GEO-ENVIRONMENTAL

SOLUTIONS

LAND CAPABILITY ASSESSMENT

52 Richardsons Road, Sandford

CLIENT

JMG

July 2020



Geo-Environmental Solutions P/L 29 Kirksway Place Battery Point, 7004. Ph 6223 1839 Fax 6223 4539

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1 Introduction

Geo-Environmental Solutions Pty Ltd (GES) were contracted by Johnstone, McGee and & Gandy PTY LTD (JMG) to prepare a land capability assessment for a proposed subdivision at Sandford. The proposed development is located at cadastral title (CT 158742/9) located at 52 Richardson Road, Sandford (The Site). GES are to undertake a land capability assessment of the proposed development in conjunction with the requirements of the Clarence Interim Planning Scheme 2015.

GES have undertaken this assessment through using site observations and investigation, photographs and publicly available datasets. Estimations are determined by approximation with regional information applied where appropriate to site specific information. Data collection and site-specific modelling was undertaken in assessment of the site.

2 Objectives

The land area falls within land zoned Rural Resource and Environmental Living under the Clarence Interim Planning Scheme 2015.

It is the scope of this report to consider the agricultural capability of the property, and the potential impact of the proposed development on agricultural use in the local area.

3 Site Details

3.1 Project Area Land Title

The land studied in this report is defined by the following title reference:

- CT 158742/9

This parcel of land is referred to as the 'Site' and/or the 'Project Area' in this report.

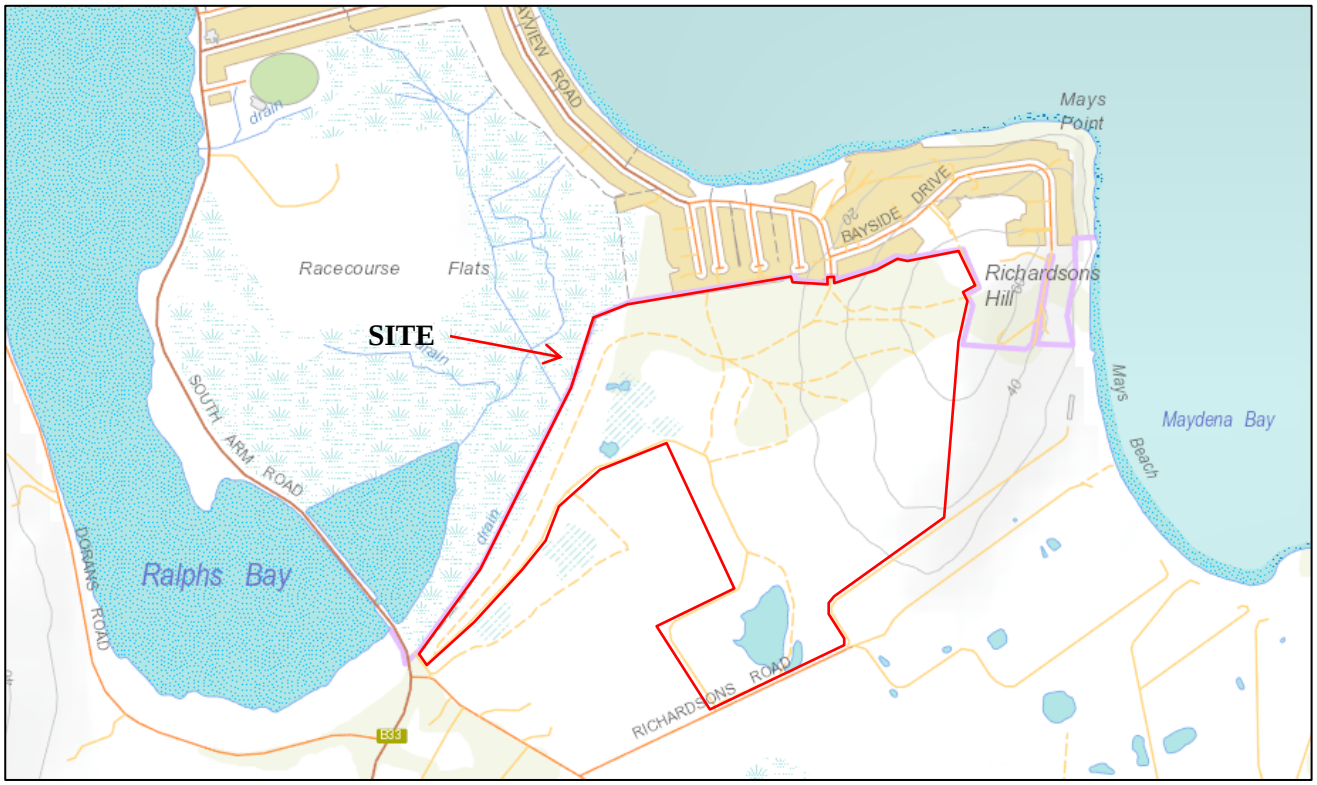


Figure 1 Regional Location of Project Area (The LIST)



Figure 2 Local Project Area Setting (The LIST)

4 Planning

4.1 Zoning

The land area falls within land zoned Rural Resource and Environmental Living under the Clarence Interim Planning Scheme 2015 (Figure 3). Land immediately to the north is zoned Residential, whilst a small parcel to the West containing the radio tower facility is zoned utilities. Land immediately to the south east of the property is also zoned rural resource, despite the land being fragmented into a number of small cadastral parcels less than 20 ha in size.

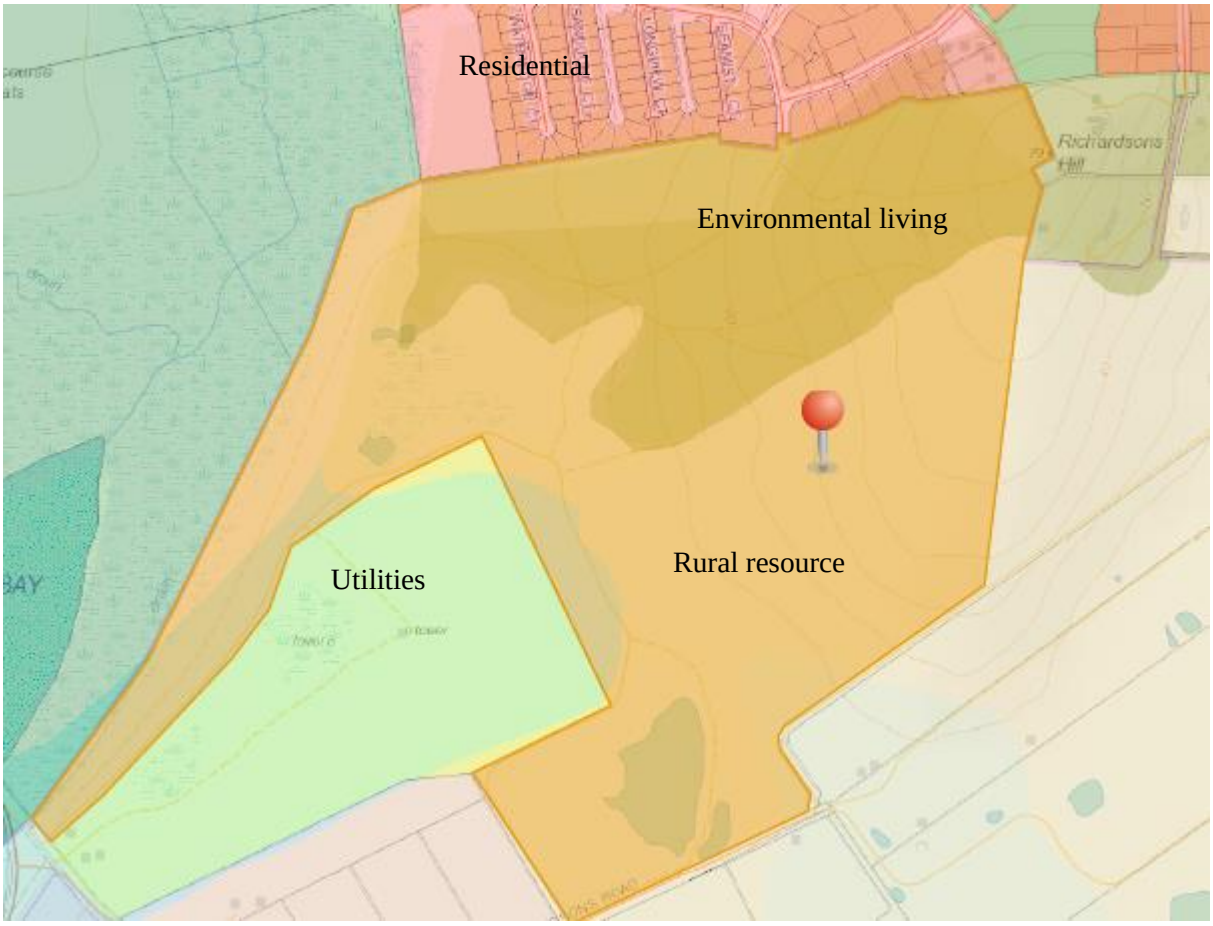


Figure 3 Planning scheme zoning the Site (The LIST).

5 Site Mapping

5.1 Site Geology

Based on the MRT 1:250,000 Mineral Resources Tasmania (MRT) mapping of the site geology comprises of the following geological units:

- **Quaternary Windblown Sand Deposits (Map Unit – Qhw);**
- **Permian Sandy Mudstone, Siltstone, Sandstone and Mudstone (Map Unit – Pm and Ps) potentially metamorphosed by Jdl intrusion**;
- **Jurassic Dolerite (Map Unit – Jdl).**

Majority of the site is underlain by a thin mantling of Quaternary-aged windblown sand deposits atop of Permian Sandy Mudstone, Siltstone, Sandstone and Mudstone. Boreholes BH18 – BH20 within the lower lots are underlain by Quaternary-aged windblown sand deposits to a minimum of 1.4m with AMS Power Probe

refusal occurring in dense, well sorted sands in BH18 and BH20. Evidence of Jurassic-aged dolerite intrusion was encountered in borehole BH08 with Quaternary-aged windblown sand deposits atop residual dolerite soils and AMS Power Probe refusal at 1.3m on dolerite.

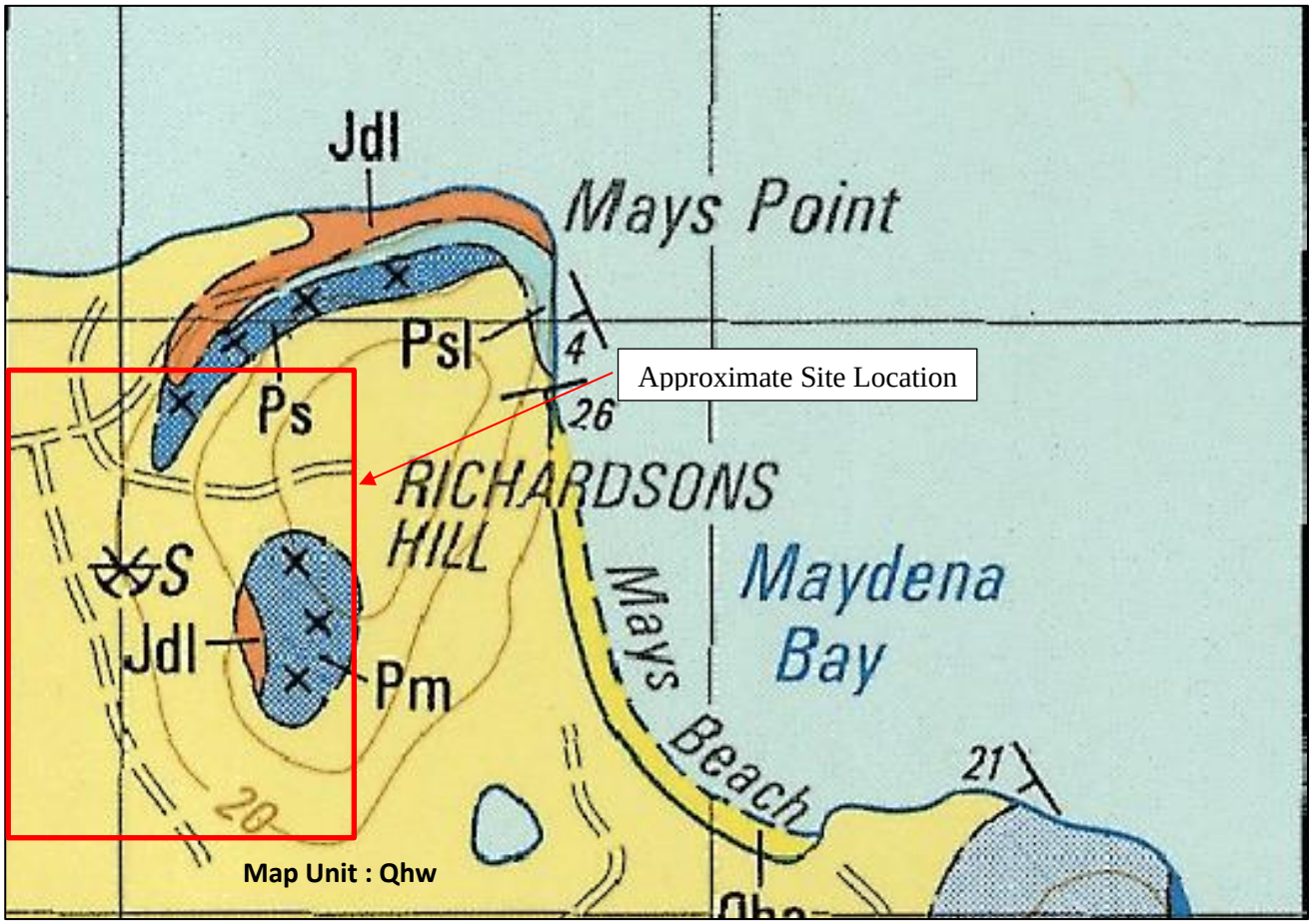


Figure 4. Site Geology (Extract from 1:50,000 Sorell – Geological Survey of Tasmania)

5.2 Field Investigation

A geotechnical investigation was carried out by GES on 28th April 2020. A total of 20 no. push probe boreholes were carried out (BH01 to BH20) to a maximum investigation depth of 3.0 m below ground surface level with Dynamic Cone Penetrometer (DCP) testing alongside boreholes >1.5m in depth. location of the boreholes has been presented in Figure 2.

During the investigation, variable ground conditions were encountered with overlying SANDS ranging from 0.2m near the apex of Richardsons Hill to >3.0m below ground surface in the western portion of the site within the lower lots.

Depth of overlying soils across site was typically shallow with refusal on Permian-aged sandstone and siltstone in Boreholes BH01-BH07 and BH09-BH17, and Jurassic-aged dolerite in BH08 between 0.5m and 1.3m depth below surface. Refusal on dense Quaternary-aged SAND occurred in boreholes BH18 and BH20. In BH19 the Quaternary-aged sediments extend to >3.0m. Typical soil profiles are shown in Tables 1-3.

The shallow soils on the Permian sediments on the upper elevations are generally too shallow to support good plant growth, and generally regarded as poor agricultural soils. The dolerite derived soils are rich in clay and provide adequate drainage is present can support pastures and a range of horticultural crops with careful soil management. The deep sandy spoils on the quaternary sediments, are often acidic and generally support poor pasture growth unless significant irrigation and nutrient management is provided. The sandy soils also represent a significant erosion risk if surface cover is removed.

Table 1 Borehole log of BH06 – typical siltstone soil

BH06 **Depth (m)**	**Description**
0.00 – 0.10	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.
0.10 – 0.20	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.
0.20 – 0.40	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.
0.40– 0.5+	SILTSTONE recovered as Clayey SILT: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.5m.

Table 2 Borehole log of BH08 – typical dolerite soil

BH08 **Depth (m)**	**Description**
0.00 – 0.20	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.
0.20 – 0.40	SAND with trace clay; Orange-brown, fine to medium grained, moist, medium dense.
0.40 – 0.70	CLAY with minor sand and trace gravel: Dark brown mottled orange and pale yellow, moist, low plasticity, stiff to very stiff.
0.70 – 1.0	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.
1.0 – 1.3+	Sandy gravelly CLAY: Grey-brown mottled orange, medium plasticity, moist, very stiff. Gravels are angular to sub-angular doloerite. Refusal at 1.3m on dolerite.

Table 3 Borehole log of BH20- typcial sandy soil

BH20 **Depth (m)**	**Description**
0.00 – 0.20	TOPSOIL - SAND: Dark grey, moist.
0.20 – 0.40	SAND: Pale brown, fine to medium grained, wet.
0.40 – 0.70	SAND: Dark orange mottled grey, fine to medium grained, wet, tight.
0.70 – 1.2	Clayey SAND: Pale brown mottled orange, wet to moist.
1.2 – 2.0+	SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, low plasticity. Refusal on dense sand at 2.0m.

6 Land Capability Assessment

Agricultural Land Capability assessment has been developed in Tasmania by the Department of Primary Industries Water and Environment according to the guidelines described in Noble (1992) and Grose (1999). The system uses a rating system of 7 classes to classify land according to the ability of the land to sustain a range of agricultural uses without land degradation. Agricultural land capability is generally based upon the permanent biophysical features of the land such as geology, soils, slope, climate, erosion hazard etc. The classification system assumes an average standard of land management and that production will be sustainable if the land is managed according to the guidelines of its Class. The system does not take into account the economics of production, distance from markets, social or political factors; all of which can change over time.

The agricultural land capability system in Tasmania utilizes a hierarchical framework of 7 classes which describe the degree of limitation from little to no limitations in class 1, to extreme limitations in class 7. Subclasses then describe the dominant limitation(s) within the class, i.e. erosion, wetness, soils, and climate.

Land classified as class 1 – 4 is generally suitable for cropping activities subject to the limitations of each class, class 5 & 6 land is generally suitable only for grazing with careful management, and class 7 land is unsuitable for agricultural use (Grose 1999).

According to the State Policy on the Protection of Agricultural Land 2009 land classified as class 1, 2 and 3 is defined as prime agricultural land. The revised Protection of agricultural land policy also has provision for the protection of significant agricultural land from other land classes, and in particular land within declared irrigation districts. Therefore, the task of the current land capability assessment was to confirm the published land capability mapping of the area, and further define the agricultural capability of the site.

6.1 Agricultural Land Capability Classes

The Land Capability Survey of Tasmania, Derwent 1:100 000 edition 6 (DeRose, 2001) in Figure 5 indicates that the land proposed for development is predominantly Class 5 land, with smaller areas of class 4 and class 6 land. Field assessment confirmed that the majority of the property is class 5 land, with a much larger area of class 6 land than that mapped, which would cover the low lying and swampy land in the western areas of the property. The small area of land mapped as class 4 land in the south east corner of the property would also be reclassified as class 5 land based upon the soil types examined.

According to Grose (1999):

CLASS 5 land is defined as

This land is unsuitable for cropping, although some areas on easier slopes may be cultivated for pasture establishment or renewal and occasional fodder crops may be possible. The land may have slight to moderate limitations for pastoral use. The effects of limitations on the grazing potential may be reduced by applying appropriate soil conservation measures and land management practices.

CLASS 6 is defined as:

Land marginally suitable for grazing because of severe limitations. This land has low productivity, high risk of erosion, low natural fertility or other limitations that severely restrict agricultural use. This land should be retained under its natural vegetation cover.

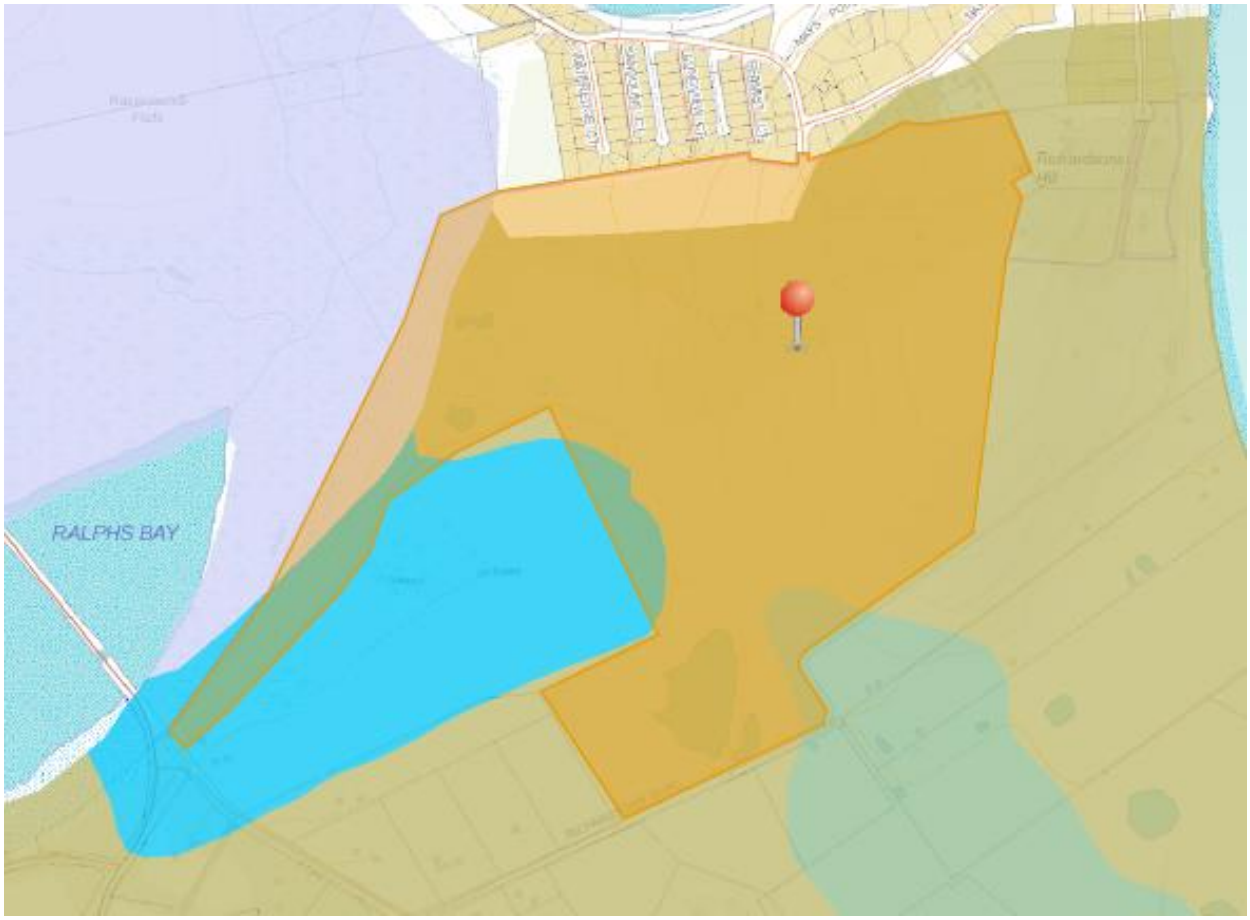


Figure 5 – Land Classification boundaries from Land Capability Survey of Tasmania, Derwent 1:100 000 edition 6 (DeRose, 2001). Blue – Class 6, Olive Brown - Class 5, Green - Class 4

The Class 5 land is primarily suited to grazing, with the possibility of opportunistic cropping on flat land and gentle slopes. This could only be achieved if soil conservation techniques are utilized. Examination of the site indicates that the pastures are predominantly native species (see figure 6), with little evidence of the sowing of improved pastures or coordinated weed control and nutrient management. The areas of class 6 land in the low-lying parts of the property show signs of poor pasture growth and the presence of species such as spikey rush which indicate seasonal waterlogging. Long term grazing productivity of these areas could also be increased if lower lying areas are fenced to allow stock exclusion during wet periods and protect soil structure However the agricultural productivity of the class 6 land is severely restricted and limited to sparse seasonal grazing at best.



Figure 6 – Typical Class 5 land on the property on the slopes of Richardsons hill



Figure 7 – Typical Class 6 land on the property on flatter waterlogged areas

6.2 Agricultural Land Capability Summary

The property at 52 Richardson Road is classified as Class 5 and 6 agricultural land. This is consistent with the current land use which supports little agricultural enterprise. Following field inspection of the land proposed for development, it is clear the capability of the land is limited. Any increase in agricultural viability of the property would require extensive capital investment and is not guaranteed to have substantial benefit. None of the land surveyed is Class 1, 2 or 3 agricultural land and there is no evidence that the area in question could be classified as agricultural land of local or regional significance.

The surrounding land has been classified as Class 5 land with a small area to the south classified as Class 4 land. Field assessment confirmed that class 5 land is the predominant land class. The surrounding land is predominantly used for rural residential purposes, with no evidence of intensive or structured agricultural use. The proposed development will not hinder agricultural use of surrounding properties and it is very unlikely to fetter any other existing agricultural enterprises in the local area. The proposed development and the Class 4 land to the south will have a significant separation distance from the proposed residential zoned area, via larger lots, which allows for a significant buffer. The rural resource zoned land to the east on Richardsons hill also currently supports a residential dwelling and no known agricultural use.

6.3 Rezoning Requirements

As the proposed development is for the rezoning of land from Rural Resource zoning to a non-agricultural use (i.e. residential) the proposal must demonstrate compliance with the intent of the scheme and the state policy on the protection of agricultural land (otherwise known as the PAL policy). The policy has a number of principles that must be implemented through planning instruments. The principles recognise that agricultural land is a valuable resource and should not be unreasonably constrained by alternative development. In particular, the principles outline the protection for prime agricultural land (class 1, 2 and 3) and the appropriate protection of land of local or regional significance.

The land capability field survey of the property identified that it is predominantly Class 5 and class 6 land. None of the land surveyed is Class 1, 2 or 3 agricultural land and there is no evidence that the area in question could be classified as agricultural land of local or regional significance. Therefore, the development will be located on land with limited agricultural potential and use.

The surrounding land has comparable land classification (predominantly Class 5 land) and similar restricted land use of limited grazing as part of small rural residential lots. Much of the land surrounding the property is zoned for residential use, ranging from general residential, to environmental living, and rural living. An area of land to the South is also zoned rural resource although the land is divided into small titles supporting dwellings more in keeping with a rural residential use. The proposed development will not hinder the continued limited agricultural use of these surrounding properties.

The nearest land zoned significant agriculture is over 12m to the north at Cambridge, and the property is not within a declared irrigation district. Therefore, it is clear that the property and the local area has limited agricultural potential, and would be highly unlikely to support any future investment into agricultural uses. The poor soil quality, rainfall deficit, and lack of irrigation resources severely limits the potential agricultural use of the land on the property and in the surrounding area.

It is concluded that the proposal for rezoning of the land would be consistent with the protection of agricultural land policy as the land has no demonstrated agricultural use and very limited agricultural potential.

7 Conclusions and Recommendations

The land area examined is suitable for the proposed development, with the following conclusions:

- The land capability field survey of the property identified that it is predominantly Class 5 and class 6 land
- The proposed development is located on land with limited agricultural potential and use
- None of the land examined is prime agricultural land as defined under the State Protection of Agricultural Land Policy 2009
- The land also does not have identified local or regional agricultural significance
- The proposed development of the land in question does not conflict with continued management of the adjacent properties



Dr John Paul Cumming B.Agr.Sc (hons) PhD CPSS GAICD
Environmental and Engineering Soil Scientist

8 References

Grose. C.J. (1999). Land Capability Survey Handbook: Guidelines for the Classification of Agricultural Land in Tasmania – Second Edition, Department of Primary Industries, Water and Environment, Tasmania

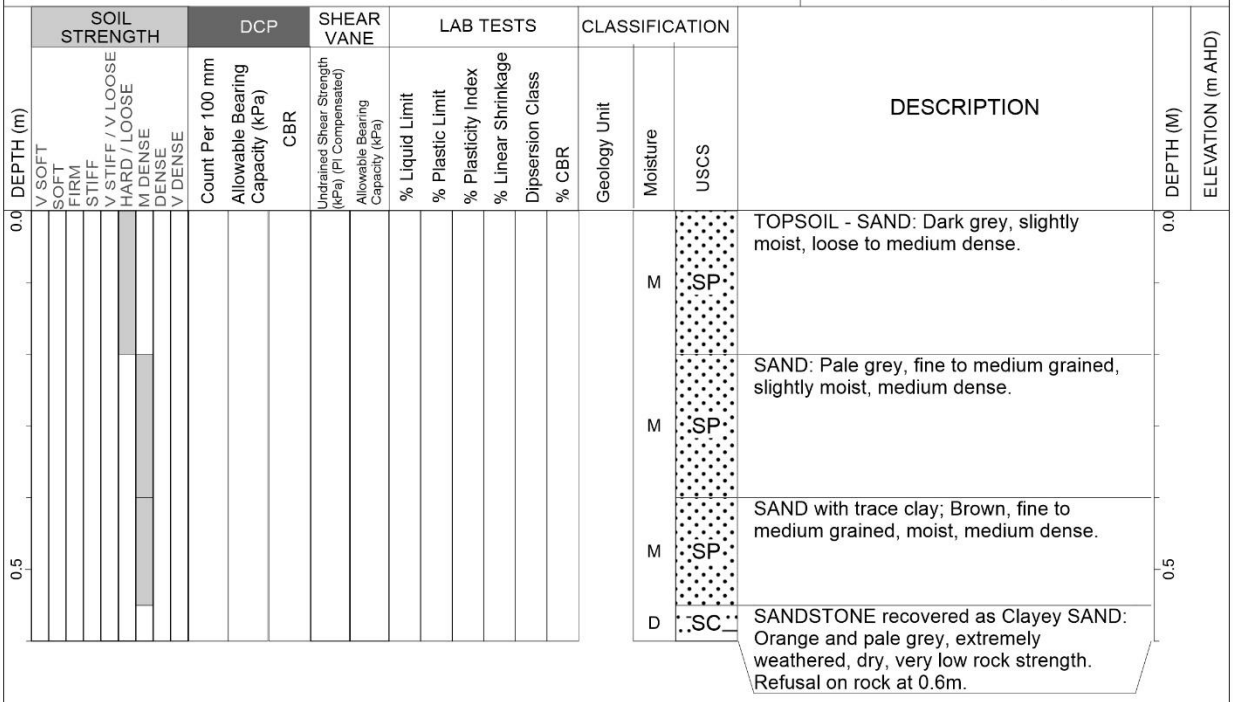
Musk R. and De Rose R. (2000), Land Capability Survey of Tasmania. Derwent Report. Department of Primary Industries, Water and Environment, Tasmania, Australia.

Noble K E (1992). Land Capability Survey Handbook. Department of Primary Industries, Water and Environment, Tasmania

Appendix 1 Borehole Logs

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH01**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.6**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH02

CLIENT: **JMG**

EASTING (GDA94):

LOCATION: **Sandford**

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.6**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	SP	SAND with trace clay; Brown, fine to medium grained, moist, medium dense.		
0.5														D	SC	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.6m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH03**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.7**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	SP	SAND with trace clay; Brown, fine to medium grained, moist, medium dense.		
0.5														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.	0.5	
														D	SC	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.7m.		

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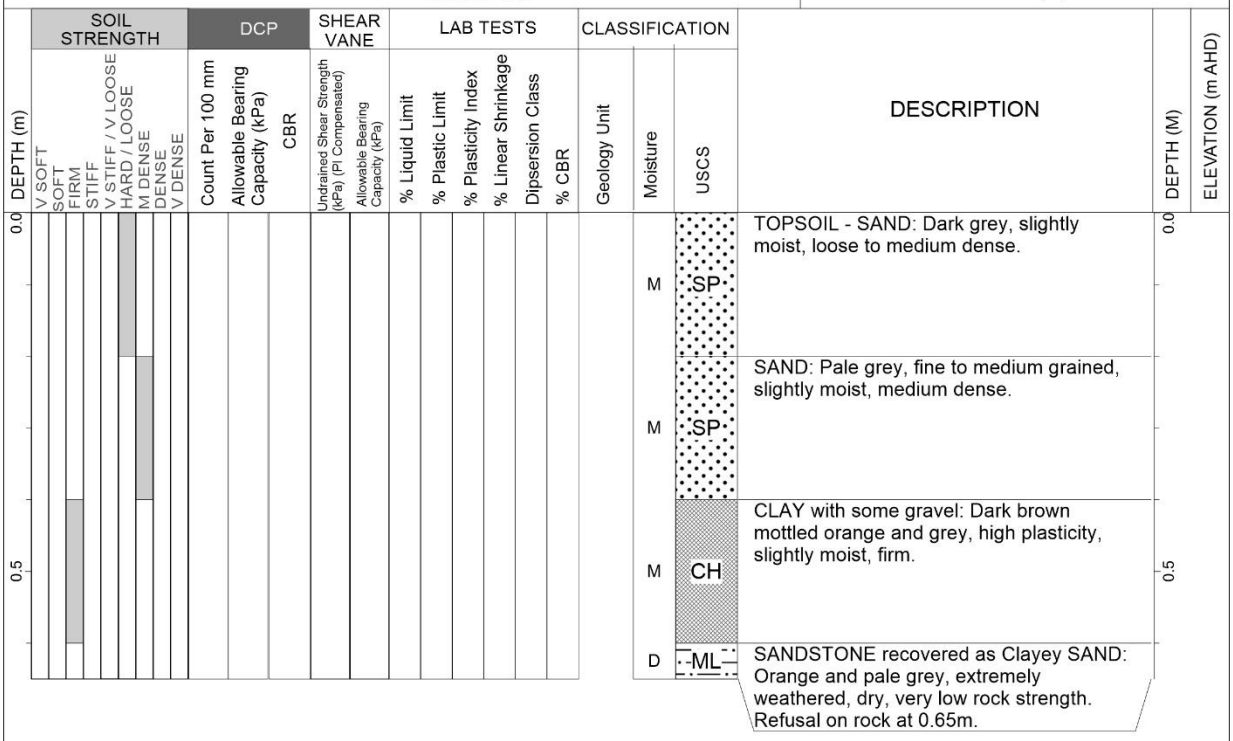
PROJECT: 52 Richardsons Road		**Log of BH04**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.7**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	SP	SAND with trace clay; Brown, fine to medium grained, moist, medium dense.		
0.5														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.	0.5	
														D	SC	SANDSTONE recovered as Clayey SAND: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.7m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH05**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.65**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH06

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

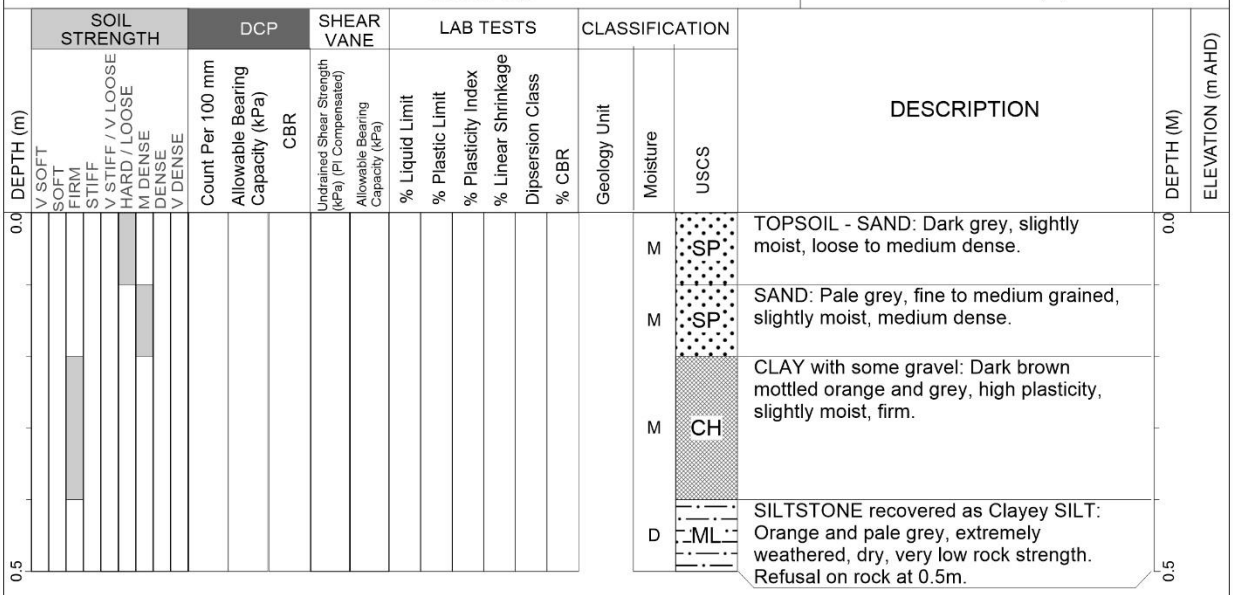
SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH07

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.7**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, slightly moist, loose to medium dense.	0.0	
														M	SP	SAND: Pale grey, fine to medium grained, slightly moist, medium dense.		
														M	CH	CLAY with some gravel: Dark brown mottled orange and grey, high plasticity, slightly moist, firm.		
0.5														D	ML	SILTSTONE recovered as Clayey SILT: Orange and pale grey, extremely weathered, dry, very low rock strength. Refusal on rock at 0.7m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH08**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.3**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	SP	SAND with trace clay; Orange-brown, fine to medium grained, moist, medium dense.		
0.5														M	CL	CLAY with minor sand and trace gravel: Dark brown mottled orange and pale yellow, moist, low plasticity, stiff to very stiff.	0.5	
1.0														M	CH	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.	1.0	
														M	CI	Sandy gravelly CLAY: Grey-brown mottled orange, medium plasticity, moist, very stiff. Gravels are angular to sub-angular doloerite. Refusal at 1.3m on dolerite.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH09

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	SP	SAND with trace clay; Orange-brown, fine to medium grained, moist, medium dense.		
														M	SP	SAND with trace clay; Orange-brown, fine to medium grained, moist, slightly cemented, very dense.		
														M	CL	Sandy CLAY: Orange and pale grey, fine grained sand, moist, low plasticity, very stiff. Refusal on SANDSTONE at 0.5m.		
0.5																	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH10**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.9**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
0.5														M	CL	CLAY with minor sand and trace gravel: Dark brown mottled orange and pale yellow, moist, low plasticity, stiff to very stiff.	0.5	
														M	CH	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.		
														D	GC	SANDSTONE recovered as Clayey GRAVEL: Pale grey-brown and orange, dry, low rock strength. Refusal at 0.9m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH11**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **0.7**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CH	CLAY: Dark brown, high plasticity, moist, stiff to very stiff.		
0.5														D	GC	SANDSTONE recovered as Clayey GRAVEL: Pale grey-brown and orange, dry, low rock strength. Refusal at 0.7m.	0.5	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH12**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.2**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CI	Gravelly CLAY: Dark brown, moist, medium plasticity, stiff.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff.	0.5	
1.0														M	CL	Gravelly, silty CLAY: Yellow-brown mottled white, moist, low plasticity, stiff. Refusal on rock at 1.2m.	1.0	

GEO ENVIRONMENTAL SOLUTIONS - 29 KIRKSWAY PLACE, BATTERY POINT - T: 03 6223 1839 | Page 1 of 1

GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH13

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

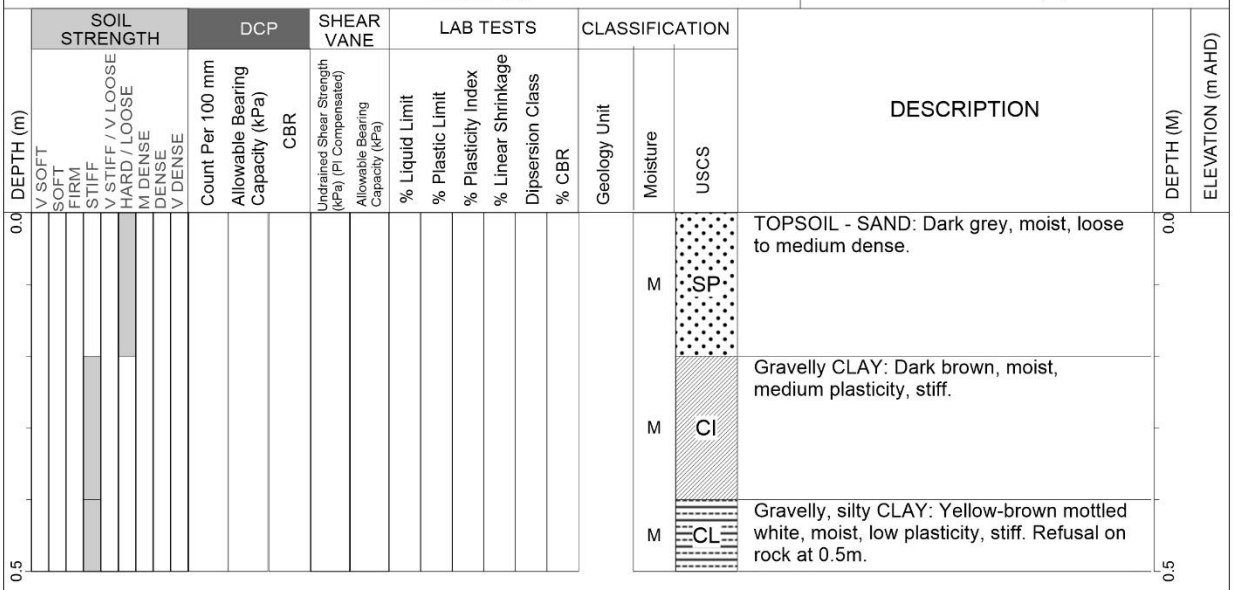
SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH14

CLIENT: **JMG**

EASTING (GDA94):

LOCATION: **Sandford**

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.5**

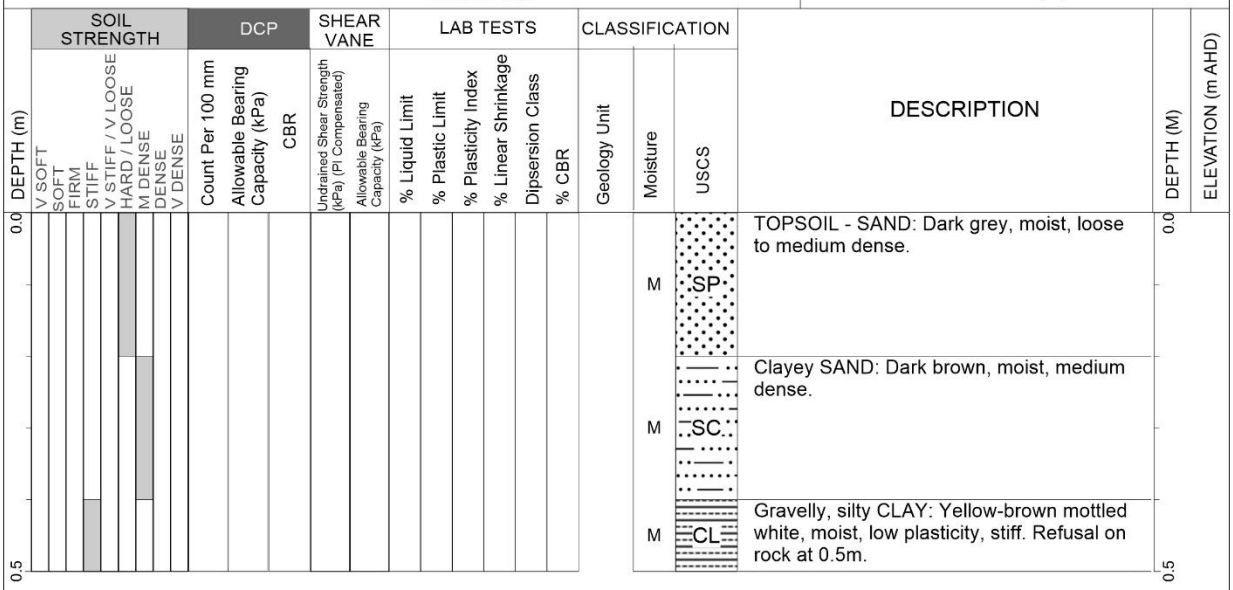
SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):



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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH15

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **0.9**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
0.5														W	CI	Gravelly CLAY: Dark brown, moist to wet, medium plasticity, stiff.	0.5	
														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff. Refusal on rock at 0.9m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH16**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.3**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / HARD / V LOOSE / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, medium to high plasticity, very stiff.	0.5	
1.0														M	SC	Clayey SAND: Orange and pale grey, moist, very dense. Refusal at 1.3m.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH17**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR: **GES**		ELEVATION (m AHD):
DRILLING METHOD: **AMS Power Probe**		TOTAL DEPTH (m): **1.3**
SAMPLING METHOD: **Core**		NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														W	SP	SAND with trace clay; Orange-brown, fine to medium grained, wet, medium dense.		
0.5														M	SC	Clayey SAND: Orange and pale grey, moist, very dense.	0.5	
1.0														M	GC	SILTSTONE recovered at Clayey GRAVEL: Orange and pale grey, moist, low rock strength. Refusal at 1.3m.	1.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH18**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **1.4**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH: V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	DCP: Count Per 100 mm	DCP: Allowable Bearing Capacity (kPa)	DCP: CBR	SHEAR VANE: Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE: Allowable Bearing Capacity (kPa)	LAB TESTS: % Liquid Limit	LAB TESTS: % Plastic Limit	LAB TESTS: % Plasticity Index	LAB TESTS: % Linear Shrinkage	LAB TESTS: Dipsersion Class	LAB TESTS: % CBR	CLASSIFICATION: Geology Unit	CLASSIFICATION: Moisture	CLASSIFICATION: USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0														M	SP	TOPSOIL - SAND: Dark grey, moist, loose to medium dense.	0.0	
														M	CI	Gravelly CLAY: Dark brown, moist, medium plasticity, stiff.		
0.5														M	CH	Gravelly CLAY: Dark brown, moist, high plasticity, very stiff.	0.5	
1.0														M	CL	Gravelly, silty CLAY: Yellow-brown mottled white, moist, low plasticity, stiff.	1.0	
														M	SC	SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, very dense. Refusal on dense sand at 1.4m.		

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road

Log of BH19

CLIENT: **JMG**

LOCATION: **Sandford**

EASTING (GDA94):

NORTHING (GDA94):

CONTRACTOR: **GES**

ELEVATION (m AHD):

DRILLING METHOD: **AMS Power Probe**

TOTAL DEPTH (m): **3**

SAMPLING METHOD: **Core**

NATURAL GROUND (m):

DATE: **01/05/2020**

LOGGED BY: **D. Lee**

DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH	DCP Count Per 100 mm	DCP Allowable Bearing Capacity (kPa)	DCP CBR	SHEAR VANE Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE Allowable Bearing Capacity (kPa)	LAB TESTS % Liquid Limit	% Plastic Limit	% Plasticity Index	% Linear Shrinkage	Dipsersion Class	% CBR	CLASSIFICATION Geology Unit	Moisture	USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0	V SOFT / SOFT / FIRM / STIFF / V STIFF / V LOOSE / HARD / LOOSE / M DENSE / DENSE / V DENSE	1	30	2										M	SP	TOPSOIL - SAND: Dark grey, moist.	0.0	
		1	30	2														
		2	55	4										W	SP	SAND: Pale brown, fine to medium grained, wet.		
		3	85	6														
0.5		6	170	13										M	SC	Clayey SAND: Brown mottled orange, moist.	0.5	
		9	250	20														
		12	335	27														
		13	365	30										W	SP	SAND: Orange, fine to medium grained, wet.		
1.0		13	365	30													1.0	
		12	335	27														
		11	310	25														
		7	195	15														
		5	140	10														
1.5		5	140	10										W	CI	Sandy CLAY: Pale brown-grey mottled orange, wet to moist, medium plasticity.	1.5	
		4	110	8														
		9	250	20														
		13	365	30														
2.0		16	450	37													2.0	
		20	560	48														
														M	SP	SAND: Pale grey mottled orange, moist, dense.		
2.5																	2.5	
														M	CI	Sandy CLAY: Pale brown-grey mottled orange, moist, medium plasticity, very stiff. Lower boundary undefined.		
3.0																	3.0	

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GEO-ENVIRONMENTAL SOLUTIONS

PROJECT: 52 Richardsons Road		**Log of BH20**
CLIENT: **JMG**		EASTING (GDA94):
LOCATION: **Sandford**		NORTHING (GDA94):
CONTRACTOR:	**GES**	ELEVATION (m AHD):
DRILLING METHOD:	**AMS Power Probe**	TOTAL DEPTH (m): **2**
SAMPLING METHOD:	**Core**	NATURAL GROUND (m):
DATE: **01/05/2020**	LOGGED BY: **D. Lee**	DEPTH WATER STRUCK (m):

DEPTH (m)	SOIL STRENGTH	DCP Count Per 100 mm	DCP Allowable Bearing Capacity (kPa)	DCP CBR	SHEAR VANE Undrained Shear Strength (kPa) (PI Compensated)	SHEAR VANE Allowable Bearing Capacity (kPa)	LAB TESTS % Liquid Limit	% Plastic Limit	% Plasticity Index	% Linear Shrinkage	Dipsersion Class	% CBR	CLASSIFICATION Geology Unit	Moisture	USCS	DESCRIPTION	DEPTH (M)	ELEVATION (m AHD)
0.0	V STIFF / V LOOSE	1	30	2										M	SP	TOPSOIL - SAND: Dark grey, moist.	0.0	
		1	30	2														
		1	30	2										W	SP	SAND: Pale brown, fine to medium grained, wet.		
0.5	HARD / LOOSE	2	55	4													0.5	
	M DENSE	6	170	13												SAND: Dark orange mottled grey, fine to medium grained, wet, tight.		
		10	280	22										W	SP			
		7	195	15														
	DENSE	9	250	20												Clayey SAND: Pale brown mottled orange, wet to moist.		
1.0		9	250	20													1.0	
		12	335	27										M	SC			
	V DENSE	10	280	22														
		12	335	27														
		4	110	8												SAND with some clay: Grey-brown mottled orange, fine to medium grained, moist, low plasticity. Refusal on dense sand at 2.0m.		
1.5		5	140	10													1.5	
		7	195	15														
		4	110	8										M	SC			
		8	225	17														
		15	420	35														
2.0		20	560	48													2.0	

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Appendix 2 Development Plan

