



Works approval number	W6547/2021/1
Works approval holder	FMR Investments Pty Ltd
ACN	009 411 349
Registered business address	Suite 11, 2 Hardy Street SOUTH PERTH WA 6151
DWER file number	DER2021/000217
Duration	10/09/2021 to 09/09/2024
Date of issue	10 September 2021
Premises details	Greenfields Mill Great Eastern Highway COOLGARDIE WA 6429 Part of mining tenement M15/1836 and Lot 102 on Plan 40393

Prescribed premises category description (Schedule 1, <i>Environmental Protection Regulations 1987</i>)	Assessed design capacity
Category 5: Processing or beneficiation of metallic or non-metallic ore: premises on which – (a) Metallic or non-metallic ore is crushed, ground, milled or otherwise processed; (b) Tailings from metallic or non-metallic ore are reprocessed; or (c) Tailings or residue from metallic or non-metallic ore are discharged into a containment cell or dam	Maximum of 1,300,000 tonnes of tailing slurry into TSF4 at Stage 1B

This works approval is granted to the works approval holder, subject to the attached conditions, on 10 September 2021, by:

Lauren Edmands

Manager, Resource Industries

REGULATORY SERVICES

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

Works approval history

Date	Reference number	Summary of changes
10 September 2021	W6547/2021/1	Works approval granted.

Interpretation

In this works approval:

- (a) the words 'including', 'includes' and 'include' in conditions mean "including but not limited to", and similar, as appropriate;
- (b) where any word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning;
- (c) where tables are used in a condition, each row in a table constitutes a separate condition;
- (d) any reference to an Australian or other standard, guideline, or code of practice in this works approval:
 - (i) if dated, refers to that version; and
 - (ii) if not dated, refers to the latest version and therefore may be subject to change over time;
- (e) unless specified otherwise, any reference to a section of an Act refers to that section of the EP Act; and
- (f) unless specified otherwise, all definitions are in accordance with the EP Act.

NOTE: This works approval requires specific conditions to be met but does not provide any implied authorisation for other emissions, discharges, or activities not specified in this works approval.

Works approval conditions

The works approval holder must ensure that the following conditions are complied with:

Construction phase

Infrastructure and equipment

1. The works approval holder must:
 - (a) construct the critical containment infrastructure,
 - (b) in accordance with the corresponding design and construction requirements; and
 - (c) at the corresponding infrastructure location as set out in Table 1.

Table 1: Critical containment infrastructure design and construction requirements

	Infrastructure	Design and construction requirements	Infrastructure location
1.	TSF4 - starter embankment	<ul style="list-style-type: none"> Height of TSF4 starter embankment maximum of 10 m (RL 403 m AHD) TSF starter embankment must be constructed in accordance with: <ul style="list-style-type: none"> Section 6; Drawings PER2020-0003AB no. 01 to 07; and Appendix D (Sections 2.1 to 2.7.2, 2.7.4 and 2.7.5) <p><i>of Tailings Storage Facility No. 4 (TSF) - Greenfields Mill, Coolgardie WA – Design Report for Works approval Application (19/01/2021) as set out in Schedule 3.</i></p> <ul style="list-style-type: none"> The minimum top of embankment freeboard of 300 mm marked. A 4 m wide, 0.75 m deep stormwater diversion channel to be constructed on the northern side of TSF4, designed for stormwater capacity of 9.2 m³/s. Dust to be minimised by using water carts to wet down work areas. 	As shown in Schedule 1, Figure 1 and Figure 2
2.	Pipelines carrying tailing and decant return water	<p>Bunded pipeline fitted with leakage detection system, monitored for pressure and flow changes or drops.</p> <p>In the event of a pipeline failure the affected pipeline will be shut down until repaired.</p> <p>Bunded open trenches sufficient to contain any spill of material resulting from pipeline leaks or bursts during operation.</p>	

Construction of groundwater monitoring wells

- The works approval holder must design, construct, and install groundwater monitoring bores and vibrating wire piezometers in accordance with the requirements specified in Table 2.

Table 2: Infrastructure requirements – groundwater monitoring bores

Infrastructure	Design, construction, and installation requirements	Monitoring well location(s)	Timeframe
Six vibrating wire piezometers (VWP)	<p>VWP's are to be installed as part of the starter embankment constructions.</p> <p>VWPs must be installed in three pairs, in a trench 0.5 m wide and 0.3 m deep, with one VWP installed at nominally 10 m away from upstream toe of TSF4 Stage 1A embankment, and another VWP at 10 m inside the upstream toe of TSF4 Stage 1A embankment.</p> <p>Bentonite collars are to be fitted to reduce seepage pathways.</p>	As depicted in Schedule 1, Figure 3 and Schedule 2, Table 8	Must be installed and determined to be operational by no later than 3 calendar months prior to the commencement of time limited operations under condition 7.
Three groundwater monitoring bores	<p><u>Well design and construction:</u></p> <p>Designed and constructed in accordance with <i>ASTM D5092/D5092M-16: Standard practice for design and installation of groundwater monitoring bores</i>.</p> <p>Well screens must target the part, or parts, of the aquifer most likely to be affected by contamination¹. Where temporary/seasonal perched features are present, wells must be nested, and the perched features individually screened.</p> <p><u>Logging of borehole:</u></p> <p>Soil samples must be collected and logged during the installation of the monitoring wells.</p> <p>A record of the geology encountered during drilling must be described and classified in accordance with the Australian Standard Geotechnical Site Investigations AS1726.</p> <p>Any observations of staining / odours or other indications of contamination must be included in the bore log.</p> <p><u>Well construction log:</u></p> <p>Well construction details must be documented within a well construction log to demonstrate compliance with <i>ASTM D5092/D5092M-16</i>. The construction logs shall include elevations of the top of casing position to be used as the reference point for water-level measurements, and the elevations of the ground surface protective installations.</p>	As depicted in Schedule 1, Figure 3 and Schedule 2, Table 8	Must be constructed, developed (purged) and determined to be operational by no later than 3 calendar months prior to the commencement of time limited operations under condition 7.

Infrastructure	Design, construction, and installation requirements	Monitoring well location(s)	Timeframe
	<p><u>Well development:</u></p> <p>All installed monitoring wells must be developed after drilling to remove fine sand, silt, clay, and any drilling mud residues from around the well screen to ensure the hydraulic functioning of the well. A detailed record should be kept of well development activities and included in the well construction log.</p>		
	<p><u>Installation survey:</u></p> <p>The vertical (top of casing) and horizontal position of each monitoring well must be surveyed and subsequently mapped by a suitably qualified surveyor.</p>		
	<p><u>Well network map:</u></p> <p>A well location map (using aerial image overlay) must be prepared and include the location of all monitoring wells in the monitoring network and their respective identification numbers.</p>		

Note 1: refer to Section 8 of Schedule B2 of the *Assessment of Site Contamination NEPM* for guidance on well screen depth and length.

3. The works approval holder must, within 60 calendar days of the monitoring bores being constructed, submit to the CEO a bore construction report evidencing compliance with the requirements of condition 2.

Compliance reporting

4. The works approval holder must within 60 calendar days of the Critical Containment Infrastructure identified in condition 1 being constructed:
 - (a) Undertake an audit of their compliance with the requirements of condition 1, and;
 - (b) Prepare and submit to the CEO a Critical Containment Infrastructure Report on the compliance.
5. The Critical Containment Infrastructure Report required by condition 4 must include as a minimum the following:
 - (a) certification by a suitably qualified geotechnical engineer that each item of critical containment infrastructure or component thereof, as specified in condition 1, has being built and installed in accordance with the requirements specified in condition 1;
 - (b) as constructed plans and a detailed site plan showing the location and dimensions for each item of critical containment infrastructure or component thereof, as specified in condition 1;
 - (c) photographic evidence of the installation of the infrastructure;
 - (d) be signed by a person authorised to represent the works approval holder and contains the printed name and positions of that person; and

- (e) include monitoring data indicating the baseline ambient environmental conditions at the premises prior to and immediately following construction of TSF4.
6. The monitoring of the baseline ambient environmental conditions required under condition 5(e) must be undertaken in accordance with the requirement of Table 3.

Table 3: Determination of baseline ambient environmental conditions

Parameter	Monitoring location	Unit	Frequency	Averaging period	Method	
					Sampling	Analysis
SWL ¹	All proposed monitoring bores/VWPs as established under condition 2 of this works approval	mbgl	Prior to the commencement of time limited operations for TSF4	Spot sample	In accordance with AS/NZS 5667.11	In accordance with AS/NZS 5667.1
pH ²		-				
EC ²		mS/cm				
TDS		mg/L				
CN-Free						
WAD-CN						
CN-Total						

Note 1: SWL must be determined before the collection of any other water samples

Note 2: In-field non-NATA accredited analysis is permitted

Time limited operations

Commencement and duration

7. The works approval holder may only commence time limited operations for an item of critical containment infrastructure identified in condition 1 where the CEO has notified the works approval holder that the Critical Containment Infrastructure Report for that item of infrastructure as required by condition 4 meets the requirements of that conditions.
8. The works approval holder may conduct time limited operations for an item of infrastructure specified in condition 1 (as applicable):
- for a period not exceeding 180 calendar days from the day the works approval holder meets the requirements of condition 7 for that item of infrastructure: or
 - until such time as a licence amendment for that item of infrastructure is granted in accordance with Part V of the *Environmental Protection Act 1986*, if one is granted before the end of the period specified in condition 8(a).

Time limited operations requirements and emission limits

9. During time limited operations, the works approval holder must ensure that the premises infrastructure and equipment listed in Table 4, and located at the corresponding infrastructure location, is maintained, and operated in accordance with the corresponding operational requirements set out in Table 4.

Table 4: Infrastructure and equipment requirements during time limited operations

Site infrastructure and equipment	Operational requirements	Infrastructure location
TSF4	Minimum freeboard of 300 mm. Decant pond is to be maintained so that it is always a minimum of 100 m away from the perimeter	As located in Schedule 1, Figure 1 and

Site infrastructure and equipment	Operational requirements	Infrastructure location
	<p>embankment.</p> <p>Decant pond of no more than 15% of surface area of paddock during normal operating hours.</p> <p>The minimum capacity of the water recovery system should be not less than 120 tph, including the additional capacity to recover water from a 1:100 year. AEP 72-hour storm event.</p> <p>Underdrainage.</p>	Figure 2
Pipelines carrying tailings and decant return water	<p>Bunded pipeline fitted with leakage detection system, monitored for pressure and flow changes or drops.</p> <p>In the event of a pipeline failure the affected pipeline will be shut down until repaired.</p> <p>Bunded open trenches sufficient to contain any spill of material resulting from pipeline leaks or bursts during operation.</p>	

Time limited operations – authorised discharge points for emissions

10. During time limited operations, the works approval holder must ensure that the emission(s) specified in Table 5, are discharged from the corresponding discharge point(s) and at the corresponding discharge point location(s).

Table 5: Authorised discharge points

Emission	Discharge point	
Tailings	TSF3	As located in Schedule 1, Figure 1
	TSF4	

Monitoring during time limited operations

11. The works approval holder must monitor the groundwater during time limited operations for concentrations of the identified parameters in accordance with Table 6.

Table 6: Monitoring of ambient concentrations during time limited operations.

Parameter	Monitoring location	Unit	Frequency	Averaging period	Method	
					Sampling	Analysis
SWL ¹	All proposed monitoring bores/VWPs as established under condition 2 of this works approval.	mbgl	Quarterly	Spot sample	In accordance with AS/NZS 5667.11	In accordance with AS/NZS 5667.1
pH ²		-				
EC ²		mS/cm				
TDS		mg/L				
CN-Free						
WAD-CN						
CN-Total						

Note 1: SWL must be determined before the collection of any other water samples

Note 2: In-field non-NATA accredited analysis is permitted

- 12.** The works approval holder must record the results of all monitoring activity required by condition 11.

Compliance reporting

- 13.** The works approval holder must submit to the CEO a report on the time limited operations within 60 calendar days of the completion date of time limited operations, or 60 calendar days before the expiration date of the works approval, whichever is sooner.
- 14.** The works approval holder must ensure the report required by condition 13 includes the following:
- (a) a summary of the time limited operations, including timeframes and amount of tailing discharged;
 - (b) a summary of monitoring results obtained during time limited operations under condition 11
 - (c) a summary of the environmental performance of each item of infrastructure or equipment as constructed or installed, which at minimum includes records detailing the:
 - (i) environmental performance of the tailing delivery and decant water pipelines including spigots for discharge of tailings into the TSF paddock; and
 - (ii) performance of the underdrainage systems.

Records and reporting (general)

- 15.** The works approval holder must record the following information in relation to complaints received by the works approval holder (whether received directly from a complainant or forwarded to them by the Department or another party) about any alleged emissions from the premises:
- (a) the name and contact details of the complainant, (if provided);
 - (b) the time and date of the complaint;
 - (c) the complete details of the complaint and any other concerns or other issues raised; and
 - (d) the complete details and dates of any action taken by the works approval holder to investigate or respond to any complaint.
- 16.** The works approval holder must maintain accurate and auditable books including the following records, information, reports, and data required by this works approval:
- (a) the works conducted in accordance with condition 1;
 - (b) any maintenance of infrastructure that is performed while complying with condition 9;
 - (c) monitoring programmes undertaken in accordance with conditions 6 and 11; and
 - (d) complaints received under condition 15.
- 17.** The books specified under condition 16 must:
- (a) be legible;
 - (b) if amended, be amended in such a way that the original version(s) and any subsequent amendments remain legible and are capable of retrieval;

- (c) be retained by the works approval holder for the duration of the works approval;
and
- (d) be available to be produced to an inspector or the CEO as required.

Definitions

In this works approval, the terms in Table 7 have the meanings defined.

Table 7: Definitions

Term	Definition
AEP	means annual exceedance probability
AHD	Means Australia Height Datum
books	has the same meaning given to that term under the EP Act.
CEO	means Chief Executive Officer. CEO for the purposes of notification means: Director General Department administering the <i>Environmental Protection Act 1986</i> Locked Bag 10 Joondalup DC WA 6919 info@dwer.wa.gov.au
critical containment infrastructure	means the items of infrastructure listed in condition T2.
Critical Containment Infrastructure Report	means a report to satisfy the CEO that works of critical containment infrastructure have been constructed in accordance with the works approval.
Department	means the department established under section 35 of the <i>Public Sector Management Act 1994</i> and designated as responsible for the administration of Part V Division 3 of the EP Act.
discharge	has the same meaning given to that term under the EP Act.
EC	means electrical conductivity, a measure of salinity.
emission	has the same meaning given to that term under the EP Act.
EP Act	<i>Environmental Protection Act 1986</i> (WA).
EP Regulations	<i>Environmental Protection Regulations 1987</i> (WA).
freeboard	is the distance between the maximum water surface elevations and the top of retaining banks or structure at their lowest point.
mbgl	means metres below ground level
mS/cm	means milliSiemens per centimeter
Mtpa	means million tonnes per annum

Term	Definition
premises	the premises to which this licence applies, as specified at the front of this licence and as shown on the premises map (Figure 1) in Schedule 1 to this works approval.
prescribed premises	has the same meaning given to that term under the EP Act.
quarterly	means the 4 inclusive periods from 1 January to 31 March, 1 April to 30 June, 1 July to 30 September, 1 October to 31 December in the same year.
RL	means reduced levels, which is a height above (or below) a nominated datum.
suitably qualified geotechnical engineer	means a person who: <ul style="list-style-type: none"> • holds a Bachelor of Engineering recognised by the Australian Institute of Engineers; and • has a minimum of five years of experience working in geotechnical engineering, including experience in the design of tailing storage facilities.
suitably qualified surveyor	means a person who is licenced through the Land Surveyors Licencing Board of Western Australia.
SWL	means standing water level.
TDS	means total dissolved solids
time limited operations	refers to the operation of the infrastructure and equipment identified under this works approval that is authorised for that purpose, subject to the relevant conditions.
tph	means tonnes per hour
VMP	means vibrating wire piezometer
WAD	means weak acid dissociable
works approval	refers to this document, which evidences the grant of the works approval by the CEO under section 54 of the EP Act, subject to the conditions.
works approval holder	refers to the occupier of the premises being the person to whom this works approval has been granted, as specified at the front of this works approval.

END OF CONDITIONS

Schedule 1: Maps

Premises map

The boundary of the prescribed premises is shown in the map below (Figure 3).

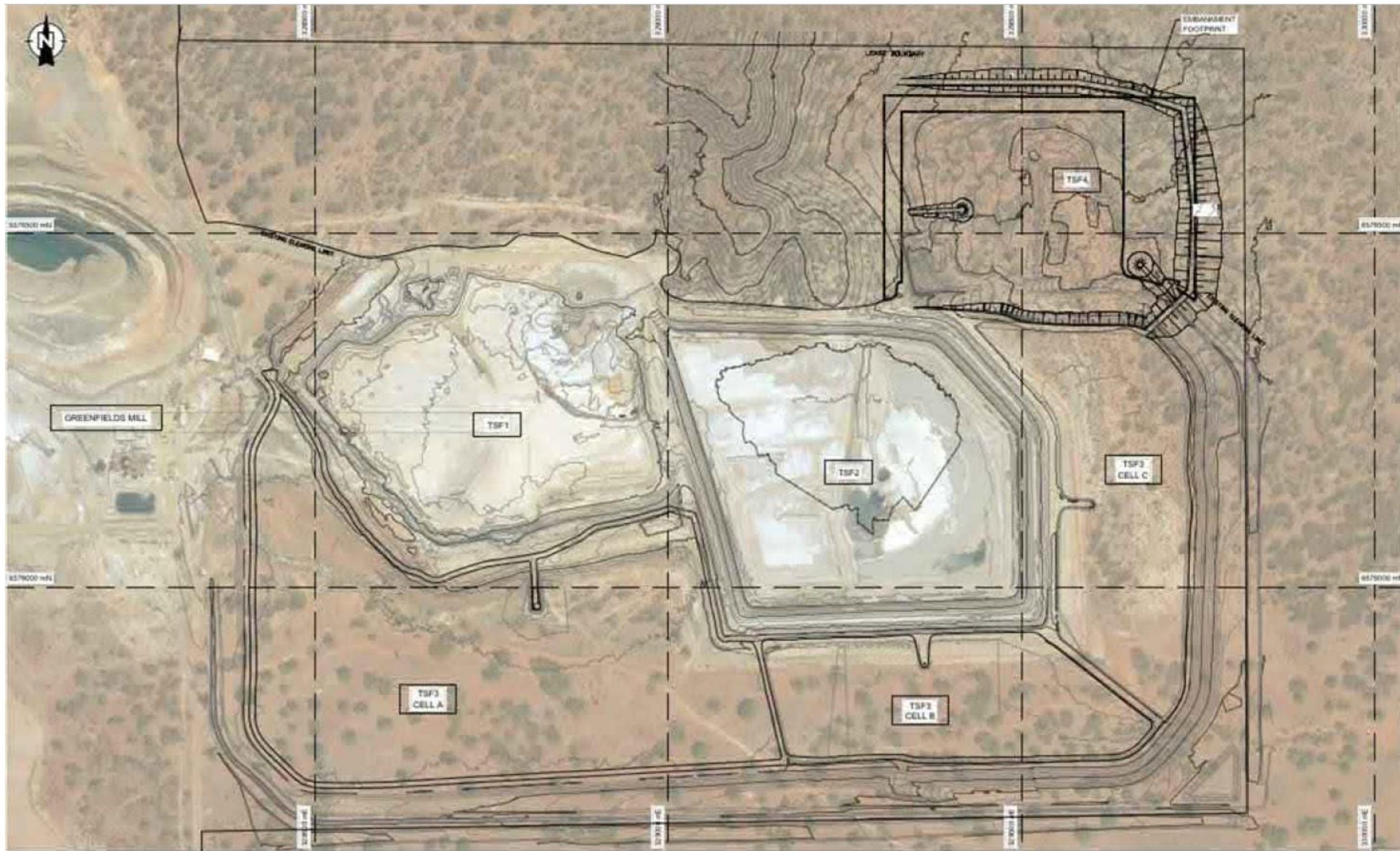


Figure 1: Map of the boundary of the prescribed premises

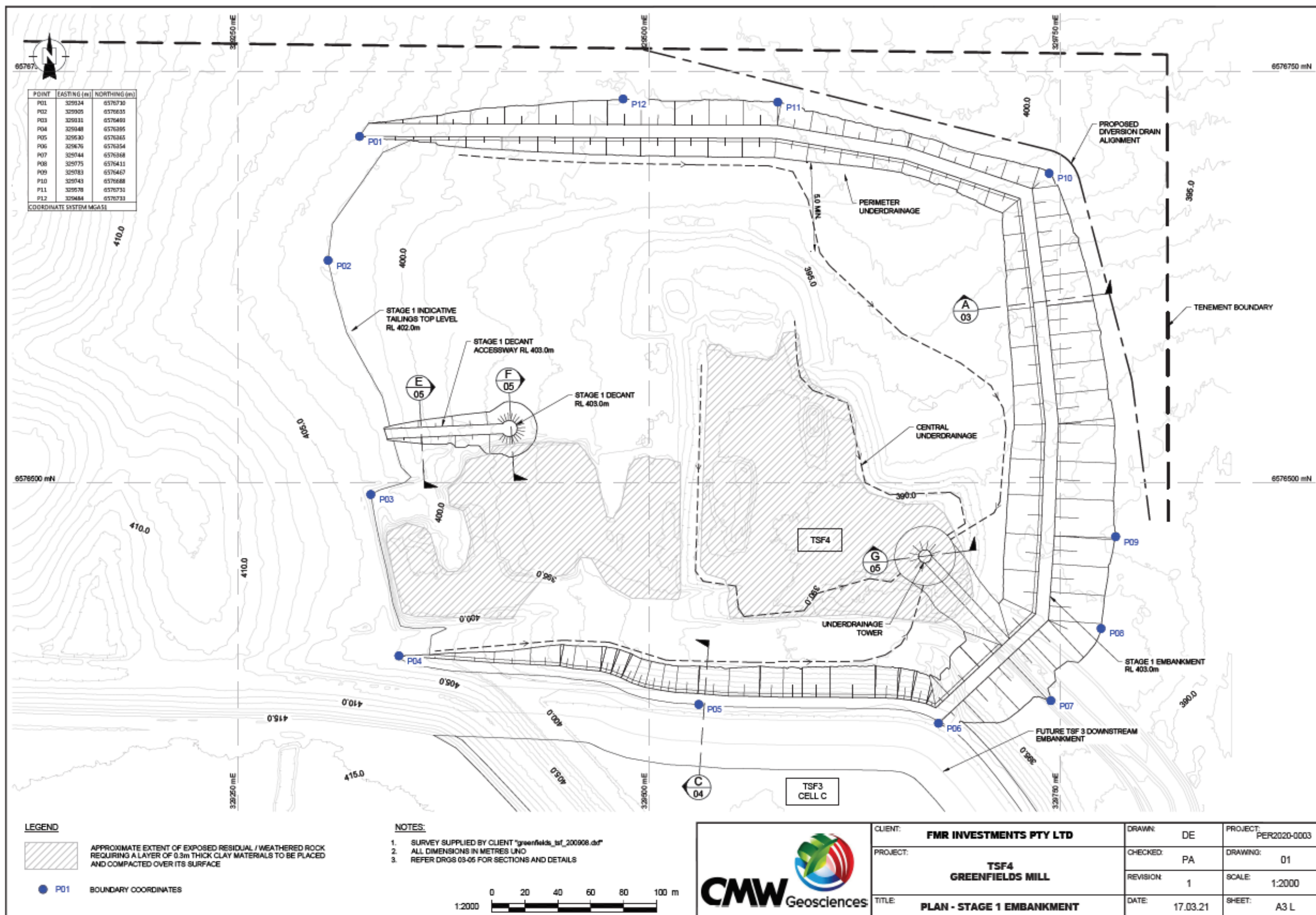


Figure 2: Premises layout

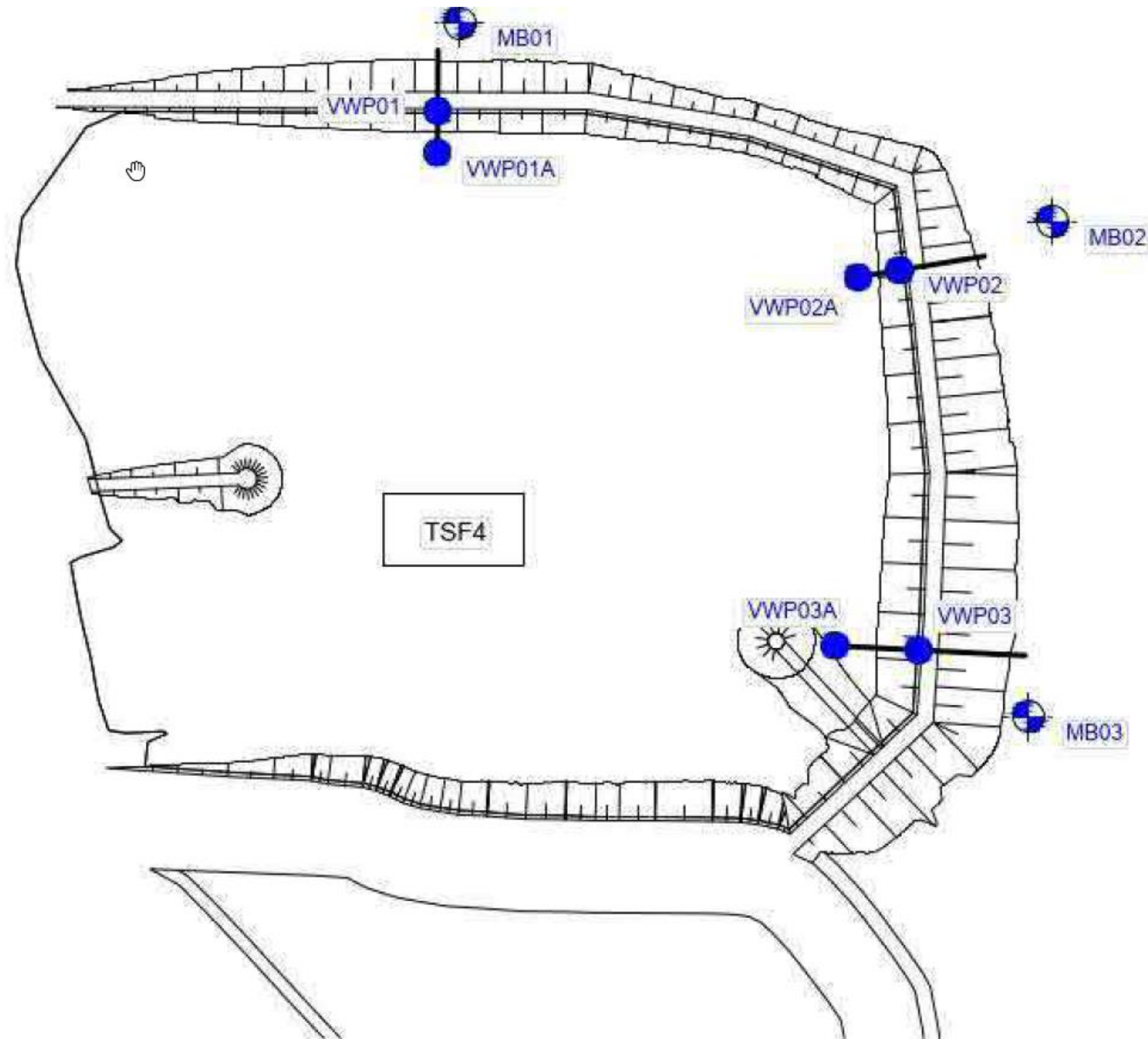


Figure 3: Monitoring bore and vibrating wire piezometer (VWP) locations

Schedule 2: TSF4 VWP and MB locations

The position of the proposed monitoring bores (MBs) and vibrating wire piezometers (VWPs) are detailed in Figure 3 and Table 8.

Table 8: TSF4 VWPs and MBs locations

Instrument number	Easting (m)	Northing (m)	RL (m AHD, approx.)
MB01	329506	6576709	397.6
MB02	329506	6576689	397.3
MB03	329726	6576632	395.7
VWP01	329706	6576629	396.4
VWP01A	329735	6576451	392.2
VWP02	329696	6576453	390.1
VWP02A	329516	6576751	398.2
VWP03	329799	6576656	395.3
VWP03A	329788	6576419	392.2

Schedule 3: TSF4 design concept, drawings, and construction specification

6 DESIGN CONCEPT

6.1 Plans and sections

The design concept for TSF4, to designed level RL 413 m AHD, is presented on Drawings PER2020-0003AB no. 01 to 07 (refer to Appendix C). The design concept is based on the following works undertaken by CMW:

- Geotechnical Investigation
- Laboratory testing
- Stability and seepage analyses
- Dam break study
- General design considerations
- Construction specification.

6.2 Construction method

6.2.1 General

TSF4 will be a paddock facility constructed at the site partly occupied by previous borrow areas. It will be built to the north and abutting TSF3 Cell C, and to the east of a low ridge. The starter embankment comprises two stages, Stage 1A designed to a crest level of RL 402.0 m AHD, and Stage 1B to RL 403.0 m AHD. Stage 1A will utilise compacted mine waste in its downstream zone and compacted clay on the upstream zone. Stage 1B will be formed completely of compacted clay.

The embankment raises will be constructed using the upstream construction method by 4 x 2.5 m lifts, to a nominal crest level of RL 413.0 m AHD. They will be formed on top of both the existing embankment and on the adjacent dried tailings beach. The embankment raises will utilise dried tailings sourced from TSF4, TSF2 and TSF3.

A decant accessway and central decant structure will be constructed. The decant and accessway will be raised along with the perimeter embankments.

An underdrainage system comprising slotted pipe underdrainage lines grading to an underdrainage sump near the southeast corner of TSF4 will be constructed. The sump will comprise a tower constructed using concrete pipes accessed from the perimeter embankment by an earth-fill accessway.

The embankment and decant accessway crests will be sheeted with a nominal 100 mm thickness of wearing course material obtained from a designated location.

Safety windrows will be utilised during construction and on the final prepared crest. Gaps in the windrows will be placed at close to facilitate the shedding of rainfall runoff.

6.2.2 Specifications

Construction Specification, Scope of Work and Technical Specification including for ancillary works is presented in Appendix D.

6.3 Area

TSF4 will have a footprint area of approximately 23.1 ha, and a storage area of approximately 16.1 ha at the designed level of RL 413 m AHD.

6.4 Height

TSF4 will have the maximum embankment height of approximately 21 m at the southeast, where the lowest natural ground levels (NGL) are approximately RL 392 m AHD.

The highest embankment height along the northern embankment will be approximately 16 m, occurring adjacent to the valley feature to the north of TSF4.

6.5 Capacity

TSF4 capacity has been estimated based on the following parameters:

- Minimum embankment freeboard: 0.7 m
- Tailings production: 1.0 Mtpa (dry tonnes)
- Tailings dry density: 1.4 t/m³
- Tailings beach slope: 1 %

Based on the above parameters TSF4 will provide approximately 41 months storage capacity (excluding TSF3). The estimated storage capacity is presented in Table 4.

Table 4 - Estimated TSF4 Storage Capacity			
Stage	Crest RL (m AHD)	Estimated storage capacity (m ³)	Estimated storage capacity (t)
1A	402.0	814,300	1,139,900
1B	403.0	117,400	164,400
2	405.5	385,000	539,000
3	408.0	288,300	403,600
4	410.5	317,500	444,500
5	413.0	522,400	731,300
Total			Approx. 3.42 Mt

TSF4 will be operated in conjunction with TSF3. The total storage capacity of TSF3 (remaining) and TSF4 is 10.1 Mt and the approximate storage life will be 10 years.

6.6 Batter angles

TSF4 starter embankment and raises will have design slopes of 1(V):2(H) upstream and 1(V):3(H) downstream. The decant and underdrainage causeway will have a design slope of 1(V):1.5(H). The decant filter rock will have a design slope of 1(V):1 (H).

6.7 Water recovery system

Liberated tailings slurry water and surface water is removed from the TSF via a pumped decant structure. Recovered water will be returned to the Process Plant.

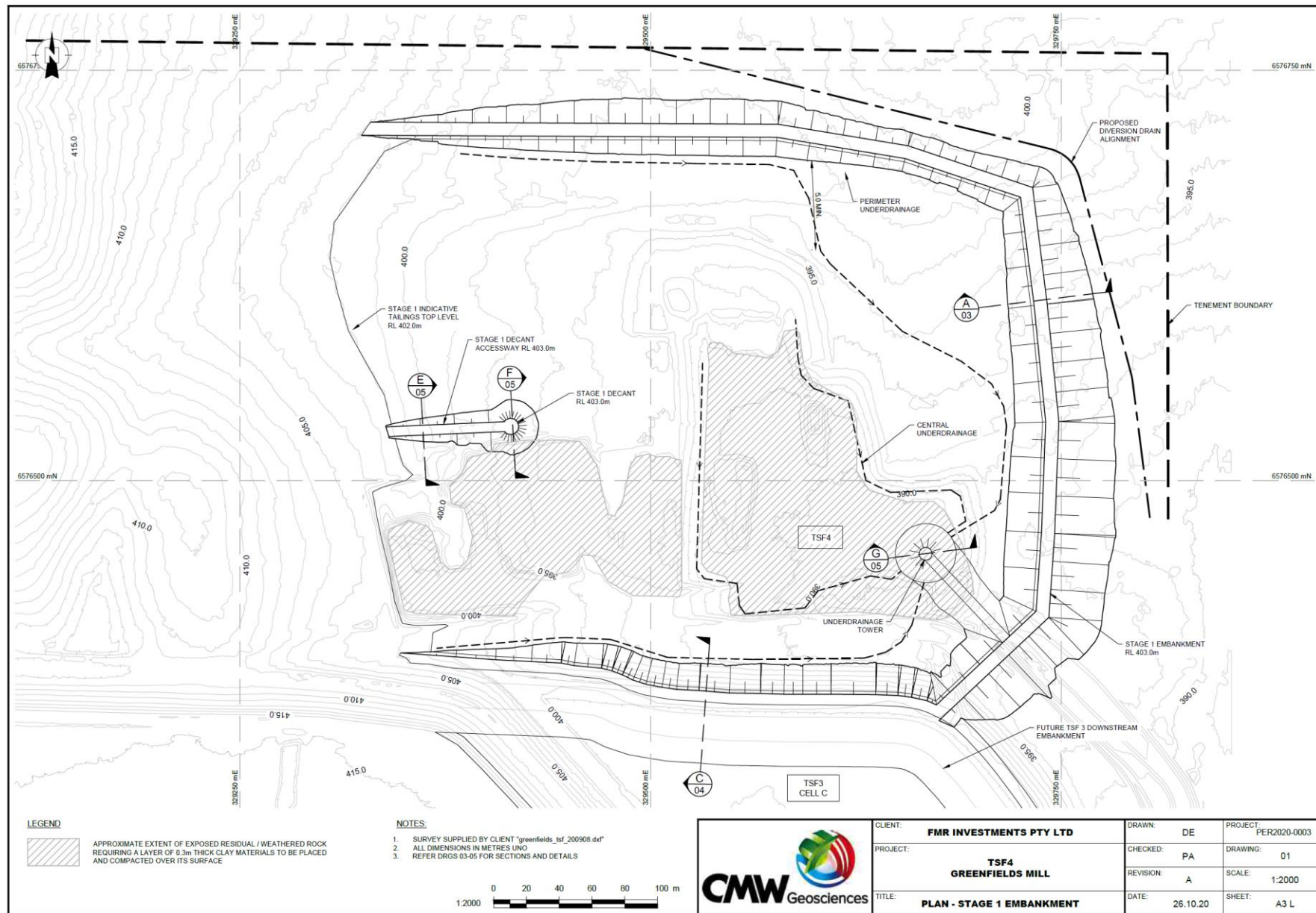
6.8 Liners

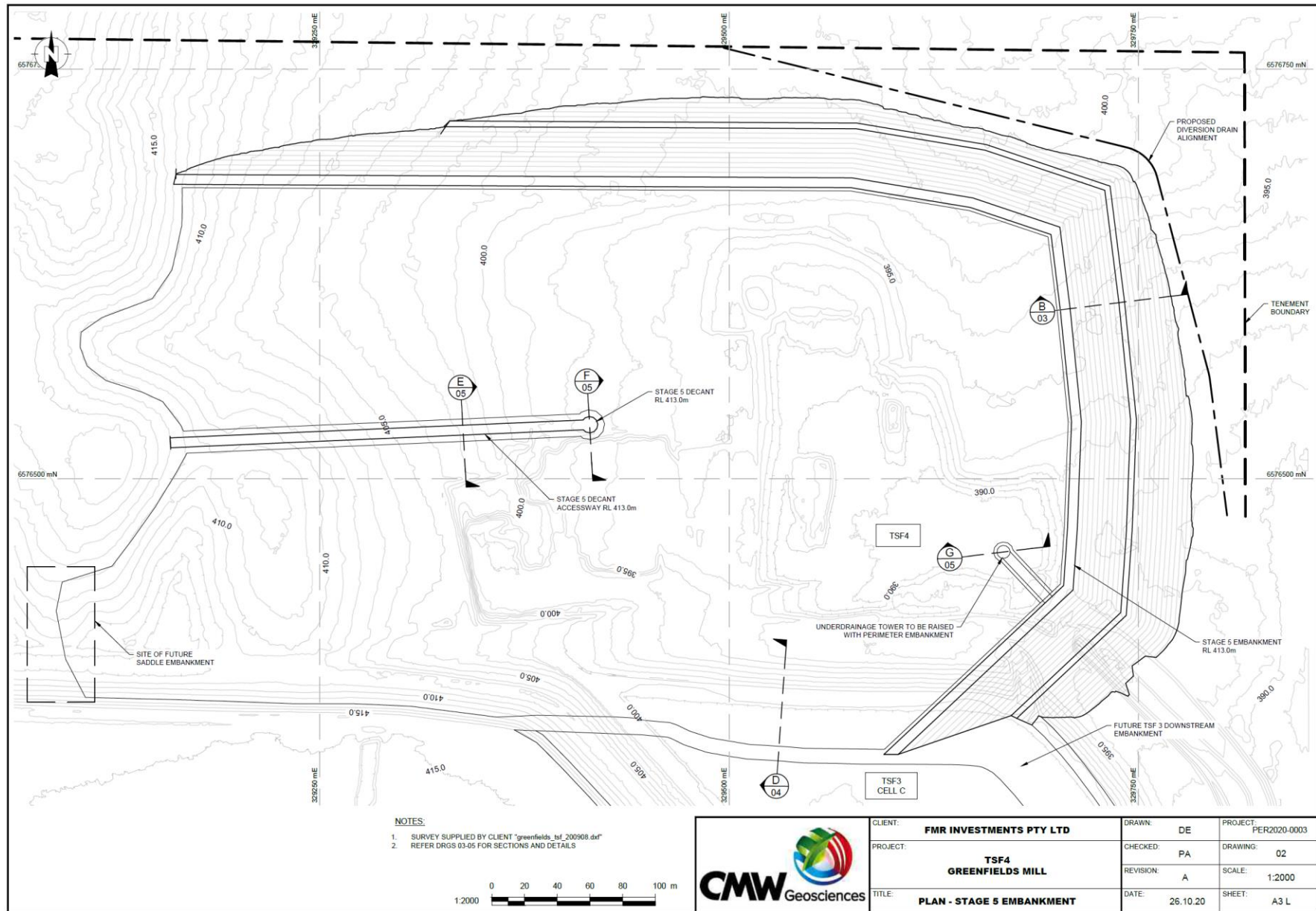
Following site stripping, both the embankment footprint and storage basin areas of TSF4 will be compacted to a depth 0.3 m. Where clay is absent, an imported compacted clay liner, 0.3m thick will be constructed.

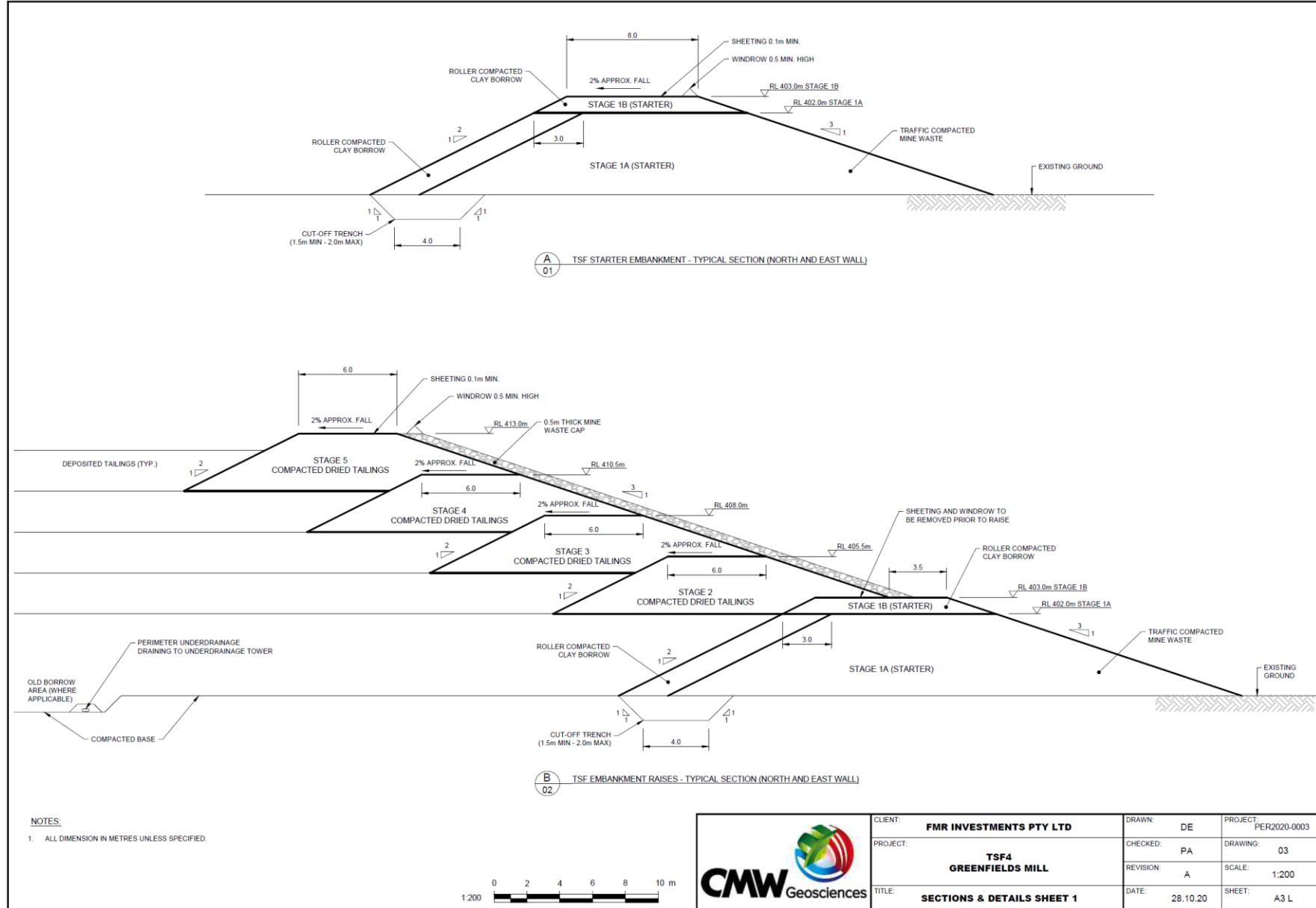
6.9 Seepage collection

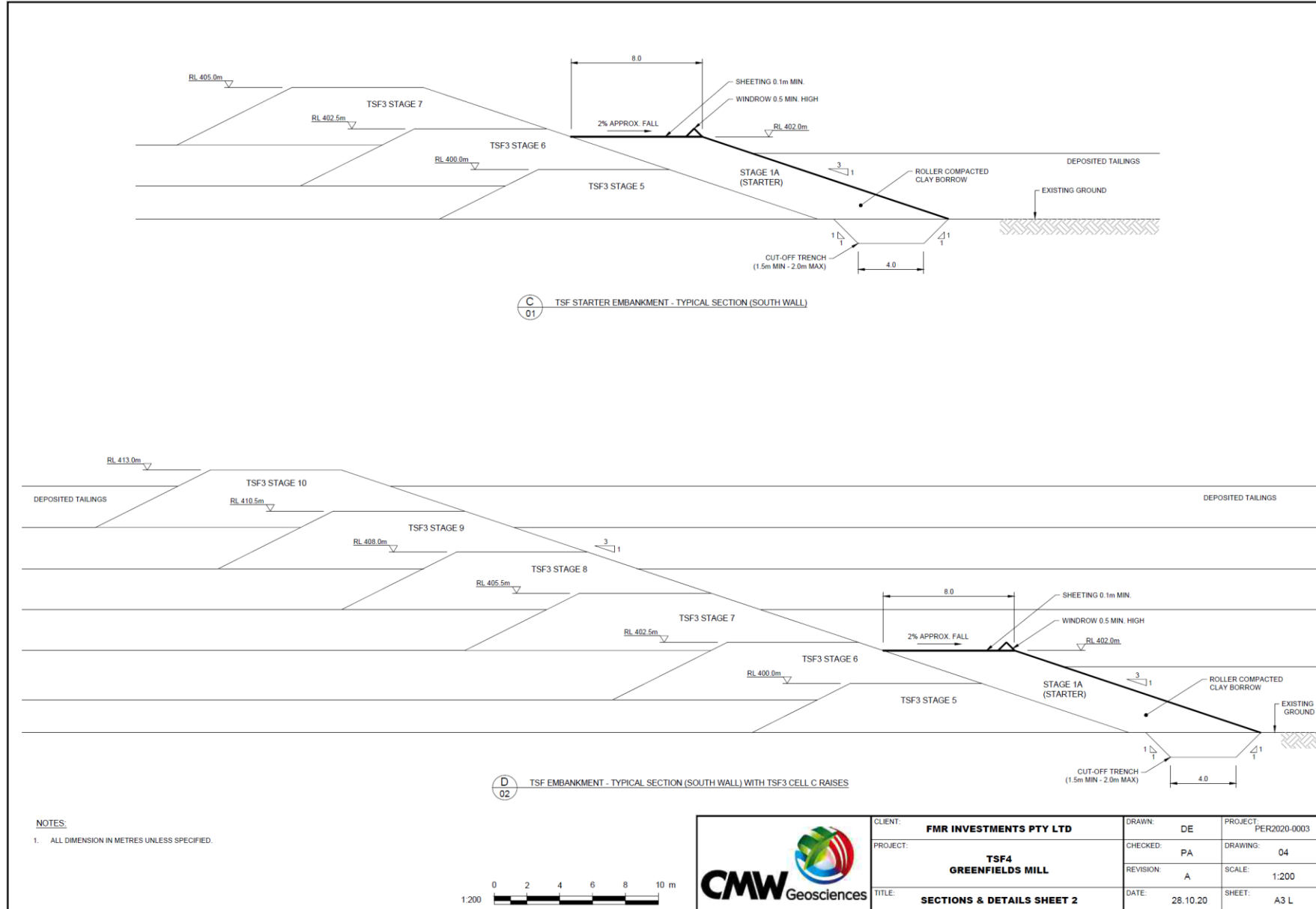
Seepage management measures will include:

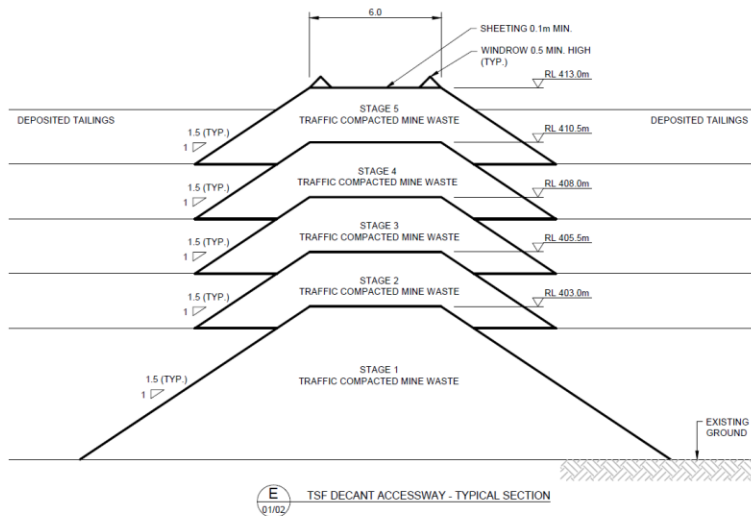
- An underdrainage system comprising underdrainage lines grading to a sump within a concrete tower.
- Embankment construction using compacted clay or clayey mine waste in the upstream zone.
- A compacted clay liner over the foundation of the basin of the TSF.
- Removal of supernatant (surface) water from the facility via a decant system.



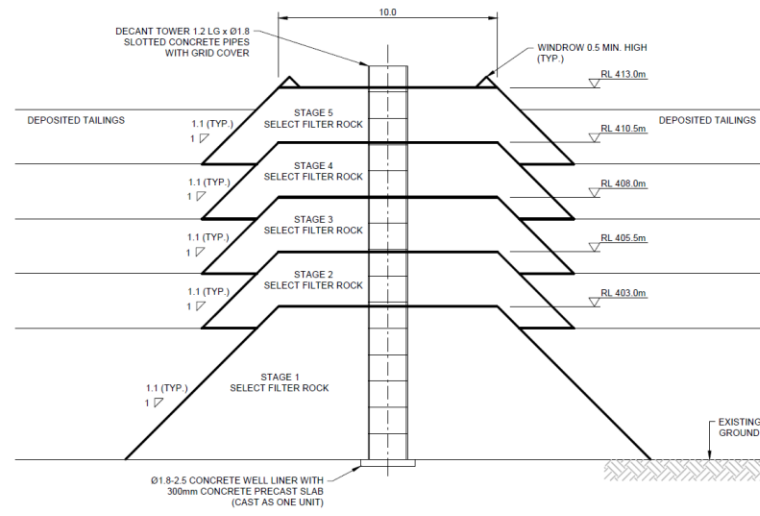




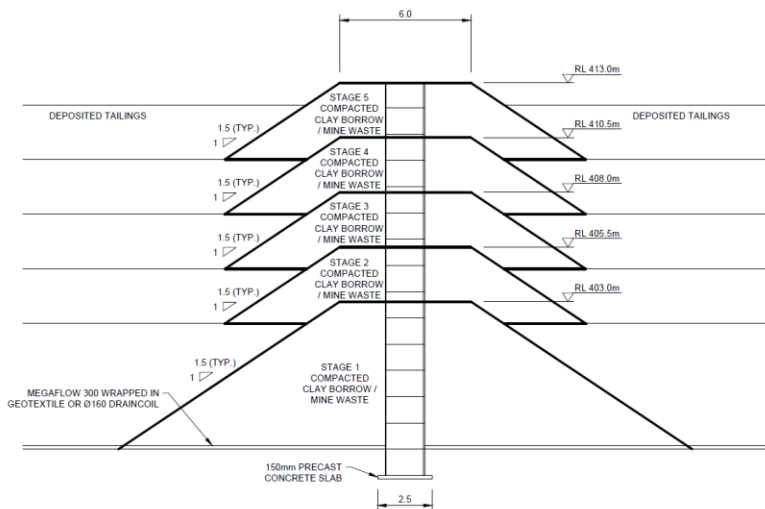




E TSF DECANT ACCESSWAY - TYPICAL SECTION
Q1/02




F TSF DECANT - TYPICAL SECTION
Q1/02

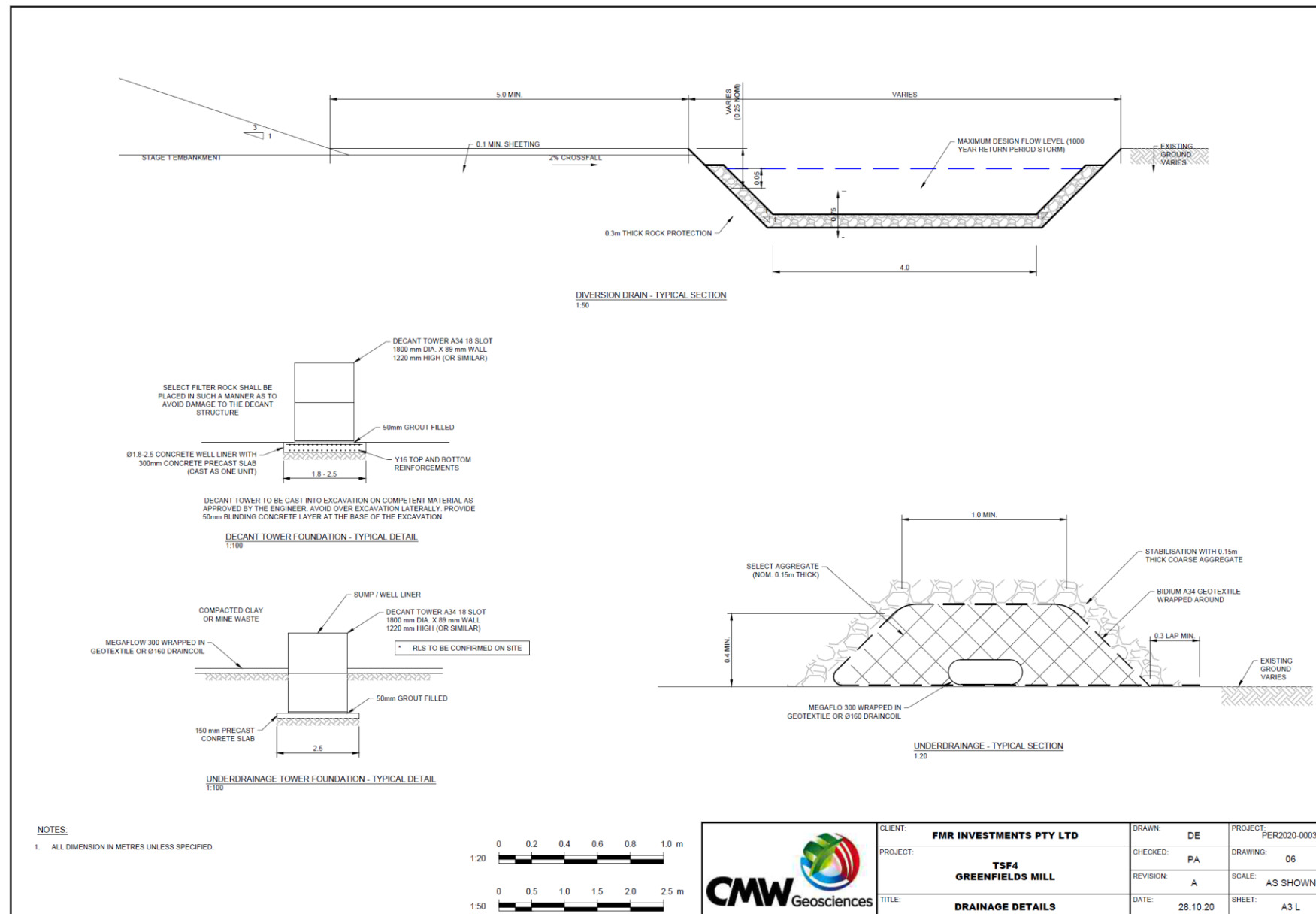


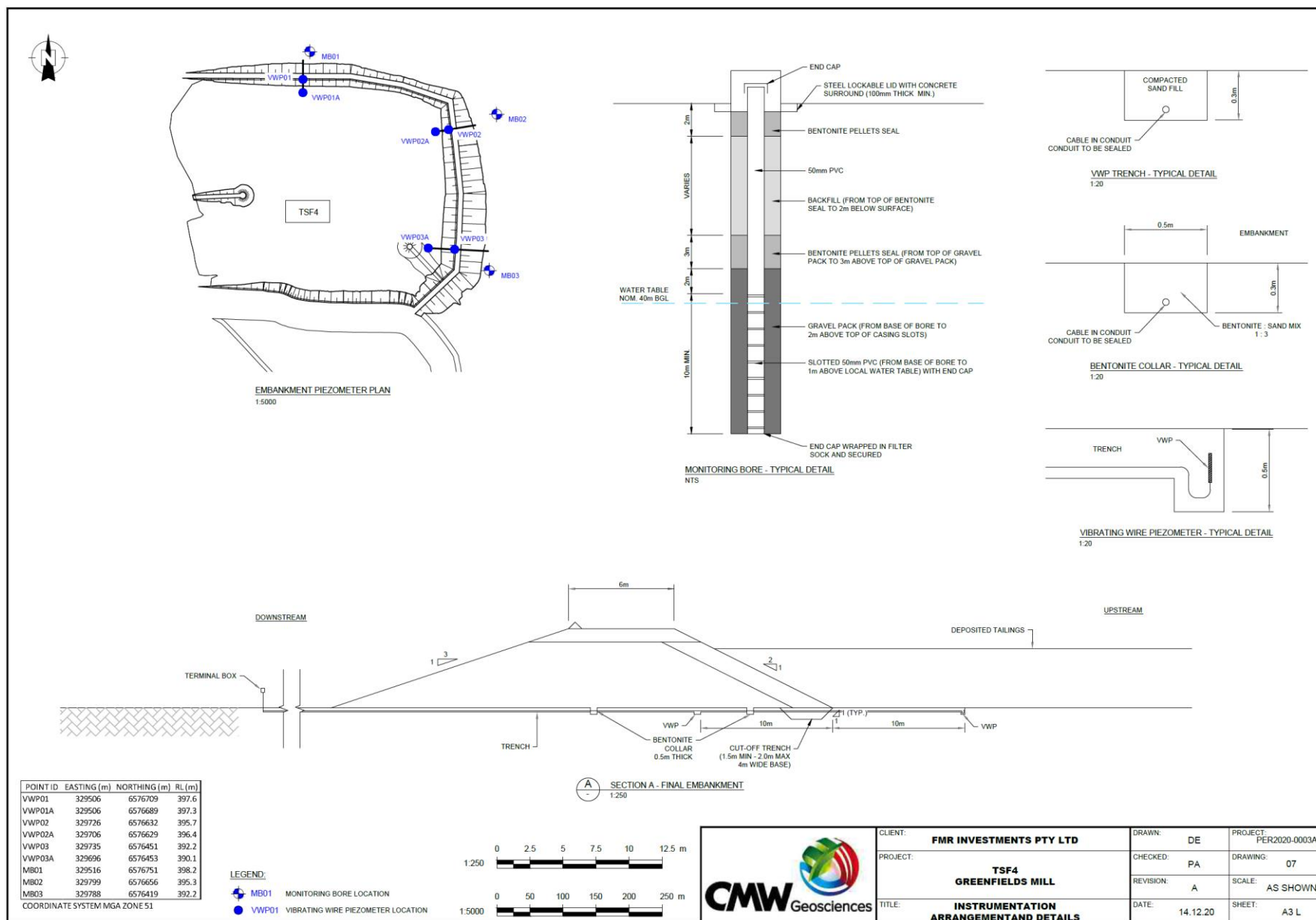
G UNDERDRAINAGE TOWER - TYPICAL SECTION
Q1/02

NOTES:
1. ALL DIMENSION IN METRES UNLESS SPECIFIED.



	CLIENT:	FMR INVESTMENTS PTY LTD		
	PROJECT:	TSF4 GREENFIELDS MILL		
	TITLE:	SECTIONS & DETAILS SHEET 3		
	DRAWN:	DE	PROJECT:	PER2020-0003
	CHECKED:	PA	DRAWING:	05
	REVISION:	A	SCALE:	AS SHOWN
	DATE:	28.10.20	SHEET:	A3 L





2 DESCRIPTION OF WORK – SPECIFIC

All works shall be constructed complete and operational except as specifically excluded and shall include all necessary auxiliary works, accessories and the incorporation of all miscellaneous 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.

This Document shall include but is not necessarily limited to the following sections.

2.1 General

The Contractor shall:

- Attend a site induction before the commencement of works if personnel have not already attended one in the last six (6) months at the Greenfields Mill;
- Prepare job safety assessments for each construction task and submit to the Owner/Principal for approval prior to commencement of tasks;
- Carry out all works indicated or implied in the Design Drawings or in this document;
- Supply all labour, plant and materials (except those indicated as being supplied by the Owner/Principal necessary for the completion of the works. A list of the fleet to be used in TSF construction is to be provided to the Owner/Principal;
- Maintain all works as required by the Contract documents and for the period stated therein;
- Develop a construction program to be agreed by the Owner/Principal for the construction of TSF4 such that any interaction with operators and other contractors can be assessed and program. The construction program shall be provided at the time of tender and shall be in Microsoft Project format. The construction program shall be reviewed during construction with the Owner/Principal at not less than fortnightly intervals. Where changes to the program are requested by the Contractor, these shall only be implemented with the consent of the Owner/Principal. Processing production schedules require adherence to the agreed construction program. Time shall be of the essence in this contract;
- Ensure the location of the piezometer infrastructure on the embankments is clearly identified and marked prior to the commencement of any works. All piezometers shall be protected against damage. If damage occurs, the contractor will be required to make good any damage;
- Construct to the minimum lines and grades shown on the Drawings or as required by the Owner/Principals Representative as work progresses.

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

The Contractor shall accept reasonable delays due to inspection and checking of any part of the works to determine grades and levels and shall allow for such short term interruptions within the Construction Schedule.

2.2 Survey

The Contractor shall:

- Perform all ground surveys using conventional and agreed surveying techniques;
- Survey and setting out the works based on the datum points provided;
- Be responsible for the protection of all permanent and temporary beacons/benchmarks;
- Be wholly responsible for the setting out of his works in accordance with the terms of the SoW. Although the Owner/Principal'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;
- Carry out surveys before the commencement of the item of work and at the completion of the item of work;
- Carry out a post-construction survey by a licensed surveyor of the works to verify that the works were constructed within the specified tolerances and submit to the Owner/Principal's Representatives;
- Submit his survey data and calculations to the Owner/Principal's Representatives; and
- Ensure initial and/or final surveys are undertaken and approved by the Owner/Principal's Representatives 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/Principal's Representatives and suitable time must be given to the Owner/Principal's Representatives to allow such calculations to be checked and approved prior to the works being covered or removed.

The Owner/Principal's Representative may undertake their own survey of any item, either in conjunction with the Contractor or separately.

The Contractor and Owner/Principal's Representative shall 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 shall be documented such that the matter can be later decided without disruption to the construction programme.

2.3 Construction Tolerances

The embankments shall be constructed to the lines, grades, dimensions and details shown on the Design Drawings.

The embankment foundation footprint shall be surveyed following stripping, prior to the placement of any fill materials. Finished work shall comply with the tolerances set out in Table 1.

The maximum permissible horizontal deviation from the finished lines or zone boundaries shall be -0 m to +0.5 m. Vertical deviation shall be -0 m to +0.2 m, provided no abrupt changes in slope or level are present on any finished surface. Payment shall, however, be to the design lines, minimum requirements, excluding tolerances.

Table 1 - Construction Tolerances			
Construction item	Tolerance item		Tolerance ¹
Perimeter and dividing embankments	Crest level		+ 200 mm, -0 mm
	Crest width		+ 500 mm, -0 mm
	Slopes ²	Upstream	+ or -10% of specified
		Downstream	+ or -2% of specified
Decant accessway	Crest level		+ 200 mm, -0 mm
	Crest width		+ 500 mm, -0 mm
	Side slopes ²		+ or -5% of specified

Notes:

1. *work. They shall mean that if a dimension is checked at a particular location, the work is acceptable provided that the dimension departs from that shown on the Drawings by no more than the amount shown above. They shall not be read to imply any basis for payment other than the design dimensions or levels are shown on the Drawings, upon which all quantities for payment purposes shall be calculated. The average dimension shall be not less than that shown on the Drawings.*
2. *Tolerances on slopes assume that slopes are specified in the format 1 vertical: X horizontal. The tolerance shall apply to X.*

Measurement for payment of all embankment fill material shall be made for the compacted material, measured in place and only to the lines and grades required (excluding tolerances), measured in either metres (m), square metres (m²) or cubic metres (m³) as defined in the Schedule of Quantities. Measurement for payment shall be undertaken to AS1181 (1982). The Owner/Principal may inspect or check any setting out or measurements at any time and the Contractor shall allow for delays while any works are checked.

At the completion of the works, the Contractor shall provide detailed as-built details including hardcopy plan layout and survey information in electronic format as well a concise summary of item volumes.

2.4 Construction Materials

2.4.1 General

Satisfactory materials shall be free from large lumps or clods, refuse or other material that might prevent proper compaction. All material shall be approved for use by the Engineer prior to placement.

The material zones are as follows:

- Zone 1, Clay Borrow Material – this material shall be used to construct TSF4 basin, the upstream zone of the starter embankment, Stage 1A as indicated on the Design Drawings, and the starter embankment Stage 1B.
- Zone 2, Mine Waste – this material shall be used to construct the bulk section or downstream zone of the starter embankment, Stage 1A as indicated on the Design Drawings, to support the compacted Zone 1, and decant accessway.
- Zone 3, Select Filter Rock – this material shall be used to construct the decant towers.
- Zone 4, Dried Tailings – these shall be used to construct the raises along the north and east embankments.

2.4.2 Zone 1 – Clay Borrow Material

Zone 1 - Clay Borrow Material shall be sourced from the designated borrow areas within the lease area and must meet the requirements listed in Table 2.

Table 2: Properties of Zone 1 – Clay Borrow Material		
Item	Test Method	Requirement
Soil Classification (USCS)	AS 1726	CL / CI / CH
Particle Size Distribution	AS 1289	100% passing 150 mm, > 25% passing 0.075 mm
Compacted In-situ Density	AS 1289	95 % SMDD
Plasticity Index	AS 1289	< 30 %, > 15 %

Testing frequencies are provided in Table 7.

2.4.3 Zone 2 – Mine Waste

Zone 2 – Mine Waste shall be sourced from the designated borrow areas within the lease area and approved external sources and must meet the requirements listed in Table 3.

Table 3: Properties of Zone 2 – Mine Waste		
Item	Test Method	Requirement
Soil Classification (USCS)	AS 1726	GM / GC
Particle Size Distribution	AS 1289	100 % passing 300 mm, < 30 % passing 0.075 mm
Compacted In-situ Density	AS 1289	95 % SMDD

Testing frequencies are provided in Table 7.

2.4.4 Zone 3 – Select Filter Rock

Zone 3 – Select Filter Rock shall be sourced from the designated borrow areas within the lease area and approved external sources, and meet the requirements listed in Table 4.

Table 4: Properties of Zone 3 – Select Filter Rock		
Item	Test Method	Requirement
Soil Classification (USCS)	AS 1726	GW including Cobbles with a trace of Boulders
Particle Size Distribution	AS 1289	100 % passing 300 mm, > 95 % passing 75 mm, < 3 % passing 0.075 mm

No testing is required for Zone 3 – Select Filter Rock as this material is to be traffic compacted during placement.

2.4.5 Zone 4 – Dried Tailings

Zone 4 – Dried Tailings shall be sourced from tailings in existing Tailings Storage Facilities No. 2 (TSF2) and No. 3 (TSF3), subject to the conditions listed in Table 5.

Table 5: Properties of Zone 4 – Dried Tailings		
Item	Test Method	Requirement
Soil Classification (USCS)	AS 1726	ML/SM, SC/CL
Particle Size Distribution	AS 1289	≤ 65 %, ≥ 25 % passing 0.075 mm
Liquid Limit	AS 1289	≤ 50 %

Testing frequencies are provided in Table 7.

2.4.6 Base Course Material

The Base Course Materials for TSF4 crest shall be well graded gravel, sourced from the borrow area or the mill, and meet the requirements listed in Table 6.

Table 6: Properties of Base Course Material		
Item	Test Method	Requirement
Soil Classification (USCS)	AS1726	GW, GP, GM
Particle Size Distribution	AS1289	100 % passing 50 mm, ≥ 50 % retained on 4.75 mm, <25 % fines (0.075 mm) - Non plastic

No testing is required for the Base Course Material.

2.4.7 Unsuitable Material

Materials that do not meet the requirements listed in Table 2 to Table 6, and soil having insufficient strength or stability to carry the loads that will be superimposed on the completed embankment or decant without excessive settlement or loss of stability, must not be used in the constructed works. Materials containing vegetable matter, muck refuse, large rocks, debris, or other materials that could cause the embankment not to compact, and organic soils with USCS of Pt, OH, or OL, are considered to be unsuitable material and shall be removed from the site.

2.5 Clearing and Establishment Works

The Contractor shall, as appropriate:

- Remove all vegetable matter and scrub from the area of the proposed TSF4 footprint and drainage diversion works. The area to be cleared shall extend approximately 10 m past the downstream toe of the embankment. All stripped vegetation should be pushed into heaps in locations as indicated by the Owner/Principal's Representative;
- Remove all solid obstructions, tree stumps, roots and logs from beneath the footprint of the TSF perimeter embankment;
- Clear the agreed routes of all haul roads of all vegetation standing and fallen. Push this vegetation into heaps as approved by the Owner/Principal's Representative;

- Form up, lay base course as is necessary and do all things necessary to form and maintain haul roads linking the pit area to the site and other haul roads necessary for the works and which are approved by the Owner/Principal's Representative;
- Keep roads sprayed and wetted to mitigate the generation of airborne dust during road construction and usage;
- Prepare a quality assurance and quality control programme to cover all aspects of work included within This Document for the Owner/Principal's approval;
- On subsequent stages, remove gravel wear course materials from the embankment crests, and stockpile for re-use if possible;
- Prepare a quality assurance and quality control (QA/QC) program to cover all aspects of work included within This Document for the approval of the Owner/Principal's Representative;
- Provide all things necessary to implement the approved QA/QC program.

2.6 Foundation Preparation

The contractor shall, as appropriate:

- Inspect the subject site to determine the extent of the requirements for preparatory works;
- Strip topsoil from the TSF footprint to a nominal depth below the natural ground surface of 0.2 m. The depth of stripping may be increased as directed by the Owner/Principal's Representative. Stockpiling of topsoil shall be in areas nominated by the Owner/Principal's Representative. Stockpiles shall have a maximum height of 2.0m and side slopes of 1 (vertical) to 1.5 (horizontal);
- Remove soil only to such depth that the soil meets the definition of topsoil. In areas with near-surface residual or weathered rock, loose pockets are to be removed. Under no circumstances is the Contractor to rip or excavate rock unless directed by the Owner/Principal's Representative;
- Allow for keeping water from excavations by pumping, dewatering, or other suitable means, and appropriately dispose of it clear of the works;
- Except in areas of residual or weathered rock, the Contractor shall tyne/scarify, moisture condition (to within -2% / $+2\%$ of OMC) and compact the TSF embankment foundation and the TSF basin area to a depth of 0.3 m (following any borrow excavation). The prepared surface of the embankment footprint should be compacted, for a typical minimum of 6 passes when using a 12 tonnes vibratory pad foot roller;
- Prepare the foundation for the cut-off trench under the starter embankment as shown on drawings by excavating within clay/silt, a nominal depth of 1.5 m to 2.0 m below existing ground levels, or to the residual or weathered rock layer, or as directed by the Owner/Principal's Representative. The depth shall be increased if loose gravels or sands are present in the excavation so the base of the excavation is in a competent low permeability material or rock. Side batters shall have a minimum slope of 1(V):1(H);
- Ripping may be necessary to construct the cut-off excavation (if directed). Blasting in the tailings storage area is not anticipated. No blasting or excavation into or through any competent rock shall be undertaken unless approval has been received from the Owner/Principal's Representative;
- All areas to receive fill shall be left in a clean and suitable condition to allow an uninterrupted placement of fill. No fill shall be placed in the cut-off until the base of all excavations has been inspected and approved by the Owner/Principal's Representative;
- Allow for keeping water from excavations by pumping, dewatering, or other suitable means, and adequately dispose of it clear of the works;

- The cut-off trench backfill shall be Zone 1 material (refer Table 2) and comply with the following:
 - The moisture content at the time of placement is within ± 2 % of the OMC as determined from laboratory test in accordance with AS1289.5.1.1 with moisture curing of materials as required during embankment construction;
 - Each layer is compacted to achieve a density ratio greater than 95 % SMDD, as determined by AS1289.5.1.1;
 - Materials specifications as detailed in Section 2.4.
- All areas to receive pipework shall be graded smooth and be free of any rock, cobbles and other deleterious materials that could damage the pipework.

2.7 Earthworks

2.7.1 General

The contractor shall:

- Ensure suitable embankment material is well mixed to ensure uniform distribution of fines;
- Ensure that all materials shall be stockpiled, transported and placed in such a manner as to minimise segregation;
- Allow for keeping water from the works during construction by shaping finished surfaces with a fall to the centre of the storage;
- Allow for maintaining the borrow areas free of large accumulations of water;
- Maintain access roads, haul roads and/or ramp(s), as appropriate, to the designated borrow to enable the fill materials to be recovered and hauled to the work area. The Contractor shall submit details of the proposed ramps to the Owner/Principal's representative prior to the commencement of construction. It is envisaged that existing haul roads can be utilised;
- Carry out testing to comply with the Specification and QA/QC procedures.

2.7.2 TSF4 Starter Embankment – Stage 1A

The Contractor shall meet the construction requirements for TSF4 starter embankment, as follow:

- Construct the downstream zone of TSF4 starter embankment, Stage 1A, using traffic compacted mine waste (Zone 2) from the designated borrow areas within the lease area and approved external sources. The material shall comply with Table 3;
- The mine waste (Zone 2) shall be moisture conditioned on site. Make-up water can be added on the embankment. The mine waste (Zone 2) shall be placed in homogeneous horizontal layers not exceeding 0.75 m loose lift thickness. Each lift shall be compacted by trafficking the full width of the layer with designated plants;
- The upstream face of the mine waste (Zone 2) shall be free of projections (large cobbles or boulders > 0.3 m in sizes, and voided rock in order to allow for placement of the upstream clay borrow material (Zone 1). Trimming of the mine waste (Zone 2) face may be required;
- Construct the upstream zone of TSF4 started embankment, Stage 1A, using selected approved clay borrow material (Zone 1) from the designated borrow areas within the area. Suitable material shall comprise low to high plasticity inorganic clay free of organic matter and other deleterious material. The material shall comply with Table 2;
- Prior to construction, zones within the TSF4 basin will be identified that have the potential for sources of materials for construction. In general, the clay above the residual and weathered rock layers can be utilised as Zone 1 material. Only material approved by the Engineer/Owner/Principal's Representative should be utilised in construction;

- Adjust the moisture content of the clay borrow material (Zone 1), to within the range of -2 %, +2 % of the OMC as per AS1289.5.1.1 (2003). The borrow materials shall be cured to ensure the moisture is thoroughly mixed and evenly spread through all materials proposed for embankment construction;
- Place the clay borrow material (Zone 1) in homogeneous horizontal layers not exceeding 0.3 m compacted lift thickness. Each lift shall be compacted by a minimum of 6 passes of a 12 tonnes vibratory pad foot roller or approved equivalent. Placement should be continuous. If a break in fill placement allows the exposed surface to dry, it should be lightly tined, watered and compacted prior to fill placement recommencing. No oversize material is to be placed into the embankments. Largest size should be 150 mm;
- Compact each layer to achieve a density ratio greater than 95 % SMDD, as determined from laboratory test AS 1289.5.1.1 (2003). The actual number of passes of the 12 tonnes vibratory pad foot roller, or approved equivalent, to achieve a density greater than 95 % standard compaction (AS 1289.5.1.1) shall be determined on site using pad foot roller trials;
- Carry out testing to comply with the Specification and QA/QC procedures;
- The crests of the completed embankment shall be graded to the inside (upstream) of the storage at a 2 % cross fall;
- Form windrows, using mine waste (Zone 2), of adequate height on both crest edges as the works proceed to comply with mine safety and operational guidelines, typically ≥ 0.5 m in heights or 1/2 wheel height of the largest vehicle. The windrows shall be raised as the works proceed. Loose edge materials shall be removed as the works proceed;
- Sheet the crest of the perimeter and internal embankments, and the decant accessway with base course material, Table 6 refers. This shall comprise well graded gravel sourced from the borrow area or the mill;
- Allow for keeping water from the works during construction by shaping finished surfaces with a fall to the storage;
- All materials shall be stockpiled, transported and placed in such a manner as to minimise segregation;
- Ensure that placed material which fails to meet the minimum test requirements of compaction or moisture content is reworked (moisture content adjusted and/or recomputed) to meet the specified requirements. The Contractor shall maintain an up-to-date Compaction Record Log in accordance with a spreadsheet example to be provided by the Owner/Principal;
- Construct and maintain haul road(s) between the ramp at the borrow areas and the works at TSF4;
- Construct and maintain access ramp(s) as required to enable the construction equipment to access TSF4. The location of these ramps shall be approved by the Owner/Principal's Representative prior to commencement of these works. The ramps may be left in place at the discretion of the Owner/Principal.

Following the completion of TSF4 Starter Embankment, Stage 1A, the Contractor shall construct Stage 1B as per the methodology used for the construction of the upstream zone of Stage 1A, including the requirements for QA/QC testing, crest grade, windrows, surface sheeting, drainage, materials stockpile, and haul road(s) and access ramp(s).

2.7.4 Decant Accessway and Structure

The decant structure will comprise a pump type decant comprising slotted concrete pipes surrounded by filter rock. The Contractor shall in relation to decant accessway and structure meet the requirements listed here:

- Confirm the alignment of the access roads to the decants with the Owner/Principal;
- As required grade or upgrade any existing road(s) or berm(s) associated with TSF3;
- Form the decant accessway using mine waste (Zone 1) sourced from borrow areas within the site area. The requirements of the mine waste are listed in Table 2;
- Compact with vibrating drum rollers in 500 mm layers (dependent on roller size) to achieve the requirements as outlined in Table 7;
- Construct access road(s) and road on the decant accessway with a minimum cross fall of 2% into the cell with edge windrows in compliance with mine safety and operational guidelines, typically ≥ 0.5 m in heights or 1/2 wheel height of the largest vehicle. Edge windrows are to be formed using mine waste (Zone 2) on each side of the decant accessway, and frequent gaps to be left in the windrows for water shedding;
- Sheet the embankment crests with a minimum thickness of 100 mm of base course material, Table 5 refers;
- Supply and install slotted pre-cast concrete well liners (Kalgoorlie cement works or Humes) of nominal 1.8 m diameter (internal) and 1.2 m length to form the decant towers;
- Carefully place, well graded select filter rock (Zone 3) sourced from borrow areas within the lease area and approved external sources. The requirements of the select filter rock are listed in Table 4. All rock shall be carefully placed to ensure the concrete pipes are not dislodged or damaged. Any damaged pipes or electric cables shall be reported to the Owner/Principal and repaired and replaced by the contractor at their cost.

2.7.5 Underdrainage System

The underdrainage system will comprise underdrainage lines grading to an underdrainage sump located near the south east corner to TSF4. The Contractor shall provide the following for its construction:

- Confirm the alignment of the underdrainage lines to the underdrainage tower with the Owner/Principal representative. The underdrainage lines shall have 0.5% minimum grade. Grade the alignments for the underdrainage lines, as directed. The foundation to accept the underdrainage lines shall be 'smooth' and free of projections that could damage geotextile and pipework;
- Carefully install the underdrainage lines comprising Megaflo MEG300 Ultra (or equivalent) with Bidim geotextile, covered with select aggregate (10-14mm size) and wrapped with Bidim A34 geotextile (or equivalent). The geotextile should be stabilised with coarse aggregate and cobbles <150 mm in size;
- Install solid underdrainage outfall pipes (DN90 PE100 PN10 SDR17) from the slotted underdrainage pipes sloping to the concrete underdrainage sump. Supply and install manufacturer end caps and slotted/outfall pipe joiners;
- The Owner/Principal representative will check that the underdrainage lines and adequately joined prior to being covered with aggregate etc.
- Construct underdrainage tower accessway using either the clay borrow material (Zone 1) or the mine waste (Zone 2), using similar procedures and testing, to TSF4 embankment Stage 2 to Stage 5 raises as outlined in Section 2.7.3;
- Supply and install the concrete footing to the underdrainage tower;
- Supply and install pre-cast concrete well liners (Kalgoorlie cement works or Humes) of nominal 1.2 m diameter (internal) and 1.2 m length to form the tower. Provide grout fillets to seal the concrete base and concrete pipes.