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Our Ref: PSM4252-002L REV5

24 August 2022

Development Graduate
Aliro Group
Level 38
Gateway
1 Macquarie Place
SYDNEY NSW 2000
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Attention: Andy Lloyd

Dear Andy,

RE: MAMRE ROAD, KEMPS CREEK
RESULTS OF DETAILED GEOTECHNICAL INVESTIGATION

1. Introduction

This report presents the results of Stage 1 and 2 geotechnical investigations undertaken by PSM at Mamre Road, Kemps Creek. The Stage 1 works have been undertaken in October 2020. The Stage 2 works have been undertaken in accordance with PSM proposal (Ref: PSM4252-008L) dated 27 July 2021.

The report has been updated to include PSM Stage 2 – Detail Geotechnical Investigation completed between 25 May and 08 June 2022.

Figure 1 presents a locality plan of the site and approximate investigation locations.

2. Background

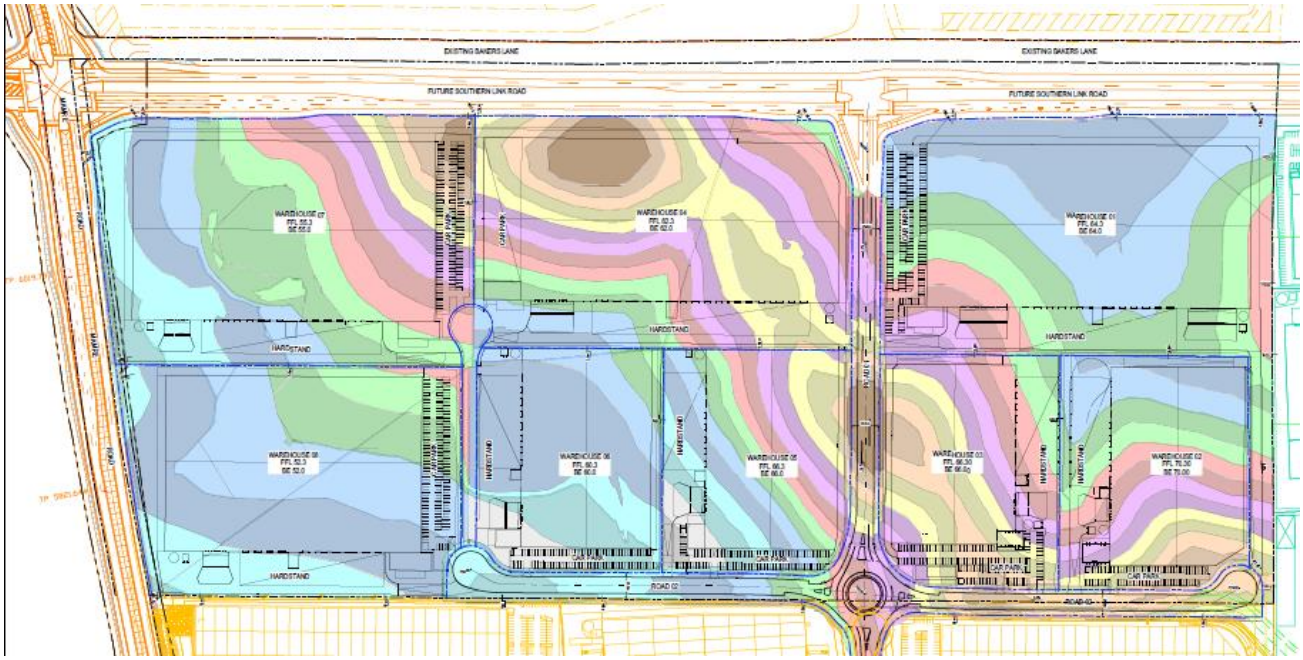
To assist with the geotechnical investigation, we were provided with and reviewed the following documents:

- Contour survey of property by C & A surveyors dated 10 September 2019
- Survey sketch from C & A surveyors dated 16 September 2019
- Concept masterplan dated 20 September 2019
- Preliminary earthworks and retaining wall plan dated 25 September 2019
- AT&L Concept Earthworks Plan (Ref" 21-855-SKC001 dated 4 May 2022).

PSM understand the following about the proposed development:

- The site has an approximate area of 52 hectares
- The proposed development will comprise typical lightweight standard warehouse facilities, with hardstand areas, carparks and retaining wall
- The proposed earthworks comprise:
  - Cut depth: up to 18 m
  - Fill depth: up to 11 m.

Inset 1 below presents the preliminary earthworks (cut and fill) and retaining wall plan.



Inset 1: Preliminary earthworks and retaining wall plan by AT&L (Ref: 21-855-SKC001 dated 4 May 2022)

3. Geotechnical Investigation

The scope of stage 1 and 2 geotechnical investigations comprises:

- Stage 1: Geotechnical investigation undertaken from 22 to 23 October 2020 as a part of due diligence study:
  - Nine (9) boreholes including 3 cored holes and 6 augured holes
  - Six (6) Cone penetration tests.
- Stage 2: Geotechnical investigation undertaken on 22 May 2022, 7 and 8 June 2022 as a part of an additional geotechnical investigation:
  - Three (3) cored boreholes within the deep cut areas.

3.1 Fieldwork – Stage 1 (October 2020)

3.1.1 Boreholes

A total of 9 boreholes, including 3 cored holes (CH01 to CH03) and 6 augered holes (AH01 to AH06), were drilled using truck mounted geotechnical drilling rigs.

The 3 cored holes were drilled to depths of between 10.2 m to 10.9 m with augering through soils and low strength rock using V-Groove carbite bit (V-bit) and tungsten carbide bit (TC-bit), followed with coring through rock with NMLC diamond bit. The 6 augered holes were drilled to depths of between 5.25 to 6.0 m with V-bit and TC-bit.

The geotechnical borehole logs and core photos together with explanation sheets are presented in Appendix A1. Point load strength index testing was performed on the recovered core at approximately one metre intervals with results tabulated in Appendix B1.

3.1.2 Cone penetration testing (CPT)

In addition to the boreholes, a total of 6 CPTs (CPT01 to CPT06) were completed to refusal depths of 4.8 m to 6.6 m. The CPTs were carried out using a 24-tonne truck mounted rig. At the completion of each test, the holes were topped with sand fill. The results of the CPTs including interpreted subsurface profiles are included in Appendix C.

3.2 Fieldwork – Stage 2 (May and June 2022)

A total of three (3) cored boreholeswere drilled using track mounted geotechnical drilling rigs. The 3 cored holes were drilled to depths of between 13.0 m to 20.6 m with augering through soils and low strength rock using V-Groove carbite bit (V-bit) and tungsten carbide bit (TC-bit), followed by coring through rock with NMLC diamond bit.

The geotechnical borehole logs and core photos are presented in Appendix A2. Point load strength index testing was performed on the recovered core at approximately one metre intervals with results tabulated in Appendix B2.

3.3 General

All work was conducted under the full-time supervision of a PSM geotechnical engineer, who undertook the following tasks:

- Preparing engineering logs of the material encountered
- Collection of disturbed samples for geotechnical and analytical laboratory testing
- Point load testing of recovered core samples
- Directing the backfilling of boreholes
- Directing the service locators, drillers, and CPT operators to investigation locations.

Prior to testing, on-site service location “scans” were undertaken by a licensed service locator in the presence of a PSM geotechnical engineer to assess if the test locations were free from buried utilities.

The investigation locations were recorded with a hand-held GPS unit with a horizontal accuracy of approximately +/- 5 m.

Standard Penetration Tests (SPTs) were undertaken at regular intervals in soil units and some weathered rock. Soil samples were taken directly from the auger. At the completion of the fieldwork, the boreholes were backfilled with excavated spoil and sand as required.

Figures 2 to 8 present selected photos of the fieldwork.

3.4 Analytical Laboratory Testing

Six (6) soil samples were retrived by a PSM Geotechnical Engineer for testing in an analytical laboratory. The disturbed soil samples were sent to a NATA accredited analytical laboratory and the following tests were undertaken:

- Resistivity
- Electrical conductivity
- Soil pH
- Moisture content
- Chlorides
- Sulphates
- Cation Exchange Capacity (CEC) of calcium, magnesium, potassium, and sodium
- Exchangeable sodium percentage.

3.5 Geotechnical Laboratory Testing

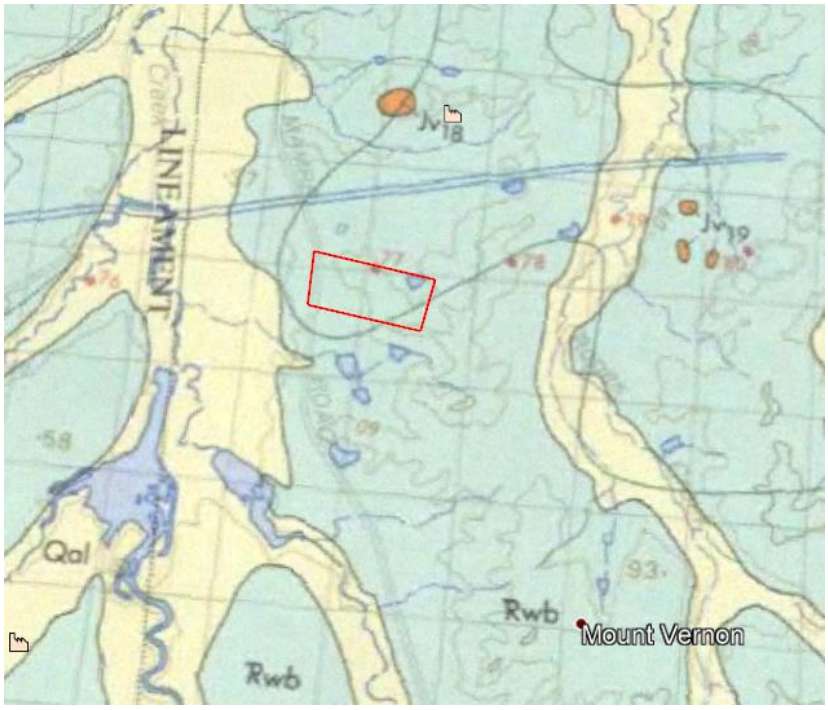
Soil samples from three (3) of the boreholes were sent to a geotechnical laboratory for California Bearing Ratio (CBR). Tests were undertaken on 4-day-soaked samples compacted to 98% MDD at OMC, with a 4.5 kg surcharge.

4. Site Conditions

4.1 Geological Setting

The 1:100,000 Sydney Geological Map indicates that the site is underlain by Bringelly Shale of the Wianamatta group (Rwb) which consists of shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff.

Inset 2 presents the geological map of the site.



Inset 2: Sydney Geological Map indicating approximate site location in red polygon

4.2 Surface Conditions

The site comprises a farmhouse to the north and water reservoirs around the site. The site primarily comprises of thickly vegetated areas and landscape areas, with wired fences dividing the site. Cattle occupies the approximate 52 hectares site. At the time of the fieldwork, the surfaces were dry and accessible by foot or vehicles.

There are three peaks on the site, one in the east of the farmhouse, and two at the south eastern corner of the site. The slopes are gentle with the lowest area on site located at the south western corner.

4.3 Subsurface Conditions

The subsurface conditions encountered within the boreholes are summarised in Table 1 and Table 2. The Bringelly Shale bedrock unit has been classified using the system developed by Pells et al (1998). With regards to Bedrock unit, we have inferred CPT refusal depths as the top of the unit.

Table 1 - Summary of Inferred Subsurface Conditions Encountered in the Boreholes

Inferred Unit	Inferred Top of unit Depth Below Ground Surface (m)	Description
TOPSOIL	0.0	CLAY to Clayey SAND; brown to dark brown, low to high plasticity, fine grained sand, grass and rootlets observed, dry to moist condition and firm to stiff consistency.
NATURAL SOIL	0.1 – 0.05	CLAY to Sandy CLAY; low to high plasticity, orange and mottled grey to dark brown and red, shale fragments observed, fine grained Sand, dry to moist condition, stiff to hard consistency.
BEDROCK A	0.6 – 6.6	SHALE/SANDSTONE; dark brown and grey, poorly developed to developed rock fabric, extremely to highly weathered, very low to low strength.
BEDROCK B	3.1 – 6.3	SHALE/SANDSTONE; grey to dark grey, fine grained, developed to well developed rock fabric, thinly laminated, highly to slightly weathered, low to very high strength, moderately spaced defects greater than 60 mm spacing. LAMINITE; SHALE (70%-90%) and SANDSTONE (10%-30%). SANDSTONE: medium coarse grained, grey, thinly bedded. SHALE: dark grey to grey, poorly developed, thinly laminated, highly to moderately weathered, low to medium strength.

Table 2 – The reduced level (R.L.) of Inferred Geotechnical Units Encountered in the Boreholes and CPT

Stage Investigation	Test ID	The reduced level of Inferred Geotechnical Units (m)				
		Topsoil	Natural Soil	Bedrock A	Bedrock B	EOH
STAGE 1	AH01	74.5	74.4	72.6	-	68.5
	AH02	72.7	72.6	71.0	-	66.7
	AH03	73	72.8	71.8	-	67.0
	AH04	63.3	63.2	60.7	-	57.3
	AH05	65.6	65.5	63.8	-	59.6
	AH06	46.6	46.5	45.0	-	41.4
	CH01	85.7	85.6	85.1	82.6	74.8
	CH02	73.5	73.3	71.6	66.1	63.3
	CH03	63.5	63.4	61.5	53.5	53.0
	CPT01	47.2	47.1	42.3*	-	42.3
	CPT02	43.7	43.5	37.1*	-	37.1
	CPT03	51.6	51.5	46.8*	-	46.8
	CPT04	67.6	67.5	62.6*	-	62.6
	CPT05	58.7	58.5	54.4*	-	54.4
	CPT06	57.7	57.5	51.6*	-	51.6
STAGE 2	BH01	82.0	81.9	80.5	70.2	61.4
	BH02	81.0	80.9	80.2	71.3	64.3
	BH03	74.0	73.9	73.2	67.7	61.0

Note:

* CPT refusal is inferred as top of BEDROCK A.

4.4 Groundwater

Water seepage was observed at AH05 at depth of 5.7 m.

No groundwater was observed within any of the other boreholes during the geotechnical investigation. Long term groundwater monitoring was not undertaken.

5. Laboratory Testing Results

5.1 Geotechnical Testing

Table 3 present a summary of the CBR test results. The laboratory test sheets for each set of tests are included in Appendix D.

Table 3 – Summary of CBR test results

Sample ID	Borehole ID (Depth)	Material Description	Soaked CBR (%)	Moisture Content (%)	OMC (%)	Standard Maximum Dry Density (t/m^3)	Swell (%)
CBR01	AH04 (0.5 m – 1.0m)	CLAY	2.5	21.4	20.5	1.64	2.5
CBR02	CH03 (0.5 m – 1.0m)	CLAY	2.0	21.7	22.1	1.63	3.5
CBR03	AH03 (0.5 m – 1.0m)	Sandy CLAY	1.5	17.6	21.1	1.64	5.5

5.2 Analytical Testing

5.2.1 Aggressivity

Table 4 presents a summary of the analytical laboratory testing results for aggressivity. Detailed results are provided in Appendix D.

The laboratory test results summarised indicate the following:

- pH of the soil samples analysed ranged from 5.1 to 8.9, with an average of 7.1
- The concentrations of soluble sulphate in samples analysed ranged from 10 mg/kg to 190 mg/kg
- The concentrations of chlorides in samples analysed ranged from <10 mg/kg to 390 mg/kg
- The moisture content ranged from 9.1 to 19.3 %
- The resistivity of the soil samples ranged from 2,500 ohm.cm to 12,800 ohm.cm.

Table 4 – Aggressivity Classification

Sample ID	Material Description	BH ID (Depth)	pH	Moisture Content [%]	Chloride by Discrete Analyser [mg/kg]	Soluble Sulphate by ICPAES [mg/kg]	Resistivity [ohm.cm]
ES01	SHALE	CH01 (1.1 m)	8.4	9.1	<10	10	7,190
ES02	Sandy CLAY	CH02 (0.8 m)	8.9	14.7	280	90	2,500
ES03	CLAY	CH03 (0.7 m)	7.7	15.7	120	10	9,090
ES04	CLAY	AH06 (0.6 m)	5.8	13.7	50	90	10,100
ES05	CLAY	AH04 (0.7 m)	5.1	19.3	390	190	2,900
ES06	CLAY	AH02 (0.5 m)	6.5	16.1	90	90	12,800

Table 4.8.1 of Australian Standard AS 3600 (2009) Concrete Structures provides criteria for exposure classification for concrete in sulphate soils based on sulphate content and acidity in the soil and groundwater. Based on soil sulphate content and pH testing completed, we assess the exposure classification for concrete in the soil to be “A1” to “A2”.

Table 6.4.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for concrete piles based on sulphates in the soil and groundwater, soil and groundwater pH, and chlorides in groundwater. On the basis of the soil sulphates and pH testing completed we assess the exposure classification for concrete piles in the soil to be “Non-aggressive” to “Mild”.

Table 6.5.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for steel piles based on resistivity, soil and groundwater pH, and chlorides in soil and groundwater. On the basis of soil chlorides, resistivity and pH testing completed we assess the exposure classification for steel piles in the soil to be “Non-aggressive”.

5.2.2 Salinity and Sodicity

Table 5 presents a summary of the analytical laboratory testing results for salinity and sodicity. Detailed results are provided in Appendix D.

“Site Investigations for Urban Salinity” (DLWC, 2002) classify soil salinity based on electrical conductivity (ECe). The method of conversion from EC1:5 to ECe (electrical conductivity of saturated extract) is based on DLWC (2002) and given by ECe = EC1:5 x M, where M is the multiplication factor based on “Soil Texture Group”.

Table 5 - Salinity and Sodicity Classification

Sample ID	BH ID (Depth)	Exchangeable Cations [meq/100g]					ESP [%]	Electric Conductivity EC1:5 [µS/cm]	M	Electric Conductivity ECe [dS/m]	Salinity Class
		Ca	Mg	K	Na	CEC					
ES01	CH01 (1.1 m)	17	3.1	<0.2	0.6	20.9	3.1	139	8[1]	1.1	Non-saline
ES02	CH02 (0.8 m)	9.7	17.2	<0.2	3.7	21.3	17.2	400	9[2]	3.6	Slightly saline
ES03	CH03 (0.7 m)	10.6	12.2	<0.2	2.6	21.4	12.2	110	8[1]	0.9	Non-saline
ES04	AH06 (0.6 m)	3.7	14.2	0.2	1.9	15.6	14.2	99	9[2]	0.9	Non-saline
ES05	AH04 (0.7 m)	0.7	18.8	0.2	2.3	12.4	18.8	345	8[1]	2.8	Slightly saline
ES06	AH02 (0.5 m)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	78	8[1]	0.6	Non-saline

Note:

[1] Multiplication factor based on “Soil Texture Group” - Light medium clay is plastic and smooth to the touch and will form a ribbon of 7.5 cm.

[2] Multiplication factor based on “Soil Texture Group” - Clay Loam can be easily rolled to a thread 3-4 mm thick but will have a number of fractures along its length. The soil is becoming plastic, capable of being moulded into a stable shape.

The “Soil Texture Group” of the samples tested were assessed during our investigation. The salinity classification for the soil samples that were tested are presented in Table 5. It is assessed that the soils on site are classified as “Non-saline” to “Slightly saline”. We have referred to Clause 4.8.2 of Australian Standard AS3600-2009 “Concrete Structures” and note that the assessed soil electrical conductivity (EC_e) is less than the upper limit of the “A2” exposure classification.

Sodicity provides a measure of the likely dispersion on wetting and to shrink / swell properties of a soil. Soil sodicity is classified based on the Exchangeable Sodium Percentage (ESP) which is the amount of exchangeable sodium as a percentage of the Cation Exchange Capacity (DLWC, 2002).

The Exchangeable Sodium Percentages calculated from the laboratory results was compared to the criteria provided in "Site Investigations for Urban Salinity" (DLWC, 2002). In the inferred NATURAL SOIL unit, the laboratory testing shows ESP ranges from < 0.1 % to 18.8%, indicating that the NATURAL SOIL on the site is classified as "Non-sodic" to "Highly sodic", as per DLWC (2002).

5.2.3 Acid Sulphate Soils Impacts – Desktop assessment

Based on the NSW Government SEED (Sharing and Enabling Environmental Data), the site is not located within the areas covered by the Acid Sulphate Soil Risk Map Data. It is our opinion that the risk of acid sulphate soils is low within this site.

Should further assessment be required, we recommend an environmental consultant be engaged to undertake the assessment.

Inset 3: Acid Sulphate Soils Map – Blue Outline Defines Approximate Site Boundary

6. Bulk Earthworks

A bulk earthworks specification has been prepared for the site (Ref. PSM4252-003S) which sets out clearly the roles and responsibilities of the earthworks contractor and its Geotechnical Inspection and Testing Authority (GITA). The proposed bulk earthworks within the site shall be undertaken in accordance with the PSM Specification prepared for this site. The Specification will only be varied with the consent of PSM to ensure that this interim design advice is able to be confirmed at the completion of the earthworks.

The Specification allows for a broad range of fill to be incorporated into the earthworks. The Specification requires close inspection, and frequent testing to provide a high level of confidence that the completed work complies with the Specification.

We have based our assessment of moduli on numerous plate load tests (PLTs) completed on VENM/ENM fills by PSM. Fill placed in accordance with such a specification is referred to herein as ENGINEERED FILL.

The Specification complies with the intent of AS 3798-2007 “Guidelines on earthworks for commercial and residential developments” and is intended to specify the minimum requirements to achieve a fill with the properties provided in Section 7 of this letter.

The Specification requires close inspection, frequent testing and external auditing of the earthworks to provide a high level of confidence that the completed work complies with the Specification. The Specification will only be varied with the consent of PSM to ensure that this interim design advice is able to be confirmed at the completion of the earthworks.

If the structural or civil engineer requires engineering properties different to those provided in Section 7 then the specification can be modified such that these properties will be obtained in the final earthworks. This allows the additional cost of the earthworks to be balanced against any economies achieved in other parts of the works.

6.1 Excavation Conditions

Excavation in the TOPSOIL, NATURAL SOIL, and most of BEDROCK A units is expected to be achievable using conventional earth moving equipment with minor rock breaking.

It is our experience that excavatability is heavily dependent on both the operator and the plant used. Any earthworks contractor should satisfy itself with regard to excavatability especially in the BEDROCK B or better unit. The presence of medium to very high strength sandstone in BEDROCK B unit will require the use of rock breaking equipment. Prospective contractors should make their own assessment of excavatability based on our logs and their site inspection and experience.

7. Interim Geotechnical Design Advice

7.1 General

The design advice in the following sections is provided on the basis that:

- The bulk earthworks on site to be completed in accordance with a PSM Specification, currently PSM4252-003S REV1 (the Specification) provided in Appendix E
- PSM to audit the earthworks to confirm the advice in this letter at the completion of the bulk earthworks.

We note that the final bulk earthworks subgrade will require proof rolling and plate load testing to confirm the properties provided and may require some boxing out and refilling, etc.

We understand that the structural engineer should be able to design an efficient slab and shallow footings for these geotechnical conditions. If assessed deformation and settlement is an issue, then our advice can be further refined if required.

We note that desiccation and/or wetting up of the pad surface is possible should it be exposed to the elements for an extended period of time, particularly at completion of the bulk earthworks prior to the builder taking

responsibility for the pad. To reduce the likelihood of this and preserve the pad condition we recommend the following should be considered following completion of the bulk earthworks:

- Placement of a sacrificial layer comprising roadbase or other equivalent material
- Grade the pad surface to reduce the extent and severity of standing water during and after weather events
- Minimise the time between the completion of earthworks and the builder commencing construction of the warehouse roof
- Limit vehicular and plant access until a roof has been installed.

Alternately, the developer or builder may have to undertake some surficial remediation if the pad is to comply with the requirements of this IGDA (i.e. comply with the PSM Specification) at the time of construction.

It is PSM's opinion that it should be the builder's responsibility to maintain the condition of the pad after the handover date and accept the risk that comes with modifying excavation levels and weather. There should be a strict transfer of the risk. We recommend that building tenderers be required to indicate how they intend to manage this risk.

7.2 Site Classification

While the proposed development is out of scope of AS2870-2011 "Residential slabs and footings", we assess that for natural clay soil placed in accordance with the Specification, the characteristic surface movement, y_s, would be in the range 40 mm to 60 mm and thus would classify the site as Class H1. The civil and structural engineers should consider likely heave / settlement due to the effect of climatic factors in their designs.

We recommend that all structures and services be detailed such that they preclude any local wetting up or drying out of the subgrade after initial equilibrium is reached following construction of the slab and that the subgrade be within specification at the time of construction of the slab. We note that normal mounding or sagging away from the perimeter of covered areas will still occur and perimeters, or open joints, will still respond to environmental changes.

For effectively sealed areas away from the perimeter, the design should allow for the following:

- Differential mound movement, ym = 20 mm. We note that this is not the total heave or settlement but the estimated local heave or settlement due to FILL variability
- Tilts of up to approximately 1 in 300.

Mounds at perimeters or penetrations of slabs open to the environment can be taken to be as per AS2870-2011 for y_s = 55 mm.

7.3 Foundations

7.3.1 Pad Footings

Pad footings can be proportioned based on an allowable bearing pressure (ABP) for centric vertical loads provided in Table 6. Higher ABPs in soil units may be available, but these depend on the size, depth, loads, etc., and would be subject to specific advice. The ABP needs to be confirmed by a geotechnical engineer during an inspection.

Settlements in soil units can be estimated using the elastic parameters provided in Table 6. We note that allowable bearing pressures presented in assume a settlement of approximately 1% (or less) of the least footing dimension for footings in the BEDROCK units.

Table 6 – Engineering Parameters of Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m^3)	Soil Effective Strength Parameters		Ultimate Bearing Pressure Under Vertical Centric Loading (kPa)	Allowable Bearing Pressure Under Vertical Centric Loading (kPa)	Ultimate Shaft Adhesion (kPa)	Elastic Parameters	
		c' (kPa)	*ϕ'* (deg)				Young's Modulus (MPa)	Poisson's Ratio
ENGINEERED FILL, NATURAL SOIL	18	0	30	420[1]	150[1]	N/A	10	0.3
BEDROCK A	22	N/A	N/A	3,000[2]	700[2]	50	100	0.25
BEDROCK B	24	N/A	N/A	6,000[2]	1,500[2]	350	350	0.25

Note:

1 Pad footings in soil unit should have a minimum horizontal dimension of 1.0 m and a minimum embedment depth of 0.5 m.

2 Ultimate bearing pressure for bedrock assumes a settlement of approximately 5% of the least footing dimension for footings in rock.

3 Allowable bearing pressure assumes a settlement of approximately 1% of the least footing dimension for footings in rock.

7.3.2 Piled Foundations

Piled foundation should be founded within the BEDROCK units.

Piles should be designed in accordance with the requirements in AS 2159 (2009), *Piling – Design and Installation.* The parameters provided in Table 6 may be adopted in the design of piles founded in the BEDROCK unit.

The foundation designer should note the following with regards to the pile design:

- The ABP needs to be confirmed by a geotechnical engineer during a pile inspection
- Under permanent load, the contribution of side adhesion for soils including soil units should be ignored
- Pile settlement needs to be checked using the recommended elastic parameters in Table 6.

The bearing capacities provided are contingent on piles or footings being vertically and centrally loaded. Further advice should be sought if the footings are not vertically centrically loaded. Should higher bearing capacities be required in Table 6 further advice should be sought from PSM.

With regards to the pile design, we recommend that:

- A geotechnical strength reduction factor, Φg = 0.60 (AS2159 CL. 4.3.2) be adopted for a high redundancy system for an assessed average risk rating (ARR) between 2.5 and 3.0. This should be reviewed to suit the specific design and appropriate pile testing proposed by the structural designers in accord with the requirements of AS2159
- It may be possible to increase the pile reduction factors, if the details of the proposed pile installation procedures indicate a high level of quality control with regards to concrete placement, base cleanliness, etc
- If a geotechnical strength reduction factor, Φg = 0.40 is adopted then no pile testing will be required (AS2159 Clause 8.2.4 (b)).

Foundation conditions at the proposed pile locations should be inspected by a suitably qualified geotechnical engineer prior to pouring concrete to confirm this advice.

7.3.3 Slab on Ground

In general, we advise the slab on ground design can be based on a subgrade with a long-term Young's modulus of 10 MPa. The short-term Young's modulus can be taken to be 15 MPa. We note that the environmental effects (e.g. drying or wetting up of the finished surface) affecting the land prior to the development should be considered by the various designers of any development.

We note that the final bulk earthworks subgrade will require proof rolling and plate load testing to confirm the properties provided and may require some boxing out and refilling, etc. Plate load testing during the filling will be required where blended topsoil has been used.

We understand that the structural engineer should be able to design efficient slabs. If assessed deformation and settlement is an issue, our advice can be further refined if required.

The structural designer or builder may wish to employ a surface layer of road base / crushed sandstone / concrete for trafficability or structural purposes. This is not required to achieve the properties in this design advice.

7.4 Pavements

A total of three (3) CBR tests were undertaken. The test results indicate a soaked CBR value of between 1.5% and 2.5%.

Based on our experience with typical clay VENM in western Sydney, the soaked CBR value could be as low as 1%. We advise that a CBR of 2% can be adopted for subgrade and FILL formed in bulk earthworks constructed in accordance with the Specification.

Higher values may be provided on completion of testing on the finished bulk earthworks or if, on request, the Specification is varied to obtain such higher values on ENGINEERED FILL.

We recommend that specific CBR testing be undertaken at subgrade level when pavement layouts are finalised.

7.5 Permanent and Temporary Batters

The batter slope angles in Table 7 are recommended for the design of batters up to a nominal 3 m height; subject to the following recommendations:

1. All batters shall be protected from erosion.
2. Permanent batters shall be drained.
3. Temporary batters shall not be left unsupported for more than 1 month without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events.
4. Where loads are imposed or structures/services are located within one batter height of the crest of the batter, further advice should be sought.

If the conditions above cannot be met, further advice should be sought.

Steeper batters may be possible subject to further advice. This could include the requirement for soil nails or rock bolts. The length and spacing of soil nail and rock bolts is a matter of design.

The batters should be inspected by an experienced geotechnical engineer or engineering geologist during excavation to confirm the batter advice provided and assess the need for localised support.

Proper and suitable safe work method statements and OHS documents need to be developed for works to be undertaken in the vicinity of the crest and toe of batters.

Table 7 – Batter Slope Angles

Unit	Temporary	Permanent
ENGINEERED FILL	1.5H : 1V	2.0H : 1V
NATURAL SOIL	1.5H : 1V	2.0H : 1V
BEDROCK A	1H : 1V*	1.5H : 1V*
BEDROCK B	0.5H : 1V (subject to local support)	1H : 1V (subject to design)

Note:

* See above requirements regarding inspections and local support.

7.6 Retention Systems

Permanent cuts in the NATURAL SOIL and BEDROCK unit's steeper than the recommended permanent batter slopes in Table 7 will need to be supported by some form of retaining structure.

The design of retaining structures should be based on the following:

- Effective soil strength parameters in Table 6
- Water pressure (depending on the type of the structure)
- With regards to the BEDROCK units, the designer shall allow a minimum lateral pressure of 10 kPa for the BEDROCK units when cut vertical. This is to allow for blocks and rock wedges formed due to adverse defects that may exist within the unit. These loads may be able to be reduced by specifying inspections during the works and provision of additional support (rock bolts, shotcrete etc.) should the inspection indicate that support is required. In any case excavation in BEDROCK units will need to be inspected during the works to confirm/dismiss the presence of defects/structure in the unit that may result in higher loads than anticipated in this design. The designer of the wall should consider including inspection requirements in their design at no more than 2 m intervals in the excavation.

Note that design of retention systems may be based on either K_a or K_p earth pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

Where the design is based on K_o pressures, construction should be carefully controlled to avoid unwanted effects. It should be noted that designing for K_o pressures does not, of itself, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drainage needs to be designed and constructed properly to prevent pore water pressures from building up behind the retaining walls or appropriate water pressures must be included in the design.

8. General

If at any time, the conditions are found to vary from those described in this report, further advice should be sought.

Should there be any queries, do not hesitate to contact the undersigned.

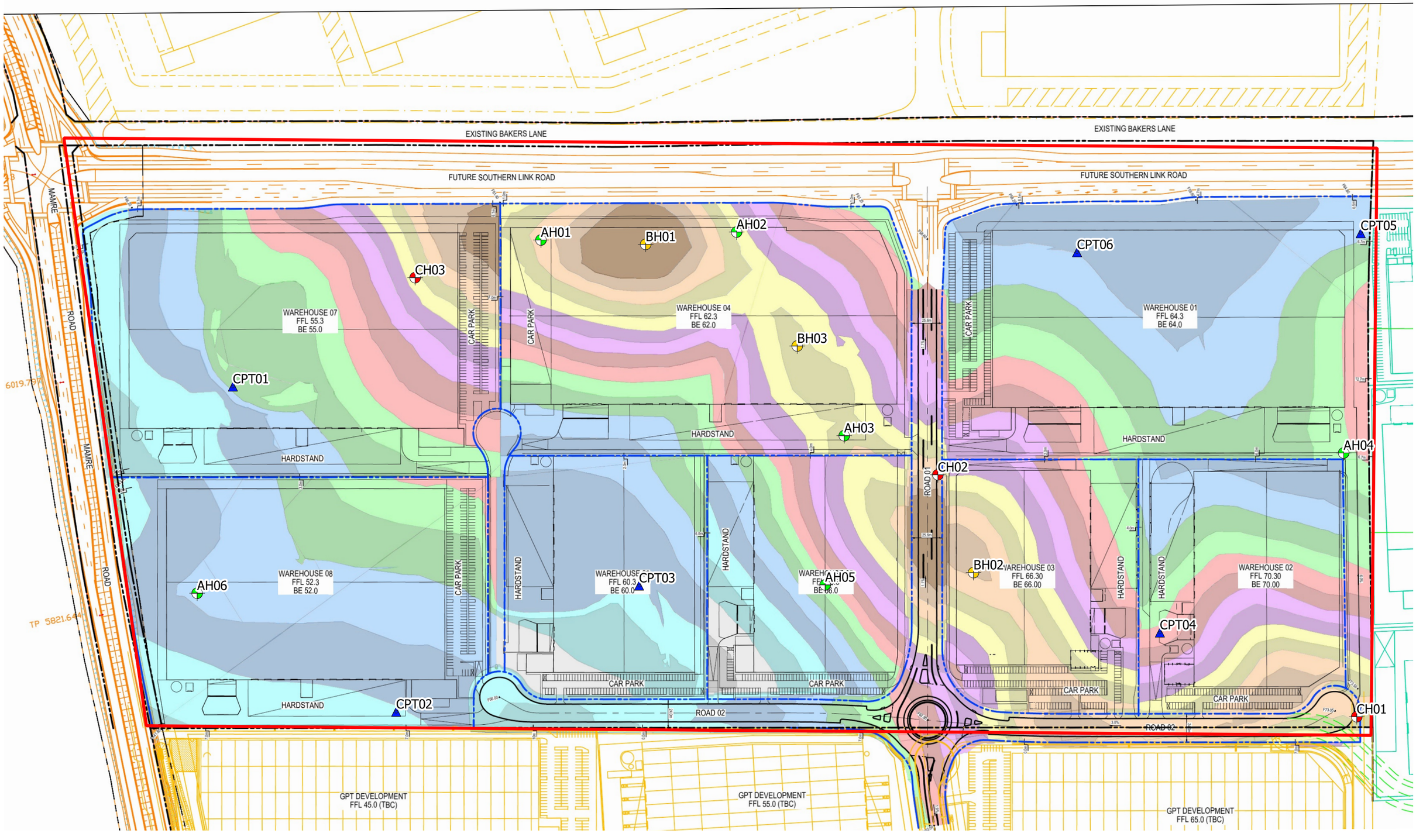
Yours Sincerely

TONY OU
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl.

Figure 1:	Location of Boreholes (Cored and Augered) and CPT
Figures 2 – 5:	Selected Site Photos (2020 Site Investigation)
Figures 6 – 8:	Selected Site Photos (2022 Site Investigation)
Appendix A:	Geotechnical Engineering Borehole Logs
	A1 – 2020 Site Investigation
	A2 – 2022 Site Investigation
Appendix B:	Point Load Test Results
	B1 – 2020 Site Investigation
	B2 – 2022 Site Investigation
Appendix C:	CPT Results
Appendix D:	Laboratory Testing Results
Appendix E:	PSM4252-003S Rev 1 - Bulk Earthworks Specification



Legend

- Approximate Borehole Locations of PSM Additional Geotechnical Investigation (May & June 2022)

Previous Site Investigations (Oct 2020)

- AH (Auger Holes)
- CH (Cored Holes)
- CPT (Cone Penetration Tests)
- Approximate Site Boundary

Notes:
1. Earthworks plan retrieved from AT&L Concept Earthwork drawing (Ref: 21-855-SKC001 dated 4 May 2022)

Scale 1:3,000

N

0 25 50 75 100 m

Horizontal Datum: GDA2020
Grid: MGA Zone 56

P S M	Created By: PSM	Revision: 4
	Date: 22 Jul 2022	Paper Size: A3

Aliro Group
Mamre Road, Kemps Creek
Geotechnical Investigation

Site Locality Plan

PSM4252-002L Rev 5 | Figure 1

\\anf.psm.local\anf-files\4000\PSM4252\Eng\QGIS\PSM4252.qgz Layout: Site Locality

Photo 1 - General site conditions at CH01 facing north-west (22/10/2020)

Photo 2 - General site conditions at CH02 facing north (22/10/2020)

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Mamre Road, Kemps Creek

SELECTED SITE PHOTOGRAPHS (1 of 4)
2020 Site Investigation

PSM4252-002L Rev 5	FIGURE 2

Photo 3 - General site conditions at AH01 facing west (23/10/2020)

Photo 4 - General site condition at CH03 facing south-west and backfilled borehole (23/10/2020)

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Mamre Road, Kemps Creek

SELECTED SITE PHOTOGRAPHS (2 of 4)
2020 Site Investigation

PSM4252-002L Rev 5	FIGURE 3

Photo 5 - Drill rig setup at CH02 facing north-east (22/10/2020)

Photo 6 - Drill rig setup at AH02 facing south-west (23/10/2020)

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SELECTED SITE PHOTOGRAPHS (3 of 4)
2020 Site Investigation

PSM4252-002L Rev 5	FIGURE 4

Photo 7 - CPT truck at CPT03 facing south-west (22/10/2020)

Photo 8 - Service Locator at CH03 facing west (22/10/2020)

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Mamre Road, Kemps Creek

SELECTED SITE PHOTOGRAPHS (4 of 4)
2020 Site Investigation

PSM4252-002L Rev 5	FIGURE 5

Photo 1 - General Site Photo Centre of Site Facing East (07/6/2022)

Photo 2 - General Site Photo Centre of Site Facing South West (25/5/2022)

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Mamre Road, Kemps Creek

Selected Site Photographs (1 of 3)

2022 Site Investigation

PSM4252-002L Rev 5	Figure 6

Photo 3 - General Site Conditions at the North Side of Site Facing South East (25/5/2022)

Photo 4 - 5.4-tonne Track-mounted Drill Rig Setup (08/6/2022)

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Mamre Road, Kemps Creek

Selected Site Photographs (2 of 3)

2022 Site Investigation

PSM4252-002L Rev 5	Figure 7

Photo 5 - Typical Soil Profile at BH01 (25/5/2022)

Photo 6 - Typical Bedrock (SHALE) Material at BH03 (08/6/2022)

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Mamre Road, Kemps Creek

Selected Site Photographs (3 of 3)

2022 Site Investigation

PSM4252-002L Rev 5	Figure 8

Appendix A
Geotechnical Engineering Borehole Logs

A1: 2020 Site Investigation

A2: 2022 Site Investigation

A1 – 2020 Site Investigation

Borehole ID

CH01

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295669.4 m E 6253677.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	85.70 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N							SP	SAND with traces of Clay: low plasticity, brown, fine grained.		F	0.00: Topsoil.
									CL	Sandy CLAY: low plasticity, orange and red, fine grained.	D	St	0.10: Inferred Natural Soil.
AD/T		N	Not Observed	SPT: 1.00 - 1.16 m 9, 3/10 mm N=Refusal - ES 1.10 m		84.7	1			SHALE: pale orange and grey, extremely weathered, very low strength, ironstone fragments observed.			0.60: Inferred Bedrock. V-bit refusal.
						83.7	2			SANDSTONE: fine grained, brown, highly weathered, very low strength.			1.00: SPT recovered: 150 / 160 mm.
										Becomes grey, fragments of shale observed.			
						82.7	3			Continued on cored borehole sheet			
						81.7	4						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295669.4 m E 6253677.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	85.70 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information | **Rock Substance** | **Rock Mass Defects**

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering (XW HW MW SW FR)	Strength Is(50) ● - Axial O - Diametral (VL 0.1 L 0.3 M 1 H 3 VH 10 EH)	Defect Spacing (mm) (<20 60 200 600 1000)	Defect Descriptions / Comments: Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					84.7	1						
					83.7	2						
			2.90m					Continued from non-cored borehole sheet				
NMLC	Not Observed	71	C-1	93	82.7	3	No core	No Core: 200 mm.				
							Sandstone	SANDSTONE: medium grained, light brown, developed rock fabric.				BP, 5°, FE SN, CU, RF
												SM, 0°, Clay infill, 10 mm
			3.94m - Is(50) d=1.28 a=1.7 MPa		81.7	4						
								Becomes well developed.				
			4.34m - Is(50) d=0.71 a=0.01 MPa									Highly fractured
												BP, 5°, FE SN, CU, RF
												SM, 10°, RF, 20 mm
												JT, 70°, FE SN, PR, S

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295669.4 m E 6253677.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	85.70 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							***Rock Substance***				***Rock Mass Defects***	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ●- Axial ○- Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Observed	71	5.37m - Is(50) d=0.75 a=0.75 **5.60m** MPa	93	79.7	6		SANDSTONE: medium grained, light brown, well developed rock fabric. (continued)				BP, 0°, FE SN, UN, RF JT, 45°, FE SN, PR, S Highly fractured BP, 0°, FE SN, PR, RF
		23	C-2 6.51m - Is(50) d=1.02 a=1.13 MPa **6.90m**	35				No Core: 850 mm.				
		100	C-3 7.23m - Is(50) d=0.12 a=0.35 MPa 7.35m	100	78.7	7		SANDSTONE: medium grained, light brown, well developed rock fabric, indistinct bedding. SHALE: pale brown and grey, poorly developed rock fabric, iron staining observed.				Highly fractured BP, 5°, FE SN, UN, S
		86	C-4 8.33m - Is(50) d=0.08 a=0.04 MPa **9.40m**	100	77.7	8		Becomes grey. Becomes grey and orange.				Highly fractured with clay infill BP, 0°, FE SN, ST, S BP, 0°, FE SN, PR, S BP, 20°, FE SN, UN, RF BP, 0°, FE SN, PR, S JT, 70°, FE SN, PR, S
		79	C-5 9.50m - Is(50) d=0.01 a=0.08 MPa	100	76.7	9						Highly fractured JT, 45°, FE SN, PR, S JT, 45°, FE SN, PR, S BP, 0°, FE SN, PR, RF BP, 5°, FE SN, UN, RF BP, 0°, FE SN, ST, S

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Borehole ID
CH01

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295669.4 m E 6253677.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	85.70 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Material Description	Defect Descriptions / Comments
NMLC	Not Observed	79 (10.9m)	10.75m - Is(50) d=0.07 a=0.18 MPa	100			SHALE: grey orange, poorly developed rock fabric, iron staining observed. (continued) Becomes dark grey.	Highly fractured; BP, 10°, FE SN, PR, S; BP, 0°, FE SN, PR, S; Highly fractured
					74.7	11	Hole Terminated at 10.90 m Target depth	
					73.7	12		
					72.7	13		
					71.7	14		

Column headings: Drilling Information; Rock Substance — Graphic Log; Material Description: ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components; Weathering (XW HW MW SW FR); Strength Is(50) (● - Axial, ○ - Diametral; VL 0.1 L 0.3 M 1 H 3 VH 10 EH); Rock Mass Defects — Defect Spacing (mm) (<20 60 200 600 1000); Defect Descriptions / Comments: Description, alpha/beta, infilling or coating, shape, roughness, thickness, other

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

JOB NO:	PSM4252	**BH ID:**	CH01
PROJECT:	Mamre Road	**FROM:**	2.9 m
LOCATION:	Kemps Creek	**TO:**	7.0 m
DATE:	22/10/2020		

Aliro Group

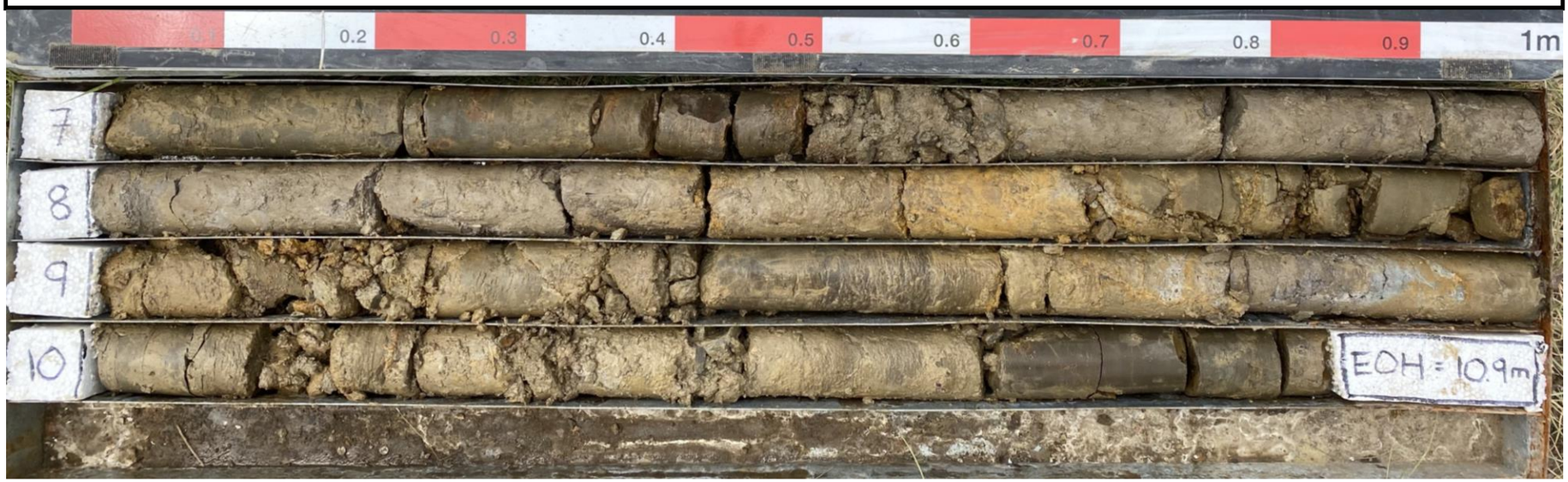
Mamre Road

Kemps Creek

CORE PHOTOS CH01
(Core Photo 1 of 2)

PSM4252-002L	Appendix A

JOB NO:	PSM4252	**BH ID:**	CH01
PROJECT:	Mamre Road	**FROM:**	7.0 m
LOCATION:	Kemps Creek	**TO:**	10.9 m
DATE:	22/10/2020		



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Mamre Road

Kemps Creek

CORE PHOTOS CH01
(Core Photo 2 of 2)

PSM4252-002L	Appendix A

Borehole ID

CH02

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295350.6 m E 6253926.7 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	73.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density / Hand Penetrometer UCS (kPa)	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- ES 0.80 m - SPT: 1.00 - 1.45 m 3, 10, 14 N = 24		72.5	1		SP	SAND: dark brown, fine grained, rootlets observed.	D	F	0.00: Topsoil.
									CL-CI	Sandy CLAY: low to medium plasticity, dark brown, fine grained.		St	0.20: Inferred Natural Soil.
									CI	CLAY: medium plasticity, grey and pale orange.		VSt	1.00: SPT recovered: 450/450 mm.
						71.5	2			SHALE: grey and pale orange, extremely weathered, very low strength.			1.90: Inferred Bedrock. V-bit refusal.
AD/T		N				70.5	3			Becomes grey.			
						69.5	4			Becomes low strength.			4.00: Based on increased drilling resistance.
										Becomes dark grey.			

Hand Penetrometer UCS (kPa): 100 200 300 400 500

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295350.6 m E 6253926.7 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	73.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			67.5	6			SHALE: grey and pale orange, extremely weathered, very low strength. (continued)				
						66.5	7							
										Continued on cored borehole sheet				
						65.5	8							
						64.5	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID
CH02

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295350.6 m E 6253926.7 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting: 24 tonnes truck mounted — Inclination: -90° — RL Surface: 73.50 m
Barrel Type and Length: NMLC 3 m — Bearing: — Datum: AHD — Operator: JK Drilling

Drilling Information | **Rock Substance** | **Rock Mass Defects**

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering	Strength Is(50) ● - Axial ○ - Diametral	Defect Spacing (mm)	Defect Descriptions / Comments: Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					67.5	6						
					66.5	7						
			7.20m					Continued from non-cored borehole sheet				
NMLC	Not Observed	79	C-1	92			No core	No core: 250 mm.				
			7.68m - Is(50) d=1.6 a=1.43 MPa				Sandstone	SANDSTONE: medium grained, dark brown, developed rock fabric.	MW	H	200–600	
					65.5	8	Shale	SHALE: dark grey, poorly developed rock fabric, thinly laminated bedding.	MW	M	<20	Highly fractured
												JT, 60°, FE SN, PR, S
												BP, 20°, FE SN, CU, S
			8.55m - Is(50) d=0.15 a=0.49 MPa									BP, 5°, FE SN, PR, S
												SM, 0°, RF, 10 mm
					64.5	9						BP, 0°, FE SN, PR, RF
									HW			BP, 5°, FE SN, PR, S
												BP, 5°, FE SN, CU, RF
			9.58m - Is(50) d=0.01 a=0.36 MPa									BP, 0°, FE SN, CU, S
												BP, 10°, FE SN, UN, RF
			10.00m									BP, 0°, FE SN, UN, S

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	22/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	22/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295350.6 m E 6253926.7 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	73.50 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Rock Substance														Rock Mass Defects		
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW	HW	MW	SW	FR	Strength Is(50) ●- Axial ○- Diametral VL 0.1	L 0.3	M 1	H 3	VH 10	EH	Defect Spacing (mm) <20	60	200	600	1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
		79	10.20m	92				SANDSTONE: medium grained, dark brown, developed rock fabric.*(continued)*							○		●							BP, 0°, FE SN, PR, S
			Is(50) d=0.05 a=0.72 MPa					Hole Terminated at 10.20 m Target depth																
					62.5	11																		
					61.5	12																		
					60.5	13																		
					59.5	14																		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

JOB NO:	PSM4252	**BH ID:**	CH02
PROJECT:	Mamre Road	**FROM:**	7.2 m
LOCATION:	Kemps Creek	**TO:**	10.2 m
DATE:	22/10/2020		

Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS CH02
(Core Photo 1 of 1)

PSM4252-002L	Appendix A

Borehole ID

CH03

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294940.6 m E 6254150.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	1 LB 0.50-1.00 m - ES 0.70 m - SPT: 1.00 - 1.45 m 2, 4, 12 N = 16		62.5	1		CI	Sandy CLAY: medium plasticity, dark brown, fine grained sand, rootlets observed.		F	0.00: Topsoil. 0.10: Infered Natural Soil.
									CI	CLAY: medium plasticity, brown and orange.		St	
									CI	Becomes brown and light orange.	M		1.00: SPT recovered: 300 / 450 mm.
									CI	Fragments of shale observed.		VSt	
AD/T		N				61.5	2			SHALE: grey with pale orange, extremely weathered, very low strength.			2.00: Infered Bedrock. V-bit refusal.
						60.5	3			Becomes grey.			
						59.5	4						
										Continued on cored borehole sheet			

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294940.6 m E 6254150.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.50 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial O - Diametral VL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					62.5	1						
					61.5	2						
					60.5	3						
					59.5	4						
								Continued from non-cored borehole sheet				
NMLC	Not Observed	76	4.50m C-1	93				No core: 200 mm.				
								SHALE: grey, poorly developed rock fabric, thinly laminated bedding.	HW	VL	200	Highly fractured

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294940.6 m E 6254150.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.50 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Observed	76	5.86m - Is(50) d=0.04 a=0.22 MPa 6.17m - Is(50) d=0.27 a=0.06 MPa	93	57.5	6		SHALE: grey, poorly developed rock fabric, thinly laminated bedding.*(continued)*				BP, 0°, FE SN, PL, S BP, 5°, FE SN, PL, S SM, 0°, FE SN, PL, RF, 10 mm carbonaceous infill BP, 0°, FE SN, PL, S BP, 0°, FE SN, PL, S BP, 0°, FE SN, PL, S
					56.5	7						BP, 0°, FE SN, PL, S BP, 5°, FE SN, PL, S
		7.5m C-2	7.41m - Is(50) d=0.25 a=0.34 MPa		55.5	8						BP, 5°, FE SN, UN, S SM, 0°, FE SN, PL, RF, 20 mm SM, 0°, FE SN, PL, RF, 30 mm JT, 70°, FE SN, PL, S SM, RF SN, 20 mm BP, 0°, FE SN, PR, S
		85	8.74m - Is(50) d=0.06 a=0.19 MPa	100	54.5	9						BP, 5°, FE SN, UN, S BP, 0°, FE SN, PL, S SM, 0°, RF, 20 mm BP, 0°, FE SN, PL, S BP, 5°, FE SN, PL, RF JT, 50°, FE SN, PR, S
			9.71m - Is(50) d=0.46 a=0.48 MPa									

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294940.6 m E 6254150.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.50 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial O - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Observed	85	10.13m - Is(50) d=1.86 a=2.76 MPa 10.50m	100				SHALE: grey, poorly developed rock fabric, thinly laminated bedding. (continued)				BP, 5°, FE SN, PL, S BP, 5°, FE SN, PL, RF
					52.5	11		Hole Terminated at 10.50 m Target depth				
					51.5	12						
					50.5	13						
					49.5	14						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

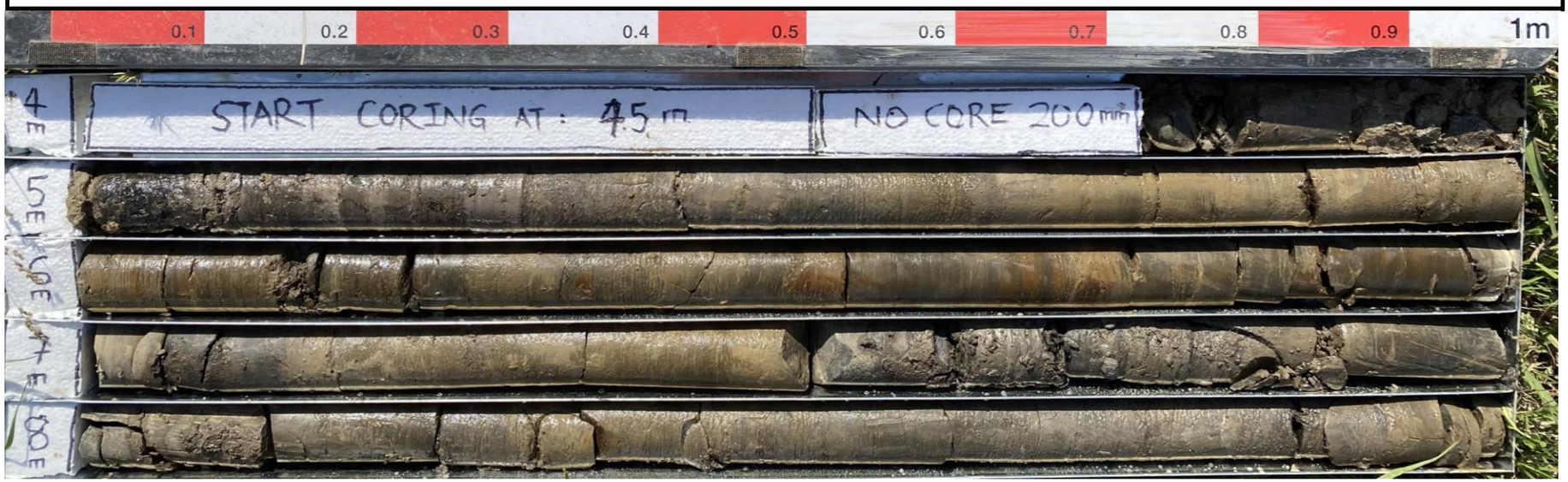
Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

JOB NO:	PSM4252	**BH ID:**	CH03
PROJECT:	Mamre Road	**FROM:**	4.5 m
LOCATION:	Kemps Creek	**TO:**	9.0 m
DATE:	23/10/2020		



Aliro Group

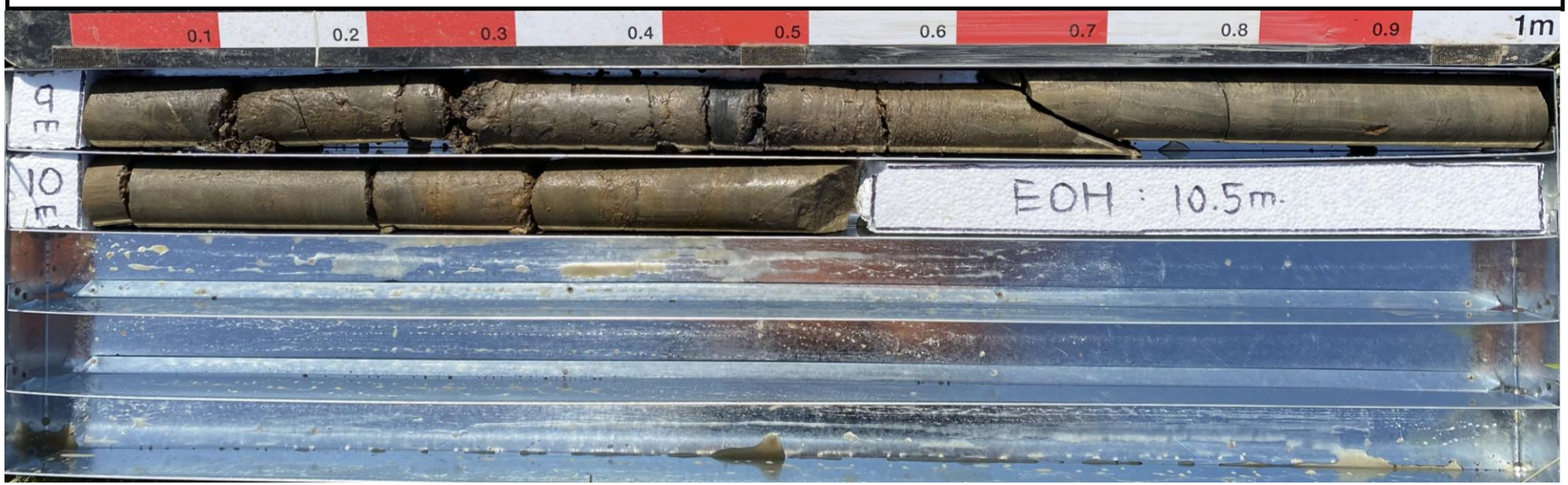
Mamre Road

Kemps Creek

CORE PHOTOS CH03
(Core Photo 1 of 2)

PSM4252-002L	Appendix A

JOB NO:	PSM4252	**BH ID:**	CH03
PROJECT:	Mamre Road	**FROM:**	9.0 m
LOCATION:	Kemps Creek	**TO:**	10.5 m
DATE:	23/10/2020		



Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS CH03
(Core Photo 2 of 2)

PSM4252-002L	Appendix A

Borehole ID

AH01

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295049.2 m E 6254167.3 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	74.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	SPT: 1.00 - 1.37 m 7, 12, 8/70 mm N=Refusal		73.5	1		SC	Clayey SAND: low plasticity, brown, fine grained.	D	F		0.00: Topsoil.
									Cl	CLAY: medium plasticity, brown and orange.				0.10: Inferred Natural Soil.
									Cl	Becomes pale orange, shale fragments observed, up to 6 mm.		St		1.00: SPT recovered: 370 / 370 mm.
												H		
									Cl	Becomes grey.				1.90: Inferred Bedrock. V-bit refusal.
AD/T		N				72.5	2			SHALE: grey, extremely weathered, very low strength.				
						71.5	3							
						70.5	4			Becomes dark grey, highly weathered, low strength.				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295049.2 m E 6254167.3 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	74.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			68.5	6			SHALE: dark grey, highly weathered, low strength. (continued)				
										Hole Terminated at 6.00 m Target depth				
						67.5	7							
						66.5	8							
						65.5	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH02

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295212.2 m E 6254151.2 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	72.70 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- ES 0.50 m					SC	Clayey SAND: medium plasticity, dark brown, fine grained sand, rootlets observed.	M	F		0.00: Topsoil.
									CI					0.10: Inferred Natural Soil.
										CLAY: medium plasticity, dark brown.		St		
				- SPT: 1.00 - 1.45 m 5, 9, 12 N = 21		71.7	1		CI	Becomes brown.	D			1.00: SPT recovered: 450 / 450 mm.
												VSt		
AD/T		N				70.7	2			SHALE: grey and pale orange, extremely weathered, very low strength.				1.70: Inferred Bedrock. V-bit refusal.
						69.7	3			Becomes grey.				
						68.7	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295212.2 m E 6254151.2 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	72.70 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			66.7	6			SHALE: grey, extremely weathered, very low strength. (continued) Becomes dark grey.				
						65.7	7			Hole Terminated at 6.00 m Target depth				
						64.7	8							
						63.7	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH03

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295277.6 m E 6253970.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	73.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa)	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- LB 0.50-1.00 m		72.0	1		SP	SAND: dark brown, fine grained.	D	F		0.00: Topsoil.
									CL-Cl	Sandy Clay: low to medium plasticity, orange and red, fine grained.		St		0.20: Inferred Natural Soil.
				- SPT: 1.00 - 1.25 m 4, 8/100 mm N=Refusal								H		1.00: SPT recovered: 250 / 250 mm.
AD/T		N				71.0	2			SANDSTONE: light brown, fine grained, highly weathered, very low strength.				1.20: Inferred Bedrock. V-bit refusal.
						70.0	3			SHALE: grey, extremely weathered, very low strength.				
						69.0	4							

Hand Penetrometer UCS (kPa): 100 200 300 400 500

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295277.6 m E 6253970.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	73.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed							SHALE: grey, extremely weathered, very low strength. *(continued)*				
						67.0	6			Hole Terminated at 6.00 m Target depth				
						66.0	7							
						65.0	8							
						64.0	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH04

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295689.3 m E 6253897.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- LB 0.50-1.00 m - ES 0.70 m - SPT: 1.00 - 1.45 m 5, 12, 16 N = 28		62.3	1		CI	CLAY with Sand: medium plasticity, dark brown, fine grained sand.	D	F		0.00: Topsoil.
									CI	CLAY: medium plasticity, red and orange, mottled grey.	M	VSt		0.10: Inferred Natural Soil. 1.00: SPT recovered: 450 / 450 mm.
						61.3	2		CI	CLAY: medium plasticity, pale orange and grey. Becomes red mottled grey.	D			
AD/T		N				60.3	3			SHALE: pale orange, extremely weathered, very low strength.				2.60: Inferred Bedrock. V-bit refusal.
						59.3	4			Becomes grey.				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295689.3 m E 6253897.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	63.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			57.3	6			SHALE: grey, extremely weathered, very low strength. (continued)				
										Hole Terminated at 6.00 m Target depth				
						56.3	7							
						55.3	8							
						54.3	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH05

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295237.0 m E 6253839.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	65.60 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N		- SPT: 1.00 - 1.45 m 3, 6, 11 N = 17		64.6	1		CL	Sandy CLAY: low plasticity, dark brown, fine grained.		F		0.00: Topsoil.
									CL-Cl	CLAY: low to medium plasticity, dark brown and red.		St		0.10: Inferred Natural Soil.
									CL-Cl	Becomes orange.	M			1.00: SPT recovered: 450 / 450 mm.
									CL-Cl	Becomes light brown mottled grey.		VSt		
AD/T		N				63.6	2			SHALE: grey, extremely weathered, very low strength.				1.80: Inferred Bedrock. V-bit refusal.
						62.6	3							
						61.6	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	295237.0 m E 6253839.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	65.60 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Soil Description						Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Water observed.			59.6	6			SHALE: grey, extremely weathered, very low strength. *(continued)* Becomes low strength.				
						58.6	7			Hole Terminated at 6.00 m Target depth				
						57.6	8							
						56.6	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH06

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294723.4 m E 6253914.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	46.60 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- ES 0.60 m - SPT: 1.00 - 1.45 m 8, 7, 10 N = 17		45.6	1		SP	SAND: dark brown, fine grained.	D	F		0.00: Topsoil.
									CL-CI	CLAY: low to medium plasticity, orange mottled grey.		St		0.10: Inferred Natural Soil.
														1.00: SPT recovered: 250 / 450 mm.
									CL-CI	Becomes orange and grey.		VSt		
AD/T		N				44.6	2			SHALE: grey, extremely weathered, very low strength.				1.60: Inferred Bedrock. V-bit refusal.
						43.6	3							
						42.6	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

AH06

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	23/10/2020
Project Name:	Mamre Road, Kemps Creek	Completed:	23/10/2020
Hole Location:	Mamre Road Kemps Creek	Logged By:	DT
Hole Position:	294723.4 m E 6253914.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	24 tonnes truck mounted	Inclination:	-90°	RL Surface:	46.60 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N								SHALE: grey, extremely weathered, very low strength. *(continued)*				
										Becomes low strength.				5.25: T-bit refusal.
										Hole Terminated at 5.25 m Target depth				
						40.6	6							
						39.6	7							
						38.6	8							
						37.6	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

A2 – 2022 Site Investigation

Borehole ID

BH01

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	SPT@0.5m 3,8,28 N=36		81.0	1		CH	Silty CLAY: high plasticity, dark brown.	M	F to St		0.00: TOPSOIL: grass on surface
									CH	CLAY: high plasticity, dark brown	D	H		0.10: NATURAL
AD/T		N				80.0	2			SHALE: dark brown and grey, extremely weathered to highly weathered, inferred very low to low strength				1.35: V-bit refusal Bedrock
						79.0	3							
						78.0	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			76.0	6			SHALE: dark brown and grey, extremely weathered to highly weathered, inferred very low to low strength *(continued)*				
						75.0	7							
						74.0	8							
						73.0	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			71.0	11			SHALE: dark brown and grey, extremely weathered to highly weathered, inferred very low to low strength *(continued)*				
						70.0	12			Continued on cored borehole sheet				
						69.0	13							
						68.0	14							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering RS XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral EL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
					71.0	11		Continued from non-cored borehole sheet				
NMLC	Not Observed		87	Is(50) d=0.09 a=0.27 MPa	70.0	12		LAMINITE: SHALE (90%) and SANDSTONE (10%) SANDSTONE: medium coarse grained, grey SHALE: dark grey, well developed, thinly bedded, spaced 1-3mm				BP, 5°, CL, UN, S BP, 5°, CL, UN, S BP, 5°, CL, UN, S BP, 5°, CL, UN, S BP, 0°, CL, PR, S CZ, 45°, CL, IR, RF
				Is(50) d=0.04 a=0.08 MPa	69.0	13		LAMINITE: SHALE (70%) and SANDSTONE (30%) SANDSTONE: medium coarse grained, grey, thinly bedded SHALE: grey, thinly bedded, spaced 2-5mm				BP, 0°, CL, UN, S JT, 60°, CL, PR, S JT, 60°, CL, PR, S CZ, 3mm
			92	Is(50) d=0.18 a=0.25 MPa	68.0	14						BP, 30°, CN, UN, RF

Method
AS - auger screwing
AD - auger drilling
CB - claw of blade bit
WB - washbore
NMLC - wireline core (51.9 mm)
NQ - wireline core (47.6 mm)
HQ - wireline core (63.5 mm)
PQ - wireline core (85.0 mm)
SPT- standard penetration test

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering and Strength
RS - Residual Soil
CW - Completely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
UW - Unweathered
VW - Very Weak
W - Weak
MS - Moderately Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Defect Type
BS - Bedding Shear
PT - Parting
JT - Joint
SZ - Shear Zone
SS - Shear Surface
CO - Contact
CS - Crushed Seam
SM - Seam

Coating
KL - Clean
SN - Stain
VN - Veneer
CO - Coating
SU - Sulphides
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
KT - Chlorite
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL- Polished
SO - Smooth
RO - Rough
VR - Very Rough

Planarity
PL - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering RS XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral EL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
NMLC	Not Observed		92	Is(50) d=0 MPa Is(50) a=0.37 MPa	66.0	16		LAMINITE:SANDSTONE (70%) and SHALE (30%) SANDSTONE: medium-coarse grained, grey SHALE: dark grey, thinly bedded, spaced 2-5mm*(continued)* Becomes grey at 15.40m				BP, 30°, CN, UN, RF BP, 5°, CN, PR, RF BP, 5°, CN, PR, S BP, 10°, CN, PR, S
					65.0	17						JT, 85°, CN, PR, S BP, 10°, CL, UN, RF
			100	Is(50) d=0 a=0.36 MPa Is(50) d=0.52 a=0.47 MPa	64.0	18		SHALE: dark grey, well developed, thinly bedded				BP, 0°, CN, ST, S
					63.0	19						SM, CL, 3mm CZ, RF, 5mm
				Is(50) d=0.4 a=0.41 MPa								BP, 0°, CL, PR, S, 3mm

Method
AS - auger screwing
AD - auger drilling
CB - claw of blade bit
WB - washbore
NMLC - wireline core (51.9 mm)
NQ - wireline core (47.6 mm)
HQ - wireline core (63.5 mm)
PQ - wireline core (85.0 mm)
SPT- standard penetration test

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering and Strength
RS - Residual Soil
CW - Completely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
UW - Unweathered
VW - Very Weak
W - Weak
MS - Moderately Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Defect Type
BS - Bedding Shear
PT - Parting
JT - Joint
SZ - Shear Zone
SS - Shear Surface
CO - Contact
CS - Crushed Seam
SM - Seam

Coating
KL - Clean
SN - Stain
VN - Veneer
CO - Coating
SU - Sulphides
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
KT - Chlorite
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL- Polished
SO - Smooth
RO - Rough
VR - Very Rough

Planarity
PL - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	25/05/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	25/05/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295135.4 m E 6254151.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	3-tonne track mounted	Inclination:	-90°	RL Surface:	82.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Matrix Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering RS XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral EL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
NMLC	Not Observed		100	Is(50) d=0.2 a=0.5 MPa				SHALE: dark grey, well developed, thinly bedded*(continued)*		○●		
					61.0	21		Hole Terminated at 20.60 m				
					60.0	22						
					59.0	23						
					58.0	24						

Method
- AS - auger screwing
- AD - auger drilling
- CB - claw of blade bit
- WB - washbore
- NMLC - wireline core (51.9 mm)
- NQ - wireline core (47.6 mm)
- HQ - wireline core (63.5 mm)
- PQ - wireline core (85.0 mm)
- SPT- standard penetration test

Water
- Level (Date)
- Inflow
- Partial Loss
- Complete Loss

Graphic Log/Core Loss
- Core recovered (hatching indicates material)
- No core recovery

Weathering and Strength
- RS - Residual Soil
- CW - Completely Weathered
- HW - Highly Weathered
- MW - Moderately Weathered
- SW - Slightly Weathered
- UW - Unweathered
- VW - Very Weak
- W - Weak
- MS - Moderately Strong
- S - Strong
- VS - Very Strong
- ES - Extremely Strong

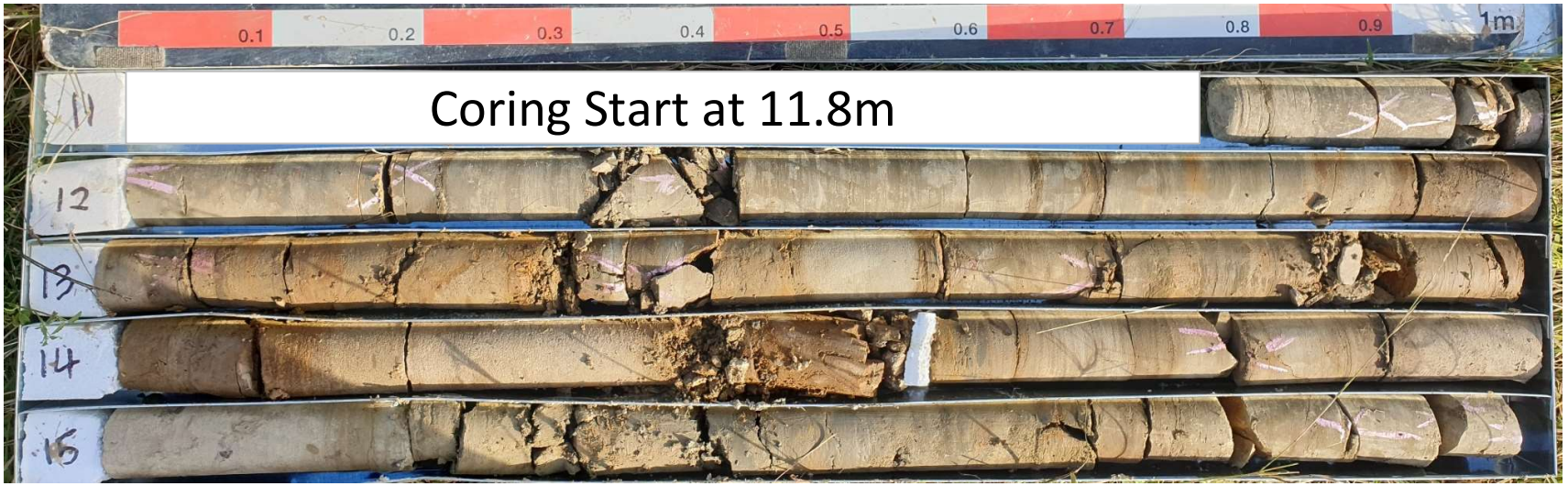
Defect Type
- BS - Bedding Shear
- PT - Parting
- JT - Joint
- SZ - Shear Zone
- SS - Shear Surface
- CO - Contact
- CS - Crushed Seam
- SM - Seam

Coating
- KL - Clean
- SN - Stain
- VN - Veneer
- CO - Coating
- SU - Sulphides
- RF - Rock fragments
- G - Gravel
- S - Sand
- Z - Silt
- CA - Calcite
- CL - Clay
- FE - Iron
- KT - Chlorite
- QZ - Quartz
- X - Carbonaceous

Roughness
- SL - Slickensided
- POL- Polished
- SO - Smooth
- RO - Rough
- VR - Very Rough

Planarity
- PL - Planar
- CU - Curved
- UN - Undulating
- ST - Stepped
- IR - Irregular

JOB NO:	PSM4252	**BH ID:**	BH01
PROJECT:	Mamre Road	**FROM:**	11.8 m
LOCATION:	Kemps Creek	**TO:**	16.0 m
DATE:	25/05/2022		



Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH01
(Core Photo 1 of 2)

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JOB NO:	PSM4252	**BH ID:**	BH01
PROJECT:	Mamre Road	**FROM:**	16.0 m
LOCATION:	Kemps Creek	**TO:**	20.6 m
DATE:	25/05/2022		

Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH01
(Core Photo 2 of 2)

Borehole ID

BH02

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	07/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	07/06/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295368.8 m E 6253841.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	81.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	SPT@0.5m 5,12,13 N=25		80.0	1		CH	CLAY: high plasticity, dark brown.	D	VSt		0.00: TOPSOIL: grass on surface 0.10: NATURAL 1.00: Clay lumps up to gravel size (easily breakable)
				SPT@1.5m 6,7,8 N=15		79.0	2			Becomes pale grey		St		
				SPT@3.0m, 13,7, HB 25/150mm		78.0	3					H		
AD/T		N				77.0	4			SHALE: pale grey, extremely weathered to highly weathered.				3.30: V-bit refusal Bedrock 4.50: Thin laminations observed in rock fragments

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	07/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	07/06/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295368.8 m E 6253841.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	81.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log / Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			75.0	6		SHALE: pale grey, extremely weathered to highly weathered. *(continued)*				
						74.0	7						
						73.0	8		Becomes brown				
						72.0	9		Inferred strength becomes low to medium				

Continued on cored borehole sheet

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

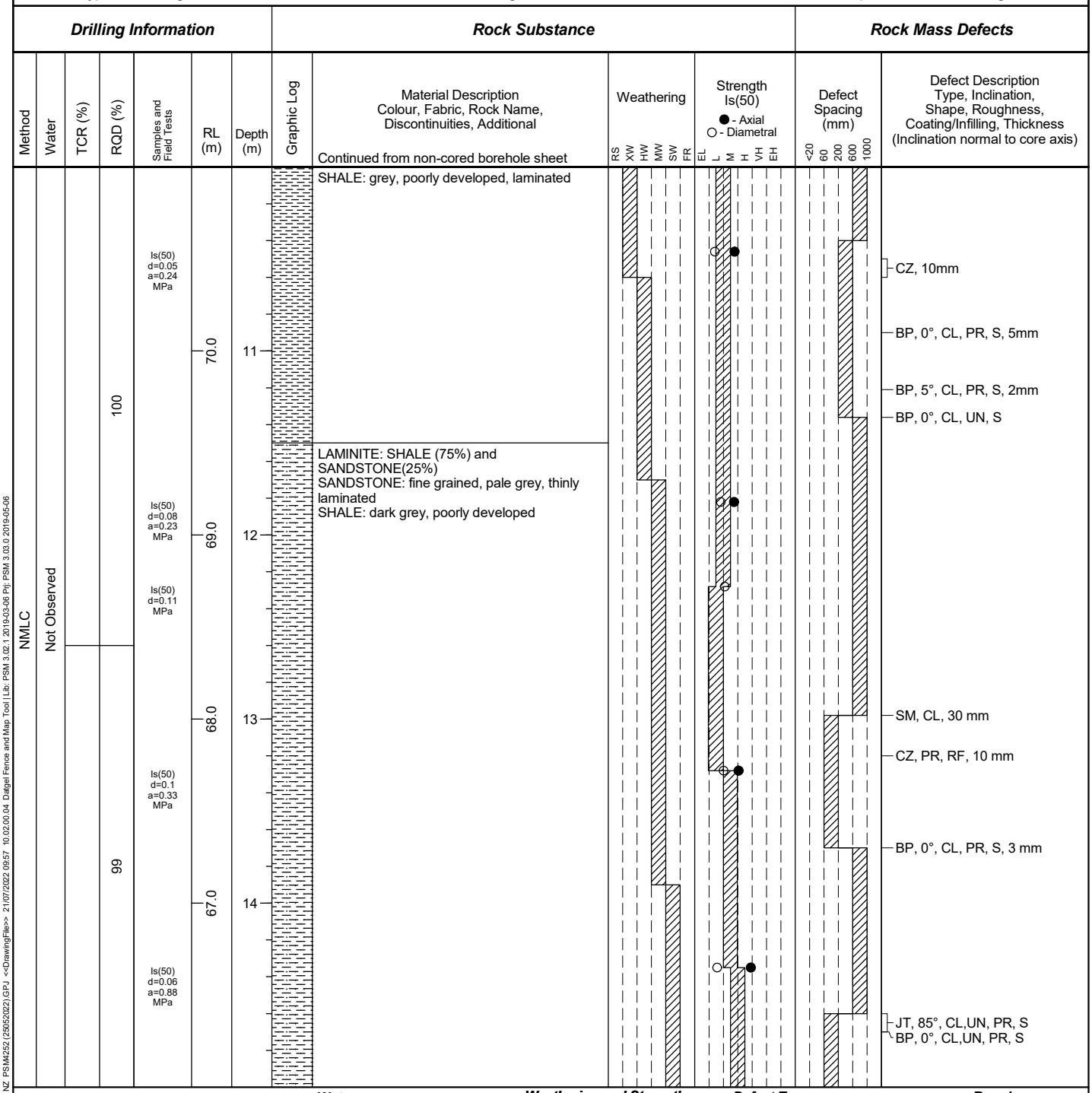
Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	07/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	07/06/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295368.8 m E 6253841.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	81.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling



Method
AS - auger screwing
AD - auger drilling
CB - claw of blade bit
WB - washbore
NMLC - wireline core (51.9 mm)
NQ - wireline core (47.6 mm)
HQ - wireline core (63.5 mm)
PQ - wireline core (85.0 mm)
SPT- standard penetration test

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering and Strength
RS - Residual Soil
CW - Completely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
UW - Unweathered
VW - Very Weak
W - Weak
MS - Moderately Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Defect Type
BS - Bedding Shear
PT - Parting
JT - Joint
SZ - Shear Zone
SS - Shear Surface
CO - Contact
CS - Crushed Seam
SM - Seam

Coating
KL - Clean
SN - Stain
VN - Veneer
CO - Coating
SU - Sulphides
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
KT - Chlorite
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL- Polished
SO - Smooth
RO - Rough
VR - Very Rough

Planarity
PL - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	07/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	07/06/2022
Hole Location:	Refer to Figure 1	Logged By:	JBL
Hole Position:	295368.8 m E 6253841.6 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	81.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information | **Rock Substance** | **Rock Mass Defects**

Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering (RS XW HW MW SW FR)	Strength Is(50) ● - Axial ○ - Diametral (EL L M H VH EH)	Defect Spacing (mm) (<20 60 200 600 1000)	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
NMLC	Not Observed		99	Is(50) d=1.27 a=1.98 MPa				LAMINITE: SHALE (75%) and SANDSTONE(25%) SANDSTONE: fine grained, pale grey, thinly laminated SHALE: dark grey, poorly developed*(continued)*				BP, 5°, CN, PR, S
												BP, 5°, CN, PR, S
			96		65.0	16						BP, 0°, CL, PR, S, 2 mm
												BP, 0°, CN, PR, S
				Is(50) d=1.1 a=2.65 MPa				LAMINITE: SANDSTONE (60%) and SHALE (40%) SANDSTONE: fine grained, pale grey, thinly laminated SHALE: dark grey, poorly developed				BP, 15°, CN, ST, S
												JT, 60°, CN, ST, S
								Hole Terminated at 16.71 m				
					64.0	17						
					63.0	18						
					62.0	19						

Method
AS - auger screwing
AD - auger drilling
CB - claw of blade bit
WB - washbore
NMLC - wireline core (51.9 mm)
NQ - wireline core (47.6 mm)
HQ - wireline core (63.5 mm)
PQ - wireline core (85.0 mm)
SPT - standard penetration test

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering and Strength
RS - Residual Soil
CW - Completely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
UW - Unweathered
VW - Very Weak
W - Weak
MS - Moderately Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Defect Type
BS - Bedding Shear
PT - Parting
JT - Joint
SZ - Shear Zone
SS - Shear Surface
CO - Contact
CS - Crushed Seam
SM - Seam

Coating
KL - Clean
SN - Stain
VN - Veneer

CO - Coating
SU - Sulphides
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
KT - Chlorite
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
SO - Smooth
RO - Rough
VR - Very Rough

Planarity
PL - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

JOB NO:	PSM4252	**BH ID:**	BH02
PROJECT:	Mamre Road	**FROM:**	10.0 m
LOCATION:	Kemps Creek	**TO:**	15.0 m
DATE:	7/06/2022		

Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH02
(Core Photo 1 of 2)

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JOB NO:	PSM4252	**BH ID:**	BH02
PROJECT:	Mamre Road	**FROM:**	15.0 m
LOCATION:	Kemps Creek	**TO:**	16.71 m
DATE:	7/06/2022		

Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH02
(Core Photo 2 of 2)

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Borehole ID

BH03

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	08/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	08/06/2022
Hole Location:	Refer to Figure 1	Logged By:	TO
Hole Position:	295256.0 m E 6254060.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	74.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	SPT@0.5m 2,7,14 N=21		73.0	1			Silty CLAY: medium to high plasticity, dark brown	M	F		0.00: TOPSOIL: grass on surface 0.05: NATURAL
										CLAY: high plasticity, orange mottled grey and brown	D	VSt		
				SPT@1.5m 11+, refusal						SHALE: pale grey, extremely weathered to highly weathered, inferred very low strength.				0.80: Inferred Bedrock
AD/T		N				72.0	2			SHALE: pale grey, extremely weathered to highly weathered, inferred low strength.				1.70: V-bit refusal
						71.0	3			Becomes highly weathered				
						70.0	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Non Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	08/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	08/06/2022
Hole Location:	Refer to Figure 1	Logged By:	TO
Hole Position:	295256.0 m E 6254060.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	74.00 m		
Hole Diameter:	120 mm	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Plasticity, behaviour or particle characteristics of primary component, colour, secondary components, additional observations	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/T		N	Not Observed			68.0	6			Becomes highly weathered *(continued)*				
						67.0	7			Continued on cored borehole sheet				
						66.0	8							
						65.0	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance
Refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	08/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	08/06/2022
Hole Location:	Refer to Figure 1	Logged By:	TO
Hole Position:	295256.0 m E 6254060.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	74.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering RS XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral EL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
					68.0	6		Continued from non-cored borehole sheet				
NMLC	Not Observed		99	Is(50) d=0.35 a=0.36 MPa Is(50) d=0.25 a=0.18 MPa	67.0	7		CLAY ZONE SHALE: dark grey and pale grey, massive, iron staining throughout. Becomes pale grey and poorly developed				CZ BP, 0°, CL & Sand, PR, RF BP, 10°, CL & Sand, PR, RF BP, 0°, CL & FE, PR, S CZ
					66.0	8		Becomes dark grey and massive SHALE: grey, indistinctly cross-bedded, poorly developed, iron staining throughout.				CZ SM, CL BP, 30°, FE, UN, S BP, 0°, FE, ST, S
			100	Is(50) d=0.21 a=0.19 MPa Is(50) d=0.03 a=0.16 MPa	65.0	9						JT, 80°, FE, PR, S JT, 70°, FE, PR, S JT, 45°, FE, PR, S

Method
- AS - auger screwing
- AD - auger drilling
- CB - claw of blade bit
- WB - washbore
- NMLC - wireline core (51.9 mm)
- NQ - wireline core (47.6 mm)
- HQ - wireline core (63.5 mm)
- PQ - wireline core (85.0 mm)
- SPT- standard penetration test

Water
- Level (Date)
- Inflow
- Partial Loss
- Complete Loss

Graphic Log/Core Loss
- Core recovered (hatching indicates material)
- No core recovery

Weathering and Strength
- RS - Residual Soil
- CW - Completely Weathered
- HW - Highly Weathered
- MW - Moderately Weathered
- SW - Slightly Weathered
- UW - Unweathered
- VW - Very Weak
- W - Weak
- MS - Moderately Strong
- S - Strong
- VS - Very Strong
- ES - Extremely Strong

Defect Type
- BS - Bedding Shear
- PT - Parting
- JT - Joint
- SZ - Shear Zone
- SS - Shear Surface
- CO - Contact
- CS - Crushed Seam
- SM - Seam

Coating
- KL - Clean
- SN - Stain
- VN - Veneer
- CO - Coating
- SU - Sulphides
- RF - Rock fragments
- G - Gravel
- S - Sand
- Z - Silt
- CA - Calcite
- CL - Clay
- FE - Iron
- KT - Chlorite
- QZ - Quartz
- X - Carbonaceous

Roughness
- SL - Slickensided
- POL- Polished
- SO - Smooth
- RO - Rough
- VR - Very Rough

Planarity
- PL - Planar
- CU - Curved
- UN - Undulating
- ST - Stepped
- IR - Irregular

Engineering Log - Cored Borehole

Project No.: PSM4252

Client:	Aliro Group	Commenced:	08/06/2022
Project Name:	Mamre Road, Kemps Creek	Completed:	08/06/2022
Hole Location:	Refer to Figure 1	Logged By:	TO
Hole Position:	295256.0 m E 6254060.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	5.4-tonne track mounted	Inclination:	-90°	RL Surface:	74.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	JK Drilling

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	Samples and Field Tests	RL (m)	Depth (m)	Graphic Log	Material Description Colour, Fabric, Rock Name, Discontinuities, Additional	Weathering RS XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral EL L M H VH EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Description Type, Inclination, Shape, Roughness, Coating/Infilling, Thickness (Inclination normal to core axis)
NMLC	Not Observed		100	Is(50) d=0.19 a=0.22 MPa				LAMINITE: pale grey and dark grey, thinly laminated, developed, Laminite; Shale (80%), Sandstone (20%), sandstone is fine grained.				BP, 0°, FE, PR, S BP, 0°, CN, PR, S BP, 10°, FE, PR, S
					63.0	11		Becomes Shale (60%), Sandstone(40%), sandstone is fine grained, indistinct laminations, developed				BP, 5°, CL & RF, PR, RF
				Is(50) d=0.38 a=0.49 MPa								
				Is(50) d=0.46 a=1.79 MPa	62.0	12						JT, 90°, CL, PR, RF
			100					SHALE: dark grey & pale grey, thinly laminated, developed.				BP, 0°, CL, PR, RF BP, 0°, CN, PR, RF BP, 0°, CL, PR, RF
					61.0	13		Hole Terminated at 13.00 m				
					60.0	14						

Method
AS - auger screwing
AD - auger drilling
CB - claw of blade bit
WB - washbore
NMLC - wireline core (51.9 mm)
NQ - wireline core (47.6 mm)
HQ - wireline core (63.5 mm)
PQ - wireline core (85.0 mm)
SPT- standard penetration test

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering and Strength
RS - Residual Soil
CW - Completely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
UW - Unweathered
VW - Very Weak
W - Weak
MS - Moderately Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

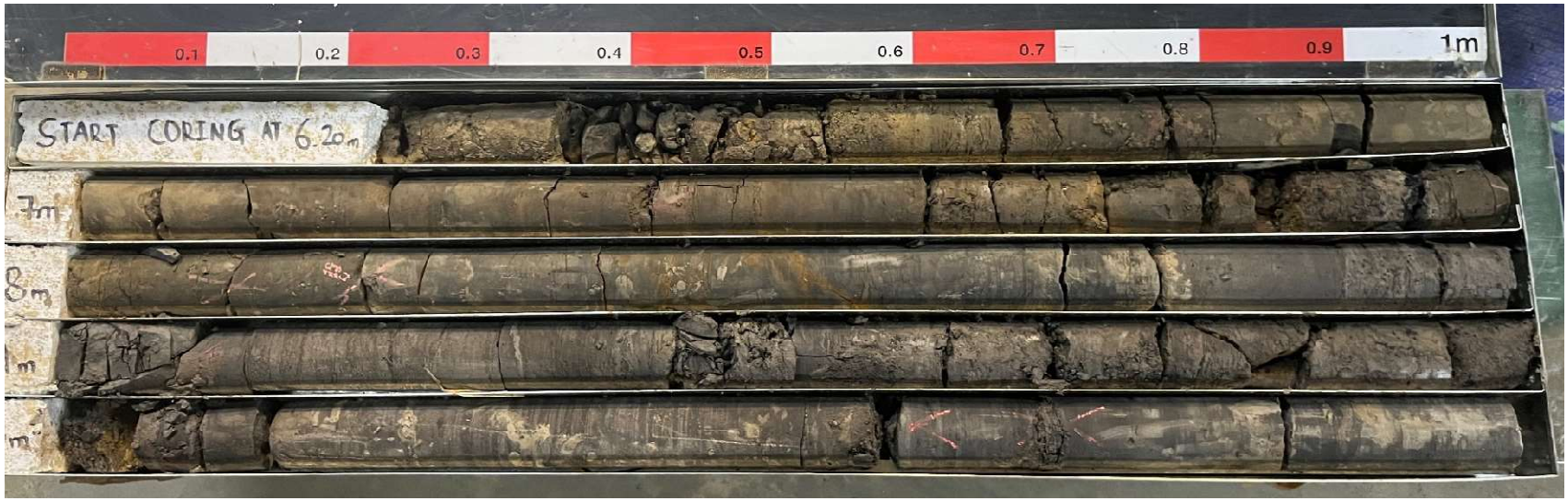
Defect Type
BS - Bedding Shear
PT - Parting
JT - Joint
SZ - Shear Zone
SS - Shear Surface
CO - Contact
CS - Crushed Seam
SM - Seam

Coating
KL - Clean
SN - Stain
VN - Veneer
CO - Coating
SU - Sulphides
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
KT - Chlorite
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL- Polished
SO - Smooth
RO - Rough
VR - Very Rough

Planarity
PL - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

JOB NO:	PSM4252	**BH ID:**	BH03
PROJECT:	Mamre Road	**FROM:**	6.2 m
LOCATION:	Kemps Creek	**TO:**	11.0 m
DATE:	8/06/2022		



Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH03
(Core Photo 1 of 2)

PSM4252-002L Rev 4	Appendix A2

JOB NO:	PSM4252	**BH ID:**	BH03
PROJECT:	Mamre Road	**FROM:**	11.0 m
LOCATION:	Kemps Creek	**TO:**	13.0 m
DATE:	8/06/2022		

Aliro Group

Mamre Road

Kemps Creek

CORE PHOTOS BH03
(Core Photo 2 of 2)

Appendix B
Point Load Test Results

B1: 2020 Site Investigation

B2: 2022 Site Investigation

B1 – 2020 Site Investigation

PSM

APPENDIX B - POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM4252*** **Sheet 1 of 1**

Project ***Mamre Road, Kemps Creek***

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*HQ3*	Sampling Date	*22 - 23/10/2020*
		Storage History	*In Field*	Testing Date	*22 - 23/10/2020*
Test Machine	*HMA 6510*	Moisture Condition	*Natural*	Tested By	*DT*
Calibration Date	*16/08/2018, 28/08/2020*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests							AS 1726 Strength Class
			D	L	P	$I_{s(50)}$	Failure Mode	W	D	L	P	I_s	$I_{s(50)}$	Failure Mode	
		(m)	(mm)	(mm)	(kN)	(MPa)		(mm)	(mm)	(mm)	(kN)	(MPa)	(MPa)		
Sandstone	***CH01***	***3.94***	*50*	*62*	*3.2*	***1.28***	*Parallel to bedding*	*50*	*24*		*2.9*	*1.9*	***1.7***	*Through substance*	***H***
Sandstone	***CH01***	***4.34***	*50*	*67*	*1.8*	***0.71***	*Parallel to bedding*	*50*	*20*		*0*	*0*	***0.01***	*Along defect*	***VL***
Sandstone	***CH01***	***5.37***	*50*	*67*	*1.9*	***0.75***	*Parallel to bedding*	*50*	*39*		*1.9*	*0.7*	***0.75***	*Through substance*	***M***
Sandstone	***CH01***	***6.51***	*50*	*48*	*2.6*	***1.02***	*Parallel to bedding*	*50*	*21*		*1.7*	*1.3*	***1.13***	*Through substance*	***H***
Shale	***CH01***	***7.23***	*50*	*66*	*0.3*	***0.12***	*Parallel to bedding*	*50*	*32*		*0.8*	*0.4*	***0.35***	*Through substance*	***VL / L***
Shale	***CH01***	***8.33***	*50*	*58*	*0.2*	***0.08***	*Parallel to bedding*	*50*	*30*		*0.1*	*0*	***0.04***	*Along defect*	***L***
Shale	***CH01***	***9.50***	*50*	*57*	*0*	***0.01***	*Along defect*	*50*	*35*		*0.2*	*0.1*	***0.08***	*Along defect*	***VL***
Shale	***CH01***	***10.75***	*50*	*57*	*0.2*	***0.07***	*Along defect*	*50*	*31*		*0.4*	*0.2*	***0.18***	*Through substance*	***VL / L***
Shale	***CH02***	***7.68***	*50*	*74*	*4*	***1.6***	*Parallel to bedding*	*50*	*38*		*3.5*	*1.4*	***1.43***	*Through substance*	***L / M***
Shale	***CH02***	***8.55***	*50*	*69*	*0.4*	***0.15***	*Parallel to bedding*	*50*	*33*		*1.1*	*0.5*	***0.49***	*Through substance*	***L / M***
Shale	***CH02***	***9.58***	*50*	*48*	*0*	***0.01***	*Along defect*	*50*	*26*		*0.7*	*0.4*	***0.36***	*Through substance*	***M***
Shale	***CH02***	***10.00***	*50*	*70*	*0.1*	***0.05***	*Along defect*	*50*	*39*		*1.8*	*0.7*	***0.72***	*Through substance*	***VL / H***
Shale	***CH03***	***5.86***	*50*	*74*	*0.1*	***0.04***	*Along defect*	*50*	*39*		*0.5*	*0.2*	***0.22***	*Through substance*	***VL / L***
Shale	***CH03***	***6.17***	*50*	*52*	*0.7*	***0.27***	*Parallel to bedding*	*50*	*36*		*0.1*	*0.1*	***0.06***	*Along defect*	***VL / L***
Shale	***CH03***	***7.41***	*50*	*63*	*0.6*	***0.25***	*Parallel to bedding*	*50*	*30*		*0.7*	*0.4*	***0.34***	*Through substance*	***L / M***
Shale	***CH03***	***8.74***	*50*	*72*	*0.2*	***0.06***	*Along defect*	*50*	*40*		*0.5*	*0.2*	***0.19***	*Through substance*	***VL / L***
Shale	***CH03***	***9.71***	*50*	*70*	*1.2*	***0.46***	*Parallel to bedding*	*50*	*46*		*1.4*	*0.5*	***0.48***	*Through substance*	***M***
Shale	***CH03***	***10.13***	*50*	*71*	*4.7*	***1.86***	*Parallel to bedding*	*50*	*44*		*7.5*	*2.7*	***2.76***	*Through substance*	***H***

By: ***DT*** **Checked:** ***AS*** **Date:** ***22 - 23/10/2020***

B2 – 2022 Site Investigation

PSM

APPENDIX B - POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. *PSM4252* **Sheet** 1 **of** 1

Project *Mamre Road, Kemps Creek Kemps Creek - Additional Geotechnical Investigation*

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*HQ3*	Sampling Date	*25/05/2022 - 08/06/2022*
		Storage History	*In Field*	Testing Date	*25/05/2022 - 08/06/2022*
Test Machine	*HMA 6510*	Moisture Condition	*Natural*	Tested By	*TO & JBL*
Calibration Date	*16/08/2018, 28/08/2020*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests						AS 1726 Strength Class
		(m)	D (mm)	L (mm)	P (kN)	$I_{s(50)}$ (MPa)	Failure Mode	W (mm)	D (mm)	P (kN)	I_s (MPa)	$I_{s(50)}$ (MPa)	Failure Mode	
Shale	***BH01***	***11.80***	*50*	*35*	*0.2*	***0.08***	*Parallel to bedding*	*50*	*48*	*1.5*	*0.5*	***0.5***	*Through substance*	***VL / M***
Shale	***BH01***	***12.58***	*50*	*40*	*0.2*	***0.09***	*Parallel to bedding*	*50*	*40*	*0.7*	*0.3*	***0.27***	*Through substance*	***VL***
Shale	***BH01***	***13.15***	*50*	*40*	*0.1*	***0.04***	*Parallel to bedding*	*50*	*40*	*0.2*	*0.1*	***0.08***	*Through substance*	***VL***
Laminite	***BH01***	***14.76***	*50*	*50*	*0.5*	***0.18***	*Parallel to bedding*	*50*	*47*	*0.7*	*0.2*	***0.25***	*Through substance*	***VL***
Laminite	***BH01***	***15.78***	*50*	*40*	*0*	***0***	*Parallel to bedding*	*50*	*46*				*Bad break*	
Laminite	***BH01***	***16.00***	*50*	*45*			*Bad break*	*50*	*40*	*0.9*	*0.4*	***0.37***	*Through substance*	***VL***
Shale	***BH01***	***17.60***	*50*	*55*	*0*	***0***	*Parallel to bedding*	*50*	*45*	*1*	*0.3*	***0.36***	*Through substance*	***M***
Shale	***BH01***	***18.00***	*50*	*60*	*1.3*	***0.52***	*Parallel to bedding*	*50*	*48*	*1.4*	*0.4*	***0.47***	*Through substance*	***M***
Shale	***BH01***	***19.28***	*50*	*60*	*1*	***0.4***	*Parallel to bedding*	*50*	*40*	*1*	*0.4*	***0.41***	*Through substance*	***M***
Shale	***BH01***	***20.33***	*50*	*45*	*0.5*	***0.2***	*Parallel to bedding*	*50*	*45*	*1.4*	*0.5*	***0.5***	*Through substance*	***L / M***
Shale	***BH02***	***10.46***	*50*	*50*	*0.1*	***0.05***	*Parallel to bedding*	*50*	*45*	*0.7*	*0.2*	***0.24***	*Through substance*	***VL / L***
Laminite	***BH02***	***11.82***	*50*	*55*	*0.2*	***0.08***	*Parallel to bedding*	*50*	*45*	*0.7*	*0.2*	***0.23***	*Through substance*	***VL / L***
Laminite	***BH02***	***12.28***	*50*	*45*	*0.3*	***0.11***	*Parallel to bedding*	*50*	*45*				*Bad break*	***L***
Laminite	***BH02***	***13.28***	*50*	*50*	*0.3*	***0.1***	*Parallel to bedding*	*50*	*45*	*0.9*	*0.3*	***0.33***	*Through substance*	***L / M***
Laminite	***BH02***	***14.35***	*50*	*65*	*0.2*	***0.06***	*Parallel to bedding*	*50*	*40*	*2.2*	*0.9*	***0.88***	*Through substance*	***VL / M***
Laminite	***BH02***	***15.22***	*50*	*55*	*3.2*	***1.27***	*Parallel to bedding*	*50*	*45*	*5.5*	*1.9*	***1.98***	*Through substance*	***H***
Laminite	***BH02***	***16.46***	*50*	*45*	*2.7*	***1.1***	*Parallel to bedding*	*50*	*40*	*6.7*	*2.6*	***2.65***	*Through substance*	***H***
Shale	***BH03***	***6.92***	*50*	*40*	*0.9*	***0.35***	*Parallel to bedding*	*50*	*45*	*1*	*0.3*	***0.36***	*Through substance*	***M***
Shale	***BH03***	***7.22***	*50*	*55*	*0.6*	***0.25***	*Parallel to bedding*	*50*	*45*	*0.5*	*0.2*	***0.18***	*Through substance*	***L***
Shale	***BH03***	***8.75***	*50*	*55*	*0.5*	***0.21***	*Parallel to bedding*	*50*	*45*	*0.5*	*0.2*	***0.19***	*Through substance*	***L***
Shale	***BH03***	***9.34***	*50*	*40*	*0.1*	***0.03***	*Parallel to bedding*	*50*	*35*	*0.4*	*0.2*	***0.16***	*Through substance*	***VL / L***
Shale	***BH03***	***10.56***	*50*	*45*	*0.5*	***0.19***	*Parallel to bedding*	*50*	*40*	*0.6*	*0.2*	***0.22***	*Through substance*	***L***
Shale	***BH03***	***11.32***	*50*	*45*	*1*	***0.38***	*Parallel to bedding*	*50*	*40*	*1.2*	*0.5*	***0.49***	*Through substance*	***M***
Shale	***BH03***	***12.00***	*50*	*50*	*1.1*	***0.46***	*Parallel to bedding*	*50*	*30*	*3.6*	*1.9*	***1.79***	*Through substance*	***M / H***

By: *TO & JBL* **Checked:** *AS* **Date:** *08/06/2022*

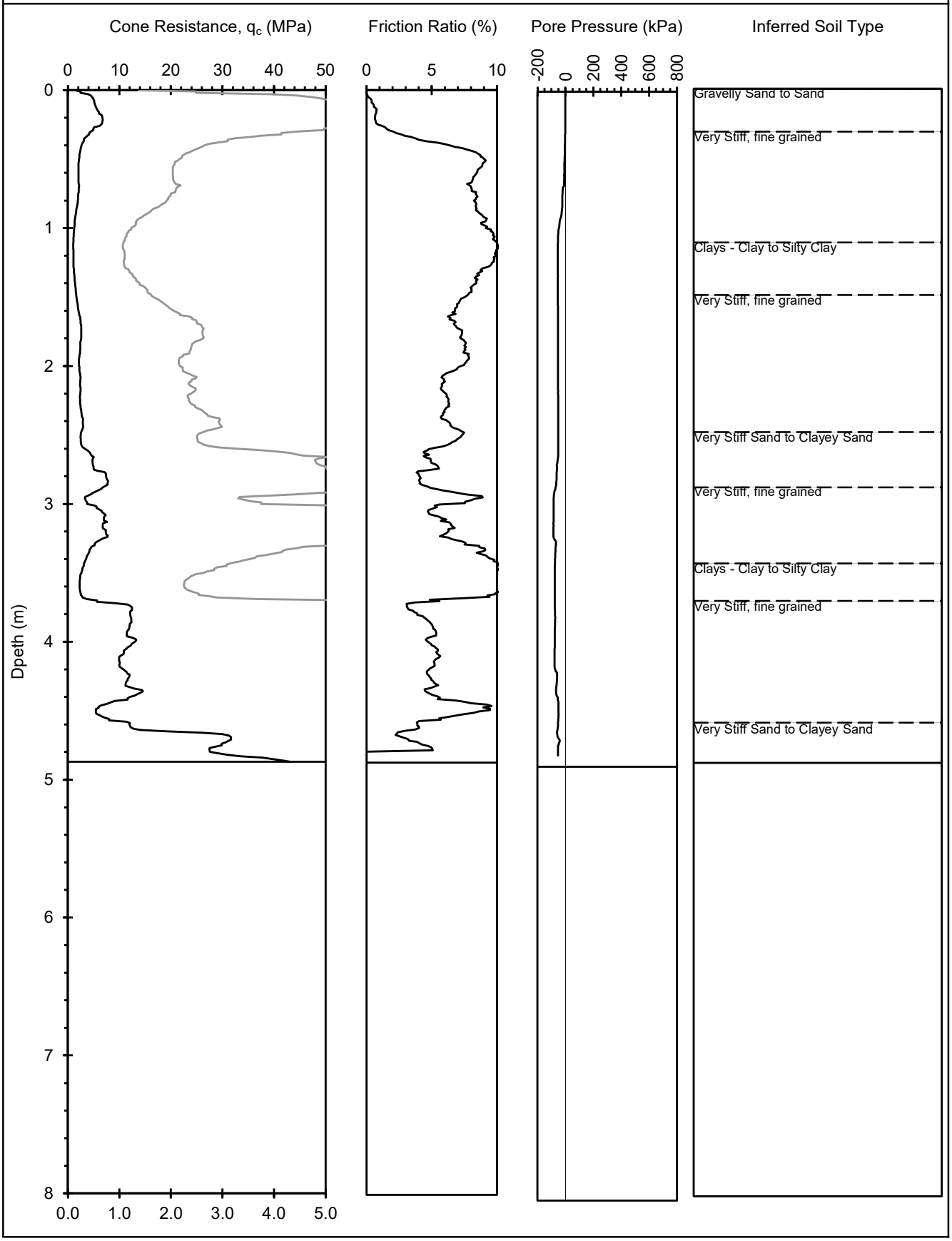
Appendix C
CPT Results

Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT01***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*294761 m E, 6254077 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*47.2 m*	Field work	*JK Drilling*

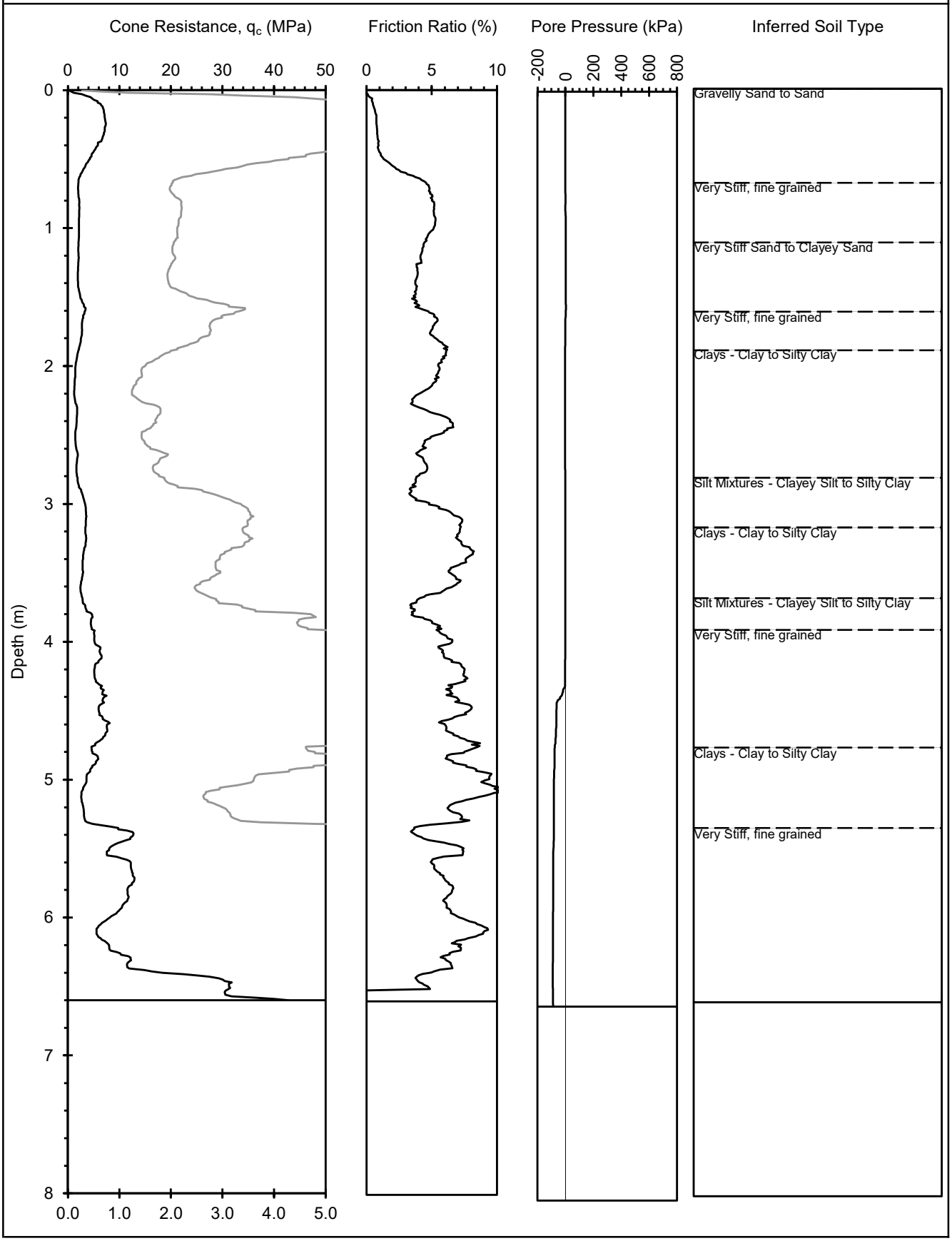


Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT02***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*294873 m E, 6253786 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*43.8 m*	Field work	*JK Drilling*

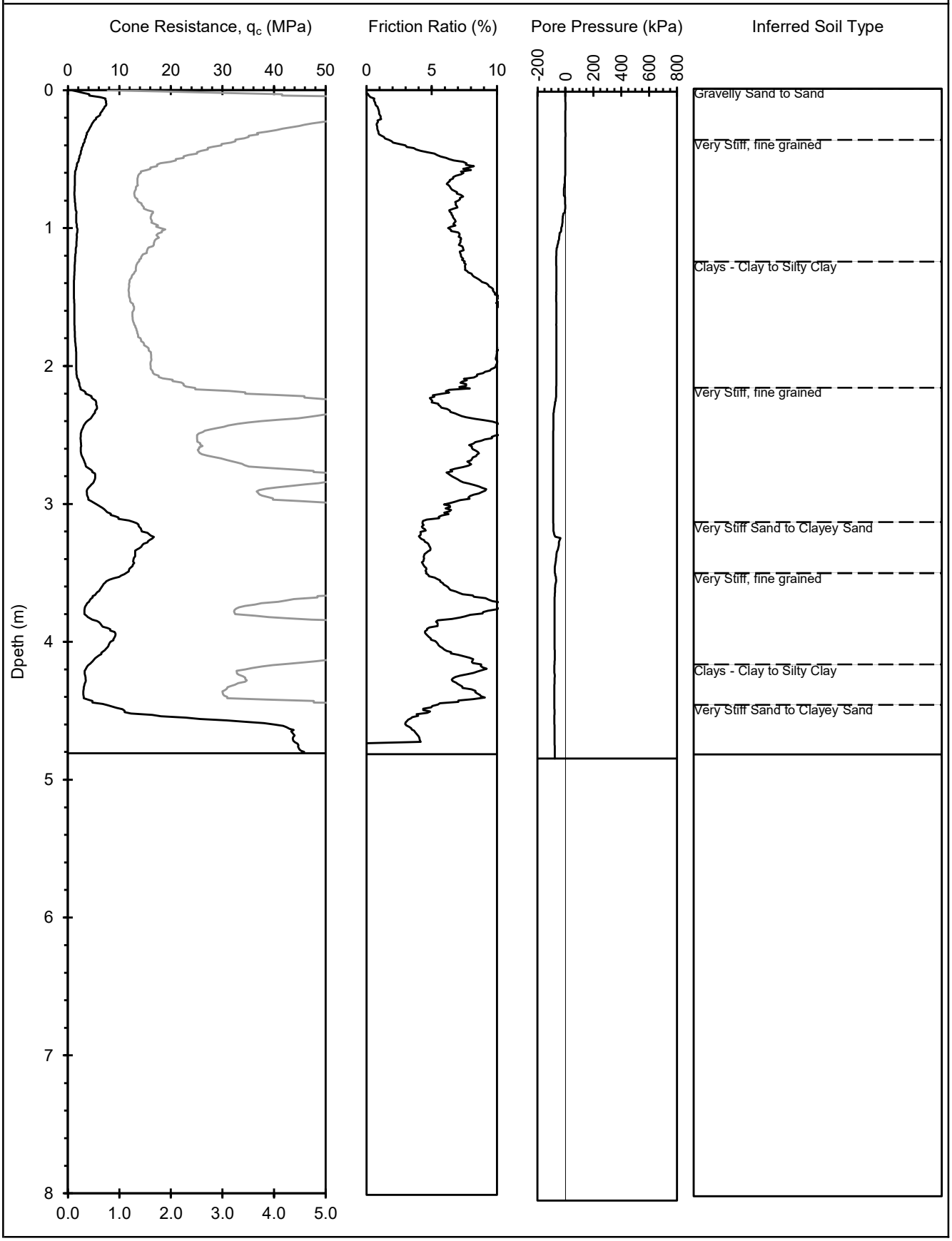


Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT03***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*295093 m E, 6253872 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*51.7 m*	Field work	*JK Drilling*

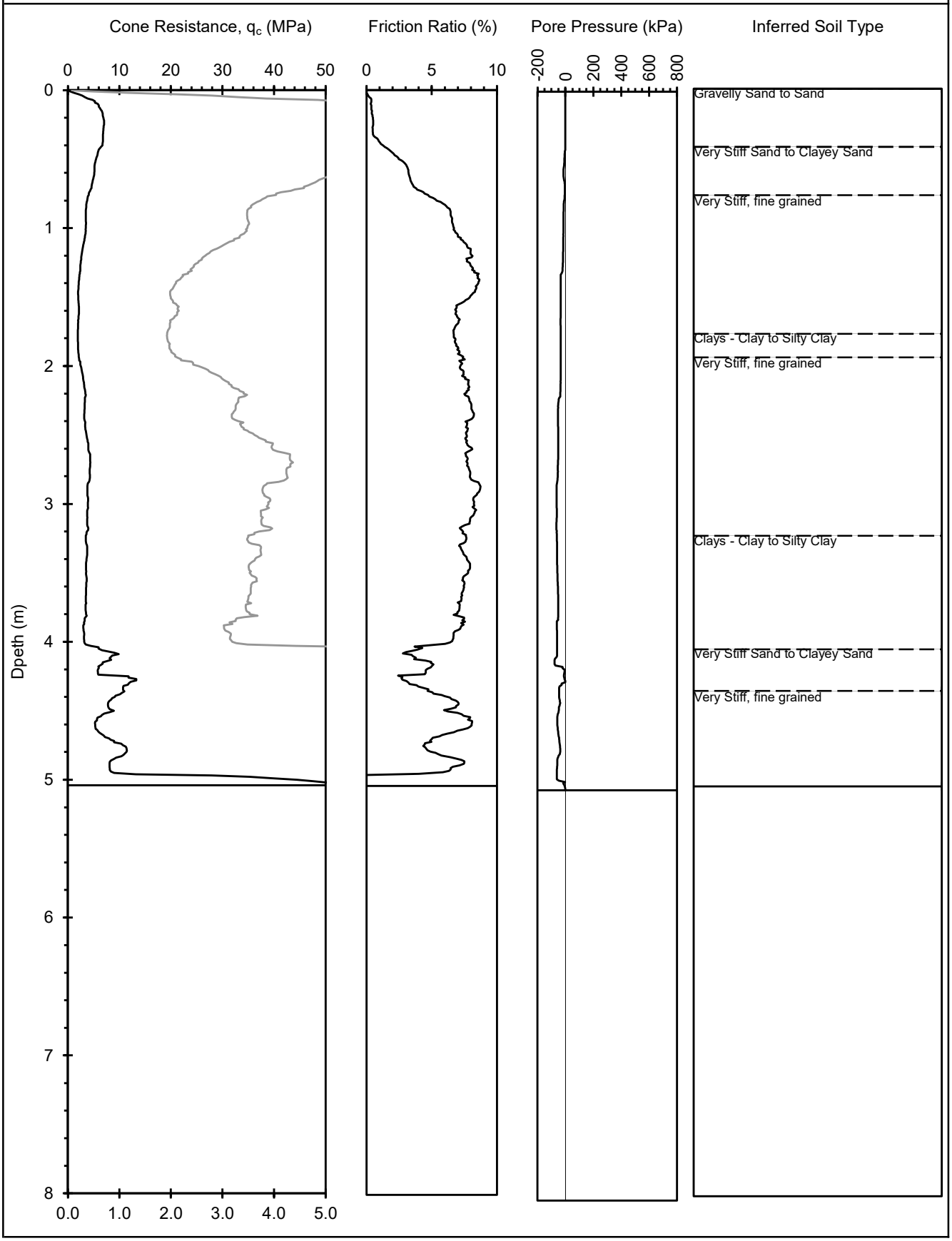


Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT04***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*295507 m E, 6253781 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*67.6 m*	Field work	*JK Drilling*

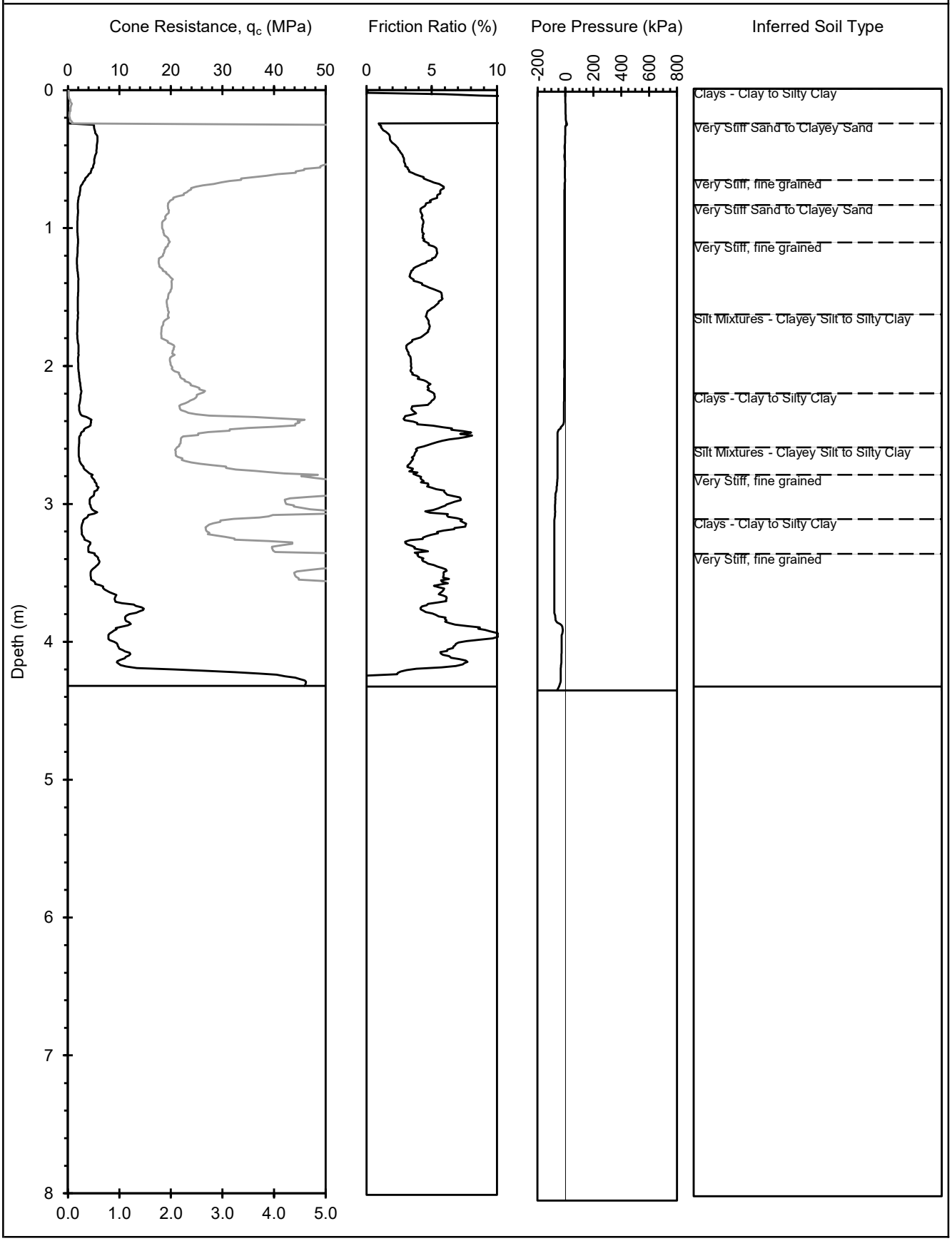


Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT05***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*295727 m E, 6254083 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*58.8 m*	Field work	*JK Drilling*

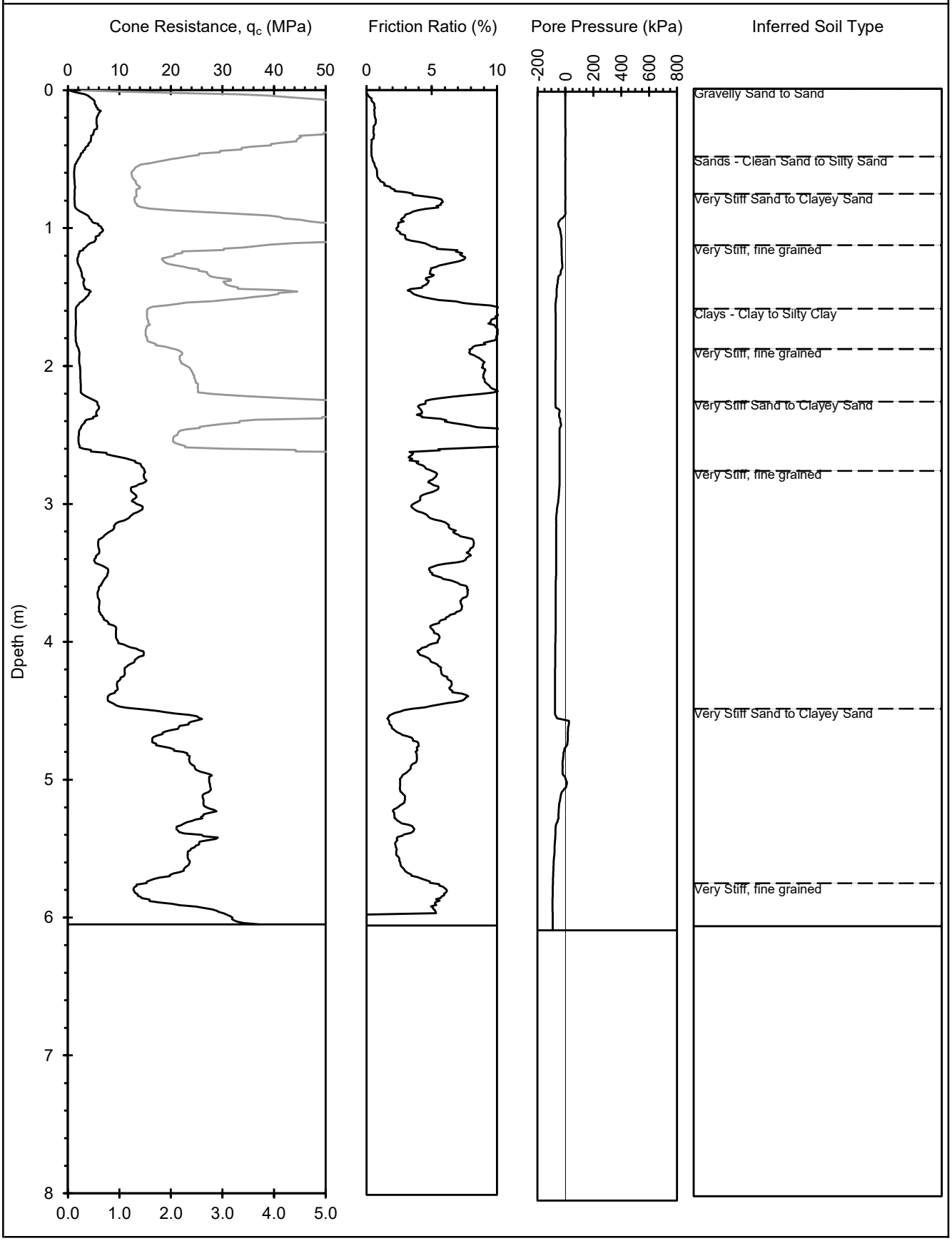


Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM4252***	**Test No.**	***CPT06***
Project	***Mamre Road, Kemps Creek***	**Page**	***1 of 1***

Pushing rig	*24-tonne truck*	Test date	*22/10/2020*
Location	*295500 m E, 6254092 m N*	Cone I.D.	*S15CFIIP.S09162*
Surface R.L.	*57.7 m*	Field work	*JK Drilling*



Appendix D
Laboratory Testing Results

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink
PSM Job No.: PSM4252

Ref No: L4509E
Report: 1
Report Date: 3/11/2020
Page 1 of 1

SAMPLE NUMBER	CBR01 AH04	CBR02 CH03	CBR03 AH03
DEPTH (m)	0.50 - 1.00	0.50 - 1.00	0.50 - 1.00
Surcharge (kg)	4.5	4.5	4.5
Maximum Dry Density (t/m^3)	1.64 STD	1.63 STD	1.64 STD
Optimum Moisture Content (%)	20.5	22.1	21.1
Moulded Dry Density (t/m^3)	1.61	1.59	1.61
Sample Density Ratio (%)	99	98	98
Sample Moisture Ratio (%)	99	102	99
Moisture Contents			
Insitu (%)	21.4	21.7	17.6
Moulded (%)	20.3	22.6	20.8
After soaking and			
After Test, Top 30mm(%)	32.0	38.4	40.3
Remaining Depth (%)	24.9	26.7	28.0
Material Retained on 19mm Sieve (%)	0	0	0
Swell (%)	2.5	3.5	5.5
C.B.R. value: @2.5mm penetration	2.5	2.0	1.5

NOTES: Sampled and supplied by client. Samples tested as received.
- Refer to appropriate notes for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.

NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.
This document shall not be reproduced except in full without approval of the laboratory. Results relate only to the items tested or sampled.

3/11/20
Authorised Signature / Date
(T. Pinnegan)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2037509**	Page	: 1 of 4
Amendment	: **1**		
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: DANIEL TAN	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: PSM4252	Date Samples Received	: 26-Oct-2020 13:30
Order number	: ----	Date Analysis Commenced	: 29-Oct-2020
C-O-C number	: ----	Issue Date	: 06-Nov-2020 11:28
Sampler	: Daniel Tan		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- Amendment (06/11/2020): This report has been amended and re-released to allow the reporting of additional analytical data.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	CH01	CH02	CH03	AH06	AH04
			Client sampling date / time	22-Oct-2020 00:00	22-Oct-2020 00:00	23-Oct-2020 00:00	23-Oct-2020 00:00	23-Oct-2020 00:00
Compound	CAS Number	LOR	Unit	ES2037509-001	ES2037509-002	ES2037509-003	ES2037509-004	ES2037509-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.9	7.7	5.8	5.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	139	400	110	99	345
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.1	14.7	15.7	13.7	19.3
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	7190	2500	9090	10100	2900
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	17.0	9.7	10.6	----	----
Exchangeable Magnesium	----	0.2	meq/100g	3.2	8.0	8.1	----	----
Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	<0.2	----	----
Exchangeable Sodium	----	0.2	meq/100g	0.6	3.7	2.6	----	----
Cation Exchange Capacity	----	0.2	meq/100g	20.9	21.3	21.4	----	----
Exchangeable Sodium Percent	----	0.2	%	3.1	17.2	12.2	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	3.7	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	7.4	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.2	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	1.9	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	15.6	----
Exchangeable Sodium Percent	----	0.1	%	----	----	----	14.2	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	0.7
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	9.1
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.2
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	2.3
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	12.4
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	18.8
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	90	10	90	190
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	280	120	50	390

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	AH02	----	----	----	----
			Client sampling date / time	23-Oct-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2037509-006	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**6.5**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**78**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**16.1**	----	----	----	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**12800**	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	<0.1	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**10**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**90**	----	----	----	----

Appendix E
PSM4252-003S Rev 1 - Bulk Earthworks Specification

Mamre Road, Kemps Creek

Bulk Earthworks Specification Filling, Cutting and Testing

PSM4252-003S Rev1 22 July 2022

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Table of Contents

List of Appendices

1. Scope

This specification details the requirements for the bulk earthworks to be undertaken at Mamre Road, Kemps Creek. The area where this specification is applicable is shown in Figure 1. This includes areas where material is filled to bulk earthworks level (BEL) within the site.

Fill placed in accordance with this specification is denoted as Engineered Fill.

This specification does not address any environmental, contamination or erosion issues with respect to the fill material.

There is a HOLD POINT on placing fill in Section 2.4 of this specification.

2. Filling Works

2.1 Subgrade Preparation

The condition of the subgrade should be assessed immediately prior to the commencement of filling.

All Engineered Fill is to be placed on one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Engineered compacted fill placed in accordance with this or other approved specifications for which the Geotechnical Inspection and Testing Authority (GITA) has a Level 1 certificate certifying compliance with that approved specification AND of at least stiff consistency.
4. Existing fill and other materials as approved by PSM.

Proof rolling shall only be undertaken under the direction of PSM. PSM may also direct a bridging layer of Engineered Fill be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) of between 95% and 102%. Any such layer shall be a Lot under Clause 5.3.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be moisture conditioned and compacted to be in accordance with Clauses 2.5 and 2.6 of this specification.

Engineered Fill shall be placed only on subgrade approved by the GITA as being in accordance with this specification.

2.2 Base Geometry and Permanent Batters

The slope of any buried batter shall be less than 2H:1V unless otherwise directed by PSM.

The contractor shall remove or flatten any geometrical obstructions (e.g. protrusions or holes) such that subsequent Engineered Fill can be placed to achieve the requirements of this specification.

Engineered Fill shall be placed only on areas where the base geometry has been approved by the GITA.

Permanent batters in fill shall be built by overfilling then cut back to the final slopes as shown in the bulk earthworks drawings, e.g. 2H:1V, or other method as approved by PSM.

2.3 Material

2.3.1 Imported Fill

Imported Engineered Fill is to conform to one of the following definitions:

1. “Virgin excavated natural material” (**VENM**) as defined by the Protection of the Environment Operations Act 1997 No 156, Schedule 1, on Page 209:

   “Virgin excavated natural material (e.g. clay, gravel, sand, soil and rock) that is not mixed with any other waste and that:

a. *has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphide ores or soils, or.*

b. *consists of excavated natural materials that meet such criteria as may be approved by the EPA".*

2. "Excavated natural material" (**ENM**) as defined under Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014:

"Excavated natural material is naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

a. *been excavated from the ground, and*

b. *contains at least 98% (by weight) natural material, and*

c. *does not meet the definition of Virgin Excavated Natural Material in the Act.*

Excavated Natural Material does not include material that has been located in a hotspot; that has been processed; or that contains asbestos, Acid Sulphate Soils (ASS), Potential Acid Sulphate soils (PASS) or sulfidic ores."

2.3.2 Site Won Material

Site won material shall comprise material won from excavations on site including natural and existing fill. Material needs to satisfy Clause 2.3.3.

2.3.3 All Fill

The Engineered Fill shall be approved by the GITA as suitable for use in a structural fill.

Engineered Fill shall not comprise unsuitable material as defined by Clause 4.3 of AS3798-2007 "Guidelines on earthworks for commercial and residential developments" as:

a. *"organic soils, such as many topsoils, severely root-affected subsoils and peat.*

b. *materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture.*

c. *materials containing substances which can be dissolved or leached out in the presence of moisture (e.g.: gypsum), or which undergo volume change or loss of strength when disturbed and exposed to moisture (e.g.: some shales and sandstones), unless these matters are specifically addressed in the design.*

d. *silts, or materials that have the deleterious engineering properties of silt.*

e. *other materials with properties that are unsuitable for the forming of structural fill; and.*

f. *fill that contains wood, metal, plastic, boulders or other deleterious material, in sufficient proportions to affect the required performance of the fill."*

The GITA shall assess that the proportion of deleterious material in each Lot is not greater than 1% by weight. Deleterious material is defined by Table 3015.3 of the RTA QA Specification 3051 (Edition 5 June 1998) as:

"Type III: Rubber, Plastic, Bitumen, Paper, Cloth, Paint, Wood and Other Vegetable Matter".

If the GITA is not able to visually assess the above criterion, the GITA shall arrange appropriate testing.

All Engineered Fill particles shall be able to be incorporated within a single layer. Further, less than 30% of particles shall be retained on the 37.5 mm sieve.

Engineered Fill shall be able to be tested in accordance with the Standard Compaction method (AS1289.5.4.1) or Hilf test method (AS1289.5.7.1). These methods require less than 20% retained on the 37.5 mm sieve. Where between 20% and 30% of particles are retained on the 37.5 mm sieve the above test methods shall still be adopted and test reports annotated appropriately.

These requirements should be met by the material after placement and compaction.

Only material approved by the GITA shall be placed as Engineered Fill.

2.4 Fill Zonation and Placement

HOLD POINT

Process Held	Placing of Fill
Submission detail	The Contractor / GITA submit to PSM a Weekly Certificate as defined in Clause 6.2.1 of this specification for the earthworks completed to the previous Saturday no later than 5 pm of the subsequent Wednesday.
Release of Hold Point	PSM to confirm receipt of Weekly Certificate and recommend release of Hold Point if initial assessment of the Weekly Certificate indicates it complies with requirements of this specification. The contract superintendent should then release the Hold Point if it considers appropriate.

2.5 Compaction

Engineered Fill shall be placed and compacted to a Dry or Hilf Density Ratios (Standard Compaction) of between 98% and 102%.

The insitu density shall be measured over the full depth of each layer placed.

2.6 Moisture Control

The placement moisture variation or Hilf moisture variation shall be controlled to be between 2% dry of optimum and 2% wet of optimum.

Placement moisture content of the Engineered Fill shall be measured.

3. Cutting

3.1 Subgrade Condition

The subgrade is to comprise one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Existing fill and other materials as approved by PSM.

Proof rolling shall only be undertaken under the direction of PSM.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be excavated and filled to the BEL in accordance with this specification.

4. Survey

4.1 Filling Areas

The survey requirements are as follows:

1. Any approved subgrade shall be surveyed prior to first filling such that subgrade levels are established to within ± 0.1 m. The area subject to approval shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
2. The Lot boundaries shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
3. The location of the field density tests shall be assessed and shown on the Lot boundary plan drawing to an accuracy of at least +/-5 m in plan.

4. The elevation of the field density tests shall be surveyed to an accuracy of +/-0.05 m.

The plan drawing shall show at the boundaries of the site and other identifiable site features, so as to allow the location of the lots and the test to be recoverable.

4.2 Cutting Areas

Any approved subgrade for cut areas shall be surveyed such that subgrade levels are established to within ± 0.1 m.

5. Inspection and Testing

5.1 Role of the GITA

The Geotechnical Inspection and Testing Authority (GITA) shall be contracted to document and certify that the works undertaken by the contractor has been completed in accordance with the relevant design and specifications.

5.2 Level 1 Control

The GITA shall adopt Level 1 responsibility as described in Section 8.2 of AS 3798-2007 "Guidelines on earthworks for commercial and residential developments":

> *"The primary objective of Level 1 Inspection and Testing is for the geotechnical inspection and testing authority (GITA) to be able to express an opinion on the compliance of the work. The GITA is responsible for ensuring that the inspection and testing are sufficient for this purpose.*
>
> *The geotechnical inspection and testing authority need to have competent personnel on site at all times while earthwork operations are undertaken. Such operations include:*
>
> - *Completion of removal of topsoil*
> - *Placing of imported or cut material*
> - *Compaction and adding/removal of moisture*
> - *Trenching and backfilling*
> - *Test rolling*
> - *Testing.*
>
> *The superintendent should agree a suitable inspection and testing plan prior to commencement of the works.*
>
> *On completion of the earthworks, the GITA will usually be required to provide a report setting out the inspections, sampling and testing it has carried out, and the locations and results thereof. Unless very unusual conditions apply, the GITA should also be able to express an opinion that the works (as far as it has been able to determine) comply with the requirements of the specification and drawings."*

For this particular contract, Level 1 responsibility includes:

1. Lot testing as per Clause 5.3 of this specification.
2. A frequency of compaction testing not less than that specified in Clause 5.4 of this specification.
3. The GITA documenting and reporting its activity in the terms required by Clause 6 of this specification.
4. The GITA undertaking adequate inspections and testing to comply with the above requirements and to be able to certify the fill in the terms required by Clause 6 of this specification.

5.3 Lot Testing

This specification requires lot testing to be undertaken.

A Lot is defined as a single layer of Engineered Fill consisting of uniform material which has undergone similar treatment.

Lot testing comprises the following:

1. A Lot shall be identified by the Contractor or the GITA with a Lot Number and presented for testing.

2. A Lot shall be deemed to be in accordance with the specification if all the tests undertaken within the Lot are in accordance with the specification, i.e. "a none to fail basis".
3. If any one test undertaken within a Lot fails, the whole of the Lot shall be reworked and retested.

Any portion of the placed Engineered Fill must be part of a single lot and all Lots will require approval by the GITA.

5.4 Testing Frequency (Compaction Testing)

The frequency of compaction testing for each lot shall not be less than the greater of:

1. For lot less than 50 m^3
   a. 1 test per lot.
2. For lot between 50 m^3 and 100 m^3
   a. 2 tests per lot.
3. For lot greater than 100 m^3
   a. 1 test per 500 m^3 of material placed.
   b. 3 tests per lot.

A laboratory moisture content test shall be undertaken for each field density test.

5.5 Proof Rolling and Plate Load Testing

Proof rolling, together with minor boxing out and refilling, of the upper surface of the bulk earthworks will be undertaken as directed by PSM. The plant to be adopted depends upon the design loads adopted by the structural engineers for each section of the site. Any remediation of soft spots identified during proof rolling shall be undertaken in accordance with this Specification (Cl 2.5 and 2.6).

Plate load testing shall be undertaken at the direction of PSM at the following stages:

1. At final bulk earthworks level (BEL). Expected test frequency is approximately a day of testing for each building pad.

The contractor is to make a suitable reaction (e.g. 20 tonne excavator) available for the tests.

5.6 Inspection and Testing

The GITA shall at least undertake the following tasks:

Cut areas

1. Identify the subgrade as one of the three (3) subgrade types listed in Clause 3.1 of this specification and assess that the subgrade condition of cut areas is in accordance with the subgrade condition requirements of Clause 3.1 of this specification. If the cut subgrade has been approved by PSM, the GITA will be required to reference the approval in its weekly report.
2. Should Engineered Fill be required to fill overcut areas, assess that filling has been placed in accordance with this specification.

Fill areas

1. For fill areas, identify the subgrade as one of the four (4) subgrade types listed in Clause 2.1 of this specification and assess that the subgrade condition of any area prior to placement of fill material is in accordance with the subgrade preparation requirements of Clause 2.1 of this specification. For the following subgrade types, GITA needs to include / refer to PSM approval in its weekly report:
   a. Existing fill and other materials as approved by PSM.
2. Assess that the base geometry of any area prior to placement of fill material is in accordance with the base geometry requirements of Clause 2.2of this specification.
3. For each Lot, identify the material as either Site Won or Imported fill as defined in Clause 2.3 of this specification and assess that the material placed is in accordance with the fill material requirements of Clause 2.3 of this Specification.

4. Assess the proportion of deleterious material is in accordance with the requirements of Clause 2.3.3 of this Specification.
5. Assess that the Engineered Fill has been placed in accordance with the requirements for fill zonation and placement of Clause 2.4 of this specification.
6. Assess that each Lot as presented for approval by the contractor is in accordance with the requirements for Lot definition of Clause 5.3 of this specification.
7. Ensure that the survey requirements in Clause 5 of this specification have been completed.
8. Estimate the approximate volume of Engineered Fill placed in each Lot presented for approval.
9. Conduct Lot testing in accordance with the construction control testing requirements of Clauses 5.3 and 5.4 of this specification.
10. Assess that the compaction of each Lot is in accordance with the requirements of Clause 2.5 of this specification. The GITA shall select a depth of insitu density tests that allows the density of the full layer to be assessed.
11. Assess that the moisture variation of each Lot is in accordance with the requirements for moisture control in Clause 2.6 of this specification.
12. Conduct material property testing in accordance with the material testing requirements in this specification.

6. Reporting and Certification

6.1 Reporting

The GITA shall produce at least the following reports:

1. *VENM / ENM Validation Reports*. Such a report shall transmit the VENM or ENM validation certificates for the fill imported to site.
2. *Subgrade Approval Reports* (a sample is attached). Such a report shall:
   - Document assessments undertaken for tasks 1 and task 3 of Clause 5.6 including reporting the subgrade type
   - Document the subgrade survey that has been undertaken
   - Approve or reject the subgrade condition and base geometry for filling, based on tasks 3 and 4 of Clause 5.6
   - Approve or reject the subgrade condition for cut areas based on task 1.
3. *Lot Approval Reports* (a sample is attached). Such a report shall:
   - Document assessments, testing and survey undertaken for tasks 3 to 14 of Clause 5.6
   - Report material identification undertaken for task 5 of Clause 5.6
   - Report the assessed proportion of deleterious material for task 6 of Clause 5.6
   - Report the results of testing undertaken for task 11 of Clause 5.6
   - Approve or reject lots based on tasks 12 and 13 of Clause 5.6.
4. Material Testing Reports. Such a report shall:
   - Report the results of material property testing undertaken for task 14 of Clause 5.6.
5. *Daily Reports* (a sample is attached). Such a report shall be completed daily and shall:
   - Document time spent on site by the GITA personnel
   - List subgrade assessments and approvals undertaken each day with reference to relevant Subgrade Approval Report(s)
   - List Lots presented, accepted and approved or rejected each day, with reference to relevant Lot Approval Report(s)
   - List survey undertaken each day as for task 9 of Clause 5.6 and not already documented in the Subgrade or Lot Approval Reports

– Document other relevant activities undertaken on site that day (site instructions, breakdowns, compaction equipment used, etc.).

6.2 Certification

6.2.1 Weekly Certificate

The GITA shall produce a Weekly Certificate for any week in which earthworks are undertaken in accordance with this specification. The Weekly Certificate will cover all works from the previous Weekly Certificate until the end of work on a Saturday.

The Weekly Certificate shall transmit the following:

- Copy or reference to the complete specification document(s)
- Subgrade Approval Reports
- Lot Approval Reports
- Material property testing reports
- Daily Reports
- Survey of subgrade geometry prior to filling or in cut areas
- Plan survey drawing showing lot boundaries and location of density tests
- Survey documenting filling undertaken to date and showing location of testing
- Provide an Excel spreadsheet presenting the results of the week's acceptance testing completed by the GITA.

And certify that:

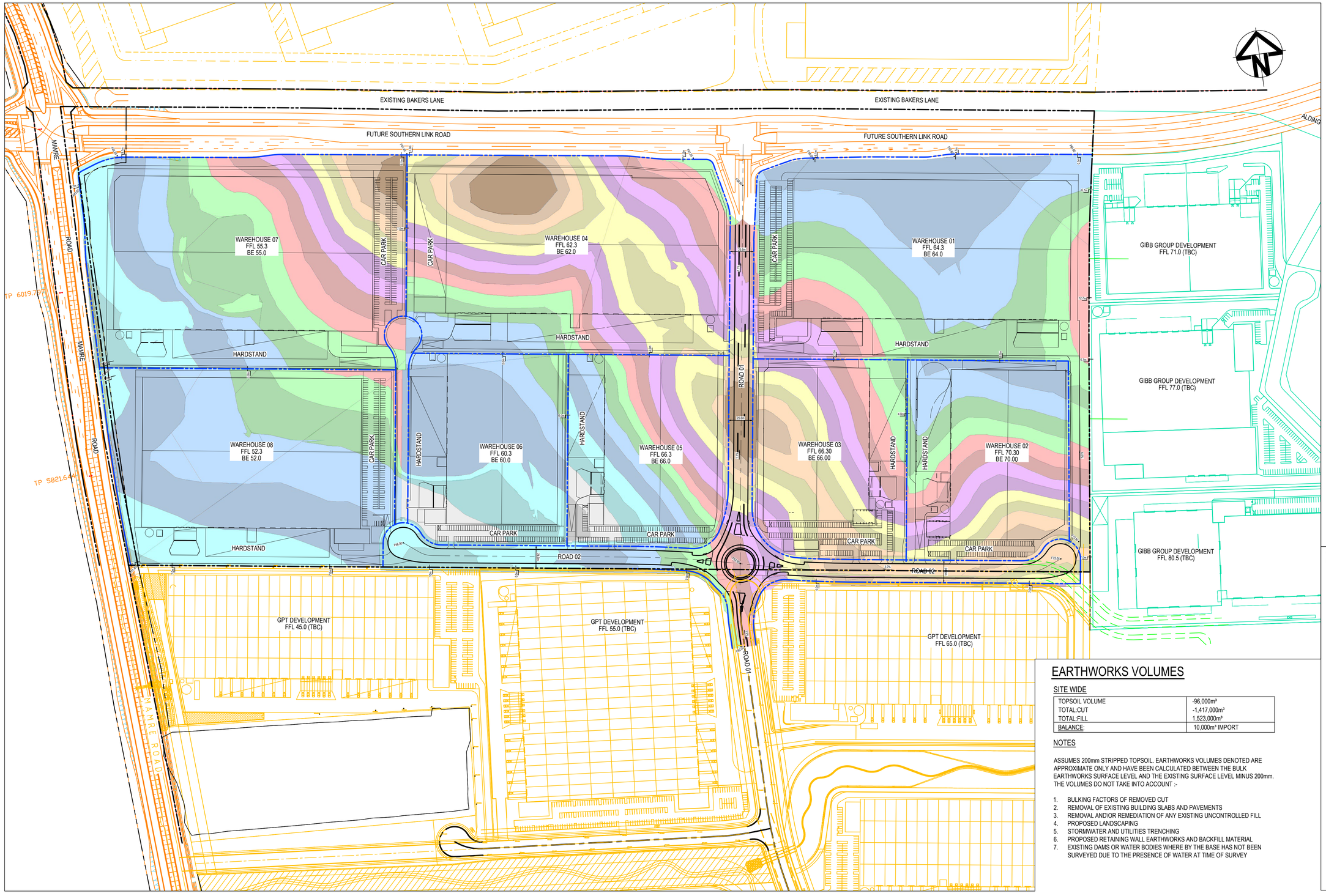
"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4252-003S Rev XX dated XXX)."

6.2.2 Interim or Final Filling Certificate

At the completion of the bulk earthworks, or as requested by the Client, the GITA shall provide an Interim or Final Filling Certificate which shall:

1. Transmit a reference list of the Weekly Certificates.
2. Provide an Excel spreadsheet presenting the results of all the acceptance testing completed by the GITA.
3. Certify that *"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4252-003S Rev XX dated XXX)."*

Appendix A
Figure 1



EARTHWORKS VOLUMES

SITE WIDE

TOPSOIL VOLUME	-96,000m³
TOTAL:CUT	-1,417,000m³
TOTAL:FILL	1,523,000m³
BALANCE:	10,000m³ IMPORT

NOTES

ASSUMES 200mm STRIPPED TOPSOIL. EARTHWORKS VOLUMES DENOTED ARE APPROXIMATE ONLY AND HAVE BEEN CALCULATED BETWEEN THE BULK EARTHWORKS SURFACE LEVEL AND THE EXISTING SURFACE LEVEL MINUS 200mm. THE VOLUMES DO NOT TAKE INTO ACCOUNT :-

1. BULKING FACTORS OF REMOVED CUT
2. REMOVAL OF EXISTING BUILDING SLABS AND PAVEMENTS
3. REMOVAL AND\OR REMEDIATION OF ANY EXISTING UNCONTROLLED FILL
4. PROPOSED LANDSCAPING
5. STORMWATER AND UTILITIES TRENCHING
6. PROPOSED RETAINING WALL EARTHWORKS AND BACKFILL MATERIAL
7. EXISTING DAMS OR WATER BODIES WHERE BY THE BASE HAS NOT BEEN SURVEYED DUE TO THE PRESENCE OF WATER AT TIME OF SURVEY

CUT\FILL DEPTH RANGE LEGEND

Lower_value		Upper_value	Colour
-21.0	to	-16.0 m	
-16.0	to	-14.0 m	
-14.0	to	-12.0 m	
-12.0	to	-10.0 m	
-10.0	to	-8.0 m	
-8.0	to	-6.0 m	
-6.0	to	-4.0 m	
-4.0	to	-2.0 m	
-2.0	to	0.0 m	
0.0	to	2.0 m	
2.0	to	4.0 m	
4.0	to	6.0 m	
6.0	to	8.0 m	
8.0	to	10.0 m	
10.0	to	12.0 m	
12.0	to	14.0 m	
14.0	to	16.0 m	

Issue	Description	Date
P4	ISSUED FOR INFROMATION	04-05-22
P3	ISSUED FOR INFROMATION	21-04-22
P2	ISSUED FOR INFROMATION	25-09-21
P1	ISSUED FOR INFORMATION	28-04-21

100mm on Original

Bar Scales

0 50 100 150 200m

1 : 2000

Client: Aliro

Scales	1 : 2000 @ A1
Grid	GDA2020
Height Datum	AHD
Drawn	GB
Designed	AMc
Checked	AMc
Approved	

GDA2020

Project: ALIRO DEVELOPMENTS BAKERS LANE

Title: CONCEPT EARTHWORKS

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

Status: FOR INFORMATION
NOT TO BE USED FOR CONSTRUCTION

A1

Project - Drawing No.: 21-855-SKC001

Issue: P4

F:\21-855 Aliro Mamre\6.0 Drgs\Civil\Sketches\21-855-SKC001 - EARTHWORKS PLAN.dwg

Appendix B
Subgrade Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

SUBGRADE APPROVAL REPORT

Client:	Contractor:
Job number:	Report number:
Project:	Technician:

Subgrade areas assessed:

Area ID	Date	Approximate extent	Subgrade description	Geometry summary	Specification reference	Compliance (Pass/Fail)	Survey reference	Approved (Yes/No)

COMMENTS:

Signed: Date:

Appendix C
Lot Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

LOT APPROVAL REPORT

Client:	Report number:
Job number:	Report date:
Project:	Technician:
Contractor:	Test methods:

LOT ID:	**Sheet of**
Retest (Yes/No)	Original test report number:
Specification reference	
Location:	
Lot boundary survey reference/location:	
Materials description:	*(MATERIAL TYPE, colour, minor components, maximum particle size)*
Material identification:	*(Identify the material as defined in Clause 2.3.1, Clause 2.3.2 or Clause 2.3.3 of the Specification)*
Deleterious material assessment:	*(Report proportion of deleterious material)*
Layer thickness:	
Accepted as Lot: (Yes/No)	Date:
Approximate volume (m3)	Number of tests required:

Test ID No.				
Test soil description				
Date tested:				
Grid reference				
Surveyed test locations (RL,E,N)				
Test depth (mm)				
Max size (mm)				
% Oversize material (wet)				
Field wet density (t/m^3)				
Field moisture content (%)				
PWCD (t/m^3)				
Compactive effort				
Moisture variation (%)				
HILF density ratio (%)				
TEST (Pass/Fail)				

LOT APPROVAL	(Pass/Fail)	Signed:	Date:

Appendix D
Daily Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

DAILY REPORT

Client:	Report number:
Job number:	Report date:
Project:	
Location:	Level of testing: Level 1
Contractor	Technician:
Time on site:	
Time off site:	

1. Subgrade Approval

Areas ID	Subgrade Approval Report No:	Comments

2. Lot Approval

Lot ID	Lot Approval Report No:	Comments

3. Survey

Type of survey	Survey undertaken by:	Reference

4. Instructions received on site

5. Instructions given on site

COMMENTS:

Signed: Date:

Appendix E
Certification Letter (Sample Only)

Our Ref:

Date:

Addressed to: Earthwork Contractor

Attention: Earthwork Contractor Representative

Dear

RE: SAMPLE INTERIM (OR FINAL) FILLING CERTIFICATE
INDUSTRIAL DEVELOPMENT, BULK EARTHWORKS
CERTIFICATION OF EARTHWORKS
BETWEEN [DATE OF COMMENCEMENT] AND [DATE OF COMPLETION]

In the period between [date start] and [date finish] the contractor has undertaken earthworks in areas XXX and XXX.

During the above period:

- The GITA has prepared the following Subgrade Approval Reports:

1. Subgrade Approval Report No 1
2. ……

- The GITA has prepared the following Lot Approval Reports:

1. Lot Approval Report No 1
2. ……

- The GITA has prepared the following Daily Reports:

1. Daily Report No 1……
2. ……

- The following subgrade survey was undertaken:

1. Subgrade Survey reference……
2. ……

- The following weekly survey was undertaken:

1. Weekly survey of week ending …….reference……..
2. ……

Copies of all the above documents are attached.

The GITA certifies that all the earthworks undertaken in the above stated period are documented in the above reports and have been undertaken in accordance with the Specifications (ref. PSM4252-003S Rev 1, dated XXX) a copy of which is attached, with the exception of:

1. List outstanding issues (not approved subgrade, lots, unsuitable material, failed tests etc.)
2. ……..

Signed

GITA