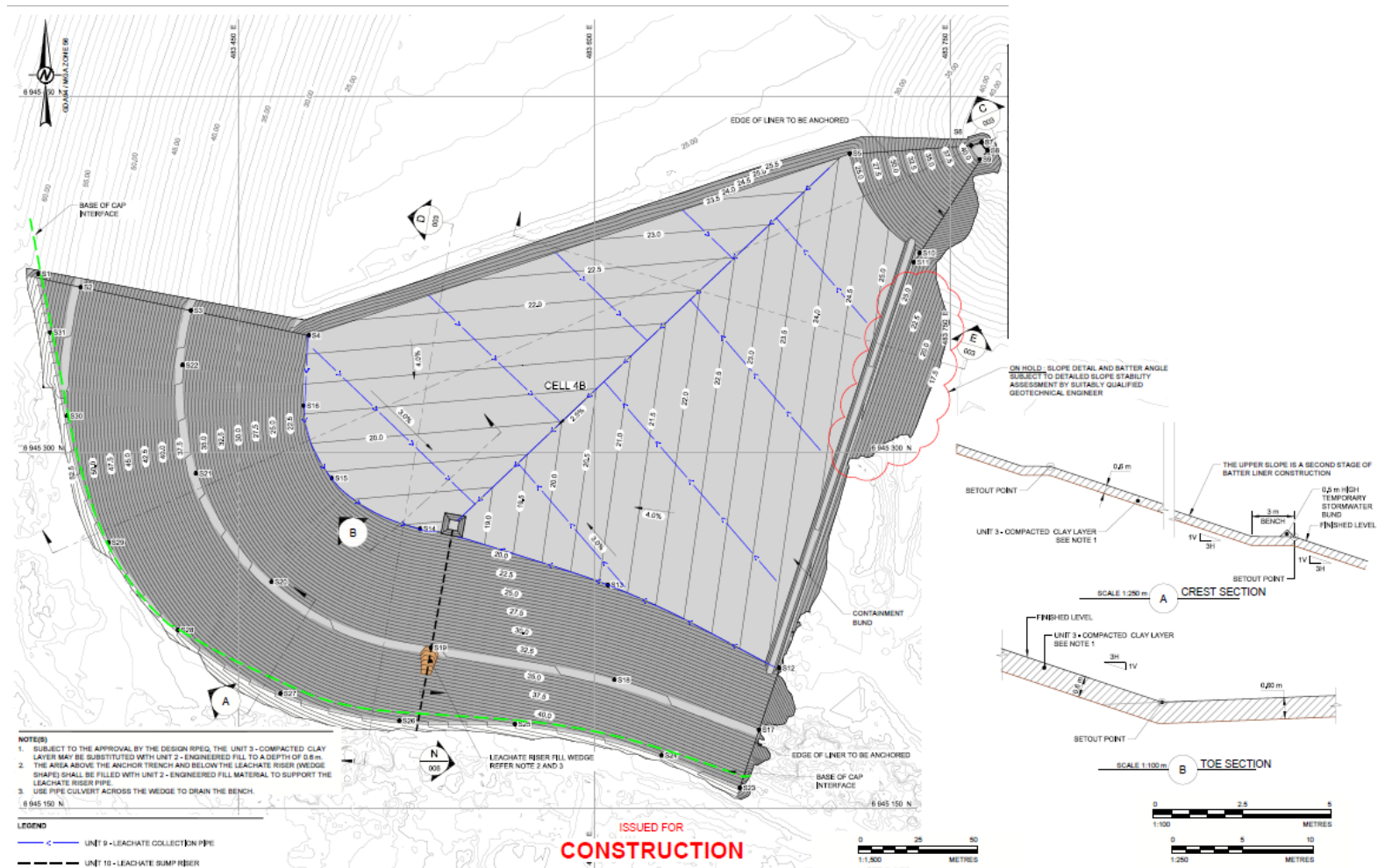


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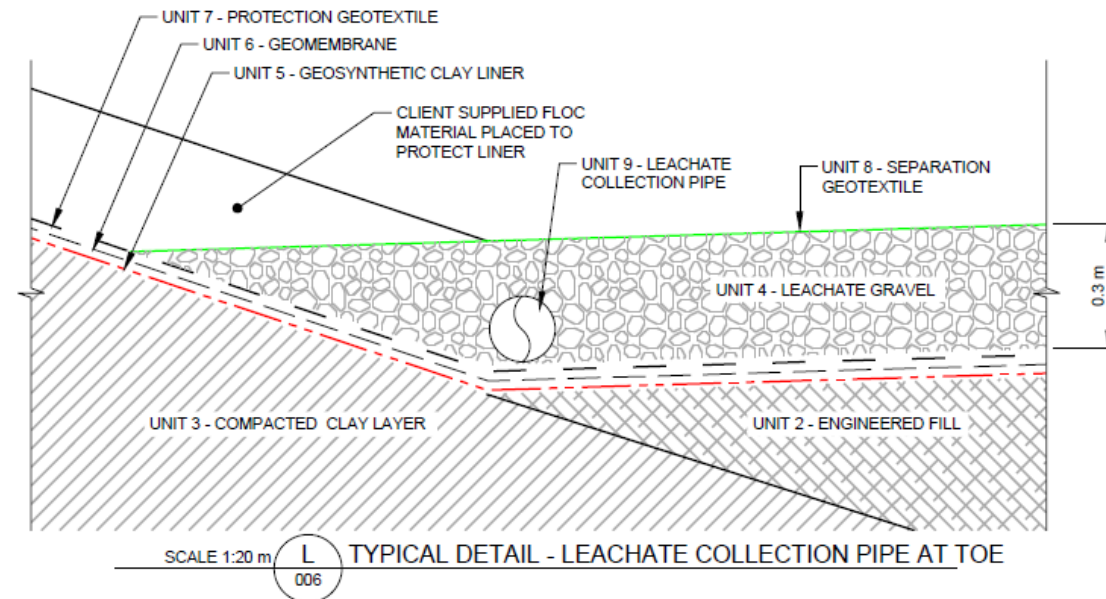
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Layout



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Lining System



LEGEND

- . . . — . . . — UNIT 7 - PROTECTION GEOTEXTILE
- — — — — UNIT 6 - GEOMEMBRANE
- — — — — UNIT 5 - GEOSYNTHETIC CLAY LINER

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Clay lining specification

2.2.3 Unit 3 – Compacted Clay Layer

Unit 3 – Compacted Clay Layer shall have the same material testing requirement and properties of Unit 2 – Engineered Fill, with the exception of the following properties:

- Particle size passing a 2.36 mm sieve > 90%
- Particle size passing a 0.075 mm sieve > 40%
- Have a coefficient of permeability of $\leq 1 \times 10^{-9}$ m/sec as measured in a triaxial cell when remoulded to a dry density ratio of 95% Standard Dry Density Ratio (SDDR) at Optimum Moisture Content (OMC) and a confining pressure of 150 kPa, back pressure of 50 kPa, and effective pressure of 100 kPa.

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Geosynthetic Clay Liner (GCL) specification

Table 7: Unit 5 GCL Properties

Property	Units	Type 1 (floor) Value (MARV) ¹	Type 2 (batters) Value (MARV) ¹	Test	Independent testing frequency (GITA)	MQC testing frequency
GCL Mass	g/m ²	≥ 4350	≥ 4350	ASTM D 5993	1 test per 500 m ²	1 test per 4,000 m ²
Bentonite Mass (measure at 0% moisture content)	g/m ²	≥ 4000	≥ 3700	ASTM D 5993	1 test per 2,500 m ²	1 test per 4,000 m ²
Bentonite Particles passing 0.075 mm sieve	mm	≥75 %	≥75 %	AS 1289.3.6.1	1 test	NA
Cation exchange capacity of Bentonite	M eq/100 g (or cmol/kg)	≥ 70	≥ 70	Methylene Blue Method	1 test per 500 m ²	NA
Montmorillonite Content	% by weight	≥70	≥70	X-ray diffraction	1 test per 10,000 m ²	NA
Additional Bentonite in edge overlap @ 0% moisture	g/m ²	≥ 800	≥ 800	ASTM D 5993	1 test per 40 m overlap	NA
Strip Tensile Strength	kN/m	≥ 8	≥ 12	ASTM D 6768	1 tests from 2 different rolls	1 test per 20,000 m ²
CBR Elongation	%	≥ 30	≥ 30	AS 3706.4		
CBR Strength	N	≥ 1500	≥ 3900	AS 3706.4		
Peel Strength	N/m	≥ 360	≥ 360	ASTM D 6496	1 test per 500 m ²	1 test per 4,000 m ²
Swell Index	mL/2g	≥ 24	≥ 24	ASTM D 5890		1 test per 50 tonnes
Fluid Loss	mL	≤ 15	≤ 15	ASTM D5891		1 test per 50 tonnes
Hydraulic conductivity	m/s	≤ 3 x 10 ⁻¹¹	≤ 3 x 10 ⁻¹¹	ASTM D 5887	1 test per 10,000 m ²	Manufacture r's data

Notes: 1. MARV = Minimum Average Roll Value representing a confidence level of 97.5% of test results meet the required value.

2. Type 1 shall be used on the floor only. Type 2 shall be used on the batters

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Geomembrane

Table 8: Unit 6 – Geomembrane material properties

Property	Units	Value for smooth	Value for textured	Test	Independent testing frequency (GITA)	MQC Testing Frequency	
Thickness (minimum average value)	mm	1.5 with a tolerance of -5%	1.5 with a tolerance of -5%	ASTM D 5994 (textured)	One test per 10 000 m ²	As per GRI-GM13	
Density (min)	g/cm ³	≥ 0.94	≥ 0.94	ASTM D 1505 or ASTM D 792	One test per five rolls	As per GRI-GM13	
Asperity Height	mm		>0.45	ASTM D 7466	2 samples	As per GRI-GM13	
Melt Flow Index	g/10 min		< 1.0	ASTM D 1238	Review MQC	Manufacturer's data	
Tensile Properties (each direction)					One test per five rolls	As per GRI-GM13	
- Strength at break	N/mm	≥ 40	≥ 16	ASTM D 6693			
- Elongation at break	%	> 700	> 150	ASTM D 6693			
- Strength at yield	N/mm	> 22	> 22	ASTM D 6693			
- Elongation at yield	%	> 12	> 12	ASTM D 6693			
Tear Resistance	N	> 187	> 187	ASTM D 1004			
Puncture Resistance	N	≥ 480	≥ 400	ASTM D 4833			
Carbon Black Content	%	2 to 3	2 to 3	ASTM D 1603			
Carbon Black Dispersion	Rating	¹	¹	ASTM D 5596			
Oxidative Induction Time (OIT) Standard OIT (AND) High Pressure OIT	min min	≥ 100 ≥ 400	≥ 100 ≥ 400	ASTM D 3895 ASTM D 5885	One test per resin type or per 10 000 m ² , or per manufacturing run per geomembrane type		
Oven Aging at 85°C High Pressure OIT	% retained after 90 days	≥ 80	≥ 80	ASTM D 5721 ASTM D 5885	One test per resin batch, or as demonstrated by manufacturer data to the satisfaction of the Superintendent		
Environmental Tensile Load Crack Resistance	Hr	> 300	> 300	ASTM D 5397	One test per resin type or per 10 000 m ² , or manufacturing run per geomembrane type, or as demonstrated by manufacturer data to the satisfaction of the Superintendent		

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Protection Geotextile

2.2.7 Unit 7 – Protection Geotextile

Unit 7 – Protection Geotextile shall be a non-woven, needle-punched polyester or polypropylene material. The Contractor shall provide a certificate confirming the geotextile is needle free. The material shall have the following properties:

- Thickness > 4 mm (Typical value)
- Mass per unit area > 550 g/m²
- Trapezoidal tear strength > 1060 N
- CBR burst strength > 6850 N
- Tensile Strength ≥ 41.5 kN/m
- Puncture Resistance ≥ 4000 N
- Grab Strength ≥ 3010 N with Elongation ≥ 50%