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Our Ref: PSM4352-003L REV1

28 April 2021

The GPT Group
Level 51/19 Martin Place
Sydney NSW 2000
Tom.Falconer@gpt.com.au

Attention: Tom Falconer

Dear Tom

RE: 754-770 AND 784-786 MAMRE ROAD, KEMPS CREEK - RESULTS OF GEOTECHNICAL INVESTIGATION

1. Introduction

This letter presents the results of geotechnical investigations and testing undertaken by PSM for the proposed development on 754-770 and 784-786 Mamre Road, Kemps Creek. The work has been undertaken in accordance with the PSM proposal PSM4352-001L dated 4th March 2021.

2. Background

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

- SBA Architects updated drawing 20194_SK03_P1_Site Plan_Opt3 "*Site Plan – Option 3*" dated 10 March 2021
- Costin Roe drawing Co13874.06-SKC100-A "*Preliminary Earthworks Volumes Estimates and Contours"* dated 10 March 2021
- KPMG report PSI – KPMG "*Preliminary Site Investigation*" dated 19 January 2021
- KPMG letter 388134 - 754-782 Mamre Road, Kemps Creek, NSW - Groundwater and Surface Water Sampling Event - KPMG Draft 11-11-20 "*Groundwater and Surface Water Sampling Event (GWSWSE)*" dated 11 November 2020
- Urbis report 20201005 GPT Updated Scoping Report "*Request for Secretary Environment Assessment Requirement*" dated 02 October 2020
- Costin Roe drawing CO13874.06-SK01-210308
- Costin Roe drawing CO13874.06-SK210303 "*Option A – Discharge Sketch*" dated 3 March 2021
- Costin Roe drawing CO13874.06-SK191031 Earthworks & Walls Stage 1&2 Option 1 "*Preliminary Earthworks Plan, Stage 1+2 Kemps Creek Option 1"* dated 31 October 2019
- Costin Roe drawing Level Plans "*Concept Stormwater Management Plan"* dated 29 July 2020
- Boxall drawing Site Survey Plan "*Site Detail and Levels*" dated 22 July 2020.

We understand The GPT Group's proposed development for this stage will comprise of warehouses, office combined compounds and hardstands. Bulk earthworks will be required as part of the development with:

- Cut Depths up to approximately 16 m

- Fill Depths up to approximately 10 m.

PSM have previously completed a geotechnical investigation under the request of The GPT Group for the adjacent Lot (DP708347 Lot 40) at 1-23 Aldington Road, Kemps Creek in October 2019. This consisted of one borehole drilled to a final depth of 20 m near the north-eastern corner of the current site boundary, shown in Figure 1. This informed the subsurface conditions at the steep hills near the north-eastern site boundary where deep cut depths up to approximately 16 m have been proposed. A copy of the borehole log and core photo is presented in Appendix G of this letter.

3. Geotechnical Investigation – March 2021

As requested by The GPT Group, PSM has completed a geotechnical investigation for the area.

3.1 Field Work

The fieldwork was undertaken on 15 and 16 of March 2021, under the full-time supervision of a PSM geotechnical engineer, who undertook the following tasks:

- Directed the testing locations and excavation
- Prepared tabulated engineered logs of the material encountered
- Collected disturbed soil samples for further testing.

The test locations were recorded with a hand-held GPS unit with a horizontal accuracy of approximately +/- 5 m. Figure 1 presents the approximate test locations.

3.1.1 Test Pits

A total of sixteen (16) test pits were undertaken at the proposed development using a 14-tonne excavator. Three (3) augered boreholes were drilled to a maximum depth of 5.0 m using a pendulum auger attachment to an excavator.

The test pits were excavated to depths of 2.1 m to 3.9 m. Soil samples were taken directly from the spoil or from the base of the test pit.

Prior to testing, on-site service location “scans” were undertaken by a service locator to check the test locations for buried utilities. At the completion of the fieldwork, the test pits were backfilled with excavated spoil and lightly compacted with several passes of the excavator.

Figures 2, 3 and 4 presents selected photos of the fieldwork.

3.2 Geotechnical Laboratory Results

3.2.1 California Bearing Ratio (CBR)

Five (5) bulk soil samples were recovered for the California Bearing Ratio (CBR) testing.

The following sample preparation was undertaken prior to CBR testing:

- Compact to 98% Maximum Dry Density (MDD), at optimum moisture content (OMC)
- Four (4) day-soaked sample; and
- 4.5 kg surcharge.

Table 1 presents a summary of the CBR test results. The test results are included in Appendix C.

Table 1 – CBR Test Results

Sample (Depth)	Material Description	Soaked CBR (%)	Optimum Moisture Content (%)	Standard Maximum Dry Density (t/m^3)	Swell (%)
TP01 (3.7 – 3.9 m)	CLAY with gravel	4.0*	17.3	1.82	1.5
TP05 (1.9 – 2.0 m)	CLAY	1.5*	23.0	1.60	4.0
TP06 (0.8 – 0.9 m)	CLAY	2.0*	18.9	1.70	4.0
TP11 (3.5 – 3.7 m)	CLAY	4.5**	16.5	1.84	2.0
TP18 (1.2 - 1.8 m)	CLAY	2.0**	17.8	1.76	3.0

Note: * Indicates Soaked CBR value at 2.5 mm penetration

** Indicates Soaked CBR value at 5.0 mm penetration

4. Site Conditions

4.1 Geological Setting

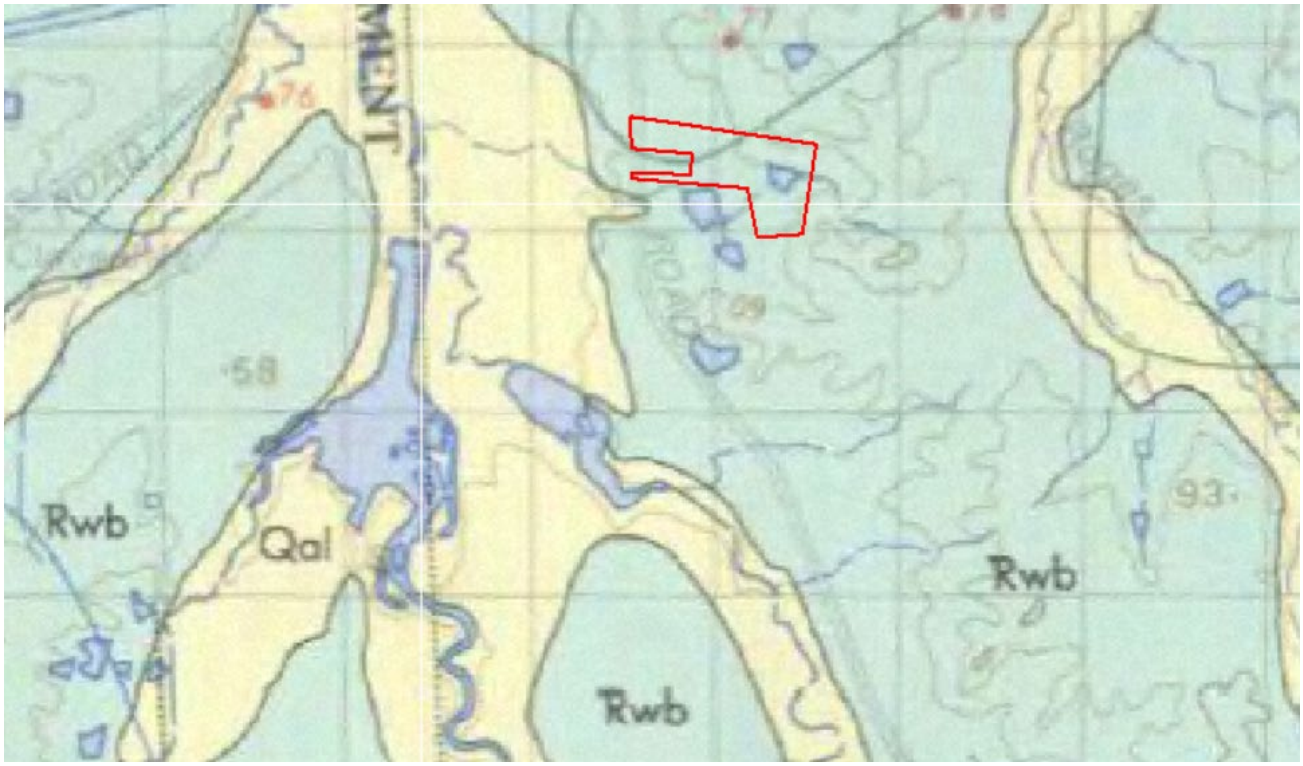
The 1:100,000 Penrith Geological Map indicates that the site is underlain by:

- (Rwb) Bringelly Shale of the Wianamatta Group consisting of shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

The following unit is in close proximity to the proposed site area:

- (Qal) fluvial fine-grained sand, silt and clay in areas.

Inset 1 presents the geological map of the site.



Inset 1: Geological Map for Sydney (The red boundaries mark the approximate site location)

4.2 Surface Conditions

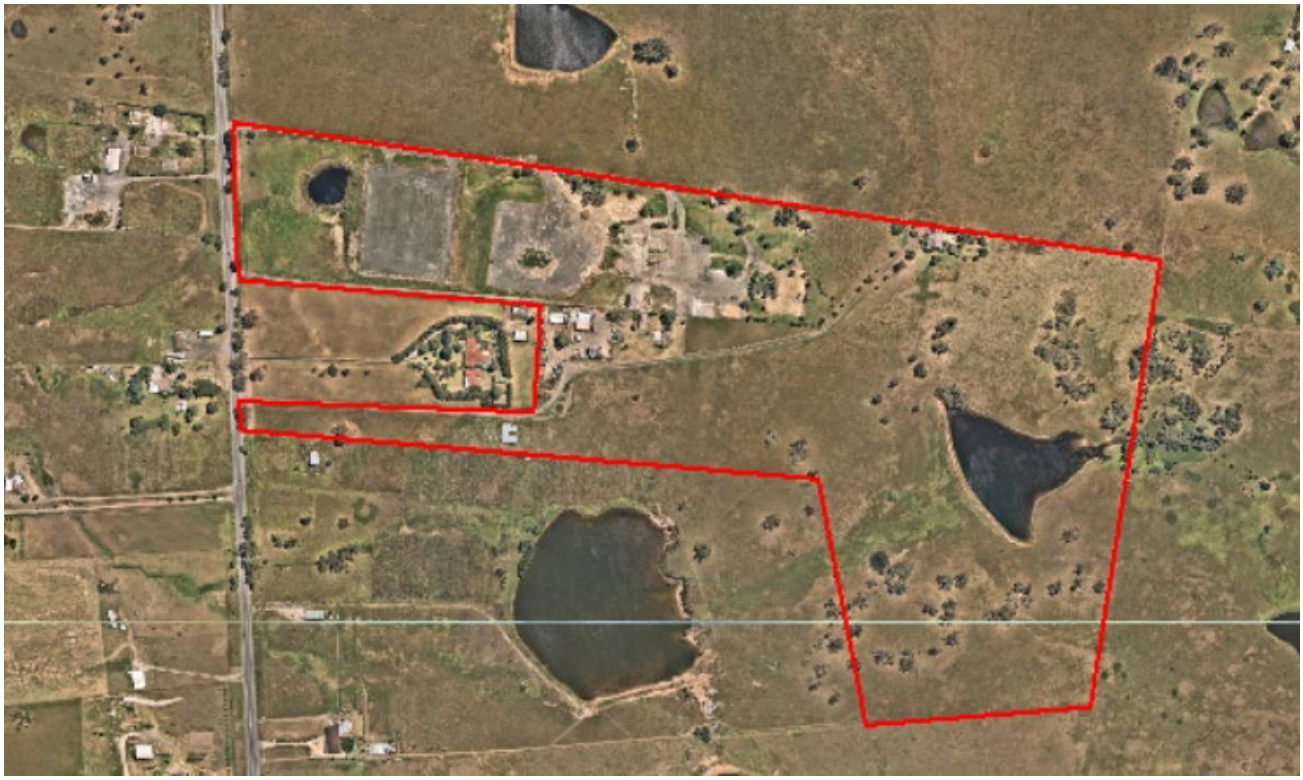
The site is located at 754-770 and 784-786 Mamre Road, Kemps Creek. The site is approximately 37 ha in area, and it is bounded by Mamre Road to the west, and rural land and private properties to the north, east and south.

The site is generally sloping towards Badgery's Creek in the southwest direction. It is noted that the regions around the north-east and south-east corner of the site boundaries are steep hills.

Two dams exist at the site, with the largest approximately 1.3 ha in area. Historical aerial photographs reveal no obvious signs of backfilling of these dams. We note that the dam is entirely contained within the site boundary (Inset 2).

At the time of fieldwork, the majority of the site consisted of:

- Grassed and vegetated areas
- A residential house, sheds, farmhouses, dirt and gravel roads, dams and a concrete and asphalt hardstand
- There are livestock that graze on the land.



Inset 2: Nearmap aerial photograph of site condition on 26 January 2021

4.3 Subsurface Conditions

Table 2 shows the approximate depth to the top of the inferred geotechnical units encountered in the test locations.

Table 2 – Summary of inferred subsurface conditions encountered in test locations.

Inferred Unit	Inferred Top of unit depth below ground surface (m)	Description
TOPSOIL	0.0	Silty CLAY; dark brown, medium to high plasticity, soft to firm consistency, moist. Rootlets and grasses observed throughout.
FILL	0.0	Sandy GRAVEL with some Clay; pale grey, fine to medium grained, medium to high strength, gravels, cobbles up to 300 mm, moist, with clay, reddish-brown and medium plasticity. Crushed Sandstone. CLAY, brown with mottled red, high plasticity, stiff to hard consistency, moist, trace fine black gravels.
NATURAL SOIL	0.1 to 2.1	CLAY; medium to high plasticity, generally stiff to very stiff consistency, moist.
BEDROCK	0.9 to 3.1	SHALE; extremely weathered to fresh weathered, very low to high strength, iron-stained red, brown and grey. Laminations and rock fabric visible in some sections. SANDSTONE; extremely weathered to fresh, low to high strength, fine to medium grained, black grey and pale grey. Decreasing weathering and increasing strength generally observed as depth increases.

Note: Strengths and weathering inferred from rock fragments recovered from drilling.

The subsurface conditions encountered within the test locations are summarised in Table 3 The Reduced levels of the test pits were estimated from the Site Survey Plan.

Table 3 – RLs at the Top of Inferred Geotechnical Units encountered in test locations

Test ID	Elevations at Top of Inferred Geotechnical Units (m AHD)				
	TOPSOIL	FILL	NATURAL SOIL	BEDROCK	EOH
TP01	N/E	42.9	41.1	N/E	39
TP02	N/E	43.8	41.7	40.7	40.6
TP03	N/E	50	49.1	48.2	47.1*
TP04	N/E	54.1	53.1	N/E	50.6
TP05	42	N/E	41.9	N/E	39
TP06	48.2	N/E	48	46.6	45.6*
TP09	53.7	N/E	53.5	N/E	50.7
TP10	67	N/E	66.7	65.7	64.9*
TP11	67.3	N/E	67	N/E	63.5

Test ID	Elevations at Top of Inferred Geotechnical Units (m AHD)				
	TOPSOIL	FILL	NATURAL SOIL	BEDROCK	EOH
TP12 (Auger)	82	N/E	81.9	81.1	77
TP13 (Auger)	81.4	N/E	81.3	80.4	76.8
TP14	46.6	N/E	46.4	N/E	43.6
TP16	51.9	N/E	51.6	N/E	48.5
TP18	52.5	N/E	52.2	51	50*
TP19 (Auger)	61.5	N/E	61.4	59.4	57
TP20	63.2	N/E	63.1	61.5	60.3*

Note: EOH = End of Hole
N/E = Not Encountered
* = Practical refusal using a 14 tonne excavator

4.4 Groundwater

Groundwater was observed at the following test locations:

- TP01 at 3 m depth (minor seepage)
- TP16 at 3 m depth (minor seepage).

We consider that this is possibly due to the location of the Test pits being in the vicinity of a dam.

No long-term groundwater monitoring was undertaken.

5. Soil Salinity and Aggressivity Investigation

A total of eight (8) disturbed soil samples were collected by a PSM Geotechnical Engineer for testing in an environmental laboratory.

5.1 Laboratory Results

The disturbed soil samples were sent to a NATA accredited environmental laboratory and the following tests were undertaken:

- Cation Exchange Capacity (CEC) of calcium, magnesium, potassium, and sodium
- Exchange sodium percentage
- Salinity (EC 1:5, one-part soil to five parts water)
- Soil pH
- Chlorides
- Sulphates
- Resistivity.

Table 4 presents a summary of the results. The laboratory reports are presented in Appendix D

Table 4 – Laboratory Testing Results

Sample ID (Depth)	pH	Electrical Conductivity [µS/cm]	Resistivity (ohm cm)	Moisture Content [%]	Chloride by Discrete Analyser [mg/kg]	Soluble Sulfate by ICPAES [mg/kg]	Exchangeable Cations [meq/100g]					ESP [%]
							Ca	Mg	K	Na	CeC	
TP01 (1.6 m)	6.4	325	910	14.4	320	100	6.7	3.3	0.2	0.2	10.4	2.5
TP02 (2.2 m)	6.2	533	400	17.3	850	130	<0.1	4.8	<0.1	2.3	7.3	31.4
TP03 (1.5 m)	7.0	548	440	17.6	140	350	6.9	9.3	0.1	1.2	17.6	6.9
TP05 (2.0 m)	5.7	118	1510	18.6	260	360	<0.1	13.4	0.2	4.6	18.2	25.1
TP09 (0.8 m)	4.8	674	430	13.3	680	150	0.8	6.4	0.2	3.0	10.3	29.0
TP11 (3.6 m)	8.0	237	840	14.2	350	140	8.6	3.8	<0.2	3.0	15.5	19.3
TP12 (1.0 m)	8.0	146	2470	9.0	<10	20	12.2	1.1	<0.2	0.2	13.7	1.7
TP19 (1.2 – 1.6 m)	5.0	450	510	11.3	640	150	0.2	8.0	0.4	3.6	12.2	29.2

5.1.1 Soil Chemistry

The salinity and aggressivity test results, summarised in Table 4 indicate the following:

- pH of the soil samples analysed was in the range of 4.8 to 8, with an average of 6.4
- The 1:5 soil to water extraction and subsequent electrical conductivity ($EC_{1:5}$) of the soil samples analysed to be in the range of 118 µS/cm to 674 µS/cm
- Concentrations of chlorides in samples analysed was in the range of 10 mg/kg to 850 mg/kg
- Concentrations of soluble sulphate in samples analysed was in the range of less than 20 mg/kg to 360 mg/kg
- Cation Exchange Capacity (CEC) in samples analysed was in the range less than 7.3 meq/100g to 18.2 meq/100g
- Exchange Sodium Percentage (ESP) in samples analysed was in the range of 1.7% to 31.4%.

6. Salinity Assessment

6.1 Salinity

Site Investigations for Urban Salinity (DLWC 2002) classify soil salinity based on electrical conductivity (EC_e) as per Richards (1954). The method of conversion from $EC_{1:5}$ to EC_e (electrical conductivity of saturated extract) is based on DLWC (2002) and given by $EC_e = EC_{1:5} \times M$, where M is the multiplication factor based on "Soil Texture Group".

The "Soil Texture Group" of the samples tested has been assessed during our investigation. The salinity classification for the soil samples that were tested are presented in Table 5.

Table 5 – Salinity Classification

Sample ID (Depth)	$EC_{1:5}$ (dS/m)	Soil Type	M	EC_e (dS/m)	Salinity Class
TP01 (1.5 m)	0.325	Light Medium Clay	8	2.60	Slightly saline
TP02 (2.2 m)	0.533	Light Medium Clay	8	4.26	Moderately Saline
TP03 (1.5 m)	0.548	Light Medium Clay	8	4.38	Moderately Saline
TP05 (2.0 m)	0.118	Light Medium Clay	8	0.94	Non-saline
TP09 (0.8 m)	0.674	Light Medium Clay	8	5.39	Moderately Saline
TP11 (3.6 m)	0.237	Light Medium Clay	8	1.90	Non-saline
TP12 (1.0 m)	0.146	Light Medium Clay	8	1.17	Non-saline
TP19 (1.2 – 1.6 m)	0.450	Light Clay	8.5	3.83	Slightly saline

It is assessed that the majority of the soils on site are classified as "non-saline to moderately saline".

We have referred to Clause 4.8.2 of Australian Standard AS3600-2018 "Concrete Structures" and note that the assessed soil electrical conductivity (EC_e) is less than the upper limit of the "A2" exposure classification.

6.2 Corrosivity / Aggressivity

Table 4.8.1 of AS3600-2018 “Concrete Structures” provides criteria for exposure classification for concrete in sulphate soils based on sulphates in soil and groundwater, and pH of soil. On the basis of the sulphate and pH testing completed we assess the exposure classification for concrete in sulphate soils to be “A2”.

Similarly, Table 6.4.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for concrete piles in soil, and here the exposure classification for concrete piles in soils is “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 the resistivity, pH and chloride testing completed we assess the exposure classification for steel piles in the soil to be “Non-aggressive” to “Mild”.

6.3 Sodicity

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 these laboratory results, ranging from 1.7% to 31.4%, indicates that the soils on site range from sodic to highly sodic when compared to criteria listed in “Site Investigations for Urban Salinity”, DLWC (2002).

6.4 Bulk Earthworks Specification

We have prepared separate documents for the following:

- Bulk Earthworks Specification – Refer PSM4352-005S REV1, see Appendix F

6.5 Warehouse facilities – Interim Geotechnical Design Advice (IGDA)

Interim Geotechnical Design Advice (IGDA) for the proposed industrial development has been included with his report. It is presented in Appendix E.

The advice for the proposed development has been provided based on the following:

- The results of the investigation presented in this report
- The bulk earthworks completed in accordance with a PSM Earthworks Specification (Appendix F)
- PSM review the earthworks documents as per the specifications, e.g. earthworks audit, to confirm the advice.

7. 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.

For and on behalf of
PELLS SULLIVAN MEYNINK

HENRY ZHANG
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl.	Figure 1	Locality Plan and Test Locations
	Figure 2	Selected Site Photos (1 of 3)
	Figure 3	Selected Site Photos (2 of 3)
	Figure 4	Selected Site Photos (3 of 3)
	Appendix A	Tabulated Test Pit Logs
	Appendix B	Selected Test Pit Photographs
	Appendix C	CBR Test Results
	Appendix D	Salinity and Aggressivity Testing Results
	Appendix E	PSM4352-004L REV1 - Interim Geotechnical Design Advice (IGDA)
	Appendix F	PSM4352-005S REV1 - Bulk Earthworks Specification
	Appendix G	Borehole log at 1-23 Aldington Road, Kemps Creek in October 2019

Appendix A
Tabulated Test Pit Logs

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP01	0 – 1.8	FILL; CLAY, brown, high plasticity, traces of plastic, glass, timber fibres, rootlets and sandstone fragments up to 60 mm, moist, very stiff – hard consistency. Becomes dry at 0.1 m.	Grass observed on surface. Pocket Penetrometer (PP) readings of 350, 320 and 400 kPa at 0.3 m depth. Jar sample taken at 1.6 m.
	1.8 – 3.9	CLAY; greyish brown, high plasticity, moist, stiff to very stiff consistency. Becomes CLAY with Gravel; reddish-brown and mottled grey Becomes wet at 3.0 m.	PP readings of 180, 200 and 260 kPa at 2.1 m depth. Water inflow at 3.0 m. CBR Sampling at 3.7 – 3.9 m.
	3.9	TP01 terminated at 3.9 m.	
TP02	0 – 0.15	Unsealed GRAVEL with cobbles; blue grey, angular, rock fragments up to 60 mm, dry.	
	0.15 – 0.5	FILL; Sandy GRAVEL with CLAY; pale grey, fine to medium grained, sub-angular, medium to high strength gravels, cobbles up to 100 mm, moist, reddish-brown and medium plasticity clay. Fill comprises crushed sandstone.	
	0.5 – 2.1	FILL; CLAY with silt, brown with mottled reddish brown, high plasticity, trace fine black gravels, moist, stiff to hard consistency.	PP readings of 150, 200, 300, 230, 280 and 400 kPa at 0.7 m depth.
	2.1 – 3.1	CLAY; orange brown, high plasticity, trace fine dark grey clay, moist, firm to stiff consistency. Becomes pale grey and orange, trace tree rootlet, very stiff consistency at 2.5 m.	Water Seepage observed at 2.4 m. PP readings of 270, 330 and 380 kPa at 2.7 m depth.
	3.1 – 3.2	SHALE: Dark grey and brown, highly weathered, very low to low strength, moist.	
	3.2	TP02 terminated 3.2 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP03	0 – 0.1	Unsealed GRAVEL and COBBLES; dark grey to black, fine to coarse grained gravels and cobbles up to 70 mm, dry, angular.	
	0.1 – 0.4	FILL; Sandy GRAVEL with CLAY; pale grey, fine to medium grained, sub-angular, medium to high strength gravels, cobbles up to 300 mm, moist. Fill comprises crushed sandstone.	
	0.4 – 0.9	FILL; CLAY, brown, low to medium plasticity, traces of rootlets, plastic, styrofoam, dry, hard consistency.	Organic odour PP readings of 400, 600 and >600 kPa at 0.5 m.
	0.9 – 1.8	CLAY; orange brown with mottled red, medium to high plasticity, moist, very stiff to hard consistency. Becomes orange/pale brown with mottled pale grey at 1.6 m.	PP readings of 210, 270 and 330 kPa at 1.0 m.
	1.8 – 2.9	SHALE; brownish grey, highly weathered, low to medium strength.	
	2.9	Practical Refusal at 2.9 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP04	0 – 0.2	Unsealed GRAVEL with cobbles and sand; fine to coarse grained, sub-angular to angular, rock fragments up to 70 mm, moist, angular.	
	0.2 – 0.4	FILL; Sandy Gravel; dark grey, with rock fragments up to 300 mm. Fill comprises crushed Shale.	
	0.4 – 1.0	FILL; Silty CLAY, dark brown, high plasticity, moist, stiff to very stiff consistency.	PP Readings of 310, 310 and 390 kPa at 0.45 m. Clayey SILT within some regions.
	1.0 – 3.5	CLAY; light brown with mottled grey, medium to high plasticity, moist, stiff to very stiff consistency. Becomes orange and reddish brown with grey at 1.2 m. Becomes pale grey with mottled red and trace of shale fragments.	PP Readings of 140, 230 and 240 kPa at 1.3 m.
	3.5	TP04 terminated at 3.5 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP05	0 – 0.1	TOPSOIL; Silty CLAY, brown, dry, contains rootlets.	Organic odour
	0.1 – 3.0	CLAY; yellow-brown, medium plasticity, trace of fine gravel up to 20 mm, dry, hard consistency. Becomes reddish-brown with mottled grey, high plasticity, moist at 0.7 m.	Organic rootlets at 0.3 m. PP Readings of 550, 510 and 560 kPa at 1.1 m. Jar and CBR sampling at 2.0 m.
	3.0	TP05 terminated at 3.0 m.	
TP06	0 – 0.2	TOPSOIL; Silty CLAY, dark brown, contains rootlets, moist.	
	0.2 – 1.6	CLAY; reddish-brown, medium plasticity, dry, stiff to hard consistency. Becomes grey with mottled red-brown at 0.6 m.	PP Readings of 450, >600 kPa at 0.5 m. CBR Sampling at 0.8 – 0.9 m.
	1.6 – 2.6	SHALE; dark brown/grey and inclusions of white and reddish-brown, highly weathered, medium to high strength.	Excavation bucket penetration increased at 2.0 m.
	2.6	Practical Refusal at 2.6 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP09	0 – 0.2	TOPSOIL; Silty CLAY, dark brown, medium plasticity, moist, contains rootlets,	
	0.2 – 3.0	CLAY; reddish-brown with mottled grey, low plasticity, dry, hard consistency. Becomes pale grey with mottled red-brown, medium to high plasticity, moist, very stiff consistency at 2.1 m.	PP Readings of 550 and >600 kPa at 0.5 m. Jar sample taken at 0.8 m. PP Readings of 560 and >600 kPa at 1.6 m. PP Readings of 280, 310 and 290 kPa at 2.4 m.
	3.0	EOH terminated at 3.0 m.	
TP10	0 – 0.3	TOPSOIL; Silty CLAY, dark brown, contains rootlets, moist.	
	0.3 – 1.3	CLAY; reddish-brown, medium plasticity, dry, very stiff to hard consistency.	PP Readings of 550, >600 kPa at 0.5 m.
	1.3 – 1.6	SHALE; pale grey with orange brown, highly weathered, low strength.	
	1.6 – 2.1	SANDSTONE; fine to medium grained, dark grey with orange brown, medium to highly weathered, medium to very high strength.	
	2.1	Practical Refusal at 2.1 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP11	0 – 0.3	TOPSOIL; Silty CLAY, dark brown, medium plasticity, moist, contains rootlets and tree bark.	
	0.3 – 3.8	CLAY; yellow-brown, medium plasticity, trace of fine-grained sand, moist, very stiff to hard consistency. Becomes CLAY trace sand and gravel, yellow brown with inclusions of black-grey and reddish-brown, fine-grained gravel up to 30 mm, sub-angular at 2.6 m. Becomes stiff consistency at 3.3 m.	PP Readings of 510, 550, 450 and 510 kPa at 1.6 m. PP Readings of 330, 200, 500 and 600 kPa at 2.6 m. PP Readings of 190, 260 and 240 kPa at 3.6 m. Jar and CBR Sampling at 3.6 m.
	3.8	TP11 terminated at 3.8 m.	
TP12 (Auger)	0 – 0.1	TOPSOIL; Silty CLAY, brown, dry, contains rootlets.	Organic odour
	0.1 – 0.9	CLAY; brown, medium to high plasticity, dry, very stiff to hard consistency.	PP Readings of 310, 440 and 500 kPa at 0.3 m.
	0.9 – 1.2	SANDSTONE; fine to medium grained, brown, dry, highly weathered, low strength.	
	1.2 – 5.0	SHALE; yellow brown to grey, dry, highly weathered, low to medium strength. Becomes moderately weathered at 1.6 m. Becomes dark grey, fresh and medium strength at 4.7 m.	
	5.0	TP12 terminates at 5.0 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP13 (Auger)	0 – 0.1	TOPSOIL; Silty CLAY, dark brown, trace of fine grained and sub-angular gravel, dry, contains rootlets.	Contains rootlets.
	0.1 – 1.0	CLAY; yellow brown, low plasticity, dry. Becomes CLAY trace sand and gravel, low to medium plasticity, fine-grained up 20 mm.	
	1.0 – 2.3	Interbedded SANDSTONE and SHALE (Approximately 60% Sandstone & 40% Shale); yellow-brown and dark grey, highly weathered, low strength, dry.	
	2.3 – 4.0	SHALE; dark grey, slightly to moderately weathered, medium strength, dry.	Low Strength band at 3.5 m inferred from drilling resistance.
	4.0 – 4.6	Interbedded SANDSTONE & SHALE (approximately 50% Sandstone & 50% Shale), pale and dark grey, fine grained sandstone, slightly to moderately weathered, low to medium strength, dry.	High Strength band at 4.3 m inferred from drilling resistance.
	4.6	TP13 terminated at 4.6 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP14	0 – 0.2	TOPSOIL; Silty CLAY, dark brown, medium plasticity, contains rootlets.	
	0.2 – 3.0	CLAY; yellow brown, medium plasticity, trace of fine-grained sand, moist, hard consistency. Becomes trace gravel at 0.9 m. Becomes pale grey with inclusions of yellow and brown, high plasticity, very stiff consistency. Becomes CLAY trace fine to medium grained sand at 2.2 m.	PP readings greater than 600 kPa at 0.5 m. PP reading of 300, 350 and 300 kPa at 1.6 m.
		TP14 terminated at 3.0 m.	
TP16	0 – 0.3	TOPSOIL; Silty CLAY, brown to grey, high plasticity, moist, contains rootlets.	
	0.3 – 3.4	CLAY; orange-brown, high plasticity, moist, very stiff to hard consistency. Becomes reddish-brown at 2.4 m. Becomes pale grey and reddish-brown and wet at 3.0 m.	PP readings of 520, 420 and 510 kPa at 0.5 m. Water seepage observed at 3.0 m.
	3.4	TP16 terminated at 3.4 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP18	0 – 0.3	TOPSOIL; Silty CLAY, dark brown, moist, contains rootlets and vegetation.	
	0.3 – 1.5	CLAY; reddish-brown, medium to high plasticity, dry, very stiff to hard consistency. Becomes yellow brown at 0.8 m.	PP readings of >600, >600 and 510 kPa at 0.7 m. CBR Sampling at 1.2 – 1.8 m.
	1.5 – 2.5	SHALE: pale grey and reddish-brown, moderately weathered, medium to high strength, dry.	Excavator penetration difficulty increased at 2.0 m.
	2.5	Practical refusal at 2.5 m.	
TP19 (Auger)	0 – 0.1	TOPSOIL; Silty CLAY, dark brown, moist.	
	0.1 – 2.1	CLAY; pale grey, medium plasticity, dry, stiff consistency. Becomes CLAY with inclusions of mottled reddish brown, very stiff to hard consistency at 1.1 m. Becomes brown with mottled grey and reddish-brown, high plasticity Becomes brown at 1.8 m.	Rootlets at 0.7 m. PP reading of 200, 210 and 230 kPa at 0.7 m. PP readings of 550 and 600 kPa at 1.3 m. Jar Sampled at 1.9 m.
	2.1 – 4.5	SHALE; brown to dark grey, slightly to moderately weathered, medium to high strength.	Low strength band at 3.3 and 4.0 m inferred from drilling resistance.
	4.5	Practical refusal at 4.5 m.	

Test Pit ID	Approximate Depth (m)	Material Encountered	Notes
TP20	0 – 0.1	TOPSOIL; Silty CLAY, dark brown, traces of sub-angular gravel up to 30 mm, moist, contains rootlets.	
	0.1 – 1.7	CLAY; yellow-brown, medium plasticity, dry, very stiff to hard consistency. Becomes pale grey with mottled yellow brown at 0.6 m.	PP reading of >600 and 450 kPa at 0.45 m.
	1.7 – 2.9	SHALE; pale grey, moderately weathered, low to medium strength, dry.	
	2.9	Practical refusal at 2.9 m.	

Appendix B
Selected Test Pit Photographs

Test Pit TP01

The GPT Group

754 - 786 Mamre Rd, Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP01

PSM4352-003L	**Appendix B**

Test Pit TP02

The GPT Group

754 - 786 Mamre Rd, Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP02

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Test Pit TP03

The GPT Group

754 - 786 Mamre Rd, Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP03

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Test Pit TP04

The GPT Group

754 - 786 Mamre Rd, Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP04

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Test Pit TP05

The GPT Group

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP05

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Test Pit TP06

The GPT Group

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP06

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Test Pit TP09

The GPT Group

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP09

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Test Pit TP10

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP10

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Test Pit TP11

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP11

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Test Pit TP12

The GPT Group

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP12

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Test Pit TP13

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP13

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Test Pit TP14

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GEOTECHNICAL INVESTIGATION
TEST PIT PHOTOS
TP14

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Test Pit TP16

The GPT Group
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GEOTECHNICAL INVESTIGATION
TEST PIT PHOTOS
TP16

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Test Pit TP18

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP18

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Test Pit TP19

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GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP19

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Test Pit TP20

The GPT Group

754 - 786 Mamre Rd, Kemps Creek, NSW

GEOTECHNICAL INVESTIGATION

TEST PIT PHOTOS

TP20

PSM4352-003L	**Appendix B**

Appendix C
CBR Testing Results

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North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

SOIL TEST SERVICES
ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink
PSM Job No.: PSM4352

Ref No: L4587E
Report: 1
Report Date: 24/03/2021
Page 1 of 1

BOREHOLE NUMBER		TP 1	TP 5	TP 6	TP 11	TP 18
DEPTH (m)		3.70 - 3.90	1.90 - 2.00	0.80 - 0.90	3.50 - 3.70	1.20 - 1.80
Surcharge (kg)		4.5	4.5	4.5	4.5	4.5
Maximum Dry Density (t/m^3)		1.82 STD	1.60 STD	1.70 STD	1.84 STD	1.76 STD
Optimum Moisture Content (%)		17.3	23.0	18.9	16.5	17.8
Moulded Dry Density (t/m^3)		1.79	1.56	1.67	1.80	1.73
Sample Density Ratio (%)		98	98	98	98	98
Sample Moisture Ratio (%)		99	99	98	98	99
Moisture Contents						
Insitu (%)		26.4	27.2	18.0	17.5	15.9
Moulded (%)		17.1	22.8	18.4	16.2	17.7
After soaking and						
After Test, Top 30mm(%)		20.3	39.1	33.7	25.2	31.5
Remaining Depth (%)		18.5	26.8	22.9	17.8	23.3
Material Retained on 19mm Sieve (%)		0	0	0	0	8 *
Swell (%)		1.5	4.0	4.0	2.0	3.0
C.B.R. value:	@2.5mm penetration	4.0	1.5	2.0		
	@5.0mm penetration				4.5	2.0

NOTES: Sampled and supplied by client. Samples tested as received.

- Refer to appropriate Test Pit logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 17/03/2021.
- TP 1, 5 & 6 dried back prior to testing as the sample was too saturated.
- * Denotes not used in test sample.

NATA Accredited Laboratory Number:1327

Approved Signatory / Date
(D. Treweek)
24/3/21

Appendix D
Salinity and Aggressivity Testing Results

CERTIFICATE OF ANALYSIS

Work Order	: **ES2109361**	Page	: 1 of 4
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: HENRY ZHANG	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	: 754-786 Mamre Road, Kemps Creek	Date Samples Received	: 16-Mar-2021 18:30
Order number	: ----	Date Analysis Commenced	: 18-Mar-2021
C-O-C number	: ----	Issue Date	: 24-Mar-2021 11:25
Sampler	: Henry Zhang		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 8		
No. of samples analysed	: 8		

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, unless the sampling was conducted by ALS. 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
Franco Lentini	LCMS Coordinator	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	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.

- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- 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+).
- ALS is not NATA accredited for the calculation of saturated resistivity in a soil.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TP19 1.2-1.6m	TP09 - 0.8m	TP11 - 3.6m	TP03 - 1.5m	TP05 - 2.0m
			Sampling date / time	15-Mar-2021 08:15	15-Mar-2021 03:00	15-Mar-2021 11:05	16-Mar-2021 11:15	16-Mar-2021 12:13
Compound	CAS Number	LOR	Unit	ES2109361-001	ES2109361-002	ES2109361-003	ES2109361-004	ES2109361-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.0	4.8	8.0	7.0	5.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	450	674	237	548	118
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	11.3	13.3	14.2	17.6	18.6
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	510	430	840	440	1510
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	----	8.6	----	----
Exchangeable Magnesium	----	0.2	meq/100g	----	----	3.8	----	----
Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	----	----
Exchangeable Sodium	----	0.2	meq/100g	----	----	3.0	----	----
Cation Exchange Capacity	----	0.2	meq/100g	----	----	15.5	----	----
Exchangeable Sodium Percent	----	0.2	%	----	----	19.3	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	<0.1
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	13.4
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.2
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	4.6
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	18.2
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	25.1
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.2	0.8	----	6.9	----
Exchangeable Magnesium	----	0.1	meq/100g	8.0	6.4	----	9.3	----
Exchangeable Potassium	----	0.1	meq/100g	0.4	0.2	----	0.1	----
Exchangeable Sodium	----	0.1	meq/100g	3.6	3.0	----	1.2	----
Cation Exchange Capacity	----	0.1	meq/100g	12.2	10.3	----	17.6	----
Exchangeable Sodium Percent	----	0.1	%	29.2	29.0	----	6.9	----
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	150	150	140	600	360
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	640	680	350	440	260

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TP02 - 2.2m	TP01 - 1.6m	TP12 - 1.0m	----	----
			Sampling date / time	16-Mar-2021 10:15	16-Mar-2021 08:45	16-Mar-2021 04:15	----	----
Compound	CAS Number	LOR	Unit	ES2109361-006	ES2109361-007	ES2109361-008	--------	--------
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.2	6.4	8.0	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	533	325	146	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	17.3	14.4	9.0	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	400	910	2470	----	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	----	12.2	----	----
Exchangeable Magnesium	----	0.2	meq/100g	----	----	1.1	----	----
Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	----	----
Exchangeable Sodium	----	0.2	meq/100g	----	----	0.2	----	----
Cation Exchange Capacity	----	0.2	meq/100g	----	----	13.7	----	----
Exchangeable Sodium Percent	----	0.2	%	----	----	1.7	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	<0.1	6.7	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	4.8	3.3	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.2	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	2.3	0.2	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	7.3	10.4	----	----	----
Exchangeable Sodium Percent	----	0.1	%	31.4	2.5	----	----	----
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	100	20	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	850	320	<10	----	----

Appendix E
PSM4352-004L REV1
Interim Geotechnical Design Advice (IGDA)

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E mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM4352-004L REV 1

29 April 2021

The GPT Group
Level 51/19 Martin Place
Sydney NSW 2000

Tom.Falconer@gpt.com.au

Attention: Tom Falconer

Dear Tom

RE: 754-770 AND 784-786 MAMRE ROAD, KEMPS CREEK
INTERIM GEOTECHNICAL DESIGN ADVICE

1. Introduction

This letter provides interim geotechnical design advice (IGDA) for the proposed development at 754-770 and 784-786 Mamre Road, Kemps Creek. This interim advice will be issued as final on completion of the bulk earthworks.

We are not aware of any performance requirements for the proposed development.

2. Bulk Earthworks

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 PSM4352-005S REV1(the Specification)
- PSM to audit the earthworks to confirm the advice in this letter at the completion of the bulk 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 criteria for and selection of acceptable material is set out in Clause 3.3 of The Specification.

If the structural or civil engineer requires engineering properties different to those provided in Section 3, 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.

3. Design Advice

3.1 General

The design advice provided in the following sections has been prepared on the following basis:

- The subsurface conditions are as those encountered in PSM4352-003L REV1
- The earthworks are to be completed in accordance with the PSM bulk earthworks specification PSM4352-005S REV0.

If any of the above is not applicable, PSM should be requested to confirm that the design advice below is still valid.

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 road base 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 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.

3.2 Site Classification

While the proposed development is out of scope of AS2870-2011 "Residential slabs and footings", we assess that, for the natural site, cut and fill 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 the site be classified 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, y_m = 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.

The designer should consider variation of fill depth across any area. Further the designer should consider the impact of any delay in construction of slabs and pavements following completion of the bulk earthworks.

3.3 Foundations

Footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 1.

Table 1 – Engineering Parameters of Inferred Geotechnical Units

Inferred Unit	Bulk Unit Weight (kN/m³)	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*	150*	N.A.	10	0.3
BEDROCK	22	20	30	3000**	1000**	150	200	0.25

Note: * Minimum plan dimension of 1 m and embedment depth of at least 0.5 m.

** ABP for BEDROCK assumes a settlement of approximately 1% of the least footing dimension for footings in rock

*** UBP for BEDROCK assumes a settlement of approximately 5% of the least footing dimension for footings in rock.

3.3.1 Shallow Foundations

We note that an allowable bearing pressure (ABP) is not a soil property. It depends on many factors such as the size of the footings, the embedment depth, the load direction and eccentricity, the stiffness of the footing, the adopted factor of safety (FOS), as well as the soil properties. As footings get bigger or deeper the capacity increases rapidly, as the load gains eccentricity or becomes inclined, the capacity reduces rapidly.

Settlements in soil units can be estimated using the elastic moduli provided in Table 1. When assessing the settlement of the shallow footings, the designer needs to consider the additional ground movement due to the total building load on both shallow and deeper units. The differential settlement due to the building load shall also be assessed. This should be considered by the designer.

Foundations conditions at the proposed shallow pad footings locations should be inspected by a suitable qualified geotechnical engineer prior to the pouring of concrete.

3.3.2 Piled Foundations

Piled foundation should be founded within the BEDROCK unit.

Piles should be designed in accordance with the requirements in AS 2159 (2009), *Piling – Design and Installation*. Selection of the pile system depends on many considerations and should be undertaken by the designer in conjunction with the Principal and contractor / builder. The parameters provided in Table 1may be adopted in the design of piles founded in the BEDROCK units.

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 1.

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 1, further advice should be sought from PSM.

With regards to the pile design, we recommend that:

- A geotechnical strength reduction factor, Φ_g = 0.60 (AS2159-2009 CL. 4.3.2) be adopted for a high redundancy for an assessed average risk rating (ARR) of 3.0. This should be reviewed to suit the specific design and construction methods proposed by the structural designers
- 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.
  - A geotechnical strength reduction factor Φ_g = 0.40 is adopted then no pile testing will be required (AS2159-2009 CL 8.2.4 (b)).

Where the pile is sized using the allowable bearing capacity in Table 1 (i.e. assuming all serviceability load is carried by the base), the settlement would be expected to be less than 1% of the pile diameter plus elastic shortening of the pile itself.

Further advice should be sought if piles are to be founded within a unit other than BEDROCK.

3.4 Excavation Conditions

Excavation of the TOPSOIL, FILL, NATURAL SOIL and BEDROCK units is expected to be achievable using conventional earth-moving equipment. Hydraulic rock hammers may be required in BEDROCK unit particularly in sandstone.

Prospective contractors should make their own assessment of excavatability based on the logs and their site inspection and experience. 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 unit.

Please note that during our geotechnical investigation the 14-tonne excavator encountered practical refusal when excavating test pits TP03, TP06, TP10, TP18 and TP20.

We expect the existing dams will need to be drained and the sediments at the base of the dams excavated/removed prior to filling.

3.5 Permanent and Temporary Batters

The batter slope angles shown in Table 2 are recommended for the designs of batters up to 16 m height subject to the following recommendations:

- The batters shall be protected from erosion. The following could be adopted in combinations:
  - Landscaping / vegetation
  - crest drain
  - shaping the crest as such that the surface water is flowing back to crest drain rather than over the batter face
  - Other face protection, e.g. shotcrete, etc.
- Permanent batters shall be drained
- Temporary batters shall not be left unsupported for more than 2 months without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events
- No buildings, loads or services should be located within 1 batter height of the crest

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

Where Fill is not engineered/controlled fill, batter slope angles should be assessed by a geotechnical engineer.

Exposed rock faces should be inspected by a geotechnical engineer or engineering geologist to assess the need for localised rock bolting to control adverse jointing in the BEDROCK unit and concreting for overall face support.

Table 2 – Batter Slope Angles

Unit	Temporary	Permanent
SOIL UNITS, e.g. ENGINEERED FILL, NATURAL SOIL	1.75H :1V	2.5H:1V
BEDROCK	1H:1V	1.5H:1V

Note: *: See above requirements regarding inspections.

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, including temporary batters for the BEDROCK unit.

Steeper batters may be possibly subject to further advice, probably including inspection during construction and possible shotcreting, spot bolting etc.

3.5.1 North and East Boundaries

We understand the proposed cut depth at the North and East boundaries could be up to 16 m. Batter angles in Table 2 can be adopted.

Adopting a 1H:1V slope in SOIL unit will require excavation support (e.g. soil nail wall or other retention system).

Adopting a 1H:V slope in BEDROCK unit will require some structural face support (e.g. soil nails, and shotcrete) that is less intensive than those in SOIL unit. Where slightly weathered to fresh BEDROCK is encountered, the permanent batter angle of 1V:1H may be adopted for the slightly weathered to fresh BEDROCK unit only and with some surface erosion protection (e.g. shotcrete with minimum thickness that satisfies cover thickness for steel mesh).

The batter angles assume that no adverse geological structure exists on the site (e.g. continuous jointing, faulting or shear planes). The construction of the batters will need to be completed in a manner that allow for these features to be identified. We recommend this be completed by excavating the North and East slopes together in 2.5m high lifts, where each lift is inspected and mapped by a geotechnical engineer or engineering geologist to confirm the absence of adverse geological features. Where adverse geological features are identified, additional support may be required and shall be designed in accordance with Section 3.6 of this letter.

3.6 Excavation Support

Permanent cuts in the FILL, NATURAL SOIL and BEDROCK Units steeper than the recommended permanent batter slopes in Section 3.5 will need to be supported by some form of retaining structure.

The selection of the appropriate retention system is a matter of design. The designer should consider the following factors in making its selection:

- Technical factors
  - Performance
  - Ground conditions (this is addressed below in Table 1 with the design parameters)
  - Surcharge loading and
  - Proximity of structures, buildings, roads etc.
- Non-technical factors
  - Cost (to build and to maintain)
  - Other constraints such as real estate, neighbouring site/boundary, aesthetics, legislation, etc.

The design of these structures should be based on the following geotechnical properties:

- Effective soil strength parameters in Table 1
- A lateral pressure of 10 kPa for vertical cuts in the BEDROCK units. This is to allow for blocks and rock wedges formed due to adverse defects that may exist within the unit
- Proposed wall geometry

- Surcharge loads behind the retention
- Water pressure. The designer shall consider the information regarding groundwater in this report and the drainage features included in the design of the retention system.

Note that the design of retention systems may be based on either K_a or K_o earth pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires a 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 do not, of themselves, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drained 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.

3.7 Slab

The design of slabs on ground on the FILL unit 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 development should be taken into account by the various designers of the proposed 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.

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 provided in this design advice.

3.8 Pavements

The CBR tests undertaken by PSM in the geotechnical investigation (PSM4352-003L) indicate a CBR value ranging from 1.5% to 4.5%. The low CBR value is due to swelling of the samples after fully soaked.

We advise that a design subgrade CBR of 2% be adopted for earthworks completed in accordance with PSM 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 fill.

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

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

For and on behalf of
PELLS SULLIVAN MEYNINK

HENRY ZHANG
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Appendix F
PSM4352-005S REV1
Bulk Earthworks Specification

The GPT Group

754-770 and 784-786 Mamre Road, Kemps Creek NSW

BULK EARTHWORKS SPECIFICATION

PSM4352-005S REV 1 28 April 2021

Table of Contents

List of Figures

List of Appendices

1. Scope

This specification details the requirements for the bulk earthworks to be undertaken at 754-770 and 784-786 Mamre Road, Kemps Creek. The area where this specification is applicable is shown in Figure 1. This includes areas where material is filled or cut 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 of this Specification.

2. 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.

3. Earthworks

3.1 Subgrade Preparation

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

The topsoil and any vegetation must be stripped.

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 approved specifications for which the Geotechnical Inspection and Testing and 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.

It is likely sediment within existing dams will be required to be removed for the subgrade to meet the above requirement.

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 98% 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 3.5 and 3.6 of this specification.

3.2 Base Geometry and Permanent Batters

The slope of any buried batter shall be less than 1H: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 cutback to the final slopes as shown in the bulk earthworks drawings, e.g. 2H:1V, or other methods approved by PSM.

3.3 Material

3.3.1 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 by the Protection of the Environment Operations (Waste) Regulation 2014 – General Exemption Under Part 9, Clause 91 and 92, the excavated natural material exemption 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
   b) contains at least 98% (by weight) natural material, and
   c) does not meet the definition of Virgin Excavated Natural Material (VENM) in the Act.
   d) Excavated Natural Material does not include material that has been in a hotspot; that has been processed or that contains asbestos, Acid Sulphate Soils (ASS), Potential Acid Sulphate Soil (PASS) or sulfidic ores."

   and which meets the requirements of this exemption.

3.3.2 Unsuitable Material

For the purpose of this Specification, unsuitable material shall be 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."

3.3.3 Engineered Fill

Engineered Fill shall not comprise unsuitable material as defined in Clause 3.3.2 of this Specification.

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 40% 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 as meeting the requirements in this clause of the Specification shall be placed as Engineered Fill.

3.4 Fill Zonation and Placement

Fill shall be placed in near horizontal, laterally extensive layers of uniform material and thickness, deposited systemically across the work area.

The compacted thickness of each layer of Fill shall as per the requirements in Table 3.1.

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

3.5 Compaction

Fill shall be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) within the range defined in Table 3.1.

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

3.6 Moisture Control

The placement moisture variation or Hilf moisture variation shall be controlled to be within the range specified in Table 3.1.

The moisture content shall be uniform throughout the layer.

Placement moisture content of the Fill shall be measured for each field density test.

Table 3.1 - – Requirements for Layer Thickness, Compaction and Moisture Variation

Fill Type	Compacted Layer Thickness (mm) – Equal to or less than	Compaction Ratio	Moisture Variation
	Visual Assessment	AS1289.5.1.1 and AS1289.5.4.1 or AS1289.5.7.1	AS1289.5.1.1 and AS1289.5.4.1 or AS1289.5.7.1
Engineered Fill	300	Between 98% and 102% Std Comp.	Between 2% Dry and 2% Wet Std Comp.

4. Survey

The survey requirements are as follows:

1. Any approved subgrade shall be surveyed prior to first filling and for cut areas 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.

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 AS3798-2007 "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.

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

1. At final bulk earthworks level (BEL).

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

5.6 Inspection, Testing and Survey

The GITA shall at least undertake the following tasks:

1. Identify the subgrade as one of the four (4) subgrade types listed in Clause 3.1 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 3.1 of this specification.
2. Should Engineered Fill be required to fill overcut areas, assess that filling has been placed in accordance with this specification.
3. Assess that the base geometry of any area prior to placement of fill material is in accordance with the base geometry requirements of Clause 3.2 of this specification.
4. Assess that the material placed is in accordance with the fill material requirements of Clause 3.3 of this specification.
5. Assess that the fill has been placed in accordance with the requirements for fill zonation and placement of Clause 3.4 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 4 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 3.5 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 3.6 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. *Subgrade Approval Reports* (a sample is attached in Appendix A). 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 1 and 2 of Clause 5.6.
- Approve or reject the subgrade condition for cut areas based on task 1.

2. *Lot Approval Reports* (a sample is attached in Appendix B). Such a report shall:

- Document assessments, testing and survey undertaken for tasks 4 to 12 of Clause 5.6
- Approve or reject the results of testing undertaken for task 10 of Clause 5.6
- Approve or reject lots based on tasks 10 and 12 of Clause 5.6
- Where applicable, records of the compaction plant detail.

3. Material Testing Reports. Such a report shall:

- Report the results of material property testing undertaken for task 12 of Clause 5.6.

4. *Daily Reports* (a sample is attached in Appendix C). 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 document ted in the Subgrade or Lot Approval Reports
- Document other relevant activities undertaken on site that day (site instructions, breakdowns, compaction equipment used, etc).
- Where applicable, records of the compaction plant used for each lot.

6.2 Certification

6.2.1 Weekly Certificates

The GITA shall produce a Weekly Certificate for any month 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 month'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. PSM4352-005S 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:

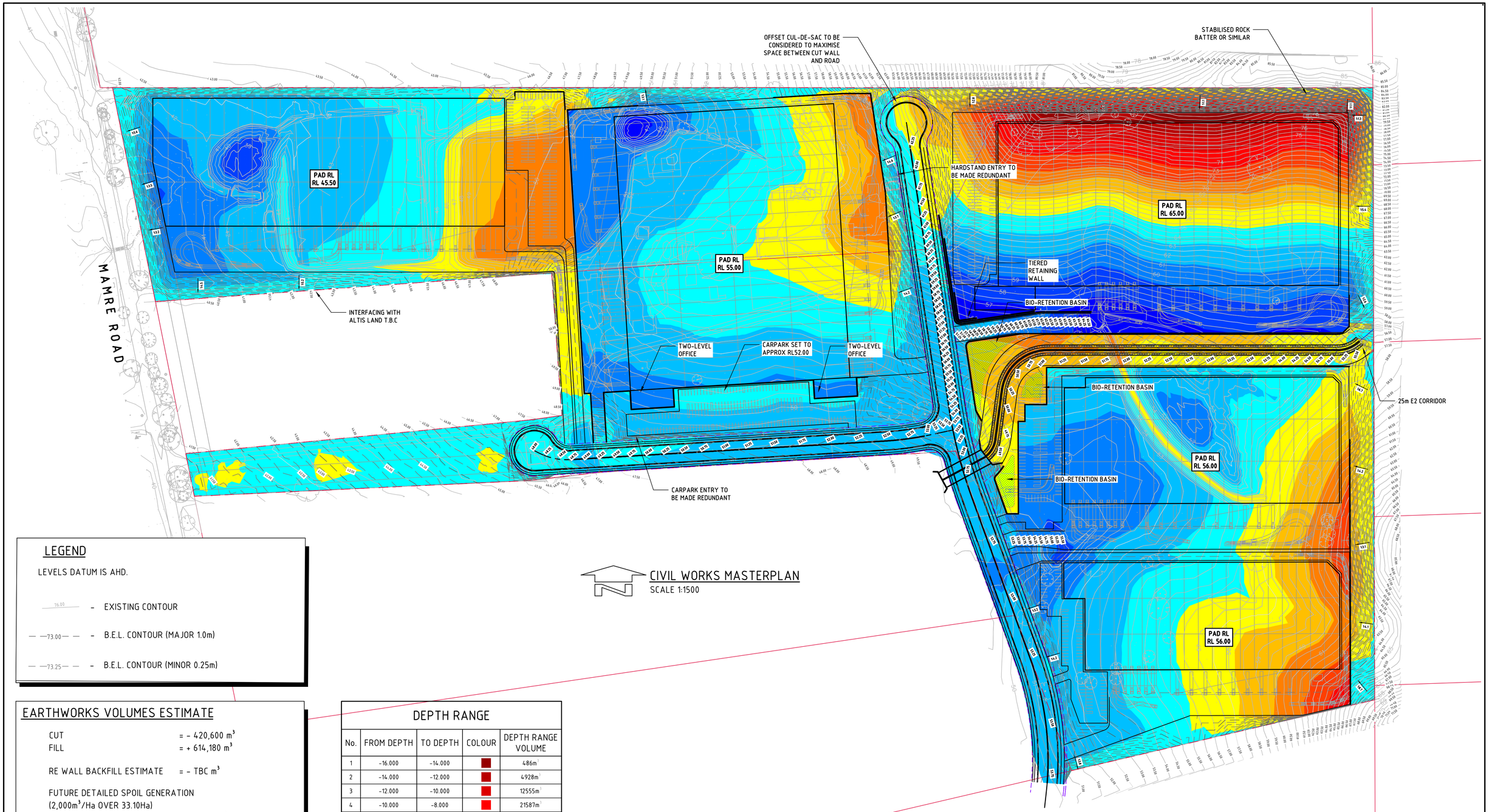
1. Transmit a reference list of the Weekly Certificates.
2. Provide an Excel spreadsheet presenting the results of all the acceptance testing completed by the GITA.
3. Certify that *"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4352-005S dated xxx)."*

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

For and on behalf of
PELLS SULLIVAN MEYNINK

HENRY ZHANG
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL



LEGEND

LEVELS DATUM IS AHD.

16.00 - EXISTING CONTOUR

73.00 - B.E.L. CONTOUR (MAJOR 1.0m)

73.25 - B.E.L. CONTOUR (MINOR 0.25m)

CIVIL WORKS MASTERPLAN

SCALE 1:1500

EARTHWORKS VOLUMES ESTIMATE

CUT	= - 420,600 m^3
FILL	= + 614,180 m^3
RE WALL BACKFILL ESTIMATE	= - TBC m^3
FUTURE DETAILED SPOIL GENERATION (2,000m^3/Ha OVER 33.10Ha)	= - 66,200m^3
BALANCE	= + 127,680m^3 (I.E. IMPORT)

EARTHWORK VOLUMES ARE APPROXIMATE ONLY.
NO ALLOWANCE HAS BEEN MADE IN THE ABOVE VOLUMES FOR BULKING OR COMPACTION OF FILLED SOILS, EROSION AND SEDIMENT CONTROL BASINS AND MEASURES, THE REMOVAL OF UNCONTROLLED FILL, TOPSOIL STRIP OR CONTAMINATED MATERIAL, TEMPORARY DRAINAGE SWALES WITHIN BUILDING PADS, RETAINING WALL BACKFILLING OR ANY OTHER UNSPECIFIED EXCAVATION RELATED TO FUTURE WAREHOUSE CONSTRUCTION.

DEPTH RANGE

No.	FROM DEPTH	TO DEPTH	COLOUR	DEPTH RANGE VOLUME
1	-16.000	-14.000		486m^3
2	-14.000	-12.000		4928m^3
3	-12.000	-10.000		12555m^3
4	-10.000	-8.000		21587m^3
5	-8.000	-6.000		33487m^3
6	-6.000	-4.000		55996m^3
7	-4.000	-2.000		109143m^3
8	-2.000	0.000		182373m^3
9	0.000	2.000		356559m^3
10	2.000	4.000		183545m^3
11	4.000	6.000		55651m^3
12	6.000	8.000		16515m^3
13	8.000	10.000		1914m^3

15m 0 15 30 45 60 75 90 105 120 135 150m

SCALE 1:1500 AT A1 SIZE SHEET

PRELIMINARY ONLY

PRELIMINARY ISSUE ONLY	10.03.21	A
AMENDMENTS	DATE	ISSUE

ARCHITECT
SBA ARCHITECTS
Commercial Industrial Residential Retail Interior Design
Suite 702, 83 Mount Street, North Sydney NSW 2060
T 02 9929 9988 F 02 9929 8899
E info@sbaarch.com.au W www.sbaarch.com.au

CLIENT
GPT The GPT Group

PROJECT
PROPOSED INDUSTRIAL ESTATE
MAMRE ROAD
KEMPS CREEK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
D.S.	D.S.	JULY '20	M.W.	A0	AS SHOWN	C013874.06 - SK

CONSULT AUSTRALIA

Costin Roe Consulting Pty Ltd.
Consulting Engineers ACN 003 696 448
Level 1, 8 Windmill Street
Walsh Bay, Sydney NSW 2000
Tel: (02) 9251-7699 Fax: (02) 9241-3731
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Costin Roe Consulting

PRECISION | COMMUNICATION | ACCOUNTABILITY

DRAWING TITLE

DRAWING No C013874.06 - SK

ISSUE

Appendix A
Subgrade Approval Report (Sample Only)

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 B
Lot Approval Report (Sample Only)

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 C
Daily Report (Sample Only)

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 D
Sample Interim 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. PSM3820-005S, 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

Appendix G
Borehole log at 1-23 Aldington Road, Kemps Creek in October 2019

Borehole ID

BH01

Engineering Log - Non Cored Borehole

Project No.: PSM3959

Client:	The GPT Group	Commenced:	03/10/2019
Project Name:	1-23 Aldington Road Geotechnical Investigation	Completed:	03/10/2019
Hole Location:	Kemps Creek	Logged By:	MB
Hole Position:	6253669.0 m E 295700.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	15t Hydrapower Scout	Inclination:	-90°	RL Surface:	86.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	KM

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 0.50 m 6,18,18, N=36		85.0	1		ML CL	SILT with gravel: Dark brown; gravel sub-angular, up to 20mm; grass and roots observed.	D	F		0.05: TOPSOIL
										CLAY trace gravel: low plasticity, Orange brown; gravel sub-angular, up to 10mm.	D to M	H		0.50: Natural soil, SPT recovery 220 mm
				SPT 1.50 m 30/140 mm, HB Refusal						SANDSTONE: Yellow-brown, Extremely weathered, very low strength; very low strength.				1.30: Bedrock, 1.50: SPT recovery 140 mm
						84.0	2			Continued on cored borehole sheet				
						83.0	3							
						82.0	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 - Cored Borehole

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Hole Position:	6253669.0 m E 295700.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	15t Hydrapower Scout	Inclination:	-90°	RL Surface:	86.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	KM

Drilling Information							***Rock Substance***				***Rock Mass Defects***	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH 0.1 0.3 1 3 10	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					85.0	1		Continued from non-cored borehole sheet				
NMLC		75	Is(50) d=1.5 a=2.2 MPa		84.0	2		SANDSTONE: medium grained, Yellow brown, Poorly developed rock fabric, distinct bedding.				SM, 0°, CL SN, UN, RF, 15 mm JT, 90°, CL SN, UN, S, 10 mm SM, 0°, CL SN, 20 mm
			Is(50) d=0.7 a=1.2 MPa		83.0	3		SHALE: Grey, Developed rock fabric, distinctly laminated bedding, some hard clay.				BP, 10°, FE SN, CU, RF, 0 mm, CN BP, 30°, FE SN, RF, 0 mm
		84	Is(50) d=0.2 a=0.5 MPa		82.0	4		SANDSTONE: fine grained, Yellow brown, Poorly developed rock fabric. SANDSTONE: medium grained, Yellow brown, Rock fabric becomes developed with laminated bedding.				SM, 2°, CL SN, 4 mm Heavily fractured JT, 45 - 90°, GR CL, IR, RF, 10 mm SM, 0°, GR CL, 25 mm SM, 0°, CL, 5 mm BP, 2°, FE SN, PR, RF, 0 mm JT, 45°, FE SN, IR, RF, 0 mm, CN BP, 0°, FE SN, PR, 0 mm, CN BP, 0°, FE SN, UN, RF, <1 mm BP, 0°, FE SN, PR, 0 mm BP, 20°, FE SN, CU, 0 mm, CN BP, 30°, FE SN, PL, 0 mm, CN BP, 1°, FE SN, PR, CN

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
WPT - Water pressure test

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

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Engineering Log - Cored Borehole

Project No.: PSM3959

Client:	The GPT Group	Commenced:	03/10/2019
Project Name:	1-23 Aldington Road Geotechnical Investigation	Completed:	03/10/2019
Hole Location:	Kemps Creek	Logged By:	MB
Hole Position:	6253669.0 m E 295700.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	15t Hydrapower Scout	Inclination:	-90°	RL Surface:	86.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	KM

Drilling Information / Rock Substance / Rock Mass Defects

Columns: Method; Water; RQD (%); Samples and Field Tests; WPT (Lugeons); RL (m); Depth (m); Graphic Log; Material Description (ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration); 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)

Method: NMLC

Water: Partial Loss (at approx. 6.0 m)

RQD (%): 84; 63; 32

RL (m): 80.0 (6 m); 79.0 (7 m); 78.0 (8 m); 77.0 (9 m)

Samples and Field Tests:
- Is(50) d=0.2 a=0.1 MPa
- Is(50) d=0.4 a=1.2 MPa
- Is(50) d=0 a=0.1 MPa
- Is(50) d=0.2 a=0.3 MPa
- Is(50) d=0.1 a=0.7 MPa

Material Description:
- SANDSTONE: medium grained, Yellow brown, Rock fabric becomes developed with laminated bedding. *(continued)*
- Some coarse grained sand and gravel.
- CL CLAY: high plasticity, Grey.
- SHALE: Red, Clay throghout, distinct bedding, rock fabric not visible, some clay.
- SHALE: Dark grey, Orange banding, developed rock fabric, distinct thinly laminated bedding, some hard clay.
- NO CORE - 100 mm

Defect Descriptions / Comments:
- BP, 0°, CL SN, PR, S, <1 mm
- JT, 90°, CL, UN, S
- BP, 0°, CL, PR, S, <1 mm
- BP, 3°, CL, PR, S, <1 mm
- BP, 0°, CL, PR, VR, <1 mm
- BP, 5°, PR, S, <1 mm
- BP, 5°, FE SN, IR, S, 0 mm, CN
- SM, 0°, CL SN, 80 mm
- BP, 5°, FE SN, PR, S, 0 mm, CN
- BP, 0°, FE SN, IR, S
- Heavily fractured
- BP, 0°, CL, PR, S, <1 mm
- BP, 0°, CL, PR, S, <1 mm
- BP, 0°, CL, PR, S, <1 mm
- BP, 0°, CL, PR, S, <1 mm
- BP, 0°, FE SN, PR, S, <1 mm
- SM, 0°, CL, PR, S, 20 mm
- 30 mm, Heavily fractured
- SM, CL, 110 mm
- Heavily fractured
- SM, 0°, CL, S, 5 mm
- SM, CL, 80 mm
- JT, 45 - 90°, FE SN
- JT, 70°, FE SN, S
- Heavily fractured

Legend

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
- WPT - Water pressure test

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

Logged in accordance with AS 1726:2017 Geotechnical site investigations

Engineering Log - Cored Borehole

Project No.: PSM3959

Client:	The GPT Group	Commenced:	03/10/2019
Project Name:	1-23 Aldington Road Geotechnical Investigation	Completed:	03/10/2019
Hole Location:	Kemps Creek	Logged By:	MB
Hole Position:	6253669.0 m E 295700.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting: 15t Hydrapower Scout | Inclination: -90° | RL Surface: 86.00 m
Barrel Type and Length: NMLC 3 m | Bearing: | Datum: AHD | Operator: KM

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	RQD (%)	Samples and Field Tests	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK NAME: particle/grain characteristics, colour, fabric/texture, inclusions or minor components, moisture, mineral composition, alteration	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL L M H VH EH 0.1 0.3 1 3 10	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		32	Is(50) d=0 a=0.4 MPa		75.0	11		SHALE: Clay throughout, indistinct bedding, rock fabric not visible.*(continued)*				Heavily fractured
								SHALE: Dark grey, Clay throughout, indistinct bedding, rock fabric not visible.				Heavily fractured SM, CL, 90 mm SM, CL, 60 mm JT, 90°, CL, 20 mm Heavily fractured
			Is(50) d=0.1 a=0.4 MPa									Heavily fractured BP, 10°, FE SN, CN
		57	Is(50) d=0.3 a=0.3 MPa		74.0	12		LAMINITE: 60% Sandstone, 40% Shale, developed bedding, distinct thinly laminated bedding, fine graded sandstone.				BP, 0°, FE SN, PR, S, 0 mm BP, 10°, FE SN, PR, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm BP, 0°, FE SN, CU, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm JT, 60°, FE SN, PR, S, 0 mm BP, 5°, FE SN, PR, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm BP, 30°, FE SN, PR, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm JT, 90°, FE SN, IR, S, 0 mm
								SHALE: Dark grey, Orange banding, developed rock fabric, distinct thinly laminated bedding, some hard clay.				
					73.0	13		NO CORE - 170 mm				JT, 80°, FE SN, IR, S, 0 mm
			Is(50) d=0.1 a=0.2 MPa					SHALE: Dark grey, Orange banding, developed rock fabric, distinct thinly laminated bedding, some hard clay.				Heavily fractured BP, 0°, FE SN, PR, S, 0 mm BP, 0°, FE, PR, S, 0 mm SM, CL, 150 mm
			Is(50) d=0.1 a=0.2 MPa		72.0	14						BP, 0°, FE SN, PR, S
		80										BP, 0°, FE SN, PR, S, 0 mm BP, 0°, CL SN, PR, S, 0 mm SM, 150 mm BP, 0°, FE, PR, S, 0 mm BP, 0°, FE SN, PR, S, 0 mm BP, 0°, FE, PR, S, 0 mm

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POL - Polished
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Engineering Log - Cored Borehole

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

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NMLC		80	Is(50) d=0.1 a=0.2 MPa		70.0	16		SHALE: Dark grey, Orange banding, developed rock fabric, distinct thinly laminated bedding, some hard clay.*(continued)*				BP, 0°, FE SN, PR, S, 0 mm
			Is(50) d=0.3 a=0.2 MPa									Heavily fractured JT, 45°, FE SN, PR, S, 0 mm JT, 90°, IR, S, 0 mm
					69.0	17						SM, CL GR, 40 mm SM, CL, 50 mm
		98	Is(50) d=0.1 a=0.3 MPa					SHALE: Dark grey, Light grey banding, well developed rock fabric, distinct thinly laminated bedding.				JT, 45°, CL, <1 mm JT, 80°, CL, PR, S, <1 mm
			Is(50) d=0.3 a=0.4 MPa		68.0	18						SM, CL, 50 mm
					67.0	19		LAMINITE: 70% shale, 30% Sandstone, fine grained sandstone, light grey with dark grey bandings, well developed rock fabric, distinct thinly laminated bedding.				
			Is(50) d=0.4 a=1.2 MPa									

Hole Terminated at 20.00 m
Target depth

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
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POL - Polished
S - Smooth
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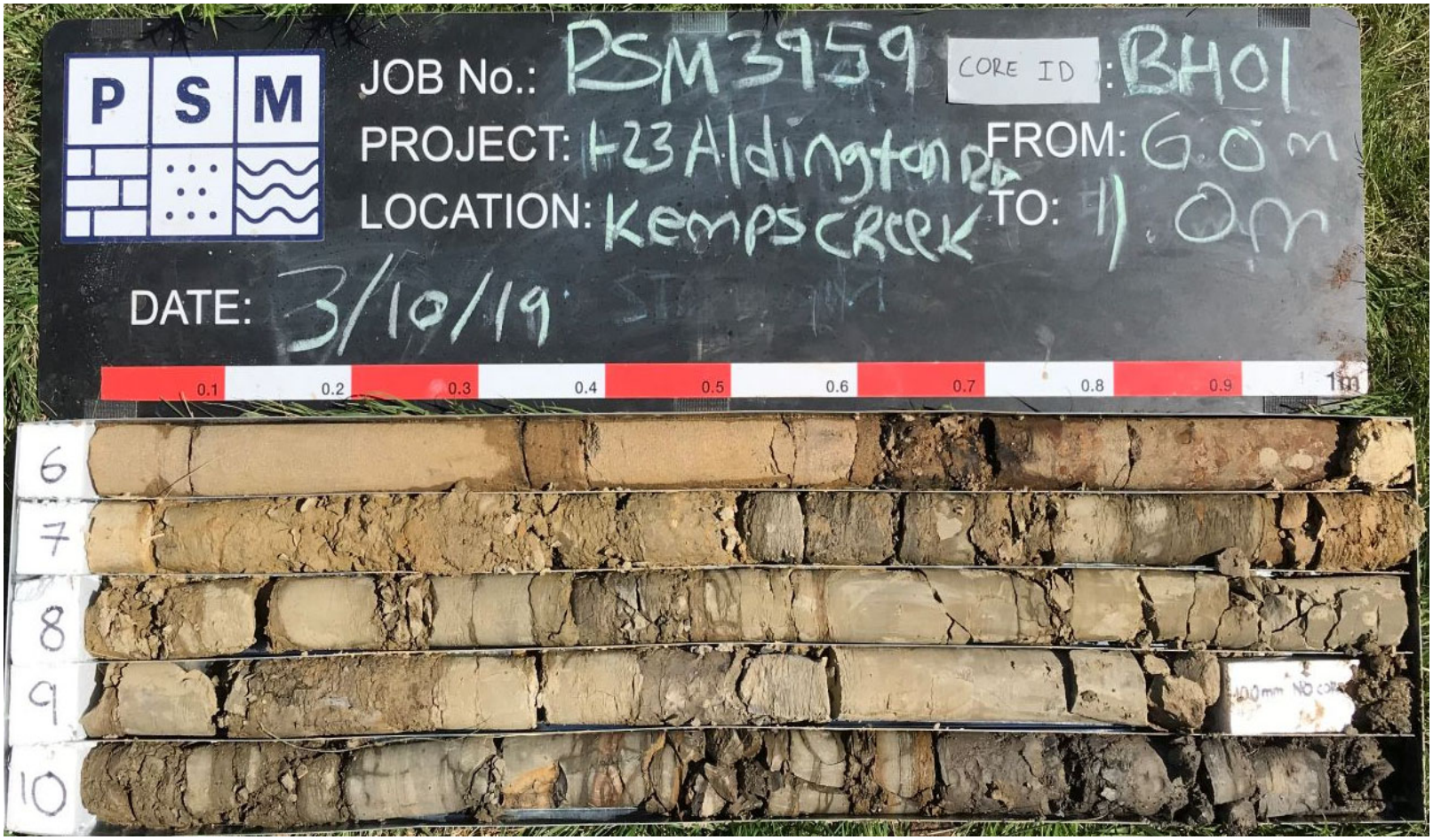
Logged in accordance with AS 1726:2017 Geotechnical site investigations

Pells Sullivan Meynink

The GPT Group
1 - 23 Aldington Road
Kemps Creek, NSW 2178
CORE PHOTO BH01
(PHOTO 1 OF 4)

PSM3959-004L	Appendix A1



Pells Sullivan Meynink

The GPT Group
1 - 23 Aldington Road
Kemps Creek, NSW 2178
CORE PHOTO BH01
(PHOTO 2 OF 4)

PSM3959-004L	Appendix A2

Pells Sullivan Meynink

The GPT Group
1 - 23 Aldington Road
Kemps Creek, NSW 2178
CORE PHOTO BH01
(PHOTO 3 OF 4)

PSM3959-004L	Appendix A3

Pells Sullivan Meynink

The GPT Group 1 - 23 Aldington Road Kemps Creek, NSW 2178 CORE PHOTO BH01 (PHOTO 4 OF 4)	
PSM3959-004L	Appendix A4