepared using an excel spreadsheet, which uses the inflows and outflows from the GTSF and estimates the balance after water return has been optimised. Water shortfall or water in excess of requirements is indicated on a monthly and annual basis. Water inflows to the TSFs consist of rainfall, incident-rainfall on the impoundment area only as the perimeter bunds exclude external runoff and slurry water from the plant. Water outflows consist of evaporation from the supernatant pond and running beaches, evapo-transpiration from drying beaches, seepage, retention of water within tailings and water returned to the plant.

It should be noted that the hydraulic conductivity of the internal containment embankment and floor of the GTSF has been assumed as at least 1.0 x 10^{-9} m/sec/m^2 as the facilities are fully HDPE-lined and have underdrainage at the upstream toe of each embankment in each cell.

Whilst there is permanent ground water in the vicinity of the project, it could reasonably have been expected that some water would seep through the floor of the pit and into the mine workings when the pit dewatering will have created a groundwater sink. The groundwater from pit dewatering activities is to be used for processing.

The following information was used for the water balance:

i) Average monthly rainfall figures for Esmeralda Station Number 029016 (recording period: 1914 to 2023); where the mean monthly rainfall is 706.9 mm and the mean annual rainfall is 686.4 mm.

ii) According to the Australian Climate Averages - Evaporation (Climatology 1975-2005), average annual evaporation is estimated to be approximately 2,500 mm/year. The evaporation data used in the TSF design is from Croydon Township (BOM Station 029012), where mean daily evaporation data for the period 1972 to 2014 is 2,476 mm. Potential evaporation is significantly greater than the annual rainfall. Evaporation (Climatology 1975-2005) is estimated to be 2,500 mm/year.

The following assumptions were made for the water balance:

i) Operational hours are 8,000 pa.
ii) Runoff co-efficient of 1.0 from the total catchment area within the crest of each cell.
iii) Settled tailings density (in-situ dry density of tailings) of 1.35 t/m^3 and the tailings stack is assumed to be saturated, which equates to a gravimetric moisture content of approximately 35%.
iv) Maximum decant pond area is assumed to be 5,027 m^2.
v) Exposed beaches 195,000 m^2.
vi) Wet beach areas are assumed to cover the whole surface area of each cell, approximately 975,000 m^2, based on multiple active spigots, which equates to approximately 83% of the total surface of a cell of 1,170,000 m^2.
vii) Seepage is assumed to be less than 1.0 x 10^{-9} m/sec/m^2.

Using the assumptions above, together with average rainfall and evaporation, the preliminary water balance results for this GTSF indicate make-up water requirements of approximately 1.80 Mm^3/pa for 9 months of the year, from April to December. Water recovery **must** be maintained during the wet season when the

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water balance indicates excess water at not less than 127 tph to avoid the build-up of excess water on the TSF, which would otherwise consume tailings solids storage capacity, significantly reducing the storage life of each facility. If the density of the deposited tailings increases, additional water must be recovered. The water balance is presented in Appendix 5.

It is recommended that the water recovery system (decant pumps and piping) has a minimum capacity of not less than 70% of the slurry water volume for the project, to ensure adequate water removal, particularly during high rainfall periods.

5.4 Erosion Control

The risk of erosion from external sources is negligible, given that the TSF walls are HDPE-lined in the inside and rock armoured on the outside. The drainage design for the project will need to ensure that any runoff from the TSF is collected and passed through silt traps to remove sediment prior to release of rainfall runoff.

Erosion of the internal wall of the TSF is not possible, as these walls are HDPE-lined. The correct deployment of spigots and conductor pipes, combined with regular inspections during operation, should minimise the risk of erosion on the tailings beach during tailings discharge.

5.5 Freeboard

The GTSF must have an adequate freeboard at all times. The adoption of the DSA and ESS Freeboard Volumes, as detailed in Tables 4.3 and 4.4, respectively, as the minimum at each stage, should be implemented as a risk mitigation strategy.

A spillway is incorporated into the design in each stage of each cell with the intention that the facility would be operated as a no-release facility, such that storm events can be contained within the facility until the embankment construction reaches Stage 4. That is, the freeboard capacity to contain extreme storm events always exceeds the design storm requirements until the final raise where the spillway would operate only if extreme events are experienced when the tailings beach is at the anticipated final elevation, refer to .

Towards the end of the life of each cell, each facility must have an adequate DSA freeboard of not less than 1.25 m. This includes the allowance to store the design storm event of a 1% annual exceedance probability (AEP), storm event, 0.53 m.

Table 1.1 shows the maximum thickness and maximum elevation of the deposited tailings in each TSF, RL 146.8 m, which assumes that the TSFs will be built to the designated crest elevations as determined in the PFS and operated to maximise water recovery and the in-situ dry density of the deposited tailings. The recommended operational freeboard for tailings deposition is the DSA freeboard for all stages.

5.6 Tailings Consolidation

Primary consolidation involves compressive deformation of the deposited tailings material as a result of change in volume caused by expulsion of pore water. As a result, increased self-weight overburden from the increasing tailings mass, coupled with the continuous removal (decanting) of water, will be the key driver of consolidation during the operation of the GTSF.

The discussion of the tailings testing in Section 2.5.1 demonstrates that high in-situ dry densities can be achieved with significate rates of supernatant water recovery.

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At this stage, once the processing operation is completed, all the tailings and the mine waste which forms the containment embankments is to be returned to the mine pit void. Consolidation and surface settlement within the pit void may need to be ascertained for the closure design.

On decommissioning, the tailings will consolidate to an increasingly stable mass. Settlement of the upper surface will occur as the tailings consolidate. The consolidation process will be reasonably quick with the primary consolidation taking place during deposition and water recovery. Consequently, as the supernatant pond develops and is removed, periodic topping-up with tailings can be executed, if required. Section 3.8 details the expected consolidation of the tailings.

Post-closure settlements of well-managed In-Pit TSFs (IPTSFs) at other locations have been predicted to be less than 1 m, which has provided certainty around the design and performance of the final cover of these facilities.

6 CONSTRUCTION

Construction of the containment embankments for the TSF is to be undertaken in accordance with the Construction Specifications for the facility, developed as part of the design to cover both earthworks construction and liner installation on the upstream face of the embankment. Preliminary documents for the construction works are provided in Appendix 2.

Typical construction requirements for the TSF implementation include the following:

i) Inspection of the downstream embankment foundation to ensure that the clearing requirements have been met, to facilitate the embankment construction works.

ii) Inspection of the seepage cut-off and the alignment of the embankment.

iii) Inspection of the liner during construction.

iv) Compliance testing of seepage cut-off and upstream zone of the perimeter embankment to ensure:

   a) Moisture-curing of materials as required during the upstream embankment construction, with content at the time of placement and compaction within -2%, +2% of the optimum moisture content. Compaction is to achieve a density ratio greater than 95% of standard maximum dry density.

   b) Materials used in the upstream embankment construction shall comprise clayey material having a fines content (material finer than 75 microns) greater than 30% for the compacted clay liner.

   c) Mine waste materials used in the downstream embankment shall be spread with a maximum loose thickness not exceeding 750 mm. This material shall be compacted using smooth drum vibrating rollers of not less than 11 tonnes front module mass, in layers of loose-lift thickness not exceeding 750 mm.

In accordance with ANCOLD (2019)[3], construction supervision for the TSF is to be undertaken on a full-time basis by an engineer who is suitably qualified in the design and construction of TSFs. ANCOLD (2019)[34] recommends that the designer provides or coordinates the construction supervision and construction reporting.

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Laboratory and field testing is to be implemented to ensure the construction materials, including the liner, are selected, placed and in the case of the earthworks materials, compacted in accordance with the intent of the design. Test types and frequencies are to be addressed in the construction specifications. In addition to the specifications, a QA/QC Manual must be developed for use in the construction. The main objectives for the implementation of the QA/QC Manual are to:

i) Ensure that construction work adheres strictly to all requirements as defined in the technical specifications, supporting construction design documents, codes and standards and regulatory requirements.

ii) Maintain quality and provide documentation to ensure that tasks performed will comply with project requirements.

iii) Prevent construction deficiencies through pre-construction quality coordination.

iv) Ensure non-conformances are reported and resolved through approved dispositions and follow-up actions to confirm acceptable results during the construction process.

v) Provide auditable records of all tests, inspections, noncompliance and corrections and any other pertinent data as required.

vi) Ensure that construction subcontractors have appropriate quality systems that will ensure work activities will meet contractual, technical and quality requirements.

vii) Comply with project requirements and specifications, using Project-approved Quality Plans, construction control procedures and Inspection and Test Plans.

viii) Ensure that the extent of inspections, verifications and assessments is commensurate with the risk, safety, cost, schedule and quality issues that may adversely impact the quality of the facility.

ix) Address and coordinate resolution of quality issues identified during reviews, surveillance, audits and inspections.

7 OPERATIONAL REQUIREMENTS

7.1 Management of Tailings Deposition and Water Recovery TSF Cells 1 to 4

Detailed Operating Manuals (OMs) have yet to be prepared for this project. Ideally, when the Operating Manuals are prepared, there must be one document for the plant management and another for plant staff responsible for the day-to-day operation of the facility. These documents must provide a description of the operating procedures to achieve the design objectives which are to provide a safe, stable, non-polluting structure during its period of operation. At the completion of processing, it is understood that the TSF will be deconstructed with the tailings and mine waste return to the mine pit void.

A summary of the operating methodology of the tailings storage cells is provided below.

To optimise tailings storage capacity, tailings will be deposited from the perimeter embankments of the GTSF with tailings deposition and beaching executed in a controlled sequence such that the supernatant solution is ponding around the decant pump. Tailings will be deposited such that the insitu densities within the stored tailings and the solution return for reuse in the process plant, is maximised.

The following considerations have been incorporated into the design of the GTSF:

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i) Tailings in the form of slurry will be discharged sub-aerially, with the initial tailings being discharged from multi-point spigots in the centre and extremities of the embankment furthest from the process plant .

ii) Deposition will progress around the perimeter embankments to force the supernatant water pond into the decant facility.

Keeping the supernatant pond (surface water) to a small size will have the effect of reducing seepage and evaporation from the surface of the pond and hence will assist in optimising the water recovery and tailings density.

Frequent inspections (once per shift, twice daily) should be made of the spigot, tailings lines, water return lines, pumps and related facilities, the position of the pond in relation to the water recovery pump and the pit walls. The return lines should be checked regularly for quantity and quality of water return. Only by regular inspection and appropriate remedial action can the performance of the water return system be optimised and additional operational problems avoided. Monthly inspections by the Process Plant Manager must be undertaken.

Monitoring bores adjacent to the pits will be utilised as monitoring/recovery bores. Water samples will be taken every three (3) months from the monitoring bores to check water quality. Water levels in the monitoring bores are to be read on a monthly basis.

Operation, safety and environmental aspects should be periodically reviewed during an inspection by a suitably experienced and qualified engineer. This inspection should be done at least annually.

Depending on the decommissioning plan adopted for the storage cells, it may be necessary to alter the deposition philosophy near the end of the life of each cell. Appropriate procedures must be developed if changes to deposition or freeboard criteria are required. If necessary, appropriate government authorities shall be advised of any changes, especially to freeboard criteria. However, Table 1.1 shows the maximum thickness and maximum elevation of the deposited tailings in each TSF, RL 146.8 m, which assumes that the TSFs will be built to the designated crest elevations as determined in the PFS and operated to maximise water recovery and the in-situ dry density of the deposited tailings.

7.2 Tailings Deposition into the Mine Pit Void

Tailings are to be removed from Cells 1 to 3 as part of the closure of the mine site with these tailings deposited into the mine pit void from RL -157 mAHD to RL 42 m AHD, which gives an approximate thickness of 199 m. The mine waste is placed from RL 42 mAHD to RL 123 mAHD, which gives an approximate thickness of 81 m. The post closure groundwater elevation is approximately RL 113 mAHD.

At all stages of the deconstruction, the TSFs must have an adequate freeboard consistent with DAS and ESS requirements, refer to Sections 4.4.1 and 4.4.2, respectively.

Frequent inspections (once per shift, twice daily) should be made of the spigot, tailings lines, water return lines, pumps and related facilities, the position of the pond in relation to the water recovery pump and the pit walls. The return lines should be checked regularly for quantity and quality of water return. Only by regular inspection and appropriate remedial action can the performance of the water return system be optimised and additional operational problems avoided. Monthly inspections by the Process Plant Manager must be undertaken.

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Monitoring bores adjacent to the pits will be utilised as monitoring/recovery bores. Water samples will be taken every three (3) months from the monitoring bores to check water quality. Water levels in the monitoring bores are to be read on a monthly basis.

Operation, safety and environmental aspects should be periodically reviewed during an inspection by a suitably experienced and qualified engineer. This inspection should be done at least annually.

7.3 Storm Events

The GTSF can accommodate storm events based on the IFD obtained from the BOM, which indicates the 1% AEP 72-hour storm is approximately 370 mm. Assuming the TSF is to be operated such that the supernatant pond is maintained away from the perimeter containment, then the minimum freeboard should always be consistent with DAS requirements refer to Section 4.4.1. The supernatant pond level within the TSF should be as low as practicable to ensure volume is available within the TSF storage to accommodate storm events without breaching or otherwise impacting on the minimum freeboard requirements.

7.4 Seepage Management

The TSF is to be HDPE lined and in the unlikely event of significant rises in ground water levels which might potentially impact on vegetation, the monitoring bores would be fitted with solar pumps to maintain water levels at least 4.5 m below ground level, which is typically well below the plant root zone.

7.5 Erosion Control

The risk of erosion of the external TSF walls, from external sources, is negligible, given that these walls will be constructed from hard durable competent rock. Erosion of the internals walls during spigotting operations is unlikely, given the correct deployment of spigots and conductor pipes combined with regular inspections during operation should minimise the risk of erosion during tailings discharge.

7.6 Performance Monitoring and Instrumentation

For this project, monitoring/recovery bores are to be located within the potential flow paths which are controlled structurally and lithologically by fractured rock. The project hydrogeologist will select the locations of the monitoring bores. These monitoring bores would be utilised as recovery bores, if required.

The standing water levels in the bores will be monitored on a monthly basis. Water samples will be taken every three (3) months from the monitoring bores located around the facilities to check water quality.

8 CLOSURE CONSIDERATIONS

8.1 Overview

It is understood that the current requirements are that towards the completion of processing, the GTSF Cells 1, 2 and 3 are to be deconstructed with all the embankment construction materials and tailings returned to the mine pit, which will become the GTSF. TSF Cell 4 will remain.

Once the tailings surface in the GTSF Cells 1, 2 3 and 4 has reached the maximum design tailings level, Cone Penetrometer Testing (CPT) investigations, with pore pressure dissipation testing of the deposited tailings within the GTSF, will be required prior to closure to extract the vital information (moisture content, density and shear strength of the tailings) for the deconstruction process of GTSF Cells 1, 2 3 and the cover placement of GTSF Cell 4.

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Deconstruction of GTSF Cells 1, 2 and 3 is outlined in the PP and Section 8.2 below.

The rehabilitation of GTSF Cell 4 will be executed according to the details outlined in Section 8.3 below.

8.2 Deconstruction GPTSF Cells 1, 2 and 3

At the completion of tailings deposition, the tailings lines to each cell will be flushed and removed.

The decant water recovery pump and the water return lines will also be removed as the site is made ready to relocate the deposited tailings back into the mine pit.

The required sequence of the deconstruction operation is that the tailings are to be placed into the mine pit first, RL -157 mAHD to RL 42 mAHD, followed by the mine waste from RL 42 mAHD to the ground level RL 123 mAHD. This will need to be carefully planned, controlled and monitored to ensure the density of the materials placed in the pit is maximised with settlements progressively monitored to ensure the target density and volume of placed materials is achieved in order to facilitate timely placement of the final cover to meet the cover design concept, where top surface will be shaped to facilitate surface water drainage and rehabilitation.

8.3 Rehabilitation of GPTSF Cell 4

The following general comments are made with respect to the rehabilitation work for the tailings contained in TSF Cell 4. These comments are based on experience on other sites which are not endowed with significant volumes of highly weathered waste rock.

Given the mine schedule, the outer batter slopes of TSF Cell 4 are likely to be constructed of hard durable competent granite, which typically comprises predominantly quartz (silica), up to 70% or more, with feldspar, mica and other accessory minerals. This material will take decades to centuries to break down through the weathering.

Rehabilitation of the outer batters of the TSF Cell 4 might reasonably take the form of weathered rock, placed over the granite, in a mosaic pattern, which has thin topsoil cover, where topsoil is available. Vegetation comprising shrubs, native to the area, could be placed in the cover

The tailings are predominantly a low-plasticity sandy silt, and the surface of the TSF Cell 4 should be covered with the granite waste rock to prevent generation of dust and the cover system described above placed over the waste rock.

8.4 Rehabilitation of the GP

Environmental management and rehabilitation plans to be implemented at the completion of the backfilling of the GP include the following:

i) Monitoring of the level of the tailings surface as the tailings are placed into the mine pit. The initial primary consolidation process of the tailings placed into the pit will be reasonably quick, taking place as the tailings are deposited, with the rate of consolidation decreasing as the level of the tailings rises.

ii) Monitoring the formation of any crust development as part of the topping-up process in the pit . This monitoring may comprise moisture and density monitoring as well as shear strength testing, as appropriate.

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iii) The top surface of the tailings may, where materials are available, be capped with a layer of competent fresh mine waste rock, up to 5 m nominal thickness to assist in trafficking over the underlying tailings.

iv) The surface layers may comprise oxide waste/growth medium. The batters of the cap above the pit may be *'profiled'*, to provide an acceptable surface to accommodate long-term settlement of the pit backfill materials and facilitate surface water drainage.

v) The final surface area will be ripped along the contour and seeded with native species appropriate to the local conditions.

Cover construction can be commenced once the tailings surface has sufficiently consolidated to permit access to earthmoving equipment.

Rehabilitation/decommissioning (closure) plans will be continually updated to incorporate successful procedures identified in site-specific trials throughout the life of the project.

8.5 Performance Monitoring Against Closure Criteria GP and GPTSF4

Settlement monitors will be installed and checked on an annual basis to track surface settlement against predictions.

Rehabilitated areas will be monitored to ensure vegetation is being established and the area is tracking towards closure.

9 IMPORTANT INFORMATION ABOUT YOUR REPORT

The reader's attention is drawn to the following important information about this report. The design of the GTSF is based on the following:

i) Data provided by the client.
ii) The results of the tailings testwork and geotechnical testwork on samples of the materials proposed for the containment embankment construction works.
iii) The expectation that the design, implementation and operating procedures provided as part of this document will be followed.

10 REFERENCES

1. DETSI *"Regulated structures—EIS information guideline"*, dated June 2024.
2. DETSI *"Manual for assessing consequence categories and hydraulic performance of structures"*, dated 24 Nov 2025.
3. ANCOLD (2019) *"Guidelines on Tailings Dams - Planning, Design, Construction, Operation and Closure"*.
4. ANCOLD (2012) *"Guidelines on the Consequence Categories for Dams"*.
5. Cartledge (2025) "*Esmeralda Graphite Project Site Geotechnical Investigation Factual Report"*, ref MEA010004.
6. Hydrogeologist (2026) *"Esmeralda Graphite Project – Groundwater Impact Assessment",* ref4169C_AARC_Graphinex_Esmeralda EIS v1.docx, 16 March 2026.

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7. RGS (2026) *"Geochemistry assessment of mine materials and tailings",* ref 01_2024066__Geochemistry assessment of mine materials and tailings_Rev E_14012026 date 14 January 2026.

8. McDonald, T., & Langridge-Monopolis, J., (1984). *'Breaching Characteristics of Dam Failures'*.
9. Rico, M., Benito, G., & Diez-Herrero, A. (2008). 'Floods from tailings dam failures'. Journal of Hazardous Materials 154, 79-87.

10. Rourke, H., & Luppnow, D. (2015). *'The Risks of Excess Water on Tailings Facilities and Its Application to Dam-break Studies'*. Tailings and Mine Waste Management for the 21st Century, 225-229.

11. Terzaghi, K. and R. B. Peck, Soil Mechanics in Engineering Practice. New York: J. Wiley and Sons, Inc. (1967).

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Appendix 1

CVs of RPEQ Registered Design Personnel

Graphinex Pty Ltd
Esmeralda Graphite Project

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Resumé - Chris Lane – Principal

Soil & Rock Engineering Pty Ltd (ABN 98 675 219 020)

SUMMARY



Chris is Director and Principal Consultant (Engineering and Environmental Geologist) of SRE with broad experience in civil construction fields, including site investigation of land based and marine based developments and particular expertise in tailing storage facilities (TSFs) for mining projects.

He has more than 40 years' experience including site investigation design and construction of tailing storage facilities (TSFs) and other mine infrastructure (plant sites, heap leach facilities, roads, railways and airstrips).

Chris has completed many strategy studies and financial analysis of TSF options (including concept designs from project start up through to project closure). His involvement with TSFs over the last 33 years covers aspects from project development to start-up through to closure including design, construction, auditing and tailings/residue management reviews for a large number of projects covering a range of commodities including: alumina residue, bauxite residue, base metals (copper, lead and zinc), coal, gold, graphite, iron ore, lithium, manganese, mineral sands, nickel (sulphide and laterite), PGM phosphate residues, rare earth residues, salt uranium and vanadium. Current work is primarily high-level TSF reviews and advice with respect to tailings storage options.

Special interests are:

i) Dry stacked tailings storage facilities (DSTSF).
ii) In-pit tailings (IPTSF).
iii) Integrated waste landforms (IWL), which is a TSF within a mine waste dump.

Chris has work experience with projects in the following countries:

i) Australia and New Zealand.
ii) Armenia.
iii) Middle East (Egypt, Iran, Oman, Saudi Arabia and the United Arab Emirates).
iv) Pakistan.
v) Southeast Asia (Indonesia, Malaysia, Papua New Guinea, Philippines and Vietnam).
vi) Africa - East Africa (Ethiopia, Mozambique, Tanzania); Southern Africa (South Africa and the Democratic Republic of Congo); West Africa (Burkina Faso, Cote D'Ivoire, Ghana, Mali, Senegal); North Africa (Tunisia).
vii) Central America (Mexico)
viii) South America (Brazil, Chile, Guyana and Uruguay); and
ix) United Kingdom

Chris has experience in the following climatic regimes:

i) Tropical (high rainfall).
ii) Humid Savannah (high seasonal rainfall).
iii) Temperate.
iv) Semi-arid.
v) Arid.
vi) Hyper Arid.

Resumé - Chris Lane (SRE P/L)

EXPERIENCE

2024 - present	**Principal Consultant, SRE P/L, WA**
2021 – present	**Principal Consultant, TSFRPL, WA**
2013 - present	**Principal Consultant, L&MGSPL, WA**
2011 - 2013	**Principal Consultant, WorleyParsons, WA**
2006 - 2011	**Senior Principal, Coffey Mining, WA**
2005 - 2006	**General Manager Operations, Coffey Geosciences Pty Ltd**
2003 - 2005	**Principal Engineering and Environmental Geologist, Regional Manager of Coffey WA (following the acquisition of Soil & Rock Engineering by Coffey in October 2003)**
1991 - 2003	**Managing Director, Soil & Rock Engineering Pty Ltd, WA**
1990 - 1991	**Director, Soil & Rock Engineering Pty Ltd, WA**
1988 - 1990	**Associate Director, Soil & Rock Engineering Pty Ltd, WA**
1985 - 1988	**Specialist Engineering Geologist, Soil & Rock Engineering Pty Ltd, WA**
1982 - 1985	**Contracts Manager, Al Otaiba Foundation Engineering Limited**
1981 - 1982	**Contracts Manager, Foundation Engineering Limited, Hong Kong**
1979 - 1981	**Project Manager, Foundation Engineering Limited, United Arab Emirates**
1978 - 1979	**Site Agent/Geologist, Foundation Engineering Limited, United Kingdom**
1977 - 1978	**Contract Geologist, C.R.A. Exploration, Cobar, New South Wales**
1975 - 1977	**Assistant Research Officer, Commonwealth Department of Environment, Housing and Community Development, Canberra**

MAJOR PROJECTS

Predictive Discovery Project (Guinea)
Project Geotechnical Consultant for the Prefeasibility Study for proposed Dry Stacked Tailings Storage Facility (DSTSF). Geotechnical tailings testing, including to optimise the TSF from project start-up to closure.

Mt Chalmers Project (Rockhampton., Queensland)
Project Geotechnical Consultant for the Prefeasibility Study for a valley-style TSF. Geotechnical tailings testing, to optimise the TSF from project start-up to closure.

Zos Uul Gold-Copper Project (Mongolia)
Project Geotechnical Consultant to Western Mongolian Development LLC for their proposed Dry Stacked Tailings Storage Facility (DSTSF) for the Zos Uul Gold-Copper Project. Tailings testing and evaluation and preparation of a report on that testwork. Future work includes waste (mine waste and tailings storage modelling) stability analysis and preparation of recommendations on dry stacking of tailings.

Roy Hill Project (Western Australia)
Project Geotechnical Consultant, for In-pit Tailings Storage Facilities (IPTSFs). Geotechnical tailings testing, including Centrifuge testing to optimise tailings deposition, high-level forward planning to 2049 and closure development for the IPTSFs.

Julimar Project PGM (Western Australia)
Project Geotechnical Consultant, Scoping Study Tailings Storage Facility (TSF), for the proposed 300 Mt Project. Geotechnical tailings testing and examination of options for TSF location for the proposed 20-year mine life.

Leo Lithium (formerly Mali Lithium) Goulamina Lithium (Mali)
Project Geotechnical Consultant for revised Goulamina Project Tailings Storage Facility (TSF), for the proposed 80 to 200 Mt Project for thickened (50% solids wet tailings stream) for the initial 20-year life of project.

Definitive Feasibility Study Sabodala Mine. (Senegal)
DFS for tailings storage facilities TSF1, TSF2, Sabodala In-Pit TSF as an alternative to TSF2, BIOX TSF (double HDPE-lined with underdrainage, leak detection between the liners and leak detection under the base liner).

Manono Lithium/Tin (DRC)
Project Geotechnical Consultant to AVZ Minerals Limited for their Tailings Storage Facility (TSF) which at this stage is a wet TSF supplemented with an in-pit TSF. Evaluation of the project site preparation of the preliminary concepts followed by detailed design for the 30-year life of project. Training of site geologists to undertake the required geotechnical investigation works as part of the TSF design.

Infinity Lithium (Spain)
Project Geotechnical Consultant to Infinity Lithium Corporation for their proposed Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of Scoping Study prepared by others and preparation of PFS dry stacking design for the 30-year life of project.

Siviour Graphite Project (South Australia)
Project Geotechnical Consultant to Wave International for the DFS for the 0.85 to 1.625 Mt Graphite Project. Evaluation of data and input to the DFS for 20-year life of project.

DeGrussa Project Sandfire Resources NL. (Western Australia)
Evaluation of TSF options (expansion of the existing TSF, construction of new TSFs adjacent to the existing facility, dry stacking and in-pit tailings storage) for the new gold project and tailings retreatment. Preparation of concepts from start up through to closure, evaluation of options, production of a technical report and client liaison.

Windimurra Vanadium Project (Western Australia)
Project reviewer for the Tailings Storage Facility designed by others. Gaps in the design identified and recommendations provided for improvements to the design. Scoping study for redesign of the TSFs.

Wahgnion Gold Project (Burkina Faso)
Project reviewer for the FS Tailings Storage Facility designed by others. Gaps in the design identified and recommendations provided for improvements to the design. Independent review of TSF construction.

El Gallo Mine Samaniego In-pit TSF (Sinaloa, Mexico)
Project Geotechnical Consultant to Minera Pangea (McEwen Mining Inc) for the proposed In-Pit TSF, the first wet tailings In-Pit TSF approved in Mexico. Direction of geotechnical laboratory testing, centrifuge testing, evaluation, analysis and reporting for the PFS study for thickened (50% solids wet tailings stream) discharge to the Samaniego Pit with 10-year life of project. Arranged site visits to in-pit facilities in Western Australia for the project owners and execution of a site visit to the El Gallo Mine in Mexico.

Goulamina Lithium (Mali)
Project Geotechnical Consultant to Birimian Limited for the proposed Water Storage Dams/Water Storage Facilities (WSD/WSF), Tailings Storage Facility (TSF), plant site foundations. Execution of PFS study for the TSF for thickened (65% solids wet tailings stream and dry tailings stream) for the initial 40-year life of project followed by the DFS Study.

SRA Quertane Project (Tunisia)
Preliminary conceptual tailings storage facility design. Gaps in the preliminary design by others identified and recommendations provided for improvements to the design.

Mahenge Graphite (Tanzania)
Project Geotechnical Consultant to Black Rock Mining Limited and CPC Engineering for their proposed Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of FS data prepared by others and preparation of recommendations on dry stacking for the 32-year life of project.

Balama Graphite (Mozambique)
Project Geotechnical Consultant to Twigg Mining and Exploration Limitada for their proposed conversion from thickened tailings to a Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of data and preparation of the preliminary study leading to the PFS for dry stacking for the remaining 38-year life of project.

Ravenswood Project (North Queensland, Australia)
Project Geotechnical Consultant to Resolute Mining Limited for their proposed (DSTSF). Evaluation of data and preparation of design concept with recommendations for dry stacking for the 10-year life of project.

Balama Graphite (Mozambique)
Project Geotechnical Consultant to Syrah Resources for the bituminous lined Tailings Storage Facility (TSF), plant site foundations and roads. Evaluation of DFS data prepared by others and preparation of recommendations, process water, mine waste and TSF for thickened tailings for the initial 40-year life of project. In mid-2018 consideration of the change to dry stacked tailings commenced.

Syama Tailings Storage Facilities. (Mali)
Project Manager for the Tailings Storage Strategy Study for 4 tailings streams from the Syama Project Mali. Evaluation of options for combined process streams, water recovery tailings handling (thickened and filtered) for the life of mine tailings storage.

Wafi Golpu Tailings Storage Facility (Papua New Guinea)
Project Manager for the Pre-Feasibility Optimisation Study for the tailings storage facility. Review and evaluation of data and development of conceptual design. Direction of design of the containment embankment evaluation reports, technical review and client liaison. Project Manager for the Tailings Storage Strategy Study for evaluation of options and selection of the “go forward option” for the Feasibility Study for thickened tailings for the first, 27 years, mine tailings storage. Review of the filtered, dry stack tailings alternative.

BC Iron Mardie Salt Project (Western Australia)
High level advice for the geotechnical aspects of the Prefeasibility Study for the design of the evaporation pond, crystallisers and process plant.

Peak Resources Ngualla Rare Earths Project (Tanzania)
Project reviewer for the DFS Tailings Storage Facility designed by others. Gaps in the design identified and recommendations provided for improvements to the design.

Evolution Mining Lake Cowal (New South Wales)
Project reviewer for the Tailings Storage Facilities designed by others November 2016. Gaps in the design and operations identified and recommendations provided for improvements to the existing design by encapsulating these facilities with mine waste from pit cutbacks to form an integrated waste landform (IWL). The IWL was adopted and constructed in 2019/2020.

Hexagon Resources Limited McIntosh Flake Graphite Project (Western Australia)
Prefeasibility Study and conceptual design of the Tailings Storage Facility design.

GME Ni-West Laterite Nickel Heap Leach Project (Western Australia)
Prefeasibility Study for conceptual design of the Heap Leach Facility and Tailings Storage Facility.

Capricorn Resources Limited Karlawinda Gold Project (Western Australia)
3rd Party reviewer of the Tailings Storage Facility designed by CMW Geosciences. Gaps in the previous design by others identified and recommendations provided for improvements to the redesign which were implemented by CMW Geosciences.

RoxGold Project (Burkina Faso)
Independent review of TSF construction.

Toro Gold Limited Mako Gold Project (Senegal)
Project reviewer for the DFS Tailings Storage Facility designed by others. Gaps in the design identified and recommendations provided for improvements to the design. Independent review of TSF construction.

Ammaroo Phosphate Residue Facilities. (Northern Territory)
Project reviewer for the Residue Storage Facility the above ground and inpit residue streams for the Prefeasibility Study. Evaluation of options for the start-up and life of mine residue storage.

Pharsalus Tailings Storage Facility and Plant Site (Guyana)
Project Manager for the mine infrastructure plant site and tailings storage facility for the Pharsalus Project Guyana. Site visit and evaluation of borrow area for tailings storage, data review, and development of conceptual design. Direction of design of the containment embankment using insitu materials supplemented with mine waste, evaluation reports, technical review and client liaison.

TSF Strategy Study Sabodala Mine. (Senegal)
Review of the life of mine (LOM) tailings storage facility strategy and preparation of the PFS Report for input to the Canadian NI 43-101 Stock Exchange Report.

Exxaro Super Fines Project Tailings Storage Facility. (Grootegeluk Muzi - South Africa)
Participation in the study and development of concept options for the design for the tailings storage facility using thickened tailings for the proposed HDPE lined Tailings Storage Facility. Review of design criteria and design documents for the final option.

Castle Hill Project for Phoenix Gold Limited. (Western Australia)
Project Manager for evaluation and design of a heap leach facility and IWL TSF (tailings storage facility within a waste dump) and geotechnical investigation of the plant site. Preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

TSF Strategy Study Edikan Mine. (Ghana)
Review of the life of mine (LOM) tailings storage facility strategy and preparation of report for input to the Canadian NI 43-101 Stock Exchange Report.

DeGrussa Oxide Project Sandfire Resources NL. (Western Australia)
Project Manager for evaluation and design of a heap leach facility and TSF (thickened tailings). Preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Dominga Tailings Storage Facility (Chile)
Review of the prefeasibility study design for the tailings storage facility using thickened tailings for the Dominga Project (magnetite / copper) as part of the 'gap analyses prior to the Definitive Feasibility Study.

Syama Tailings Storage Facilities (Mali)
Project Manager for the OTSF and FTSF (oxide and flotation tailings) for Syama Project Mali. Site visit and evaluation of borrow area for tailings storage, data review, development of conceptual design and adjustments to the adjacent aerodrome design to accommodate the OTSF. Direction of design of the containment embankment using insitu materials supplemented with mine waste, evaluation reports, technical review and client liaison.

Sabodala Tailings Storage Facility (Senegal)
Project Manager for the optimisation of TSF1 for the Sabodala Project Senegal. Site visit for annual geotechnical review works, and evaluation of borrow area for tailings storage optimisation, data review, development of conceptual design and aerodrome design to accommodate TSF1. Direction of design of the containment embankment using insitu materials supplemented with mine waste, evaluation reports, technical review and client liaison.

Kintyre Uranium Project. (Australia)
Project Manager for the value engineering study of the residue storage requirements for the Kintyre Uranium Project. Data review, development of conceptual design based on the implementation of an integrated waste landform (IWL) as an alternative to the existing concept design for the residue storage facilities which resulted in significant cost savings for the project by optimising the containment embankments.

Lynas Residue Storage Facilities. (Malaysia)
Project Manager for the evaluation of the residue storage requirements for the Lynas Residue Optimisation Project. Site visit and evaluation of site area for residue storage, data review, development of conceptual design based on the use of geotubes and adjustments to the existing residue storage facilities. Direction of conceptual design of the containment embankments, technical review and client liaison.

Solomon TSF1 for Fortescue Metals Group (Australia)
Project Manager for the TSF for the Valley of the Kings and Firetail tailings. Evaluation of data and design of the containment embankment using insitu colluvial materials supplemented with a geotextile filter zone. Preparation of concepts, evaluation reports, technical review and client liaison.

Ma'aden Aluminium Project for Ma'aden Projects (Saudi Arabia)
Project Manager for the Stage 1 Residue Storage Facility (RSF) at the refinery site. Evaluation and design of the HDPE lined facilities (Cells 1 and 2) for the refinery waste. Preparation of concepts, evaluation reports, technical review and client liaison.

Various Magnetite and Iron Ore Projects (Australia)
Provision of input for tailings and water balance studies for various magnetite projects (Eyre Iron – South Australia, Crosslands and Extension Hill – Western Australia); and iron ore (Roy Hill, Flinders, and FMG Nyidinghu – Western Australia). Work has involved evaluation of existing concepts (start up through to closure); development of new concepts; evaluation of tailings testwork; technical review and client liaison.

Valentines Magnetite Project for Zamin Resources Limited (Uruguay)
Project Manager for evaluation of valley type TSF integrated with water storage facility constructed with segregated process plant waste. Preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Esaase Project for Keegan Resources Inc. (Ghana)
Project Manager for evaluation of valley type TSF including preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Tengrela / Sissingue Project for Perseus Mining Limited. (Cote D'Ivoire)
Project Manager for evaluation of integrated waste landform TSF including preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison. Project Manager for the 2015 revised design of integrated waste landform TSF including preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Kipoi Project for Tiger Resources Limited. (Democratic Republic of Congo)
Project Manager for evaluation of heap leach and valley type, HDPE lined TSF for flotation tailings, access road and plant site. Preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Marillana Project for Brockman Resources Limited
Project Manager for evaluation of inpit tailings integrated with mine waste options (start up through to closure). Preparation of evaluation reports, technical review and client liaison.

South Balmoral Project for Australasian Resources Ltd / International Minerals Pty Ltd
Project Manager for evaluation of filtered tailings integrated with mine waste options (start up through to closure). Preparation of evaluation reports, technical review and client liaison.

Jabal Sayid Project for Bariq Mining, Saudi Arabia
Project Manager for the geotechnical aspects of mine infrastructure, including the plant site and the tailings storage facility. Evaluation of filtered tailings in a HDPE lined valley TSF (start up through to closure). Preparation of evaluation reports, technical review and client liaison.

Balla Balla Project for Aurox Limited
Project Manager for evaluation of filtered tailings integrated with mine waste options including preparation of conceptual designs (start up through to closure) evaluation reports, technical review and client liaison.

Ayanfuri Project for Perseus Mining Limited. (Ghana)
Project Manager for evaluation of valley type TSF for flotation tailings and a double HDPE lined TSF for concentrate tailings including preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Kanmantoo Project for Hillgrove Copper Limited
Project Manager for IWL design (double HDPE lined) design and documentation including co-ordination of fieldwork, laboratory test work and preparation of concepts (start up through to closure); evaluation reports; technical review; presentations for regulatory authorities and public meeting; and client liaison.

Prominent Hill Project for Oxiana Limited
Project Manager for IWL design and documentation including co-ordination of fieldwork, laboratory test work and preparation of concepts (start up through to closure), evaluation reports, technical review and client liaison.

Olympic Dam TSFs - BHP Billiton Olympic Dam
Project Reviewer for existing TSFs and reviewer for TSF Scoping Study Expansion Project.

Groote Eylandt for GEMCO
Project Manager for IWL design and documentation including co-ordination of fieldwork; laboratory test work and preparation of concepts (start up through to closure); evaluation reports; technical review; presentations for regulatory authorities and client liaison.

Project Magnet for OneSteel – Iron Duke
Project Manager including geotechnical investigations (boreholes and testpits) for the proposed plant site and TSF design concepts (start up through to closure) and documentation including co-ordination of fieldwork, laboratory test work and preparation of factual and evaluation reports, technical review and client liaison.

Tethyan Copper Project – Reko Diq Pakistan
Project Manager for Coffey Geosciences Team for environmental, hydrogeological and geotechnical studies. Specialist geotechnical responsibilities included geotechnical investigations (boreholes and testpits) for the proposed plant site, TSF, access road, airstrip and pipeline route. Geological reconnaissance work for the access road and pipeline route. Contract administration including co-ordination of fieldwork, laboratory test work and preparation of factual and evaluation reports, technical review and client liaison.

Austeel Iron Ore Project – Cape Preston WA and Newcastle
Responsibilities included Geotechnical investigations (boreholes and testpits) for the proposed plant site and TSF at the mine site south of Cape Preston; Geological reconnaissance work for the quarry site and access to the proposed port facility; Contract administration including co-ordination of fieldwork, laboratory test work and preparation of factual and evaluation reports, technical review and client liaison. Project Director responsible for the investigation works undertaken for the Steel Mill at Tomago near Newcastle NSW.

West Angelas Project – Newman WA
Geotechnical investigations (geological mapping boreholes, costeans and testpits) for the proposed 370km railway line and infrastructure at West Angelas and Cape Lambert.

Windimurra Vanadium Project – Mt Magnet WA
Extensive tailings testing programme for tailings from the magnetic separation and calcine tailings circuits; Design of TSF; Liaison and site visits during construction to monitor the progress of the works; Co-ordination of fieldwork, laboratory test work and preparation of factual and evaluation reports, technical review and client liaison.

Midwest Iron and Steel Project – Tallering Peak WA
Geotechnical investigations (geological mapping boreholes, costeans and testpits) for the proposed plant site at Oakajee and the 140km railway line from Oakajee to Tallering Peak; Design of TSF at Tallering Peak; Co-ordination of fieldwork, laboratory test work and preparation of factual and evaluation reports, technical review and client liaison.

Yandi Stage 2 Iron Ore Project – Newman WA
Project Manager with responsibility for Geotechnical investigations (geological mapping boreholes, costeans and testpits) for the proposed 10km railway line, load out facility and bridge. Organisation of all fieldwork for more than 10 cuttings along the railway alignment, laboratory test work and preparation of factual and evaluation reports. Liaison and site visits during construction to monitor the progress of the works.

Yakabindie Nickel Project – Leinster WA
Project Manager for the Yakabindie Nickel Project with responsibility for: Geotechnical investigations of the plant site tailings storage and flood diversion channels including supervision of all fieldwork, laboratory testing and preparation of reports. Preparation of the Consultative Environmental Review for the project including management of sub-consultants for fauna, flora, groundwater, surface water and ethnographic studies and preparation of the final report. Liaison with Department of Mines, Environmental Protection Authority and other Government Departments, Process Consultants and clients. Design of the project tailings storage facilities.

Mesa J Iron Ore Project – Pannawonica WA
Project Director / Project Manager with responsibility for Extensive tailings testing programme and design of the Inpit TSF. Geotechnical investigations (boreholes and testpits) for the plant sites (PP1 and PP2). Liaison with client and Governments for tailings storage approvals. Liaison and site visits during construction to monitor the progress of the works.

Brockman Iron Ore Project – Tom Price WA
Project Manager Brockman with responsibility for Fieldwork (costeans and testpits) for 46km of rail alignment. Organisation of laboratory testwork and preparation of reports.

Yandi Stage 1 Iron Ore Project – Newman WA
Project Manager with responsibility for Geotechnical investigations (geological mapping boreholes, costeans and testpits) for the proposed 32km railway line, load out facility and accommodation facility. Organisation and supervision of all fieldwork for more than 20 cuttings along the railway alignment, laboratory test work and preparation of factual and evaluation reports. Liaison and site visits during construction to monitor the progress of the works.

Marandoo Iron Ore Project – Tom Price WA
Project Manager with responsibility for: Fieldwork for the selecting and proving of a quarry site for aggregates suitable for concrete, road sealing and ballast, investigation of a 120km rail alignment and 22km access road. Coordination and management of geotechnical team, liaison with Project Design Team, preparation of reports for all aspects of the project. Liaison and site visits during construction to monitor the progress of the works.

Channar Iron Ore Project – Paraburdoo WA
Project Manager with responsibility for: Geotechnical investigation for all major structures. Primary Crusher, Primary Stockpile, Secondary Crusher, 25km Conveyor, access roads and aggregate survey. Supervision and organisation of fieldwork (geological mapping, borehole, costean and testpit excavations). Organisation of laboratory testing and preparation of factual and evaluation reports.

TAILINGS STORAGE PROJECTS

Advice on design concepts (start up through to closure), operation, audits, inspections, management reviews, advice on seepage, stability, tailings deposition, water recovery and preparation of tailings disposal strategy plans have been undertaken at the following locations:

Projects outside Australia

- Predictive Discovery, Guinea
- Chilalo Project, Tanzania (Co-mingled tailings and mine waste)
- Morila Gold Project, Mali
- Goulamina Lithium Project, Mali
- Manono Lithium Tin Project, Democratic Republic of Congo
- Infinity Lithium Project, Spain
- Tabakoto Project, Mali
- Wahgnion Project, Burkina Faso
- Mahenge Graphite Project, Tanzania
- Sra Quertane Project, Tunisia
- Balama Graphite Project, Mozambique
- Bonikro Gold Project, Cote D'Ivoire
- Mensin Bibiani Gold Project, Ghana
- Ngualla Rare Earths Project, Tanzania
- Mako Project, Senegal
- RoxGold Project, Burkina Faso
- Sukari Gold Mines, Egypt
- Wafi Golpu Project, Papua New Guinea
- Exxaro Super Fines Project, South Africa
- Dominga, Chile
- Minas Rio Project, Brazil
- Pharsalus Project, Guyana
- Syama Project, Mali, West Africa
- Lynas Project, Malaysia
- Askaf Iron Ore Project, Mauritania
- El Aouj Iron Ore Project, Mauritania
- Ma'aden Aluminium Project, Saudi Arabia
- Kipoi Project, Democratic Republic of Congo
- Valentines Project, Uruaguay
- Sissingue (Tengrela) Project, Cote D'Ivoire, West Africa
- Sabodala Project, Senegal, West Africa
- Edikan (Ayanfuri), Ghana, West Africa
- Jabal Sayid, Saudi Arabia
- Yubdo Platinum Mine, Ethiopia
- Reko Diq, Pakistan
- Rapu Rapu, Philippines
- North Mara Mine, Tanzania
- Tulawaka Mine, Tanzania
- Geita Gold Mine Tanzania
- Sokt Gold Project, Armenia
- Ararat Gold Project, Armenia
- Mt Muro Gold Project, Indonesia
- Miduk Copper Project, Iran
- Macraes Gold Project, New Zealand
- Sarcheshmeh Tailings Storage, Iran
- Bogosu Gold Project, Ghana, West Africa

- Iduapriem Project, Ghana, West Africa
- Sansu Sulphide Project, Ghana, West Africa
- Cikondang Gold Project, Cikondang, Indonesia
- Abosso Gold Project, Ghana, West Africa
- Obenemase Gold Project, Ghana, West Africa
- Amansie Resources Gold Project, Ghana, West Africa
- Ayanfuri Gold Project, Ghana, West Africa

Projects within Australia

- Mt Chalmers Project, Queensland
- Mungari Project, Western Australia
- CSA Cobar, New South Wales
- Roy Hill, In-Pit TSFs, Western Australia
- Ora Banda Mining, Western Australia
- Julimar PGM Project, Western Australia
- Siviour Graphite Project, South Australia
- Goshen Mineral Sands Project, Victoria
- Kalbar Fingerboards Project, Victoria
- Alt Resources Limited, Bottle Creek Project, Menzies
- WIM Resources, Avonbank Project, Victoria
- Beacon Mining Limited, Coolgardie
- Sheffield Resources Ltd, Thunderbird Mineral Sands Project, Western Australia.
- Deflector Mining Limited, Gullewa
- Doray Mining Limited, Meekatharra
- Diatreme Resources Limited, Cyclone Mineral Sands Project, Western Australia
- Norton Gold Fields Paddington Operations, Kalgoorlie
- Ammaroo Phosphate, Northern Territory
- Phoenix Gold, Western Australia
- Sandfire, Western Australia
- Kintyre Uranium, Western Australia
- TSF1 Solomon, Western Australia
- Olympic Dam, South Australia
- Balla Balla, Western Australia
- Kanmantoo, South Australia
- Ravenswood, Queensland
- Prominent Hill, South Australia
- Project Magnet, Iron Duke
- Bulong Nickel, Kalgoorlie
- Windimurra, Mt Magnet
- Mesa J, Pannawonica
- Yilgarn Star, Southern Cross
- Marymia Gold Operations, Meekatharra
- Plutonic Gold Operations, Mt Morgans, Laverton
- Hill 50 Gold Mine, Mt Magnet
- Bannockburn Gold Mine, Leonora
- WMC Resources Ltd, Kambalda Nickel Operations, Kambalda
- Central Norseman Gold Corporation Limited, Norseman
- Chalice Gold Mine, Norseman
- Higginsville Gold Mine, Norseman
- Agnew Gold Mine, Leinster
- Big Bell, Cue
- Mt Dimer, Southern Cross
- Youanmi Gold Mine, Mt Magnet

- Palm Springs Gold Project, Halls Creek
- Cockatoo Island Iron Ore Beneficiation Project, Cockatoo Island
- Gidgee, Sandstone
- Granny Smith, Laverton
- Mt Pleasant, Kalgoorlie
- Lady Bountiful Extended, Kalgoorlie
- Newcrest, Telfer, Kalgoorlie and Ora Banda
- Paddys Flat Gold Mine, Meekatharra
- Plutonic Gold Mine, Meekatharra
- Mawson Pacific, Southern Cross

DRY STACKED TAILINGS PROJECTS

Geotechnical advice, reviews and design for dry stacked tailings storage facilities at the following projects. Dry stacked tailings require low moisture content to facilitate compaction to achieve a high placed density to form a stable structure.

Predictive Discovery Dry Stacked TSF
Project Geotechnical Consultant to Predictive Discovery for their proposed Dry Stacked Tailings Storage Facility (DSTSF) for the Bankan Project. Tailings testing and evaluation and preparation of a PFS Design Report including mine waste and tailings storage modelling, stability analysis and preparation of recommendations on dry stacking of tailings.

Chilalo Graphite (Tanzania)
Project Geotechnical Consultant to Evolution Energy Minerals Limited for their proposed Co-Mingled Tailings and Mine Waste. Evaluation of FS data prepared by others and preparation of recommendations on stacking for the project.

Zos Uul Gold-Copper Project (Mongolia)
Project Geotechnical Consultant to Western Mongolian Development LLC for their proposed Dry Stacked Tailings Storage Facility (DSTSF) for the Zos Uul Gold-Copper Project. Tailings testing and evaluation and preparation of a report on that testwork. Future work includes waste (mine waste and tailings storage modelling) stability analysis and preparation of recommendations on dry stacking of tailings.

Nobles Nob Gold Project (Tennant Creek, Northern Territory)
Project Geotechnical Consultant to Wave International and Tennant Mining for their proposed Dry Stacked Tailings Storage Facility (DSTSF) for the Nobles Nob Gold Project. Geotechnical tailings testing and evaluation, followed by preparation of a preliminary stability analysis and preparation of recommendations on dry stacking of tailings.

FMG Dry Stacked Tailings Assessment Solomon Project (Western Australia)
Project Geotechnical Consultant to Red Earth Engineering and Fortescue Metals Group for the assessment of the dry stacked tailings option for iron ore tailings. Evaluation of filter tailings testwork, geotechnical tailings testing, evaluation of historic tailings test data (2012 to 2021) and assessment of all data, followed by preparation of the project report.

Infinity Lithium (Spain)
Project Geotechnical Consultant to Infinity Lithium Corporation for their proposed Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of Scoping Study prepared by others and preparation of PFS dry stacking design for the 30-year life of project.

Mahenge Graphite (Tanzania)
Project Geotechnical Consultant to Black Rock Mining Limited and CPC Engineering for their proposed Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of FS data prepared by others and preparation of recommendations on dry stacking for the 32-year life of project.

Balama Graphite (Mozambique)
Project Geotechnical Consultant to Twigg Mining and Exploration Limitada for their proposed conversion from thickened tailings to a Dry Stacked Tailings Storage Facility (DSTSF). Evaluation of data and preparation of the preliminary study leading to the PFS for dry stacking for the remaining 38-year life of project.

Ravenswood Project (North Queensland, Australia)
Project Geotechnical Consultant to Resolute Mining Limited for their proposed (DSTSF). Evaluation of data and preparation of design concept with recommendations for dry stacking for the 10-year life of project.

Jabal Sayid Project for Bariq Mining, Saudi Arabia
Project Manager for the geotechnical aspects of mine infrastructure, including the plant site and the tailings storage facility. Evaluation of filtered tailings in a HDPE lined valley TSF (start up through to closure). Preparation of evaluation reports, technical review and client liaison.

LATERITE NICKEL PROJECTS

Geotechnical advice, reviews and design for laterite nickel tailings storage facilities (above ground and inpit) at the following projects in Australia. Laterite nickel tailings are unusual in that they have a very low settled insitu dry density and high insitu moisture content and when dry have a dry strength sufficient to support light vehicles and light construction equipment loads.

Bulong Nickel Project – Kalgoorlie WA
Geotechnical review and advice for the above ground tailings storage facility and evaporation pond. Extensive tailings testing programme for inpit tailings to the Criterion and Federal Pits including design work for these tailings storage facilities. Liaison and site visits during construction to monitor the progress of the works; Technical review and client liaison during operation; Geotechnical investigations after the site was closed to assess the insitu material properties (strength and density).

Cawse Nickel Project – Kalgoorlie WA
Geotechnical review and advice for the above ground tailings storage facility. Liaison and advice for the implementation of the inpit tailings storage program.

Murrin Murrin Nickel Project – Leonora WA
Geotechnical review and advice for the above ground tailings storage facilities and evaporation ponds. Extensive tailings testing programme for tailings deposition to the 2/3 Pit Tailings Storage Facility (2/3PTSF) and the proposed 9/1, 9/2 and 9/7 In-Pit Tailings Storage Facilities (IPTSF). Liaison and site visits during inpit embankment construction to monitor the progress of the works. Technical review and client liaison during operation.

MINERAL SANDS PROJECTS

Geotechnical advice, reviews and conceptual designs for above ground and mined pit tailings storage facilities for the following projects in Australia. Mineral sands typically split the sand and slimes (slit and clay) fraction during the processing, with the fines fraction potentially having a very low settled insitu dry density and high insitu moisture content, which can inhibit closure.

Kalbar Fingerboards Mineral Sands Project – Gippsland, Victoria

Third party review of the proposed surface tailings storage facility, particularly the dam break assessment. Initial deposition comprised a series of ponds to accommodate tailings until the development of mine voids facilitated the tailings stream being diverted into the sterile mine voids. This project is currently assessing the use of centrifuges to produce dry tailings which can be disposed of with mine waste.

Goshen Mineral Sands Project – Victoria

Review of the proposed in-pit tailings storage system. This review resulted in tailings testwork to assess the tailings properties. This project is yet to be completed

Avonbank Mineral Sands Project – Horsham, Victoria

Review of the proposed in-pit tailings storage system. This review resulted in additional testwork which not only confirmed that the proposed flocculated tailings facility was stable and could be rehabilitated relatively quickly with the site being returned to agricultural use, but also resulted in the pit walls for mining being steepened to recover more ore. This project is yet to be completed.

Thunderbird Mineral Sands Project – Dampier Peninsula, WA

Third party review of the proposed surface tailings storage facility and in-pit tailings deposition. Initial deposition was a standalone stack with the discharge point extending longitudinally along the crest of the stack. After development of mine voids, the tailings stream was diverted into the sterile mine voids.

Cyclone Mineral Sands Project – Rawlinna, WA

Tailings from the processing comprise two streams that were to be mixed in the tailings hopper before being pumped to the discharge point. The sand stream, with a maximum particle size of 1 mm, comprises the majority of tailings. Initial deposition was a standalone stack with the discharge point extending longitudinally along the crest of the stack. After development of mine voids, the tailings stream was diverted into the sterile mine voids.

HEAP LEACH PROJECTS

Geotechnical advice on slope design (stability), liner design for heap leach pads and associated ponds for various heap leach projects including both permanent stacks and on/off stacks and involvement in assessment of flux leakage rates from HDPE liners. Involvement with projects at the following locations:

Projects outside Australia

- Kipoi Copper Project, Democratic Republic of Congo
- Bannerman Resources, Etango Project, Namibia
- Union Resources, Mehdiabad Zinc Heap Leach Project, Iran
- Grumesa, Ghana, West Africa
- Abore, Ghana, West Africa
- North Mara Mine, Tanzania

Projects within Australia

- Binduli Gold Project (Peer Review), Norton Gold Fields Limited, Kalgoorlie, Western Australia
- Hayes Creek Gold Project, PNX Metals, Northern Territory
- Jervois Heap Leach Nickel project, Young, New South Wales
- Nickel West Project, Leonora Western Australia
- Phoenix Gold Limited, Western Australia
- Sandfire Resources NL, Western Australia
- Ranger Uranium, Northern Territory
- Nifty Copper Project, Western Australia
- Sherlock Bay Nickel Heap Leach
- Radio Hill Nickel Bacterial Leach, Karratha
- WMC St Ives Dump Leach, Kambalda
- Newcrest Telfer
- Newcrest Heap Leach Trial New Celebration Mine, Kalgoorlie

ACID MINE DRAINAGE (ARD) PROJECTS

Geotechnical advice on liner and underdrainage for ARD mine waste and ARD tailings storage facilities and involvement in assessment of flux leakage rates from HDPE liners. Involvement with projects at the following locations:

Projects outside Australia

- North Mara Gokona and Nybagenia Mine Waste, North Mara Mine, Tanzania

Projects within Australia

- Kanmantoo Copper Project, South Australia
- Sally Malay Project, Western Australia.
- Nifty Copper Project, Western Australia
- Radio Hill Nickel Project, Western Australia.
- Ravenswood Project, Queensland.

OTHER PROJECTS

Mining Projects

- Agnew Gold Mine, Leinster
- Lawlers Gold Mine, Leinster
- Kambalda Nickel Operations New Concentrator, Kambalda
- Central Norseman Gold Corporation, Norseman
- Yilgarn Star, Marvel Loch
- Mt Morgans Gold Project, Laverton
- Telfer Gold Mine, Telfer
- New Celebration Gold Mine, Kalgoorlie
- Granny Smith, Laverton
- Sons of Gwalia, Leonora
- Western Mining Corporation, Leinster
- Plutonic Gold Mine, Meekatharra

Civil Construction Projects

- Low Rise Buildings, Warehouses, Perth
- Earthworks Projects, Western Australia

Route Investigations Gas Pipelines

- South Eastern Gas Pipeline, Sydney (NSW) to Sale (Victoria)
- Goldfields Gas Pipeline, Western Australia
- Pipeline Dredging, Saladin Oilfield
- Route Investigation Perch and Dolphin, Bass Strait
- Tubridgi Gas Field Development, Onslow

Route Investigations Rail Alignments

- West Angelas, Western Australia
- Mid West Iron and Steel, Western Australia
- Yandi Stage 1 and Stage 2, Western Australia
- Brockman, Western Australia
- Mesa J, Western Australia
- Marandoo, Western Australia

EDUCATION

Bachelor Applied Science, Canberra University, 1975

Executive Master of Business Administration, Australian Graduate School of Management, 2002

AusIMM Professional Certificate in Tailings Management, 2020

REGISTRATIONS/AFFILIATIONS

Fellow of the Geological Society London (14006), 1980

Corporate Member of the Institute of Geologists (United Kingdom), 1987

Member of the Australian Institute of Geoscientists, 1987

Chartered Geologist (CG 14006), 1990

Member of the Australasian Institute of Mining and Metallurgy (MAusIMM CP 109219), 1990

Registered Professional Geoscientist – The Australian Institute of Geoscientists (AIG 10009), 1997

Chartered Professional (Geotechnical) (MAusIMM CP 109219) Australasian Institute of Mining and Metallurgy, 2012

Registered Professional Engineer Queensland (RPEQ 13083) Geotechnical (Mining), 2012

PUBLICATIONS/PRESENTATIONS

Lane, J.C. (2023): The importance of water recovery for safe performance of TSFs; AusIMM, MetFest, 18 August 2023.

Lane, J.C. (2022): The importance of water recovery; how much can you achieve? In: Australian Centre for Geomechanics Mine Tailings Seminar: COR 2208, University of Western Australia, 6 to 7 December 2022.

Lane, J.C. (2022): Impact of the Global Industry Standard on Tailings Management. AusIMM, on-line, 17 February 2022.

Lane, J.C. (2020): In-pit tailings storage – El Gallo Mine, Sinaloa, Mexico. In: Australian Centre for Geomechanics Tailings Management: Responding to Challenges Seminar – COR 2030 December 2020. Australian Centre for Geomechanics, Perth, W.A, 2- 3 December 2020.

Williamson P., Beltran H., Lane C., Willis J., Baseline Investigations and Preliminary Design for an In-Pit Tailings Storage Facility, El Gallo Mine, Sinaloa. In Proceedings of Tailings and Mine Waste 2019, Vancouver, Canada, November 17-20, 2019.

DeVries J., Hogg, C., Lane, C., Moshi, P., Dry stacking of high-grade flake graphite tailings: Tanzania. In Paste 2019, Proceedings of the 22nd International Conference on Paste, Thickened and Filtered Tailings, Cape Town, South Africa, 8 – 10 May 2019.

Rafty M., and Lane J. C. Water Balance 101. In the AusIMM Mine Waste and Tailings Conference 2018 Proceedings, Brisbane, Australia, 23 – 24 July 2018.

Lane J. C. Tailings Storage Management 101: Design, Operating Essentials, Signs of Problems. In the GEMG Proceedings Environmental Management Workshop, Kalgoorlie, Australia, 16 – 18 May 2018.

Chafy, A., Tidswell, M., Lane, C., Case study: project start-up for thickened graphite tailings, storage and water recovery strategies, In the Paste 2018, Perth, Australia, 11 – 13 April 2018.

Lane J. C. Integrated Waste Landforms Design, Construction, Operation and Management. In ACG Seminar on Management, Operation and Relinquishment of Tailings Storage Facilities, Perth, Australia, 27 - 28 April 2017.

Amtsberg, M., Buckley, J., Lane, C Research and Analysis of Geosynthetics for Tailings Storage Application. In Proceedings 7th International Congress on Environmental Geotechnics, 10 – 14 November 2014.

Rafty M., and Lane J. C. (2014) Water balance 101. In 2014 Workshop on Environmental Management, Workshop Proceedings, Kalgoorlie, Australia, 21 – 23 May 2014.

Lane, J.C. (2013): In-pit tailings deposition (storage). In: 'Advanced Tailings Management'. Australian Centre for Geomechanics, Perth, W.A., 22 March, 2013.

Lane, J.C. (2011): In-pit tailings deposition – aspects to be considered. In: 'Total Tailings Management'. Australian Centre for Geomechanics, Perth, W.A., 1-3 December 2011.

McDonald L., and Lane J. C. (2010) Consolidation of Inpit Tailings. In Mine Waste 2010, Proceedings of the First International Seminar on Reduction of Risk in the Management of Tailings and Mine Waste, Perth, Australia, 29 September – 1 October 2010.

Lane, J.C. (2009) Tailings Storage Management: Essential Operating Principles. In: 'Practical Soil Mechanics in Mining and Tailings Management for Operators'. Australian Centre for Geomechanics, Perth, W.A., 1-3 December 2009.

Lane, J.C. (2008) In-pit tailings deposition – opportunities, risks and processes. In: 'Tailings Management for Decision Makers'. Australian Centre for Geomechanics, Perth, W.A., 3-4 December 2008.

Lane J. C. (2008) Inpit tailings deposition; what have we learned about this tailings storage option. In: 'Proceedings of Workshop on Environmental Management'. Goldfields Environmental Management Group, Kalgoorlie, W.A., 1-3 May 2008.

Lane, J.C. (2007) Case histories of integrated waste landforms and in-pit deposition; what are the costs of these options? In: 'Total Tailings Management Seminar'. Australian Centre for Geomechanics, Perth, W.A., 5-7 December 2007

Lacey, H. and Lane, J.C. (2007) Integrated landforms and waste stream management. In: 'Planning for Mine Closure'. Australian Centre for Geomechanics, Perth, W.A., 12-15 June 2007.

Lane J. C. (2005) Use of completed open pits for tailings disposal. In Handbook on Mine Fill. Australian Centre for Geomechanics, Perth, W.A.

Lane, J.C. (2004) Integrated landforms – an alternative approach to tailings storage. In: 'Mine Closure- Towards sustainable outcomes'. Australian Centre for Geomechanics, Perth, W.A., 5-6 August 2004.

Lane, J.C. (1999) In-pit Tailings Disposal Marymia Gold Operation: Case History. In: 'Pacrim Congress' Australasian Institute of Mining and Metallurgy 1999 Bali, Indonesia.

Lane, J.C. (1998) Innovative approaches to tailings disposal. Future Directions in Tailings Management ACMER Workshop Proceedings. Perth, W.A. 1998. ACMER PO Box 883, Kenmore QLD.

SPECIALIST COURSES

'AusIMM Mine Waste and Tailings Conference' Brisbane, Australia, 12 – 13 July 2023.

'Mine Closure 2022 – 15th International Conference on Mine Closure' Australian Centre for Geomechanics, Brisbane, Queensland, Australia, 4 to 6 October 2022.

'Paste 2021 – 23rd International Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Fremantle, Western Australia, 21 to 23 September 2021.

'Paste and Thickened Tailings Short Course. Is the Future Filtered?' Australian Centre for Geomechanics, Fremantle, Western Australia, 20 September 2021.

'AusIMM Mine Waste and Tailings Conference' Brisbane, Australia, 1 – 2 July 2021.

'ANCOLD Tailings Workshop' University House, Perth Western Australia 12 November 2019.

'Paste 2019 – 22nd International Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Cape Town, South Africa, 8 to 10 May 2019.

'Paste and Thickened Tailings Short Course. Is the Future Filtered?' Australian Centre for Geomechanics, Cape Town, South Africa, 7 May 2019.

'AusIMM Mine Waste and Tailings Conference' Brisbane, Australia, 23 – 24 July 2018.

'Paste 2018 – 21st International Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Perth, Australia, 11 to 13 April 2018.

'Management, Operation and Relinquishment of Tailings Storage Facilities Seminar'. Australian Centre for Geomechanics, Perth, W.A. Australia, 27 - 28 April 2017.

'Paste 2016 – 19th International Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Santiago, Chile, Australia, 6 to 8 July 2015.

'Paste 2015 – 18th International Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Cairns, Australia, 5 to 7 May 2015.

7th International Congress on Environmental Geotechnics, 10 – 14 November 2014.

'Paste 2014 – Seminar on Paste and Thickened Tailings' Australian Centre for Geomechanics, Vancouver, Canada, 8 to 12 June 2014.

'Paste 2013 Stacked, Thickened, Paste and Filtered Tailings' Australian Centre for Geomechanics, Belo Horizonte, Brazil, 16 to 20 June 2013.

'Advanced Tailings Management'. Australian Centre for Geomechanics, Perth, W.A. Australia, 22 March, 2013.

'Total Tailings Management'. Australian Centre for Geomechanics, Perth, W.A. Australia, 20 - 21 March, 2013.

'Environmental Geochemistry of Mine Site Pollution - An Introduction'. Australian Centre for Geomechanics, Perth, W.A. Australia, 18 - 19 March, 2013.

'Total Tailings Management'. Australian Centre for Geomechanics, Perth, W.A. Australia, 7 - 8 December 2011.

'Mine Waste 2010'. Australian Centre for Geomechanics, Perth, W.A. Australia, 29 September – 1 October 2010.

'8th International Conference Acid Rock Drainage'. SveMin and INAP, Skelleftea, Sweden, 23 to 26 June 2009.

'Short Course on Designing Sustainable Cover Systems and Final Landforms for Mine Waste Storage Facilities'. SveMin and INAP, Skelleftea, Sweden, 22 June 2009.

'Tailings Management for Decision Makers'. Australian Centre for Geomechanics, Perth, W.A. Australia, 3 - 4 December 2008.

'Total Tailings Management'. Australian Centre for Geomechanics, Perth, W.A. Australia, 5 - 7 December 2007.

'Mine Closure'. Australian Centre for Geomechanics, Perth, W.A. Australia, 14 - 15 June 2007.

'Tailings Management and Decommissioning'. Australian Centre for Geomechanics, Perth, W.A. Australia, 27 - 28 November 2003.

'6th International Conference Acid Rock Drainage'. AusIMM and ACMER, Cairns Queensland Australia, 14 to 16 July 2003.

Resumé – Dr. David Yong – Principal

Soil & Rock Engineering Pty Ltd (ABN 98 675 219 020)

SUMMARY



Dr. Yong is a Director and Principal Consultant (Geotechnical Engineering) of SRE with extensive geotechnical design experience from various major industrial, oil and gas, dams, mining, public infrastructure, and commercial/residential projects encompassing offshore, coastal nearshore, and land-based ground conditions.

He is accredited as a Chartered Engineer (CPEng) by the Instituted of Engineers Australia, Registered Professional Engineer (RPEQ) by the Board of Professional Engineers of Queensland (registration no.: 28326), Chartered Professional (CP, Geotech) by the Australasian Institute of Mining and Metallurgy, and is also registered as an International Professional Engineer (IntPE, Australia) in accordance with the International Professional Engineers Agreement (IPEA).

He has 20 years' experience in most aspects of geotechnical engineering design ranging from deep piled foundations (CFA, driven steel, Franki, helical pile), shallow raft foundations (pads and rafts), subsea foundations (suction caisson, mudmat), temporary/permanent ground retention systems (sheet pile, tubular pile, soldier pile, soil nail, grout block, gabion, reinforced earth), ground improvement (vibro-compaction, sand column, stone column, wick drains, surcharge pre-loading), embankments, dams (tailings and water).

He has also personally scoped and boots-on-the-ground supervised (including management of entire fieldwork teams and contractors) the geotechnical site investigation fieldwork for most of the geotechnical engineering design work he has been involved. His fieldwork experience include various drilling methods (diamond, wash auger, sonic, RC, air rotary percussion), test pitting, electric Cone Penetration Test (CPT), hand augering, various in-situ tests (excess porewater pressure dissipation test, seismic shear wave velocity test, shear vane, Standard Penetrometer Test, Marchetti dilatometer, self-boring pressuremeter, Dynamic Cone Penetrometer, Falling Head permeability test), and different types of geophysical survey work (ReMI, seismic reflection, seismic refraction, electric resistivity, MASW).

For the geotechnical design of earthen water and tailings storage facility (TSF) structures, Dr. Yong has extensive experience in soft soil and Critical State Soil Mechanics (CSSM) characterisation of soils that sometimes form part of the dam structure; this specialised knowledge is derived from his decades of experience in offshore oil and gas project development built over naturally-occurring soft seabed (and sometimes underconsolidated) sediments. He is able to translate his soft soil and CSSM knowledge towards evaluating the soil and porewater pressures behaviour within the dam structure, and from there he is able to quantify the risk of geotechnical slope instability as a result of over-stressing the soils towards the point of static/seismic soil liquefaction onset. He also specialise in liquefaction/cyclic mobility risk assessment considering both deterministic (FoS) and probabilistic approaches, including interpretation and merging of various geotechnical SI test data (SPT, CPT, shear wave) to build a two-dimensional risk profile across the entire sub-soil stratigraphy and dam body. He is also experienced in the geotechnical design for closure capping of tailings dam, with emphasis on designing the capping thickness and placement sequence to minimise long-term capping surface settlement due to tailings self-weight consolidation.

Software that Dr. Yong specialise in for undertaking various geotechnical design work include CPeT-IT, CLiq, Geostudio suite of software (SLOPE/W, SIGMA/W, SEEP/W), Rocscience suite of software (RSPILe, Settle3), GRLWEAP, Optum G2, Oasys Siren, SeismoMatch, PLAXIS 2D, PLAXIS 3D, and PLAXIS LE.

EXPERIENCE

2024 – present	**Principal Consultant and Director, SRE**
2020 – present	**Principal Consultant and Director, Geoanalytica**
2020 – present	**Principal Consultant (Contract), Worley**
2018 to 2019	**Lead Geotechnical Engineer, Advisian**
2016 to 2018	**Senior Geotechnical Engineer, Advisian**
2010 to 2016	**Geotechnical Engineer, WorleyParsons**
2007 to 2010	**PhD Scholar, University of Western Australia**
2006 to 2007	**Graduate Geotechnical Engineer, Coffey Geotechnics**

DAM (TAILINGS) PROJECTS

CSA Cobar South TSF (Australia)

3rd Party independent geotechnical review of engineering work executed by the main dam engineering consultant for the proposed Stage 10 raising of the South TSF, in which extensive toe berm buttressing was prescribed due to a perceived risk of underlying tailings liquefaction, with a corresponding approximate buttress construction cost ranging between ~AUD$20M – AUD$40M. As part of his review work involved scoping and supervised a CPT geotechnical site investigation fieldwork to enable accurate geotechnical characterisation of the in-situ tailings condition; this review exercise culminated in the consultant agreeing to remove the need for buttressing.

Edikan TSF (Ghana)

Detail geotechnical engineering design support for the proposed upstream TSF raising to RL 213 m.

Zulu 5 In-Pit TSF (Australia)

One-dimensional Finite Element tailings self-weight consolidation assessment, to cycle the tailings deposition timing between different Zulu In-pit TSF cells to maximise the deposited tailings dry density by giving sufficient downtime for self-weight consolidation prior to further tailings topping up.

Brad TSF (Australia)

Lead geotechnical designer for the ~100 m high down-stream raised TSF embankment constructed purely from traffic-compacted mine waste material, including scoping and overseeing the execution of a full scale compaction trial utilising mine haul trucks to evaluate the influence of (i) number of truck passes, and (ii) fill placement lift thickness, on the degree of compaction. A compaction earthwork method specification was developed from this trial and has been implemented for the embankment construction.

Futi Bagus In-pit TSF cutback (Australia)

Development of a concept design to excavate and form a temporary batter into the in-situ tailings as part of the proposed development of a new mine pit connecting to the existing Futi Bagus pit that has since been infilled with tailings.

Collie and Muja Power Station Fly Ash Dam (Australia)

Annual geotechnical stability review of both dams since 2021, and is also the main consultant providing detail engineering design for the final RL 261 m upstream raising of the Muja Power Station Fly Ash Dam Cell 2.

Mulga Downs TSF concept (Australia)

Desk study to explore various tailings disposal and storage methods applicable for the proposed metallurgical process, evaluation of suitable TSF site locations based on topography, embankment construction method and construction material availability, and Life-of-Mine unit construction cost for the considered TSF options.

Tabakoto Gold Mine TSF (Ghana)

Commissioned to undertake geotechnical stability review of the existing TSF comprising multiple upstream embankments built utilising manually-compacted in-situ tailings material (referred to as "day wall" as they are incrementally built up as tailings deposition progresses daily; this construction method sometimes referred to as 'self-raising'). David's review included (a) interpretation of the available geotechnical site investigation data comprising electric piezocone penetration test (CPTu) and excess pore pressure dissipation test (EPPD) data, (b) geotechnical slope stability assessment, and (c) Finite Element seepage assessment to predict the expected phreatic surface within the TSF body based on the EPPD test data. The geotechnical slope stability analysis was also undertaken considering undrained soil shear behaviour to evaluate the risk of static liquefaction.

Lost Dog/Black Cat In-Pit TSF (Australia)

The client is currently undertaking open pit mining operations in cells, and the mined-out cells are subsequently converted into in-pit TSF. A commission to advise the client on the appropriate geotechnical site investigation (GSI) works to evaluate the shear strength of in-situ pit walls separating the in-pit TSF from the operational cells, develop the GSI tender document, review the GSI contractor tender proposal, manage the successful GSI contractor, and provide 3rd party review of the in-situ pit wall geotechnical stability and design assessment undertaken by the client's engineering consultant, and undertake site inspection to evaluate the geotechnical stability of existing in-situ pit walls.

Bellevue Gold Project (Australia)

Commission to undertake geotechnical site investigation (GSI) to identify suitable borrow areas for sourcing low-permeability clay material to form the upstream lining for a proposed new TSF. As part of the GSI, David undertook a site walkover to study the surface geology, followed by directing a diamond drill rig to different prospective borrow areas to undertake PQ3 coring works and log / collect soil core samples for laboratory testing.

Nullagine Gold Project TSF2 Stage 2 (Australia)

3rd Party Reviewer for the Engineer on Record (EoR) Stage 2 downstream raise of TSF2and provides advice on how to grade an existing large waste rock stockpile into three (3) separate fill types comprising bulk rock fill used for constructing the downstream TSF shell, a fine-grained soil fill used to construct an upstream low-permeability liner, and a transitional fill material buffering the soil fill from the bulk rock fill. Development of the fill particle size distribution (PSD) specifications to mitigate the risk of internal erosion within each fill material (piping) and/or interface instability where finer particles from one fill percolate into another.

The 3rd Party Review also include checking the EoR's geotechnical design assessment to ensure it addresses DMIRS' concerns on static soil liquefaction. This work included reviewing the EoR's numerical seepage modelling to specify a minimum supernatant pond distance and ensure the TSF wall (including immediate tailings body) remain dry during active TSF operations, thus mitigating liquefaction risk.

GEMCO TSF1, TSF10, TSF11, and TSF15 (Australia)

Commission to undertake geotechnical characterisation assessment of the natural laterites on which numerous TSFs are founded on, including that of excavated laterite spoils that are traffic-compacted with haul trucks to form some of the TSF embankments, and attempt to identify the cause for differences in soil shear strength inferred from in-situ SPT/CPT tests and laboratory triaxial/box shear tests. This work identified the laterites to possess highly anisotropic shear strength, and is associated with the presences of layered iron/alumina oxide microfabric derived from the Tertiary sedimentation process to form the present-day laterites. Based on this understanding, a site-specific CPT cone factor was derived to interpret the laterite shear strength accounting for anisotropy, and successfully reconciled the shear strength interpretation between the different in-situ and laboratory test data across most of the GEMCO site.

Avonbank In-pit TSF (Australia)

This project was similar to that undertaken for the Beacon Mineral (see above). The results of this work was the development of a specific requirement for tailings dessication time to ensure the tailings' primary and time-dependent creep consolidation behaviour is mostly expended prior to in-pit TSF closure such that the remediated landform will undergo limited ground settlement.

Bogoso-Prestea TSF (Ghana)

Geotechnical due diligence of the existing TSF as part of the process to acquire the Bogoso-Prestea Gold Mine from Golden Star. The due diligence exercise was focussed primarily on identifying the potential presence of deleterious founding soils underlying the TSF embankment, undertake high level evaluation of the TSF geotechnical stability under as-is condition based on review of the EoR's design reports, and specification of additional geotechnical site investigation where data gaps have been identified.

Sabodala TSF1 (Senegal)

3rd party geotechnical review team commissioned by the client (working directly with the COO), including Dr. Gary Bentel and Chris Lane, as part of their acquisition of Teranga Gold by Endeavour Mining. The team successfully proved the Sabodala TSF1 possesses low to limited risk of geotechnical instability, and as such minimised the influence of the TSF geotechnical failure risk on the company acquisition price.

Gujeni Iron Ore Project (Nigeria)

Commission to undertake geotechnical design assessments for a proposed integrated waste landform (IWL) TSF. The undertaken assessments include geotechnical characterisation of the founding soils, evaluating the suitability of natural soils within the IWL TSF footprint as borrow fill material for constructing the dam embankment, site-specific seismicity characterisation, and geotechnical slope stability and seepage modelling to specify the design dam embankment geometry.

Mt. Rawdon TSF (Australia)

Commissioned by Evolution Mining to undertake the same review exercise for the Mt. Rawdon TSF (see below). Use of past offshore foundation design experience with unconsolidated transitional marine sediments to develop a modified CPT-based soil behaviour type index relationship to distinguish tailings behaving "sand-like" or "clay-like" based on the incorporation of an extensive CPTu excess pore pressure dissipation test dataset.

Castle Hill TSF (Australia)

Commissioned by Evolution Mining to develop the geotechnical site investigation scope of works, including preparation of tender documents, for an area selection feasibility study to locate a new TSF.

Lake Cowal NTSF and STSF Stage 6 (Australia)

Commissioned by Evolution Mining to undertake a 3rd party review of the geotechnical stability assessment undertaken by their Engineering on Record (EOR) for the as-built Stage 6 upstream tailings dam, which was impounding a total tailings height of approximately 26 m, and the total dam footprint perimeter is approximately 9 km. The SoW was subsequently expanded from just review to full independent design and stability assessment work, and focused on the risk of static liquefaction as a consequence of (a) strain-softening due to over-stressing of tailings, (b) development of tailing excess pore pressures due to fast external loading, and (c) seismic ground shaking. The tailings was evaluated to comprise SILTS of low plasticity, and geotechnically behaves as a transitional material instead of distinctly “sand-like” or ”clay-like”.

The design and stability assessment work comprised (a) geotechnical characterisation of tailings physical characteristics, Critical State behaviour, rate of strength gain (peak, residual, and cyclic), compressibility, and hydraulic conductivity utilising 9 years’ worth of CPT, shear vane, shear wave velocity, and dilatometer test data, (b) site seismic response assessment considering soil amplification / attenuation effects and topographic amplification effects, (c) groundwater seepage assessment considering operational and closure phase including effect of complete decant dewatering, (d) two-dimensional seismic soil liquefaction risk assessment based on transitional soil behaviour utilising CPT data, shear wave velocity data, and actual laboratory cyclic direct simple shear test data, (e) 2D Finite Element load deformation analysis to estimate the mobilised tailings shear strain including identification of critical soil failure mechanisms utilising the Shear Strength Reduction (SSR) method, and (f) geotechnical slope stability assessment considering both Limit Equilibrium and 2D Finite Element methods.

Norton Goldfields Paddington TSF cutback (Australia)

Commissioned by Norton’s geotechnical engineering consultants to review the CPT data for probing undertaken within the existing TSF tailings material and interpret its geotechnical shear strength parameters for input into the cutback slope geotechnical design assessment.

Geotechnical stability audit for various Vale dams (Brazil)

As part of a Perth-based team that undertook geotechnical stability audit for the B3, Dicao, and Capitao Do Mato dams, acting as a principal reviewer looking into independent interpretation of geotechnical design shear strength parameters from historical geotechnical site investigation data, seismic liquefaction risk assessment considering soil amplification effects, and slope stability assessment.

Wafi-Golpu TSF Concept Design (Papua New Guinea)

Provision of a concept geotechnical design assessment for the proposed construction of a ~1km long tailings dam to be built on ~100m thick Alluvial soils that is susceptible to seismic liquefaction. The design work involved interpretation various site investigation in-situ test data to derive alluvial soil geotechnical shear strength parameters considering long-term strain-softening degradation, undertake 1D and 2D seismic liquefaction risk deterministic FoS mapping for the horizontal and vertical distribution of alluvial soils present within the proposed dam footprint, and design of jet-grouting and stone column ground improvement as part of a “floating stiff crust” conceptual approach to ensure geotechnical stability of the dam in view of liquefied soils beneath the ground improvement zone.

DAM (WATER) PROJECTS

Geko Gold Project – Water evaporation pond (Australia)

Commission to evaluate the geotechnical stability of an existing water evaporation pond (formed with turkey nest earth dam embankments) to comply with DMIRS requirements.

As part of this assessment, a geotechnical site investigation programme was developed to be executed by SMS' site-based geotechnical engineer (comprising CPT and walkover inspection) to characterise the as-built embankment geotechnical properties, followed by two-dimensional Limit Equilibrium (2D LE) geotechnical slope stability and Finite Element (2D FE) seepage numerical analyses to evaluate its as-is stability and expected daily seepage loss. As part of the geotechnical slope stability assessment, David has also formulated a remediation plan to mitigate the surface expression / ponding of seepage flows via backfilling earthworks and excavation of drainage channels.

Ophthalmia Dam (Australia)

Commission to develop the trigger action response plan (TARP), as part of the proposed automated Ophthalmia Dam Early Warning System to facilitate evacuation under the different dam break and inundation scenarios, including specification of required geotechnical instrumentation to quantify the risk of different dam break modes (soil piping through dam body and foundation soils, earthquake-induced embankment failure, overtopping-induced embankment failure).

Hayes Creek Water Storage Dam (Australia)

Commission to provide geotechnical design assessment to expand the size of the existing water storage dam storage capacity by up to double its original capacity. The proposed new dam expansion footprint was required to intersect surficial swamp deposit soils due to tenement lease boundary limitations. The assessment included recommendation for ground improvement involving excavation removal and replacement of the swamp deposits, whereas geotechnical design work was undertaken to consider the use of existing waste rock stockpile material for the bulk of the dam body, followed by a thin layer of lateritic soil cover on the upstream face to form an impermeable liner. The proposed construction methodology ensured ease of dam construction where its toe is anticipated to be underwater below the original swamp surface, constructability under wet weather condition without having to consider optimum fill compaction moisture content by utilising the rock fill, and included construction cost optimisation via mitigating the need for proper fill compaction including avoiding the use of geosynthetic liners.

Kununurra Diversion Dam Upgrade (Australia)

Provision of a detailed seismic slope stability and liquefaction risk assessment for an existing dam build over Alluvium in some parts, including recommendation of ground improvement to ensure geotechnical stability of the dam under a 9,975 year ARI seismic event. The recommended ground improvement included a rock-fill cut-off trench and soil surcharging, where bedrock is present at shallow depth, to mitigate the risk of lateral flow spread via increase in effective soil confinement stress. Where the bedrock is deep, the cut-off trench was substituted with a grid of stone columns (area replacement ratio of 22.5%) keyed into residual soils; the stone columns were designed to act as both soil stiffener and "wick drain" for excess pore pressure dissipation to mitigate the risk of liquefaction in the Alluvium. Lead for the discussion with Water Corporation's 3rd party reviewer, Graeme Bell, who is the co-author for the Geotechnical Engineering of Dams book, and subsequently received his approval. Graeme Bell was also kind enough to be David's Engineers Australia chartership industry reviewer, and made the following comments:

"*I have rated David as "proficient" in the task of assessing a dam embankment for the potential of liquefaction under severe earthquake loading and for the assessment of the post-earthquake stability of that embankment. I was the third-party reviewer for the recent design of the upgrade to the abutment embankments of the Kununurra Diversion Dam, for*

which David's firm was the design engineer. I worked closely with David and his fellow team members over more than a year on this job.

I found David to be a forthright engineer with an outstanding knowledge in soil mechanics. What I liked very much was his ability to listen to the various discussions on contentious points that we all had and to agree with changes in what he was doing or to prepare well-reasoned arguments clearly and concisely for his analyses to stand as they were. At all times, he handled himself implacably.

The way David acted during all my meetings and my telephone discussions with him, I can well understand David would have developed and explained this template to his work mates effectively. David has that quiet and patient demeanour to be a leader and a mentor to his younger colleagues."

MINING PROJECTS

Kido Central Cement and Lime Project (Papua New Guinea)

Prime geotechnical engineering consultant supporting the project owner for the process plant and wharf development, including geotechnical site investigation scoping and providing remote supervision of an in-country geotechnical drilling team executing the onshore and overwater fieldwork programme.

Dampier Salt Limited (Australia)

Appointed by Dampier Salt Limited to act as a Qualified Individual (QI) in 2022, in accordance with the Rio Tinto D3 Group Standard – Management of slope geotechnical hazards, for their entire solar salt operation. As the QI, David is responsible for all engineered slope designs and natural slope geotechnical hazard management. David is also responsible for reviewing and approving the slope management plan (SMP), dump management plan (DMP), and geotechnical hazard management plan as well as ensuring the plans are properly implemented by the on-site operations management teams.

The work involved regular site inspections including interviewing on-site operations and process superintendents to ensure they are well versed with the above plans. Based on these inspections, an in-depth understanding of the entire salt production operation was developed to identify and undertake risk assessment for geohazards associated with each production step (inspected structures include crystallizer ponds, lime dosing plant, flood levee, wet salt stockpile, wet salt haul road/dump bridge, salt washing plant, dry salt stockpile, dry salt haul road/dump bridge, delivery conveyor and rill bin at shipping terminal).

Dr. Yong is also responsible to evaluating the geotechnical stability of natural slopes/cliffs present at each salt operation site, including the maintaining of a site HSE risk register.

Manono Project (Democratic Republic of Congo)

Commissioned by AVZ Minerals to provide geotechnical shallow foundation engineering design support for a proposed processing plant to be built as part of the Manono Lithium-Tin Project.

Development of the geotechnical site investigation programme for a 3rd party fieldwork contractor to execute (comprising test pits with DCP testing, and borehole drilling with SPT testing), followed by site investigation data interpretation to derive the foundation soil shear strength and deformability properties for footing design.

Geotechnical engineering design assessment for the proposed plant shallow footings/raft slabs comprising development of allowable footing ground bearing pressure curves considering different settlement limits, settlement behaviour of a raft-supported above-ground conveyor tunnel due an overlying crushed ore reclaim stockpile (including influence of stockpile slope stability on the raft slab), development of a stockpile placement strategy to maintain geotechnical

stability of the tunnel structure foundation soils, specification of geotechnical parameters for flexible pavement design, and fill earthworks recommendations.

Avonbank Mineral Sands Project (Australia)

Commissioned by WIM resources to provide geotechnical shallow foundation engineering design support for a proposed processing plant to be built as part of the Avonbank Heavy Mineral Sands Project.

The geotechnical site investigation programme was developed for a 3rd party fieldwork contractor to execute (comprising CPT, Marchetti Dilatometer, and laboratory soil tests such as the oedometer consolidation test and shrink-swell index test), followed by site investigation data interpretation to derive the foundation soil shear strength and deformability properties for footing design.

Execution of the geotechnical engineering design assessment for the proposed plant shallow footings / raft slabs including site classification, quantification of footing movement due to soil reactivity caused by seasonal moisture content changes, provision of ground improvement recommendation comprising structural fill placement to buffer the footing from reactive soils to minimise seasonal ground movement, site drainage specifications to minimise seasonal moisture content change of foundation soils, development of allowable footing ground bearing pressure curves considering different settlement limits, and fill earthworks recommendations.

Binduli water pipeline (Australia)

As part of the Binduli Gold Project being operated by Norton Goldfields, a water pipeline has been proposed to cross under Great Eastern Highway, the Eastern Goldfields Railway, a haul road running parallel to and in between the highway and railway, and an overhead power line running parallel and north of the railway.

Development of the geotechnical site investigation programme, comprising test-pitting, hand-held Dynamic Cone Penetrometer (DCP) tests, and a suite of laboratory soil tests, to evaluate the sub-soil geotechnical characteristics including undertaking qualitative geohazard risk assessment associated with the proposed pipeline installation underlying the above public infrastructure. The geohazard risk assessment considered both the micro-tunneling and horizontal direction drilling method of pipeline installation. Based on the risk assessment findings, recommendations on drilling strategies to mitigate the risks have also been provided (i.e. specifying limiting drilling mud pressure to mitigate hydrofracture risk).

Argyle Diamond Mine Closure Project (Australia)

Commissioned by Rio Tinto to develop an earthwork specification for the proposed backfilling of the existing ventilation shafts, evaluate the feasibility of borrowing top soil in close proximity to the edge of the open mine pit where a large pit wall failure occurred (involving back-analysis of the failed pit wall geometry to estimate the anisotropic rock shear strength, followed by additional analysis to estimate a standoff distance from the crest edge for which earthwork machineries shall not encroach to ensure safe operations), and also geotechnical slope stability assessment to evaluate the feasibility of borrowing topsoils along the toe of the existing waste rock dump stockpiles.

GEMCO J-Quarry and Eastern Leases Haul Road Project (Australia)

Commissioned by GEMCO's geotechnical engineering consultants to undertake geotechnical design assessment to evaluate the feasibility of adopting either a driven tubular steel pile or concrete bored pile solution to support two (2) bridge crossings over Emerald River. The assessment included geotechnical pile axial compression capacity assessment, provision of t-z, q-z, and p-y curves to facilitate the structural engineers' pile-soil interaction analyses, pile driveability assessment including specification of appropriate hydraulic hammers, and geotechnical track ground-bearing pressure assessment for 300t cranes proposed to be utilised during the pile-driving exercise including specification of track bearing pads where necessary.

Shoemaker Levy Overland Conveyor (Australia)

Provision of the pre-site investigation geotechnical design assessment for shallow footings proposed to provide ground-bearing support for the conveyor trestles, part of it which crosses over a few creeks prone to seasonal flooding including intersecting the toe of an existing waste rock dump stockpile. The typical geological sub-soil stratigraphy comprised surficial Alluvium overlying lateritic duricrust. Due to the stringent geotechnical requirement of a minimum 250 kPa design bearing capacity limited to 20 mm long-term settlement (including time-dependent creep), David proposed a ground improvement scheme of excavation removal of the Alluvium with minimum excavation depth defined by a Dynamic Cone Penetrometer (DCP) criteria, followed by filling with compacted waste rockfill to form a competent subgrade for the foundation. David also undertook geotechnical slope stability assessment to provide recommendations for stable steepening of the existing waste rock dump toe to clear the path for the conveyor alignment, including reshaping of the crest portion of the stockpile as part of a rockfall mitigation strategy.

Roy Hill Iron Ore Project - Port Landside Design Works (Australia)

Undertook geotechnical foundation option study for a 29 m high ore screen building, which is susceptible to significant lateral and uplift loads under cyclonic wind condition due to its large surface area. A piled raft foundation was adopted, whereby theoretical and finite-element analyses were performed to assess the viability of various piling options including Franki (bulbous base) pile, bored CFA piles and driven tubular steel piles. PLAXIS3D finite-element analysis was performed to simulate how wind loads acting on the building will be transmitted to the piles (bending moment, shear force, axial tensile/compression forces). Theoretical and PLAXIS2D axisymmetric finite element analyses were then performed to estimate the geotechnical capacity and required geometry for each piling options to satisfy the predicted pile loads from the PLAXIS3D analysis.

Slope stability assessment of client-provided reclaimer/stacker slope design was performed using PLAXIS2D. A cement-stabilised pad was proposed to be seated underneath the rail-sleeper formation for the stacker slope embankment, to transmit the stacker wheel loads deeper into the ground and impact less on the slope, thus increasing the global slope Factor of Safety against sliding failure.

Area CD-West, Transnet Richards Bay Port (South Africa)

Geotechnical numerical analysis to provide staged loading recommendation of chrome/magnetite stockpile build-up proposed over a 5 m thick soft and highly-compressible clay layer. PLAXIS 2D finite-element analysis was performed to predict change in geotechnical Factor of Safety (FoS) against the critical bearing/slope stability failure mechanism as the stockpile is gradually built up in 2 m intervals, and the required time for the clay layer to fully-consolidate under each stockpile lift to improve the FoS before the next lift can be performed.

EDUCATION

PhD (Engineering), University of Western Australia, 2010

Bachelor of Civil Engineering (Hons), University of Western Australia, 2006

Diploma in Civil Engineering (Hons), INTI College, 2004

REGISTRATIONS/AFFILIATIONS

Chartered Professional (Geotechnical), Australasian Institute of Mining and Metallurgy (MAusIMM CP 3053666), 2022

Chartered Professional Engineer (Geotechnical) (IEAust CPEng) Institute of Engineers Australia, 2022

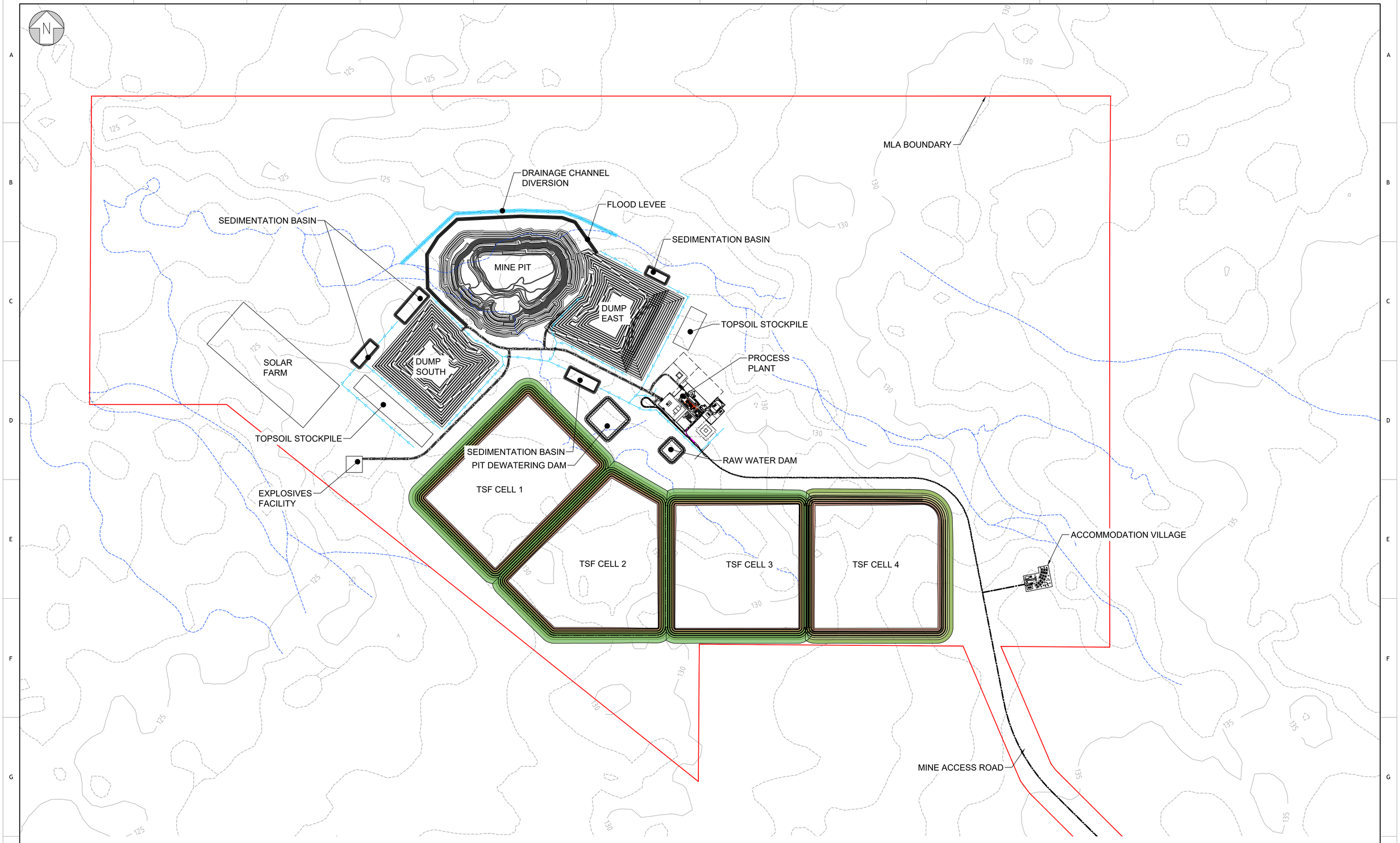
Registered Professional Engineer Queensland (RPEQ 28326) Geotechnical (Mining), 2022

Appendix 2

Design Drawings, Scope of Works and Construction Specifications for Earthwork, HDPE Liner, Geotextile and Flownet Specifications

Graphinex Pty Ltd
Esmeralda Graphite Project

Final Rev 0 (issued for use)



300 30 300 600 900 1200 1500m

SCALE 1:15,000

LOCALITY PLAN

1:15,000

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
B	10.02.2026	REISSUED FOR STUDY	AE	PG	PG	LB
A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

IN THE ABSENCE OF THE APPROVED SIGNATURE, THIS DRAWING SHALL BE TREATED AS PRELIMINARY

	DATE
DRAWN S. ROWE	10.03.2025
DESIGNED J.FEETHAM	10.03.2025
CHECKED P. GLOWERY	10.03.2025
ENGINEER P. GLOWERY	10.03.2025
APPROVED L. BLACK	10.03.2025

DRAWING NUMBER | DESCRIPTION

DRAWING REFERENCE

GRAPHINEX

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CLIENT: GRAPHINEX

PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

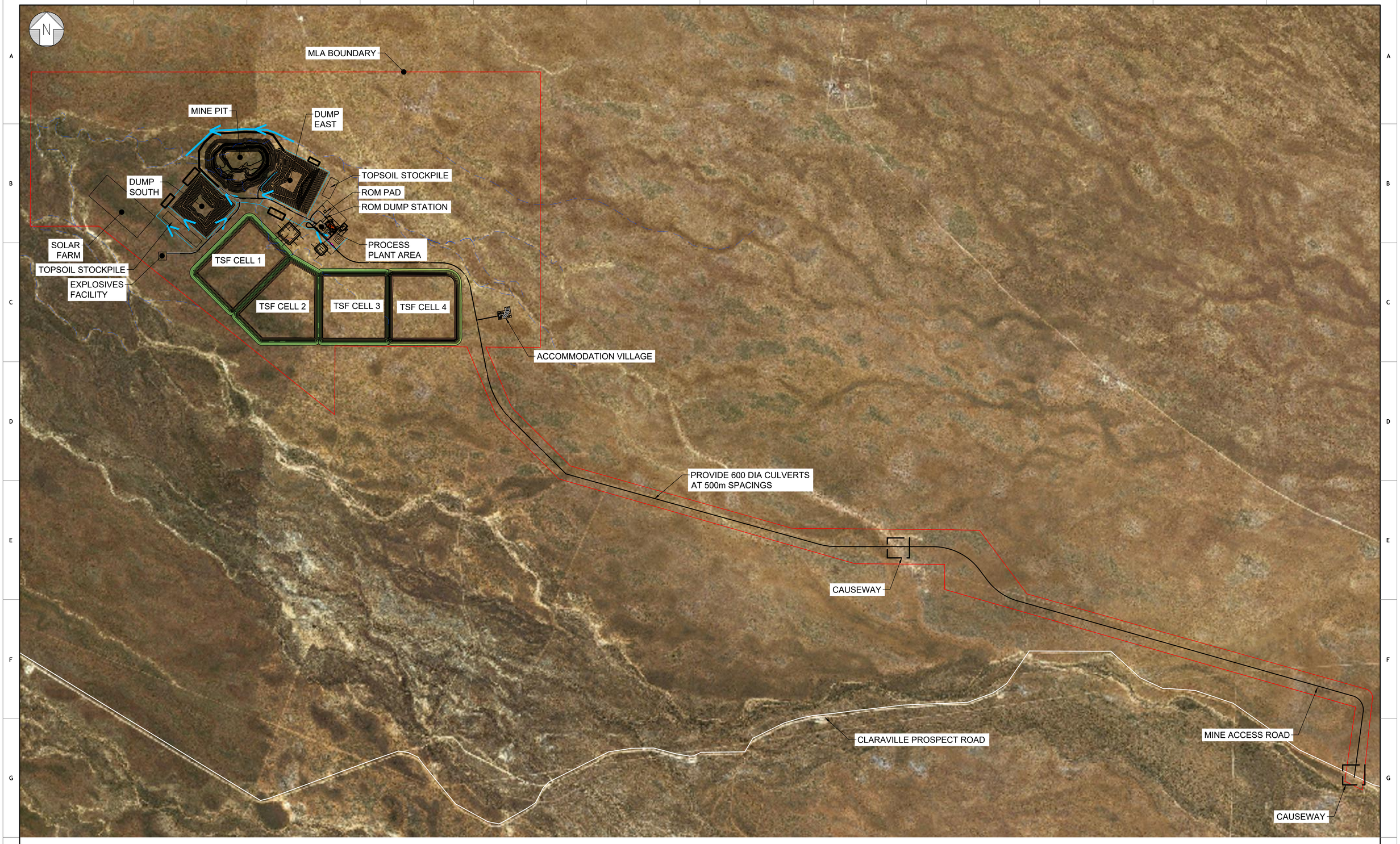
TITLE: MINE SITE GENERAL ARRANGEMENT PLAN

DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00020 REV: B



600 0 600 1200 1800 2400 3000m

SCALE 1:30,000

LOCALITY PLAN

1:30,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
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ENGINEER	P. GLOWERY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

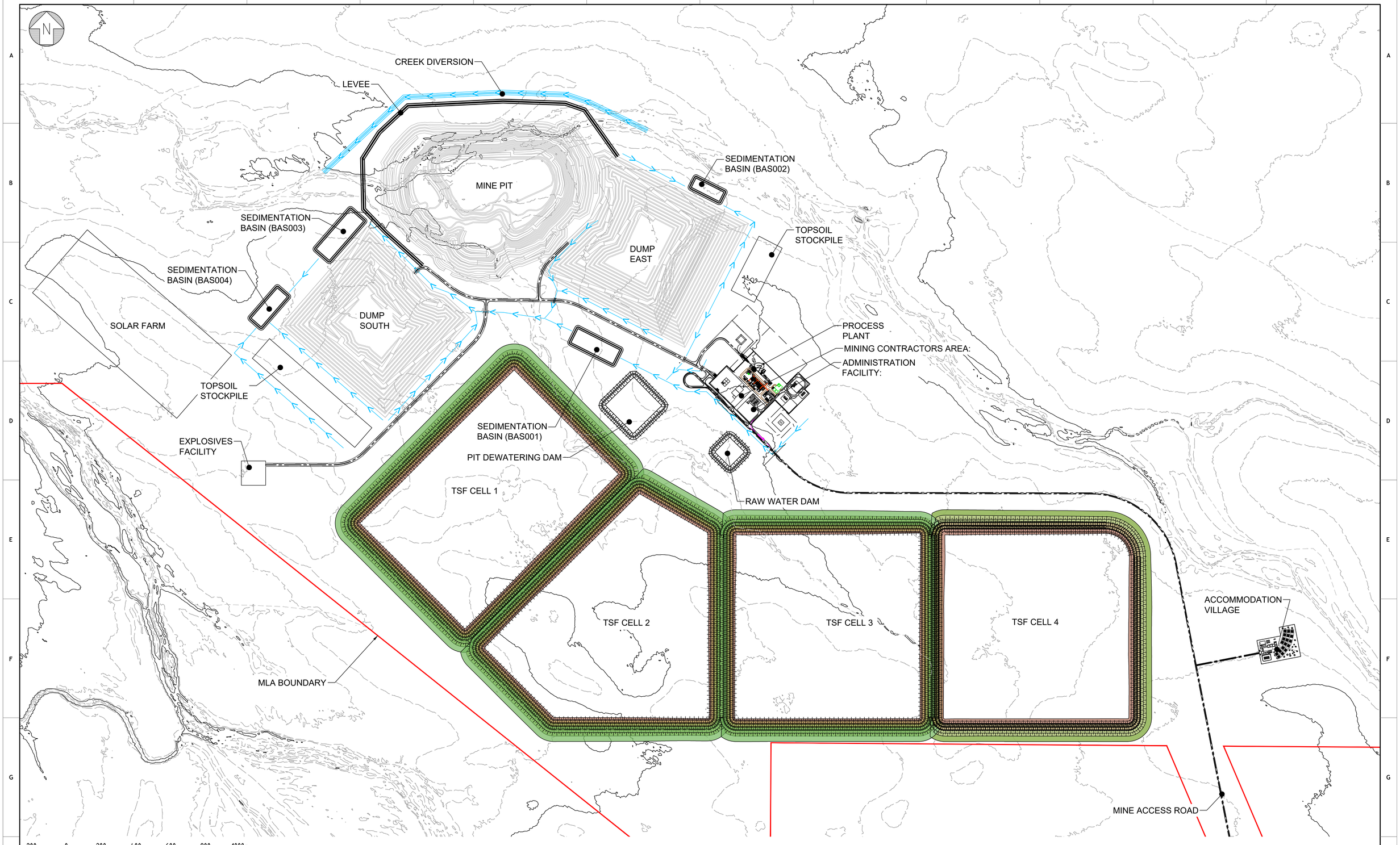
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00030 REV: B



PLAN
1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

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B	10.02.2026	REISSUED FOR STUDY	AE	PG	PG	LB
A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

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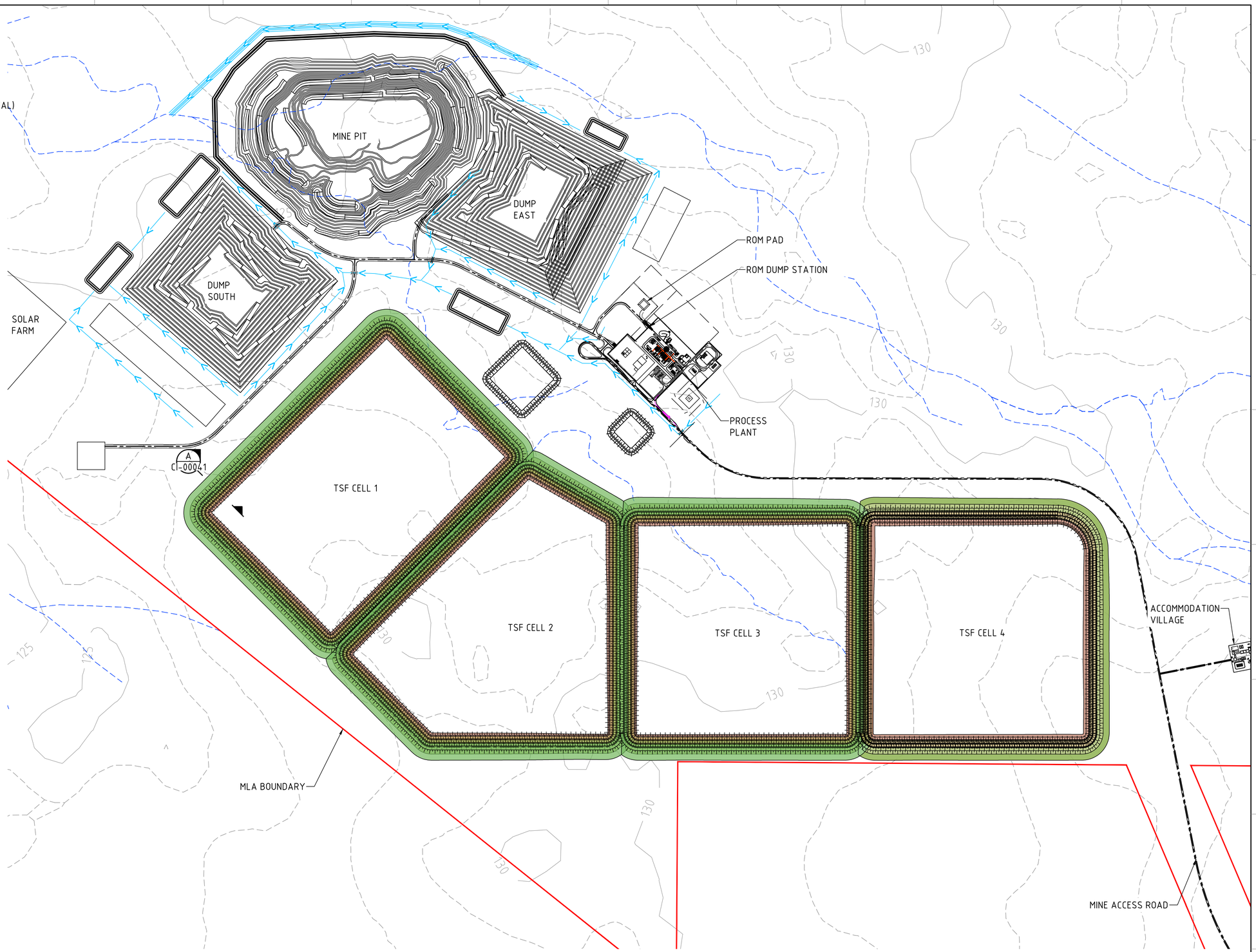
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SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00031
REV: B

LEGEND

- 385 — EXISTING SURFACE CONTOUR (1m INTERVAL)
- GRADE LINE
- PROPOSED TOP OF BATTER (LEFT)
- STAGED EMBANKMENT - LIFT 01
- STAGED EMBANKMENT - LIFT 02
- STAGED EMBANKMENT - LIFT 03
- STAGED EMBANKMENT - LIFT 04



200 0 200 400 600 800 1000m

SCALE 1:10,000

LOCALITY PLAN

1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

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APPROVED	L. BLACK	DATE 10.03.2025

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TITLE: TAILINGS STORAGE FACILITY PLAN

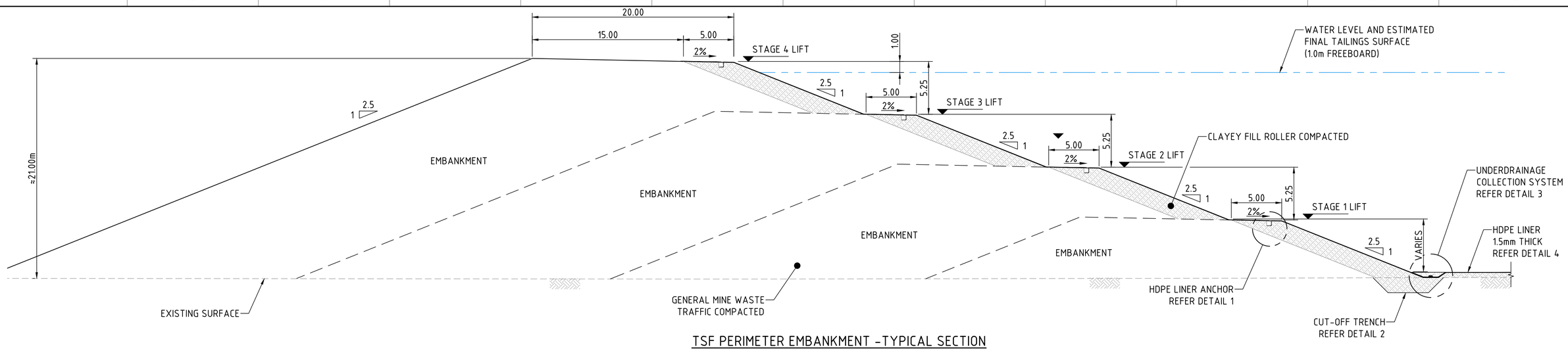
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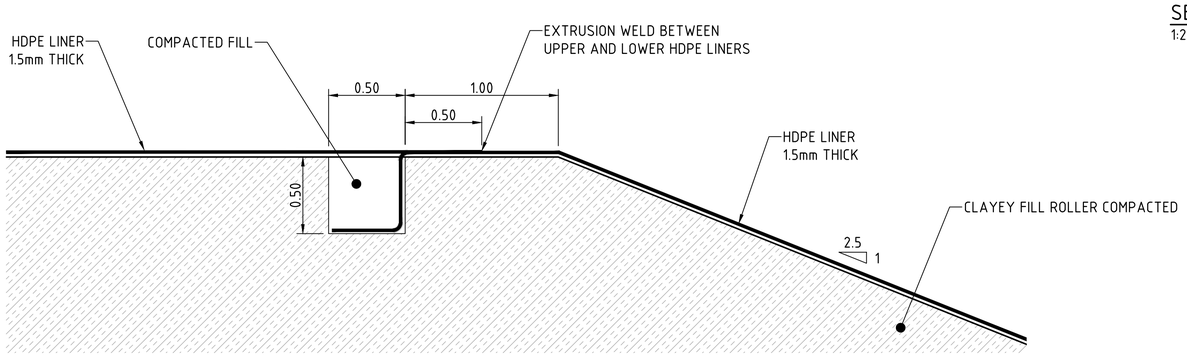
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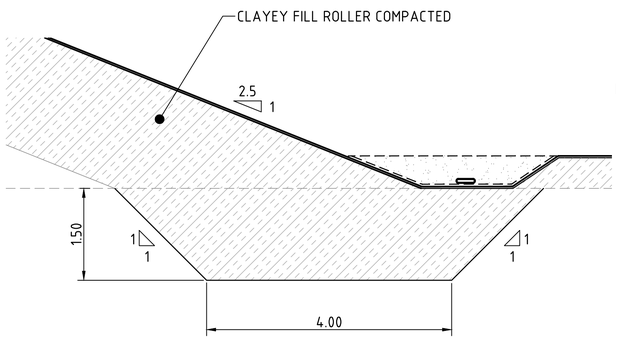


TSF PERIMETER EMBANKMENT -TYPICAL SECTION

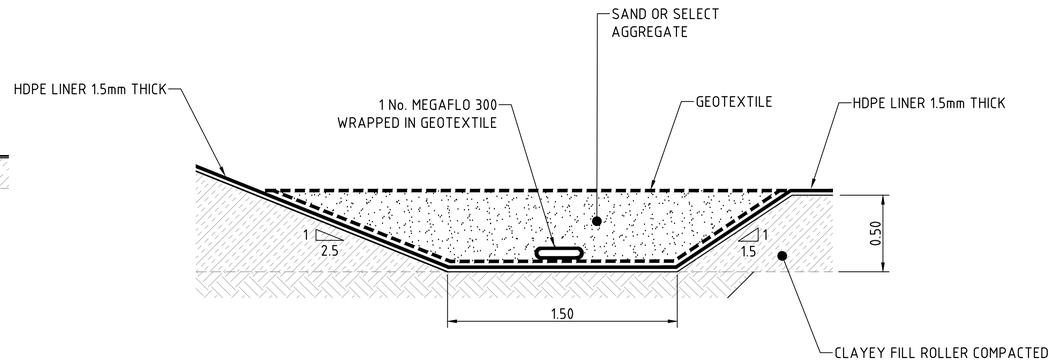
SECTION A CI-00040
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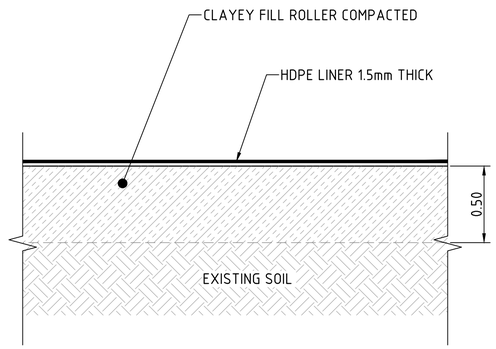
DETAIL 1 – HDPE ANCHOR -TYPICAL DETAIL
1:20



DETAIL 2 – CUT-OFF TRENCH -TYPICAL DETAIL
1:50



DETAIL 3 – UNDERDRAINAGE COLLECTION SYSTEM-TYPICAL DETAIL
1:20



DETAIL 4
1:20

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

4 0 4 8 12 16 20m
SCALE 1:200

1.0 0 1.0 2.0 3.0 4.0 5.0m
SCALE 1:50

0.4 0 0.4 0.8 1.2 1.6 2.0m
SCALE 1:20

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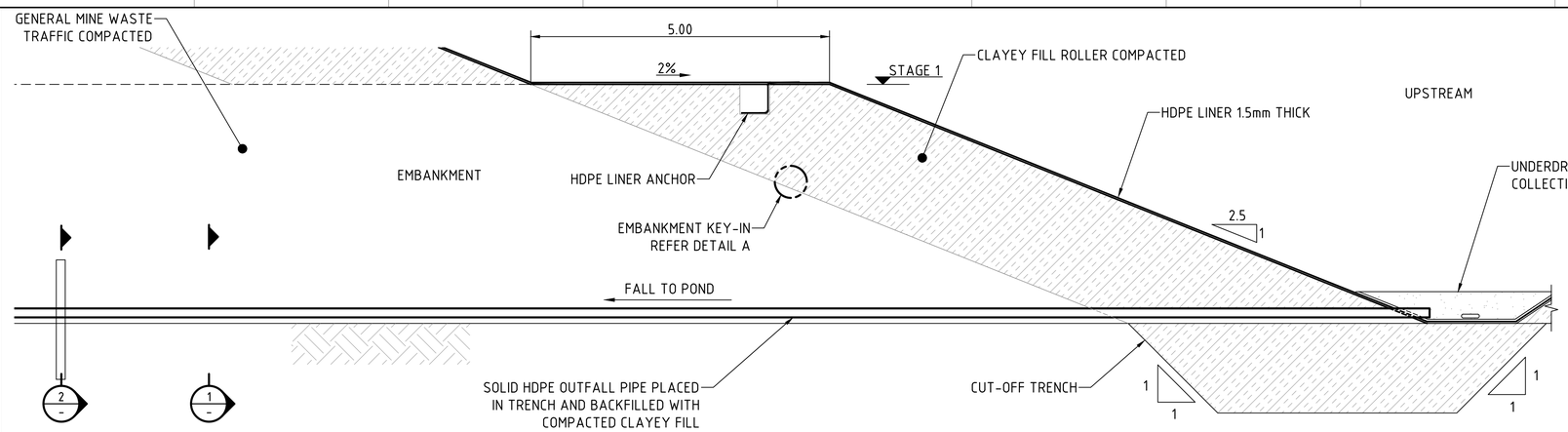
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PROJECT: ESMERALDA GRAPHITE PROJECT
TITLE: TAILINGS STORAGE FACILITY TYPICAL SECTIONS AND DETAILS SHEET 1 OF 2

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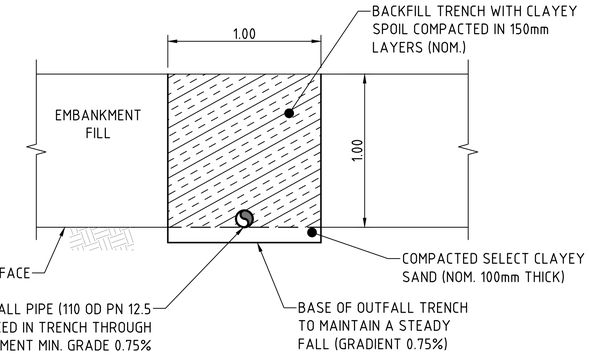
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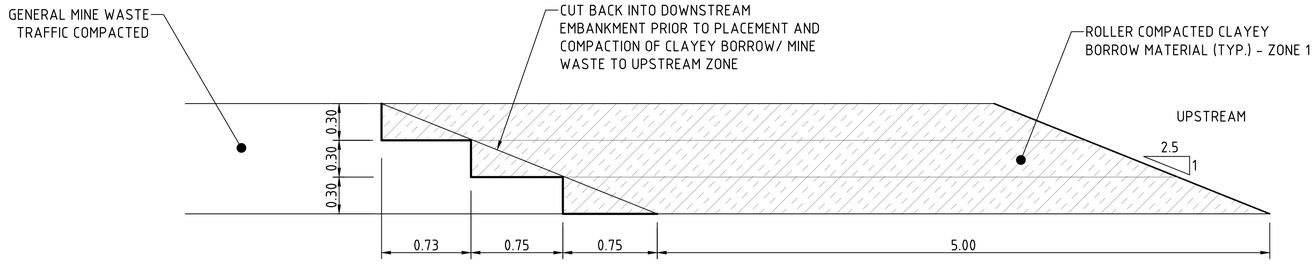
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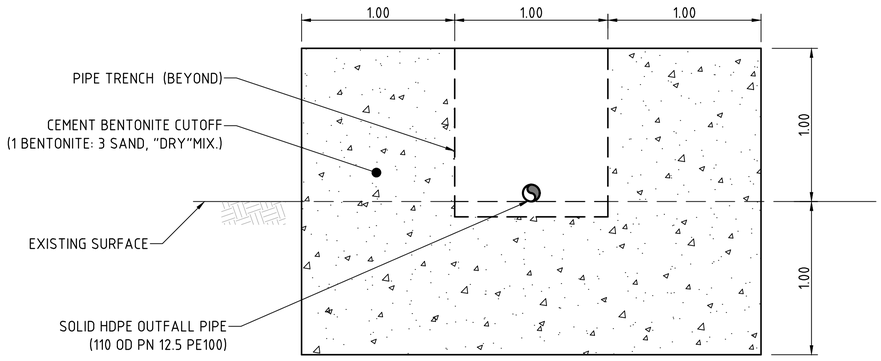
UNDERDRAINAGE OUTFALL PIPE THROUGH EMBANKMENT -TYPICAL SECTION
1:50



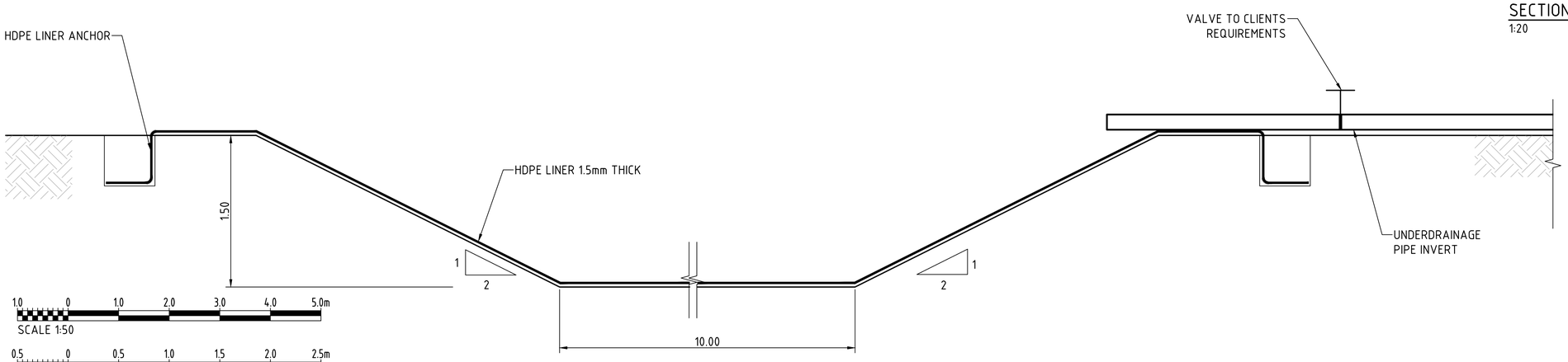
SECTION 1 / - OUTFALL PIPE TRENCH (THROUGH EMBANKMENT) -TYPICAL SECTION
1:20



DETAIL A / - EMBANKMENT KEY-IN -TYPICAL DETAIL
1:25



SECTION 2 / - CEMENT BENTONITE CUTOFF -TYPICAL SECTION
1:20



UNDERDRAINAGE SUMP -TYPICAL SECTION
1:25

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

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5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

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PROJECT: ESMERALDA GRAPHITE PROJECT
TITLE: TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS
SHEET 2 OF 2

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SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00042
REV: A

	Soil & Rock Engineering Pty Ltd (SRE)
	ABN 98 675 219 020

GRAPHINEX

Esmeralda Graphite Project

Tailings Storage Facilities

Scope of Works

Ref: **Scope of Works Rev B 202601**

Date: **15 February, 2026**

Prepared by: **SREPL**
243B Pearson Street
Woodlands WA 6018

Prepared for: **Graphinex Pty Ltd**
Level 4, 10 Eagle Street
Brisbane QLD 4000

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Document Control

Date	Revision	Purpose	Author
24/01/2026	A	Internal Review	C Lane
15/02/2026	B	Issued for Client Review	C Lane

Abbreviations and Terminology

The following abbreviations have been used in this document

ANCOLD	Australian National Committee on large Dams
AS	Australian Standard
EGP	Esmeralda Graphite Project
ha	hectare
H:V	Horizontal : Vertical
EGP	Hualian Project
GPL	Graphinex Pty Ltd
GTSF	Graphinex Tailings Storage Facilities
MB	Monitoring Bore
m^3/d	cubic metres per day
Mm^3	Million cubic metres
ML	Mine Lease
NATA	National Association of Testing Authorities
OMC	Optimum Moisture Content
PSD	Particle Size Distribution
P_{80}	80% passing, and refers to a particular particle size as stated, i.e. a P_{80} of 75 microns means 80% of the total weight of materials is finer than 75 microns
QA/QC	Quality Assurance and Quality Control
RL	Reduced Level relative to a fixed datum
SMDD	Standard Maximum Dry Density
SoW	Scope of Works
SP	Standpipe Piezometers
SREPL	Soil & Rock Engineering Pty Ltd
TSF	Tailings Storage Facility
t/m^3	tonnes per cubic metre
TDS	total dissolved solids
UCS	Unified Soil Classification System

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Appendix C - Earthworks Specification

Appendix D - HDPE Specification

Appendix E – Geotextile, Flownet and Megaflo Specification

Soil & Rock Engineering Pty Ltd (SRE)

Project: Esmeralda Graphite Project

Subject: Tailings Storage Facilities – Scope of Works

1.0 GENERAL

1.1 Introduction

This Scope of Work (SoW) covers the construction of the tailings storage embankments, decant access and decant and associated infrastructure, for the Tailings Storage Facilities at the Esmeralda Graphite Project (EGP) is to be read in conjunction with the drawings.

The work mainly involves bulk earthworks to construct/raise the starter embankments for each TSF.

The placement of tailings delivery pipework and return water pipework is not part of this Scope of Works.

The Scope of Work must comprise the provision of all material, construction plant, equipment, labour, supervision, tools, services, warehousing if required, testing equipment, and each and every item of expense necessary for the construction, acceptance testing and preparing of *'as built'* drawings and documents for work shown in the drawings schedules and Specifications forming part of the Contract for the Construction of the tailings storage embankments for the Tailings Storage Facilities at the Esmeralda Graphite Project.

All works must be constructed complete and operational, except as specifically excluded and must include all necessary auxiliary works, accessories and the incorporation of all misGPLlaneous material, minor parts and other such items, whether or not the items are specified, where it is clearly the intent of the Contract that they should be supplied or where they are obviously required and necessary to complete and commission the work.

Tailings will not be discharged into the storage during construction of Stage 1 of each TSF GPLl. Tailings deposition into the other TSF GPLls may be occurring during the construction of Stage 1 of the adjacent TSF GPLls as the EGP will be an operational mine at the time of construction of TSF GPLls 2, 3 and 4.

As such, it may be necessary to discharge tailings into TSF which may be under construction and the Principal's reserves the right to continue deposition during the construction period of the contract. Pipework is controlled and operated by the Principal's. The contractor should fully co-operate with the pipe handling/operating crew and must work in with their activities at all times. The contractor must protect all active and non-active pipework which is in place. The Principal's must be immediately notified of any damage to pipework no matter how minor. This Specification prescribes the requirements for the embankment construction works to achieve the site-finished grades indicated on the Design Drawings for TSF at the EGP. Also prescribed, are the requirements for clearing and grubbing; the removal, replacement and disposal of unsuitable materials; the disposal of surplus materials and the furnishing, placement and compaction of embankment fill material.

The Appendices referred to in this document comprise the following and are to be attached to this document by the Owner.

- Appendix A - Drawings
- Appendix B - Schedule of Materials
- Appendix C – Earthworks Specification
- Appendix D – HDPE Liner Specification
- Appendix E – Geotextile and Flownet Specification

The Contractor must coordinate work prescribed by this Specification with other related works to be performed, such as relocation of tailings pipework for future operations. This Specification must be read in conjunction with the latest revisions of the following Design Drawings, listed in Table 1.1.

Table 1.1 – Drawings

Drawing No.	Title
6235-40-DWG-00020 Rev B	Mine Site General Arrangement Plan
6235-40-DWG-00030 Rev B	Site Wide Drainage Plan
6235-40-DWG-00031 Rev B	Mine Site Drainage Plan
6235-40-DWG-00040 Rev A	Tailings Storage Facility Plan
6235-40-DWG-00041 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
6235-40-DWG-00042 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

1.2 Terminology

The following terms are defined as stated, unless otherwise indicated:

Contractor	Appropriate individual, partnership, company or corporation contractually obligated to perform the work prescribed in this Specification and associated Specifications (Appendix C) and becomes contractually obligated to the Owner.
Design Drawings	Detailed Design Drawings issued by the Owner to the Contractor.
Engineer	The engineer (or designated representative) appointed by the Owner who is responsible for evaluating the suitability of the materials involved in the work and for verifying the compliance of the work to the requirements of the Specifications.
Independent Testing and Inspection Firm	The company, partnership, or corporation retained to perform the inspections and tests required determining and verifying compliance of the work with the requirements of this Specification.
Optimum Moisture Content	The moisture content at which the Maximum Modified Dry Density is achieved.
Owner	Graphinex Pty Ltd (GPL)
Project Superintendent	The designated representative of the Contractor appointed by the Contractor who is responsible for the work by the Contractor.
Standard Maximum Dry Density	The maximum dry density achieved as per AS 1289.5.1.1 when testing a sample of material representative of that to be compacted in the field.
Work/works	The activities specified within this document as the responsibility for the Contractor.

1.3 Codes of Practice

Unless otherwise specified, or shown on the drawings, the Contractor is to provide all materials and carry out all the work in accordance with the latest revisions of the relevant Australian Standard Codes or alternative International Codes and Standards as direct by GPL.

The applicable Australian Standards for earthworks are as follows:

i) AS 1289 Methods of testing soils for engineering purposes.

ii) AS 1726 Geotechnical site investigations.

iii) AS 3798 Guidelines on earthworks for commercial and residential developments.

The Works must be carried out to comply with the latest revision of the Drawings, Codes and Standards specified, or where no standards are specified, to Australian Standards, or to the appropriate British or other recognised International Standards.

Before making any change in any work under the Contract to comply with any revisions to the relevant codes and standards, the Contractor must give to the Principal's written notice specifying the reason therefore and requesting his direction thereon. The Principal's must decide whether a change is necessary and issue an order accordingly under the provisions of the General Conditions of Contract.

1.4 Specifications

The publications listed above form part of this Specification. Each publication must be the latest revision and addendum in effect on the date this Specification is issued for construction, unless noted otherwise. Except as modified by the requirements specified herein or the details of the Design Drawings, work included in this Specification must conform to the applicable provisions of these publications.

1.4.1 Applicable Documents

The works must be carried out to comply with the latest revision of the Earthworks Specification, Design Drawings, Codes and Standards specified.

1.5 Site Inspection

The Contractor must inspect the site and must allow for the following factors in their price:

i) The nature and requirements of the work to be done.

ii) All conditions on and adjacent to the site.

iii) Access to the site.

iv) The types of soil and vegetation present on the site.

v) The expected or known water table.

vi) The nearest sources of suitable fill material which complies with this Specification.

vii) The source of water for construction purposes.

1.6 Safety

The Contractor must:

i) Carry out the works in a safe manner.

ii) Conform to all relevant Acts or Statutes of Parliament, Regulations, By-Laws or Orders relating to the safety of persons and property on or about the site.

1.7 Site Location and Description

The EGP is owned by GPL and is located approximately 70 km south of Croydon in Queensland. The TSFs, which are located between 1.2 km (TSF Cell 1) and 4.5 km (TSF Cell 4) to the southeast of the Mine Pit. These TSFs are within 1.5 km to 2.0 km of the processing plant, which is to the north of the TSF Cells.

2.0 DESCRIPTION OF WORK – SPECIFIC

The Scope of Work must include but is not necessarily limited to the following.

2.1 General

The Contractor must:

i) Attend a Site Induction of approximately four (4) hours' duration before the commencement of works if they have not already attended one in the last six (6) months.

ii) Carry out all works indicated or implied in the Drawings or in the Specification.

iii) Supply all labour, plant and materials (except those indicated as being supplied by the Principal) necessary for completion of the works.

iv) Maintain all works as required by the Contract documents and for the period stated therein.

All construction must be to the minimum lines and grades shown on the drawings or as required by the Owner's Representative as work progresses.'

During the progress of the works, the Owner's Representative may find it necessary to revise the lines, levels and grades of any part of the works because of the conditions revealed by the works.

The Contractor must accept reasonable delays due to inspection and checking of any part of the works to determine grades and levels.

2.2 Survey

The Contractor must:

i) Perform all ground surveys using conventional and agreed surveying techniques.

ii) Survey and setting out the works based on the datum points provided by the Owner's Representative.

iii) Be responsible for the protection of all permanent and temporary beacons or benchmarks.

iv) Be wholly responsible for the setting out of his works in accordance with the terms of the specification. Although the Owner's Representative will cause such setting out to be checked from time to time, such checking will not relieve the Contractor of full responsibility for the accuracy of such setting out.

v) Carry out surveys prior to the commencement of the item of work and at the completion of the item of work.

vi) Carry out a post construction survey by licensed surveyor of the works to verify that the works were constructed within the specified tolerances and submit it to the Owner's Representative.

vii) Submit his survey data and calculations to the Owner's Representative.

viii) Ensure initial and/or final surveys are undertaken and approved by the Owner's Representative prior to the removal or placement of any material, especially where such action will destroy or cover the surface just surveyed. All survey checks or quantity measurements must be supplied to the Owner's Representative, suitable time must be given to the Owner's Representative to allow such calculations to be checked and approved prior to the works being covered or removed.

The Owner's Representative may undertake his own survey of any item, either in conjunction with the Contractor, or separately. The Contractor and Owner's Representative must agree on the results of measurement surveys that are carried out prior to any works being covered up or within seven (7) days of a survey being undertaken. Should agreement not be reached, the difference must be documented such that the matter can be later decided without disruption to the Contractor's program.

The maximum permissible horizontal deviation from the finished lines or zone boundaries must be -0 m to +0.5 m.

Vertical deviation must be -0 m to +0.2 m, provided no abrupt changes in slope or level are present on any finished surface.

Measurement for payment of all embankment fill material must be made for the compacted material, measured in place and only to the lines and grades required.

Measurement for payment of all drainage details (basal drains, leakage detection and underdrains below the tailings) must be made for the materials, measured in place and only to the lines and grades required.

2.3 Clearing and Establishment Works

The Contractor must, as appropriate:

i) Remove all vegetable matter and scrub from the area of the proposed tailings storage. The area to be cleared must extend approximately 10 m past the downstream toe of the embankment, to the downstream toe drains and the water return sump. All stripped vegetation should be pushed into heaps in locations as indicated by the Owner's Representative.

ii) Remove all solid obstructions, tree stumps, roots and logs from beneath the footprint of the perimeter embankments and within all borrow areas.

iii) Clear the agreed routes of all haul roads of all vegetation-standing and fallen. Push this vegetation into heaps as approved by the Owner's Representative.

iv) Form up and lay base course as necessary and do all things necessary to form and maintain haul roads linking the mine waste dumps/borrow areas to the site and other haul roads necessary for the works and which are approved by the Owner's Representative.

v) Keep all haul roads sprayed and wet to totally prevent the generation of airborne dust during the course of road construction and usage.

vi) Seal all investigation boreholes, groundwater and sterilisation holes drilled in the area of the proposed tailings storage facility (reference Drawing No. 100) and keep an accurate record of all holes filled.

vii) Prepare a quality assurance and quality control program to cover all aspects of work included within this Construction Specification for the Principal's approval.

viii) Provide all things necessary to implement the approved QA/QC program.

2.4 Foundation Preparation

The Contractor must, as appropriate:

i) Strip topsoil from within the tailings storage area and from the embankment footprint to a nominal depth below the natural ground surface of 0.2 m, or as directed by the Engineer. Stockpiling of topsoil must be in areas nominated by the Owner's Representative. Stockpiles must have a maximum height of 2.0 m and side slopes of 1 (vertical) to 1.5 (horizontal).

ii) Tyne, water and compact any areas of loose material on the prepared surface of the embankment footprint identified by the Owner's Representative.

iii) Allow for keeping water from the work areas and borrow excavations by pumping, dewatering or other suitable means and adequately dispose of it clear of the works.

iv) Prepare the foundation for the cutoff trench under the embankment by excavating to refusal on the *'laterite'* a nominal average depth of between 1.0 and 2.0 m or as directed by the Owner's Representative. Side batters must have a minimum slope of 1:1.

v) Rip if necessary to construct the cutoff excavation. Blasting in the tailings storage area, other than in the designated fresh rock borrow area is not anticipated. Blasting and excavation into the competent rock must be undertaken with the written approval of the Owner's Representative.

vi) Leave all areas to receive fill in a clean and suitable condition to allow an uninterrupted placement of fill. No fill must be placed in the cutoff until the base of all excavations has been inspected and approved by the Owner's Representative.

vii) Grade smooth all areas to receive pipework, which must be free of any rock, cobbles and other deleterious materials that could damage the pipework.

viii) Install all pipework as shown on the Design Drawings.

ix) Install all HDPE liner and drainage systems (basal drainage below the initial HDPE liner, leak detection and tailings drainage systems).

x) Tyne and moisture condition the surface of the previously constructed embankments prior to the placement of the fill as directed by the Owner's Representative for Stages 2 to 7.

2.5 Earthworks

The Contractor must:

i) Prepare a method statement for the construction of the TSF. The method statement prepared by the Contractor must not only include details on the proposed method of construction of the earthworks and liner but also the safety measures to be adopted to ensure the work is carried out with minimal risk to personnel and equipment. The Contractor must submit details of the proposed method to the Owner's Representative prior to the commencement of construction.

ii) Take the materials for the designated construction zones as detailed in Section 2 of the Earthworks Specification and shown on the drawings. Suitable material must comply with the requirements as detailed in Section 2.2 of the Earthworks Specification. All borrow excavations in these TSFs must not

commence closer than 15 m from the upstream toe of the proposed embankment and must be extended as far as possible away from the embankments and finished with a fall to the TSF impoundment area to facilitate the placement of the HDPE liner. The excavation of deep trenches within the borrow area must be agreed with the Owner's Representative prior to the commencement of construction. Under no circumstances must the finished slopes of the excavation exceed 3:1 (H:V). The Zone 1 materials must be well mixed to ensure uniform distribution of fines (material less than 75 microns). The Contractor must not leave raised bunds in the borrow areas. During construction works protective bunds installed in the areas upstream of the designated borrow area must be of sufficient dimensions to prevent runoff entering into the adjacent excavation by collapse of the bund or overtopping. Finger trenches must be excavated from the borrow for purposes of drainage as required.

iii) Construct Zone 1 of the tailings storage embankments using selected approved material sourced from the within the designated areas which may include the TSF impoundment area, and/or designated borrow areas which comply with the requirements as detailed in Section 2.0 of the Earthworks Specification.

iv) Construct Zone 2, the downstream zone, using mine waste which complies with the requirements as detailed in Section 2.0 of the Earthworks Specification. The mine waste may be direct hauled from the active mine pit or sourced from designated areas in the mine waste dump.

v) Ensure all materials must be stockpiled, transported and placed in such a manner as to minimise segregation.

vi) Construct access roads and/or ramp(s), as appropriate, to the designated borrow or waste dump(s) as appropriate to enable the fill materials to be recovered. The Contractor must submit details of the proposed ramps to the Owner's Representative prior to the commencement of construction.

vii) Construct and maintain haul road(s) between the ramp at the waste dump/borrow area and the works at the Tailings Storage.

viii) Construct and maintain access ramps as required to enable the construction equipment to access the embankment crest. The location of these ramps must be approved by the Owner's Representative prior to commencement of these works. The ramps may be left in place at the discretion of the Principal.

ix) Adjust the moisture content of the Zone 1 material, approved for use in the upstream zone of the perimeter embankment. Moisture condition the borrow to within the range of -2%, +2% of the optimum moisture content as determined from laboratory test 5.1.1 of AS1289 (1993). The borrow materials must be cured to ensure the moisture is thoroughly mixed and evenly spread through all materials proposed for embankment construction.

x) Place all Zone 1 fill material in homogeneous horizontal layers not exceeding 300 mm loose lift thickness. Each lift must be compacted by a minimum of 6 passes of a Caterpillar 825 or Dynapac CA301PD Vibratory Roller or approved equivalent. Placement should be continuous. If a break in fill placement allows the exposed surface to dry, it should be lightly tyned, watered and compacted prior to fill placement recommencing. The finished surface of the Zone 1 must comply with the grades and lines to which the embankments are to be constructed.

xi) Each layer must be compacted to achieve an average density ratio greater than 98% of the maximum dry density - standard compaction as determined from laboratory test AS 1289.5.1.1. The actual number of passes of a Caterpillar 825 or Dynapac CA301PD or an approved equivalent to achieve a density greater than 95% standard compaction (AS 1289.5.1.1) must be determined on site using roller trials.

xii) Carry out testing of Zone 1 to comply with the Specification and QA/QC procedures.

xiii) The crests of the completed external embankments must be graded to the inside (upstream) of the storage at a 2% crossfall. A windrow of not less than 400 mm height must be left on the outside of the crest of all external embankments.

xiv) The maximum particle size for the downstream zone, Zone 2, is 500 mm.

xv) Place all Zone 2 Rock Fill material in homogeneous horizontal layers not exceeding 750 mm loose lift thickness. Each lift must be compacted using vibrating rollers of not less than 11 tonnes front module mass in layers of loose lift thickness not exceeding 500 mm. Where the front module mass is less than 11 tonnes, the loose lift thickness of the Rock Fill must be reduced. Largest size should not exceed 350 mm. Zone 2 is to be constructed to the grades and lines to which the embankments are to be constructed.

xvi) Place the basecourse materials on the crest of TSF.

xvii) Allow for maintaining the work areas and borrow excavation areas free of large accumulations of water.

2.6 Completion

The Contractor must:

i) Batter down the sides of any external borrow pits, as appropriate, for stability on completion of the work. Materials not considered suitable for use in the works must be evenly spread over the borrow pit surface. The finished surface profile of the borrow must comply with local regulatory requirements.

ii) Clean up all rubbish, remove all plant and supply materials, trim all banks neatly, spread all excavated material not specified to be removed from the site and leave the site in a clean and tidy condition.

iii) Topsoil and vegetable matter removed from the embankment footprint prior to embankment construction must be respread on the downstream face of the dam. Topsoil must be redeployed in a thickness similar to that removed from the embankment footprint.

2.7 Construction Sequence

TSF will be used during the period of the Contract for the construction of TSF2 Stage 1 and construction of Stages 2 to 4 of each TSF.

The Contractor must liaise with the Principal to agree a sequence for the works. The Contractor must endeavour to complete the external embankments in the sequence agreed.

2.8 Limits of the Contract

The limits of the Contract are as shown on the Drawings.

3.0 EXCLUSIONS

The following works will be performed by others simultaneously to the Works in this Contract:

i) Placement of HDPE liner.

ii) Construction of the underdrainage system including the outfall pipework and external sump.

iii) All pipework removal and replacement including the tailings discharge mainline and the return water line during the construction of Stages 2 to 4. The position of tailings deposition points and water recovery will be agreed prior to commencement of the construction of Stages 2 to 4.

iv) At the completion of the construction of the embankments, the Principal must re-connect the tailings distribution pipework.

The Contractor must:

i) Fully co-operate with the pipe handling and operating crew and must work in with their activities at all times.

ii) Avoid damaging the tailings distribution pipework which is either operational or has been removed from the crest of the storage by the Principal. Any pipework damaged by the Contractor through carelessness must be replaced at no additional cost to the Principal.

4.0 PRINCIPAL-SUPPLIED ITEMS

4.1 Survey

The Principal's will provide co-ordinates and levels of ten (10) survey marks within the vicinity of the TSF. The Contractor must set out all lines and levels using the survey marks provided.

4.2 Materials

The construction materials are to be sourced from the TSF impoundment area and mine waste for construction of the perimeter embankment. The items listed below, will be provided as Principal-Supplied items to the Contractor. The items will be supplied from the Principal's store during normal store hours.

4.3 Water

Water will be made available to the Contractor at no charge. Supply will be from a standpipe located near the plant site. Access to the standpipe will not be exclusive to the Contractor. The Contractor must determine the type and suitability of the water supplies for use in this Contract.

The Contractor must make his own arrangements for loading and hauling.

Note: Potable water supplies are limited and the Principal may, from time to time, direct the Contractor to use alternative sources.

5.0 QUALITY CONTROL AND QUALITY ASSURANCE

The required quality standards for implementation of this Scope of Work are the AS/NZS ISO 9001:1994 Standard Series and the Contractor must comply with the requirements of these standards.

The Contractor must provide not later than thirty (30) days after Award of Contract, fully documented details of the Quality systems and procedures to be utilised together with reference details for implementation of the stated system and procedures on previous similar projects.

6.0 INSPECTION AND TESTING

6.1 Inspection Requirements

The Owner's Representative will be entitled, at all times to inspect, examine and test the materials and workmanship being provided under the Contract. Such inspection, examination or testing, if made, must not release the Contractor from any obligation under the Contract.

The Contractor must co-operate with and provide full opportunity to the Owner's Representative to regularly monitor the progress of the Works of the Contractor and his subcontractor's to the detailed extent necessary to satisfy progress relative to the Construction Program.

All pertinent information to enable the Owner's Representative to determine the adequacy of the advance planning for material procurement, machine and manpower resources to meet the Construction Program must be made freely available to the Owner's Representative.

These requirements must be incorporated in orders placed with Subcontractor's.

6.2 Testing Plans

The Contractor must provide not later than fourteen (14) days after Award of Contract a certified Testing Program.

The Testing Program must include details of Procedures, Standards and acceptance levels and conform to the requirements of Specifications forming part of the Contract documentation.

Compliance tests must be carried out by a qualified technician from a NATA registered laboratory employed by the Contractor.

Compliance tests must be carried out to such a degree as to satisfy the Owner's Representative that the criteria on moisture content and compaction are met.

Compliance testing of compaction must be at the rate of not less than 1 test per layer per material type per 2,500 m^2.

The Contractor must, at his own expense, rework or replace materials which do not meet the compaction requirements.

7.0 PERMITS, LICENCES AND APPROVALS

Further to the General Conditions of Contract, the Principal will obtain permits, licences and approval from the regulatory authorities.

All other necessary permits, licenses and approvals must be obtained by the Contractor.

8.0 CAD DRAWINGS

Computer Aided Drafting (CAD) drawings must be supplied on files compatible with the current version of Microstation, and in accordance with specifications SE43 CAD Drawing Procedure.

9.0 SUBSTITUTIONS

The Contractor must:

i) Not substitute any alternative to the equipment and materials included in the Works without the prior written consent of the Principal.

ii) Make diligent efforts to utilise the specified Materials to be incorporated into the Works but where the Contractor considers there are commercial or other advantages to be derived by the Principal, the Contractor may submit a proposal for a substitute material for approval by the Principal's prior to commencement of the work. Such proposal for substitution must be in writing and state reasons for and (if applicable) advantages of the substitute material. The Principal must determine whether the substitute material will be permitted and such a determination must be binding and conclusive upon the Contractor. Approval of a substitution will be given as a variation under the General Conditions of Contract incorporating any adjustment to the Contract Sum.

10.0 SHIPMENT (GENERAL)

The Contractor is responsible for transporting the Plant and Equipment to the site and must maintain full responsibility for loading, unloading, handling, site storage and insurance of the Plant and Equipment during transportation.

Notice of dispatch must be sent by the Contractor to the Principal at the time of dispatch of all consignments of Plant. Such notice must contain the method and date of dispatch and date of arrival on site.

11.0 CO-OPERATION WITH OTHER CONTRACTOR'S AND OPERATIONS

It is inevitable that at times other Contractor's or Operations personnel may be working in very close proximity to the Contractor during the execution of the Works. The Contractor must at times, co-operate to the fullest extent with other Contractors and Operations and must be deemed to have made full allowance in the Contract Sum for any costs which could be incurred as a result of such co-operation up to a maximum of two (2) hours for each incident. The Contractor must make allowances for the following:

i) Inconvenience of working around other Contractor's and operations.

ii) Need to relocate to another work area if the area is considered unsafe by the Principal's due to activities of other Contractor's and Operations.

iii) Restrictions on access due to activities of others.

iv) The need to use temporary and incomplete access ways and platforms.

No claims will be accepted by the Principal's for costs or extension of time resulting from the activities of operations or other Contractor's or Operations personnel working in the same area as the Contractor for this two (2) hour delay.

12.0 TEMPORARY SERVICES AND FACILITIES

12.1 Furnished by Contractor

Except as expressly set forth in Clause 12.2 of this document, the Contractor must, as part of the Scope of Work, supply, install, properly maintain, and remove all temporary construction facilities and utilities necessary for full and complete performance of the works. Such items must include, but not necessarily be limited to, those listed below. The type of facilities, mobilisation and demobilisation dates, and locations of job site must be subject to, and in accordance with, the review and approval of the Principal's.

i) Access roads around and within the site to the approval of the Principal's.

ii) All temporary office, crib room and buildings required for use during the execution of the works.

iii) All sanitary consumables (toilet paper and hand cleaner).

iv) First-line first aid facilities at work site, including a First Aid Officer.

v) Fuels and lubricants.

vi) Compressed air and gases.

vii) Construction of electric power distribution at the work Site to the approval of the Principal's from existing supply points.

viii) Transportation facilities on Site.

ix) Communications activities, including telephone and facsimile. (Contractor must liaise with telecommunications suppliers direct).

x) Maintenance of Contractor's laydown, storage and work areas and roads within such areas.

xi) All cranes and other necessary equipment for lifting and moving equipment.

xii) All small tools and testing equipment.

xiii) Temporary lighting.

xiv) Road and traffic signs

xv) Any items specified or implied in other sections of the Contract documents.

xvi) Site clean-up and removal of rubbish to tip at an interval not exceeding one week.

12.2 Furnished by Principal

This section provides a list of Principal-furnished Services other than those items listed in Sections 1.2 and 4.0.

Any services or materials not specifically identified as being provided by the Principal's must be provided by the Contractor.

12.2.1 Utility Services

Where the Contract work is at an existing Plant, the Principal's is able to provide from existing outlets, electric power, water and plant air free of charge to the Contractor. These utility services are not guaranteed and may be withdrawn or terminated by the Principal's at any time and for any duration without notice.

Should the Contractor be required to extend water, electric power or plant air from the existing outlets, such as extensions must only be carried out with the written approval of the Principal and must be at the Contractor's cost.

All installations are to be built and maintained in accordance with relevant regulations and to the Principal's requirements.

The Contractor must not be entitled to any monetary compensation by reason of interruptions to utility service, whether such services are provided by the Principal or not.

The Contractor must not be entitled to any extension of time by reason of interruption unless each such interruption exceeds two days, in which case any extension of time which may be granted by the Principal in pursuance of claims made by the Contractor will not be greater than the period of interruption.

The Contractor must take all necessary steps to prevent waste of utility services, and the Principal reserves the right to deduct from amounts payable under the Contract, the value of any utility which, in the opinion of the Principal, is wasted or unnecessarily used.

12.2.2 Accommodation

Unless otherwise specified, the Contractor must be responsible for arranging and providing accommodation for all his employees and the cost of such accommodation must be deemed to be included in the rates and lump sum prices applicable to the Contract.

The Contractor's employees may, by application of the Contractor, be accepted for single status accommodation and messing where this is available. The Contractor must be charged for the cost of accommodation and messing for each of his employees accommodated on a single basis at the prevailing rate per manday, Sundays and Public Holidays included, such rate of this Clause, manday must be measured from noon to noon.

13.0 DATA REQUIREMENTS

The Contractor must submit the following data in addition to the data requirements detailed elsewhere in this Specification to the Principal's as part of the Work.

The Contractor must show the reference Contract Number and identifying item numbers, if applicable, on all data submitted.

13.1 As-built Drawings

Further to the General Conditions of Contract, the Contractor must supply as built drawings within 14 days of the issue of a Certificate of Practical Completion.

14.0 CONSTRUCTION PROGRAM

The Contractor must provide a construction program and indicate the following milestone dates.

i) Contract Award.

ii) Notice to Proceed with the Fieldwork.

iii) Principal's Completion Date.

iv) Final Completion Date.

15.0 ESTIMATE OF QUANTITIES

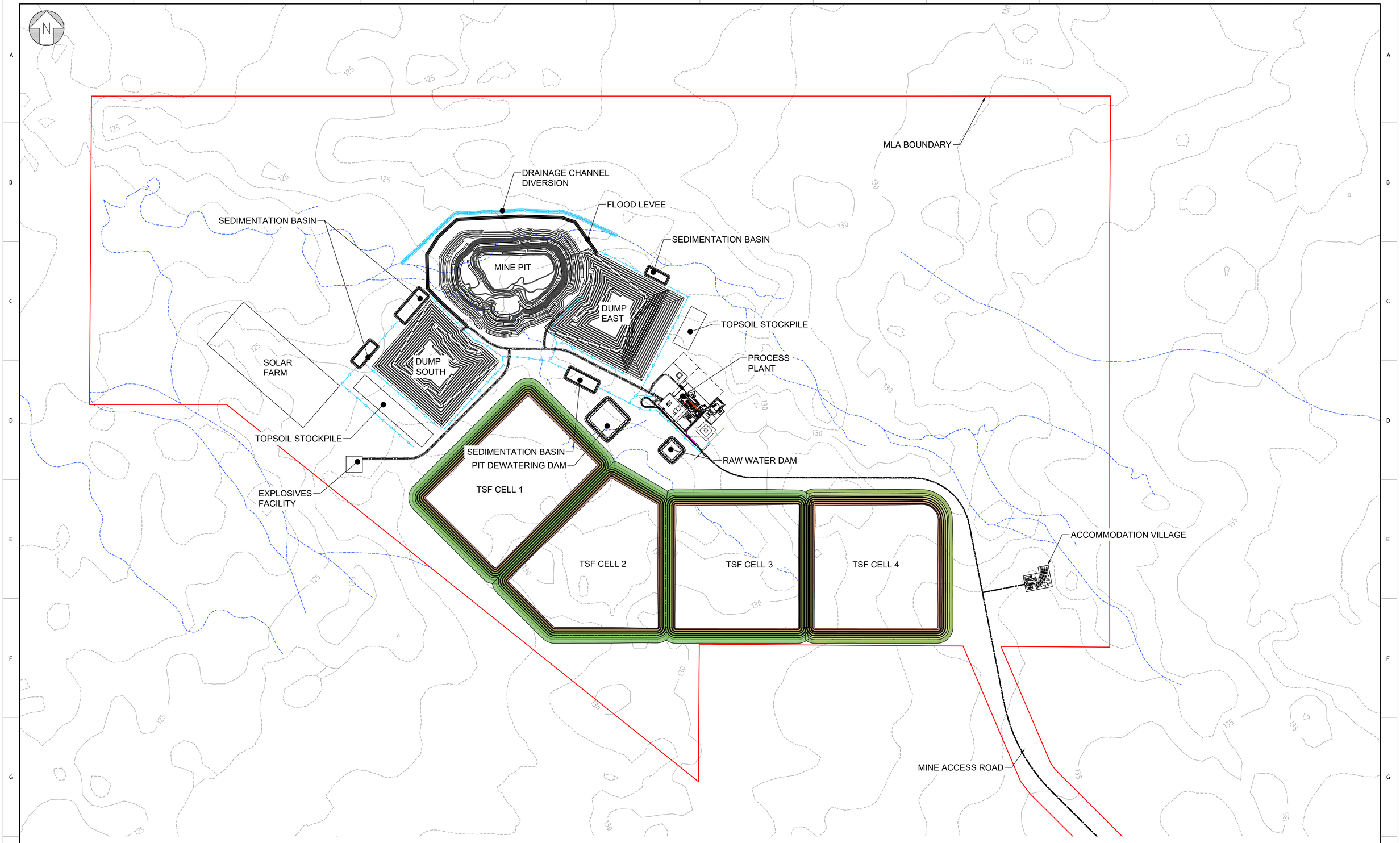
A preliminary estimate of quantities will be provided to allow material requirements to be gauged for all Stages of Construction.

Appendix A

Drawings

Graphinex Pty Ltd

Tailings Storage Facility Scope of Works



300 30 300 600 900 1200 1500m

SCALE 1:15,000

LOCALITY PLAN

1:15,000

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
B	10.02.2026	REISSUED FOR STUDY	AE	PG	PG	LB
A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

IN THE ABSENCE OF THE APPROVED SIGNATURE, THIS DRAWING SHALL BE TREATED AS PRELIMINARY

	DATE
DRAWN S. ROWE	10.03.2025
DESIGNED J.FEETHAM	10.03.2025
CHECKED P. GLOWERY	10.03.2025
ENGINEER P. GLOWERY	10.03.2025
APPROVED L. BLACK	10.03.2025

DRAWING NUMBER | DESCRIPTION

DRAWING REFERENCE

GRAPHINEX

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CLIENT: GRAPHINEX

PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

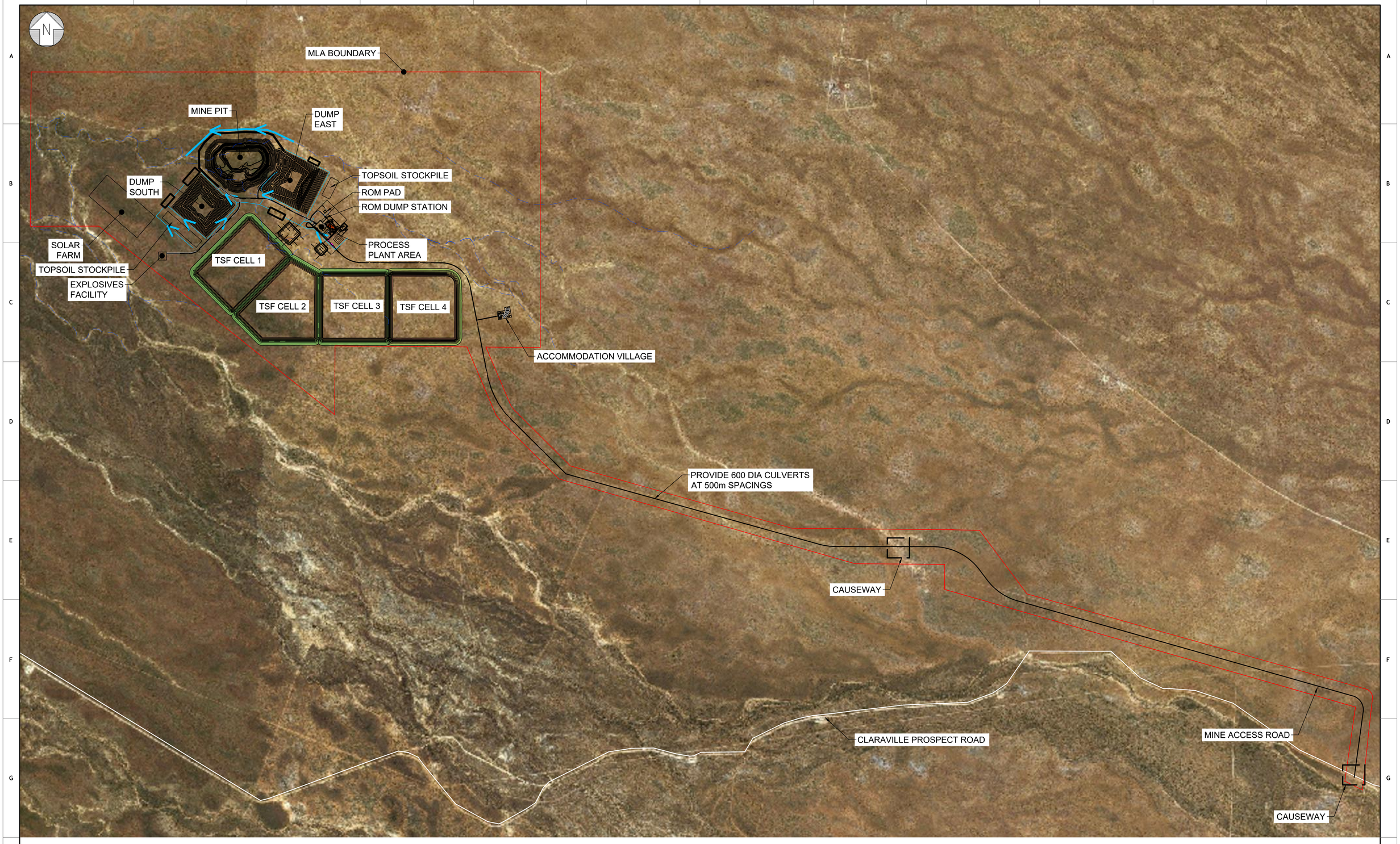
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

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AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00020 REV: B



600 0 600 1200 1800 2400 3000m

SCALE 1:30,000

LOCALITY PLAN

1:30,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

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A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

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DESIGNED	J. FEETHAM	10.03.2025
CHECKED	P. GLOWERY	10.03.2025
ENGINEER	P. GLOWERY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

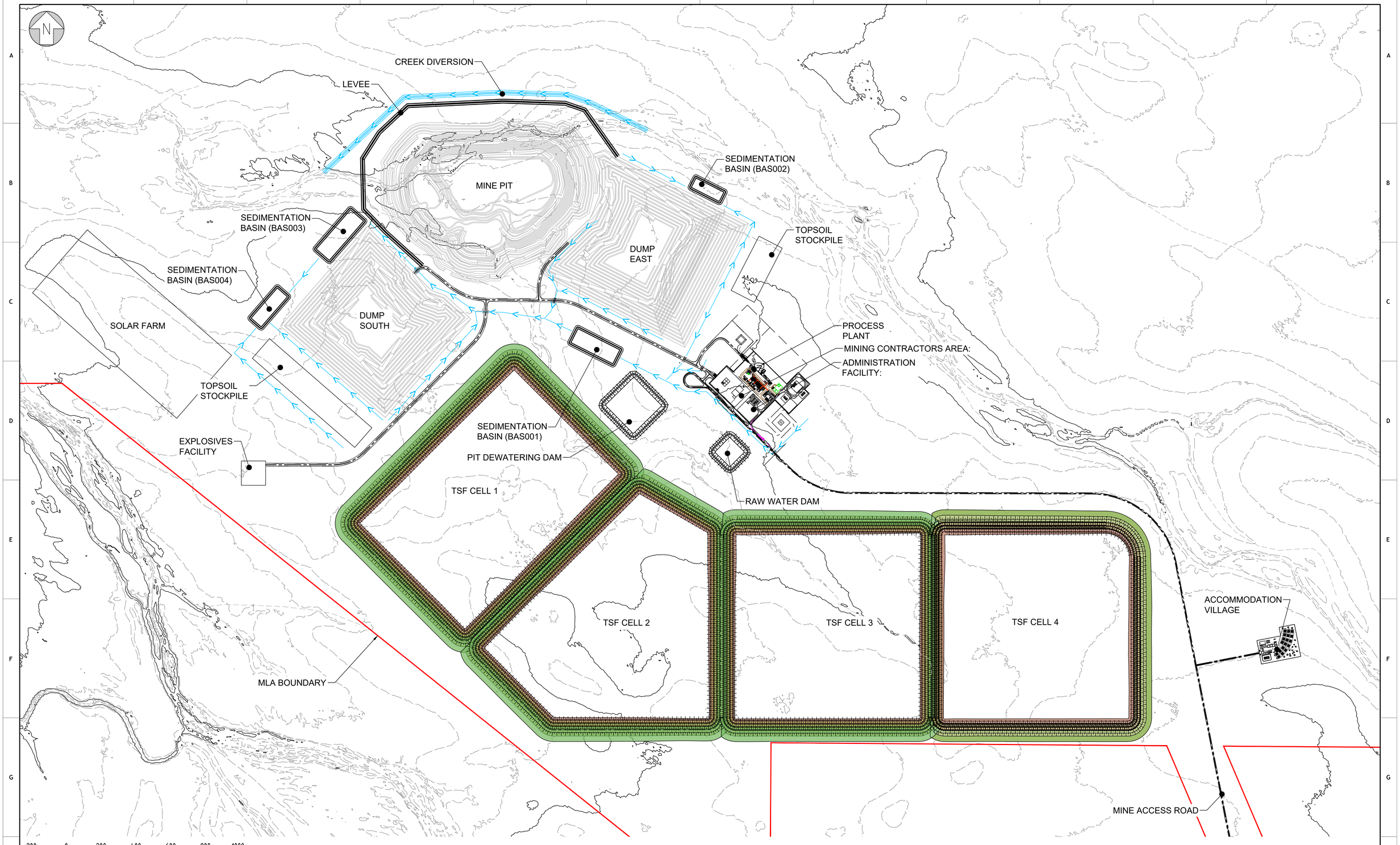
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

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DWG NO: 6235-40-DWG-CI-00030 REV: B



PLAN
1:10,000

DRAWING NUMBER	DESCRIPTION
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DESIGNED	J. FEETHAM	10.03.2025
CHECKED	P. GLOWERY	10.03.2025
ENGINEER	P. GLOWERY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS
TITLE: MINE SITE DRAINAGE PLAN

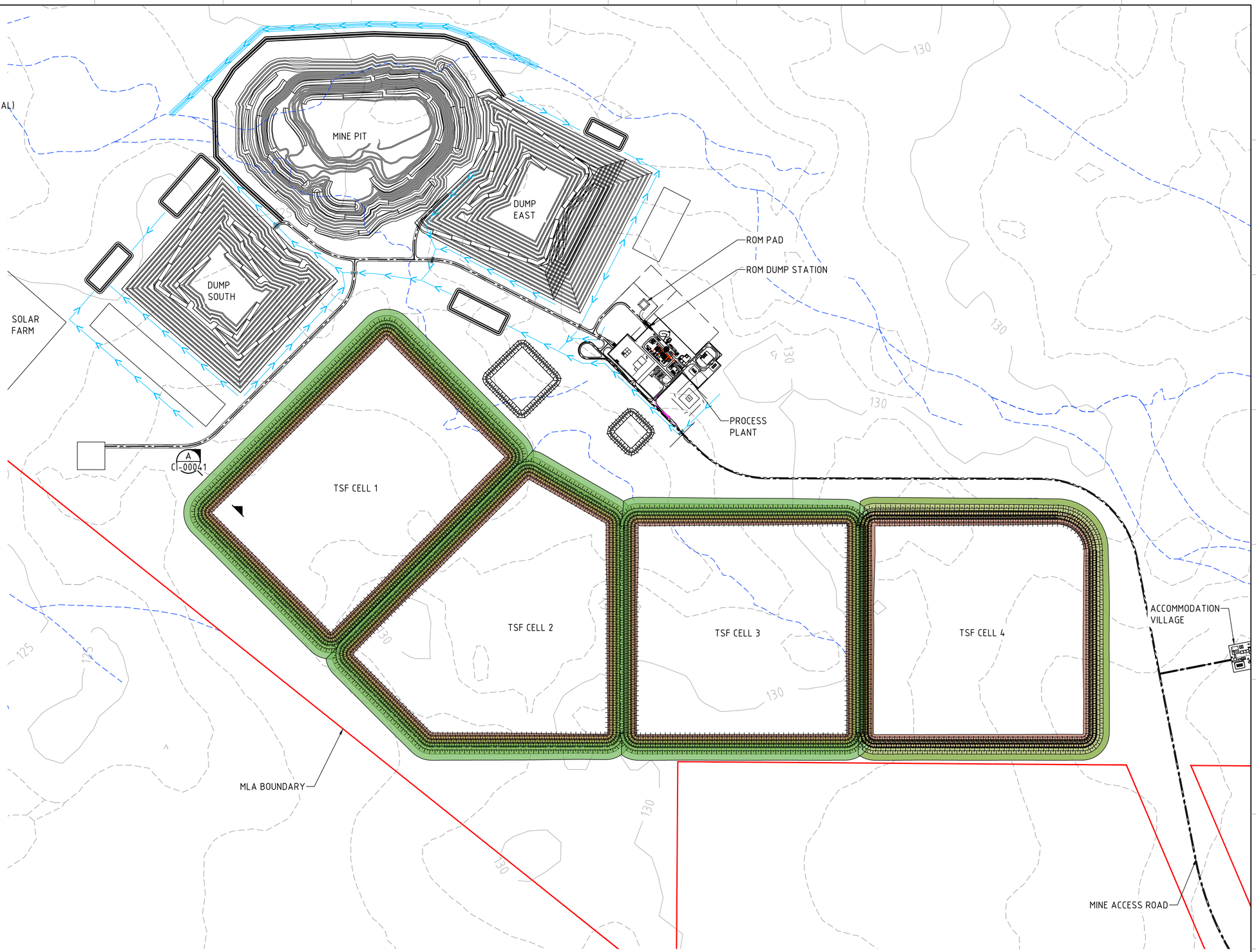
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CLIENT DWG NO:

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00031
REV: B

LEGEND

- 385 — EXISTING SURFACE CONTOUR (1m INTERVAL)
- GRADE LINE
- PROPOSED TOP OF BATTER (LEFT)
- STAGED EMBANKMENT - LIFT 01
- STAGED EMBANKMENT - LIFT 02
- STAGED EMBANKMENT - LIFT 03
- STAGED EMBANKMENT - LIFT 04



200 0 200 400 600 800 1000m

SCALE 1:10,000

LOCALITY PLAN

1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

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A	14.03.2025	ISSUED FOR STUDY	GS	PG	PG	LB

IN THE ABSENCE OF THE APPROVED SIGNATURE, THIS DRAWING SHALL BE TREATED AS PRELIMINARY

DRAWN	G. SPILLANE	DATE 10.03.2025
DESIGNED	G. SPILLANE	DATE 10.03.2025
CHECKED	P. GLOWERY	DATE 10.03.2025
ENGINEER	P. GLOWERY	DATE 10.03.2025
APPROVED	L. BLACK	DATE 10.03.2025

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CLIENT: GRAPHINEX

PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

TITLE: TAILINGS STORAGE FACILITY PLAN

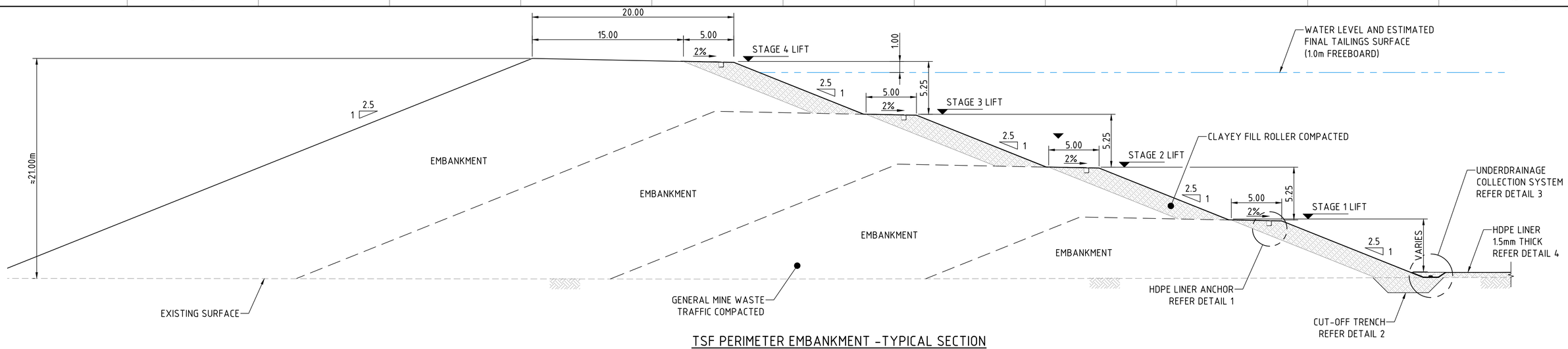
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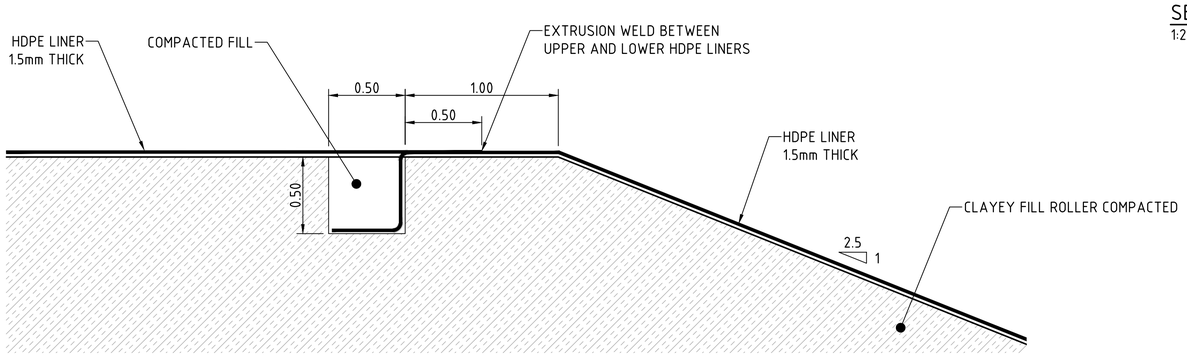
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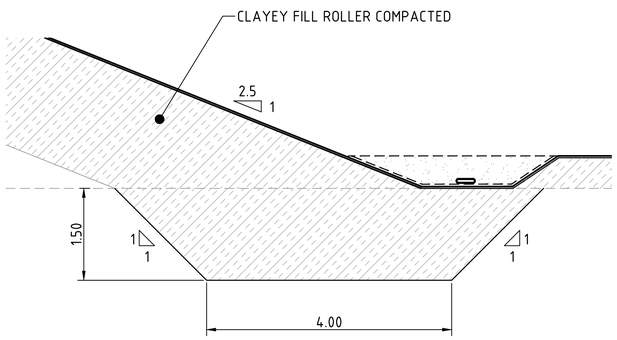


TSF PERIMETER EMBANKMENT -TYPICAL SECTION

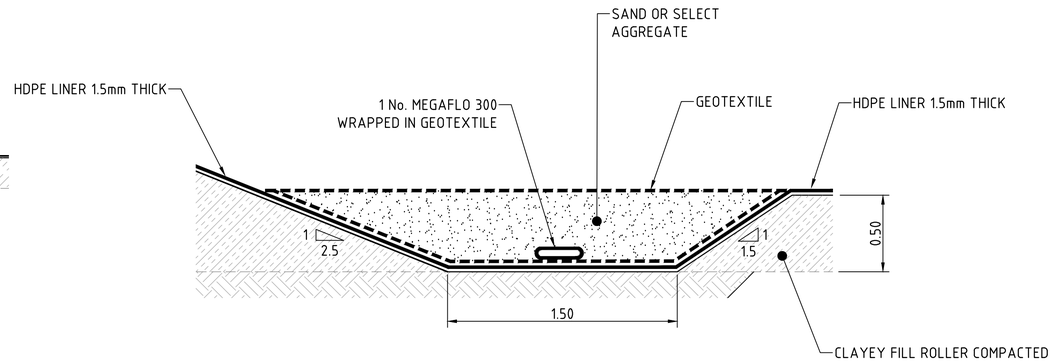
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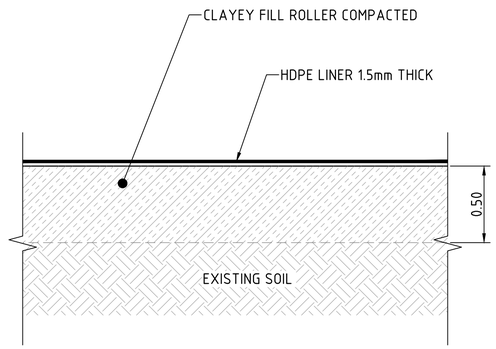
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DETAIL 2 – CUT-OFF TRENCH -TYPICAL DETAIL
1:50



DETAIL 3 – UNDERDRAINAGE COLLECTION SYSTEM-TYPICAL DETAIL
1:20



DETAIL 4
1:20

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

4 0 4 8 12 16 20m
SCALE 1:200

1.0 0 1.0 2.0 3.0 4.0 5.0m
SCALE 1:50

0.4 0 0.4 0.8 1.2 1.6 2.0m
SCALE 1:20

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
A	14.03.2025	ISSUED FOR STUDY	GS	PG	PG	LB

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APPROVED	L. BLACK	10.03.2025

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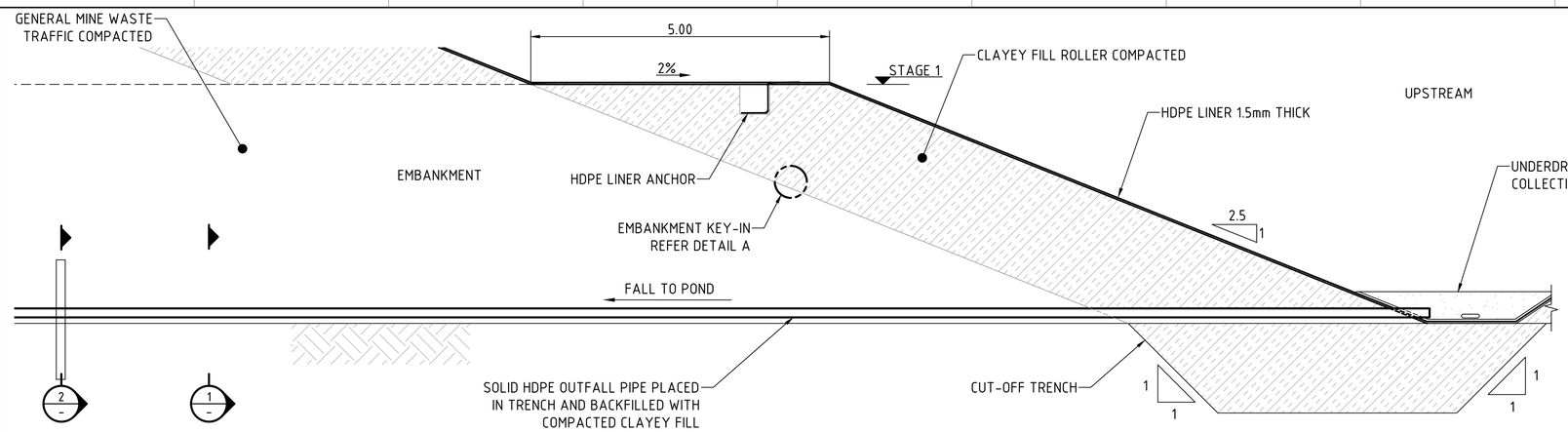
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PROJECT: ESMERALDA GRAPHITE PROJECT
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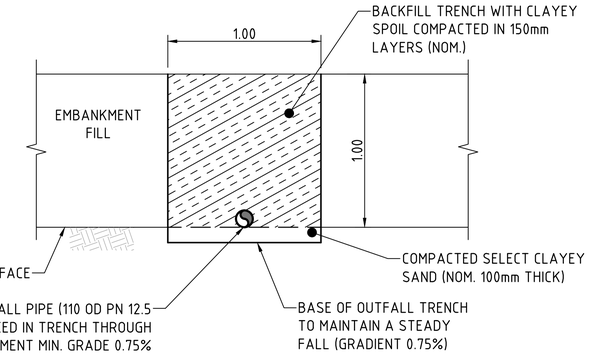
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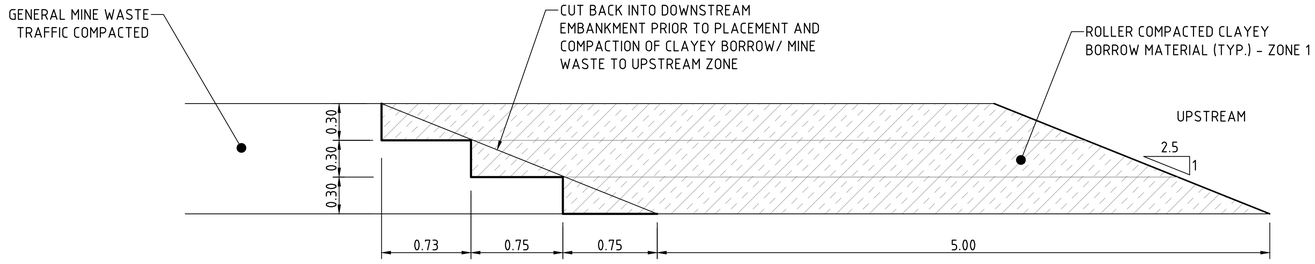
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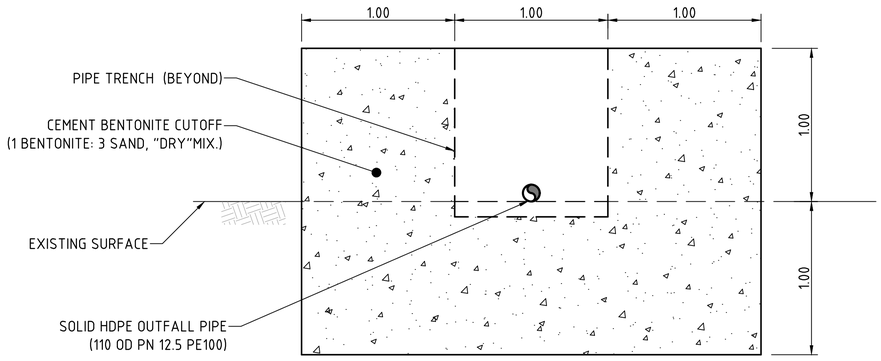
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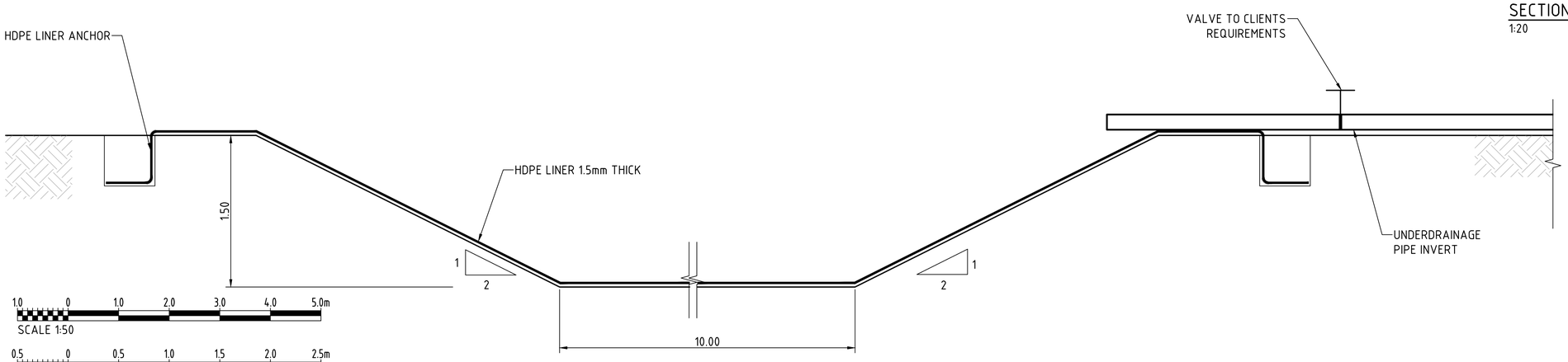
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1:20



DETAIL A / - EMBANKMENT KEY-IN -TYPICAL DETAIL
1:25



SECTION 2 / - CEMENT BENTONITE CUTOFF -TYPICAL SECTION
1:20



UNDERDRAINAGE SUMP -TYPICAL SECTION
1:25

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

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GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

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ENGINEER	P. GLOWREY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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TITLE: TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS
SHEET 2 OF 2

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CLIENT DWG NO:

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00042
REV: A

Appendix B

Schedule of Materials

(to be completed by others)

Graphinex Pty Ltd

Tailings Storage Facility Scope of Works

Appendix C

Earthworks Specification

Graphinex Pty Ltd

Tailings Storage Facility Scope of Works

Soil & Rock Engineering Pty Ltd (SRE)

ABN 98 675 219 020

GRAPHINEX

Esmeralda Project - Queensland

TSF Earthworks Specification

DRAFT Re issued for client review)

Ref: **Earthworks Specification Rev B 202602**

Date: **15 February, 2026**

Prepared by: **SREPL**
243B Pearson Street
Woodlands WA 6018

Prepared for: **Graphinex Pty Ltd**
Level 4, 10 Eagle Street
Brisbane QLD 4000

Disclaimer

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Document Control

Date	Revision	Purpose	Author
24/01/2026	A	Internal Review	C Lane
13/02/2026	B	Issued for Client Review	C Lane

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Terminology and Abbreviations

The following terminology and abbreviations have been used in this document:

AS	Australian Standard
CMW	CMW Geosciences Pty Ltd
EGP	Esmeralda Graphite Project
GPL	Graphinex Pty Ltd
GSI	Geotechnical Site Investigations
NATA	National Association of Testing Authorities
OMC	Optimum Moisture Content
QAQC	Quality Assurance and Quality Control
RL	Reduced Level
SMDD	Standard Maximum Dry Density
SREPL	Soil & Rock Engineering Pty Ltd
t/m^3	Tonnes per cubic metre
TSF	Tailings Storage Facility
USCS	Unified Soil Classification System

DRAFT Rev B (issue

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Soil & Rock Engineering Pty Ltd (SRE P/L)

Project: Graphinex Project

Subject: Tailings Storage Facilities – Earthworks Specification

1 GENERAL

1.1 Summary

This specification prescribes the requirements for the earthworks construction to achieve the site-finished grades indicated on the Design Drawings for Tailings Storage Facilities at the Esmeralda Graphite Project (EGP) Project located approximately 70 km south of Croydon in Queensland.

This Specification is to be read in conjunction with the design drawings.

The works to be executed mainly involves bulk earthworks to construct/raise the starter embankments for each TSF. Also prescribed are the requirements for clearing and grubbing; the removal, replacement and disposal of unsuitable materials; the disposal of surplus materials and the furnishing, placement and compaction of embankment fill material.

The Contractor must coordinate work prescribed by this Specification with other related works to be performed.

1.1.1 Related Specifications

The latest revisions of the following specifications prescribe items of related Work:

i) High Density Polyethylene (HDPE) Liner
ii) Geotextile and Flownet Specification
iii) HDPE Pipework Specification (supplied by the Client).

The Contractor must coordinate work prescribed by this Specification with work performed for the above listed Specifications. The Appendices referred to in this document comprise the following and are to be attached to this document by the Owner:

- Drawings Appendix 1
- Schedule of Materials Appendix 2
- HDPE Specification Appendix 3
- Geotextile and Flownet Specification Appendix 4

The Contractor must coordinate work prescribed by this Specification with other related works to be performed. This Specification must be read in conjunction with the latest revisions of the following Design Drawings as listed in Table 1.1.

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Table 1.1 – Drawings

Drawing No.	Title
6235-40-DWG-00020 Rev B	Mine Site General Arrangement Plan
6235-40-DWG-00030 Rev B	Site Wide Drainage Plan
6235-40-DWG-00031 Rev B	Mine Site Drainage Plan
6235-40-DWG-00040 Rev A	Tailings Storage Facility Plan
6235-40-DWG-00041 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
6235-40-DWG-00042 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

1.2 Terminology

The following terms are defined as stated, unless otherwise indicated:

Contractor	Appropriate individual, partnership, company or corporation contractually obligated to perform the work prescribed in this Specification and associated Specifications (Appendix C) and becomes contractually obligated to the Owner.
Design Drawings	Detailed Design Drawings issued by the Owner to the Contractor.
Engineer	The engineer (or designated representative) appointed by the Owner who is responsible for evaluating the suitability of the materials involved in the work and for verifying the compliance of the work to the requirements of the Specifications.
Independent Testing and Inspection Firm	The company, partnership, or corporation retained to perform the inspections and tests required determining and verifying compliance of the work with the requirements of this Specification.
Optimum Moisture Content	The moisture content at which the Maximum Modified Dry Density is achieved.
Owner	Challenger Exploration Limited (GPL)
Project Superintendent	The designated representative of the Contractor appointed by the Contractor who is responsible for the work by the Contractor.
Standard Maximum Dry Density	The maximum dry density achieved as per AS 1289.5.1.1 when testing a sample of material representative of that to be compacted in the field.
Work/works	The activities specified within this document as the responsibility for the Contractor.

1.3 References

The publications listed below form part of this Specification. Each publication must be the latest revision and addendum in effect on the date this Specification is issued for construction, unless noted otherwise. Except as modified by the requirements specified herein or the details of the Design Drawings, work included in this Specification must conform to the applicable provisions of these publications.

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1.3.1 Applicable Codes/Standards

Unless otherwise specified, or shown on the drawings, the Contractor is to source all materials for the earthworks from within the HP permit and carry out all the work in accordance with the latest revisions of the relevant Australian Standard Codes or alternative International Codes and Standards as direct by GPL.

The applicable Australian Standards for earthworks are as follows:

i) AS 1289 - Methods of testing soils for engineering purposes.

ii) AS 1726 - Geotechnical site investigations.

iii) AS 3798 - Guidelines on earthworks for commercial and residential developments.

The Works must be carried out to comply with the latest revision of the Drawings, Codes and Standards specified, or where no standards are specified, to Australian Standards, or to the appropriate British or other recognised International Standards.

1.4 Submittals

All submittals must be delivered to the Owner. The following information must be submitted prior to the work:

i) One month before the start of the work, the Contractor must submit a description of fill procedures/sequences.

ii) One month before the start of work, the Contractor must submit proposed methods and construction details for any excavation where groundwater is expected to be encountered, to ensure that all excavations are kept dry during construction. Discharge/disposal of the dewatering system effluent must be coordinated with the temporary installations for Storm Water Management and dust control. Certified design calculations are required for all groundwater dewatering systems.

A Construction Report must be submitted by the Contractor at the completion of the earthworks and liner installation for each stage of each TSF as a permanent project record of all activities executed during construction. This report must provide a detailed record of the construction activities executed and be supported by:

i) All field and laboratory test results executed during construction.

ii) Daily reports weekly reports and monthly reports.

The reports submitted are to be reviewed and signed-off *'as being accepted'* by the Engineer Supervising the construction and the Engineer of Record (EOR). Any comments must be compiled and retained by the Owner. Documents which do not meet the requirements for acceptable must be reworked by the Contractor such that final payment for the construction can be processed.

1.5 Site Conditions

A geotechnical site investigation (GSI) of the mine pit, where the mine waste is to be utilised for the construction of the GTSF waste site proposed for the TSF has been executed by Cartledge and the details of that work are presented in the report titled 'Esmeralda Graphite Project Site Geotechnical Investigation -

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Factual Report', ref MEA010004 dated August 2025. The report contains the results of the geotechnical works, boreholes, photographs of the materials from the boreholes, and laboratory test results of the mine waste materials encountered during the geotechnical investigations.

A copy of the latest data will be included prior to the tender site visit and/or execution of construction works.

The information contained in the documents provided must not be construed as a guarantee of the depth, extent, or character of materials and groundwater level and quality actually present.

The Contractor should be aware of any existing piezometers and monitoring bores and must not damage this existing infrastructure. Any costs to repair or replace the instrumentation due to damage during construction by the Contractor, must be recovered from the Contractor.

2 MATERIALS

2.1 General

Satisfactory materials for use in the construction must be free from large lumps or clods, organic materials, refuse or other material that might prevent proper compaction. All material must be approved for use by the Engineer prior to placement. The material zones are described as follows.

2.2 Zone 1 Fill Material

Zone 1 embankment fill material for the construction must be sourced from within the work area, or another designated borrow area if insufficient satisfactory material is not available in the work area and must meet the requirements listed in Table 2.1.

Table 2.1 – Properties of Zone 1 Embankment Fill Material

Item	Test Methods	Requirement
Soil Classification	AS 1726 - 1993	SM, SC, GM
Particle Size Distribution	AS 1289 - 3.6.1	100% passing 19 mm > 30% passing 0.075 mm
Plasticity Index	AS 1289 - 3.2.1 AS 1289 - 3.3.1	< 25
Liquid Limit	AS 1289 - 3.1.1 AS 1289 - 3.2.1	< 45
Organic materials or other deleterious inclusions		0 (zero)
Compacted In situ Density	AS 1289 - 5.1.1	95% SMDD or (as designated)

Zone 1 Fill Material – the in-situ material sourced from mine excavations and used as select fill, as appropriate, to construct the upstream embankment of the TSFs, as indicated on the Design Drawings. This material is to comprise a mix of clay, silt, sand and fine gravel and have low potential for AMD. The local materials will likely need to be screened, to remove oversized materials, in order be suitable as the base for placement of the HDPE liner, without a geotextile underlay, moisture-conditioned and compacted to form a relatively smooth surface, free of projections on the floor and upstream face of the embankment, suitable for placement of the HDPE liner.

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2.3 Zone 2 Rock Fill

The Zone 2 Rock Fill Materials for the downstream embankments must be competent rock material sourced from the designated borrow and meet the requirements listed in Table 2.2.

This material must be competent mine waste with low to moderate potential for AMD sourced from the designated borrow (waste dumps) and meet the requirements as agreed with the Project Superintendent for the downstream embankment, as indicated on the Design Drawings or directed by the Engineer.

Table 2.2 – Properties of Zone 2 Rock Fill Material

Item	Test Method	Requirement
Soil Classification	AS 1726 - 1993	SM, SC, GM, GC with Cobbles
Particle Size Distribution	AS 1289 - 3.6.1	100% passing 500 mm < 35% passing 0.075 mm

Testing required for Zone 2 Rock Fill material must comprise particle size distribution tests as detailed in Table 4.1.

An outer surface layer of competent mine waste (Rock Fill) for materials up 1250 mm can be placed on the downstream face of the Stage 4 embankment, if available. It is understood that the current requirements are that towards the completion of processing, the GTSF is to be deconstructed with all the embankment construction materials and tailings returned to the mine pit.

2.4 Base Course Material

The Base Course Materials for the access routes crest must be well graded gravel sourced from the designated borrow and meet the requirements listed in 2.3.

Table 2.3 – Physical Properties of Base Course Material

Item	Test Method	Requirement
Soil Classification	AS 1726 - 1993	GW
Particle Size Distribution	AS 1289 - 3.6.1	100% passing 50 mm 50% or more retained on 4.75 mm <25% fines (0.075 mm)

2.5 Unsuitable Material

Materials that do not meet the requirements listed in Table 2.1, Table 2.2 and Table 2.3 soil having insufficient strength or stability to carry the loads that will be superimposed on the completed fill or embankment without excessive settlement or loss of stability, must not be used in the constructed works.

Material containing vegetable matter, muck refuse, large rocks, debris, or other materials that could cause the embankment fill not to compact and organic soils with Unified Soil Classifications of Pt, OH or OL are considered to be unsuitable material and must be removed from site.

2.6 Geotextile

Geotextile, if/where used as a filter layer, must comprise BIDIM A34 (or approved equivalent) and be placed within the downstream zone of the main embankment of TSF such that it prevents contact between Zone 1 and/or the in-situ materials.

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The geotextile must comply with the requirements of the Geotextile Specification, and be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter.

3 EXECUTION

3.1 Examination

Before starting work, the Contractor must thoroughly examine the site to ascertain conditions under which the work must be performed and the nature of the materials to be used in the construction. The Contractor must obtain all necessary site-specific permits prior to commencing work on site.

3.2 Site Preparation

3.2.1 Construction Layout

The earthworks must be set out in accordance with the Design Drawings. The Contractor must examine the site and verify all existing levels and survey control points and the set-out points shown on the Design Drawings, before commencing the earthworks. The Contractor must be responsible for checking and agreeing the correctness of all values of monuments, datum or benchmarks, prior to the commencement of work. The Engineer may find it necessary to revise the lines, levels and grades of any part of the works during progress because of conditions revealed during construction.

The Contractor must confirm that there are no existing services in the area. If any services are noted, the Contractor must bring them to the notice of the Owner.

3.2.2 Clearing and Grubbing

The Contractor must remove trees, stumps, roots, rubbish and any debris and vegetation resting on or protruding through the ground surface, from the designated areas as shown on the Design Drawings. Trees, stumps, roots and other vegetation must be removed to the bottom of their root zone. The cut materials from the clearing works may, with the permission of the Engineer, be placed on the outer, downstream, batter slope.

3.2.3 Topsoil Stripping

The Contractor must remove soil only to such depth that the soil meets the definition of topsoil. The Contractor must avoid mixing topsoil with subsoil or other undesirable materials. The Contractor must place the removed topsoil in stockpiles to a maximum height of two metres.

3.2.4 Stockpiling

The Contractor must deposit material resulting from the clearing and grubbing operations in the disposal areas. The Contractor must cover with soil or burn if permitted by applicable regulations.

3.2.5 Haul Roads and Access

The Contractor must clear all vegetation, standing and fallen, from the agreed routes of all haul roads. The Contractor must push this vegetation into heaps.

The Contractor must form up, lay base course as is necessary and do all things necessary to form and maintain haul roads linking the mine waste dumps/borrow areas to the site and other haul roads necessary for the works.

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The Contractor must keep all haul roads sprayed and wetted to totally prevent the generation of airborne dust during the course of road construction and usage.

3.2.6 Foundation Preparation

The Contractor must remove unsuitable material as directed by the Engineer.

The Contractor must scarify/tyne, water and compact any areas of loose material on the surface of the construction footprint which have been identified by the Engineer.

Material containing vegetable matter, cohesive materials, debris or other materials that could cause the embankment fill not to compact and organic soils with Unified Soil Classifications of Pt, OH, or OL are considered to be unsuitable material and must be removed from site.

All areas to receive fill must be left in a clean and suitable condition to allow an uninterrupted placement of fill. No fill must be placed until the base of all excavations has been inspected and approved by the Engineer.

All areas to receive pipework or geotextile for finger/blanket drains must be graded smooth and be free of any rock, cobbles and other deleterious materials that could damage the pipework.

3.3 Fill and Compaction

3.3.1 General

The Contractor must utilise satisfactory materials resulting from excavation and removal of unsuitable materials to the fullest extent in the construction.

3.3.2 Surface Preparation

The Contractor must immediately prior to placing the first layer of fill materials, scarify the surface of areas on which fill is to be placed to a depth of no less than 150mm and then proof compact to no less than 95% of the Standard Maximum Dry Density (SMDD) AS1289 -5.1.1.

3.3.3 Placement and Compaction of Zone 1 Fill Material

The Contractor must construct the works using suitable material in accordance with Section 2.2, sourced from within the designated borrow areas approved by the Engineer. It is assumed that the materials may have to be screened to meet the grading requirements as presented in Section 2.2. After screening, the materials would be transported to the site of the TSF and placed in such a manner as to minimise segregation. The materials are to be moisture-conditioned and cured, to ensure the moisture is thoroughly mixed and evenly spread through all materials proposed for embankment construction, to within the range of -2%, +2% of the optimum moisture content, as determined from laboratory testing in accordance with the latest version of AS1289 - 5.1.1., prior to placement and compaction. The moisture content must be uniformly distributed throughout the fill and there must be no clods of soil. Only approved water must be used for moisture control.

The construction methodology for Zone 1 Fill placement must be as follows:

i) Spread a loose lift of moisture cured embankment fill material with a loose thickness not exceeding 300 mm.

ii) Apply water with one or more passes of the water truck, as required, to retain the moisture within the fill within the range of -2%, +2% of the optimum moisture content.

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iii) Grade, mix to ensure the moisture is uniformly distributed and trim with a grader.

iv) Compact the material with 6 to 10 passes using either a sheepsfoot roller (Caterpillar 825 or approved equivalent) or a minimum 10 tonne vibratory padfoot drum roller to 95% of the maximum SMDD, at a moisture content within ±2% of OMC, as determined by.

v) Test the material for compaction (refer to Section 4 for testing requirements).

vi) After successful compaction testing, add another lift and repeat steps i) to v).

vii) Placement must be continuous. If the material dries out due to inactivity at the site, it should be lightly watered and compacted prior to fill placement recommencing.

viii) The Contractor must verify the above construction methodology prior to execution.

Where the required finished grade has a slope steeper than 1 vertical to 4 horizontal, overbuild the slope by no less than 600 mm (measured horizontally) and trim back to finished grade after compaction.

Where the existing ground surface, on which the fill or embankment is to be constructed, has a slope steeper than 1 vertical to 4 horizontal, bench the existing slope so that each lift can be placed and compacted horizontally. Benching must be of sufficient width to permit the safe and effective operation of placing and compacting equipment. Begin each horizontal cut at the intersection of the original ground surface and the vertical sides of the previous cut. Place and compact material cut out for benching in conjunction with the compaction of the fill material. Compaction by water jetting or flooding is not permitted.

3.3.4 Placement of Zone 2 Rock Fill Material

The Contractor must construct the required parts of the works designated as to be constructed of Zone 2 Rock Fill Material using the designated material in accordance with Section 2.3 sourced from the designated borrow and designated areas approved by the Engineer.

The construction methodology for Zone 2 fill placement must be as follows, where the Rock Fill Material is to be encapsulated within the downstream zone and be contained by the compacted outer protection layer:

i) Spread a loose lift of Zone 2 Rock Fill Material with a maximum thickness normal to the embankment face not exceeding 750 mm.

ii) The Rock Fill Material shall be compacted using smooth drum vibrating rollers of not less than 11 tonnes front module mass in layers of loose lift thickness not exceeding 750 mm. Where the front module mass is less than 11 tonnes, the loose lift thickness of the Rock Fill shall be reduced.

3.3.5 Placement of Base Course

The Contractor must place the base course material using suitable material in accordance with Section 2.4. The construction methodology for fill placement must be as follows:

i) Spread the base course material with a thickness of 75mm.

ii) Grade and trim with a grader to shape the material to a smooth and even surface, free of voids and to the required lines and grades on the Design Drawings.

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iii) Compact the base course material to 98% of the SMDD, as determined by AS1289 - 5.2.1, in the designated areas.

The Contractor must verify the above construction methodology prior to execution.

Where base course materials are designed to be placed on the crest of the TSF over a HDPE liner, to provide road access around the facilities, a sacrificial layer of HDPE is to be welded over the initial HDPE liner, with a layer of geotextile placed over the sacrificial layer of HDPE. A 150 mm thick layer of base course is to be spread over the geotextile and rolled, with the compaction plant operating in static mode.

3.3.6 Surface and Drainage

The Contractor must conduct fill operations in such a manner and sequence that proper drainage is maintained at all times in and around the work area. Promptly remove surface waters that become impounded. Remove and replace with satisfactory fill materials or stabilise (by drying, or by approved mechanical or chemical amendment methods) materials that become loosened due to exposure to the elements.

3.3.7 Maintenance

The Contractor must maintain the final surfaces in a well-drained, dewatered and sufficiently moist condition to prevent shrinkage cracking and minimise dusting. The compacted surface must be smooth and generally free from roller marks, ruts, holes, depressions or protrusions.

4 TESTING AND INSPECTION

4.1 Testing Firm/Facilities

An Independent Testing and Inspection Firm will be retained by the Owner to perform field and laboratory testing and soil evaluations for control of construction activities and/or to verify compliance of the work with the requirements of this Specification. The performance or lack of performance of Quality Control tests and inspections must not be construed as granting relief from the requirements of these Specifications or the other contract documents.

The Independent Testing and Inspection Firm must meet the technical criteria of NATA or AS for agencies involved in soil and rock inspection and testing. Any work failing to meet the criteria of the Specification must be rectified at the Contractor's expense.

4.2 Finishing Tolerances

The Contractor must fine grade the surfaces and perform all work to a vertical tolerance of ±50mm from the elevations shown on the Design Drawings. All lines and dimensions must be constructed to within a horizontal tolerance of ±1% and with a maximum tolerance of 100mm from the dimensions and lines on the Design Drawings. The average slope of batters must not exceed the specified slope.

4.3 Material Suitability

Prior to the placement of Zone 1 or Zone 2 Rock Fill materials and Base Course Material field and laboratory testing must be performed by the Independent Testing and Inspection Firm to assess the suitability of the materials for construction. Materials must meet the requirements outlined in Section 2.0 of this Specification. Compaction criteria for the construction must be established by performing compaction

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testing on representative samples in accordance with AS 1289 - 5.1.1/AS 1289 -5.2.1, as appropriate to the materials and the designated compaction standard relevant to the work.

4.4 Compaction Testing

Field density testing must be performed by the Independent Testing and Inspection Firm on the compacted embankment material to ensure the compaction criteria meets the requirements of this Specification. The preferred field density testing method is the Nuclear Density test method in accordance with AS 1289. The calibration curves must be checked and adjusted using either the sand cone method as described in AS 1289, or by an approved method designated by the Engineer supervising the construction.

The calibration checks of both the density and moisture of each gauge must be made at the beginning of the project, on each different type of material encountered and at intervals as directed by the Supervising Engineer. The number of tests must be increased if visual inspection indicates non-uniform moisture content or variable compaction effort considered inadequate to achieve the specified dry density.

The Contractor must provide surveys of the locations and Reduced Levels (RLs) of the test sites.

4.5 Testing Program

Laboratory testing for Zone 1 materials and Base Course Material materials must follow the requirements of Table 4.1 as a minimum.

Table 4.1 – Quality Control Tests

Property	Test Method	Minimum Testing Frequency	
		Material Stockpiles	Material Compacted in Place
		Zone 1 - Embankment Fill Material	
Moisture Density	AS 1289 – 5.1.1	1:5,000m³	1:2,500m³
Soil Classification	AS 1726 - 1993	1:5,000m³	
Plasticity	AS 1289 - 3.2.1 AS 1289 – 3.3.1	1:5,000m³	
Particle Size Distribution	AS 1289 - 3.6.1	1:5,000m³	
Field Density	AS 1289 - 5.3.1	1:2,500m³	1:500m³ (per layer)

4.6 Additional Inspections

The Contractor must perform random surveys of the top of every third layer to monitor fill progress.

5 CLEAN UP

Upon completion of the work, the Contractor must leave the project site clear of debris and surplus material resulting from the construction operations.

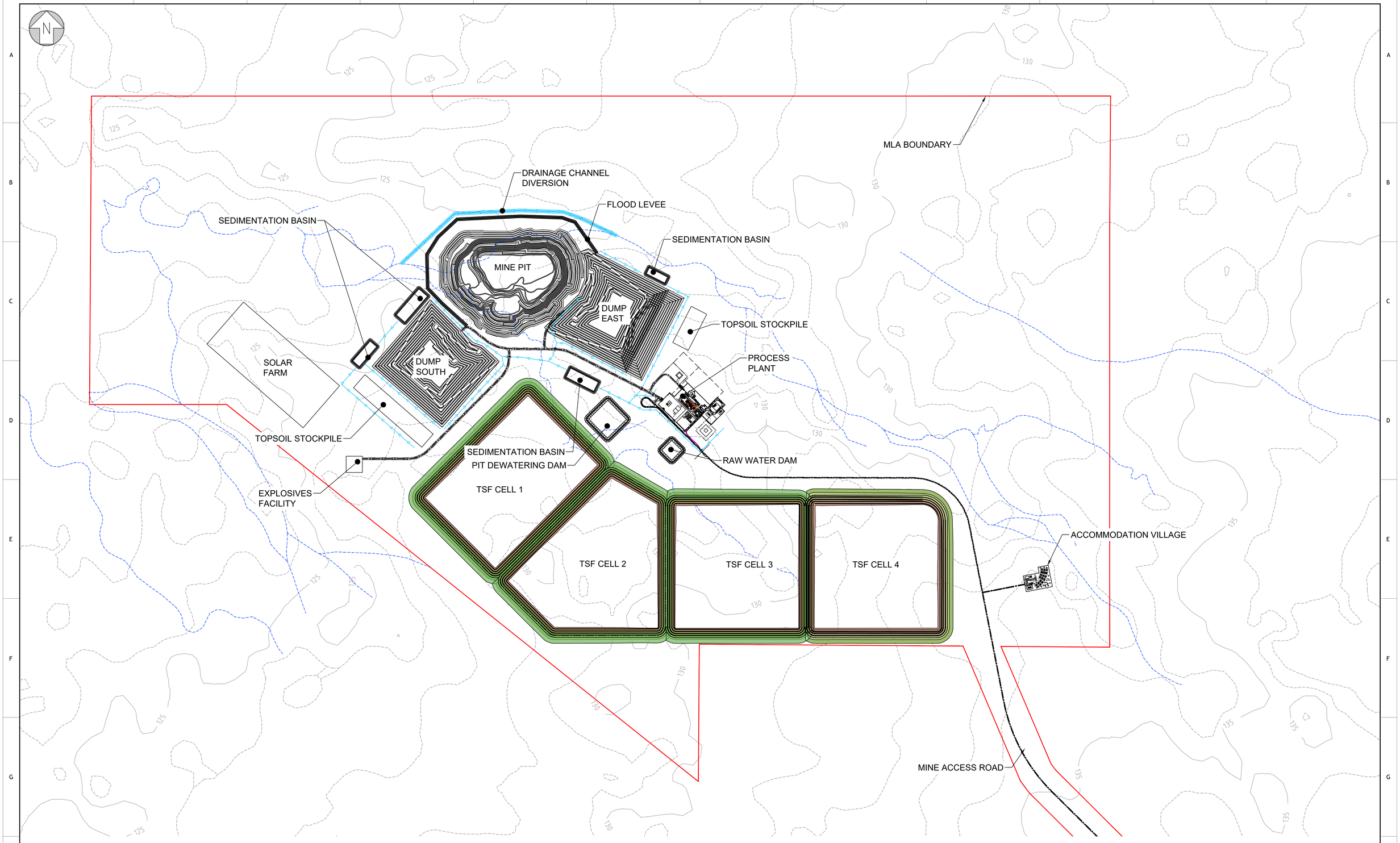
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Appendix 1

Drawings

Graphinex Pty Ltd
Tailings Storage Facilities - Earthworks Specification

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300 30 300 600 900 1200 1500m

SCALE 1:15,000

LOCALITY PLAN

1:15,000

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ENGINEER P. GLOWERY	10.03.2025
APPROVED L. BLACK	10.03.2025

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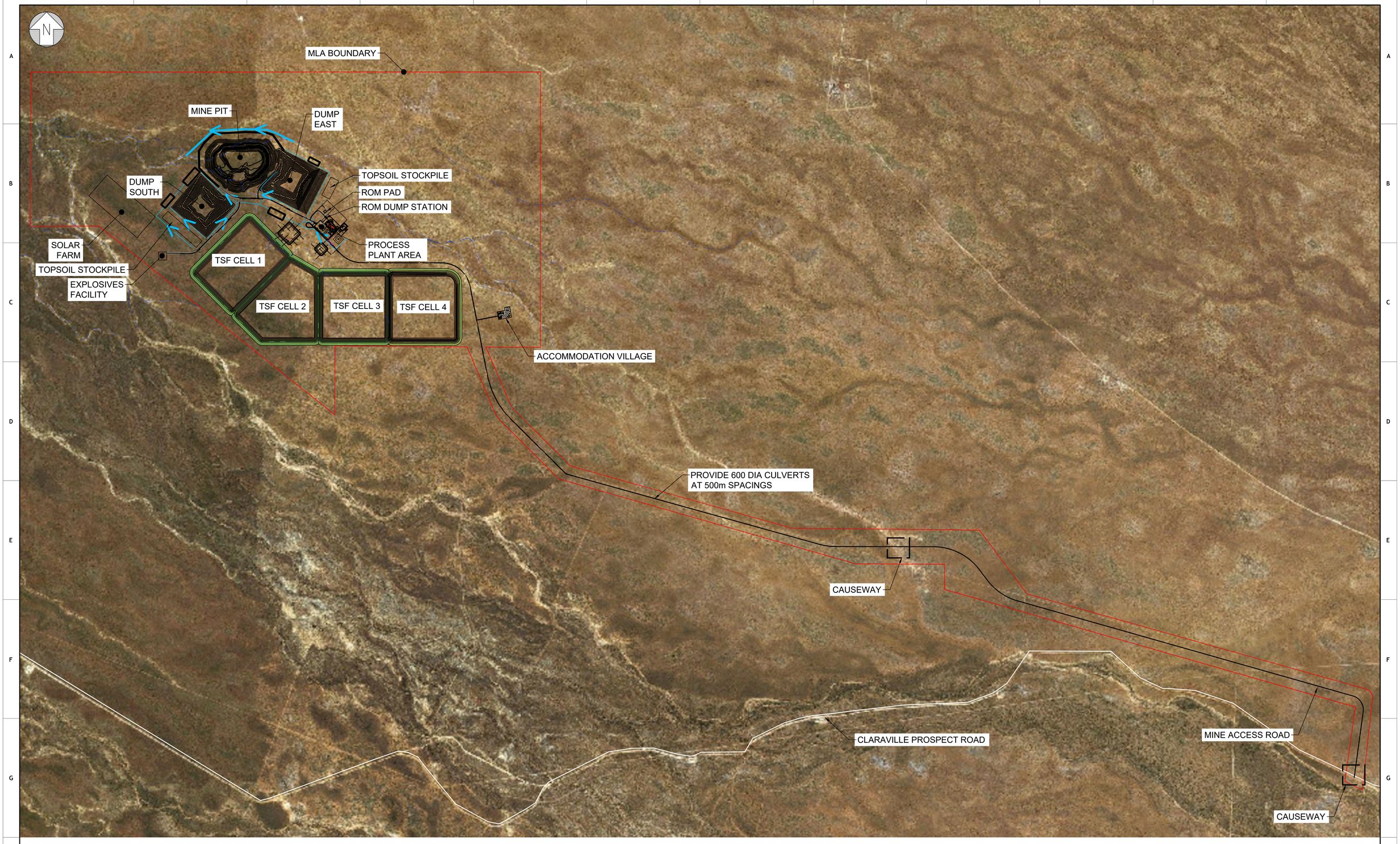
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600 0 600 1200 1800 2400 3000m

SCALE 1:30,000

LOCALITY PLAN

1:30,000

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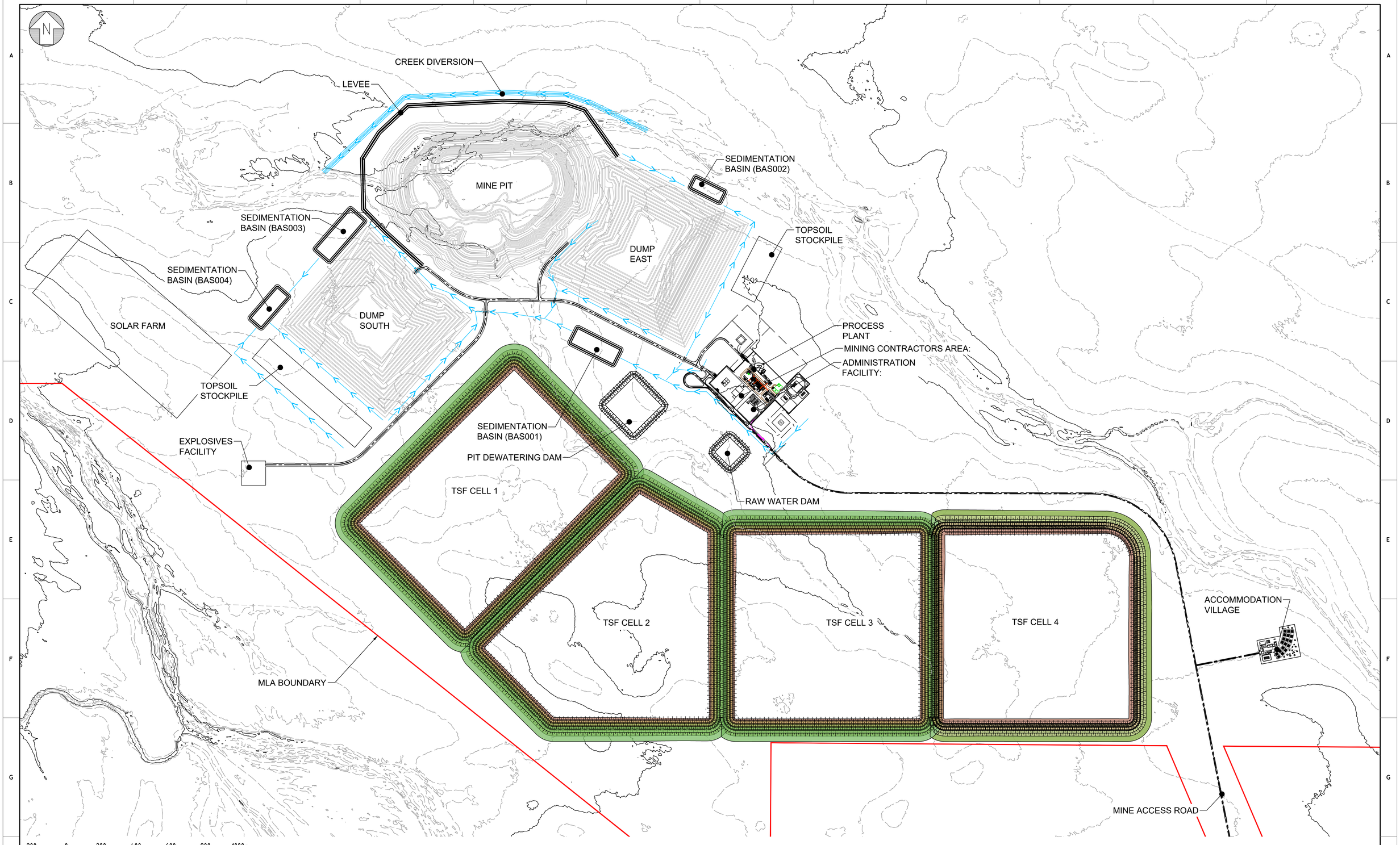
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PLAN
1:10,000

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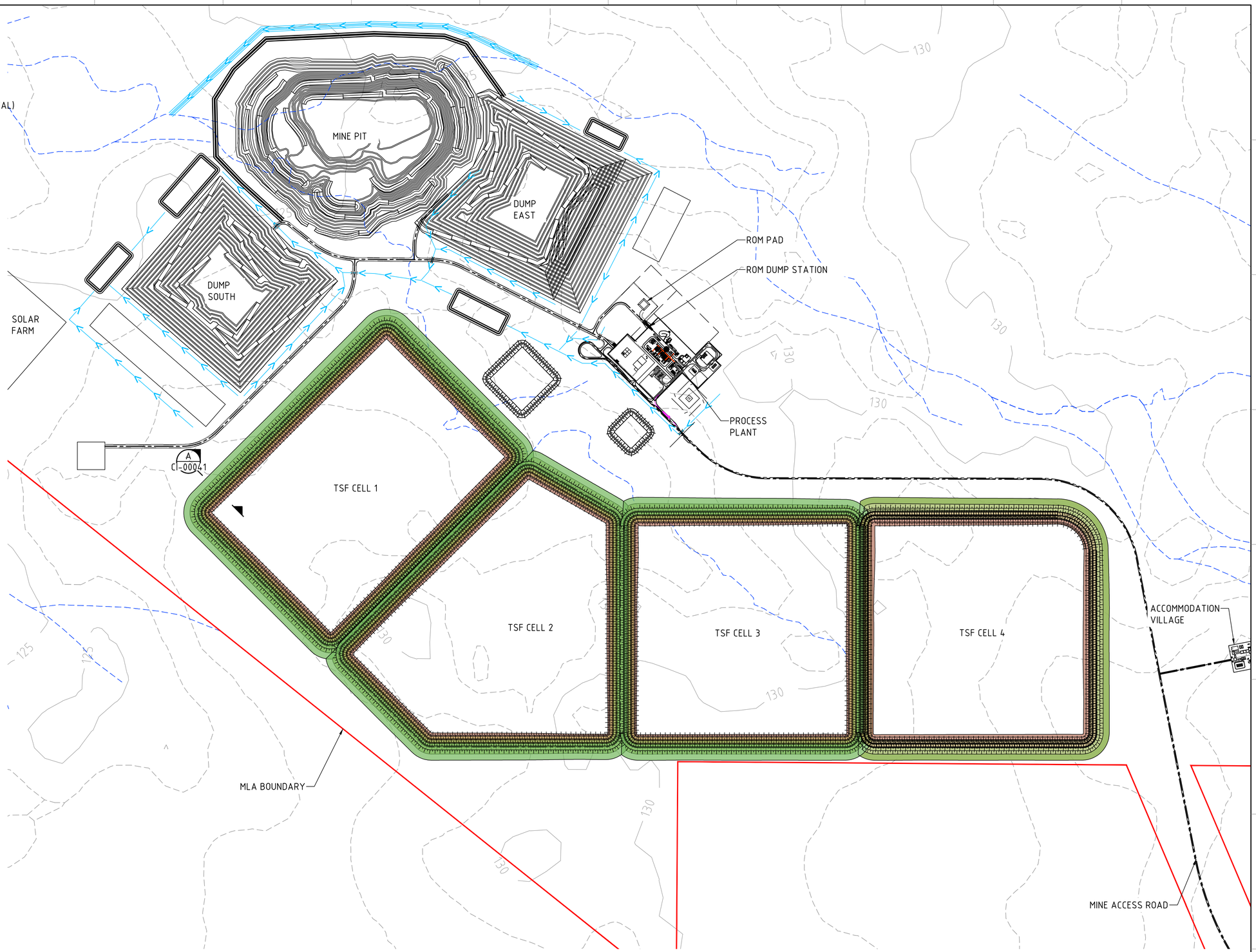
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REV: B

LEGEND

- 385 — EXISTING SURFACE CONTOUR (1m INTERVAL)
- GRADE LINE
- PROPOSED TOP OF BATTER (LEFT)
- STAGED EMBANKMENT - LIFT 01
- STAGED EMBANKMENT - LIFT 02
- STAGED EMBANKMENT - LIFT 03
- STAGED EMBANKMENT - LIFT 04



200 0 200 400 600 800 1000m

SCALE 1:10,000

LOCALITY PLAN

1:10,000

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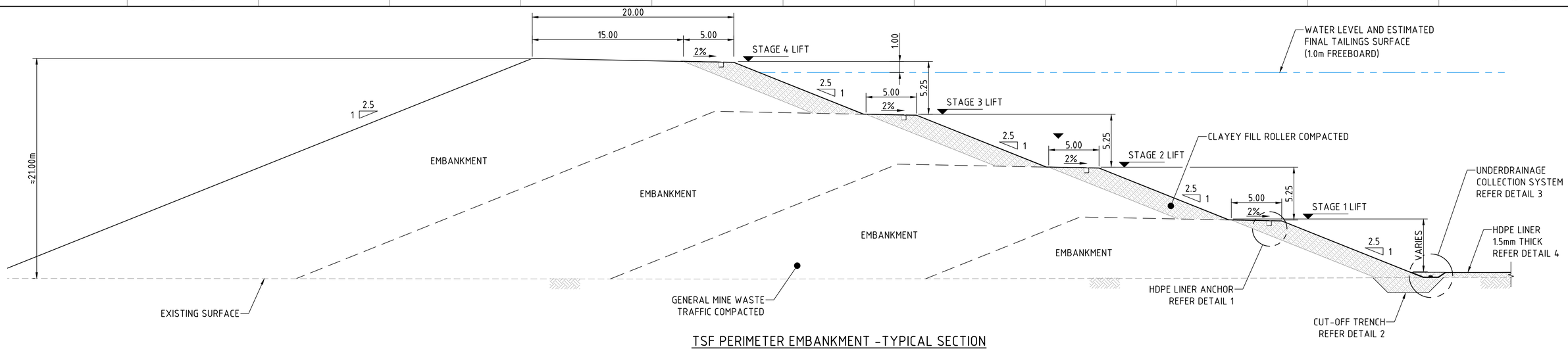
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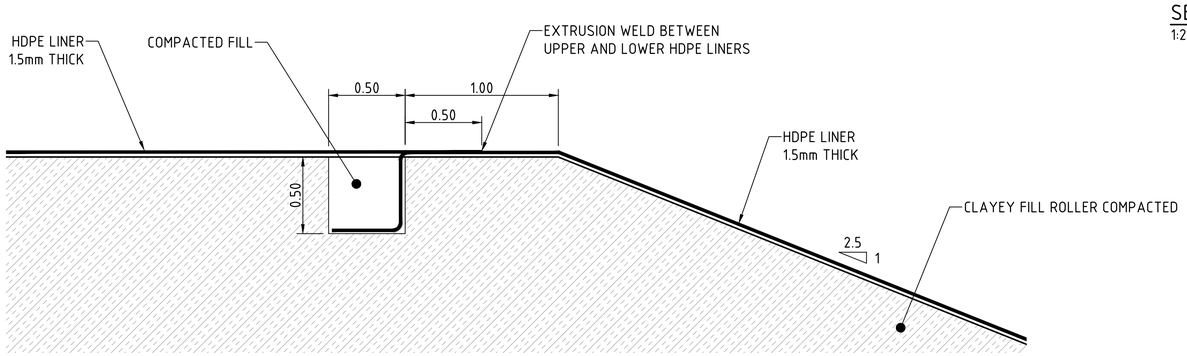
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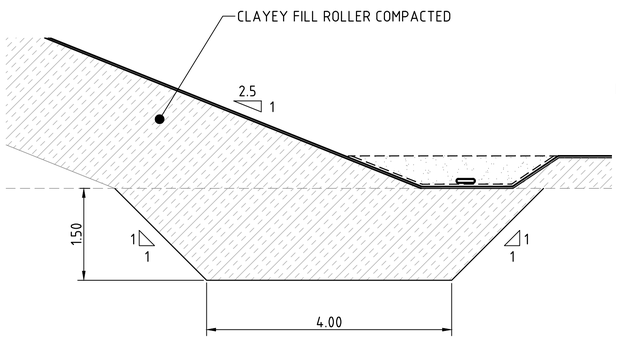


TSF PERIMETER EMBANKMENT -TYPICAL SECTION

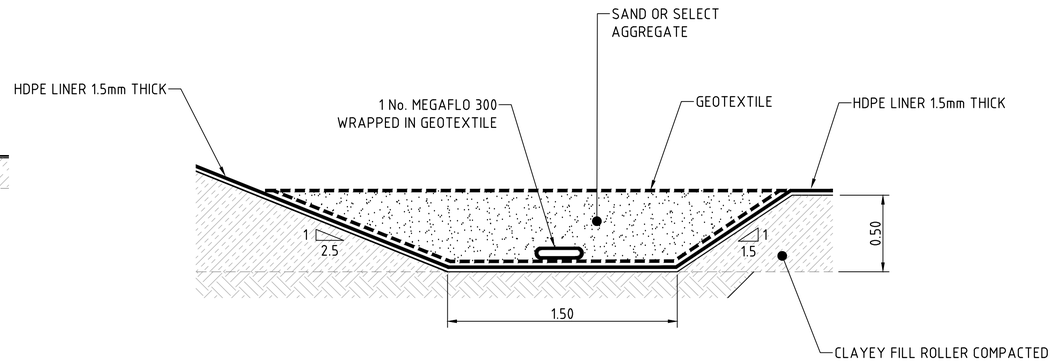
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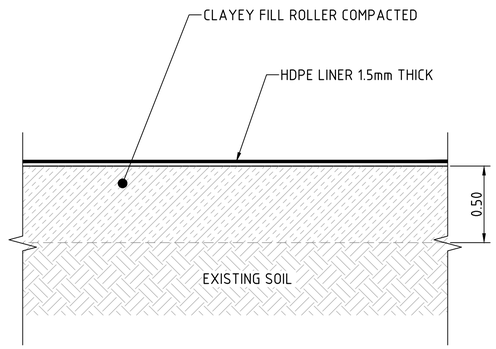
DETAIL 1 – HDPE ANCHOR -TYPICAL DETAIL
1:20



DETAIL 2 – CUT-OFF TRENCH -TYPICAL DETAIL
1:50



DETAIL 3 – UNDERDRAINAGE COLLECTION SYSTEM-TYPICAL DETAIL
1:20



DETAIL 4
1:20

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

4 0 4 8 12 16 20m
SCALE 1:200

1.0 0 1.0 2.0 3.0 4.0 5.0m
SCALE 1:50

0.4 0 0.4 0.8 1.2 1.6 2.0m
SCALE 1:20

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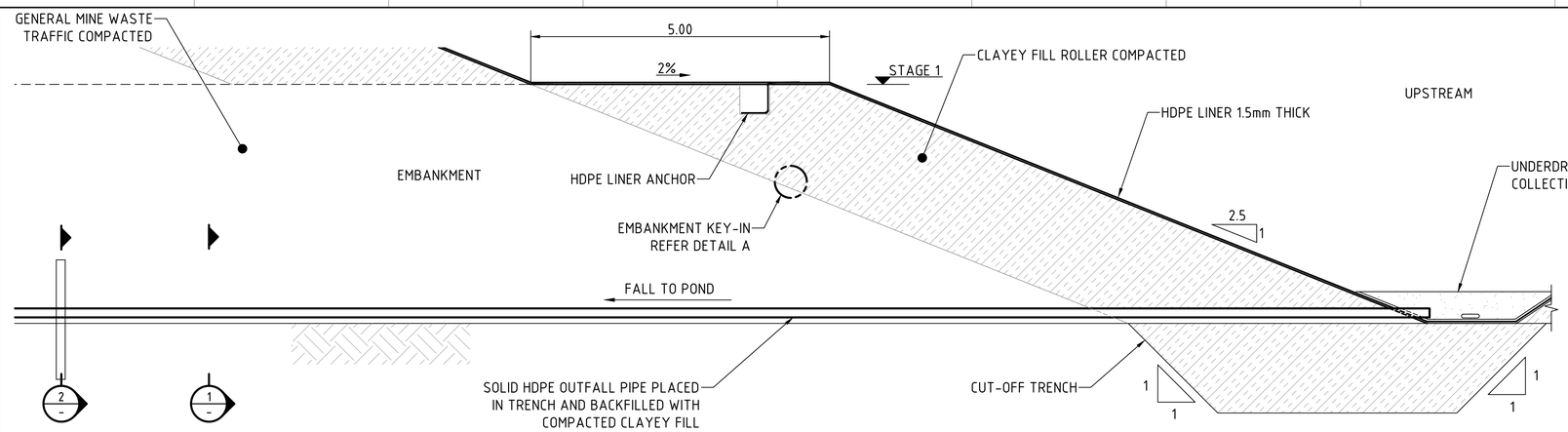
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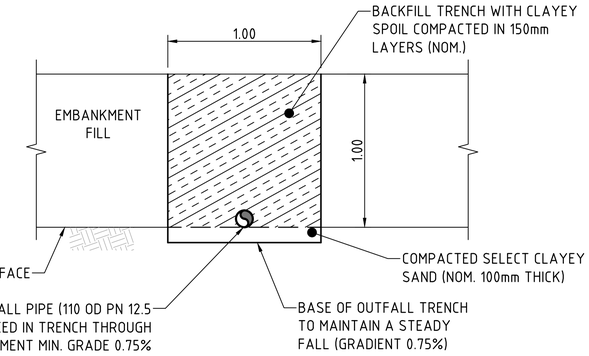
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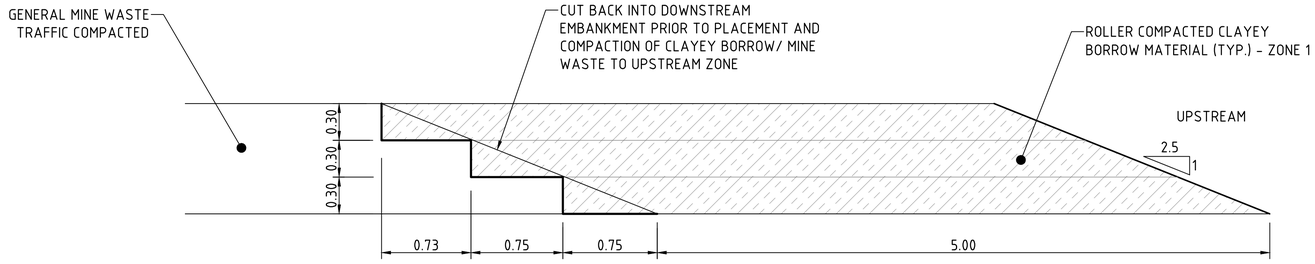
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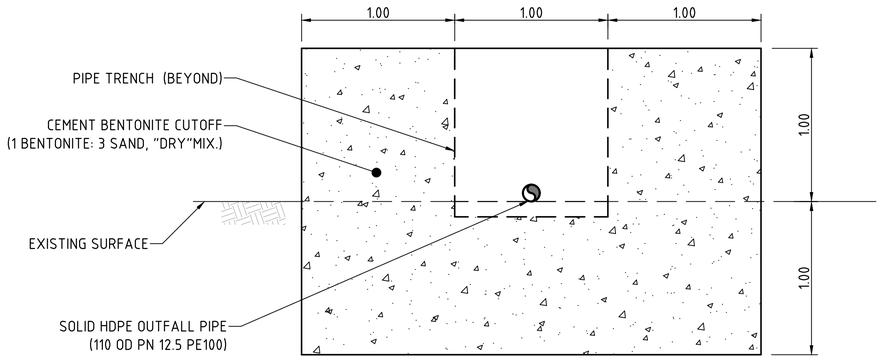
UNDERDRAINAGE OUTFALL PIPE THROUGH EMBANKMENT -TYPICAL SECTION
1:50



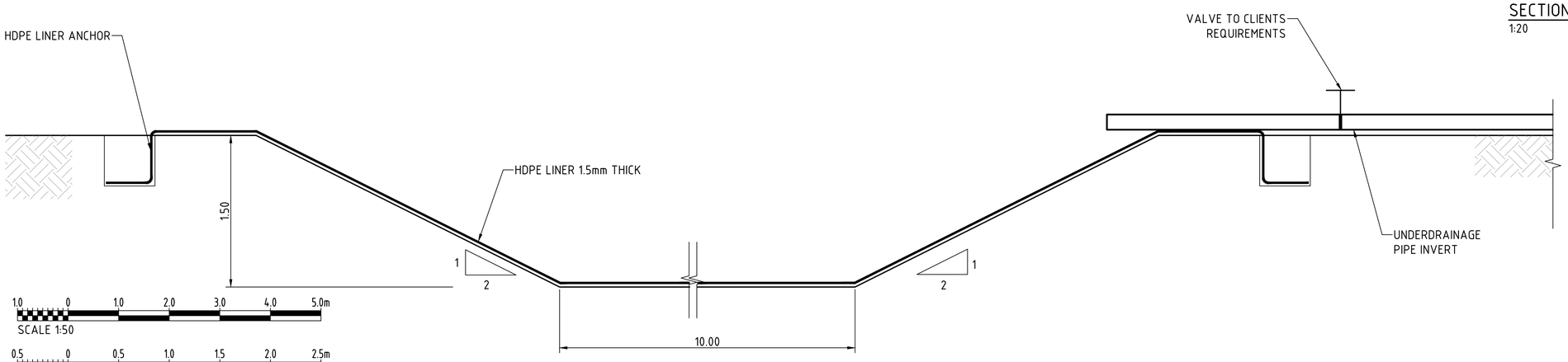
SECTION 1 / - OUTFALL PIPE TRENCH (THROUGH EMBANKMENT) -TYPICAL SECTION
1:20



DETAIL A / - EMBANKMENT KEY-IN -TYPICAL DETAIL
1:25



SECTION 2 / - CEMENT BENTONITE CUTOFF -TYPICAL SECTION
1:20



UNDERDRAINAGE SUMP -TYPICAL SECTION
1:25

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

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GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

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Appendix 2

Schedule of Materials

(to be completed by others)

Graphinex Pty Ltd

Tailings Storage Facilities - Earthworks Specification

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Appendix D

HDPE Liner Specification

Graphinex Pty Ltd

Tailings Storage Facility Scope of Works

Soil & Rock Engineering Pty Ltd (SRE)
ABN 98 675 219 020

GRAPHINEX

Esmeralda Graphite Project

Tailings Storage Facilities

HDPE Liner, Supply, Installation, Inspection and Testing Specification

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Ref: **HDPE Liner Rev B 202406**

Date: **15 February, 2026**

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Prepared by: **TSFRPL**
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Cowaramup WA 6284

Prepared for: **Graphinex Pty Ltd**
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Brisbane QLD 4000

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13/02/2026	B	Issued for Client Review	C Lane

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Terminology and Abbreviations

The following terminology and abbreviations have been used in this document:

AS	Australian Standard
AOS	Apparent Opening Size
ASTM	American Society for Testing and Materials
CBR	Californian Bearing Ratio
CMW	CMW Geosciences Pty Ltd
DST	Double Sided Textured HDPE Liner
GCL	Geosynthetic Clay Liner
GPL	Graphinex Pty Ltd
GRI	Geosynthetic Research Institute
HDPE	High Density Polyethylene
MARV	Minimum Average Roll Value (50% of results will typically exceed this value, and 50% will typically not meet this value)
MSDS	Material Safety Data Sheet
NATA	National Association of Testing Authorities
OIT	Oxidative Induction Time
QAQC	Quality Assurance and Quality Control
RL	Reduced Level
SST	Single Sided Textured HDPE Liner
TSF	Tailings Storage Facility

DRAFT Rev

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DRAFT Rev B (issued for client review)

Project: Esmeralda Graphite Project - Tailings Storage Facilities

Subject: HDPE Liner, Supply, Installation, Inspection and Testing Specification

1 GENERAL

1.1 Summary

This Specification prescribes the requirements for the manufacture, supply, installation, inspection and testing of a geomembrane liner manufactured from High Density Polyethylene (HDPE) for the purpose of liquid and solid containment in the construction of the Tailings Storage Facilities (TSFs) for the Esmeralda Graphite Project (EGP). This Specification in conjunction with relevant International standards and codes, other referenced Specifications and related documents define the technical requirements for the material component, manufacture, marking, inspection, testing and packing of the geotextile. It encompasses the furnishing of all labour, materials, transportation, handling, storage, supervision, tools, and other equipment that may be necessary to install, seam, patch and test the installation as described herein, in associated plans, and engineering drawings.

This document prescribes the work to be undertaken by the Supplier and the Contractor as follows:

Supplier: Sections 1, 2, 3, and 4.
Contractor: Sections 1, 4, 5, and 6.

Related Specifications

The latest revisions of the following specifications prescribe items of related Work:

i) Earthworks Specification.
ii) Geotextile Specification.
iii) HDPE Pipework Specification (supplied by the client).

The Contractor must coordinate work prescribed by this Specification with work performed for the above listed Specifications.

The Appendices referred to in this document comprise the following and are to be attached to this document by the Owner.

- Appendix 1 Drawings
- Appendix 2 Schedule of Materials

The Contractor must coordinate work prescribed by this Specification with other related works to be performed, such as relocation of tailings pipework, as appropriate.

This Specification must be read in conjunction with the latest revisions of the Design Drawings listed in Table 1.1.

DRAFT Rev B (issued for client review)

Table 1.1 - Drawings

Drawing No.	Title
6235-40-DWG-00020 Rev B	Mine Site General Arrangement Plan
6235-40-DWG-00030 Rev B	Site Wide Drainage Plan
6235-40-DWG-00031 Rev B	Mine Site Drainage Plan
6235-40-DWG-00040 Rev A	Tailings Storage Facility Plan
6235-40-DWG-00041 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
6235-40-DWG-00042 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

1.2 Terminology

The following terms are defined as stated, unless otherwise indicated:

Contractor	Appropriate individual, partnership, company, or corporation contractually obligated to perform the work prescribed in this Specification and associated Specifications (Section 1.1) and becomes contractually obligated to the Owner.
Design Drawings	Detailed Design Drawings issued by the Owner to the Contractor.
Engineer	The engineer (or designated representative) appointed by the Owner who is responsible for evaluating the suitability of the materials involved in the work, and for verifying the compliance of the work to the requirements of the Specifications.
Independent Testing and Inspection Firm	Independent Testing and Inspection Contractor.
Manufacturer	The entity or fabricator of the HDPE Liner. The Manufacturer must be the Supplier or a subcontractor to the Supplier.
Master Seamer	The designated representative of the Contractor appointed by the Contractor with the required experience in geomembrane seaming to supervise the seaming. This may or may not be the Supervisor.
Project Superintendent	The designated representative of the Contractor appointed by the Contractor who is responsible for the work by the Contractor.
Work / works	The activities specified within this document as the responsibility for the Contractor.

1.3 References

The publications listed below form part of this Specification. Each publication must be the latest revision and addendum in effect on the date this Specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Design Drawings, work included in this Specification must conform to the applicable provisions of these publications.

1.3.1 Applicable Codes / Standards

The works must be carried out to comply with the latest revision of the Design Drawings, Codes and Standards specified or to the appropriate Australian Standards, or to other recognised International Standards approved by the Owner or the Engineer where there is no comparable Australian Standard.

The standards applicable to this work are as follows:

- American Society for Testing and Materials (ASTM):
  - ASTM D413 Standard Test Methods for Rubber Property - Adhesion to Flexible Substrate.
  - ASTM D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics.
  - ASTM D1004 Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
  - ASTM D1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
  - ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
  - ASTM D3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry.
  - ASTM D4437 Standard Practice for Determining the Integrity of Field Seams Used in Jointing Flexible Polymeric Sheet Geotextile.
  - ASTM D4801 Standard Specification for Polyethylene Sheeting in Thickness of 0.25mm (0.010 inch) and Greater.
  - ASTM D4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
  - ASTM D5199 Standard Test for Measuring the Nominal Thickness of Geosynthetics.
  - ASTM D5321 Standard test Method for determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
  - ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
  - ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
  - ASTM D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
  - ASTM D5721 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
  - ASTM D5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
  - ASTM D5885 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
  - ASTM D5994 Standard test method for measuring Nominal Thickness of Geotextiles and Geomembranes.
  - ASTM D6693 Standard Test Method for Determining Tensile Properties of Non reinforced Polyethylene and Non reinforced Flexible Polypropylene Geomembranes.
  - ASTM D6392 Standard Test Method for Determining the Integrity of Non reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
  - ASTM D7002 Standard Practice for Leak Location on Exposed Geomembranes Using the Water Puddle System.
  - ASTM D7007 Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials.
  - ASTM D7240 Leak Location using Geomembranes with an Insulation Layer in Intimate Contact with a Conducive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test).

- ASTM D7703 Standard Practice for Leak Location on Exposed Geomembranes Using the Water Lance Method.

- Federal Test Method:
  - NSF Standard 54 Flexible Membrane Liners.

- Geosynthetic Research Institute (GRI):
  - GRI - GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device.
  - GRI – GM12 Asperity Measurement of Textured Geomembranes Using a Depth Gage.
  - GRI – GM13 Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.
  - GRI – GM19 Seam Strength and Related properties of Thermally Bonded polyolefin Geomembranes.

1.4 Submittals

All submittals must be delivered to the Owner. The following information must be submitted prior to the work. All submittals must be delivered to the Owner.

1.4.1 Bid Submission

The following information or materials must be submitted with the bid documents:

i) Product samples, product data including material safety data sheet (MSDS), and Manufacturer's or Supplier's written certificate, indicating that the liner meets the requirements of this standard and other project documents. The Manufacturer/Supplier must submit a 5-year warranty for the geomembrane material.

ii) Evidence of the Contractor's expertise and qualifications for installing the liners, including the name and qualifications of its project superintendent and senior installation personnel that will carry out the work. Personnel performing welding operations must be certified or approved by the liner manufacturer.

iii) A complete written description of the Contractor's quality assurance/quality control (QA/QC) program, as applicable, for handling, installing, testing, and repairing the liner in accordance with the requirements of this Specification. The program must cover all items intended for shop inspection, field supervision and the procedures for carrying out installation. The program must define a system for identification of all materials from manufacture through to delivery at site. This submittal must also include a detailed outline of methods for controlling expansion and contraction during installation of the geomembrane.

iv) Written acceptance of the design drawings and general configuration of the geomembrane lining system for the intended purpose. In case the Contractor does not approve the original design, he must submit to the Owner for review and approval, detailed drawings showing an alternative design and configuration that will better serve the intended purpose.

1.4.2 Supplier

The Supplier must submit all the following at least 14 days prior to shipping the materials. To meet this requirement, the supplier needs to pay special attention to acquiring the required soil samples from the site and arranging the interface shear strength tests.

i) The Supplier must submit to the Engineer in writing the following documentation on the raw materials used to manufacture the geomembrane:

   a) Copies of quality control certificates issued by the resin supplier including production dates of the resin.
   b) Results of tests conducted to verify the quality of the resin used to manufacture the geomembrane.
   c) Certification that no reclaimed polymer is added to the resin during the manufacture of the geomembrane to be used in this project.

The Supplier must submit to the Engineer the following information on geomembrane:

i) Manufacturing quality control certificates for each shift's production, signed by responsible parties employed by the Manufacturer (such as the production manager).

ii) The quality control certificate must include:
   a) Roll numbers and identification.
   b) Sampling procedures.
   c) Results of quality control tests, including descriptions of test methods used.

iii) The interface shear strength test results as required.

The Supplier must provide a material warranty against manufacturing defects for a period of five years from the receipt date of geomembrane onsite.

If a test result is in non-conformance, all material from the lot represented by the failed test must be considered out-of-specification and rejected. Alternatively, at the request of the Manufacturer or the Supplier and at the discretion of Owner, additional conformance tests may be conducted at the Manufacturer's or the Supplier's expense if the failed test is a QA test. Additional conformance test samples may be taken to 'bracket' the portion of the lot not meeting specification (note that this procedure is valid only when all rolls in the lot are consecutively produced and numbered from one manufacturing line). To isolate the out-of-specification material, additional samples must be taken from rolls that have roll numbers immediately adjacent to the roll that was sampled and failed. If additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number) must be rejected. If one or both of the additional tests fail, the entire lot must be rejected or the procedure repeated with two additional tests that bracket a greater number of rolls within the lot.

In case the Engineer rejects the geomembrane due to non-conformance test results, and the Supplier or the Manufacturer has reason to believe that failing tests may be the results of the Geosynthetic Laboratory incorrectly conducting the tests, the Manufacturer may request that the sample in question be retested by the Geosynthetic Laboratory with a technical representative of the Supplier/Manufacturer present during the testing. Alternatively, the Supplier/Manufacturer may have the sample retested at two different Owner-approved Geosynthetic Laboratories. If both laboratories produce passing results, the material must be

accepted. If both laboratories do not produce passing results, the original Geosynthetic Laboratory's test results must be accepted. The use of these procedures for dealing with failed test results is subject to the approval of the Owner, and the expenses paid by the Supplier/Manufacturer.

1.4.3 Construction

The following information or materials must be submitted prior to and during the work:

i) One month before the start of the work, the Contractor must submit drawings, a description of installation procedures/sequences, and a schedule for performing the work. The installation drawings must clearly show the proposed liner sheet layout with size, number (identification), position and sequence of placing of all sheets, and the location of all field seams. The drawings must also show the complete details of liner anchors, field seams, and seals to items penetrating the liner.

ii) One month before the start of work, the Contractor must submit samples of the geomembrane for compliance testing (refer to Section 5.4).

iii) One week before the start of work, the Contractor must prepare and submit a site-specific Health, Safety and Environmental Management Plan including site specific considerations and traffic management during construction of the work.

iv) One week before the start of work, the Contractor must submit a complete description of welding procedures, including welding equipment, for making field seams and repairs. The welding procedures must conform to the latest procedures recommended by the Manufacturer and to this specification.

v) One week before the start of work, the Contractor must submit trial field seams to the owner for review and approval (refer to Section 4.4). The seams must be fabricated using the same materials, personnel, equipment and procedures that will be used during the actual liner installation. Samples must be numbered and dated.

vi) Prior to the field installation of the liners, the Contractor must submit a written acceptance, indicating that the surface on which the liner is to be placed is acceptable. Installation must not commence until this certification is submitted to and approved by the Owner.

vii) Daily reports must be submitted by the Contractor, documenting work accomplished the previous day including all personnel and equipment on-site, quantities of materials received, panels placed, welding completed, tests performed, repairs made, weather conditions and other applicable comments relevant to the progress of the work. The identification number, location, date and roll number of each panel deployed should be noted.

The following information or materials must be submitted at the completion of work:

The Contractor must submit written certification signed and stamped by a professional engineer, stating that the liner was installed in accordance with the Manufacturer's recommendations, project specifications and drawings:

i) Test results from all field and laboratory tests.

ii) As built drawings including the identification number, location, date and roll number of each panel deployed.

iii) Record of repairs.

iv) Written 1 year guarantee that the entire liner work constructed is free of defects in materials and workmanship.

1.4.4 Geomembrane Handling and Shipping

The Supplier must deliver the geomembrane only after obtaining the Engineer's approval of the shipping. Each roll of geomembrane delivered to the site must be labelled by the Manufacturer, including the Manufacturer's name, product identification, thickness, length, width, roll number.

2 PRODUCTS

2.1 Liner Materials

The geomembrane liner must be smooth, single-sided textured (SST) or double-sided textured (DST) HDPE, as noted on the Drawings, manufactured from polyethylene resin produced in a low-pressure ethylene polymerisation process, and as a minimum meeting the requirements of ASTM D4801. The manufacture of the liner sheet must be by an extrusion process using pure HDPE entirely free of plasticisers or other filler materials, and without any prefabrication.

The resins used for extrusion welding with extrudate to make field seams between HDPE sheets must be the same as the HDPE sheet resins. The geomembrane manufacturer (smooth and textured) must provide resin certificates indicating that the raw material meets or exceeds the requirements of this specification as shown in Table 2.1.

Table 2.1 – Physical Properties of HDPE Resin

Property	American Standard Test Method	Unit	Value	Qualifier	Manufacturer Supplied QC	QA Confirmation
Density	ASTM D1505	(g/cm²)	0.932	Minimum	1 per Lot	None
Melt Flow Index	ASTM D1238 (190/2.16)	(g/10 min)	1.0	Maximum	1 per Lot	None
Oxidative Induction Tim	ASTM D3895 (1 atm/200°C)	(minutes)	100	Minimum	1 per Lot	None

Physical properties of the resins must be the same as the liner sheets.

The liner must be comprised of material manufactured of new, first-quality products designed and manufactured specifically for the purpose of this work and must have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes.

The liner materials must be produced to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defects must be repaired by the Contractor using the extrusion fusion welding technique in accordance with the Manufacturer's recommendations.

The liner material must be uniform in colour, thickness, size and surface texture.

Except where shown on the drawings, individual sections of the liner, as supplied, must not be less than 7 m wide without prefabrication and must be of such dimensions and shape to result in the minimum on-site seam weld length. The minimum nominal thickness of the base liner must be 1.5 mm, and the additional liner for the W-drains must be 2.5 mm.

The geomembrane must be chemically resistant to the material to be contained, and suitable for service temperatures as well as the soils/groundwater conditions of the site. Material specifications supporting this confirmation must be supplied on request. Unless otherwise specified in the project documents, the physical properties of the HDPE liner must meet the requirements listed in Table 2-2 for textured liner.

The Contractor may submit physical properties for different or alternative liner for review by the Owner. Different/ alternative liner may be used with written approval from the Owner.

Table 2.2 – Properties of Textured Liner

Property	Test Method	Unit	Value	Qualifier	Manufacturer Supplied QC	QA Confirmation
Thickness[1]	ASTM D5199	mm	1.5	Nominal	1 per roll	1 per roll
			2.5			
			1.45	MARV		
			2.3			
			1.37	Note 1		
			2.13			
Density	ASTM D1505	g/cm³	0.940	Minimum	1 per 90,800kg	None
Asperity Height[2]	GRI - GM12	mm	0.41	Minimum	Every 2nd roll	None
Yield Strength[4]	ASTM D6693 Type IV	kN/m	22	MARV	1 per 9,080kg	1 per 3,717m²
			37			
Break Strength[4]		kN/m	16			
			26			
Yield Elongation[4]		%	12			
Break Elongation[4]		%	100			
Tear Resistance	ASTM D1004	kN	0.187	MARV	1 per 20,430kg	1 per 3,717m²
			0.311			
Puncture Resistance	ASTM D4833	kN	0.40	MARV	1 per 20,430kg	None
			0.667			
Stress Crack Resistance[3]	ASTM D5397	Hrs	300	Minimum	1 per lot	None
Carbon Black Content[5]	ASTM D1603	%	2-3	Range	1 per 9,080kg	None
Carbon Black Dispersion[6]	ASTM D5596	Number	Note 6	Note 5	1 per 20,430kg	None
Standard OIT[7]	ASTM D3895	Minutes	100	Minimum	1 per 9,080kg	None
High Pressure OIT[7]	ASTM D5885		400			
Oven Aging at 85°C[7]	ASTM D5721	% Retained at 90 days	55	MARV	1 per formulation	None
Standard OIT[8]	ASTM D3895		55			
High Pressure OIT[8]	ASTM D5885		80			
UV Resistance High Pressure OIT[9,10]	GRI - GM11	% Retained at 1600hrs	50	MARV	1 per formulation	None

Notes:

1) *Only 2 out of 10 values should be less than 1.35mm.*
2) *In addition to asperity height, the Manufacturer must also meet the interface shear strength requirements in Table 2-3.*
3) *Test should be conducted on smooth ends of the textured liner or on smooth sheet made from exactly the same formulation as the textured liner. The yield stress used to calculate the applied load for SP-NCTL should be Supplier's mean value.*
4) *Machine direction and cross-machine direction average values should be based on average of 5 test specimen in each direction. Yield elongation calculation using a gauge length of 3.3cm. Break elongation is based on a gauge length of 5.08cm.*
5) *Other methods are acceptable if an appropriate relationship to ASTM D 1603 can be established.*
6) *For 10 different views, 9 in category 1 or 2 and 1 in category 3.*
7) *Values from both methods (ASTM D5596 and ASTM D5885) must be provided.*
8) *The manufacturer has the option to select either method.*
9) *The condition of the test is 20hr UV cycle at 75°C followed by 4hr condensation at 60°C.*
10) *Based on % retained value regardless of the original High Pressure OIT value.*

Abbreviations:

MARV *minimum average roll value*

OIT *Oxidative Induction Time*

Table 2.3 – Interface shear Strength Requirements for Textured HDPE Geomembrane

Interface	Test Method	Manufacturer Supplied QC	QA Confirmation	Qualifier
Material above HDPE to textured HDPE[1,2,3]	ASTM D5321	1 per project and 1 per lot	At the engineer's discretion	Minimum
Textured HDPE[1,3]	ASTM D5321	1 per project and 1 per lot	At the engineer's discretion	Minimum

Notes: 1) *All tests to be constructed under normal stress of 12kPa, 24kPa, and 48kPa, in wet (inundated) condition, or as directed by the Engineer.*

2) *Clay moisture content must be 2% wet of optimum, compacted to 98% Standard Maximum Dry Density, or as directed by the Engineer.*

3) *The friction angle (φ) and cohesion (c) determined by the best-fit line of the three points must be above a straight line defined by*
point A [φ = 30 degrees, c = 0kPa] and point B [Ø = 0 degrees, c = 12kPa] in a c – Ø plot, as shown in Figure 2.1 below.

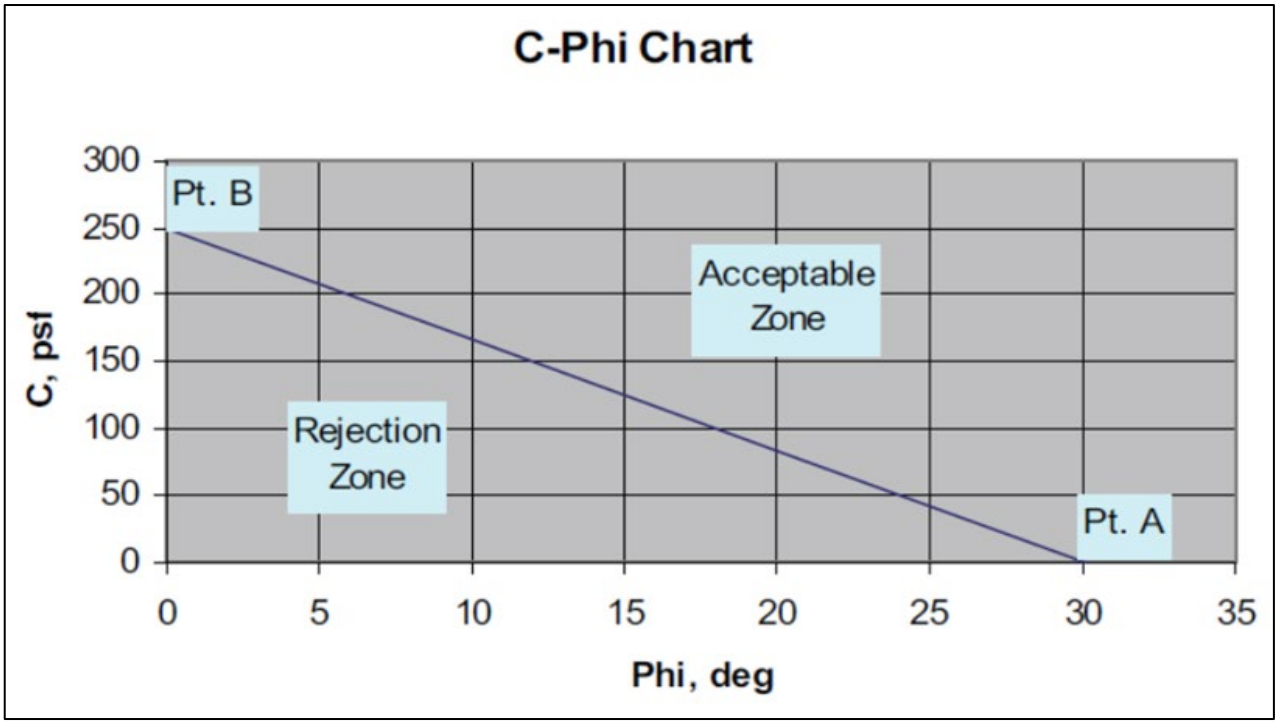


Figure 2.1 - ϕ plot

2.2 Field Seams

The field seams must meet the requirements of Table 2-4.

Table 2.4 – Field Seam Requirements

Seam Property	Test Method	Requirements
Shear strength (n/mm)	ASTM D4437 (as modified in NSF 54) ASTM D6392	21
Peel strength (n/mm)	ASTM D413 (as modified in NSF 54) ASTM D6392	FTB * 14
Continuous seams – air pressure testing (kPa)	ASTM D5820	207 minimum for 5 mins with <34.5 kPa drop
Continuous seams – vacuum testing (kPa)	ASTM D5641	207 minimum for 15 seconds with no visible bubbles

**FTB - Film Tear Bond is defined as failure of the sheets by tearing, instead of separating from the other sheet at the weld interface area (sheet fails before weld).*

3 DELIVERY, STORAGE AND HANDLING

The Owner is responsible for receiving, storing and handling the HDPE Liners without damage.

The Contractor is responsible for receiving the HDPE Liners from the warehouse / store of the Owner and transporting the HDPE Liners to the work site. Geotextile materials received by the Contractor must be inspected for damage and must be loaded / unloaded and stored with minimum handling.

Materials must not be stored directly on the ground. The storage area must be such that all materials are protected against theft, vandalism, passage of vehicles, puncture, dirt, grease, water, moisture, mud, excessive heat, UV exposure and other conditions which may damage the liner. The stacking of liner must not be higher than two rolls.

Materials, including sandbags, equipment, or other items must be carried and placed on the surface of the liner.

Under no circumstances must the liner be subjected to materials, equipment, or other items being dragged across its surface, nor must workmen and others slide down slopes atop the liner. All scuffed surfaces resulting from abuse of any kind by the Contractor must be repaired at no additional cost to the Owner.

4 INSTALLATION BY THE CONTRACTOR

4.1 Preparation

The preparation of the surface to receive the HDPE Liners is part of the works prescribed for the Contractor in the Earthworks Specification.

Prior to lining any given area with liner the Engineer and the Contractor will visually inspect the surfaces to receive liner to ensure the surface which is to be covered by liner is free from sharp objects and other materials which may damage the liner before placement of the geotextile.

The Engineer must accept and approve, in writing to the condition of the surfaces on which the liner will be installed.

The Contractor must note that careful scheduling of the earthworks works is required in order to synchronise with the works which require placement of liner in order to minimise rework which may be caused by delays or poor scheduling.

The Contractor must record the roll number of liner placed and provide survey of the locations and Reduced Levels (RLs) of the corners of each roll of liner placed during construction.

The liners must be placed to the lines and grades and anchored in accordance with the Design Drawings and Supplier's recommendations.

4.2 Installation Personnel

The Contractor's installation personnel must be the Manufacturer or an approved Contractor trained and licensed to install the Manufacturer's geomembranes and have a minimum of two (2) continuous years' experience in the installation of geomembranes. Details of relevant certification and individual experience in the installation of similar lining systems of the proposed site personnel are to be submitted and approved by the Owner prior to mobilisation to site. Installation must be performed under the constant direction of a Supervisor who must remain on site throughout the liner installation. The Supervisor must have installed or supervised the installation and seaming of a minimum of 220,000m^2 of the geomembrane to be installed. Actual seaming must be performed under the direction of a Master Seamer (who may also be the Supervisor) who has seamed a minimum of 220,000m^2 of the geomembrane to be installed, using the same type of seaming apparatus specified herein. This Supervisor and/or Master Seamer must be present whenever seaming is performed.

4.3 Installation

The liner must be installed in accordance with the project plans and approved installation drawings as soon as practically possible after approval of the sub-base by the Engineer.

Before the work begins, the Contractor must inspect all liner materials for damage during transit. Damaged materials that can be repaired may be used when approved in writing by the Engineer. Damaged materials that cannot be repaired or have been rejected by the Engineer must be removed immediately from the work area and site.

Only liner materials that can be installed during the same day's work must be unwrapped.

During unwrapping of liner materials for use and placement, the Contractor must visually inspect all materials, particularly surfaces of liner sheets, for imperfections and faulty areas. Any defective areas must be marked and recorded.

The Engineer's inspection and approval must be obtained prior to any repair work, which must be conducted in accordance with the approved methods.

Liner sheets must be of such length and width and placed in a manner to reduce field seaming to a minimum. All panels over 2.5 m^2 in area must be designated with a panel number. The Contractor must be responsible for assigning the number and must locate the number near the middle of panels that are less than 15m in length and at both ends of panels that are over 15 m in length. These numbers must also be noted on the as-built drawings. Panels under 2.5 m^2 in area must be considered a patch and must not require a number.

The liner must be anchored in accordance with the Design Drawings. Anchor trenches must be adequately drained to prevent ponding or softening of the soils while the trench is open and must be free of loose soil prior to liner installation.

The liner must be placed with a yoke rollout, or as otherwise approved by the Engineer to prevent dragging along the ground. Installation of the liner must be as follows:

i) Unroll only those sections which are to be seamed together or anchored in one day. Panels should be positioned with the overlap recommended by the Manufacturer, or not less than 10 cm. The liner sections will be placed in an upslope anchor trench which is then backfilled by the Contractor with compacted soil as shown on the Design Drawings. Compaction of anchor trench backfill must be to a minimum of 85 percent of the maximum dry density as determined by Proctor Compaction Tests ASTM D 1557 or ASTM D 698, respectively.

ii) After panels are initially in place, remove as many wrinkles as possible. If necessary, the liner must be positioned by hand after being unrolled to minimise wrinkles. Unroll several panels and allow the liner to 'relax' before beginning field seaming. The purpose of this is to make the edges which are to be bonded as smooth and free of wrinkles as possible.

iii) The sheets must be placed in such a manner as to minimise seams.

iv) End panel seams must be placed cross the slope and all seams must be singled with the upslope panel overlapping the downslope panel at all times.

v) Once panels are in place and smooth, commence field seaming operations (refer to Section 4.4).

Extreme care must be taken during installation to prevent damage to the liner. All personnel walking on the liner must have smooth soled shoes. Persons working on the liner must not smoke and must not engage in activities that could damage the liner. Damage to the liner during installation must be repaired by the Contractor as described in Section 4.6 at no cost to the Owner.

No liner installation must take place during inclement weather such as rain, snow, periods of high wind and at temperatures below 5°C or above 40°C. The weather condition should be recorded in the daily field logs (deployment log).

If wind is prevalent, deployment should start at the upwind position. The Contractor must be responsible for protecting the liner against adverse effects of wind such as uplift. Sandbags must be in position during the installation. Sandbags must be sufficiently close-knit to preclude fines from working through the bottom, sides or seams. Paper bags, whether or not lined with plastic will not be permitted. Burlap bags, if used, must be lined with plastic. Bags must contain not less than, nor more than 15 kg of sand having 100% passing a Number 8 screen and must be tied closed after filling, using only plastic ties. Metal or wire ties must not be used. Bags that are split, torn, or otherwise losing their content must be immediately removed from the work area and any spills immediately cleaned up.

4.4 Field Seaming

Welding must be performed only when the temperature of the sheets is between 5°C and 40°C.

All foreign matter (dirt, water, oil, etc.) must be removed from the edges to be bonded. For extrusion-type welds, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the Engineer to remove surface cure and prepare the surfaces for bonding. All abrasive buffing

must be performed using No. 80 grit or finer sandpaper. The grinding must be performed so that grind marks are generally perpendicular to the edge of sheet. No solvents must be used to clean the liner.

As much as practically possible, field seaming must start from the top of the slope down. This will minimise the development of wrinkles which may occur due to having people working on the side slopes behind the area being seamed.

Tack welds (if used) must use heat only; no double-sided tape, glue or other method will be permitted. The liner should be seamed completely to the ends of all panels to minimise the potential of tear propagation along the seam.

The completed liner must not exhibit any 'trampolining' during any daylight hours (6:00 am to 8:00 pm).

At the end of each day or installation segment, all unseamed edges must be anchored by rope, sand bags, or other approved device. Sand bags securing the liner on the side slopes should be connected by rope fastened at the top of the slope section by a temporary anchor. Staples, U-shaped rods or other penetrating anchors must not be used to secure the liner. Any damage to the liner due to wind, rain, hail, or other weather must be the sole responsibility of the Contractor.

Intermediate erosion and sedimentation control measures must be initiated in accordance with general engineering practice, or as directed by the Engineer to protect the liner.

Field seaming must be dual band track Hot Wedge Fusion Seaming. Extrusion Weld Fillet Seaming must be used on repairs, patches, panel intersections, and as otherwise approved by the Engineer. Solvent welding is not acceptable. All wedge welders used must be specifically designed for and compatible with the liner material and recommended by the Manufacturer. The Engineer reserves the right to reject any proposed seaming method believed to be unacceptable.

Field seams must be lap seams, formed by lapping the edges of liner sheets a minimum of 100 mm. The field panel layout must be inspected for proper overlap prior to seaming. No horizontal seams must be within 1.5 m of the toe of the slope.

The seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams should be minimised.

No seaming should be attempted above 40°C ambient air temperature. Below 5°C ambient air temperature, preheating of the liner will be required, unless it is demonstrated that this is not necessary (i.e., acceptable trial test (start-up) seams which duplicate, as closely as possible, actual field conditions). Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Ambient temperature is measured 18 inches above the liner surface. The Contractor must supply instrumentation for measurement of ambient temperature.

A moveable protective layer of plastic may be required, as recommended by the Engineer, to be placed directly below each overlap of liner that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded.

Seaming will extend to the outside edge of panels to be placed in anchor trenches.

If required, a firm working surface should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

No excessive grinding prior to welding must be permitted. Overground or improperly ground areas must be replaced at the Contractor's expense (refer to Section 4.6).

Seams at panel corners of 3 or 4 sheets must be completed with a patch having a minimum dimension of 61cm, extrusion welded to the parent sheet. All cross seams are to be extrusion welded where they intersect before capping the patch.

The Contractor, prior to seaming, must clean the immediate seaming area of all dust, dirt, moisture, debris of any kind, and foreign material. Seams are to be aligned with the fewest possible wrinkles.

No 'fish mouths' must be allowed within the seam area. Where 'fish mouths' or wrinkles occur at the seam, overlaps must be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut 'fish mouths' or wrinkle must be seamed and any portion where the overlap is inadequate must then be patched with an oval or round patch of the same liner extending a minimum of 15cm beyond the cut in all directions. All welds on completion of the work must be tightly bonded.

4.5 Defects

All seams and non-seam areas of the liner must be examined by the Contractor for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign materials.

The Contractor must mark the location of all defects with high visibility spray paint. Each defect must be marked with the date the defect was identified and a number corresponding with the entry into the Daily Defect Report.

4.6 Repair of Defects

All seams and seals of the liner must be tightly bonded on completion of the work. All seams and non-seam areas of the liner must be examined by the Contractor for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matters.

Any liner surface showing defects, holes, blisters, undispersed raw materials, signs of contamination by foreign matter, unacceptable welds and other unsatisfactory conditions will be identified on the Daily Report Form and must be replaced or repaired using accepted methods. The repair/corrective action to *'fix'* the problem will also be recorded on a similar form. All repairs must be completed within 3 working days of the initial welding of the seam.

Identified locations of defects, out-of-specification seam, damaged, and destructive sample coupon areas of liner must be repaired by the Contractor by construction of a cap strip. No repairs must be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods.

Damaged materials are the property of the Contractor and will be removed from the site at the Contractor's expense. The Contractor will retain all ownership and responsibility for the liner until acceptance by the Owner. The liner must be accepted by the Owner after the installation and repairs are complete, and after the Owner has received documentation for the installation by the Engineer.

Any portion of the liner exhibiting a flaw must be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate procedure must be agreed upon between the Engineer and the Contractor. The procedures available include:

i) Patching - used to repair large holes, tears, and contamination by foreign matter.

ii) Buffing and re-welding - used to repair small sections of extruded seams.

iii) Spot welding - used to repair small tears, pinholes, or other minor flaws.

iv) Capping - used to repair large lengths of failed seams.

v) Topping - used to repair areas of inadequate seams which have an exposed edge.

In addition, the following provision must be satisfied:

i) Surfaces of the liner which are to be repaired must be abraded no more than one hour prior to the repair.

ii) All surfaces must be clean and dry at the time of the repair.

iii) All seaming equipment used in repairing procedures must be approved.

iv) The repair procedures, materials, and techniques must be approved in advance of the specific repair by the Engineer and the Contractor.

v) Patches or caps must extend at least 15 cm beyond the edge of the defect, and all corners of patches must be rounded with a radius of at least 7.5 cm.

Small holes must be repaired by extrusion welding. If the hole is larger than 6 mm, it must be patched. Tears must be repaired by patching. If the tear is on a slope or on an area of stress, and it has a sharp end, it must be rounded prior to patching.

Blisters, large holes, undispersed raw materials, and contamination by foreign matter must be repaired by patching. Liner surfaces to be patched must be abraded and cleaned no more than 15 minutes prior to the repair. No more than 10% of the thickness must be removed.

Patch materials must be of the same material, type and thickness as the material being repaired. A patch must be a minimum of 150 mm larger in all directions than the area requiring the repair. All patches must have rounded corners. The Contractor must mark adjacent to all welds and repairs, the seam number, date, time, equipment number and technician performing the welding. Each major repair requiring a patch or cap must be identified on the as-built drawing.

4.7 Record (As-Built) Drawings

A reproducible set of contract drawings must be kept in the field office. Changes must be noted on the drawings as soon as changes are made.

All changes in approved installation drawings and procedures must be approved by the Owner. Requests for field changes to the approved installation drawings, procedures and schedule must be submitted in writing to the Owner for review and approval. No changes must be made prior to written approval by the Owner. Changes must be documented on recorded drawings by the Contractor.

4.8 Liner Acceptance

The Contractor must retain all ownership and responsibility for the installed liner until acceptance by the Owner.

The liner must be accepted by the Owner when all of the following conditions are met:

i) Installation is complete.

ii) Verification of the adequacy of all field seams and repairs is complete.

iii) Documentation of completed installation, including all submittals and reports, is complete.

5 TESTING AND INSPECTION

5.1 Contractor Quality Control and Testing

The Contractor is responsible for all geomembrane field and laboratory testing of the seams and repairs, in accordance with this Specification.

One week prior to the work proceeding, trial test seams must be made to verify that adequate conditions exist for field seaming to proceed.

All geomembrane field seams will be tested and evaluated by the Contractor in the presence of the Engineer prior to acceptance.

For laboratory testing, coupons of geomembrane materials will be obtained by the Contractor as directed by the Engineer. The Contractor will arrange for testing of the coupon by the Contractor's Geosynthetics Laboratory.

Contractor's QAQC personnel are responsible for performing the inspections, documenting inspections, and submission of inspection results to the Engineer. The Contractor's QAQC personnel must compile the inspection reports within a daily report submitted to the Engineer. The daily report submission must include a summary of work accomplished, non-conforming inspection results, and attached field inspection forms. The inspection forms must include:

i) Identification and location of inspection item.

ii) Time and date.

iii) Inspector name and signature.

iv) Photographs, if appropriate.

v) Inspection observations including field test results (e.g., weather condition).

vi) Non-conforming and rejected work elements.

Prior to Contractor mobilisation, the QAQC personnel will prepare the inspection forms to be completed and must submit these forms for approval by the Engineer.

The Contractor must perform the quality control tests as shown in Table 5-1 during installation.

The Contractor must maintain and use equipment and personnel at the site to perform testing of trial test seams. Trial test seams will be made each day prior to commencing field seaming, matching actual equipment with operators. These seams will be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate.

Table 5.1 – Tests During Installation

Test	Requirements	Specified Value
Trial seams[1] Peel and shear (ASTM D6392)	2 tests per 8 hour work shift/seamer (while seaming is taking place) plus where seaming equipment has been turned off for more than 30 minutes	Peel (fusion): 0.41 kN per 2.54 cm width and FTB*2 Peel (extrusion): 0.35 kN per 2.54 cm width and FTB*2 Shear (fusion and extrusion): 0.53 kN per 2.54 cm width and FTB*2 and Engineer's approval of break
Air pressure (GRI-GM6)	Every 300 mm (1 ft) of lineal hot wedge seam produced	207 minimum for 5 minutes with <34.5 kPa
Vacuum (ASTM D5641)	Every 300 mm (1 ft) of lineal extrusion fillet seam produced	207 minimum for 15 seconds with no visible bubbles
Destructive testing of seams Peel and shear (ASTM D6392)	1 test per 305 m (1,000 ft) of seam produced	Peel: 0.44 kN per 2.54 cm width and FTB*2 Shear: 0.54 kN per 2.54 cm width and FTB*2 A minimum of 5 specimens per sample 4 of 5 specimens must pass seam strength, FTB*, and separation requirements

**FTB - Film Tear Bond is defined as failure of the sheets by tearing, instead of separating from the other sheet at the weld interface area (sheet fails before weld).*

Notes 1) Field testing trials must be done on a minimum 2 specimens or 'bones' in peel from each end of the trial weld samples and 1 'bone' is selected across the trial weld sample. On double-tracked fusion welds, both sides of the seam must be tested. An acceptance trial weld is obtained when all 'bones' meet seam strength, FTB, seam separation requirements. Failed trial welds must be followed by two passing trial weld samples.

2) For fusion welded seams (single or double-tracked welds), no more than 10% of seam width must separate at any point. For extrusion welded seams no more than 3.2mm (1/8 inch) seam separation from seam edge at any point.

Such test seams will be made at the beginning of each seaming period, at the Engineer's discretion, and at least once every four hours during continuous operation of each welding machine. Also, each seamer will make at least one test seam each day. Requirements for trial test seams are as follows:

i) The test seam sample will be at least 91 cm long by 31 cm wide with the seam centred widthwise. Six adjoining specimens 2.54 cm wide each will be die cut from the test seam sample. The test seams must be marked with date, time, ambient temperature, operator's name, and welding machine number. These specimens will be tested in the field with a tensiometer for both shear (3 specimens) and peel (3 specimens). Test seams will be tested by the Contractor under observation of the Engineer. The specimens must not fail in the weld. The Contractor must supply all necessary knowledgeable personnel and testing equipment. No strain measurements need be obtained in the field. A passing fusion or extrusion welded test seam will be achieved when the criteria described in Table 2-4 are satisfied with the exclusion of any strain requirements. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

ii) The Engineer and the Contractor's QAQC personnel will observe all test seam procedures. The remainder of the successful test seam sample will be assigned a number and marked accordingly by the Contractor's QAQC personnel, who will also log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The sample itself must be retained in the

Owner's archives. In addition, at least one tested specimen from each test as selected by the Contractor's QAQC personnel will be retained by the QAQC personnel.

The field seams must meet the requirements of Section 2.2

5.2 Visual Inspections by the Contractor

Visual inspection of the liner sheets, seams, and seals must be made by the Contractor as the installation progresses and again on completion of the installation. Defective and questionable areas must be clearly marked and repaired.

5.3 Supervision by Engineer

All testing by the Contractor must be under supervision by the Engineer. Any work failing to meet the criteria of the Specification must be rectified at the Contractor's expense.

5.4 Liner Material Testing

Before delivery of liner materials to the site, the Contractor will randomly collect samples (1 per 5000 m^2) for testing by an Independent Testing and Inspection Contractor to confirm compliance with this Specification. Conformance tests must be in accordance with the required standards and must include:

i) Thickness.
ii) Density.
iii) Tensile Properties.
iv) Carbon Dispersion.

The sample must be taken across the entire width of the roll and must not include the first metre. The sample must be 1 m long by the roll width. The sample should be marked with the machine direction with an arrow and the Manufacturer's roll and lot identification number. The cost of conformance testing will be paid for by the Owner, except for retest of failed samples. Any failed tests will result in the material roll where the sample was obtained, to be considered out of specification and rejected.

5.5 Non-Destructive Testing

In the presence of the Engineer, the Contractor must non-destructively test all field seams over their full length using a vacuum test unit, air pressure testing, or other approved method. The purpose of non-destructive tests is to check the continuity of seams. It does not provide information on seam strength. Continuity testing must be carried out as the seaming work progresses, not at the completion of all field seaming.

5.5.1 Vacuum Testing (for Extrusion Fillet Welds)

The equipment must be comprised of the following:

i) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a gauge to indicate chamber vacuum.
ii) A steel vacuum and pump assembly equipped with a pressure controller and pipe connections.
iii) A rubber pressure/vacuum hose with fittings and connections.
iv) A bucket and wide brush or spray assembly.

v) A soapy solution.

The following procedures must be followed:

i) Energise the vacuum pump and reduce the tank pressure to approximately 35 kPa gauge.
ii) Wet a strip of geomembrane approximately 0.3 m by 1.2 m with the soapy solution.
iii) Place the box over the wetted area.
iv) Close the bleed valve and open the vacuum valve.
v) Ensure that a tight seal is created with no leaks.
vi) For a period of approximately 5 to 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
vii) If no bubble appears after 10 to 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 7.5 cm overlap, and repeat the process.
viii) All areas where soap bubbles appear must be marked and repaired as described in Section 5.7.
ix) Vacuum tested seams are recorded on daily reports.

5.5.2 Air Pressure Testing (for Dual Hot Wedge Weld)

The equipment must be comprised of the following:

i) An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure between 173 and 207 kPa.
ii) A rubber hose with fittings and connections.
iii) A sharp hollow needle, or other approved pressure feed device.

The following procedures must be followed:

i) Seal both ends of the seam to be tested.
ii) Insert needle or other approved pressure feed device into the channel created by the fusion weld.
iii) Energise the air pump to a pressure between 173 and 207 kPa, close valve, and sustain pressure for approximately five minutes.
iv) If a loss of pressure exceeds 34.5 kPa, or does not stabilise, locate faulty area and repair as described later in this section.
v) Release air from channel at far end of seam (opposite of needle placement) to verify that the entire seam has been tested (i.e. there are no blockages in the length of the seam).
vi) Remove needle or other pressure feed device and seal.
vii) Repair all holes as described in Section 5.7.

5.5.3 Conductive Geomembrane Spark Testing

The entire surface of the placed, welded, HDPE liner must be subjected to Conductive Geomembrane Spark Testing in accordance with ASTM D7240. All holes identified by this testing must be repaired as described in this Section 5.7.

5.6 Destructive Testing

Destructive seam tests must be performed at selected locations. Sampling and testing must be done under an approved QA/QC plan. Seam strength testing must be done as the seaming work progresses and not at

the completion of field seaming. After the initial welding of any seam, seam testing and repairs must be completed within 3 working days.

The purpose of these tests is to check that welds are fully integrated with each other and to evaluate seam strength. Seam strength testing must be done as the seaming work progresses, not at the completion of all field seaming.

Location and Frequency - The Engineer must select locations where seam samples will be cut by the Contractor. These locations must be established as follows:

i) A minimum frequency of one sample per 305m welded. This minimum frequency is to be taken as an average for the entire facility and not necessarily at exact 305 m intervals.

ii) A maximum frequency must be agreed upon by the Contractor and the Engineer at the Pre-Construction Meeting but must be not greater than 150m (of seaming performed).

iii) The seaming technician must not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedure - Samples must be cut by the Contractor at locations selected by the Engineer as seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The Contractor must cut samples and:

i) Assign a number to each sample which is to be based upon seam and sample number and mark it accordingly.

ii) Record sample location on layout drawing.

iii) All holes in the geomembrane resulting from destructive seam sampling must be immediately repaired in accordance with repair procedures described later in this section. The continuity of the new seams in the area must be tested as described in other portions of this section.

Size of Samples - At a given sampling location, two types of samples must be taken by the Contractor as follows:

i) First, two small samples for field testing must be taken. Each of these samples must be 2.54 cm wide by 31 cm long with the seam centred. The distance between these two samples must be 1 m.

ii) Field Testing - The two 2.54cm wide strips mentioned above must be tested in the field for peel and shear and must not fail in the seam.

If both samples pass the field test, a full-size sample between the two small samples must be removed and cut into three parts and distributed as follows:

i) One portion to the Contractors (if requested) laboratory for testing, 0.3 m x 0.3 m.

ii) One portion to the Contractor’s independent geosynthetic testing laboratory for testing, 0.3 m x 0.3 m (12 inches x 12 inches).

iii) One portion to the Engineer for archive storage, 0.3 m x 0.3 m (12 inches x 12 inches).

Final determination of the sample sizes must be made at the Pre-Construction Meeting.

All samples must be marked with the date, ambient temperature, location, precipitation, wind, and welding machine running temperature number.

The Testing and Inspection Company must save all test samples until notified by the Owner regarding disposal.

Results of tests that have failed must be forwarded immediately to the Owner for determination of corrective measures.

For destructive samples that have failed, the Contractor must take two new samples approximately 3m on each side of the failed test. The Contractor must deliver these samples to the same Independent Testing and Inspection Contractor and pay for the shear and peal tests. Once two samples have passed, the Contractor must repair the seams.

In the event capping of a field seam is required, the Contractor must use a cover strip of the same thickness as the liner (and from the same roll, if available) that is a minimum width of 200mm. It must be positioned over the centre of the field seam and welded to the liner using a fillet weld on each side.

5.7 Repair Testing

All repairs must be non-destructively tested by methods described in Section 5.5. Repairs must also be inspected by the Engineer for deficiencies prior to panel acceptance and seam acceptance.

5.8 Independent Testing Company/Facilities

An Independent Testing and Inspection Contractor may be retained by the Owner, to perform testing for control of construction activities, and/or to verify compliance of the work with the requirements of this Specification.

6 CLEAN UP

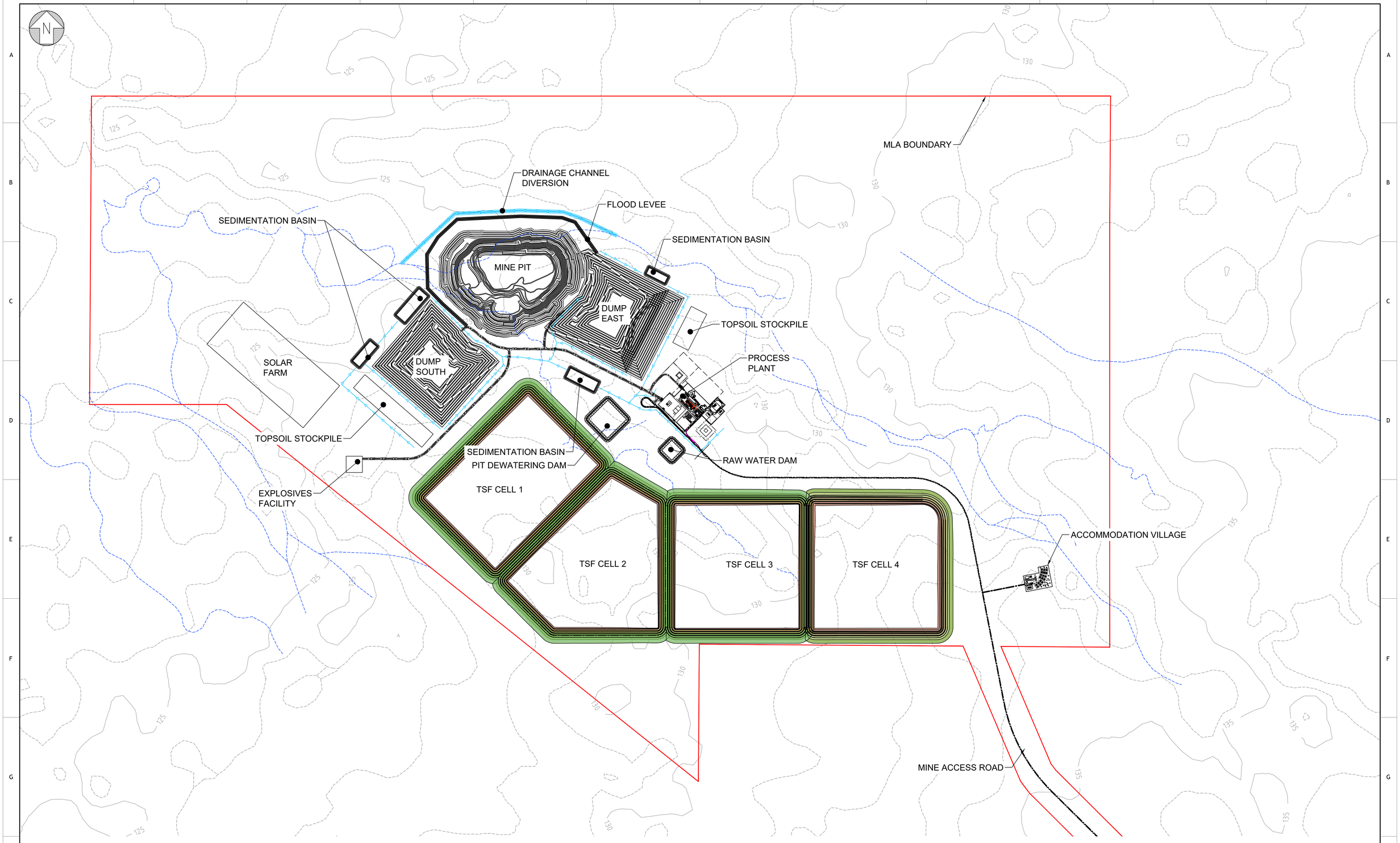
Upon completion of the work, the Contractor must remove from site to appropriate waste management facilities:

i) Any debris and surplus material resulting from the construction operations.
ii) Any temporary site facilities.
iii) All waste and rubbish.
iv) Any contaminated soil from Contractor activities (such as diesel spills).

Appendix 1

Drawings

Graphinex Pty Ltd
Tailings Storage Facilities – HDPE Liner Specification



300 30 300 600 900 1200 1500m

SCALE 1:15,000

LOCALITY PLAN

1:15,000

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
B	10.02.2026	REISSUED FOR STUDY	AE	PG	PG	LB
A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

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	DATE
DRAWN S. ROWE	10.03.2025
DESIGNED J.FEETHAM	10.03.2025
CHECKED P. GLOWERY	10.03.2025
ENGINEER P. GLOWERY	10.03.2025
APPROVED L. BLACK	10.03.2025

DRAWING NUMBER | DESCRIPTION

DRAWING REFERENCE

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

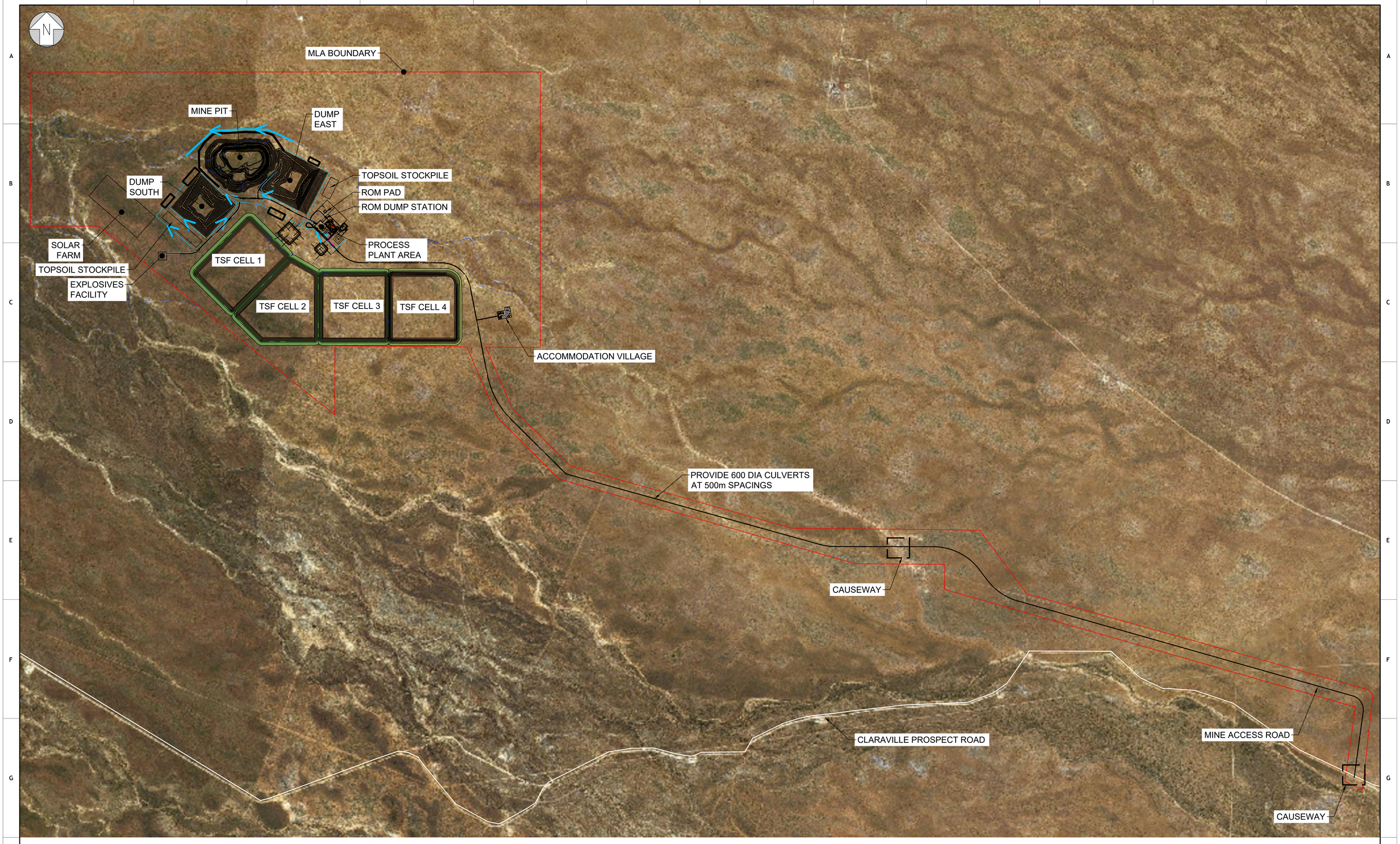
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

SCALE	GRID	DATUM	SIZE
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DWG NO: 6235-40-DWG-CI-00020 REV: B



600 0 600 1200 1800 2400 3000m

SCALE 1:30,000

LOCALITY PLAN

1:30,000

DRAWING NUMBER	DESCRIPTION
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CHECKED	P. GLOWERY	10.03.2025
ENGINEER	P. GLOWERY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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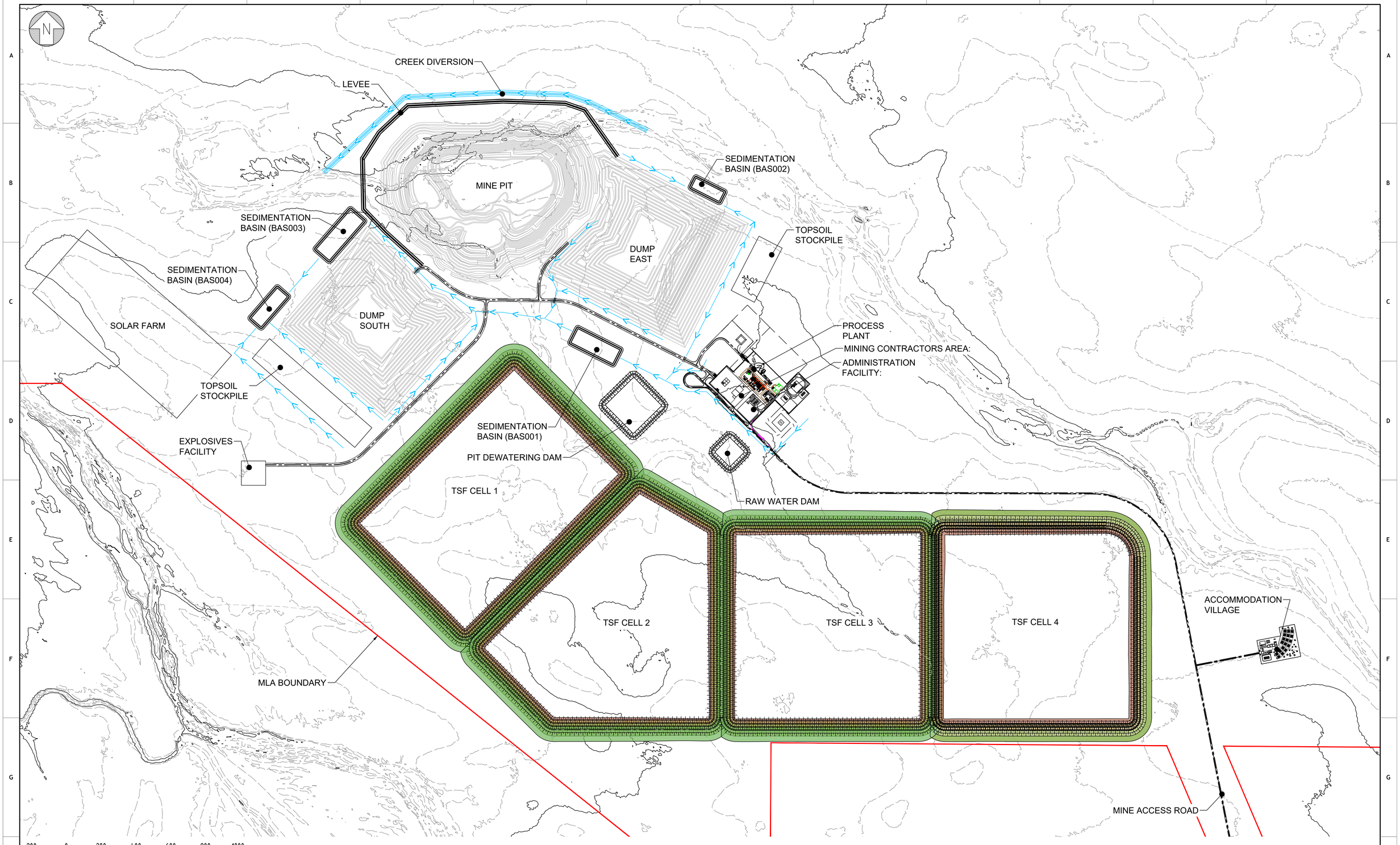
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00030 REV: B



PLAN
1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

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A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

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ENGINEER	P. GLOWERY	10.03.2025
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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS
TITLE: MINE SITE DRAINAGE PLAN

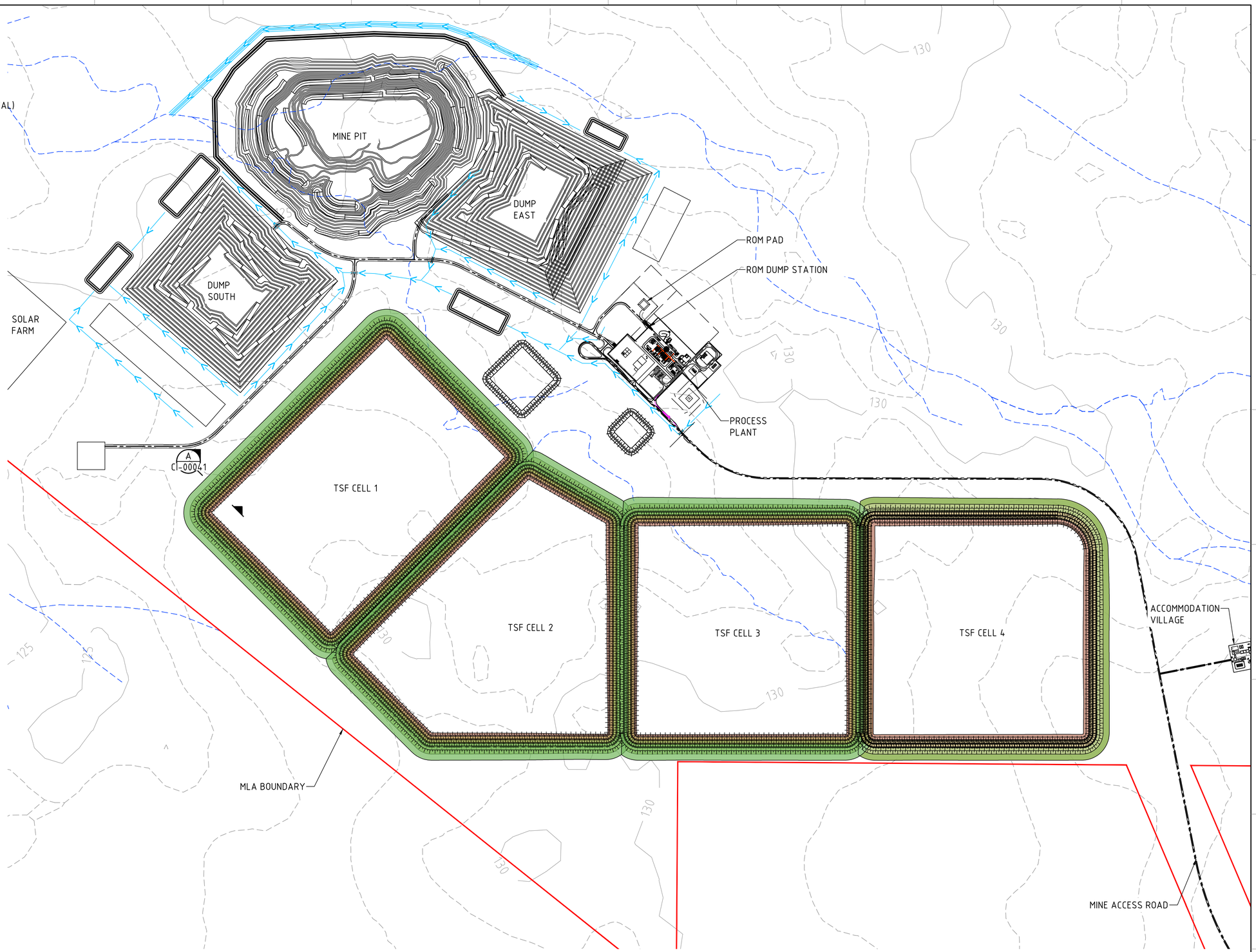
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CLIENT DWG NO:

SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00031
REV: B

LEGEND

- 385 — EXISTING SURFACE CONTOUR (1m INTERVAL)
- GRADE LINE
- PROPOSED TOP OF BATTER (LEFT)
- STAGED EMBANKMENT - LIFT 01
- STAGED EMBANKMENT - LIFT 02
- STAGED EMBANKMENT - LIFT 03
- STAGED EMBANKMENT - LIFT 04



200 0 200 400 600 800 1000m

SCALE 1:10,000

LOCALITY PLAN

1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
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DRAWN	G. SPILLANE	DATE 10.03.2025
DESIGNED	G. SPILLANE	DATE 10.03.2025
CHECKED	P. GLOWERY	DATE 10.03.2025
ENGINEER	P. GLOWERY	DATE 10.03.2025
APPROVED	L. BLACK	DATE 10.03.2025

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CLIENT: GRAPHINEX

PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

TITLE: TAILINGS STORAGE FACILITY PLAN

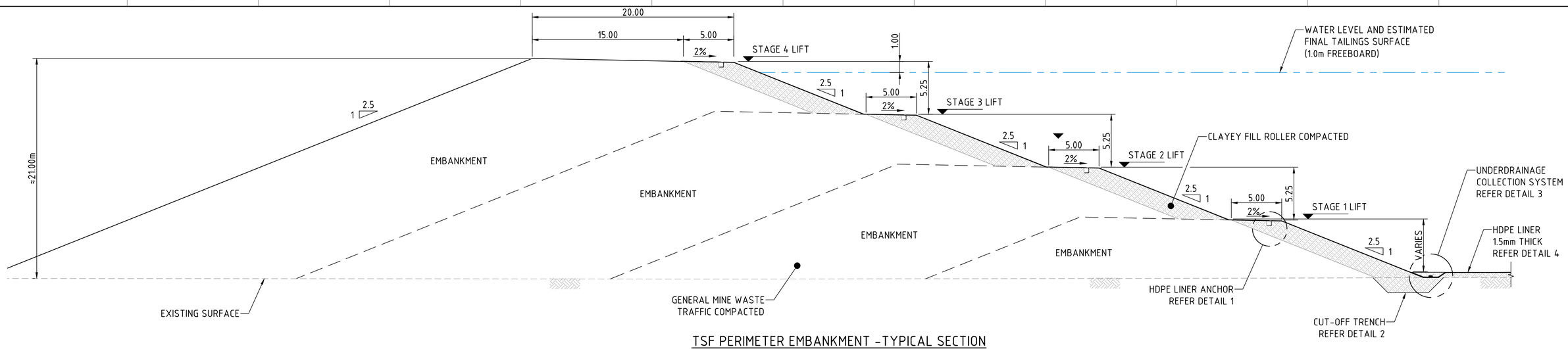
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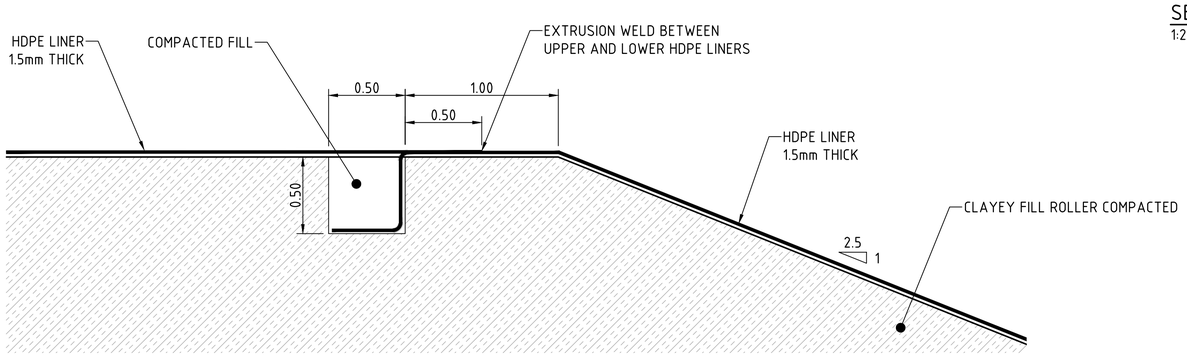
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REV: A

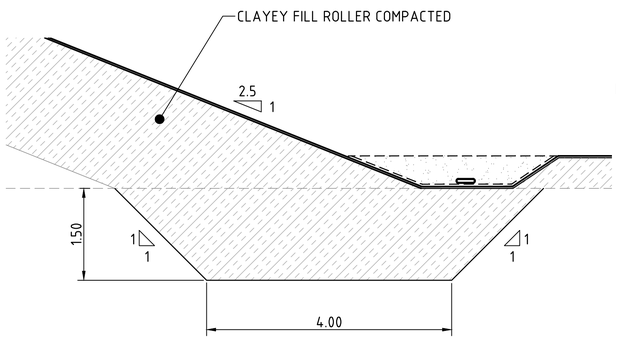


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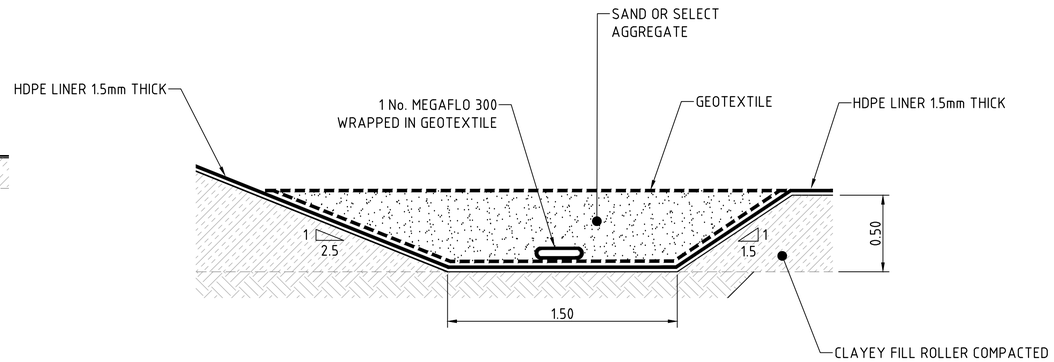
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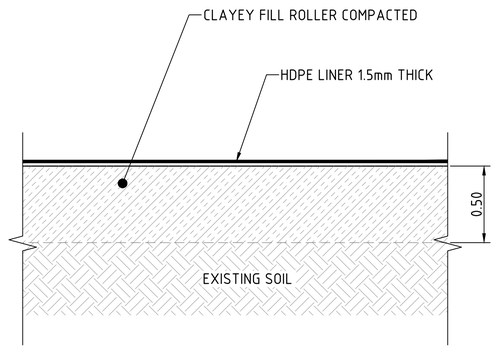
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DETAIL 2 – CUT-OFF TRENCH -TYPICAL DETAIL
1:50



DETAIL 3 – UNDERDRAINAGE COLLECTION SYSTEM-TYPICAL DETAIL
1:20



DETAIL 4
1:20

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

4 0 4 8 12 16 20m
SCALE 1:200

1.0 0 1.0 2.0 3.0 4.0 5.0m
SCALE 1:50

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SCALE 1:20

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

GRAPHINEX

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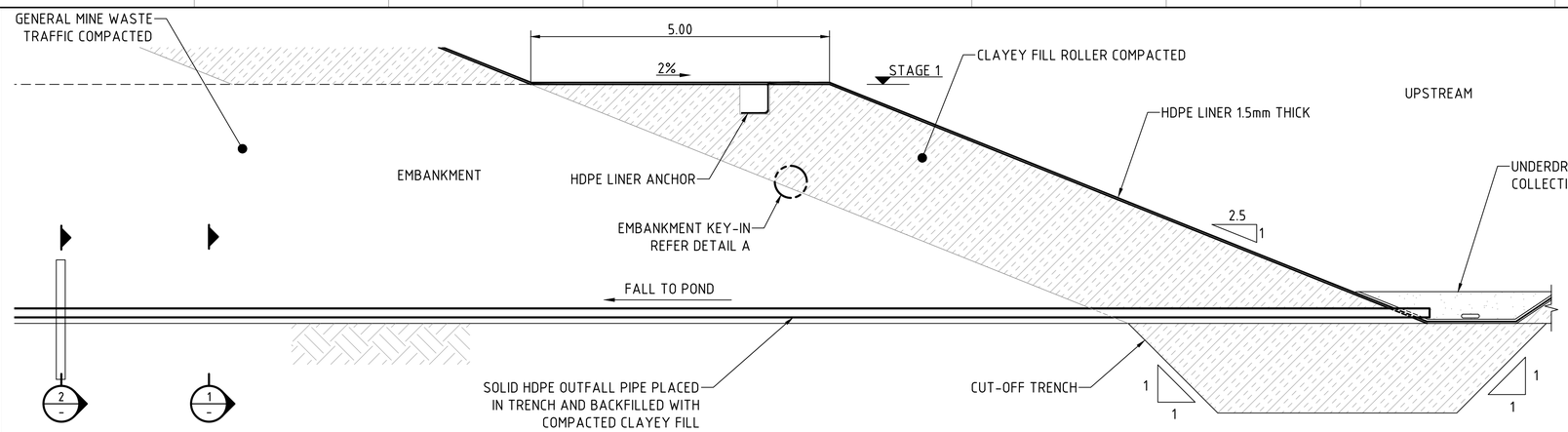
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PROJECT: ESMERALDA GRAPHITE PROJECT
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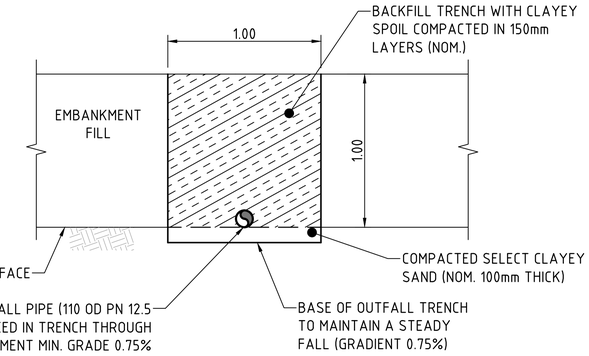
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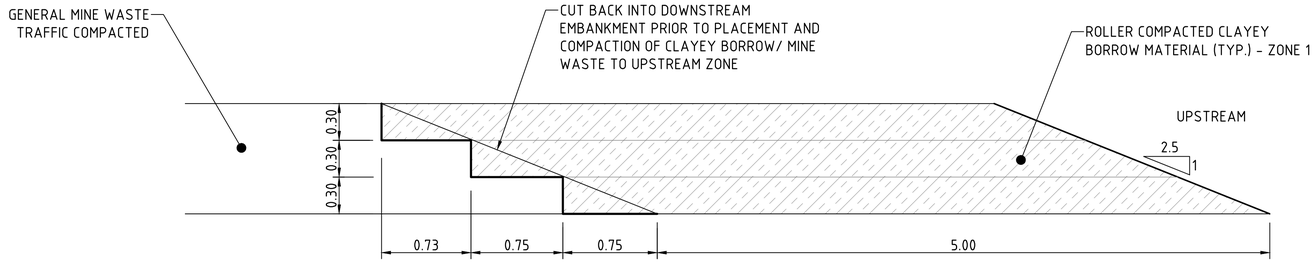
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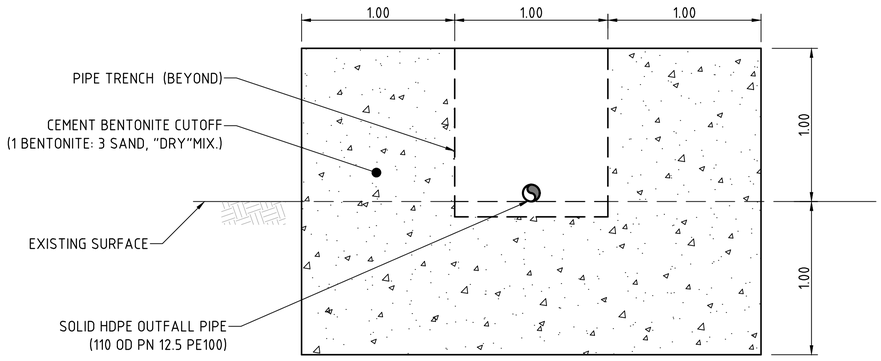
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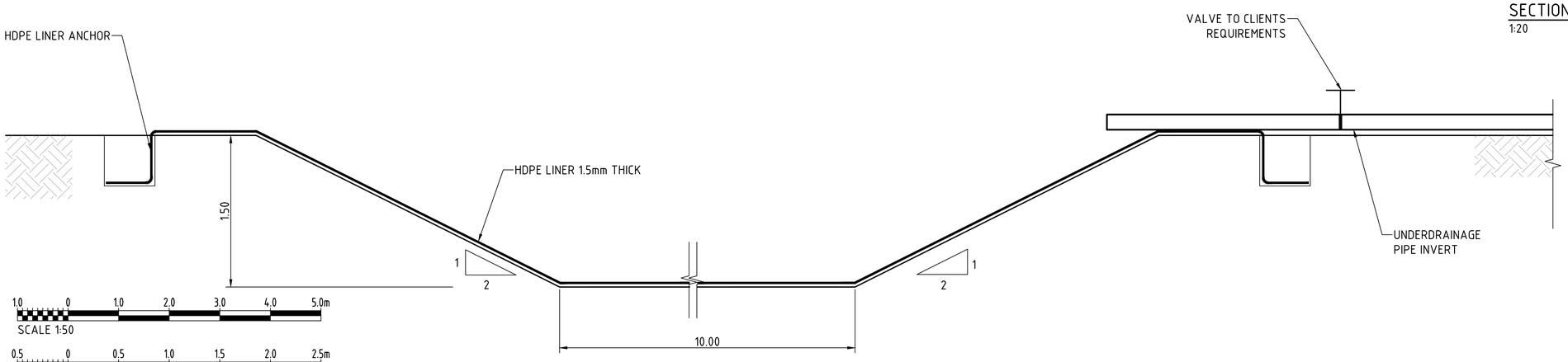
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1:20



DETAIL A / - EMBANKMENT KEY-IN -TYPICAL DETAIL
1:25



SECTION 2 / - CEMENT BENTONITE CUTOFF -TYPICAL SECTION
1:20



UNDERDRAINAGE SUMP -TYPICAL SECTION
1:25

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

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GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

DRAWING NUMBER	DESCRIPTION
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REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
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ENGINEER	P. GLOWREY	10.03.2025
APPROVED	L. BLACK	10.03.2025

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TITLE: TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS
SHEET 2 OF 2

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SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00042
REV: A

Appendix 2

Schedule of Materials

(to be completed by others)

Graphinex Pty Ltd

Tailings Storage Facilities – HDPE Liner

Specification

Appendix E

Geotextile Flownet and Megaflo Specification

Graphinex Pty Ltd

Tailings Storage Facility Scope of Works

	Soil & Rock Engineering Pty Ltd (SRE)
	ABN 98 675 219 020

GRAPHINEX

Esmeralda Project - Queensland

Tailings Storage Facilities

Geotextile Flownet and Megaflo Specification

DRAFT Rev B Issued for client review)

Ref: **Geotextile and Flownet Specification Rev B 202601**

Date: **15 February, 2026**

Prepared by: **SREPL**
243B Pearson Street
Woodlands WA 6018

Prepared for: **Graphinex Pty Ltd**
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Brisbane QLD 4000

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Document Control

Date	Revision	Purpose	Author
25/01/2026	A	Internal Review	C Lane
13/02/2026	B	Issued for Client Review	C Lane

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Terminology and Abbreviations

The following terminology and abbreviations have been used in this document:

AOS	Apparent Opening Size
AS	Australian Standard
ASTM	American Society for Testing and Materials
CMW	CMW Geosciences Pty Ltd
CBR	Californian Bearing Ratio
EP	Esmeralda Project
GCL	Geosynthetic Clay Liner
GPL	Graphinex Pty Ltd
MARV	Minimum Average Roll Value (50% of results will typically exceed this value, and 50% will typically not meet this value)
NATA	National Association of Testing Authorities
QA/QC	Quality Assurance and Quality Control
RL	Reduced Level
TSF	Tailings Storage Facility
WSD	Water Storage Dam

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Project: Esmeralda Project

Subject: Geotextile and Flownet Specification

1 GENERAL

1.1 Summary

This specification prescribes the requirements for the supply and installation of the geotextile manufactured from prime quality new polymer designed and manufactured specifically for the purpose of use in the construction of the TSF at the Challenger Exploration Limited (GPL) Hualilan Project (HP). This Specification in conjunction with relevant International standards and codes, other referenced Specifications and related documents define the technical requirements for the material component, manufacture, marking, inspection, testing and packing of the geotextile. It encompasses the furnishing of all labour, materials, transportation, handling, storage, supervision, tools, and other equipment that may be necessary to install, seam, patch and test the installation as described herein, in associated plans, and engineering drawings.

This document prescribes the work to be undertaken by the Supplier and the Contractor as follows:

i) Supplier: Sections 1, 2, 3, and 4.
ii) Contractor: Sections 1, 4, 5, and 6.

1.1.1 Related Specifications

The latest revisions of the following specifications prescribe items of related Work:

i) Earthworks Specification.
ii) HDPE Liner Specification.

The Contractor must coordinate work prescribed by this Specification with work performed for the above listed Specifications.

The Appendices referred to in this document comprise the following and are to be attached to this document by the Owner:

- Drawings Appendix 1
- Schedule of Materials Appendix 2

The Contractor must coordinate work prescribed by this Specification with other related works to be performed.

This Specification must be read in conjunction with the latest revisions of the following Design Drawings as presented in Table 1.1.

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Table 1.1 – Drawings

Drawing No.	Title
6235-40-DWG-00020 Rev B	Mine Site General Arrangement Plan
6235-40-DWG-00030 Rev B	Site Wide Drainage Plan
6235-40-DWG-00031 Rev B	Mine Site Drainage Plan
6235-40-DWG-00040 Rev A	Tailings Storage Facility Plan
6235-40-DWG-00041 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
6235-40-DWG-00042 Rev A	Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

1.2 Terminology

The following terms are defined as stated, unless otherwise indicated:

Contractor	Appropriate individual, partnership, company or corporation contractually obligated to perform the work prescribed in this Specification and associated Specifications (Section 1.1) and becomes contractually obligated to the Owner.
Design Drawings	Detailed Design Drawings issued by the Owner to the Contractor.
Engineer	The engineer (or designated representative) appointed by the Owner who is responsible for evaluating the suitability of the materials involved in the work and for verifying the compliance of the work to the requirements of the Specifications.
Independent Testing and Inspection Firm	The company, partnership, or corporation retained to perform the inspections and tests required for determining and verifying compliance of the work with the requirements of this Specification.
Owner	Challenger Exploration Limited (GPL)
Project Superintendent	The designated representative of the Contractor appointed by the Contractor who is responsible for the work by the Contractor.
Work/works	The activities specified within this document are the responsibility of the Contractor.

1.3 References

The publications listed below form part of this Specification. Each publication must be the latest revision and addendum in effect on the date this Specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the Design Drawings, work included in this Specification must conform to the applicable provisions of these publications.

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1.3.1 Applicable Codes / Standards

The works must be carried out to comply with the latest revision of the Design Drawings, Codes and Standards specified, ASTM Standard, or to other recognised International Standards approved by the Owner or the Engineer.

The applicable ASTM Standards for the geotextile are as follows:

i) ASTM D4632 - Methods of test for textiles - Physical tests - Determination of maximum force using the grab method (ISO 13934-2:1999, MOD).
ii) ASTM D6241 - Geotextiles - Methods of test-Determination of burst strength - California bearing ratio (CBR) - Plunger method.
iii) ASTM D4595 - Geotextiles - Methods of test-Determination of tensile properties - Wide strip and grab method.
iv) ASTM D4533- Geotextiles - Methods of test-Determination of tearing strength - Trapezoidal method.
v) ASTM D4751- Geotextiles - Methods of test - Determination of pore-size distribution - Dry-sieving method.
vi) ASTM D4491 - Geotextiles - Methods of test-Determination of permittivity, permeability and flow rate.

1.4 Submittals

All submittals must be delivered to the Owner.

1.4.1 Supplier

The following information must be submitted prior to supply of the material:

i) Supplier Method Statement including Inspection and Test Plans and quality control procedures used in the manufacturing process (discussed in Section 2).
ii) Quality Control Certificates for the geotextile (discussed in Section 3).

1.4.2 Contractor

The following information must be submitted with the tender bid documents:

i) Evidence of the Contractor's expertise and qualifications for earthworks construction, including the name and qualifications of its Project Superintendent and senior personnel that will carry out the work.
ii) Written acceptance of the Design Drawings and general configuration of the geotextile. In case the Contractor does not approve the original design, the Contractor must submit to the Owner for review and approval, detailed drawings showing an alternative design and configuration that will better serve the intended purpose.

The following information must be submitted prior to and during the work:

i) One month before the start of the work, the Contractor must submit drawings and a description of geotextile installation procedures. The installation drawings must clearly show the proposed geotextile layout with size, number (identification), position and sequence of placing all rolls. The drawings should also show the complete details of the geotextile anchors and overlaps.

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ii) One week before the start of work, the Contractor must prepare and submit a site specific Health, Safety and Environmental Management Plan including site specific considerations and traffic management during construction of the work.

iii) Daily reports must be submitted by the Contractor, documenting work accomplished the previous day including all personnel and equipment on-site, quantities of materials placed, tests performed, weather conditions and other applicable comments relevant to the progress of the work.

The following information must be submitted at the completion of the work:

i) Records of placement and location of the geotextile including the roll number, place and survey locations with RLs of the geotextile of each roll placed.

ii) The Contractor must submit written certification signed and stamped by the Engineer, stating that the geotextile was installed in accordance with these Specifications and Design Drawings. Any changes to the design must be recorded.

2 PRODUCTS

2.1 Geotextile

The geotextile to be used is Geofabrics *'Bidim A24G'* and *'Bidim A34G'* as shown on the Design Drawings or approved equivalent from Polytex, or other recognised and approved geotextile manufacturer.

The geotextile must be comprised of material designed and manufactured specifically for the purpose of this work and must have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes. The geotextile must be chemically resistant to the material to be contained and suitable for service temperatures as well as the soil/groundwater conditions of the site. Material specifications supporting this confirmation must be supplied on request. Except where shown on the Design Drawings, individual sections of the geotextile, as supplied, must not be less than 4.5 m wide without prefabrication and must be of such dimensions and shape to result in the minimum on-site seam length. Unless otherwise specified in the project documents, the physical properties of the geotextile must meet the requirements listed in Table 2-1 and Table 2-2 for Bidim A24G and Bidim A34G respectively.

Table 2.1 – Physical Properties of Bidim A24G Geotextile

Property	Test Method Australian Standard (ASTM equivalent)	Units	Value	Manufacturer Supplied QC
Wide Strip Tensile Strength	ASTM D4595	kN/m	14.0	1 per roll
Wide Strip Toughness	ASTM D4595	kJ/m2	2.7	1 per roll
Grab Tensile Strength	ASTM D4595	N	850	1 per roll
Trapezoidal Tear Strength	ASTM D4533	N	345	1 per roll
CBR Burst Strength	ASTM D6241	N	2,500	1 per roll
Pore Size (AOS)	ASTM D7451	µm	80	1 per roll
Permeability (Flow)	ASTM 4491	s-1	2.65	1 per roll

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Table 2.2 – Physical Properties of Bidim A34G Geotextile

Property	Test Method Australian Standard	Units	Value	Manufacturer Supplied QC
Wide Strip Tensile Strength	ASTM D4595	kN/m	18.5.0	1 per roll
Wide Strip Toughness	ASTM D4595	kJ/m2	3.5	1 per roll
Grab Tensile Strength	ASTM D4595	N	1,270	1 per roll
Trapezoidal Tear Strength	ASTM D4533	N	440	1 per roll
CBR Burst Strength	ASTM D6241	N	3,400	1 per roll
Pore Size (AOS)	ASTM D7451	µm	8075	1 per roll
Permeability (Flow)	ASTM 4491	s-1	1.75	1 per roll

The Supplier may submit physical properties for a different or alternative geotextile for review by the Owner.

The Supplier must ensure the geotextile incorporated in the works is sufficient to protect the underlying Zone 1 without damage to the geotextile.

Seam threads must be of equal or better resistance to chemical and biological degradation than the geotextile fabric.

2.2 Flownet

The Flownet to be used is *'Flownet M5A14X2'* and '*Trinet T5A14NFX2*' or approved equivalent as shown on the Design Drawings.

These materials must be designed and manufactured specifically for the purpose of this work and must have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes.

Unless otherwise specified in the project documents, the physical properties of these materials must meet the requirements listed in Table 2 3 and Table 2 4.

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Table 2.3 – Physical Properties of Flownet M5A14X2

Property	Test Method	Value Type	Units	Values
Geonet Properties				
Polymer				High-density polyethylene (HDPE)
Carbon Black	ASTM D4218	Range	%	2-3
Density	ASTM D1505	Minimum	g/cm^3	0.94
Thickness[1]	ASTM D5199	MAV	mm	5.0
Flow Rate/Width, MD[2]	ASTM D4716	Typical	L/s.m	1.85
Tensile Strength, MD	ASTM D7179	Minimum	kN/m	7.9
Bidim Geotextile Properties				
CBR	ASTM D6241	MARV	N	1815
Grab Strength, MD	ASTM D4632	MARV	N	616
Grab Elongation, MD	ASTM D4632	MARV	%	60
Trapezoid Tear Strength, MD	ASTM D4533	MARV	N	246
AcGPLerated UV Resistance	ASTM D4355	MARV	% Strength Retained	50
Pore Size, O_{95}	ASTM D4751	MARV	µm	174
Permeability (flow)	ASTM D4491	MARV	s^{-1}	3.20
Geocomposite Properties				
Ply Adhesion	ASTM D7005	Typical	N/m	170
Flow Rate/Width[2]	ASTM D4716	Typical	L/s.m	0.52

NOTES:

1. Thickness determined at 2 kPa
2. Flow Rate determined at 480 kPa, hydraulic gradient 1.0, hard plates, 15-minute seat period
3. MD = Roll Machine Direction.
4. MAV = Minimum Average Value
5. MARV = Minimum Average Roll Value

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Table 2.4 – Physical Properties of TRINET T5A14NFX2

Property	Test Method	Value Type	Units	Values
Geonet Properties				
Polymer				High-density polyethylene (HDPE)
Carbon Black	ASTM D4218	Range	%	2-3
Density	ASTM D1505	Minimum	g/cm^3	0.94
Thickness[1]	ASTM D5199	MAV	mm	5.0
Tensile Strength, MD	ASTM D7179	Minimum	kN/m	11
Compressive Strength, MD	ASTM D6364	Minimum	kPa	1250
bidim Geotextile Properties				
CBR	AS 3706.4	MARV	N	1815
Grab Strength, MD	AS 3706.2b	MARV	N	616
Grab Elongation, MD	AS 3706.2b	MARV	%	50
Trapezoid Tear Strength, MD	AS 3706.3	MARV	N	246
AcGPLerated UV Resistance	AS 3706.11	MARV	% Strength Retained	50
Pore Size, O_{95}	AS 3706.7	MARV	µm	174
Permittivity	AS 3706.9	MARV	s^{-1}	3.20
Geocomposite Properties				
Ply Adhesion	ASTM D7005	Typical	N/m	170
Flow Rate/Width[2]	ASTM D4716	Typical	L/s.m	1.10

NOTES:
1. Thickness determined at 2 kPa
2. Flow Rate determined at 480 kPa, hydraulic gradient 1.0, hard platens, 15-minute seat period
3. MD = Roll Machine Direction.
4. MAV = Minimum Average Value
5. MARV = Minimum Average Roll Value

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2.3 Megflo

The Megaflo (Megaflo Ultra) 300 or approved equivalent as shown on the Design Drawings.

- 6235-40-DWG-00041 Rev A Tailings Storage Facility Typical Sections and Details Sheet 1 of 2
- 6235-40-DWG-00042 Rev A Tailings Storage Facility Typical Sections and Details Sheet 2 of 2

These materials must be designed and manufactured specifically for the purpose of this work and must have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes.

Unless otherwise specified in the project documents, the physical properties of these materials must meet the requirements listed in Table 2 5.

Table 2.5 – Physical properties of Megaflo 300

Property	Standard	Method	Product Code MEG 300
Slot Length (mm)	ASTM D2122	MW139	≥ 25.0
Slot Width (mm)	ASTM D2122	MW139	≥ 3.0
Width (mm) **inside diameter** **outside diameter**	ASTM D2122	MW139	≥ 22.0 < 43.0
Height (mm) **inside diameter** **outside diameter**	ASTM D2122	MW139	≥ 292.0 < 316.0
Pipe Stiffness @ 20% Deflection (kPa)	ASTM D2412	MW140	> 240.0
Horizontal Compressive Strength @ Yield (kPa)	ASTM D2412 (mod)	MW140	> 300.0

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3 TESTING AND INSPECTION

Inspection and Test Plans and quality control procedures used in the manufacturing process must form part of the Supplier Method Statement and must be submitted for approval by the Owner prior to the commencement of work.

All geotextile rolls will be subject to inspection in accordance with the Owner-approved Supplier's Inspection and Test Plan.

Quality Control certificates are required for the geotextiles. The certificates must be clearly legible, in the English language and as a minimum include:

i) Roll numbers, lot or batch numbers and identification.
ii) Sampling procedures.
iii) Results of quality control tests, including description of tests used.

All certificates must be signed by responsible parties employed by the Supplier (such as the Engineer).

4 PACKAGING, TRANSPORT, AND HANDLING

All geotextiles must be suitably packed to prevent damage during transport, handling and extended storage on site. Geotextiles must be supplied in rolls wrapped in relatively impermeable and opaque protective covers. The geotextile rolls must be labelled with the following information:

i) Supplier's name.
ii) Product identification.
iii) Roll number.
iv) Roll dimensions.

5 INSTALLATION BY THE CONTRACTOR

5.1 Delivery, Storage and Handling

The Owner is responsible for receiving, storing and handling the geotextile without damage.

The Contractor is responsible for receiving the geotextile from the warehouse / store of the Owner and transporting it to the work site. Geotextile materials received by the Contractor must be inspected for damage and must be loaded / unloaded and stored with minimum handling.

Materials must not be stored directly on the ground. The storage area must be such that all materials are protected against theft, vandalism, passage of vehicles, puncture, dirt, grease, water, moisture, mud, excessive heat, UV exposure and other conditions which may damage the geotextile. The stacking of geotextile must not be higher than two rolls.

Materials, equipment or other items must be carried and placed on the surface of the geotextile until it is anchored in place.

Under no circumstances must the geotextile be subjected to materials, equipment or other items being dragged across its surface, nor must workmen and others slide down slopes atop the geotextile. All scuffed surfaces resulting from abuse of any kind by the Contractor must be repaired at no additional cost to the Owner.

5.2 Installation

The preparation of the surface to receive the geotextile is part of the works prescribed for the Earthworks Contractor in the Earthworks Specification.

Prior to lining any given area with geotextile, the Engineer and the Contractor will visually inspect the surfaces to receive geotextile to ensure the surface which is to be covered by geotextile is free from sharp objects, and other materials which may damage the geotextile before placement of the geotextile.

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The Engineer must accept and approve, in writing, to the condition of the surfaces on which the geotextile will be installed.

No vehicle movement is allowed over the exposed geotextile.

The Contractor must note that careful scheduling of the earthworks is required in order to synchronise with the works which require placement of geotextile in order to minimise rework which may be caused by delays or poor scheduling.

The Contractor must record the roll number of geotextile placed and provide survey locations and RLs of the corners of each roll of geotextile placed during construction.

The geotextile must be placed to the lines and grades and anchored in accordance with the Design Drawings and Supplier's recommendations.

6 CLEAN UP

Upon completion of the work, the Contractor must remove from site to appropriate waste management facilities:

i) Any debris and surplus material resulting from the construction operations.
ii) Any temporary site facilities.
iii) All waste and rubbish.
iv) Any contaminated soil from Contractor activities (such as diesel spills).

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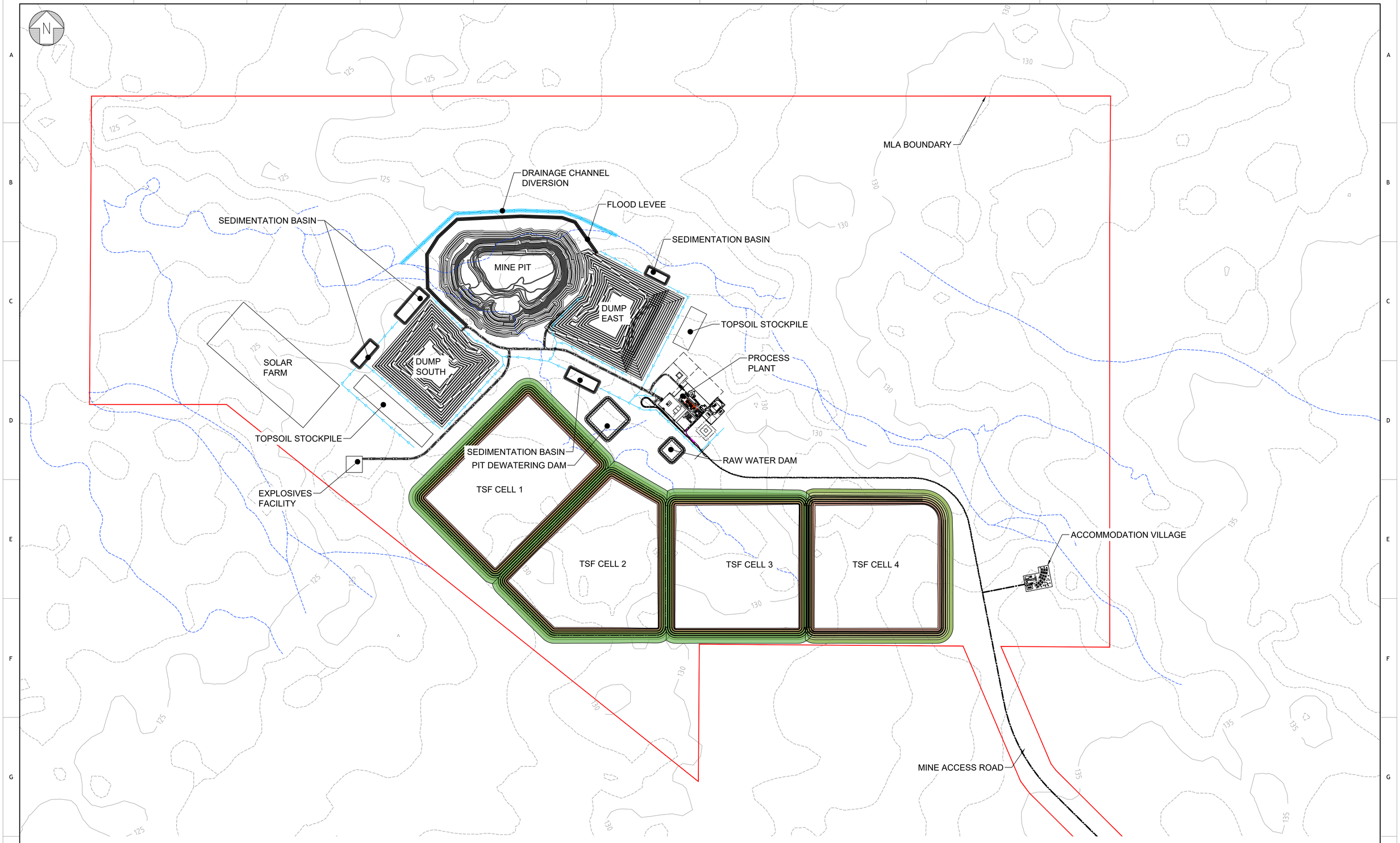
Appendix 1

Drawings

Graphinex Pty Ltd

Tailings Storage Facilities – Geotextile and Flownet Specification

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300 30 300 600 900 1200 1500m

SCALE 1:15,000

LOCALITY PLAN
1:15,000

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	ENGINEER	APPROVED
B	10.02.2026	REISSUED FOR STUDY	AE	PG	PG	LB
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DESIGNED J.FEETHAM	10.03.2025
CHECKED P. GLOWERY	10.03.2025
ENGINEER P. GLOWERY	10.03.2025
APPROVED L. BLACK	10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

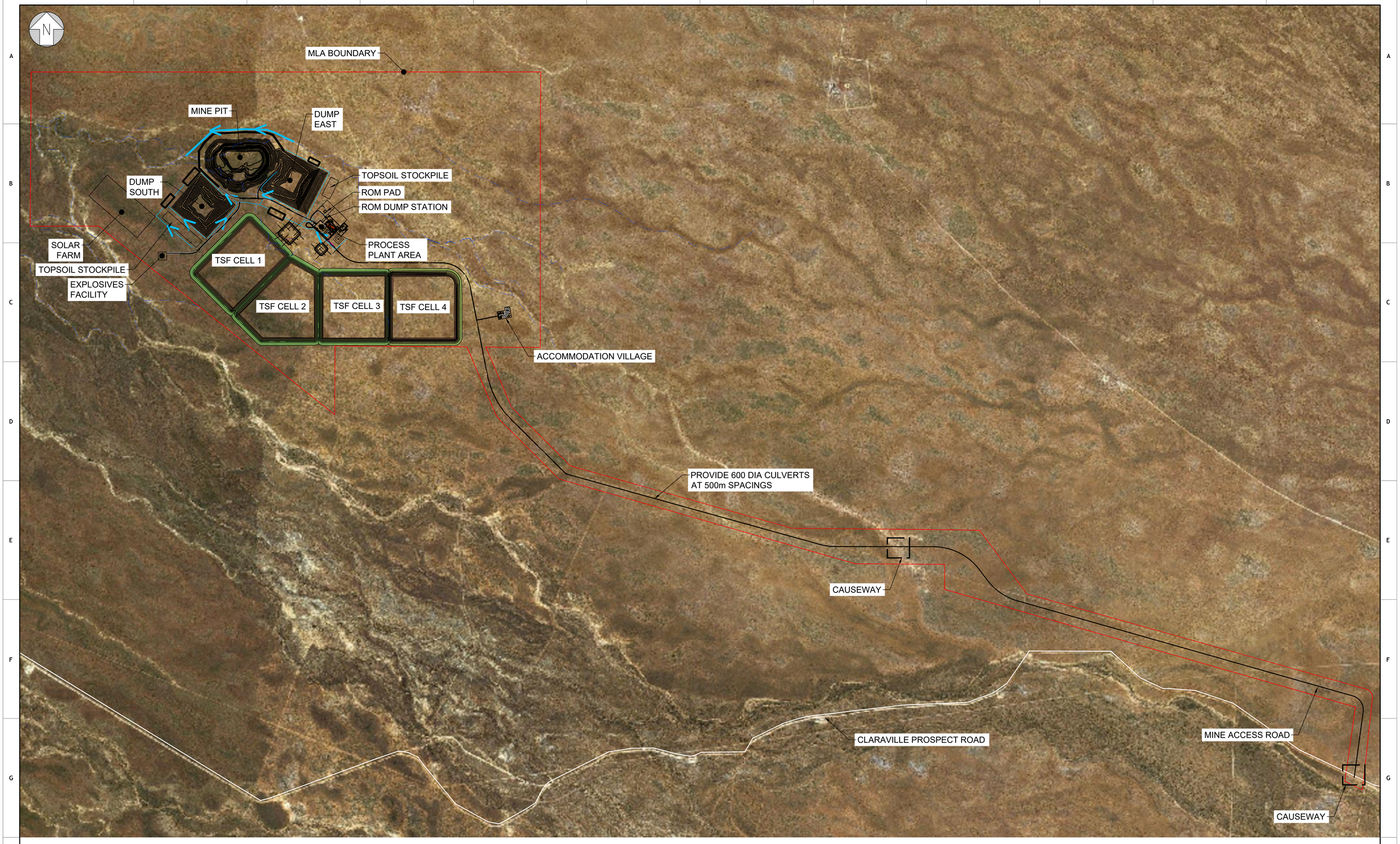
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DRAWING STATUS: ISSUED FOR STUDY

CLIENT DWG NO

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AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00020 REV: B



600 0 600 1200 1800 2400 3000m

SCALE 1:30,000

LOCALITY PLAN

1:30,000

DRAWING NUMBER	DESCRIPTION
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APPROVED	L. BLACK	10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

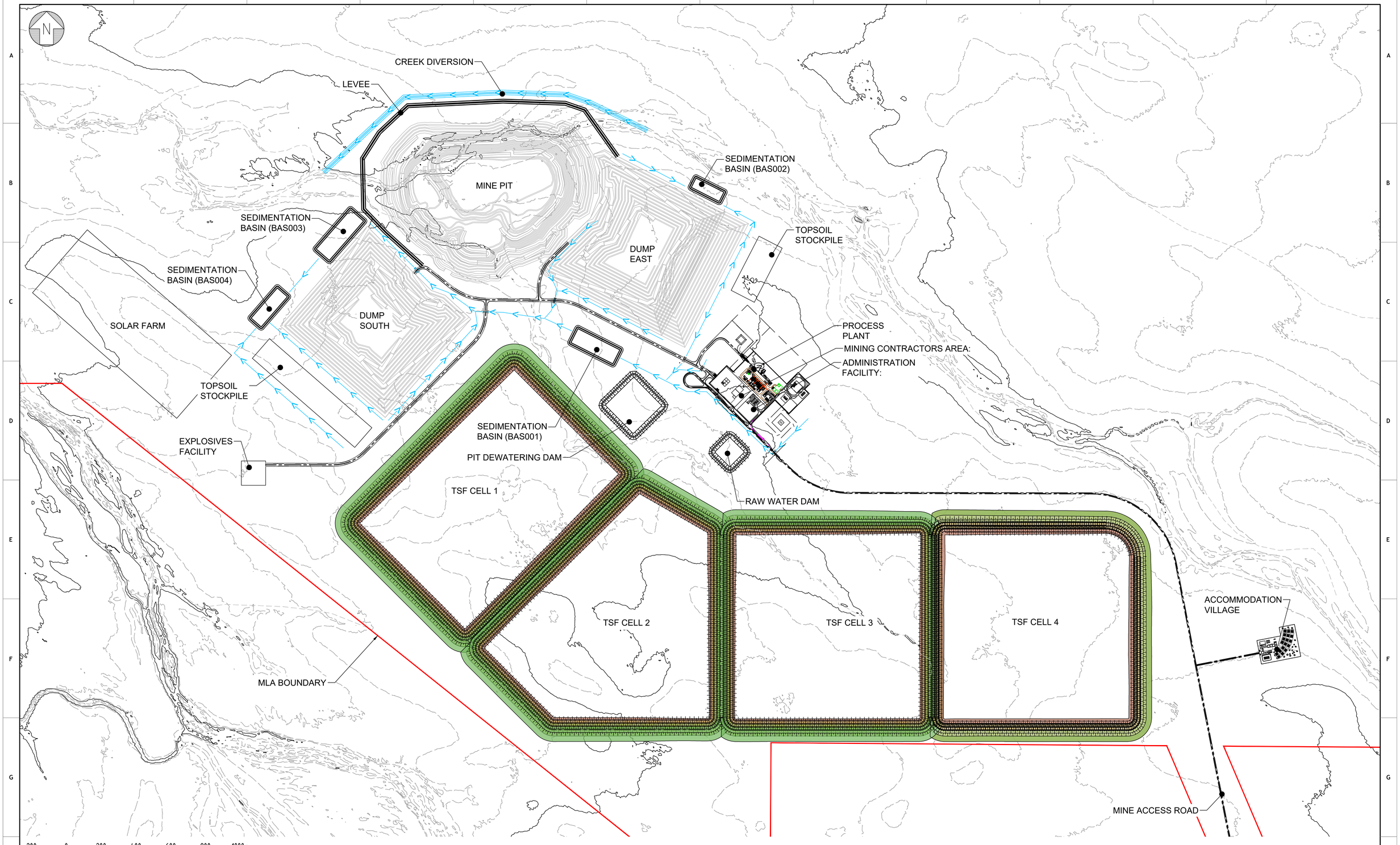
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DWG NO: 6235-40-DWG-CI-00030 REV: B



PLAN
1:10,000

DRAWING NUMBER	DESCRIPTION
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A	14.03.2025	ISSUED FOR STUDY	SR	PG	PG	LB

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS
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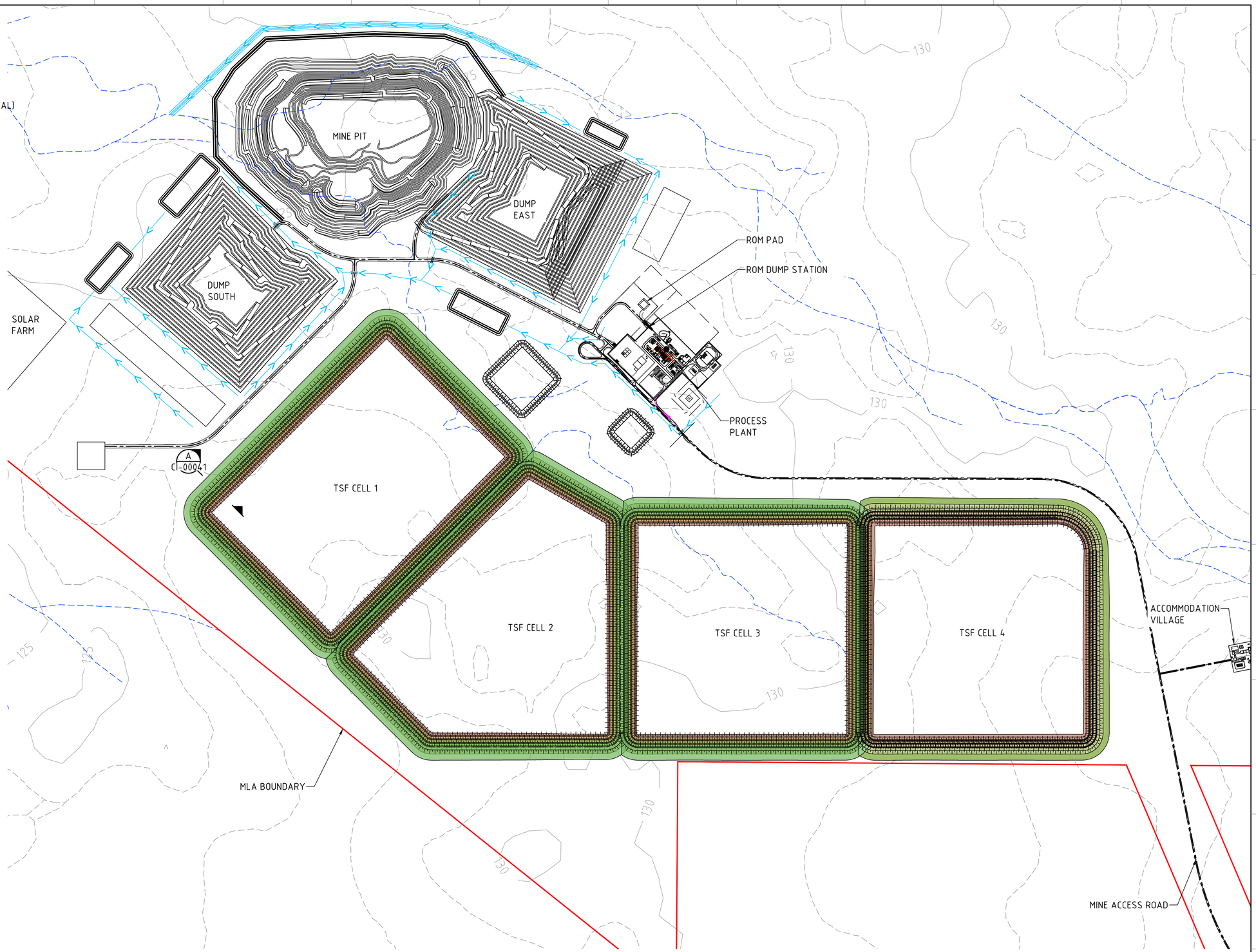
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DWG NO: 6235-40-DWG-CI-00031
REV: B

LEGEND

- 385 — EXISTING SURFACE CONTOUR (1m INTERVAL)
- GRADE LINE
- PROPOSED TOP OF BATTER (LEFT)
- STAGED EMBANKMENT - LIFT 01
- STAGED EMBANKMENT - LIFT 02
- STAGED EMBANKMENT - LIFT 03
- STAGED EMBANKMENT - LIFT 04



200 0 200 400 600 800 1000m

SCALE 1:10,000

LOCALITY PLAN

1:10,000

DRAWING NUMBER	DESCRIPTION
DRAWING REFERENCE	

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APPROVED	L. BLACK	DATE 10.03.2025

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PROJECT: ESMERALDA GRAPHITE PROJECT - PFS

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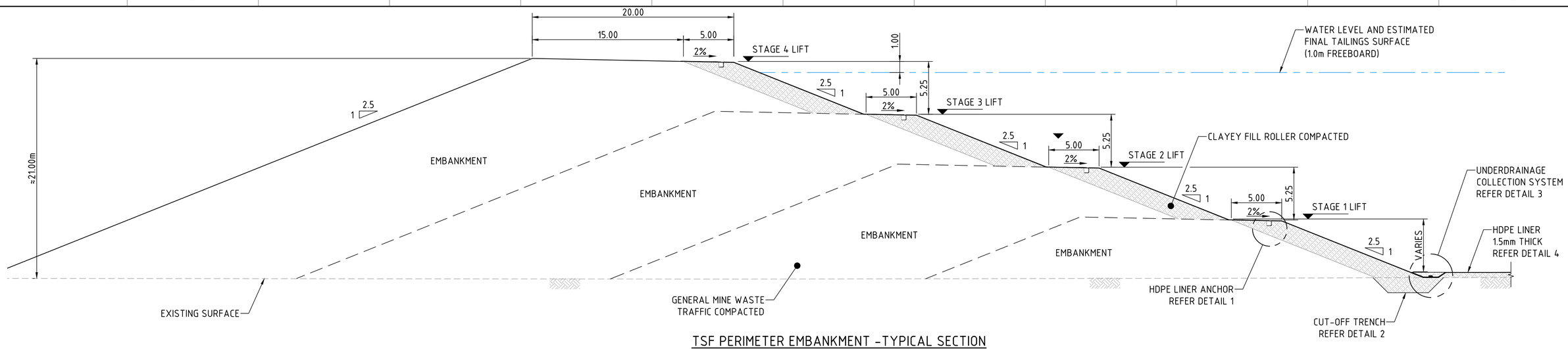
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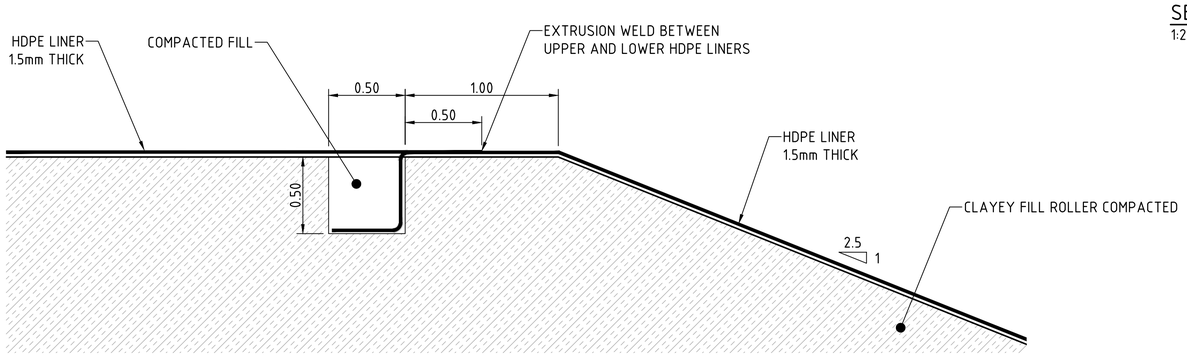
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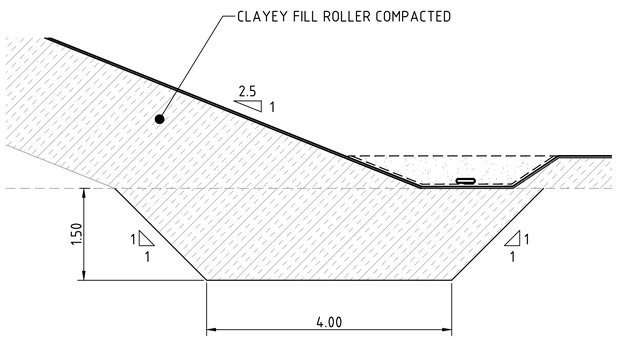


TSF PERIMETER EMBANKMENT -TYPICAL SECTION

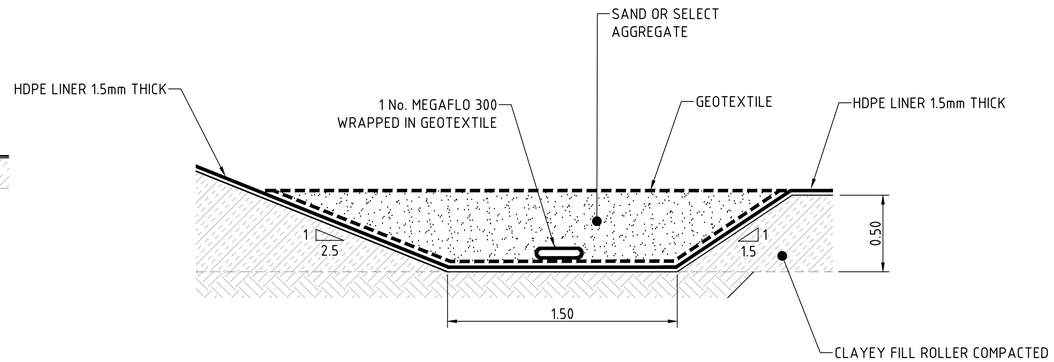
SECTION A CI-00040
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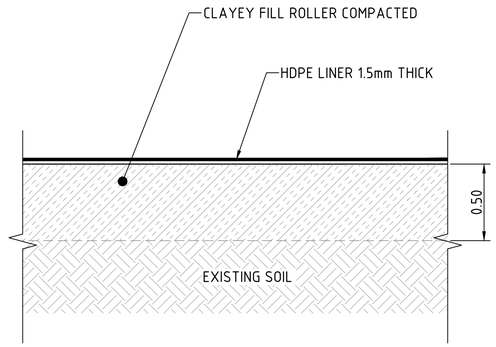
DETAIL 1 – HDPE ANCHOR -TYPICAL DETAIL
1:20



DETAIL 2 – CUT-OFF TRENCH -TYPICAL DETAIL
1:50



DETAIL 3 – UNDERDRAINAGE COLLECTION SYSTEM-TYPICAL DETAIL
1:20



DETAIL 4
1:20

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

4 0 4 8 12 16 20m
SCALE 1:200

1.0 0 1.0 2.0 3.0 4.0 5.0m
SCALE 1:50

0.4 0 0.4 0.8 1.2 1.6 2.0m
SCALE 1:20

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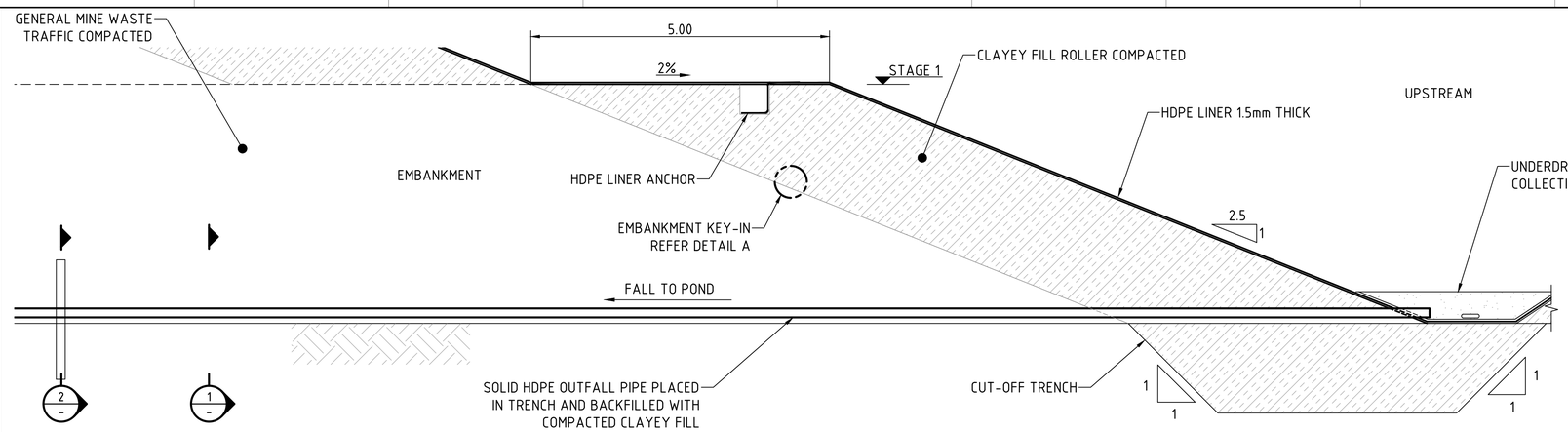
CLIENT: GRAPHINEX
PROJECT: ESMERALDA GRAPHITE PROJECT
TITLE: TAILINGS STORAGE FACILITY TYPICAL SECTIONS AND DETAILS SHEET 1 OF 2

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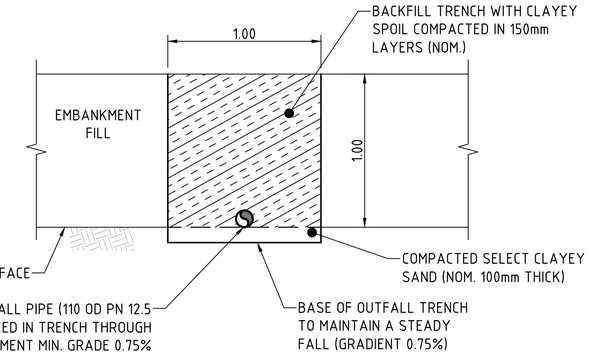
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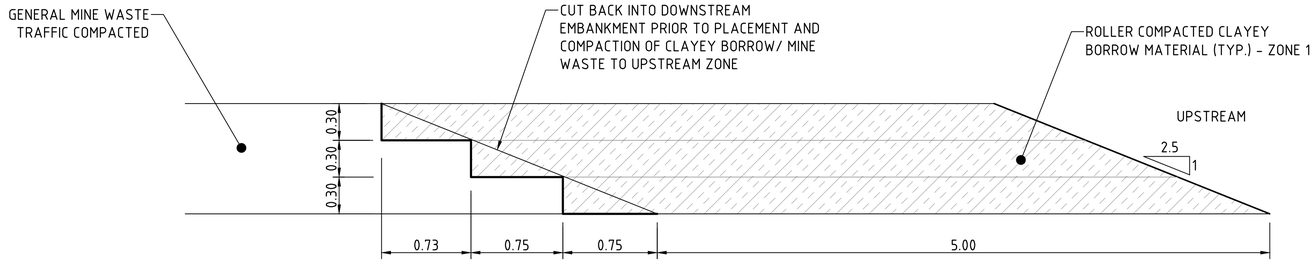
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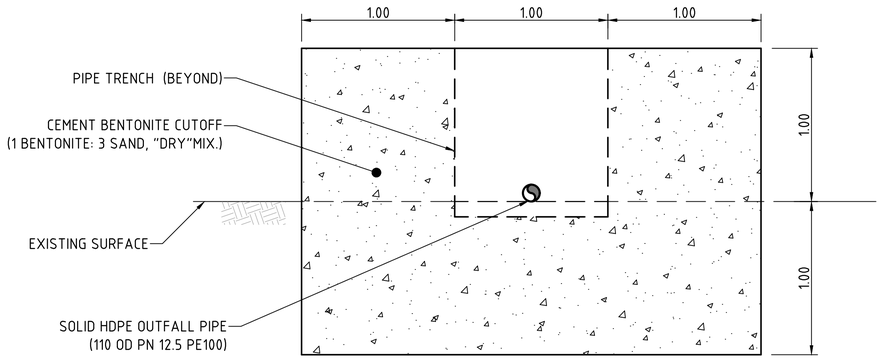
UNDERDRAINAGE OUTFALL PIPE THROUGH EMBANKMENT -TYPICAL SECTION
1:50



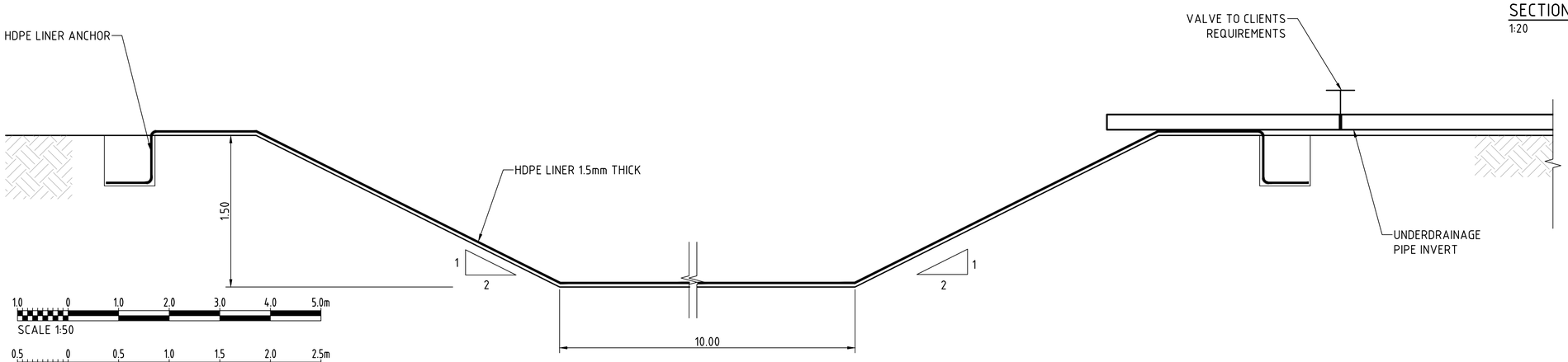
SECTION 1 / - OUTFALL PIPE TRENCH (THROUGH EMBANKMENT) -TYPICAL SECTION
1:20



DETAIL A / - EMBANKMENT KEY-IN -TYPICAL DETAIL
1:25



SECTION 2 / - CEMENT BENTONITE CUTOFF -TYPICAL SECTION
1:20



UNDERDRAINAGE SUMP -TYPICAL SECTION
1:25

NOTES:

ROLLER COMPACTED CLAYEY BORROW MATERIAL (UPSTREAM ZONE):

1. CLAYEY MINE WASTE FROM THE PIT WILL BE USED TO CONSTRUCT THE LOW PERMEABILITY UPSTREAM EMBANKMENT ZONE AND BACKFILL TO CUT OFF TRENCHES.
2. THE CLAYEY MINE WASTE WILL BE MOISTURE CONDITIONED AND ROLLER COMPACTED IN 0.3m NOMINAL LAYERS.
3. EACH LAYER SHOULD BE COMPACTED TO A MINIMUM OF 95% OF SMDD.

TRAFFIC COMPACTED GENERAL MINE WASTE:

4. THE CONSTRUCTED DOWNSTREAM ZONE WILL BE CONSTRUCTED FROM GENERAL MINE WASTE .
5. THE DOWNSTREAM ZONE MINE WASTE WILL BE PLACED IN 1m NOMINAL LAYERS AND TRAFFIC COMPACTED USING MINING EQUIPMENT.

GENERAL:

6. ALL DIMENSIONS IN METERS UNO.

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TITLE: TAILINGS STORAGE FACILITY
TYPICAL SECTIONS AND DETAILS
SHEET 2 OF 2

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SCALE	GRID	DATUM	SIZE
AS SHOWN			A1

DWG NO: 6235-40-DWG-CI-00042
REV: A

Appendix 2

Schedule of Materials

(to be completed by others)

Graphinex Pty Ltd

Tailings Storage Facilities – Geotextile and Flownet

Specification

DRAFT Rev B (issued for client review)

Appendix 3

Geotechnical Assessment - Tailings Testwork

Graphinex Pty Ltd
Esmeralda Graphite Project

Final Rev 0 (issued for use)

Soil; & Rock Engineering Pty Ltd (SRE)

TECHNICAL MEMORANDUM

To:	Graphinex Pty Ltd	From:	Chris Lane
Attn:	Blair Richardson/Iain Goode	Date:	9 March, 2026
Subject	Tailings Testwork Esmeralda Graphite Project, Queensland		

1.0 INTRODUCTION

This document presents the details of the geotechnical tailings testwork which has been executed on the tailings samples provided for the Esmeralda Graphite Project, Queensland.

2.0 TAILINGS TESTING

2.1 Tailings Testing Program

Tailings testwork was executed by E-Precision on samples of the tailings produced from metallurgical testwork. The laboratory testwork comprised:

i) One particle size distribution (PSD) and hydrometer with soil particle density (SPD) determination.
ii) One Atterberg Limits (AL) Test.
iii) One Air Drying Test (ADT).
iv) One Undrained Settling Test (UST).
v) One Drained Settling Test (DST)
vi) One Extended Height Consolidation Test.

2.2 Discussion of Test Results

The results are presented in Appendix 1 of this document. The results of this testing and the implications for the operation of the TSFs are summarised as follows:

i) The results of the PSD and AL testing indicate that the tailings can be classified as a low plasticity sandy clay/sandy silt and are classified as CL-ML, according to Table 10, Classification of Fine-Grained Soils in AS 1726:2017, Geotechnical Site Investigations. Based on the results of the PSD and AL tests the hydraulic conductivity for the settled, consolidated tailings is estimated to be in the range of 10^{-8} m/s to 10^{-10} m/s. The relevant geotechnical test results (PSD and AL testing) on which the screening for liquefaction is based, include moisture content, particle size distribution, clay content (defined as % passing the 0.002 mm sieve) and Atterberg limits. The screening implies that there is an overall tendency for the tailings materials which have a low plasticity clay fraction, to be susceptible to liquefaction under sufficiently adverse conditions of saturation, in-situ stress and cyclic loading. As the tailings will be contained within an above ground facility raised by downstream construction and ultimately back into mined pit, effectively and In-Pit TSF (IPTSF) is highly unlikely that the deposited tailings would form a foundation for future embankment raises and therefore, apart from some settlement of the tailings in the pit as a result of any seismic activity there are no adverse consequences if the tailings were to liquefy.

ii) The tailings have an SPD of 2.678 t/m^3.

iii) The ADT indicates that solar drying and desiccation (a function of the % solids, clay fraction and plasticity of the tailings) occur over a period of approximately 10.4 days, with the final estimated dry density peaking at approximately 1.32 t/m^3. This does not include the effects of consolidation which would occur within the tailings stack.

iv) The objective of the UST is to monitor the tailings settlement and the development of clear supernatant water in undrained conditions. By monitoring the percentage of supernatant with respect to the initial water volume, an indication of how much water will be available for recovery and the speed at which this water is released, can be assessed. The results show the available supernatant water with respect to the total water discharged to the tailings storage. The points to note from the laboratory results are:

- Water available for recovery (approximately 54.07%) takes approximately 1.0 days under laboratory conditions.
- The dry density of the tailings after 1.26 days is approximately 1.47 t/m^3 in the UST, which does not include the effects of consolidation, which would occur within the tailings stack.

v) The objective of the DST, which was top and bottom drained, is to monitor the tailings settlement and the development of clear supernatant water and underdrainage in drained conditions. By monitoring the percentage of supernatant and underdrainage with respect to the initial water volume, an indication of how much water will be available for recovery and the speed at which this water is released, can be assessed. The points to note from the laboratory results are:

- The recovery of water from the top drainage, by decantation, is approximately 28% of the slurry water and is available 1.83 hours after tailings deposition. The recovery of water from the underdrainage is 30.1% of the slurry water, which is available 1.83 hours after tailings deposition. Total water recovery is 58.85%, under laboratory conditions, which does not include the effects of consolidation, which would occur within the tailings stack, increasing the total water available for recovery.
- The dry density of the tailings after approximately 1 day is 1.57 t/m^3 in the drained settling test, which does not include the effects of consolidation, which would occur within the tailings stack.

vi) The objective of the Consolidation Test, which is undrained, is to determine the consolidation and permeability characteristics of the tailings. The points to note from the laboratory results are:

- The tailings have good consolidation characteristics with C_v between 4.55 and 16.677 m^2/yr.
- The hydraulic conductivity (k) for the tailings is in the range of 3.6 x 10^{-8} m/sec, at Stage 1 (12.5 kPa) to 5.7 x 10^{-11} m/sec, at Stage 8 (1600 kPa) under laboratory conditions, which does include the effects of consolidation, which would occur within the tailings stack in the above ground TSF, where an increased overburden loading combined with drainage through the underdrainage in the base of the tailings stack, would further reduce the hydraulic conductivity (k) for the tailings. A similar effect would occur where the tailings are deposited back into the mine pit at the end of processing.

3.0 CONCLUSION

From a review of the test results above and the performance of similar TSFs where fresh ores are discharged into the storage facility, the results of the consolidation testing indicate that the final in-situ dry densities of the tailings deposited into the above ground TSF are likely to be in the range of 1.55 to 1.65 t/m^3, with the

final in-situ dry densities of the tailings deposited back into the mine pit being in the range of 1.65 to 1.85 t/m^3.

The design must consider the inclusion of a rock ring decant filter for the above ground TSFs to maximise the water recovery/removal and explore the benefits of inclusion of an underdrainage system.

A technical note on the rock ring filter and tailings deposition is attached in Appendix 2.

4.0 CLOSURE

We trust the details provided in this document meet your current requirements.

Should you require further information or clarification of any details, please do not hesitate to contact this office.

Yours faithfully
pp L&MGSPL

Christopher Lane
PRINCIPAL

Attachments: - Appendix 1 - Laboratory Test Certificates
Appendix 2 – Technical Note Rock Ring Filter and Tailings Deposition

Appendix 1

Laboratory Test Certificates

Perth
16 Gympie Way, Willetton
WA 6155
Ph: (08) 9418 8742
E-mail: Phillip.li@eprecisionlab.com

E-Precision Laboratory

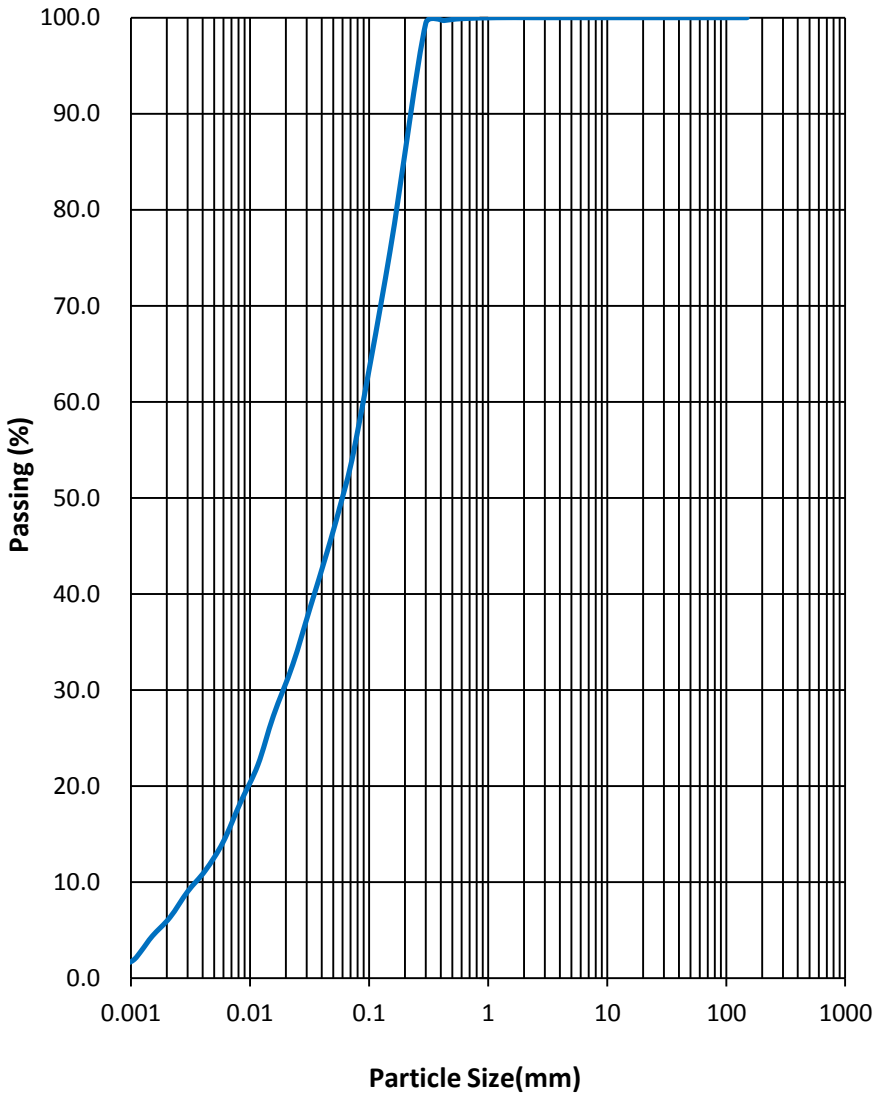
PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.3 3.5.1

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Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails	Depth (m):	-
Lab ID:	GRAPHINEX_PSD	Room Temperature at Test:	19°C
Tested by:	Raymond	2.36mm Particle Density (t/m³):	2.678
Checked by:	Phil	Moisture Content (%):	-

Sieve Size (mm)	Passing %
150	100.0
75	100.0
53	100.0
37.5	100.0
26.5	100.0
19	100.0
9.5	100.0
4.75	100.0
2.36	100.0
1.18	100.0
0.6	99.9
0.425	99.7
0.3	99.4
0.15	75.6
0.075	55.1
0.05669	49.0
0.04446	44.4
0.03192	38.5
0.02290	32.7
0.01573	27.3
0.01165	22.2
0.00832	18.3
0.00594	14.1
0.00422	11.2
0.00300	9.0
0.00213	6.3
0.00152	4.4
0.00124	2.9
0.00107	2.0
0.00091	1.5

PSD Graph



Notes:
Stored and Tested the Sample as received
Samples supplied by the Client

Authorized Signature:

The results of tests performed apply only to the specific sample at time of test unless otherwise clearly stated. Reference should be made to E-Precision Laboratory's "Standard Terms and Conditions" E-Precision Laboratory ABN 431 559 578 87

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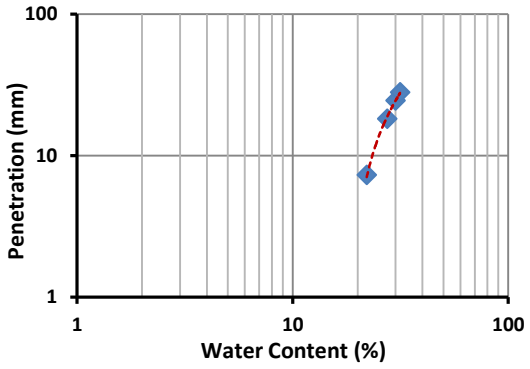
ATTERBERG LIMITS TEST REPORT

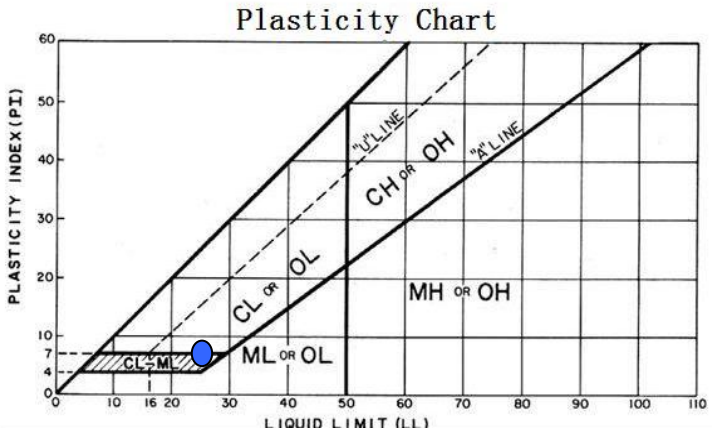
Test Method: AS1289.2.1.1 3.1.1 3.2.1 3.4.1

Client:	SRE Pty Ltd	Date Tested:	25/02/2026
Project:	Graphinex Testing 2026	Lab:	EPLAB
Sample No:	Graphinex Tails	Job Number:	SRE
Lab ID:	Graphipnex_ATT		
Depth(m):	-	Room Temperature at Test:	18°C
Tested by:	Sunny	Sample Description:	-
Moisture Content (%):	-	Wet Density (t/m³):	-
		Dry Density (t/m³):	-

Liquid Limit (%):	26.61
Plastic Limit (%):	19.76
Plasticity Index (%):	6.85
Liquidity Index (%):	-
Shrinkage Limit (%):	17.61
Linear Shrinkage(%):	3.47

Results Chart





Notes: The sample/s were tested oven dried, dry sieved and in a 125-250mm mould.

Stored and Tested the Sample as received

Samples supplied by the Client

Authorised Signature:

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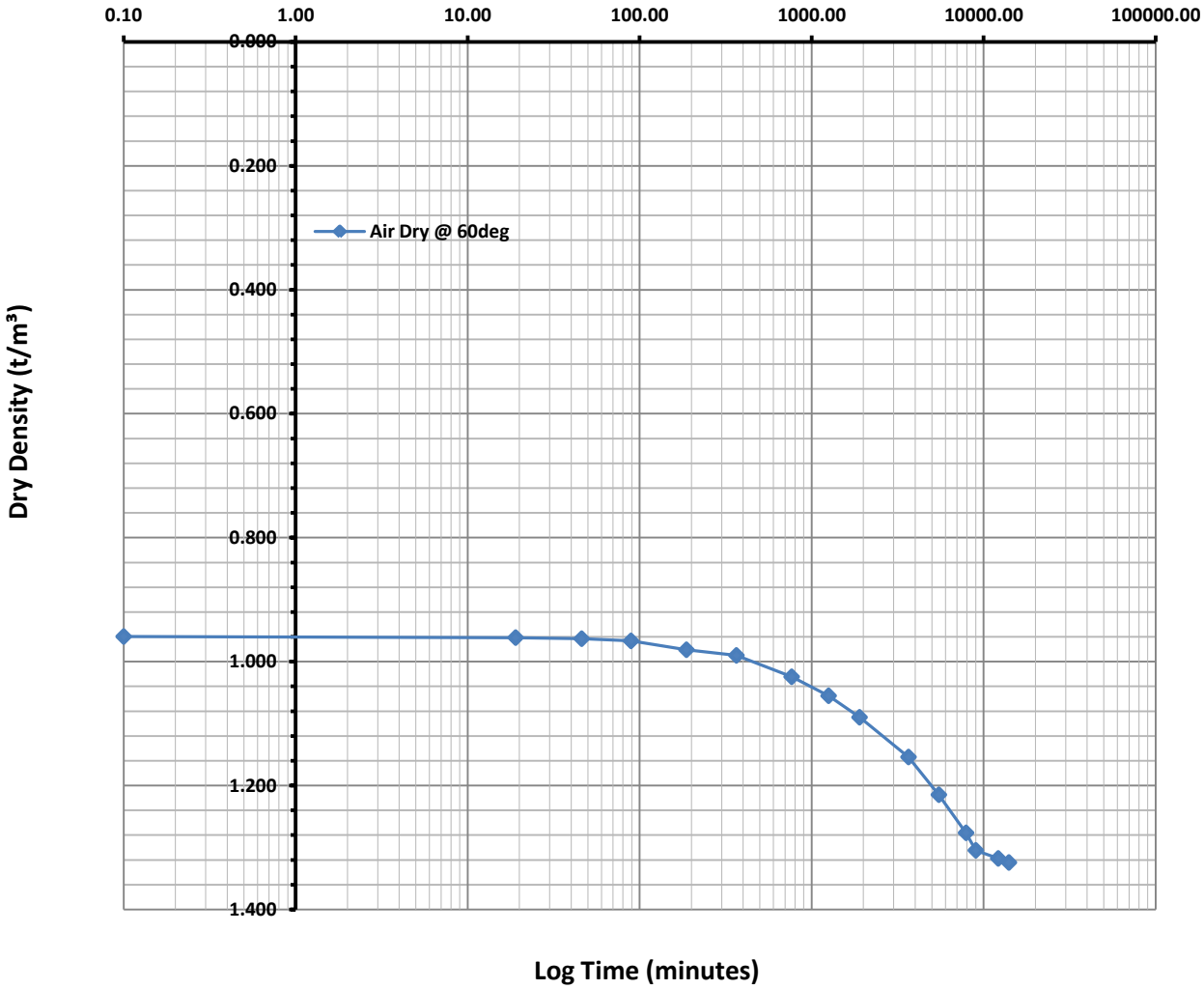
AIR DRYING SETTLING TEST

METHOD: Supplied by Client SRC-WF-100 / SRC-RF-100

Client:	SRE Pty Ltd	Date Tested:	23/02/2025
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails		
Lab ID:	GRAPHINEX_AIR_DRY	Room Temperature at Test:	19°

Tested by: Phil
Type of Test: Air Dry Testing
Sample Preparation: 60% Solids
Initial Bulk Density (t/m³): 1.599
Particle Density (t/m³): 2.678
Moisture Content Initial (%): 66.626

Dry Density (t/m³) Vs Time (minutes)



Comments:

Authorised Signature (Geotechnical Engineer):

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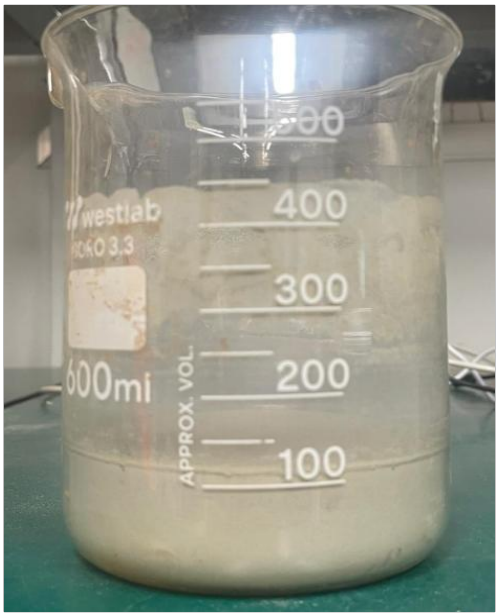
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AIR DRYING SETTLING TEST

METHOD: Supplied by Client SRC-WF-100 / SRC-RF-100

Client:	SRE Pty Ltd	Date Tested:	23/02/2025
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails		
Lab ID:	GRAPHINEX_AIR_DRY	Room Temperature at Test:	19°

Photo of Samples after Testing





Oven dried @ 60deg

Comments:

Authorised Signature (Geotechnical Engineer):

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SETTLEMENT TESTING TAILINGS

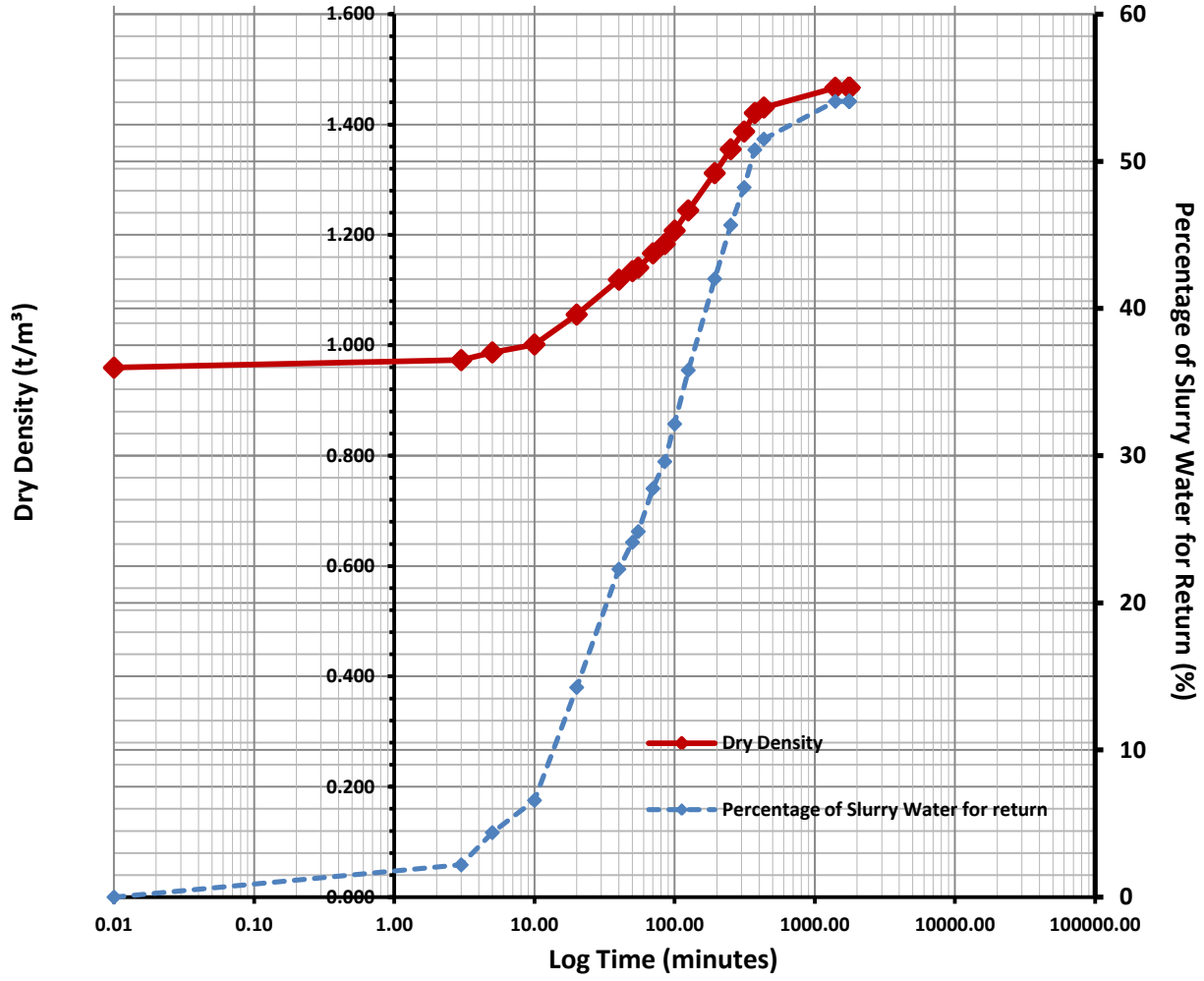
METHOD: IN-HOUSE METHOD

Client:	SRE Pty Ltd	Date Tested:	21/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails		
Lab ID:	GRAPHINEX_SETTLEMENT	Room Temperature at Test:	22°

Tested by: Phil
Type of Test: Settlement Testing
Sample Preparation: 60% Solids

Initial Dry Density (t/m³): 0.959
Particle Density (t/m³): 2.678
Initial Bulk Density (t/m³): 1.599

Undrained Dry Density (t/m³) Vs Log Time (minutes)



Comments:

Authorised Signature (Geotechnical Engineer):

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SETTLEMENT TESTING TAILINGS

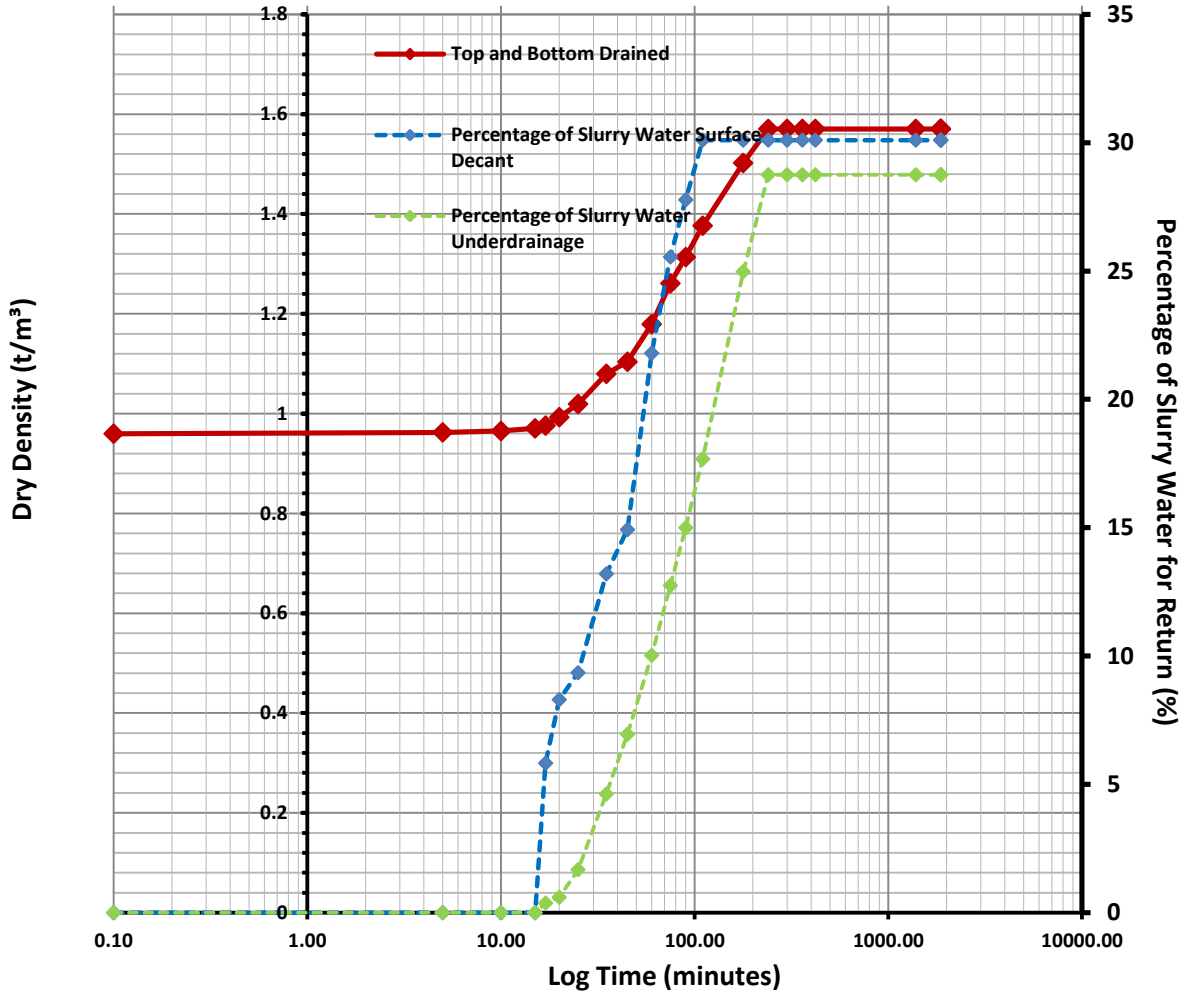
METHOD: IN-HOUSE METHOD

Client:	SRE Pty Ltd	Date Tested:	21/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails		
Lab ID:	GRAPHINEX_SETTLEMENT	Room Temperature at Test:	22°

Tested by: Phil
Type of Test: Settlement Testing
Sample Preparation: 60% Solids

Initial Dry Density (t/m³): 0.960
Particle Density (t/m³): 2.678
Initial Bulk Density (t/m³): 1.600

Top and Bottom Drained Dry Density (t/m³) Vs Log Time (minutes)



Comments:

Authorised Signature (Geotechnical Engineer):

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SETTLEMENT TESTING TAILINGS

METHOD: IN-HOUSE METHOD

Client:	SRE Pty Ltd	Date Tested:	21/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample No:	Graphinex Tails		
Lab ID:	GRAPHINEX_SETTLEMENT	Room Temperature at Test:	22°

Tested by: Phil
Type of Test: Settlement Testing
Sample Preparation: 60% Solids

Initial Dry Density (t/m³): -
Particle Density (t/m³): -
Initial Bulk Density (t/m3): -

Photo of Test Setup

Undrained



Drained



Comments:

Authorised Signature (Geotechnical Engineer):

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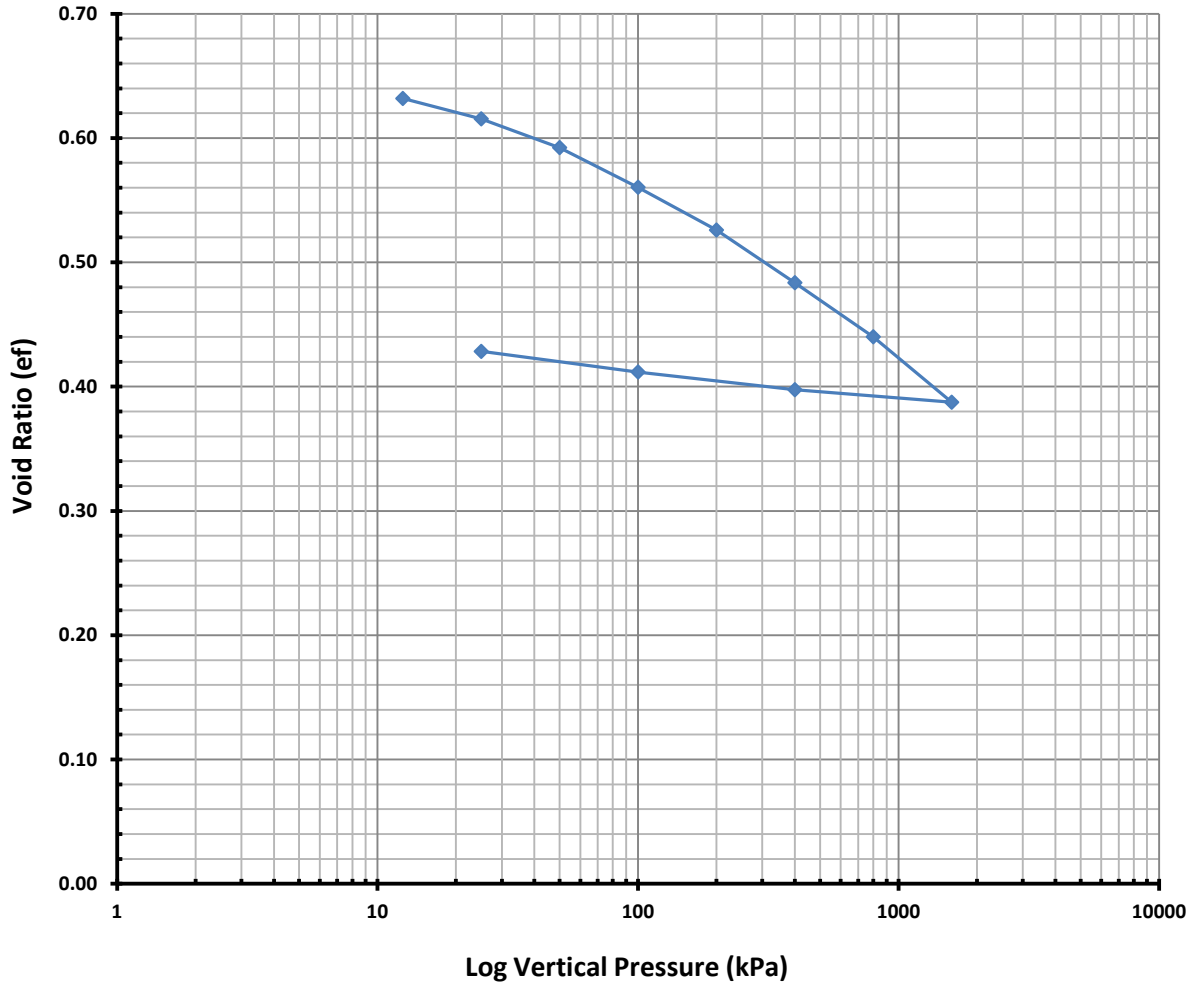
CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°c

Tested by:	Phil	Initial Moisture (%):	26.79	Test Condition:	Undrained
Height (mm):	38.89	Final Moisture Content (%):	25.71	Sample Condition:	Saturated
Diameter (mm):	61.80	Bulk Density (t/m³):	1.99	Particle Density (t/m³):	2.678
Direction:	Vertical	Dry Density (t/m³):	1.57	Initial Void Ratio (e_i):	0.707

Void Ratio (e_f) Vs Log of Vertical Pressure (kPa)



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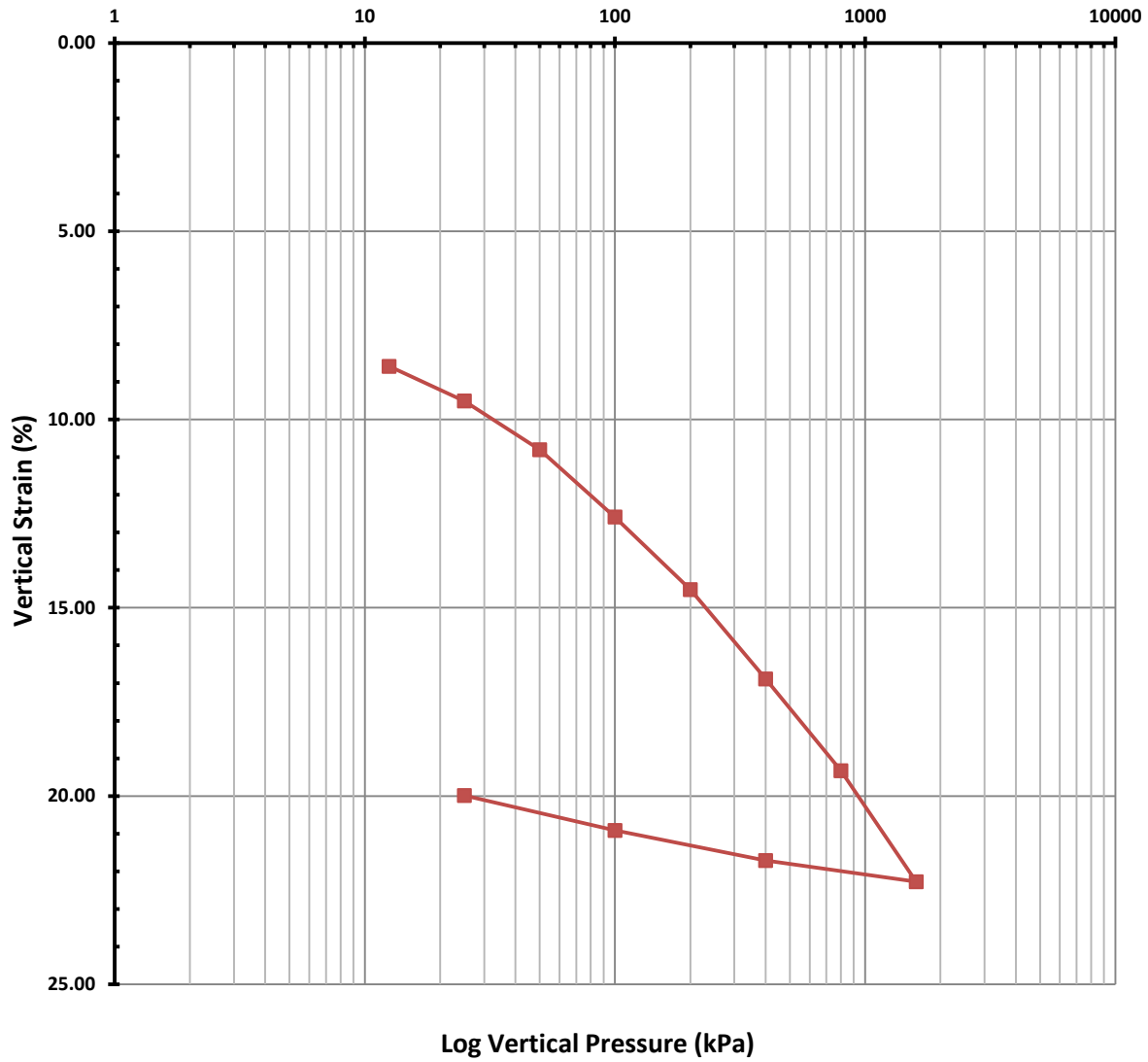
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°c

Vertical Strain (%) Vs Log of Vertical Pressure (kPa)



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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Test Results

*

Stages	Vert Disp (mm)	Cv (m^2/yr)		Compressibility Mv (m^2/kN)	K (m/s)		Void Ratio (e_f)	Vertical Strain (%)
		*t_{50}	t_{90}					
Stage 1 @ 12.5kPa	3.340	16.677	-	6.87E-03	3.6E-08		0.632	8.59
Stage 2 @ 25kPa	3.697	16.209	-	8.03E-04	4.1E-09		0.615	9.51
Stage 3 @ 50kPa	4.201	10.486	-	5.73E-04	1.9E-09		0.592	10.80
Stage 4 @ 100kPa	4.896	7.558	-	4.01E-04	9.4E-10		0.560	12.59
Stage 5 @ 200kPa	5.646	5.778	-	2.21E-04	4.0E-10		0.526	14.52
Stage 6 @ 400kPa	6.569	4.554	-	1.39E-04	2.0E-10		0.484	16.89
Stage 7 @ 800kPa	7.517	4.291	-	7.33E-05	9.8E-11		0.440	19.33
Stage 8 @ 1600kPa	8.664	3.985	-	4.57E-05	5.7E-11		0.387	22.28
Unload @ 400kPa	8.445							
Unload @ 100kPa	8.134							
Unload @ 25kPa	7.773							

** Values interpreted via lab only*

Comments: **Samples collected from Drained Settlement Testing**
Cv values to be interpreted via Engineer

Samples supplied by the Client

Authorised Signatory (Geotechnical Engineer):

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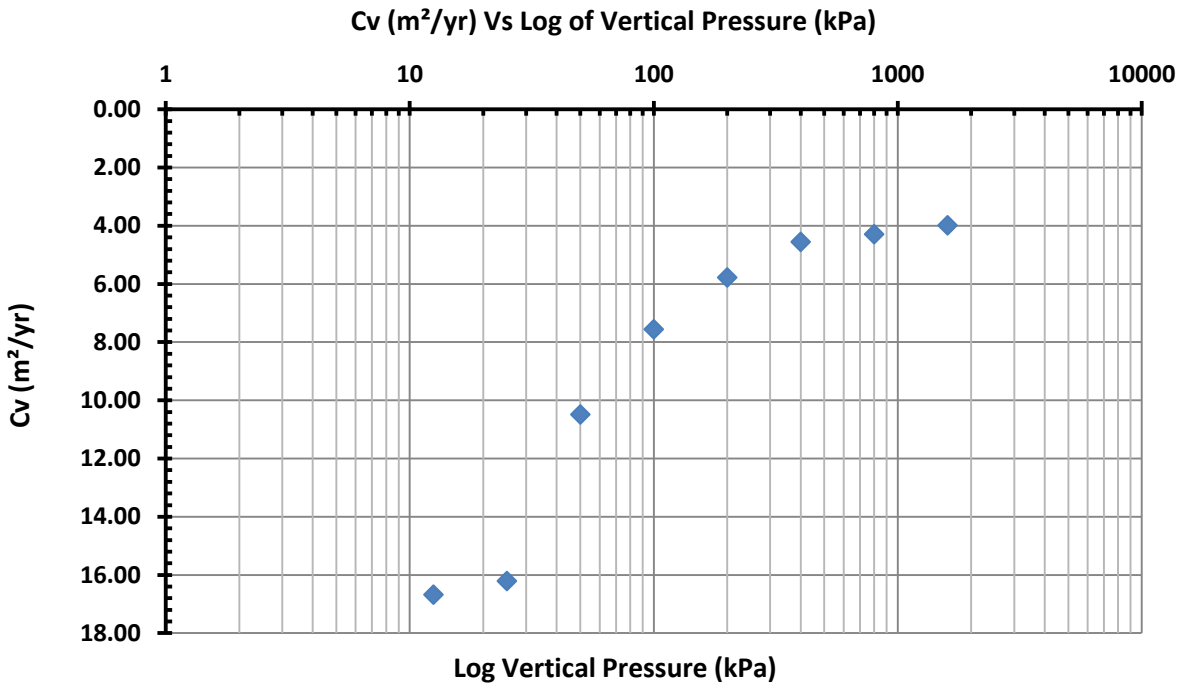
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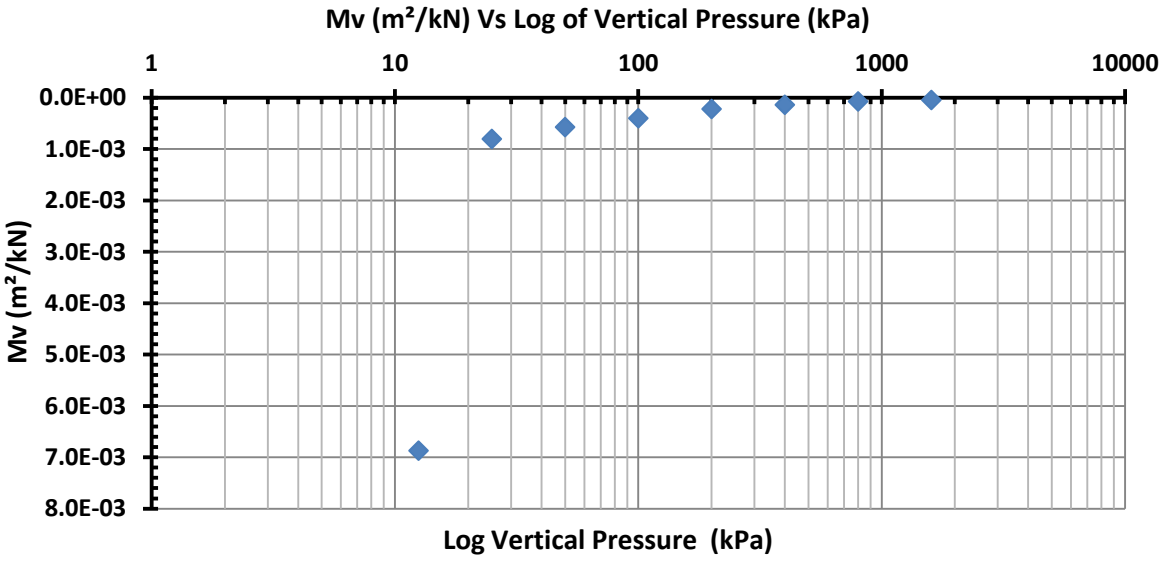
CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C



* Plot based on Log (time) data



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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

TEST RESULTS PLEASE SEE PAGES BELOW

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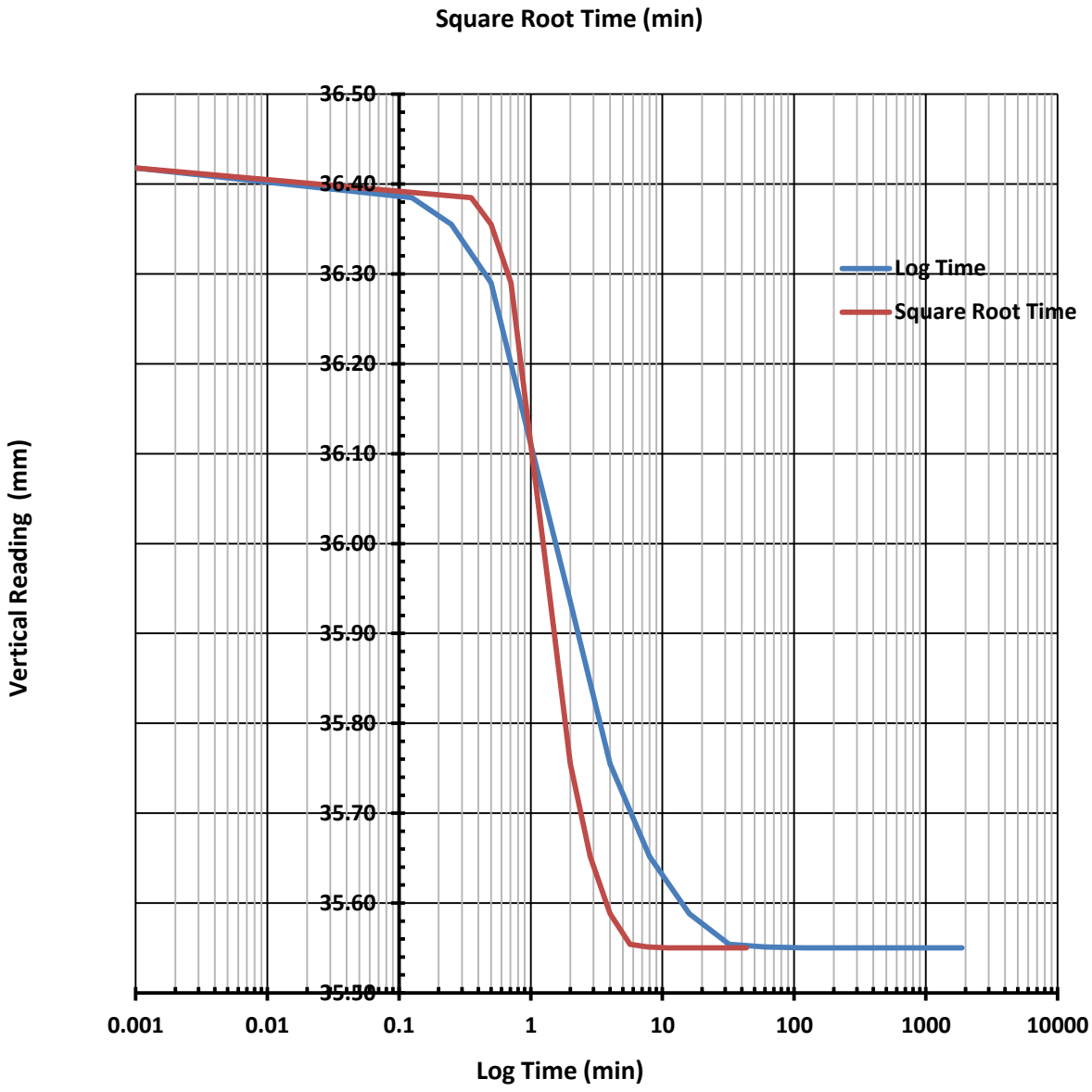
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 1 @ 12.5kPa



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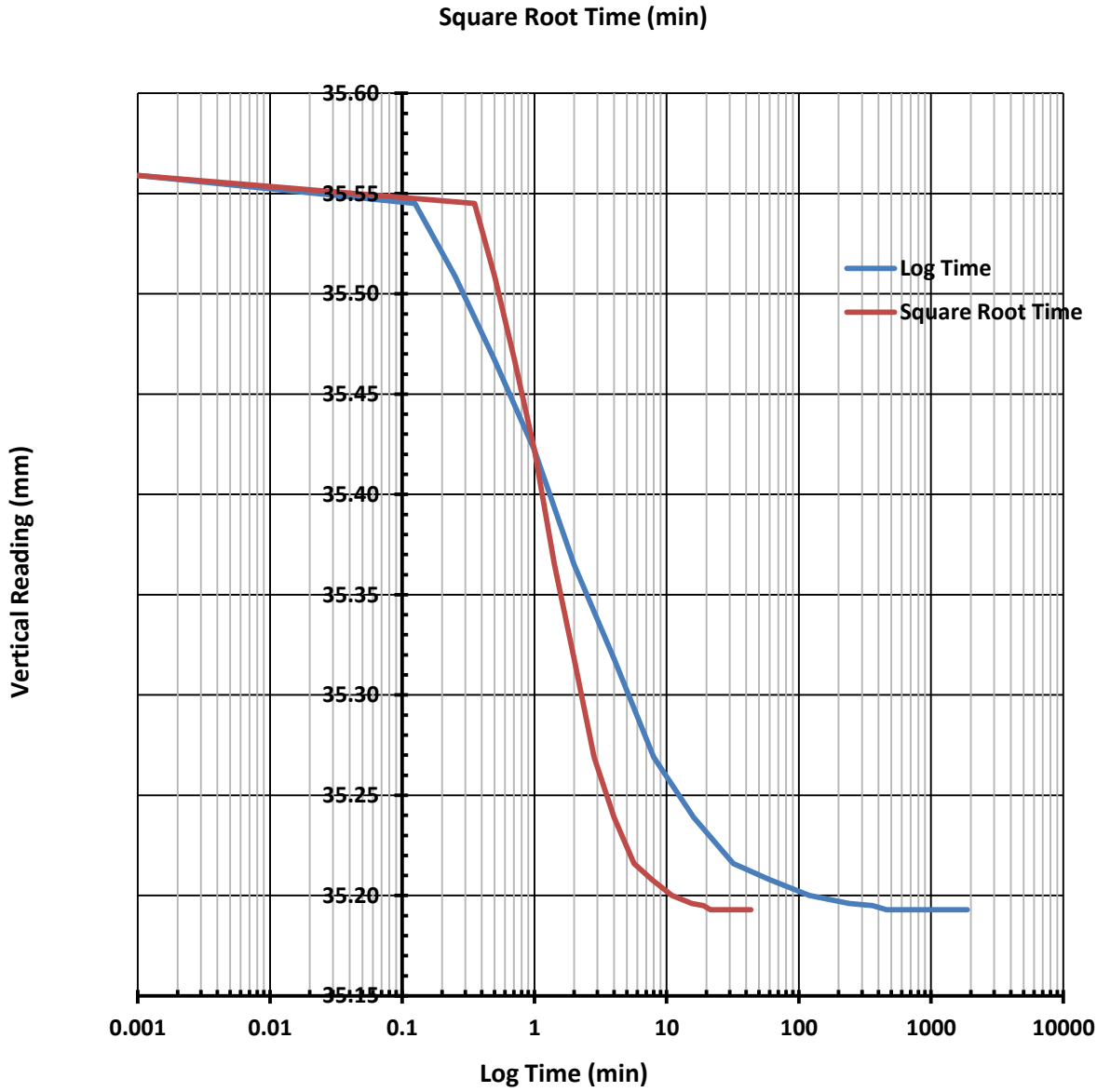
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 2 @ 25kPa



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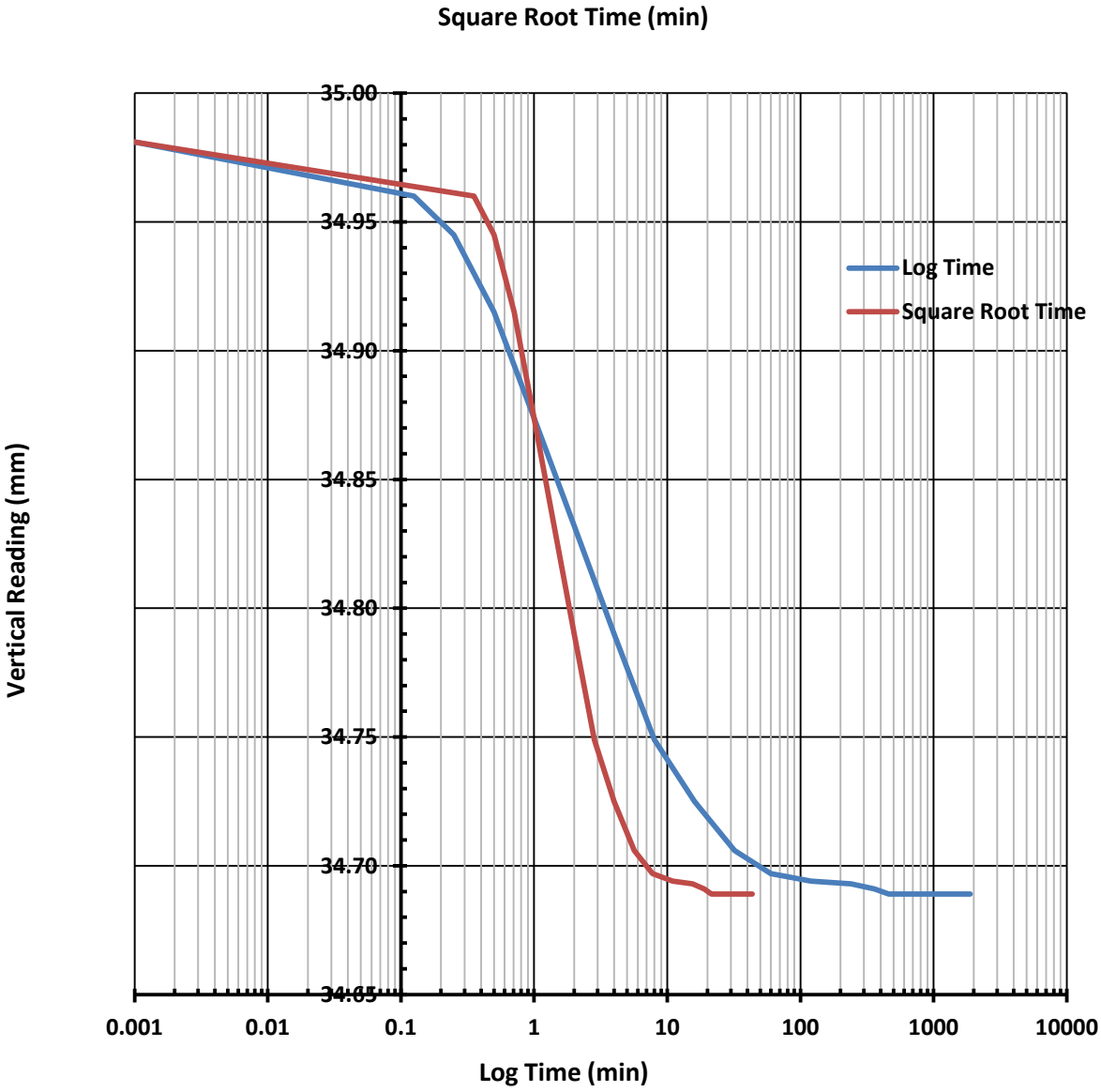
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 3 @ 50kPa



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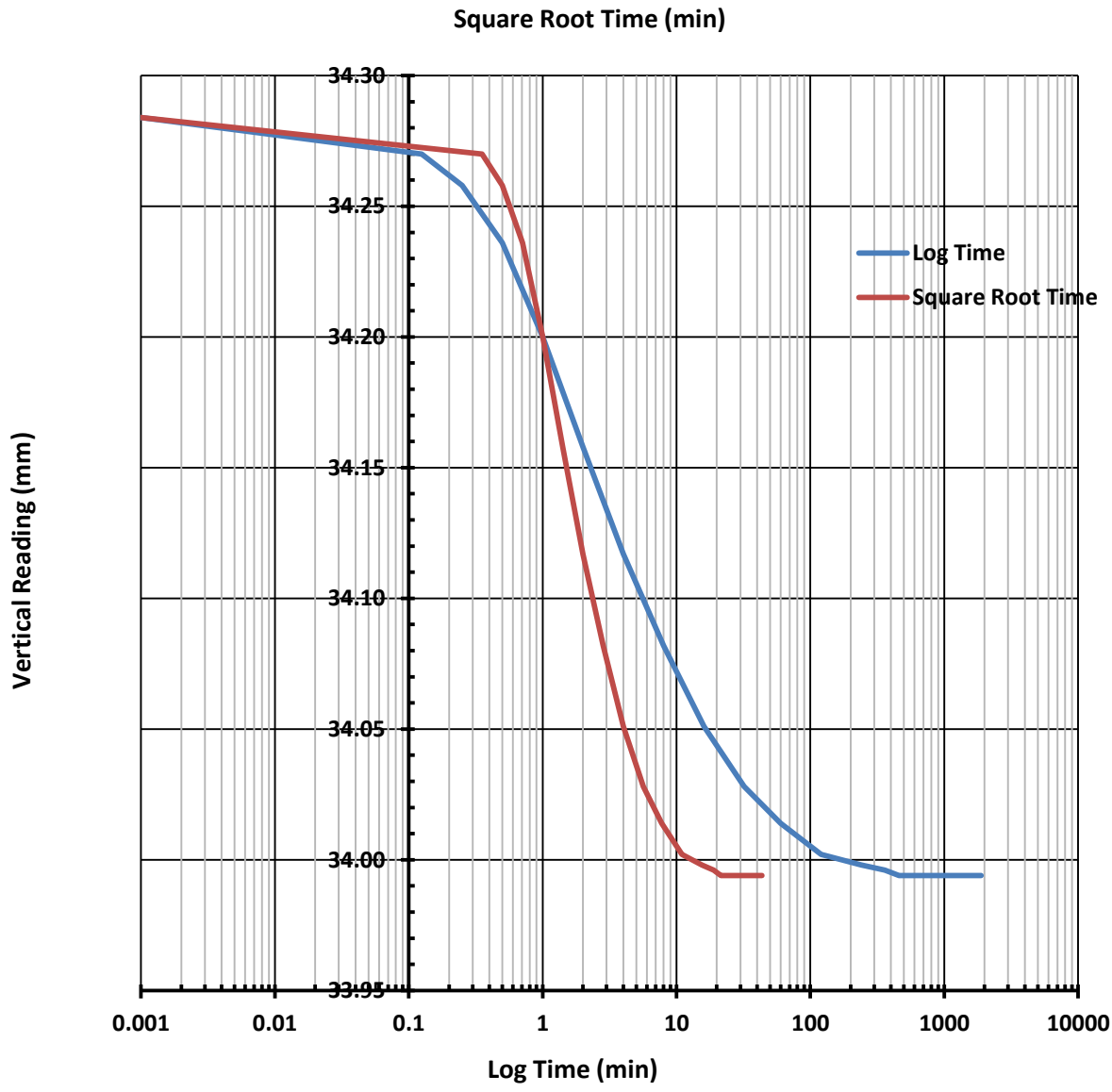
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 4 @ 100kPa



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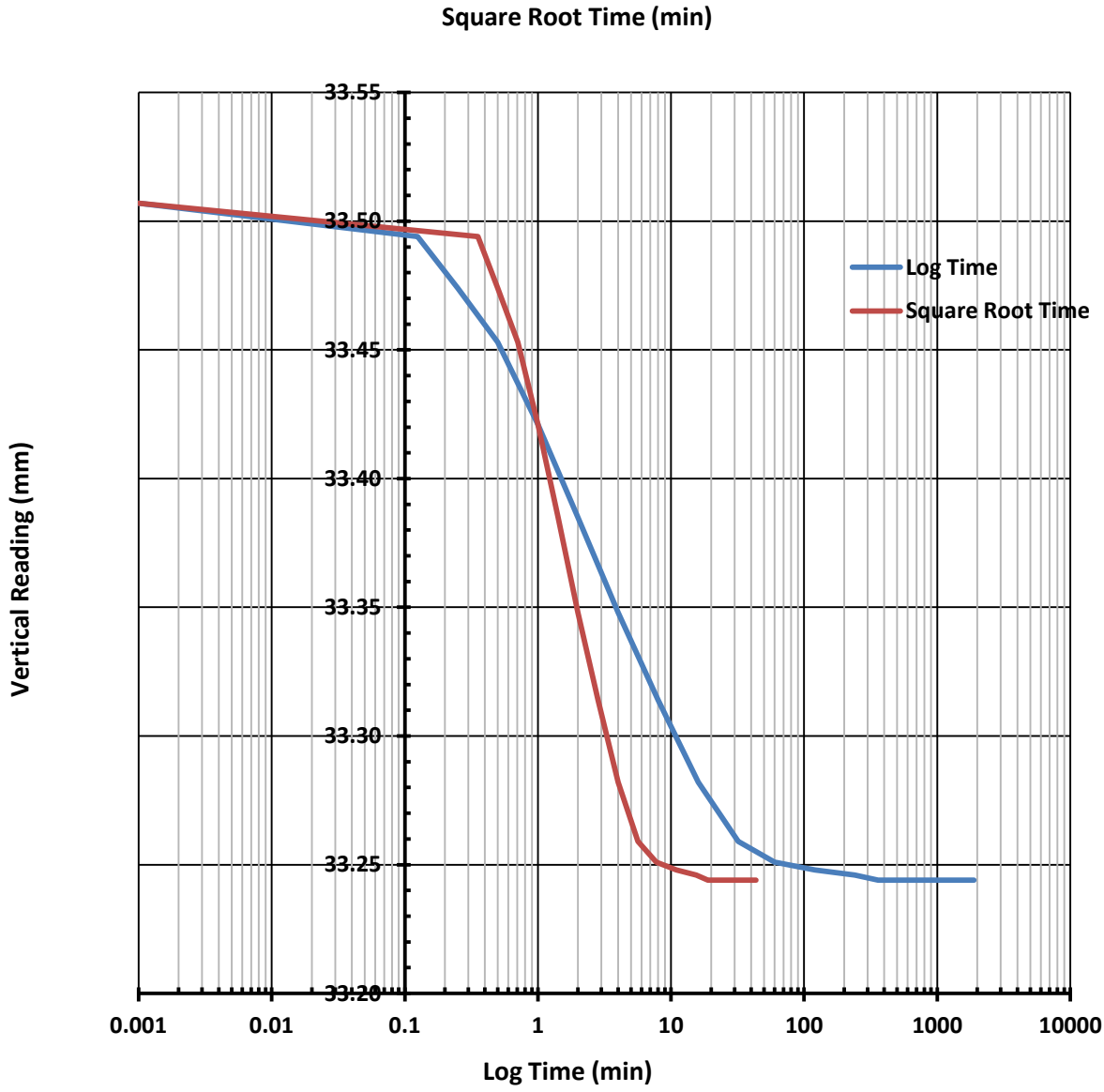
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 5 @ 200kPa



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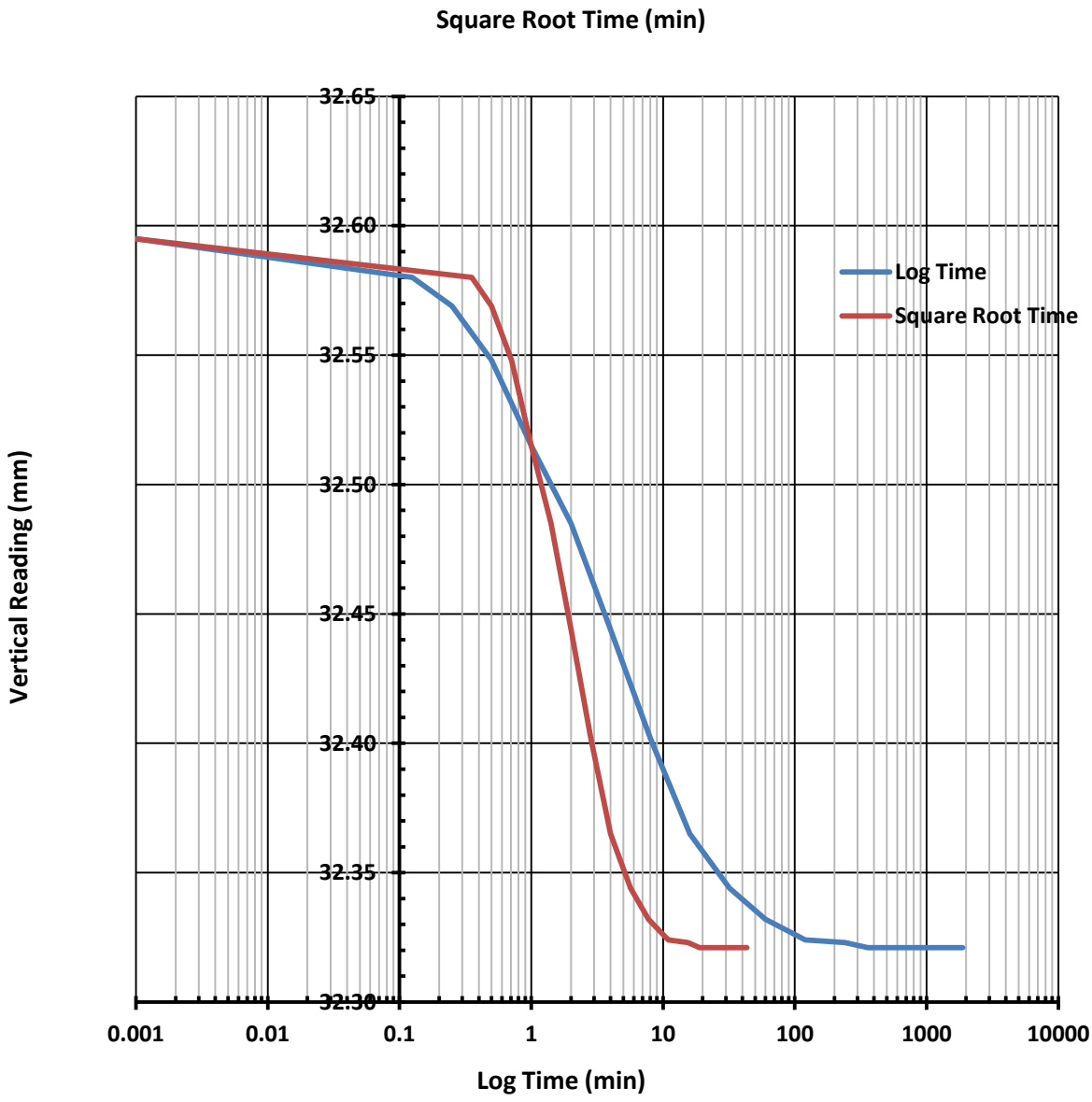
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 6 @ 400kPa



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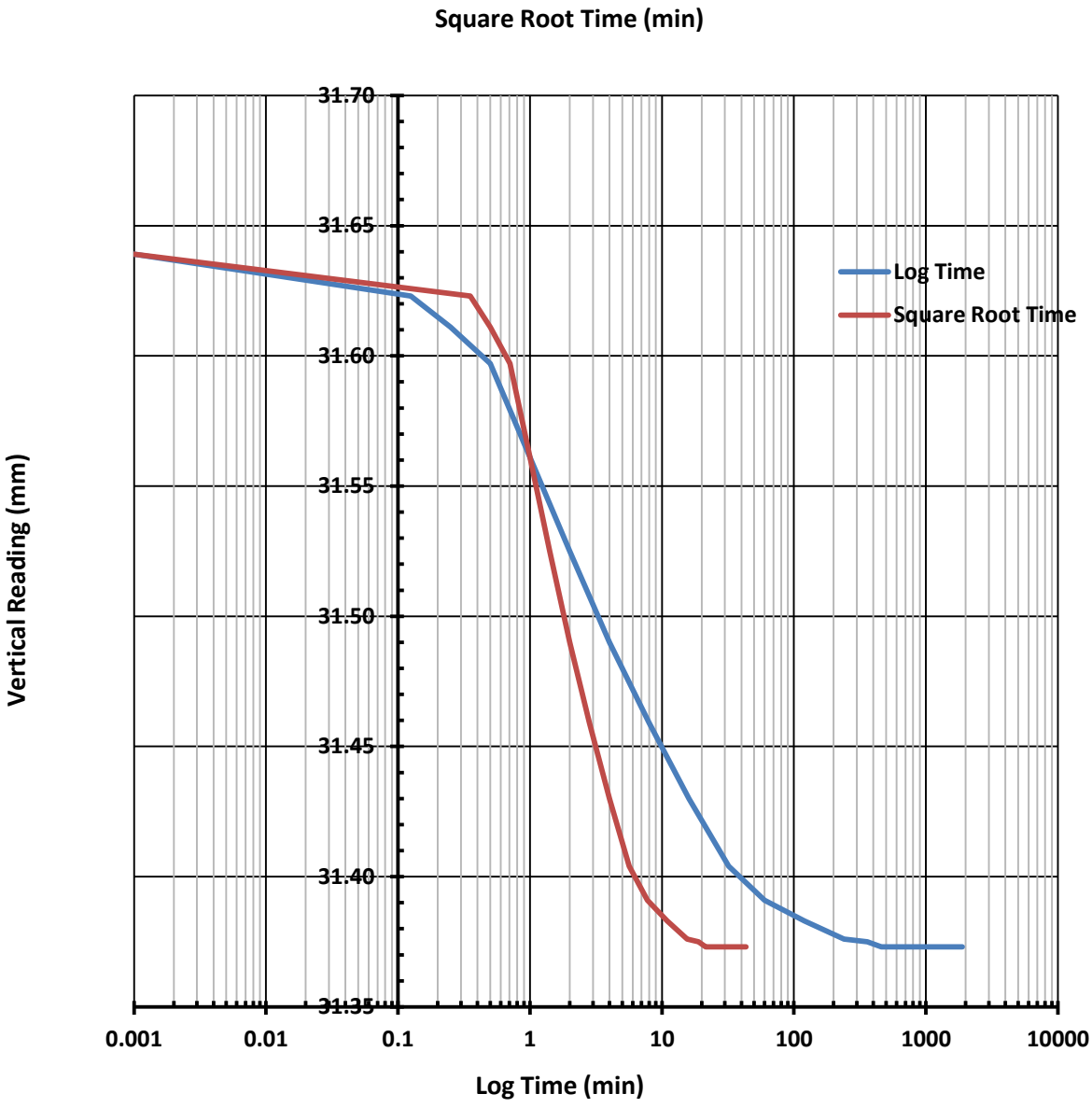
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 7 @ 800kPa



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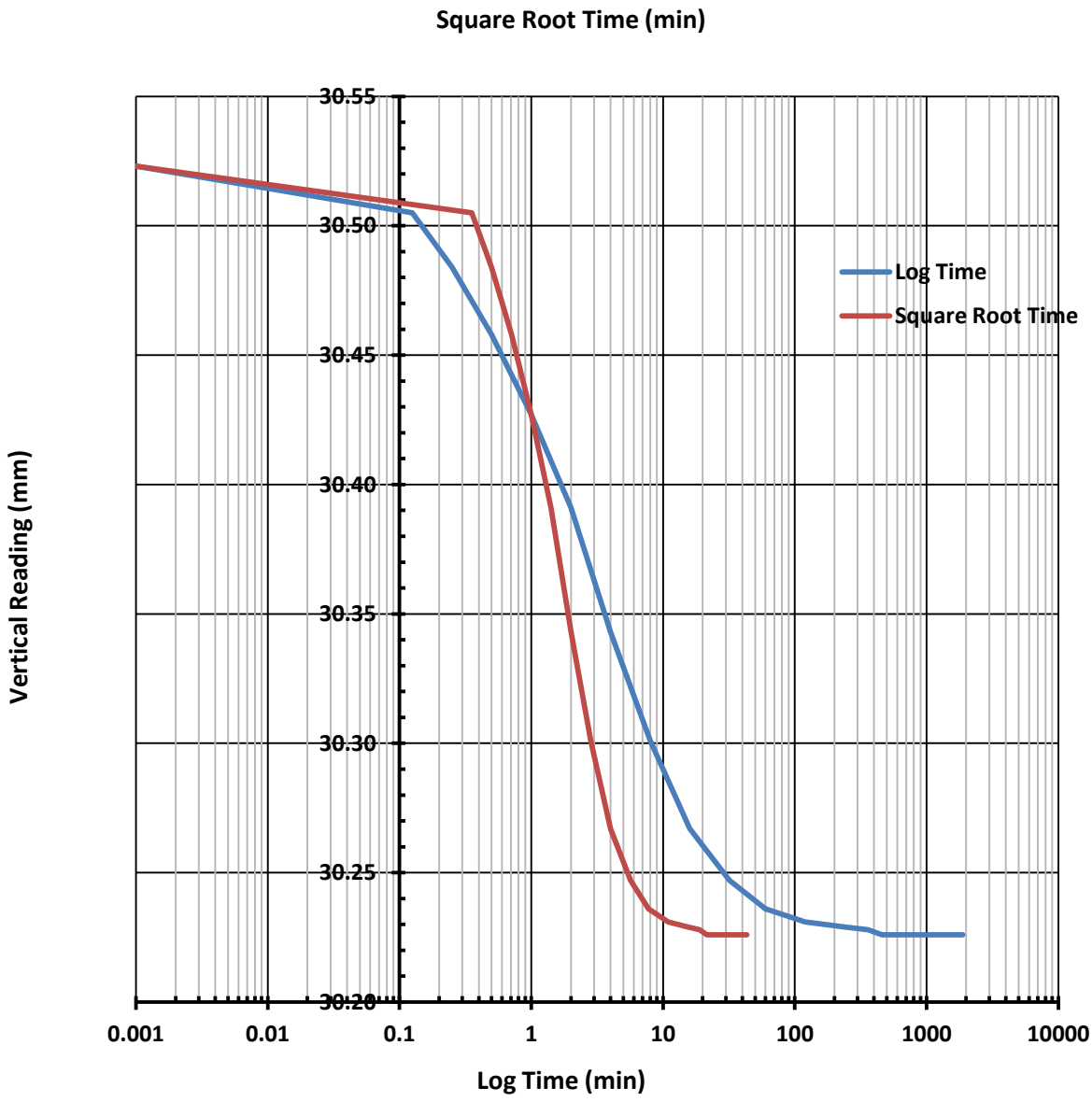
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CONSOLIDATION - ONE DIMENSION

Method: AS1289 6.6.1 / Inhouse Method

Client:	SRE Pty Ltd	Date Tested:	24/02/2026
Project:	Graphinex Testing 2026	EP Lab Job Number:	SRE
Sample ID:	Graphinex Tails		
Lab ID:	GRAPHINEX_OED	Lab:	EPLab
Depth (m):	-	Room Temperature at Test:	~ 19°C

Stage 8 @ 1600kPa



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Appendix 2

Technical Note Rock Ring Filter and Tailings Deposition

Technical Note - Decant Rock Filter

The decant rock filter typically comprises a rock ring to clarify supernatant water, which assists in removal of excess water from the tailings storage facility (TSF) by making this water an attractive economic proposition, when compared to alternative cost of water from external sources for use processing due to:

i) Proximity to the process plant, therefore less energy expended to execute water movement compared to pumping from borefields remote from the site.
ii) Recovery of reagents for reuse in the process plant e.g. Lime used to condition water in gold processing.

Access to the decant is typically via a causeway from the access road around the perimeter embankment where this style of decant facility is constructed in the center of the TSF. The filter is constructed from mine waste. The decant filter is to be raised in conjunction with the raising of the perimeter embankments. Figure 1 shows a typical decant filter.



Figure 1 – Decant filter with submersible pumps

Because of the large surface area of the decant filter, the clarity of the water within, inside the decant filter, is much better than could otherwise be achieved without such a structure. The photographs in Figure 2 show the difference in the clarity of the supernatant water inside and outside the decant filter.



Figure 2 - Supernatant water inside the decant filter (left) and outside the decant filter (right)

The benefits of implementing a well-formed decant filter are as follows:

i) Increased volume of water can be recovered, since the rock forms an efficient filter system to facilitate recovery of water with a low total suspended solids (TSS). The cross-sectional area of the filter (width) and diameter of the decant rock ring filter forms a substantial surface area, with circuitous flow paths, through which the decant water must pass. The 'flow velocities' are reduced by the circuitous flow paths through the filter wall, enabling the last remnant of the very fine fraction of solids within the supernatant water to be deposited within the filter, improving the clarity of the water inside the rock ring.

ii) The clarity of the water within the decant filter is a function of the thickness of the filter walls. Typically, the internal diameter of the decant filter is not less than 20 m and can be up to 50 m with the perimeter of the filter having a crest width of not less than 5 m excluding windrows. The actual constructed width is a function of the equipment used to place the rock forming the filter.

iii) As the tailings beach rises, a sump is formed within the filter, which remains in place as the surrounding tailings beach rises. The impact of the creation of this sump is that the spatial extent of the supernatant pond is reduced and hence evaporation is reduced. The water column within the sump being deeper than a shallow pond spread out over the TSF, means the water body within the sump is cooler and needs more absorption of heat energy to get same evaporation rate as the external pond.

iv) The improvement in the clarity of the water within the filter means that operators are less inclined to stop the operation of the decant pumps due to the turbidity within the supernatant pond.

v) The presence of the rock does not allow turbulence (wave action) to propagate through the filter wall and the area within the ring is sufficiently small to minimise the potential risk of wave action forming within the rock ring.

vi) The small pond area, surrounded by a high rock wall which encloses the pond, is also a deterrent to birds that might otherwise land on a larger TSF pond. Impacts on wildlife are reduced by the filter.

vii) The reduction of the spatial extent of the supernatant pond also has a positive impact on the height and position of the phreatic surface within the tailings stack, which provides potential improvement for embankment stability of the TSF.

In the design of the filter the following needs to be considered:

i) The specification for the rock in the filter. Typically, most mines will supply whatever hard rock is available. Ideally the rock should be hard durable competent rock with a maximum particle size not exceeding 500 mm, preferably 70% passing 200 mm, 20% passing 75 mm and non-plastic fines (silt and clay finer than 0.075 mm) < 3% and a particle density greater than 2.5 t/m^3 and preferably geochemically inert. Traces of pyrite can be accommodated, since rock ring is progressively raised during TSF life and thus rock buried with tailings. The rock filter can be backfilled with tailings and buried when TSF is decommissioned / rehabilitated.

ii) The rock is to be loose placed in lift thickness not exceeding 2 m and spread to form a uniform layer.

iii) The sizing and performance of the rock ring is governed by several relationships based around the following:
   a) Cross-sectional area of the rock ring filter (length height and width of the filter).
   b) Maximum operating capacity of the water recovery pump, which in turn determines the velocity or flow rate through the filter.
   c) Internal storage volume of the rock ring which determines the residence time of the water in the filter.

iv) The key to a success for an efficient decant filter is having a big enough in cross-sectional area to reduce the flow such that the sand, silt and clay fractions are unable to remain in suspension. In other words, the flow through the filter has to be very low.

v) Water clarity inside the rock ring and through the rock ring filter is a function of the velocity of the water flow through the rock. The diagram below, Figure 3, which comes from work by Hjulström-Sundborg shows the relationships between particle size and the tendency to be eroded, transported, or deposited at different current velocities.

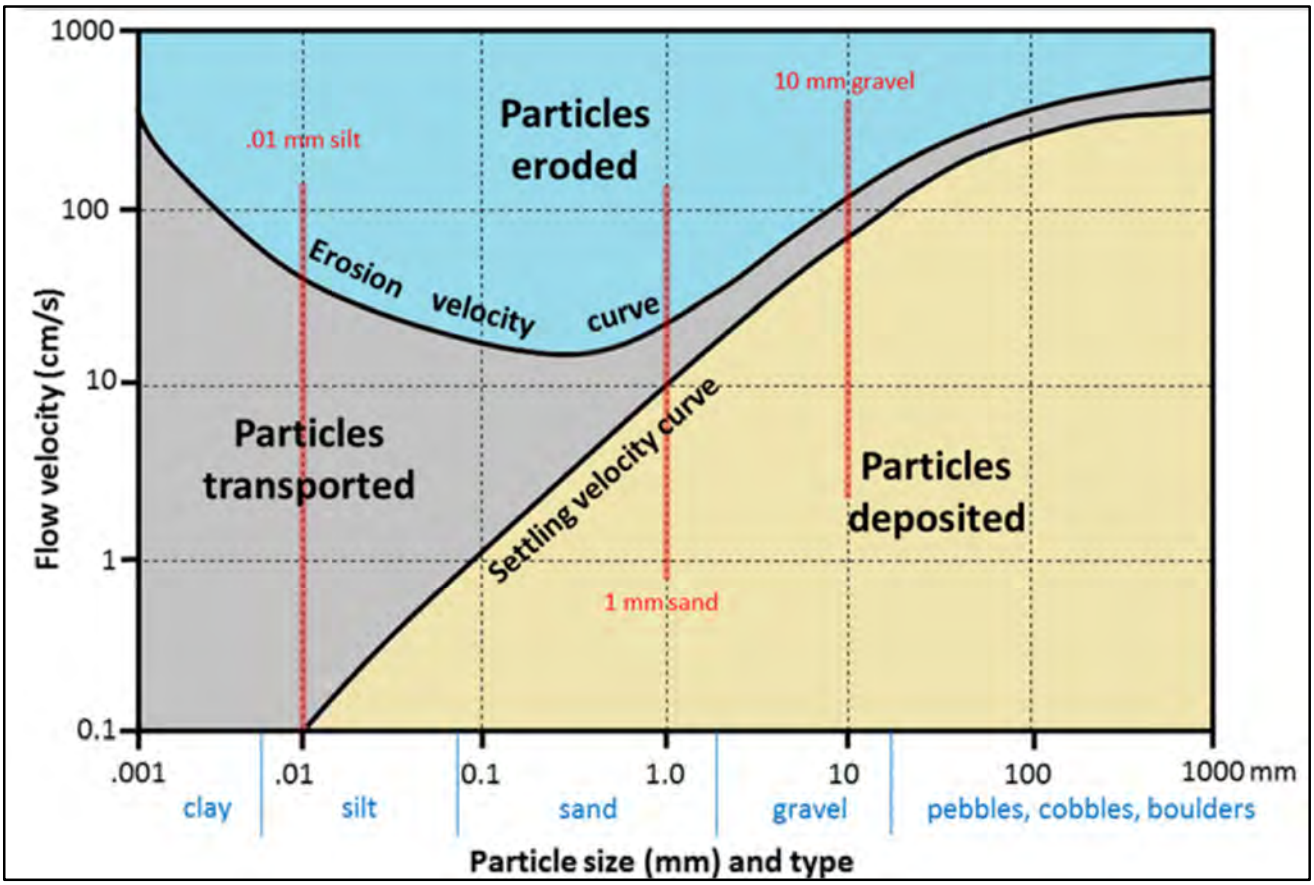


Figure 3 - Hjulström-Sundborg Diagram

Particle size distribution of the tailings must be understood to ensure the rock ring is sized correctly.

For example, a 1 mm grain of sand will remain where deposited until the velocity is high enough to erode it, around 20 cm/s. But once it is in suspension, that same 1 mm particle will remain in suspension as long as the velocity doesn't drop below 10 cm/s.

A 0.01 mm silt particle only needs a velocity of 0.1 cm/s to remain in suspension, but requires 60 cm/s to be eroded. In other words, a tiny silt grain requires a greater velocity to be eroded than a grain of sand that is 100 times larger!

For clay-sized particles, the discrepancy is even greater. In a tailings deposit, the most easily eroded particles are fine sand grains between 0.2 mm and 0.5 mm. Anything smaller or larger requires a higher water velocity to be eroded and entrained in the flow. Hence in a tailings deposit environment the sand fraction remains close to the embankment whether the deposition is from multi point spigots or single spigots. The main reason for this is that small particles, especially the tiny grains of clay, have a strong tendency to stick together and so are difficult to erode from the tailings beach after drying, where exposed and or consolidated where deposited subaqueously.

Some photographs of rock ring filters are presented as follows from:

i) Sabodala Gold Operation in Senegal from 2017 to 2020.
ii) Somisy Gold Mine at Syama in Mali, 2017.

Note the tailings beaches adjacent to the to the rock ring at Novo in August 2021 and Sabodala in June 2020 prior to the start of the wet season and Syama in Mali where the rock ring was pumped dry in early 2017.

Examples of rock ring decant – Sabodala

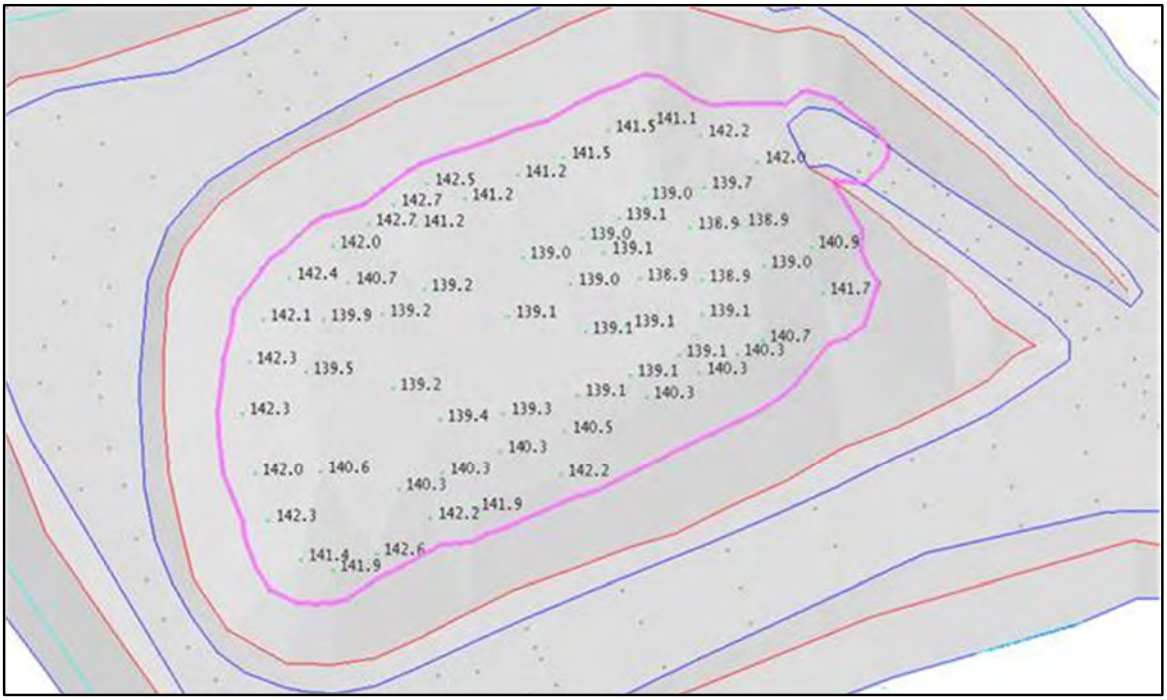


Rock ring Sabodala May 2018



Sabodala April 2017: - Rock ring filter.
Note the water clarity inside rock ring filter (left) vs outside (right)





Hydrographic Survey 13 May 2020 – Tailings Beach Level on the western embankment RL 148.3 m, water at the decant RL 143.9. Tailings solids inside the base of the rock filter RL 139.1 – 4.8 m of water inside the filter



Sabodala TSF1 (May 2020)





Sabodala - 17 September 2021

Appendix 4

Dam Break Assessment and Spillway Analyses

Graphinex Pty Ltd
Esmeralda Graphite Project

Final Rev 0 (issued for use)

TECHNICAL MEMORANDUM

To:	Soil and Rock Engineering (SRE) Pty Ltd	From:	Prasudi Atmajaya, Chris Hogg
Attention:	Chris Lane	**Date:**	7 May 2026
Email:	chris.lane@soilandrock.com.au	**Reference:**	PER2026-0032AC Rev 2
		Pages:	27
Subject:	**Dam Breach Assessment – Esmeralda Graphite Project, Graphinex**		

1 INTRODUCTION

This memorandum presents the dam breach assessment for the proposed Tailings Storage Facilities (TSFs) at the Esmeralda Graphite Project, Queensland (The Project), currently under development by Graphinex.

2 BACKGROUND

The Project is a major greenfield initiative 70 km south of Croydon, and about 60 km east and 35 km west of the localities of Claraville and Esmeralda, in north Queensland. It features an open-pit mine plus a Townsville-based processing plant to produce battery-grade anode material. It is a declared "prescribed project" by the Queensland government with a 50-year life, designed to produce about 3.5 Mtpa of ore, with construction potentially starting in 2027, followed by production after 12-18 months time. The Project is expected to support an operational workforce of up to 113 personnel at peak production.

The TSFs design work is carried out by Wave International (Wave). SRE supplied CMW with design drawings by Wave, which outline the location of the TSFs as follow in **Figure 1**.

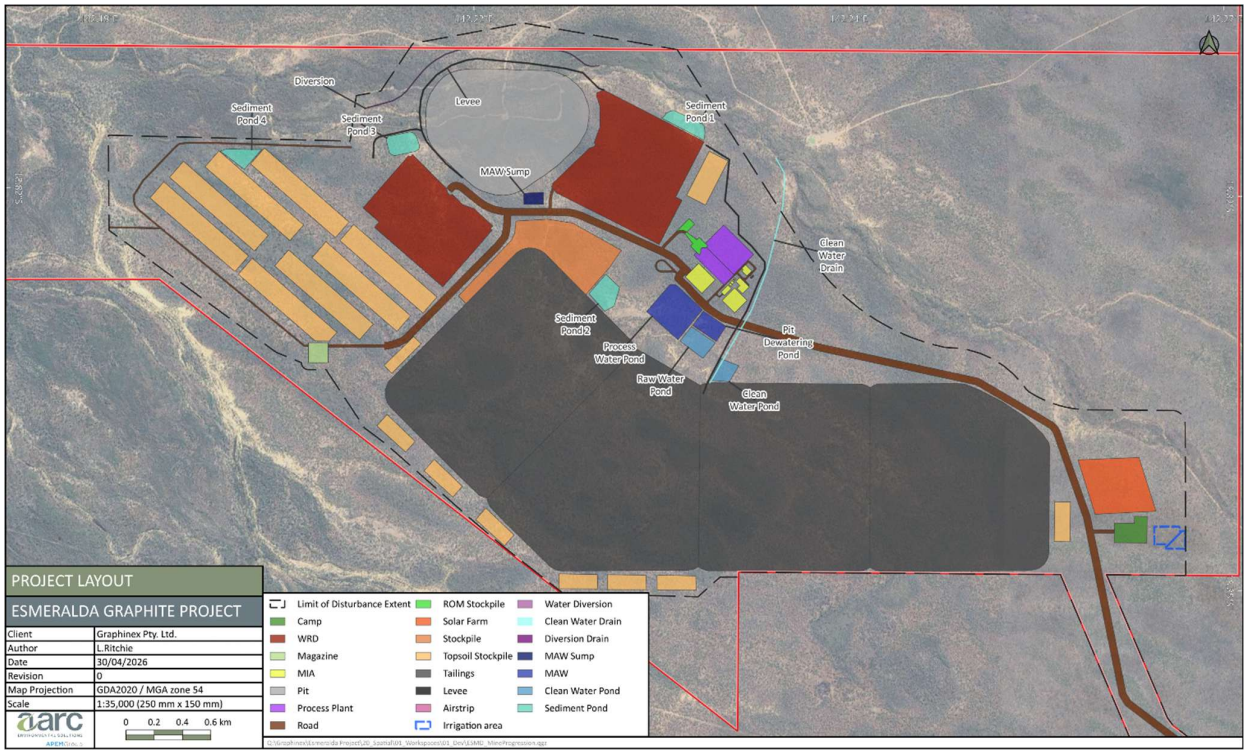


Figure 1: TSFs Location Plan (ARC Environmental Solutions 30 April 2026)

3 ASSESSMENT

3.1 Basis

The dam breach analyses cover the Sunny Day Failure (SDF, normal operation) and the Rainy Day Failure (RDF, worst-case) scenarios with an emphasis on Newtonian material behaviour. Analyses are carried out based on the following considerations as outlined in the preceding technical memorandum, CMW ref. PER2026-0032AB Rev 1 dated 21 February 2026 (CMW 2026), that is attached as Appendix A to this memorandum:

- Critical breach location from the southwest of TSF Cell 1, which will have the largest storage volume, and which will lie closest to the main infrastructure and creeks that flow to the north-northwest of The Project. It is assumed that the infrastructure and safety bunding around the mine pit have been factored into design layout to minimise the risk of the pit flooding, therefore failure modes involving northeast and northwest embankments, which lie closer to these locations, are considered as less credible for emergency response planning.
- Storage volume of approximately 24.2 Mm^3, equivalent to a capacity of about 33.5 Mt at 1.55 t/m^3 (dry).
- An estimated freeboard of 2.45 m with tailings final level at RL146.8 m based on 1.55 t/m^3 density (dry), and including the allowance for the 1:100 years AEP 72-hour duration extreme storm event of 383 mm.
- Probable Maximum Precipitation (PMP) estimation for a 6-hour storm event of 0.95 m based on the Bureau of Meteorology (BoM) Generalised Short-Duration Method (GDSM).
- Estimated flood volumes during a dam breach derived from MacDonald and Langridge–Monopolis (1984) empirical formulae, and based on the following parameters:
    - Breach development time of 6 hours that accounts for the relatively wide embankment of TSF1;

- Flood volumes from a dam breach during SDF of the full storage volume, and from a dam breach during RDF of 33% the storage volume plus the PMP 24-hour event of 0.95 m;
- A dam breach extending over approximately a third of the 22 m high TSF Cell 1 southwest embankment, as measured based on a maximum crest level of RL149.25 m and an approximate NGL of RL127.3 m;
- Peak flows estimated using a triangular hydrograph, and utilising the aforementioned flood volumes and breach development time. The resulting estimations indicate peak flows of approximately 863 m^3/s and 747 m^3/s for the RDF and SDF scenarios, respectively.

3.2 Analyses

3.2.1 Methodology

The hydraulic analyses are modelled using HEC-RAS 6.6 (USACE 2024) software that was developed for one-dimensional and two-dimensional hydraulic modelling, plus calculation of water surface profiles and water levels in rivers and other channels under different steady and unsteady flow conditions.

3.2.2 Input

The models simulate the downstream tailings released with Newtonian material behaviour in the event of a TSF Cell 1 dam break at the highest embankment crest level of RL149.25 m, and at full capacity plus PMP storm volume. Maximum peak flows and flood volumes for the RDF and SDF scenarios are based on the figures outlined in Section 3.1 of this memorandum.

The topographic data with a 1 m vertical contour interval for both the TSFs and surrounding topography are converted to raster grid digital elevation models (DEMs) at a 0.5 m x 0.5 m horizontal resolution. The terrain surface of TSF Cell 1 and mine infrastructure surrounding the facility is based on the data provided by SRE, drawing files ref. Y0 to Y50 ('Y' = year, and provided in 5-year intervals) plus Y52, Overall Design Strings, 20260120_Esmeralda_extracted_contours_1m, and 20260120_Esmeralda_MLAs. The outline of the TSFs and the adjacent infrastructure are based on file ref. Y45, which shows the greatest extent of them. The presence of the open pit, access road and laydown yards to the north of the TSFs is considered a potential concern due to their proximity to the facilities; however, it is understood that protective measures against a potential dam breach, such as flood protection bunds, have been incorporated into the mining design. In addition, the topsoil stockpiles located immediately south and west of the TSFs have been excluded from the analyses, as these structures may not be fully established during the critical stage currently being assessed.

Publicly-available 1 second, 30 m grid DEM is used to extend the surface south of the TSFs i.e. outside the site boundaries denoted by the red line in **Figure 1**. The impact of this is expected to be minimal, as runoff from the southwest of TSF1 would reconnect with the existing drainage line, which trends northwest in accordance with flood study simulations undertaken by ARC Environmental Solutions (ARC).

Computational mesh grid, or two-dimensional cells (or polygons) that discretise the flow area to form cell faces that serve as detailed cross-sections of the terrain, is set at 20 m. The computation time step, which determines the frequency of water surface calculations, is set at 15 seconds.

A relatively low uniform roughness coefficient of 0.04 is selected for the baseline model runs in order to reflect the moderate debris content and energy losses typical of conventional dam breach flow characteristics over gulf savannah ecosystem with predominantly flat to gently undulating terrain, plus drainage lines with scattered vegetation, such as found at the TSFs in The Project area.

The Shallow Water Equation Eulerian-Lagrangian Method (SWE-ELM) equation is adopted for the final model runs. The equation is based on the full, non-linear, 2D unsteady form of Saint-Venant equations, which account for mass accelerations. The equation involves variables like water surface elevation, velocity, gravity and terrain.

Simulation window of 6-hour is applied in the model runs to allow the peak discharge to fully disperse through the model, with the analyses allowed to continue until breaching reaches the 33% of full TSF capacities for an RDF breach from TSF Cell 1 southwest perimeter embankment, and full capacity for an SDF breach.

3.2.3 Output

The hydraulic analyses outputs for the SDF and RDF scenarios are depicted by the inundation maps attached as Appendix B and Appendix C, respectively. The following summarises the findings from the hydraulic analyses:

- RDF and SDF breach scenarios originating from the southwest embankment of TSF Cell 1 are not expected to impact the mine infrastructure located to the west and north of the facility. It is also noted that the process plant is planned to be constructed at a higher elevation than TSF Cell 1.
- Runoff resulting from an SDF breach of the southwest embankment of TSF Cell 1 is expected to extend approximately 4.3 km to the northwest along the natural drainage line, as well as approximately 1.8 km northward from the southwest corner of the facility. In comparison, runoff associated with an RDF breach is anticipated to extend approximately 3.9 km to the northwest following the same natural drainage pathway.
- Inundation depths following both RDF and SDF scenarios are expected to be typically ≤1 m, except within approximately 100 m and 500–700 m of the breach location, respectively, and at low-lying areas along the natural drainage line.
- Estimated flow velocities associated with an RDF event are expected to be generally ≤1 m/s beyond approximately 200 m from the breach epicentre, whereas for an SDF event, similar velocities are anticipated beyond approximately 600–900 m from the breach location. Elevated flow velocities are expected to occur within low-lying sections of the drainage line located to the southwest and northwest of TSF Cell 1.
- The estimated travel time for breach flows to reach the adjacent drainage line is approximately 0.3–0.4 hours for both the RDF and SDF scenarios.
- The SDF scenario may result in shallow inundation of the access road located northwest of TSF Cell 1, with estimated flow depths of up to approximately 0.5 m and flow velocities of around 0.7 m/s. The estimated arrival time at this location is greater than 1.3 hours following breach initiation.

3.3 Comments

Based on the inundation figures generated for the RDF and SDF scenarios, and their summaries in Section 3.2.3, the following comments are made with respect to the assessment guideline of safety criteria for vehicles, people and buildings in variable flow conditions (ARR 2016), depicted in **Figure 2**:

- A breach of the southwest embankment of TSF Cell 1 under both RDF and SDF scenarios is predicted to result in a hazard classification of H6 within approximately 100–200 m and 500–700 m of the respective breach epicentres. Beyond these distances, the hazard classification is expected to decrease to H4 or lower at approximately 300 m and 500–900 m from the breach epicentre for the RDF and SDF scenarios, respectively.

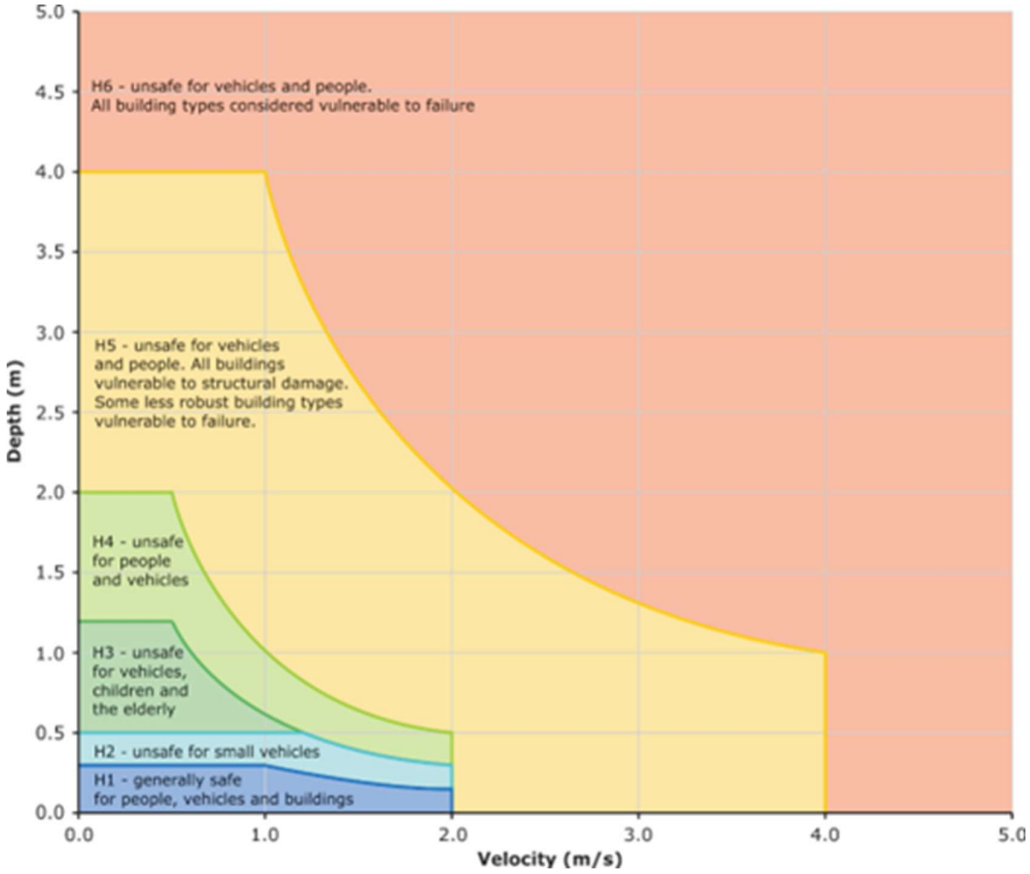


Figure 2: Dam Breach Safety Criteria (ARR 2016)

The following comments are made in addition to the dam breach assessment:

- The inundation maps plus information in the body of this report must be used by Graphinex for emergency planning. Graphinex must reassess the maps and information in order to correctly implement them based on the actual conditions encountered on site, e.g. the population at risk (PAR) and based on the actual conditions encountered at a particular time.
- The assessment made in this report and their subsequent output are subject to potential inaccuracies due to the limit imposed by the survey data, which in part include several drawing files collated together, requiring as such, interpolation with the levels. Additionally, information such as PAR distribution and physical details of areas downstream of the TSFs can be considered as real-time data. In the analyses it is assumed that there are no additional overland water flows in the downstream area or concurrent natural watercourse channel flows.
- The inclusion of an HDPE liner over the upstream slope of the embankment and the basin of the TSFs could reduce the risk of piping or erosion, which would instigate a breach during normal operating conditions (SDF). Providing the liner performs according to its design intent, the likelihood of a dam breach on a sunny day is therefore considered significantly lower than on a rainy day.
- The assessment in this memorandum considers only the facilities noted in the data supplied by SRE.

4 CLOSURE

We trust this information meets your immediate requirements. Should you require further information or clarification of any details, please do not hesitate to contact the undersigned.

For and on behalf of CMW Geosciences

Prepared by:



Prasudi Atmajaya

Senior Geotechnical Engineer

Reviewed and authorised by:



Chris Hogg

Senior Principal Tailings Engineer

Distribution: 1 electronic copy to SRE via email
Original held at CMW Geosciences

Attachments: CMW Technical Memorandum ref. PER2026-0032AB Rev 1 dated 21 February 2026 (10 pages)
Rainy Day Failure Analyses Output (4 pages)
Sunny Day Failure Analyses Output (4 pages)

Appendix A:
CMW Technical Memorandum ref. PER2026-0032AB Rev 1 dated 21 February 2026

TECHNICAL MEMORANDUM

PRELIMINARY DAM BREAK ASSESSMENT AND HYDRAULIC SPILLWAY ANALYSES

To	SRE Pty Ltd	**From**	Christopher Hogg, Senior Principal
Attention	Chris Lane	**Date**	21 March 2026
Email	chris.lane@soilandrock.com.au	**Reference**	PER2026-0032AB | Rev 1
Cc		**Pages**	10 (incl. attachments)
Subject	Esmeralda Graphite Project Preliminary Dam Break Assessment and Hydraulic Spillway Analyses		

1.0 INTRODUCTION

This memo presents the results of preliminary dam break and spillway hydraulic assessments for the Esmeralda Graphite Project TSF as part of a PFS study. The Esmeralda Graphite project is located in north Queensland in the channel country south of the Gulf of Carpentaria. The following information was provided by SRE as part of this study.

- Spreadsheet of TSF construction details including RL, Storage volumes and earthworks volumes and surface areas.
- WAVE International drawings: 6235-40-DWG-CI-00020, 6235-40-DWG-CI-00030, 6235-40-DWG-CI-000310, 6235-40-DWG-CI-00040
- Esmeralda Rainfall data (1914-2024)
- Rainfall Intensity Duration Curves for Esmeralda
- Miscellaneous details:
  - Spillway 300 mm above maximum pond elevation.
  - DSA 400 m.
  - 1 in 100 72 AEP say 400 mm

The work was commissioned by SRE Pty Ltd via a signed CTR, dated 20 January 2026.

2.0 DAM BREAK ASSESSMENT

2.1 Breach Characteristics

A dam break assessment was performed for the TSF (Cell 1 being the most critical) at the final embankment crest levels of RL149.25 (maximum embankment height, 22 m). The scenarios examined were:

- Sunny day case
- Worst case (i.e. with probable maximum precipitation (PMP) into TSF). The PMP 6 hr duration is 950 mmm, based on the BOM GSDM method.

2.1.1 Embankment Breach

If a TSF embankment breach were to occur, tailings would only be partially released from the storage impoundment, as the majority of the tailings beaches would have dried back. In addition, remobilised tailings will behave as a thickened slurry and therefore will not be as free flowing as water.

The breach characteristics of a breach of the embankment were estimated using T MacDonald and J Langridge - Monopolis (1984), embankment breaches typically occur relatively quickly (typically 0.5 hour to 4 hours). The peak flows were then estimated using Rico M, Beniti G, Diez-Herrero G (2008) and also by assuming a triangular hydrograph. The peak flows in Table 1 below are based on the Rico method and a triangular hydrograph, noting that the Rico method arrives at very peaked outflow hydrographs.

The flood volumes for the TSF from the breach for the sunny day cases were estimated to be 33 % of the storage volume. The flood volumes of TSF from the breach for the worst case were estimated to be 33 % plus a PMP event (assessed to be 950 mm) over the TSF catchment (i.e. the tailings basin).

Table 1: Results of Dam Break Analyses

Site	Scenario	Peak Flow (m^3/s) Rico M, Beniti G, Diez-Herrero G 2008*	Peak Flow (m^3/s) triangular hydrograph**	Approx. Breach Development time (hrs)	Flood Volume (m^3)
TSF Cell 1	Sunny Day	2,859	747	6	8,066,700
(RL149.25 m)	Worst Case	3,038	863	6	9,320,700
*upper bound, **lower bound					

The flow from TSF dam break will flow along a channel creek system to the north-northeast of the project. Based on Seddon (2010) the dam break run-out could be up to nominally 2 km to 3.5 km, assuming an estimated typical tailings shear strength of 0.5 kPa to 1 kPa during operation. The following figure shows the conceptual dam break flow path in the immediate project area.

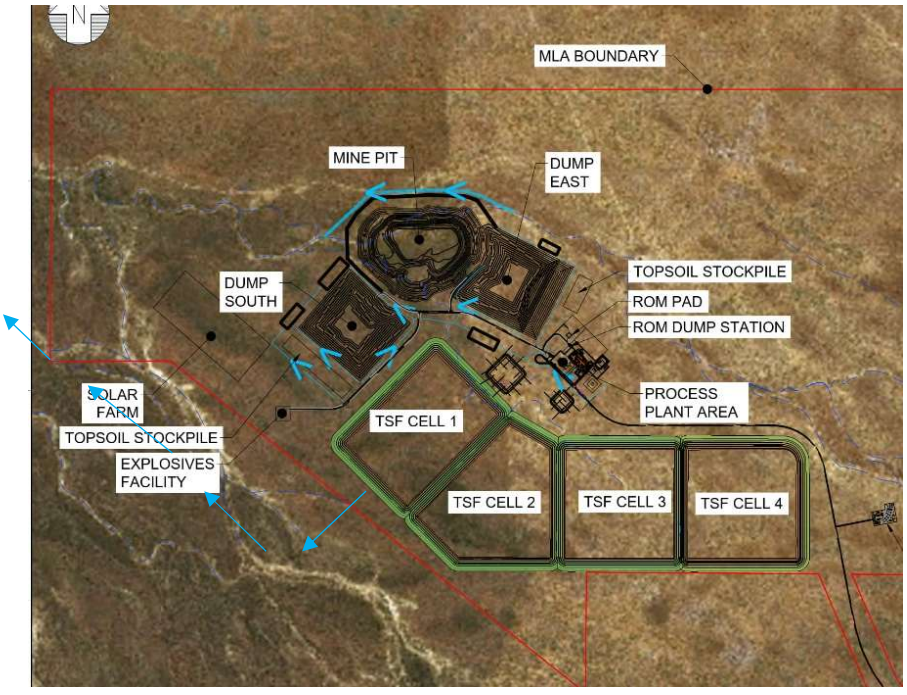


Figure 1: Site Plan show Dam Break Flow

The Rourke and Luppnow Method (ref: H Rourke, D Luppnow, 2015) for estimating volume released from the TSF was also consulted to assess potential stored volume release. It was noted from Rourke and Luppnow analysis of past TSF failures, that the release volume varies between 9 % and 67 % of stored volume. The Rourke and Luppnow Method demonstrates that in order to mitigate the consequence of a dam-break, the pond volume and area should be minimised by the adoption of good operating practices to minimise the supernatant pond on the TSF. Removal of excess water and maintaining the supernatant pond to the smallest practical minimum significantly reduces the potential for an embankment breach and the volume of liquids and solids released in the event of an embankment breach.

2.1.2 Results of Dam Break Assessment

If a dam break were to occur, the flood will flow to the channel system downstream of the TSF. A dam break flow is unlikely to flow affect remote communities or mine infrastructure.

The following consequences of a dam break are considered most likely, but it is stressed have a very low probability of occurrence:

- Loss of human life: There is some potential for loss of life of maintenance and mine personnel downstream of the TSF. The PAR is potentially ≥1-10.
- Economic loss due to plant shutdown and production loss, repairs of damaged sections of TSF and local access/haul roads.
- Environmental impact: tailings will flow downstream and contaminate soils and surface water requiring environmental 'clean-up'.

2.1.3 Controls

The conditions for TSF embankment failure to occur would be driven largely by the size and extent of the decant pond on the facility as well as the magnitude of a trigger seismic event, embankment deformation, the grading of the tailings and saturation of the tailings adjacent to the embankment. Effective management of the decant pond to ensure excess water is continually removed and that the location of the pond is maintained around the decant tower will minimise the risk of an embankment breach and release of saturated tailings.

TSF embankment failure is not expected provided the facility is operated in accordance with the requirements set out in the TSF Operations Manual (to be drafted in later studies).

In the event that the TSF were in imminent danger of failure and breach, an Emergency Action Plan (EAP) would need to be enacted.

3.0 PRELIMINARY SPILLWAY DESIGN

Each TSF cell will require a permanent spillway and temporary spillways at each stage. TSF cell spillways will be 25 m wide and approximately 80 m long with an energy dissipater on the downstream side. The spillways will be 1.0 m in depth.

The spillway has been designed based on a PMP rain event of 950 mm in 6 hours with most of the rain occurring over a 4-hr period.

Table 2 summarises the hydrology and hydraulic analyses for the TSF cell spillways.

Table 2: Summary of Hydrology/Hydraulic Analyses of the TSF Spillways

Table 8: Summary of Hydrology/Hydraulic Analyses of the TSF Spillway	
Total catchment area	120 ha
Rainfall depth of a PMP 6 hr. storm event	950 mm
Peak inflow – from catchment area	125 m^3/s
Peak outflow – down spillway	28.5 m^3/s
Spillway dimensions	25 m width, 0.7 m flow depth

We trust the above meets your requirements, should you have any queries please get back to me.

For and on behalf of CMW Geosciences



Christopher Hogg
Senior Principal Tailings
Engineer

Distribution: 1 electronic copy to SRE Pty Ltd via email
Original held at CMW Geosciences

Attachments: Breach Characteristics Calculations

PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
CLIENT	**Graphinex**	Job No	PER2026-0032
LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	1
SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
Scenario	**Worst Case (PMP Rainy Day Failure Conditions)**		

BREACH CHARACTERISTICS	**Using Empirical Method**		**MacDonald and Langridge - Monopolis (1984)**
Input Parameters	**Value**	**Unit**	**Comments**
New Embankment Crest Level	149.3	mRL	From design
Approx. ROM Pad level	127.3	mRL	From design
Maximum Embankment Height (on South-Western Side)	**22.0**	m	From design
Approximate Emb Length corresponding to Highest Section	500	m	assumed
Embankment Crest Width	20.0	m	From design
Upstream Embankment Slope	2.5	H to 1V	From design
Downstream Embankment Slope	2.5	H to 1V	From design
Embankment Cross Section Area	1,643.5	m^2	Embankment cross section area at highest section
Total Tonnes stored in Pond	30.3	Mt	Estimated total storage capacity
Density	1.25	t/m³	From design
Volume stored in Pond (VT)	**24,200,000**	m³	Estimated total volume
PMP Storm Volume over Pond Catchment	**1,254,000**	m³	*Rainy Day Failure Scenario - PMP 6-hour storm event adopted 950 mm - Area - 132 ha*
Total Released Volume from the Pond (VF)	**9,320,700**	m³	Allowed for release ~33% of storage volume
	7,621	acre-feet	Converted from m^3 to acre-feet (1 acre-feet = 1233 m3)

Note: For conservative assessment, it was assumed that embankment breaches will be occurred through the whole embankment height. Release from the embankment breaches were assumed to be liquefied.

Output Parameters - Breach Characteristics	**Value**	**Unit**	**Comments**
Breach Shape - Trapezoidal Side Slopes	**2**	**V to 1H**	Adopted approximate trapezoidal breach shape (T MacDonald and J Langridge - Monopolis, 1984)
Breach Height (H_o)	**22.0**	m	Adopted the bottom of the breach is at the base of the embankment
	72.0	feet	Converted from meter to feet
Breach Formation Factor (V_F x H_o)	**204,589,365**	m³ x m	Used this figure to predict the volume of embankment material removed during a breach
	5.5E+05	acre-ft x ft	Converted from m^3 x m to acre-feet x feet
Embankment Volume Eroded during Breach (V_M)	**7.1E+04**	yrd^3	Embankment volume removed during a breach (determined from **Figure 1**, T MacDonald and J Langridge - Monopolis, 1984)
	53,962	m³	Converted from cubic yard to cubic meter (1 cubic yard = 0.765 cubic meter)
Average Breach Width (W_{ave})	**33**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Base Breach Width (W_b)	**22**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Top Breach Width (W_t)	**44**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Breach Shape Area (A_F)	**721**	m^2	Breach shape area at highest embankment section
Equivalent Released Volume behind Breach Area	**816,654**	m³	Used this figure to estimate the equivalent failed length behind breach area
Equivalent Failed Length behind Breach Area (xo)	**1,130**	m	Calculated based on the released volume (behind breach area) and breach shape
Adopted Breach Development Time (t_F)	**6.0**	hour	Determined from **Figure 2**, T MacDonald and J Langridge - Monopolis, 1984) 5.5 check
Released Run-out Flow (QF) - average flow	**431.5**	m^3/s	Calculated based on released volume and breach development time
Peak Run-out Flow (QP)	**863.0**	m^3/s	Assuming a triangular hydrograph
Peak Run-out Flow (QP)	**3,037.1**	m^3/s	Based on Rico M, Beniti G, Diez-Herrero G 2008 Run-out distance (Dmax) 54 km

PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
CLIENT	**Graphinex**	Job No	PER2026-0032
LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	1
SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
Scenario	**Sunny Day (Normal Operation Failure Conditions)**		

BREACH CHARACTERISTICS	**Using Empirical Method**		**MacDonald and Langridge - Monopolis (1984)**
Input Parameters	**Value**	**Unit**	**Comments**
New Embankment Crest Level	149.3	mRL	From design
Approx. ROM Pad level	127.3	mRL	From design
Maximum Embankment Height (on South-Western Side)	**22.0**	m	From design
Approximate Emb Length corresponding to Highest Section	500	m	assumed
Embankment Crest Width	20.0	m	From design
Upstream Embankment Slope	2.5	H to 1V	From design
Downstream Embankment Slope	2.5	H to 1V	From design
Embankment Cross Section Area	1,643.5	m^2	Embankment cross section area at highest section
Total Tonnes stored in Pond	30.3	Mt	Estimated total storage capacity
Dry Density	1.25	t/m³	From design
Volume stored in Pond (VT)	**24,200,000**	m³	Estimated total volume
PMP Storm Volume over Pond Catchment	**0**	m³	*Rainy Day Failure Scenario - PMP 6-hour storm event adopted 950 mm - Area - 132 ha*
Total Released Volume from the Pond (VF)	**8,066,700**	m³	Allowed for release ~33% of storage volume
	6,596	acre-feet	Converted from m^3 to acre-feet (1 acre-feet = 1233 m3)

Note: For conservative assessment, it was assumed that embankment breaches will be occurred through the whole embankment height. Release from the embankment breaches were assumed to be liquefied.

Output Parameters - Breach Characteristics	**Value**	**Unit**	**Comments**
Breach Shape - Trapezoidal Side Slopes	**2**	**V to 1H**	Adopted approximate trapezoidal breach shape (T MacDonald and J Langridge - Monopolis, 1984)
Breach Height (H_o)	**22.0**	m	Adopted the bottom of the breach is at the base of the embankment
	72.0	feet	Converted from meter to feet
Breach Formation Factor (V_F x H_o)	**177,064,065**	m³ x m	Used this figure to predict the volume of embankment material removed during a breach
	4.7E+05	acre-ft x ft	Converted from m^3 x m to acre-feet x feet
Embankment Volume Eroded during Breach (V_M)	**6.3E+04**	yrd^3	Embankment volume removed during a breach (determined from **Figure 1**, T MacDonald and J Langridge - Monopolis, 1984)
	48,057	m³	Converted from cubic yard to cubic meter (1 cubic yard = 0.765 cubic meter)
Average Breach Width (W_{ave})	**29**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Base Breach Width (W_b)	**18**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Top Breach Width (W_t)	**40**	m	Calculated based on the removed embankment volume during a breach and embankment geometry
Breach Shape Area (A_F)	**642**	m^2	Breach shape area at highest embankment section
Equivalent Released Volume behind Breach Area	**648,814**	m³	Used this figure to estimate the equivalent failed length behind breach area
Equivalent Failed Length behind Breach Area (xo)	**1,010**	m	Calculated based on the released volume (behind breach area) and breach shape
Adopted Breach Development Time (t_F)	**6.0**	hour	Determined from **Figure 2**, T MacDonald and J Langridge - Monopolis, 1984) 5.2 check
Released Run-out Flow (QF) - average flow	**373.5**	m^3/s	Calculated based on released volume and breach development time
Peak Run-out Flow (QP)	**746.9**	m^3/s	Assuming a triangular hydrograph
Peak Run-out Flow (QP)	**2,858.2**	m^3/s	Based on Rico M, Beniti G, Diez-Herrero G 2008 Run-out distance (Dmax) 49 km

	PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
	CLIENT	**Graphinex**	Job No	PER2026-0032
	LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	0
	SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
	Scenario	**Worst Case (PMP Rainy Day Failure Conditions)**		

Step 1: Estimate runout volume following a dam overtopping, embankment stability or piping failure.

Total volume of tailings and water in the facility at the time of failure, V_T (m^3):	25,454,000	
Volume of tailings and water released at failure, V_F (m^3):	**10,327,741**	Eq. 7 Rico et. Al. 2007

$$V_F = 0.354 \times V_T^{1.008}$$

Assumptions:

The formula represents the maximum tailings volume that can be released in the most extreme situation in which pond volume was empouted folllowing the dam break.

The failure mechanism is from the base of the facility to the highest embankment level at RL1491m.

Step 2: Estimate preflow horizontal distance of failure volume.

Embankment height, h_0 (m):	22	
Embankment Length 1	500	
Estimated pre-flow horizontal distance, x_0 embankment 1(m):	1,130	Seddon K. D. 2010

Assumptions:

Failure occurs along full length of embankment. Failure at aech embankment is assessed.

Energy based linear method as per Seddon K.D (2010)

Zero grade.

$$H_o x_o = h\, x_f$$

$$\therefore h = (x_o / x_f) H_o$$

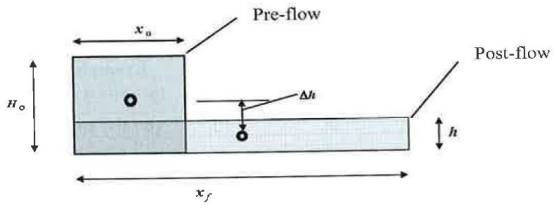


Figure 2 **Simplified flow slide geometry**

Step 3: Estimate runout distance following a dam overtopping, embankment stability or piping failure.

Bulk unit weight (kN/m^3):	12.5	
Undrained shear strength (kPa):	1	
Estimated post-flow horizontal distance of failure volume, x_f embankment 1 (m):	**3167**	Eqn. 6 Seddon K.D. 2010

$$x_f^2 + x_o x_f - 2\gamma x_o H_o^2 / s_u = 0$$

Runout distance, R_0 embankment 1 (m):	**2037**	Eqn. 7 Seddon K.D. 2010

$$Ro = x_f - x_o$$

	PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
	CLIENT	**Graphinex**	Job No	PER2026-0032
	LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	0
	SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
	Scenario	**Sunny Day (Normal Operation Failure Conditions)**		

Step 1: Estimate runout volume following a dam overtopping, embankment stability or piping failure.

Total volume of tailings and water in the facility at the time of failure, V_T (m^3):	24,200,000	
Volume of tailings and water released at failure, V_F (m^3):	**9,814,974**	Eq. 7 Rico et. Al. 2007

$$V_F = 0.354 \times V_T^{1.008}$$

Assumptions:

The formula represents the maximum tailings volume that can be released in the most extreme situation in which pond volume was empouted folllowing the dam break.

The failure mechanism is from the base of the facility to the highest embankment level at RL1491m.

Step 2: Estimate preflow horizontal distance of failure volume.

Embankment height, h_0 (m):	22	
Embankment Length 1	500	
Estimated pre-flow horizontal distance, x_0 embankment 1(m):	1,010	Seddon K. D. 2010

Assumptions:

Failure occurs along full length of embankment. Failure at aech embankment is assessed.

Energy based linear method as per Seddon K.D (2010)

Zero grade.

$$H_o x_o = h\, x_f$$

$$\therefore h = (x_o / x_f) H_o$$

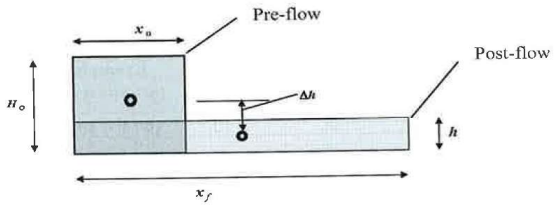


Figure 2 **Simplified flow slide geometry**

Step 3: Estimate runout distance following a dam overtopping, embankment stability or piping failure.

Bulk unit weight (kN/m^3):	12.5	
Undrained shear strength (kPa):	1	
Estimated post-flow horizontal distance of failure volume, x_f embankment 1 (m):	**3019**	Eqn. 6 Seddon K.D. 2010

$$x_f^2 + x_o x_f - 2\gamma x_o H_o^2 / s_u = 0$$

Runout distance, R_0 embankment 1 (m):	**2009**	Eqn. 7 Seddon K.D. 2010

$$Ro = x_f - x_o$$

PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
CLIENT	**Graphinex**	Job No	PER2026-0032
LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	0
SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
Scenario	**Worst Case (PMP Rainy Day Failure Conditions)**		

Step 1: Estimate runout volume following a dam overtopping, embankment stability or piping failure.

Total volume of tailings and water in the facility at the time of failure, V_T (m^3):	25,454,000	
Volume of tailings and water released at failure, V_F (m^3):	**10,327,741**	Eq. 7 Rico et. Al. 2007

$$V_F = 0.354 \times V_T^{1.008}$$

Assumptions:

The formula represents the maximum tailings volume that can be released in the most extreme situation in which pond volume was empouted folllowing the dam break.

The failure mechanism is from the base of the facility to the highest embankment level at RL1491m.

Step 2: Estimate preflow horizontal distance of failure volume.

Embankment height, h_0 (m):	22	
Embankment Length 1	500	
Estimated pre-flow horizontal distance, x_0 embankment 1(m):	1,130	Seddon K. D. 2010

Assumptions:

Failure occurs along full length of embankment. Failure at aech embankment is assessed.

Energy based linear method as per Seddon K.D (2010)

Zero grade.

$$H_o x_o = h\, x_f$$

$$\therefore h = (x_o / x_f) H_o$$

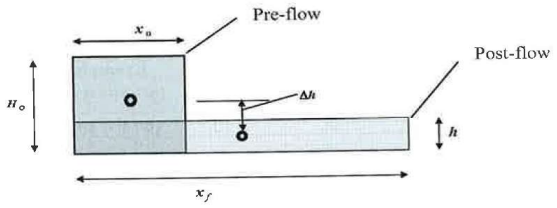


Figure 2 **Simplified flow slide geometry**

Step 3: Estimate runout distance following a dam overtopping, embankment stability or piping failure.

Bulk unit weight (kN/m^3):	12.5	
Undrained shear strength (kPa):	0.5	
Estimated post-flow horizontal distance of failure volume, x_f embankment 1 (m):	**4683**	Eqn. 6 Seddon K.D. 2010

$$x_f^2 + x_o x_f - 2\gamma x_o H_o^2 / s_u = 0$$

Runout distance, R_0 embankment 1 (m):	**3553**	Eqn. 7 Seddon K.D. 2010

$$Ro = x_f - x_o$$

	PROJECT	**Esmeralda Graphite Project**	Date	21-Apr-26
	CLIENT	**Graphinex**	Job No	PER2026-0032
	LOCATION	**Esmeralda Graphite Project, near Croyton in north of Queensland**	Rev	0
	SUBJECT	**Dam Breach Analyses - TSF Cell 1**		
	Scenario	**Sunny Day (Normal Operation Failure Conditions)**		

Step 1: Estimate runout volume following a dam overtopping, embankment stability or piping failure.

Total volume of tailings and water in the facility at the time of failure, V_T (m^3):	24,200,000	
Volume of tailings and water released at failure, V_F (m^3):	**9,814,974**	Eq. 7 Rico et. Al. 2007

$$V_F = 0.354 \times V_T^{1.008}$$

Assumptions:

The formula represents the maximum tailings volume that can be released in the most extreme situation in which pond volume was empouted folllowing the dam break.

The failure mechanism is from the base of the facility to the highest embankment level at RL1491m.

Step 2: Estimate preflow horizontal distance of failure volume.

Embankment height, h_0 (m):	22	
Embankment Length 1	500	
Estimated pre-flow horizontal distance, x_0 embankment 1(m):	1,010	Seddon K. D. 2010

Assumptions:

Failure occurs along full length of embankment. Failure at aech embankment is assessed.

Energy based linear method as per Seddon K.D (2010)

Zero grade.

$$H_o x_o = h\, x_f$$

$$\therefore h = (x_o / x_f) H_o$$

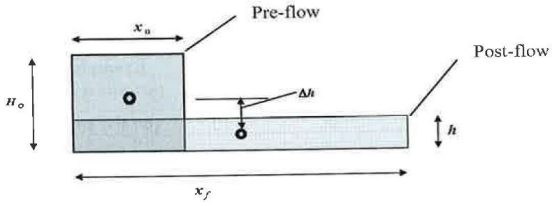


Figure 2 **Simplified flow slide geometry**

Step 3: Estimate runout distance following a dam overtopping, embankment stability or piping failure.

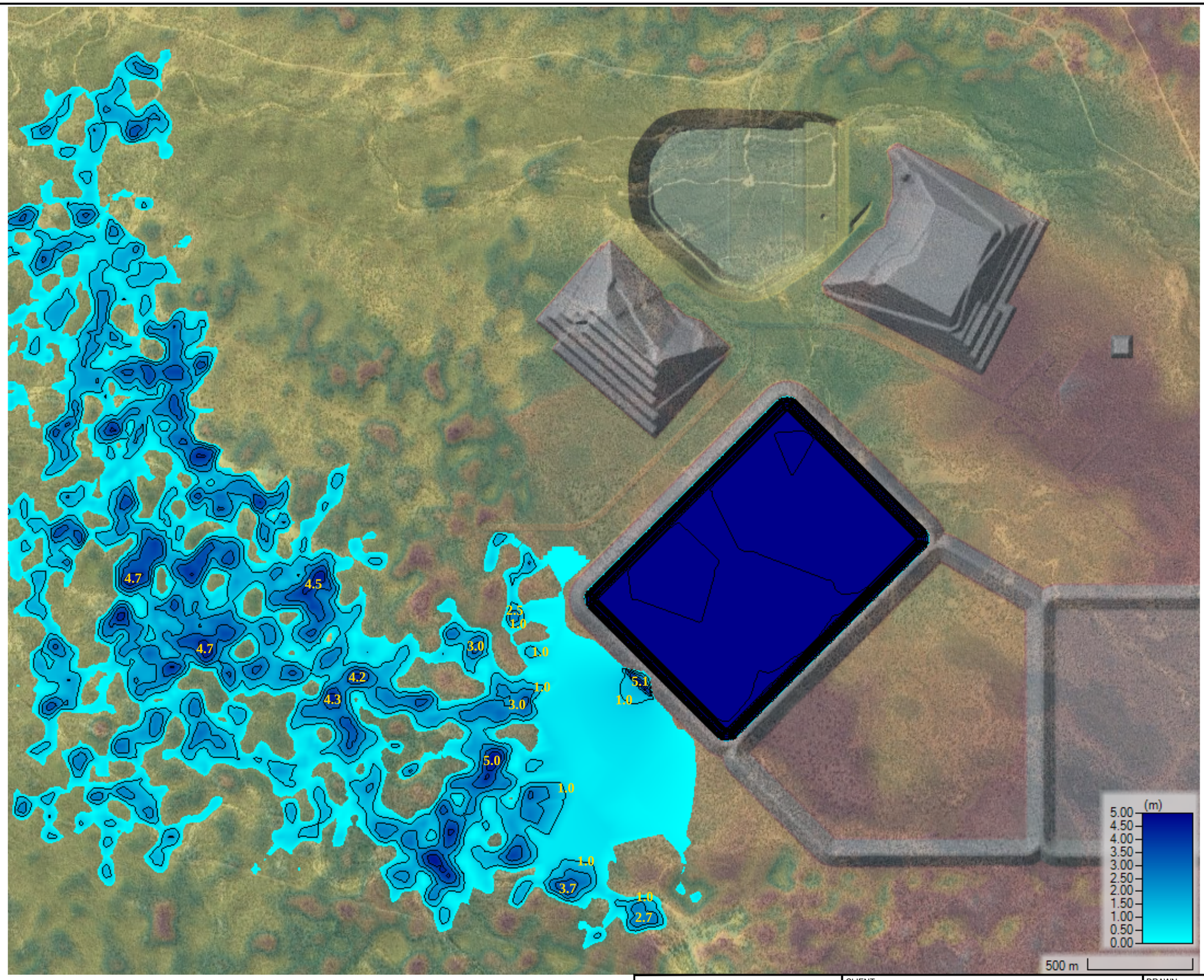
Bulk unit weight (kN/m^3):	12.5	
Undrained shear strength (kPa):	0.5	
Estimated post-flow horizontal distance of failure volume, x_f embankment 1 (m):	**4453**	Eqn. 6 Seddon K.D. 2010

$$x_f^2 + x_o x_f - 2\gamma x_o H_o^2 / s_u = 0$$

Runout distance, R_0 embankment 1 (m):	**3443**	Eqn. 7 Seddon K.D. 2010

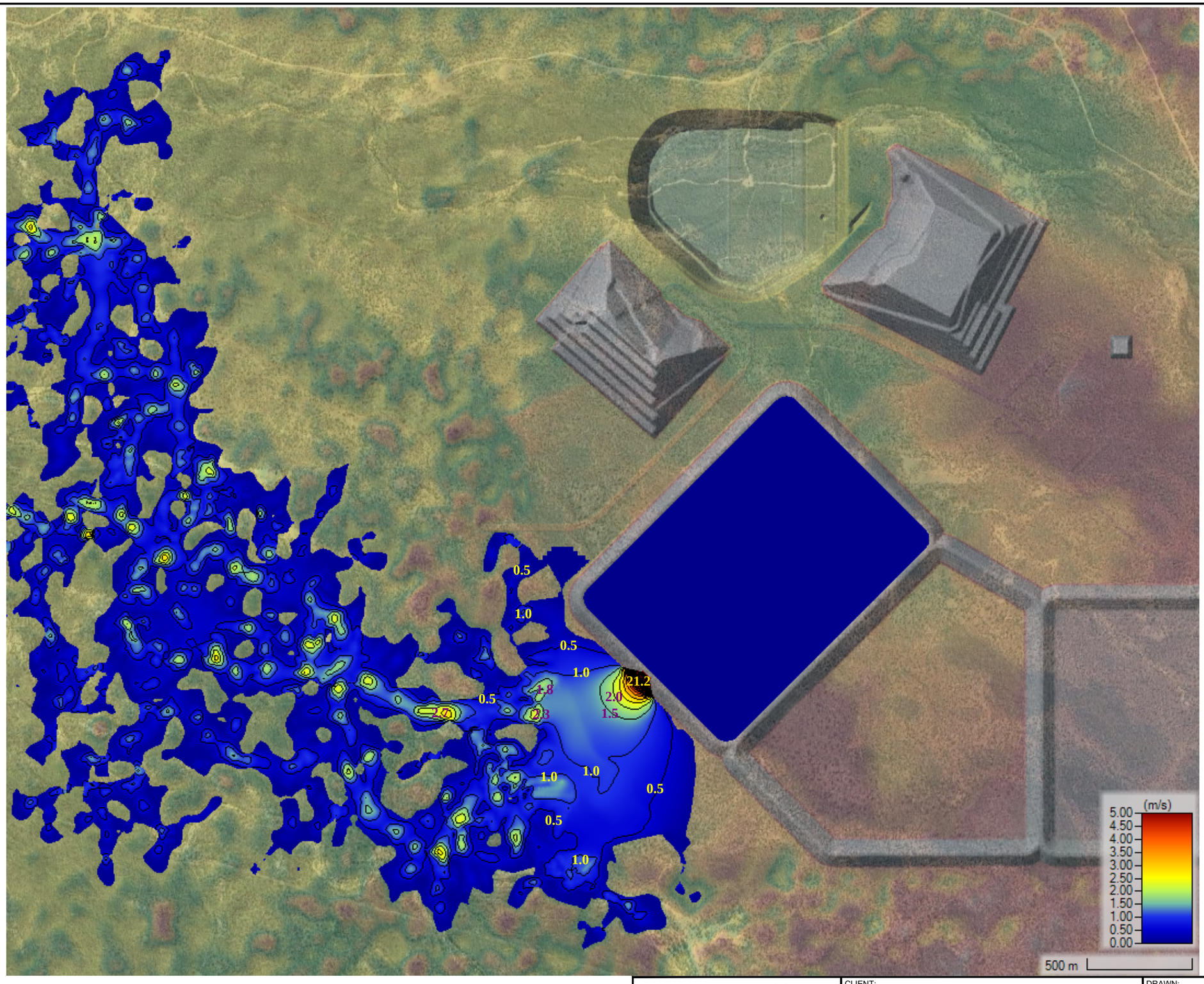
$$Ro = x_f - x_o$$

Appendix B:
Rainy Day Failure Analyses Output



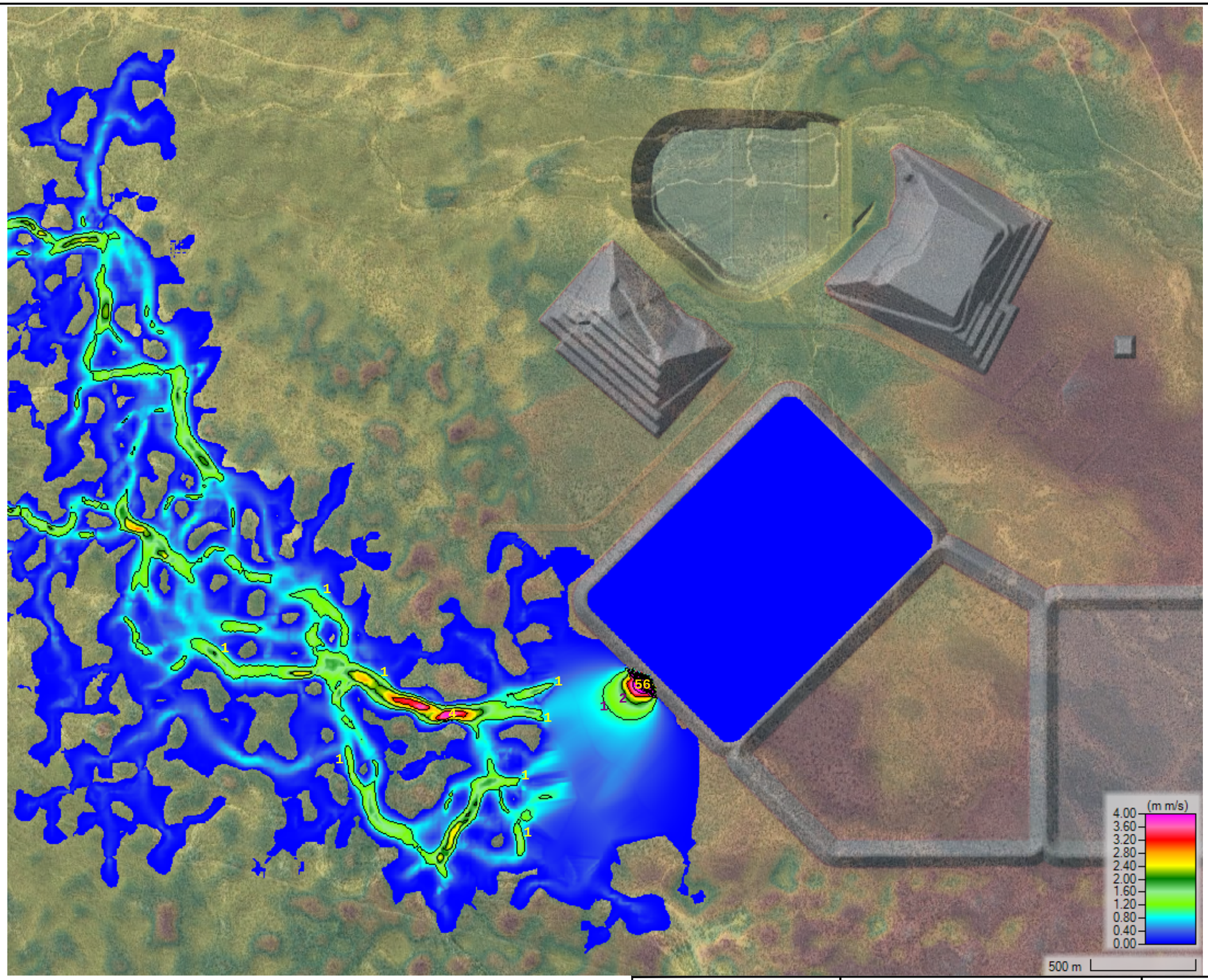
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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C01
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST RAINY DAY, DEPTH		DATE: 06/05/2026	SHEET: A3 L



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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C02
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST RAINY DAY, VELOCITY		DATE: 06/05/2026	SHEET: A3 L



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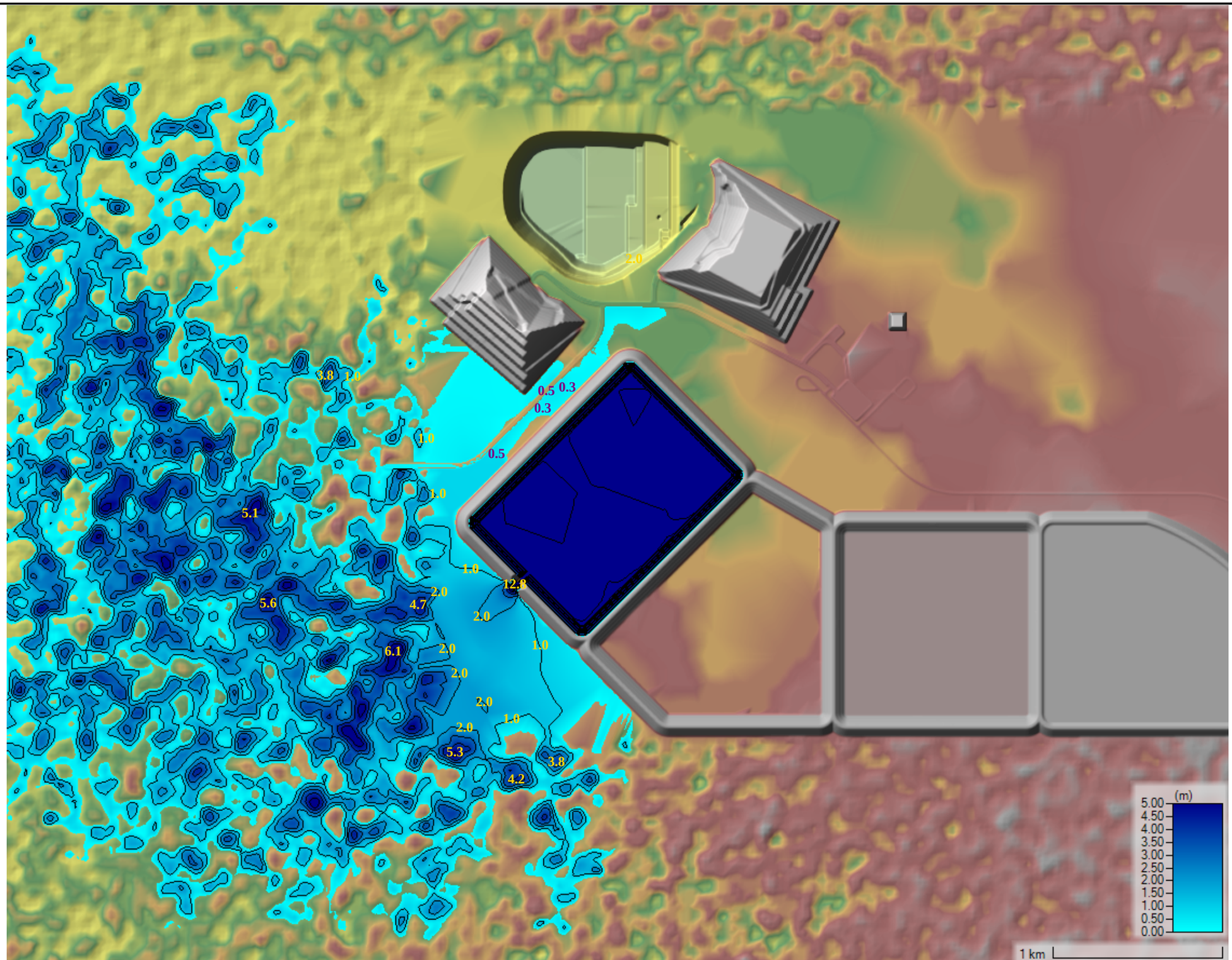
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PROJECT: **ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND**		CHECKED: CH	DRAWING: C03
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST RAINY DAY, DEPTH X VELOCITY		DATE: 06/05/2026	SHEET: A3 L



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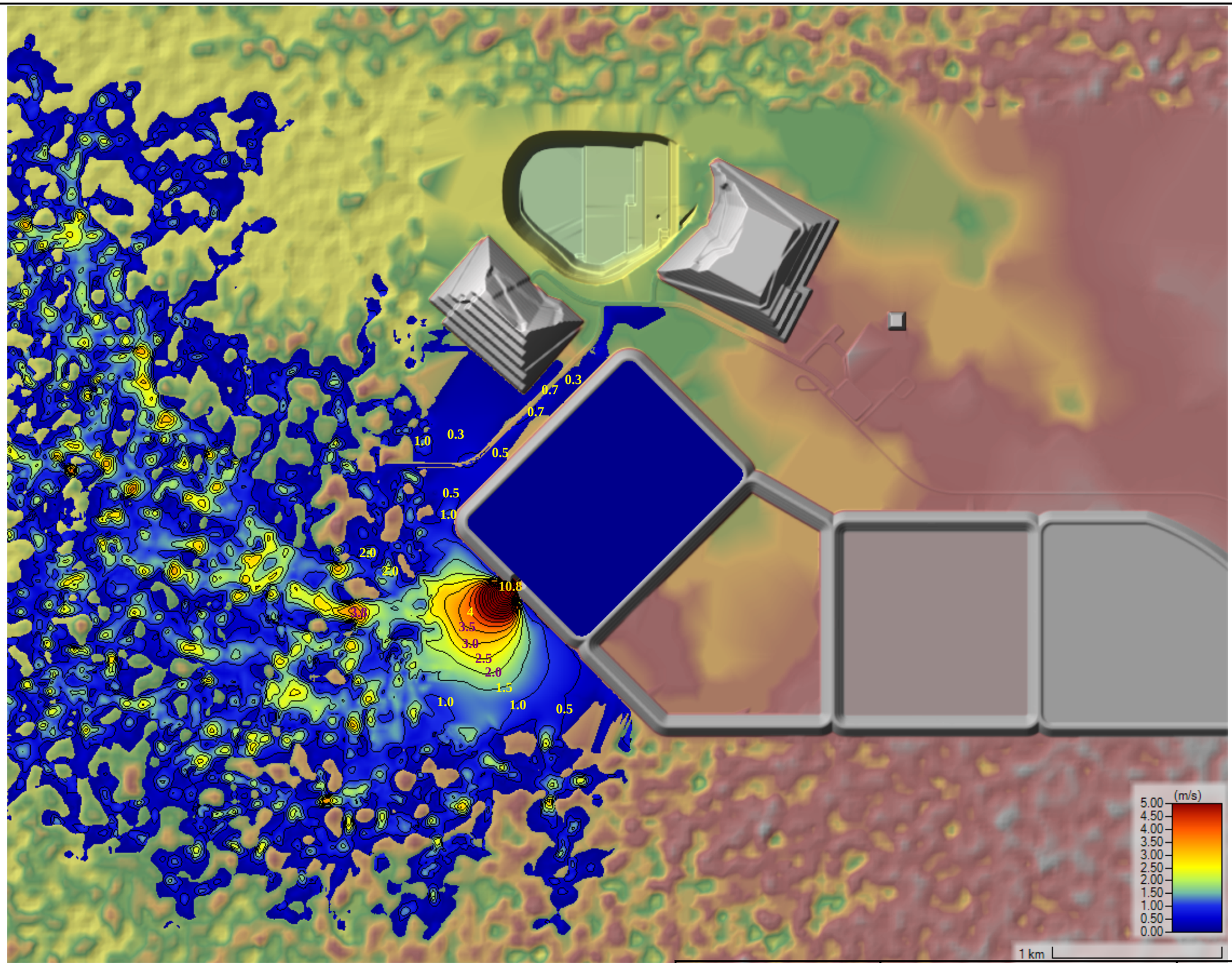
CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C04
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST RAINY DAY, ARRIVAL TIME FOR 0.3 m DEPTH		DATE: 06/05/2026	SHEET: A3 L

Appendix C:
Sunny Day Failure Analyses Output



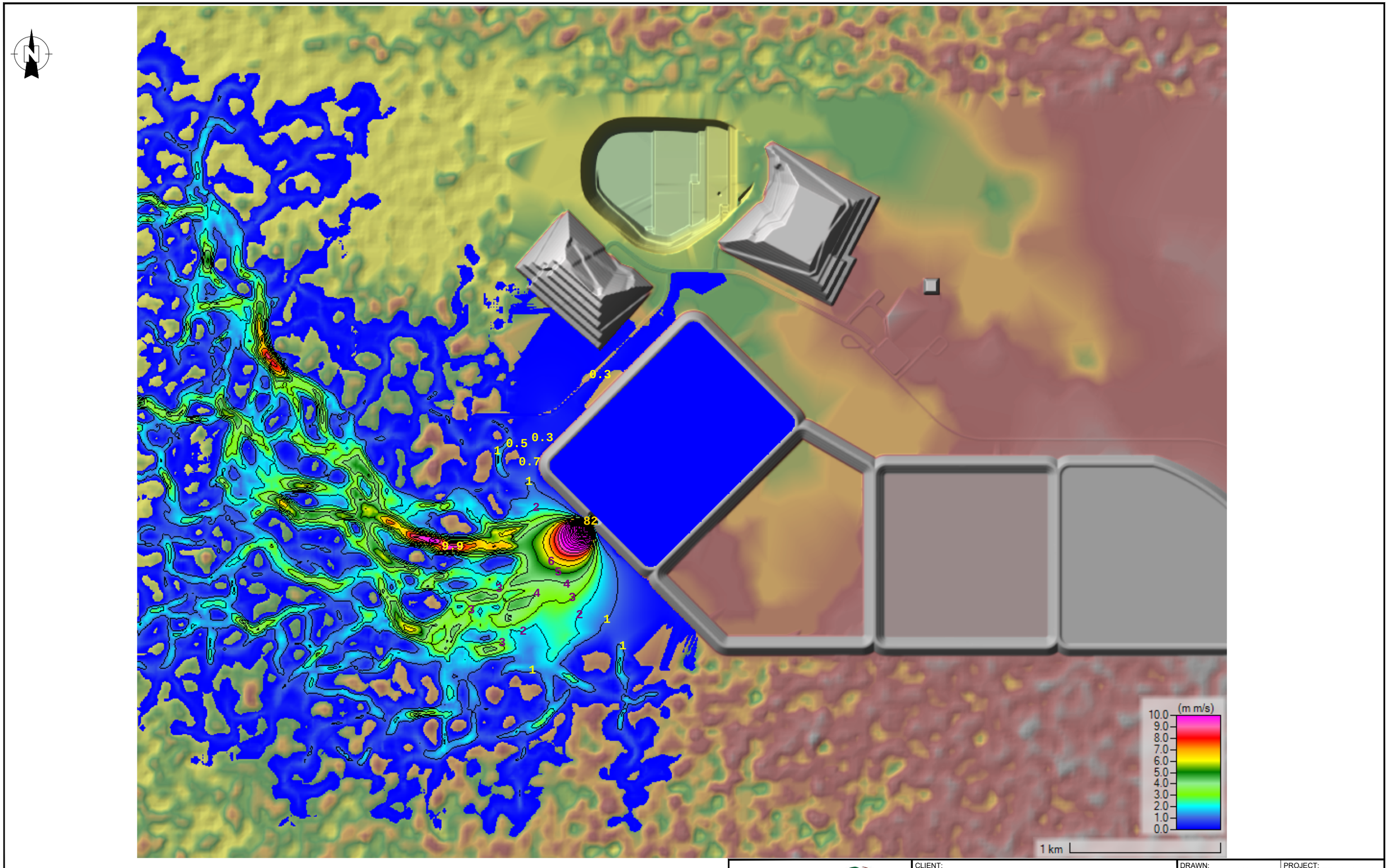
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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C05
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST SUNNY DAY, DEPTH		DATE: 06/05/2026	SHEET: A3 L



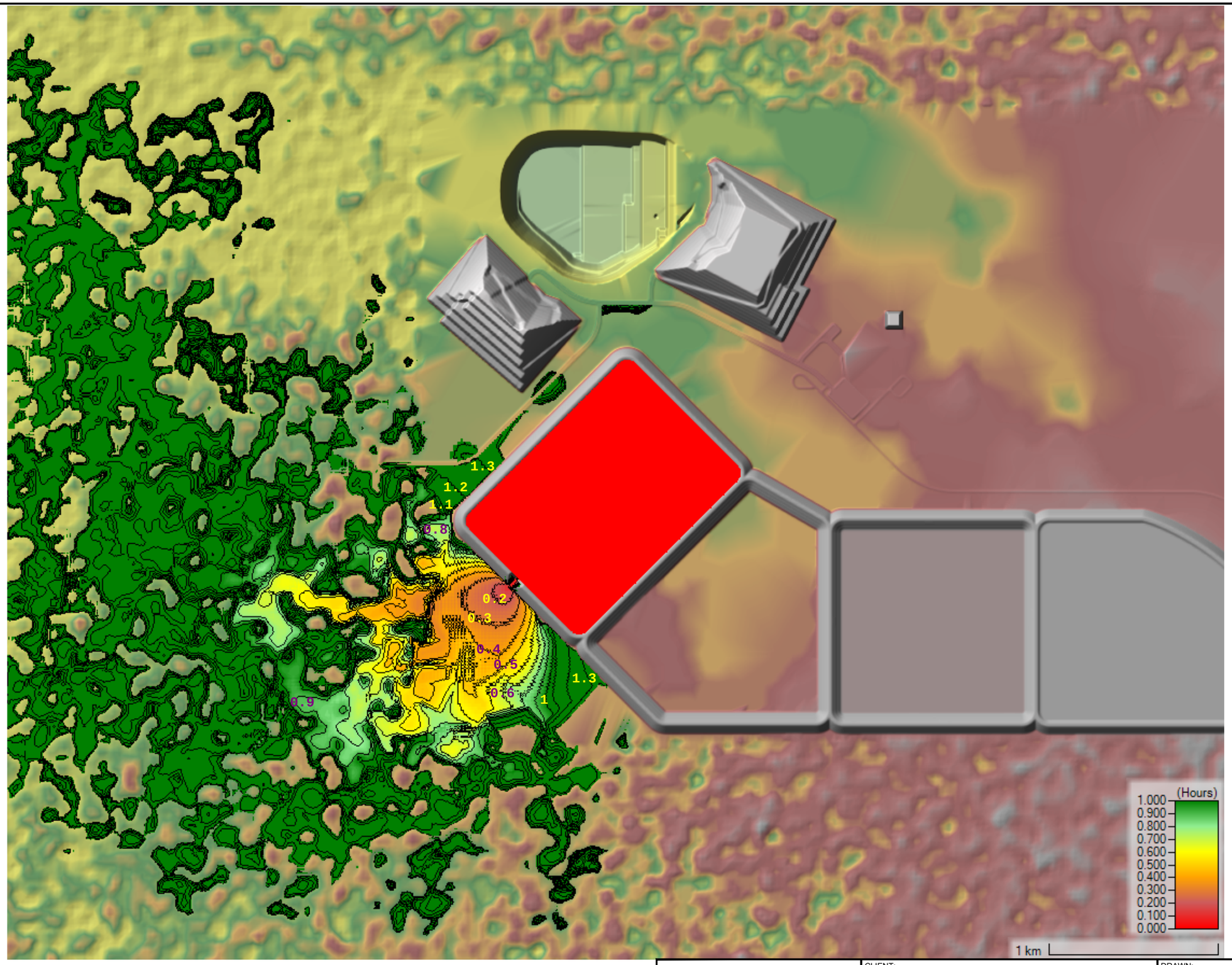
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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C06
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST SUNNY DAY, VELOCITY		DATE: 06/05/2026	SHEET: A3 L



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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C07
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST SUNNY DAY, DEPTH X VELOCITY		DATE: 06/05/2026	SHEET: A3 L



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CLIENT: GRAPHINEX		DRAWN: UA	PROJECT: PER2026-0032
PROJECT: ESMERALDA GRAPHITE PROJECT, NORTH OF QUEENSLAND		CHECKED: CH	DRAWING: C08
		REVISION: 1	SCALE: AS SHOWN
TITLE: TSF CELL 1 - BREACH FROM SOUTHWEST SUNNY DAY, ARRIVAL TIME FOR 0.3 m DEPTH		DATE: 06/05/2026	SHEET: A3 L

Appendix 5

Water Balance Cells 1 to 4

Graphinex Pty Ltd
Esmeralda Graphite Project

Final Rev 0 (issued for use)

PROJECT : ESMERALDA PROJECT

CLIENT : GRAPHINEX PTY LTD

LOCATION : CROYDON, QUEENSLAND

SUBJECT : PRELIMINARY WATER BALANCE - GTSF Cell 1

Date	15-Feb-26
Job No	Richmond Vanadium Technology
File	ETSF Water Balance.xls
Subject	TSF Water Balance Mtpa
Revision	20250328

INFLOWS		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
		31	28.25	31	30	31	30	31	31	30	31	30	31	
RAINFALL														
Mean Monthly Rainfall (mm) Esmeralda (Station ID 029016) from 1914 to 2023)		211.3	171	109.7	21.3	8.9	8.9	5.8	3.2	5.3	14.8	43.5	103.2	706.9
Average Daily Rainfall (mm)		6.82	5.90	3.54	0.71	0.29	0.30	0.19	0.10	0.18	0.48	1.45	3.33	
Cell 1 TSF Catchment Area (m^2)	**1,208,220**	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	
Runoff Coefficient Tailings		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catchment Area above the tailngs beaches (m^2)	0	0	0	0	0	0	0	0	0	0	0	0	0	
Runoff Coefficient from catchment area		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Tailings Pool Area (m^2) estimated from pond radius (m)	**40**	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	
Tailings Running Beaches (m^2) number of active spigots x spacing x length to pond	**1,203,193**	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	1,203,193	
Rainfall Inflow Total Volume (m^3/day)		8,235	7,124	4,276	858	347	358	226	125	213	577	1,752	4,022	848,747
SLURRY WATER (Recovery and Fine Tailings)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total tonnes per month	**3,250,000**	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	3,250,000
% Solids	**60%**	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60.0%
Tailings Output Solids (tpd)		8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Volume of Water (m3/day)		5,824	6,391	5,824	6,019	5,824	6,019	5,824	5,824	6,019	5,824	6,019	5,824	2,166,667
Volume of Water (m3/month)		180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	65,947,917
OTHER WATER INFLOWS														
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Other Water Inflow Total (m3/day)		0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL INFLOW (m3/day)		**14,060**	**13,516**	**10,100**	**6,876**	**6,171**	**6,377**	**6,050**	**5,949**	**6,232**	**6,401**	**7,770**	**9,847**	
TOTAL INFLOW (m3/month)		**435,852**	**381,818**	**313,097**	**206,291**	**191,309**	**191,309**	**187,563**	**184,422**	**186,959**	**198,437**	**233,113**	**305,244**	**3,015,414**

OUTFLOW-LOSSES FROM TAILINGS DAM			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
EVAPORATION (from pond and beaches)															
Monthly Evaporation (Mean Daily Croydon (Station ID 029012) data (1972 to 2014)			198	158	186	192	177	150	164	202	246	285	270	248	2,476
Pan Factor			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Adjusted Monthly Dam Evaporation Rate (mm)			149	119	140	144	133	113	123	151	185	214	203	186	
Adjusted Average Daily Evaporation Rate (mm)			5	4	5	5	4	4	4	5	6	7	7	6	
Tailings Pool Area and Running Beaches (m^2)			1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	1,208,220	
Total Evaporation Outflow (m^3/day)			5,799	5,075	5,437	5,799	5,165	4,531	4,803	5,890	7,431	8,337	8,155	7,249	26,889,993
EVAPO-TRANSPIRATION (from drying tailings)															
Evaporation Rate (mm)			198	158	186	192	177	150	164	202	246	285	270	248	
Evapo-transpiration Rate (Pan/3)			66	53	62	64	59	50	55	67	82	95	90	83	
Average Daily Evapo-transpiration Rate (mm)			2	2	2	2	2	2	2	2	3	3	3	3	
Area Transpiring (m^2)			0	0	0	0	0	0	0	0	0	0	0	0	
Daily transpiration Loss (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
SEEPAGE															
Downstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Upstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Tailings Stack and Dam Floor (m/day). 1.0 x 10^{-9}m/sec/m^2 (assumed value)		**8.64E-06**	10	10	10	10	10	10	10	10	10	10	10	10	
Total Seepage Outflow (m^3/day)			10	10	10	10	10	10	10	10	10	10	10	10	
RETENTION															
Tailings Output (tpd)			8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Calculated Average Insitu Dry Density of Tailings (t/m^3) and moisture content	1.361	35.0%													
Volume Retained in Tailings (m^3/day)			3,058	3,355	3,058	3,160	3,058	3,160	3,058	3,058	3,160	3,058	3,160	3,058	
TOTAL OUTFLOW-LOSSES FROM TAILINGS DAM (m3/day)			8,868	8,440	8,505	8,970	8,233	7,701	7,871	8,958	10,601	11,405	11,326	10,318	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/day)			5,192	5,075	1,595	-2,093	-2,062	-1,324	-1,820	-3,009	-4,369	-5,004	-3,555	-471	-11,846
BALANCE INFLOW-OUTFLOW/LOSSES (m^3/month)			160,954	143,376	49,435	-62,798	-63,926	-39,721	-56,435	-93,286	-131,062	-155,116	-106,656	-14,600	-369,835
POTENTIAL RETURN WATER TO THE PLANT (if available) m^3/day			5,192.07	5,075.26	1,594.69	-62,797.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Potential Water Return per month (m^3)			160,954	143,376	49,435	0	0	0	0	0	0	0	0	0	353,765
Total water shortfall (-) or excess (+) of requirements (m^3/month) assuming excess can be returned			160,954	143,376	49,435	-62,798	-63,926	-39,721	-56,435	-93,286	-131,062	-155,116	-106,656	-14,600	-369,835
Make-up water requirements (m3/month)			**19,602**	**37,180**	**131,120**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**1,812,901**
Total water available (m^3/year) assuming excess can be returned =			-369,835												

PROJECT : ESMERALDA PROJECT

CLIENT : GRAPHINEX PTY LTD

LOCATION : CROYDON, QUEENSLAND

SUBJECT : PRELIMINARY WATER BALANCE - GTSF Cell 2

Date	15-Feb-26
Job No	Richmond Vanadium Technology
File	ETSF Water Balance.xls
Subject	TSF Water Balance Mtpa
Revision	20250328

INFLOWS			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
			31	28.25	31	30	31	30	31	31	30	31	30	31	
RAINFALL															
Mean Monthly Rainfall (mm) Esmeralda (Station ID 029016) from 1914 to 2023)			211.3	171	109.7	21.3	8.9	8.9	5.8	3.2	5.3	14.8	43.5	103.2	706.9
Average Daily Rainfall (mm)			6.82	5.90	3.54	0.71	0.29	0.30	0.19	0.10	0.18	0.48	1.45	3.33	
Cell 1 TSF Catchment Area (m^2)	**1,281,173**		1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	
Runoff Coefficient Tailings			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catchment Area above the tailngs beaches (m^2)	0		0	0	0	0	0	0	0	0	0	0	0	0	
Runoff Coefficient from catchment area			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Tailings Pool Area (m^2) estimated from pond radius (m)	**40**		5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	
Tailings Running Beaches (m^2) number of active spigots x spacing x length to pond	**1,276,146**		1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	1,276,146	
Rainfall Inflow Total Volume (m^3/day)			8,733	7,555	4,534	910	368	380	240	132	226	612	1,858	4,265	899,995
SLURRY WATER (Recovery and Fine Tailings)			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total tonnes per month	**3,250,000**		270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	3,250,000
% Solids	**60%**		60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60.0%
Tailings Output Solids (tpd)			8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Volume of Water (m3/day)			5,824	6,391	5,824	6,019	5,824	6,019	5,824	5,824	6,019	5,824	6,019	5,824	2,166,667
Volume of Water (m3/month)			180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	65,947,917
OTHER WATER INFLOWS															
Dewatering (m3/month)			0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)			0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)			0	0	0	0	0	0	0	0	0	0	0	0	
Other Water Inflow Total (m3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL INFLOW (m3/day)			**14,557**	**13,946**	**10,358**	**6,928**	**6,192**	**6,399**	**6,064**	**5,957**	**6,245**	**6,436**	**7,876**	**10,089**	
TOTAL INFLOW (m3/month)			**451,267**	**393,970**	**321,100**	**207,845**	**191,958**	**191,958**	**187,986**	**184,655**	**187,346**	**199,517**	**236,287**	**312,773**	**3,066,662**

OUTFLOW-LOSSES FROM TAILINGS DAM			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
EVAPORATION (from pond and beaches)															
Monthly Evaporation (Mean Daily Croydon (Station ID 029012) data (1972 to 2014)			198	158	186	192	177	150	164	202	246	285	270	248	2,476
Pan Factor			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Adjusted Monthly Dam Evaporation Rate (mm)			149	119	140	144	133	113	123	151	185	214	203	186	
Adjusted Average Daily Evaporation Rate (mm)			5	4	5	5	4	4	4	5	6	7	7	6	
Tailings Pool Area and Running Beaches (m^2)			1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	1,281,173	
Total Evaporation Outflow (m^3/day)			6,150	5,381	5,765	6,150	5,477	4,804	5,093	6,246	7,879	8,840	8,648	7,687	28,513,626
EVAPO-TRANSPIRATION (from drying tailings)															
Evaporation Rate (mm)			198	158	186	192	177	150	164	202	246	285	270	248	
Evapo-transpiration Rate (Pan/3)			66	53	62	64	59	50	55	67	82	95	90	83	
Average Daily Evapo-transpiration Rate (mm)			2	2	2	2	2	2	2	2	3	3	3	3	
Area Transpiring (m^2)			0	0	0	0	0	0	0	0	0	0	0	0	
Daily transpiration Loss (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
SEEPAGE															
Downstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Upstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Tailings Stack and Dam Floor (m/day). 1.0 x 10^{-9}m/sec/m^2 (assumed value)		**8.64E-06**	11	11	11	11	11	11	11	11	11	11	11	11	
Total Seepage Outflow (m^3/day)			11	11	11	11	11	11	11	11	11	11	11	11	
RETENTION															
Tailings Output (tpd)			8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Calculated Average Insitu Dry Density of Tailings (t/m^3) and moisture content	1.361	35.0%													
Volume Retained in Tailings (m^3/day)			3,058	3,355	3,058	3,160	3,058	3,160	3,058	3,058	3,160	3,058	3,160	3,058	
TOTAL OUTFLOW-LOSSES FROM TAILINGS DAM (m3/day)			9,218	8,747	8,834	9,320	8,546	7,975	8,162	9,315	11,050	11,909	11,819	10,756	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/day)			5,339	5,198	1,524	-2,392	-2,354	-1,577	-2,097	-3,358	-4,805	-5,473	-3,942	-666	-14,604
BALANCE INFLOW-OUTFLOW/LOSSES (m^3/month)			165,494	146,855	47,242	-71,768	-72,964	-47,298	-65,021	-104,097	-144,154	-169,661	-118,275	-20,660	-454,308
POTENTIAL RETURN WATER TO THE PLANT (if available) m^3/day			5,338.52	5,198.40	1,523.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Potential Water Return per month (m^3)			165,494	146,855	47,242	0	0	0	0	0	0	0	0	0	359,591
Total water shortfall (-) or excess (+) of requirements (m^3/month) assuming excess can be returned			165,494	146,855	47,242	0	0	0	0	0	0	0	0	0	359,591
Make-up water requirements (m3/month)			**15,062**	**33,701**	**133,314**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**1,807,076**
Total water available (m^3/year) assuming excess can be returned =			359,591												

PROJECT : ESMERALDA PROJECT

CLIENT : GRAPHINEX PTY LTD

LOCATION : CROYDON, QUEENSLAND

SUBJECT : PRELIMINARY WATER BALANCE - GTSF Cell 3

Date	15-Feb-26
Job No	Richmond Vanadium Technology
File	ETSF Water Balance.xls
Subject	TSF Water Balance Mtpa
Revision	20250328

INFLOWS		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
		31	28.25	31	30	31	30	31	31	30	31	30	31	
RAINFALL														
Mean Monthly Rainfall (mm) Esmeralda (Station ID 029016) from 1914 to 2023)		211.3	171	109.7	21.3	8.9	8.9	5.8	3.2	5.3	14.8	43.5	103.2	706.9
Average Daily Rainfall (mm)		6.82	5.90	3.54	0.71	0.29	0.30	0.19	0.10	0.18	0.48	1.45	3.33	
Cell 1 TSF Catchment Area (m^2)	**1,272,657**	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	
Runoff Coefficient Tailings		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catchment Area above the tailngs beaches (m^2)	0	0	0	0	0	0	0	0	0	0	0	0	0	
Runoff Coefficient from catchment area		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Tailings Pool Area (m^2) estimated from pond radius (m)	**40**	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	5,027	
Tailings Running Beaches (m^2) number of active spigots x spacing x length to pond	**1,267,630**	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	1,267,630	
Rainfall Inflow Total Volume (m^3/day)		8,675	7,504	4,504	904	365	378	238	131	225	608	1,845	4,237	894,013
SLURRY WATER (Recovery and Fine Tailings)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total tonnes per month	**3,250,000**	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	3,250,000
% Solids	**60%**	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60.0%
Tailings Output Solids (tpd)		8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Volume of Water (m3/day)		5,824	6,391	5,824	6,019	5,824	6,019	5,824	5,824	6,019	5,824	6,019	5,824	2,166,667
Volume of Water (m3/month)		180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	65,947,917
OTHER WATER INFLOWS														
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Other Water Inflow Total (m3/day)		0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL INFLOW (m3/day)		**14,499**	**13,896**	**10,328**	**6,922**	**6,190**	**6,396**	**6,062**	**5,956**	**6,243**	**6,432**	**7,864**	**10,061**	
TOTAL INFLOW (m3/month)		**449,468**	**392,552**	**320,166**	**207,663**	**191,882**	**191,882**	**187,937**	**184,628**	**187,301**	**199,391**	**235,916**	**311,894**	**3,060,680**

OUTFLOW-LOSSES FROM TAILINGS DAM			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
EVAPORATION (from pond and beaches)															
Monthly Evaporation (Mean Daily Croydon (Station ID 029012) data (1972 to 2014)			198	158	186	192	177	150	164	202	246	285	270	248	2,476
Pan Factor			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Adjusted Monthly Dam Evaporation Rate (mm)			149	119	140	144	133	113	123	151	185	214	203	186	
Adjusted Average Daily Evaporation Rate (mm)			5	4	5	5	4	4	4	5	6	7	7	6	
Tailings Pool Area and Running Beaches (m^2)			1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	
Total Evaporation Outflow (m^3/day)			6,109	5,345	5,727	6,109	5,441	4,772	5,059	6,204	7,827	8,781	8,590	7,636	28,324,095
EVAPO-TRANSPIRATION (from drying tailings)															
Evaporation Rate (mm)			198	158	186	192	177	150	164	202	246	285	270	248	
Evapo-transpiration Rate (Pan/3)			66	53	62	64	59	50	55	67	82	95	90	83	
Average Daily Evapo-transpiration Rate (mm)			2	2	2	2	2	2	2	2	3	3	3	3	
Area Transpiring (m^2)			0	0	0	0	0	0	0	0	0	0	0	0	
Daily transpiration Loss (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
SEEPAGE															
Downstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Upstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Tailings Stack and Dam Floor (m/day). 1.0 x 10^{-9}m/sec/m^2 (assumed value)		**8.64E-06**	11	11	11	11	11	11	11	11	11	11	11	11	
Total Seepage Outflow (m^3/day)			11	11	11	11	11	11	11	11	11	11	11	11	
RETENTION															
Tailings Output (tpd)			8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Calculated Average Insitu Dry Density of Tailings (t/m^3) and moisture content	1.361	35.0%													
Volume Retained in Tailings (m^3/day)			3,058	3,355	3,058	3,160	3,058	3,160	3,058	3,058	3,160	3,058	3,160	3,058	
TOTAL OUTFLOW-LOSSES FROM TAILINGS DAM (m3/day)			9,178	8,712	8,796	9,279	8,509	7,943	8,128	9,273	10,998	11,850	11,761	10,705	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/day)			5,321	5,184	1,532	-2,357	-2,320	-1,547	-2,065	-3,317	-4,754	-5,418	-3,897	-644	-14,282
BALANCE INFLOW-OUTFLOW/LOSSES (m^3/month)			164,964	146,449	47,498	-70,721	-71,909	-46,413	-64,019	-102,835	-142,626	-167,963	-116,918	-19,953	-444,447
POTENTIAL RETURN WATER TO THE PLANT (if available) m^3/day			5,321.42	5,184.02	1,532.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Potential Water Return per month (m^3)			164,964	146,449	47,498	0	0	0	0	0	0	0	0	0	358,911
Total water shortfall (-) or excess (+) of requirements (m^3/month) assuming excess can be returned			164,964	146,449	47,498	0	0	0	0	0	0	0	0	0	358,911
Make-up water requirements (m3/month)			**15,591**	**34,107**	**133,058**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**1,807,756**
Total water available (m^3/year) assuming excess can be returned =			358,911												

PROJECT : ESMERALDA PROJECT

CLIENT : GRAPHINEX PTY LTD

LOCATION : CROYDON, QUEENSLAND

SUBJECT : PRELIMINARY WATER BALANCE - GTSF Cell 4

Date	15-Feb-26
Job No	Richmond Vanadium Technology
File	ETSF Water Balance.xls
Subject	TSF Water Balance Mtpa
Revision	20250328

INFLOWS		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
		31	28.25	31	30	31	30	31	31	30	31	30	31	
RAINFALL														
Mean Monthly Rainfall (mm) Esmeralda (Station ID 029016) from 1914 to 2023)		211.3	171	109.7	21.3	8.9	8.9	5.8	3.2	5.3	14.8	43.5	103.2	706.9
Average Daily Rainfall (mm)		6.82	5.90	3.54	0.71	0.29	0.30	0.19	0.10	0.18	0.48	1.45	3.33	
Cell 1 TSF Catchment Area (m^2)	**1,272,657**	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	
Runoff Coefficient Tailings		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Catchment Area above the tailngs beaches (m^2)	0	0	0	0	0	0	0	0	0	0	0	0	0	
Runoff Coefficient from catchment area		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Tailings Pool Area (m^2) estimated from pond radius (m)	**80**	20,106	20,106	20,106	20,106	20,106	20,106	20,106	20,106	20,106	20,106	20,106	20,106	
Tailings Running Beaches (m^2) number of active spigots x spacing x length to pond	**1,252,551**	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	1,252,551	
Rainfall Inflow Total Volume (m^3/day)		8,675	7,504	4,504	904	365	378	238	131	225	608	1,845	4,237	894,013
SLURRY WATER (Recovery and Fine Tailings)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total tonnes per month	**3,250,000**	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	270,833	3,250,000
% Solids	**60%**	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60.0%
Tailings Output Solids (tpd)		8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Volume of Water (m3/day)		5,824	6,391	5,824	6,019	5,824	6,019	5,824	5,824	6,019	5,824	6,019	5,824	
Volume of Water (m3/month)		180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	180,556	65,947,917
OTHER WATER INFLOWS														
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Dewatering (m3/month)		0	0	0	0	0	0	0	0	0	0	0	0	
Other Water Inflow Total (m3/day)		0	0	0	0	0	0	0	0	0	0	0	0	
TOTAL INFLOW (m3/day)		**14,499**	**13,896**	**10,328**	**6,922**	**6,190**	**6,396**	**6,062**	**5,956**	**6,243**	**6,432**	**7,864**	**10,061**	
TOTAL INFLOW (m3/month)		**449,468**	**392,552**	**320,166**	**207,663**	**191,882**	**191,882**	**187,937**	**184,628**	**187,301**	**199,391**	**235,916**	**311,894**	**3,060,680**

OUTFLOW-LOSSES FROM TAILINGS DAM			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**TOTAL**
EVAPORATION (from pond and beaches)															
Monthly Evaporation (Mean Daily Croydon (Station ID 029012) data (1972 to 2014)			198	158	186	192	177	150	164	202	246	285	270	248	2,476
Pan Factor			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Adjusted Monthly Dam Evaporation Rate (mm)			149	119	140	144	133	113	123	151	185	214	203	186	
Adjusted Average Daily Evaporation Rate (mm)			5	4	5	5	4	4	4	5	6	7	7	6	
Tailings Pool Area and Running Beaches (m^2)			1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	1,272,657	
Total Evaporation Outflow (m^3/day)			6,109	5,345	5,727	6,109	5,441	4,772	5,059	6,204	7,827	8,781	8,590	7,636	28,324,095
EVAPO-TRANSPIRATION (from drying tailings)															
Evaporation Rate (mm)			198	158	186	192	177	150	164	202	246	285	270	248	
Evapo-transpiration Rate (Pan/3)			66	53	62	64	59	50	55	67	82	95	90	83	
Average Daily Evapo-transpiration Rate (mm)			2	2	2	2	2	2	2	2	3	3	3	3	
Area Transpiring (m^2)			0	0	0	0	0	0	0	0	0	0	0	0	
Daily transpiration Loss (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
SEEPAGE															
Downstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Upstream Embankment (m^3/day)			0	0	0	0	0	0	0	0	0	0	0	0	
Tailings Stack and Dam Floor (m/day). 1.0 x 10^{-9}m/sec/m^2 (assumed value)		**8.64E-06**	11	11	11	11	11	11	11	11	11	11	11	11	
Total Seepage Outflow (m^3/day)			11	11	11	11	11	11	11	11	11	11	11	11	
RETENTION															
Tailings Output (tpd)			8,737	9,587	8,737	9,028	8,737	9,028	8,737	8,737	9,028	8,737	9,028	8,737	
Calculated Average Insitu Dry Density of Tailings (t/m^3) and moisture content	1.361	35.0%													
Volume Retained in Tailings (m^3/day)			3,058	3,355	3,058	3,160	3,058	3,160	3,058	3,058	3,160	3,058	3,160	3,058	
TOTAL OUTFLOW-LOSSES FROM TAILINGS DAM (m3/day)			9,178	8,712	8,796	9,279	8,509	7,943	8,128	9,273	10,998	11,850	11,761	10,705	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/day)			5,321	5,184	1,532	-2,357	-2,320	-1,547	-2,065	-3,317	-4,754	-5,418	-3,897	-644	-14,282
BALANCE INFLOW-OUTFLOW/LOSSES (m^3/month)			164,964	146,449	47,498	-70,721	-71,909	-46,413	-64,019	-102,835	-142,626	-167,963	-116,918	-19,953	-444,447
POTENTIAL RETURN WATER TO THE PLANT (if available) m^3/day			5,321.42	5,184.02	1,532.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Potential Water Return per month (m^3)			164,964	146,449	47,498	0	0	0	0	0	0	0	0	0	358,911
Total water shortfall (-) or excess (+) of requirements (m^3/month) assuming excess can be returned			164,964	146,449	47,498	-70,721	-71,909	-46,413	-64,019	-102,835	-142,626	-167,963	-116,918	-19,953	-444,447
Make-up water requirements (m3/month)			**15,591**	**34,107**	**133,058**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**180,556**	**1,807,756**
Total water available (m^3/year) assuming excess can be returned =			-444,447												