Preliminary Geotechnical Investigation Report

Civil Engineering at Stirling Golf Club

Job Number	275203
Client	Venture Capital Developments Pty Ltd
Site	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Date	04/05/2021
Revision	0

Document Status

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			Name	Date	Name	Date
0	FINAL	Frank Fu	Richard Atkinson	06/05/2021	Frank Fu	06/05/2021

Contents

1.0 Introduction

FMG Engineering (FMG) has been commissioned to undertake a preliminary geotechnical investigation at Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152 for a Development Application to develop the site as Mount Lofty Golf Estate. The approximate site extents are shown below in Figure 1.

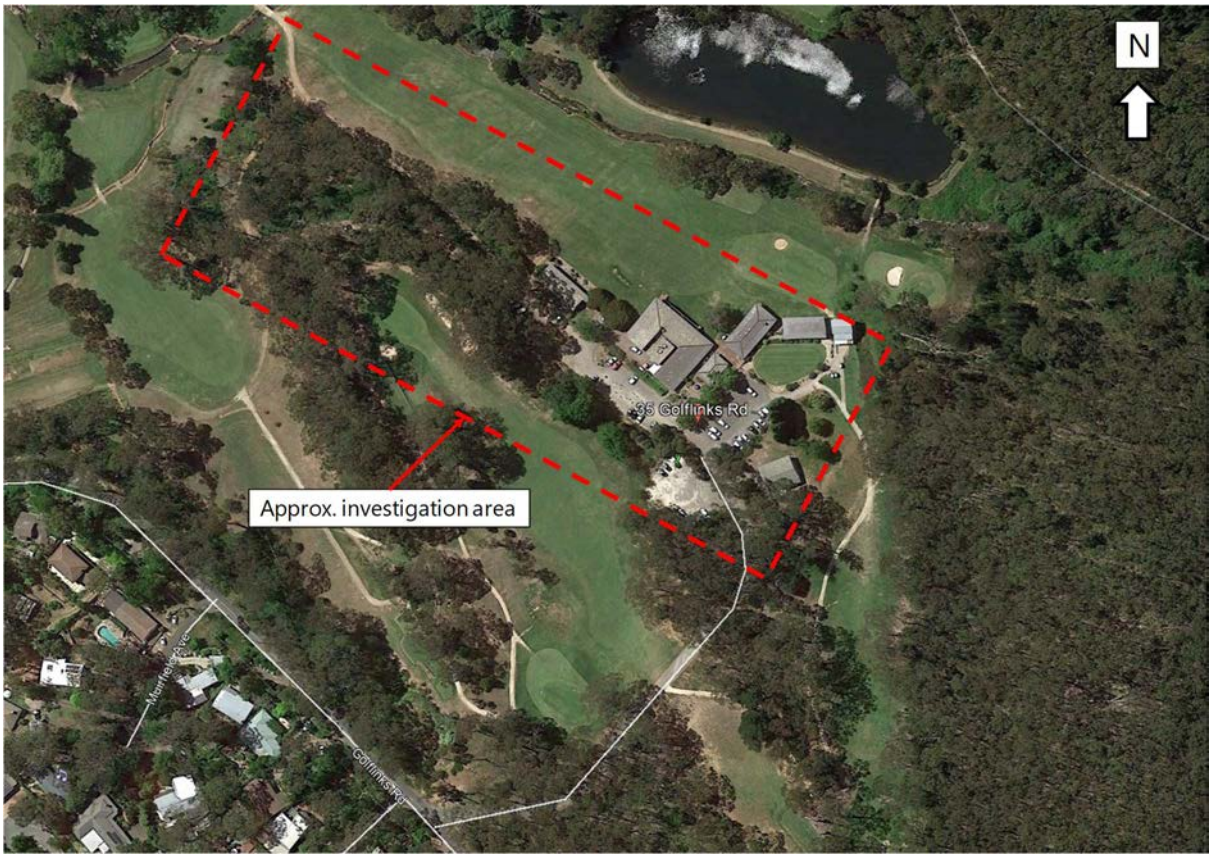


Figure 1: Site location

1.1 Proposed development and objectives

We understand from the documents and discussions provided that the proposed Mount Lofty Golf Estate development comprises accommodation Chalets, hotel, restaurant, pro shop, carpark and amphitheatre etc. Maximum building height of two-storey is proposed. We have been provided with the following drawings on which we have based this assumption.

- *MOUNT LOFTY COURSE MASTER PLAN*

A preliminary geotechnical investigation was required to better understand the top soil profiles and to classify the site soils. The approved scope of work can be found in our Fee Proposal letter (EST23936).

1.2 Reporting

This report summarizes the methodology adopted and the works undertaken during the site investigation, followed by the investigation findings and site classification. Borelogs are appended.

2.0 Preliminary / Desktop study

2.1 Site description

The site investigation area is located within the established Stirling Golf Club site. The site is approximately 20km South East of the Adelaide CBD and 0.5km off South Eastern Freeway. The site is near the toe of a hill sloping down towards the north, and terraced for buildings and carpark. A small dam and creek are noted north of the proposed development. A significant number of trees are present on site and on surrounding lands.

Surrounding site conditions comprise:

- North: Golf court
- East: Vacant land
- South: Golf court and Golflinks Road on upper hill
- West: Mount George

2.2 Geology

The South Australian Department for Energy and Mining online GIS database "SARIG" indicates that the regional near surface geology across the entire site to be Barossa Complex, described as Metamorphic rocks with retrograde metamorphism; metasediments, strongly banded parallel to gneissic foliation; minor intrusive granitic, pegmatitic and amphibolitic dykes. Granulite facies metapelites.

Nearby boreholes in the SARIG and FMG database indicate that the weathered rock bed could be at shallow depth (0.5m from shallowest record).

3.0 Site investigation and results

3.1 Methodology

Independent service locating was undertaken by ILS prior to drilling.

Borehole were located according to verbal advice provided by yourselves, and are shown on the site plan included in Appendix A. As advised, an additional borehole than proposed in our initial proposal was added. A total of 11 Boreholes were drilled using a Rockmaster 4WD mounted drill rig owned and operated by SPK Geodrill under the supervision of a Geotechnical Engineering on 29th April 2021.

Thick walled tubes were used to recover relatively continuous cores. Tubes were progressed by pushing the tube against the weight of the vehicle, by a high-frequency hydraulic hammer, and rotation of the tubes.

Only BH10 was terminated at the target depth, the rest of boreholes were all terminated when high resistance was encountered to push tubes. Depth achieved ranged from 0.4m to 4.0m. Recovered samples were placed in trays and transported to our laboratory for logging.

Visual tactile logging was carried out in accordance with AS1726 by an experienced Soil Technician and checked by Geotechnical Engineer. Borelogs are included in Appendix B.

A summary of achieved depths is shown in Table 1.

Table 1 Summary of achieved depths

TEST	DEPTH ACHIEVED (m)	TEST	DEPTH ACHIEVED (m)
BH01	2.2	**BH07**	0.4
BH02	2.8	**BH08**	1.8
BH03	2.3	**BH09**	2.1
BH04	1.2	**BH10**	4.0
BH05	2.1	**BH11**	3.0
BH06	1.6		

3.2 Summary of subsoil conditions

A description of the materials encountered during the investigation is included in the borehole log included in Appendix B and a generalised summary can be found in the table below. It should be noted that pocket penetrometer readings included on the logs indicate an approximation of unconfined shear strength and have been used in the interpretation of the allowable bearing capacities given in the footing recommendations section.

High resistance encountered to the drilling is interpreted as weathered rock. Weathering is likely to decrease with depth, with an increase in rock strength. It should be noted that the drilling method used does not provide any information regarding defects or bedding of the rock, and hence can not provide any data on the strength nor stability of the rock mass.

Table 2 outlines a summary of subsurface conditions.

Table 2 Summary of subsurface conditions

MATERIAL	DEPTH ENCOUNTERED (m)					
	BH01	**BH02**	**BH03**	**BH04**	**BH05**	**BH06**
Fill	0-0.2	0-0.35	N.E	N.E	0-0.2	0-0.2
Natural soils	0.2-1.8	0.35-2.6	0-1.6	0-0.7	0.2-1.5	0.2-1.3
Rock	1.8-2.2	2.6-2.8	1.6-2.3	0.7-1.2	1.5-2.1	1.3-1.6
MATERIAL	**DEPTH ENCOUNTERED (m)**					
	BH07	**BH08**	**BH09**	**BH10**	**BH11**	
Fill	0-0.2	0-0.3	0-0.65	0-1.4	0-0.25	
Natural soils	0.2-0.3	0.3-1.4	0.65-1.7	1.4-4.0	0.25-2.8	
Rock	0.3-0.4	1.4-1.8	1.7-2.1	N.E	2.8-3.0	

N.E Not Encountered

The natural subsurface conditions encountered in the boreholes are considered consistent with the regional geology from our desktop study.

3.3 Groundwater

Groundwater was not observed during drilling. It should be noted that the occurrence of groundwater may vary seasonally with rainfall intensity and duration.

3.4 Site classification

Free swell y_s values have been calculated in accordance with AS2870-2011. Although AS2870-2011 is considered appropriate for this application the design should be based on engineering principles.

The site in its current condition is classified as CLASS **P** (problem site) due to the presence of fill and trees and **M-D** due to soil reactivity.

The characteristic surface movement due to soil shrinking and swelling (y_s) has been calculated in accordance with AS2870-2011 "Residential Slabs and Footings" (to the nearest 5mm). Taking into account the effects of trees in accordance with AS2870-2011, the additional characteristic surface movement due to group tree effects (y_t) has also been calculated.

- y_s = 35mm
- y_t = 15mm

The site classification is strongly related to depth of the rock. Locations where rock is shallow have lower shrink-swell potential. Values of heave ys vary from 2mm at Borehole 7 to 37mm at Boreholes 2 and 11.

It must be emphasised that in classifying this site, FMG Engineering did not place sole reliance on the borelog as a means of being an absolute representation of all subsurface features existing at this site. The following have also been taken into consideration.

- The broad experience of FMG Engineering
- Well established and relevant local knowledge of the general behavioural characteristics of foundation soils in the vicinity of the site
- Specific geotechnical reports and classification on adjacent sites which were referred to
- FMG Engineering's vast experience relating to past performance of existing structures in the general area
- Published geological maps
- Engineering assessment of the likely characteristic surface movement (ys) based on estimated Ips values as noted on the borelog. Ips values are based on Shrink Swell tests (Iss) carried out in a laboratory on similar soils to this site
- It can occasionally be difficult to distinguish between natural soil and controlled FILL during testing. It is also impossible to distinguish between uncontrolled FILL and controlled FILL without appropriate information. It shall be the Client's responsibility to determine whether any controlled FILL exists on the site, and to provide FMG with the relevant Certificate(s) at the time of our engagement, prior to the fieldwork being carried out. FMG takes no responsibility for any additional costs which may be incurred due the presence of Controlled FILL which is not detected during our testing, and which is instead logged as either (uncontrolled) FILL or natural soil.

4.0 Important notes about the interpretation and use of this geotechnical report

These notes are offered to help in the interpretation of your Geotechnical Report.

The level of investigation and degree of certainty required is dependent upon the complexity of the proposed construction.

Should a more conclusive assessment be required regarding the subsoil conditions at the property, FMG Engineering can arrange to undertake a more detailed study including further sampling and laboratory testing. There will always be uncertainties arising from the practical limitations of the extent and nature of site testing and localised changes in soil conditions may not be found in any cause.

This report should be read as a whole. Borelogs should not be separated from the body of the report and interpreted independently. The whole of this report should be provided to contractors in order to provide the best available information to the contractors. To avoid any misinterpretation of the contents of the report consult the geotechnical engineer for any queries or proposed changes or unexpected conditions.

4.1 The limitations of a geotechnical investigation

Although the information provided by a geotechnical investigation can reduce exposure to such risks, no geotechnical investigation, however diligently carried out, can eliminate them. Even a rigorous professional assessment may fail to detect all subsoil and ground water variations on a site. The geology of the site may make predicting changes difficult.

A geotechnical investigation is based upon a unique set of project conditions.

Your report should not be used:

- When the nature of the proposed development or use is changed, for example if a residential development is proposed instead of a commercial one
- When the size or configuration of the proposed development is altered
- When the location or orientation of the proposed structure is modified
- When there is a change of ownership
- For application to an adjacent site.

The circumstances about a particular development or contract may require a specified approach to the assessment of soil and groundwater conditions.

To help avoid costly problems, refer to your consultant to determine how any factors which have changed subsequent to the date of the report may affect our recommendations.

4.2 Geotechnical 'findings' are professional estimates

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions

and the nature and homogeneity of subsurface conditions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration programme, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise its impact. For this reason, owners should retain the services of their consultants through the development stage, to identify variations, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site or during the tender process.

A report prepared for the purposes of the geotechnical engineer's direct client may not meet the objectives of a third party or contractor. Consult the geotechnical engineer for guidance in the application of the report to your purposes.

4.3 Unforeseen conditions

Should conditions encountered on site be markedly different from those anticipated and described in this report then FMG Engineering should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows reinterpretation and assessment of the implications for future work.

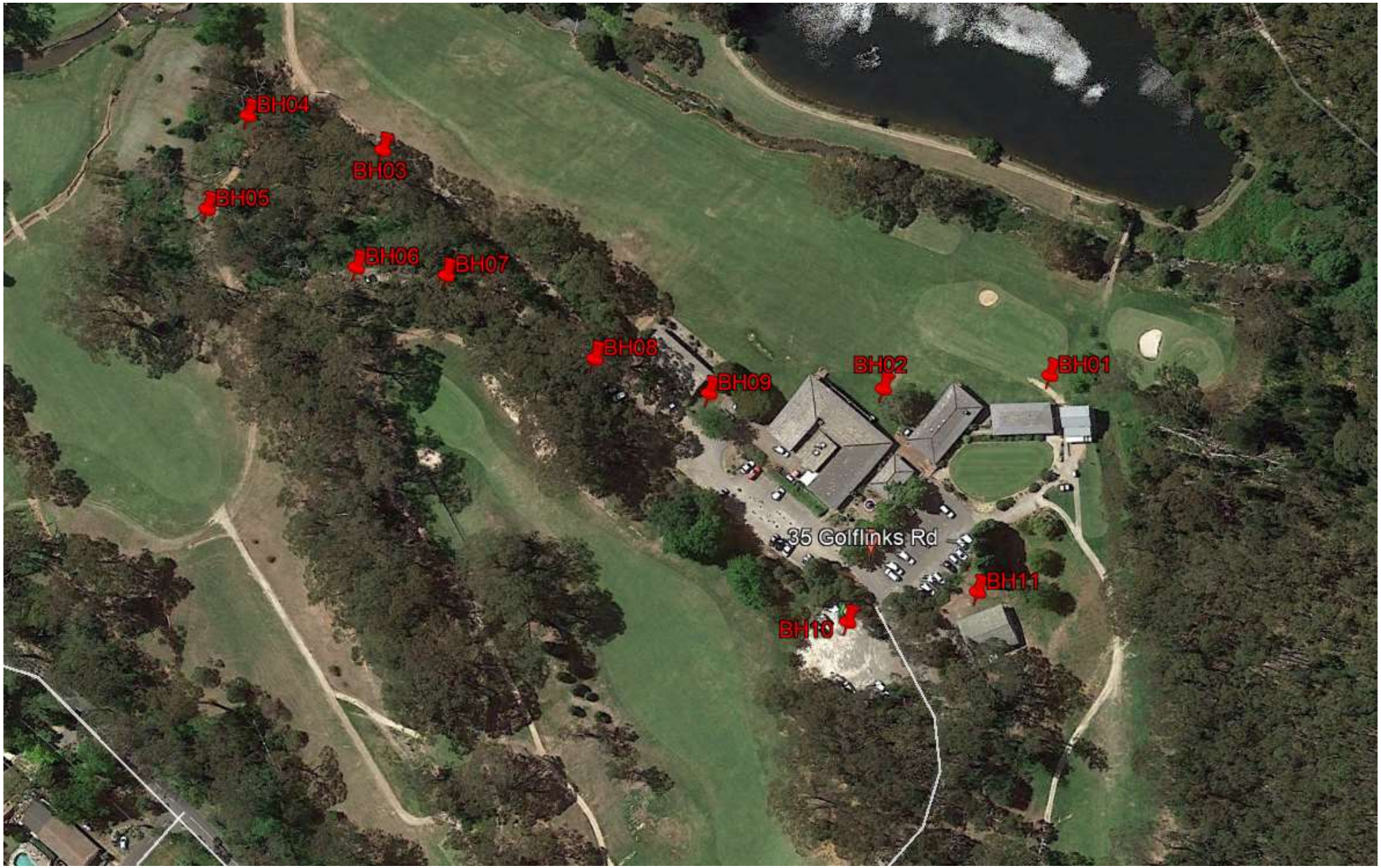
4.4 Safety in design

This Geotechnical Report presents factual information about the soil conditions at the subject site. This may be used for design purposes. At the time that this report was prepared, FMG Engineering were not informed of the details at the proposed building (workplace) to be constructed. Consequently, FMG Engineering have not carried out a Preliminary Hazard Analysis nor been able to consider Safety in Design for the proposed development. It is the responsibility of the designer to use the information contained within this report when undertaking a Safety in Design assessment for the specific development.

Please contact FMG Engineering if Safety in Design analysis is required as the project develops.

Appendix A

Site plan


BH04
BH03
BH05
BH06
BH07
BH08
BH09
BH02
BH01
35 Golflinks Rd
BH11
BH10

Appendix B

Borelogs

ENGINEERING

Borehole No.
BH01
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.50m 400kPa				FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM		M	L - MD	0.5%		TOPSOIL
							CH	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	VSt	3.5%		ALLUVIUM
							CI-CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	St	2%		
				-1	1			SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.					
							SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.3%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
				-2	2			WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
				-3	3			Hole Terminated at 2.20m - Refusal					

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

ENGINEERING

Borehole No.
BH02
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Engineering Log - Borehole

Project No.: S53897/275203

Client:	Venture Capital Developments Pty Ltd	Commenced:	29/04/2021
Project Name:	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed:	29/04/2021
Hole Location:		Logged By:	PP
Hole Position:	Coordinate System: MGA94 54H	Checked By:	FF
Drill Model:	Rockmaster	RL Surface:	
Drill Operator:	SPK GeoDrill Pty Ltd	Hole Diameter: 50mm	Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.50m 400kPa	-1	1		FILL	GRAVELLY SAND: black to orange brown; of low plasticity; with clay / silt; sand, medium grained; gravel, angular, up to 20mm; moist; loose; some roots, glass pieces were observed.	M	L	0.3%		FILL
							SC-SM		M	L - MD	0.5%		TOPSOIL
							CH	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	VSt	3.5%		ALLUVIUM
								CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.					
				-2	2		CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
							SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.3%		
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
				-3	3			Hole Terminated at 2.80m - Refusal					

Pocket Penetrometer UCS (kPa): 100, 200, 300, 400, 500

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

FMG ENGINEERING

Borehole No.
BH03
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		-1	1		SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		ALLUVIUM
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
				-2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
								Hole Terminated at 2.30m - Refusal					
				-3	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance range to refusal

Photo

FMG ENGINEERING

Borehole No.
BH04
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered		-1	1		SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							Cl	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		ALLUVIUM
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
				-2	2			Hole Terminated at 1.20m - Refusal					
				-3	3								

Pocket Penetrometer UCS (kPa): 100, 200, 300, 400, 500

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
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U - Undisturbed Sample
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SPT - Standard Penetration Test
PP - Pocket Penetrometer

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D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

ENGINEERING

Borehole No.
BH05
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.50m 400kPa				FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
				-1	1		CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
				-2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
								Hole Terminated at 2.10m - Refusal					
				-3	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
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D - Disturbed Sample
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Moisture Condition
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M - Moist
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Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

ENGINEERING

Borehole No.
BH06
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Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.50m 400kPa	-1	1		FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
				-2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 1.60m - Refusal	M	H	0%		BEDROCK
				-3	3								

Pocket Penetrometer UCS (kPa): 100, 200, 300, 400, 500

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

ENGINEERING

Borehole No.
BH07
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client:	Venture Capital Developments Pty Ltd	Commenced:	29/04/2021
Project Name:	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed:	29/04/2021
Hole Location:		Logged By:	PP
Hole Position:	Coordinate System: MGA94 54H	Checked By:	FF
Drill Model:	Rockmaster	RL Surface:	
Drill Operator:	SPK GeoDrill Pty Ltd	Hole Diameter: 50mm	Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Not Enco. water					FILL	GRAVELLY SAND: pale orange brown; of non plasticity; with clay / silt; sand, medium to fine grained; gravel, angular, up to 50mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM		M	L - MD	0.5%		TOPSOIL
								CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	H	0%		BEDROCK
				-1	1			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.					
				-2	2			Hole Terminated at 0.40m - Refusal					
				-3	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

FMG ENGINEERING

Borehole No.
BH08
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.40m 400kPa	-1	1		FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 25mm; dry to moist; loose; old paving base and bitumen.	D - M	L	0%		FILL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
									M	H	0%		BEDROCK
				-2	2			WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 1.80m - Refusal					
				-3	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

ENGINEERING

Borehole No.
BH09
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client:	Venture Capital Developments Pty Ltd	Commenced:	29/04/2021
Project Name:	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed:	29/04/2021
Hole Location:		Logged By:	PP
Hole Position:	Coordinate System: MGA94 54H	Checked By:	FF
Drill Model:	Rockmaster	RL Surface:	
Drill Operator:	SPK GeoDrill Pty Ltd	Hole Diameter: 50mm	Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.80m 400kPa	-1	1		FILL	SILTY SAND: pale orange brown; of low plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose; bitumen concrete fragments.	D - M	L	0.3%		FILL
							SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
				-2	2			WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream. Hole Terminated at 2.10m - Refusal	M	H	0%		BEDROCK
				-3	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

FMG ENGINEERING

Borehole No.
BH10
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client: Venture Capital Developments Pty Ltd
Project Name: Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152
Hole Location:
Hole Position: Coordinate System: MGA94 54H
Drill Model: Rockmaster
Drill Operator: SPK GeoDrill Pty Ltd Hole Diameter: 50mm

Commenced: 29/04/2021
Completed: 29/04/2021
Logged By: PP
Checked By: FF
RL Surface:
Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 1.50m 400kPa	0	0		FILL	GRAVELLY SAND: pale grey yellow; of non plasticity; with silt; sand, medium grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
				-1	1		FILL	SILTY SANDY CLAY: black brown; of low plasticity, trace gravel; gravel, angular, up to 30mm; moist; firm.	M	F	0.5%		
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
				-2	2		CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							SC	CLAYEY SAND: pale cream yellow ; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.3%		
				-3	3		CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								Hole Terminated at 4.00m - Target depth					

Pocket Penetrometer UCS (kPa): 100, 200, 300, 400, 500

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance range to refusal

Photo

ENGINEERING

Borehole No.
BH11
Page 1 of 1

Engineering Log - Borehole

Project No.: S53897/275203

Client:	Venture Capital Developments Pty Ltd	Commenced:	29/04/2021
Project Name:	Stirling Golf Club, 35 Golflinks Road, STIRLING, SA 5152	Completed:	29/04/2021
Hole Location:		Logged By:	PP
Hole Position:	Coordinate System: MGA94 54H	Checked By:	FF
Drill Model:	Rockmaster	RL Surface:	
Drill Operator:	SPK GeoDrill Pty Ltd	Hole Diameter: 50mm	Datum:

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa)	Structure and Additional Observations
PT		Groundwater Not Encountered	PP: 0.60m 400kPa	-1 -2 -3	1 2 3		FILL	SILTY SAND: pale orange brown; of non plasticity; with clay / gravel; sand, medium to fine grained; gravel, angular, up to 20mm; dry to moist; loose.	D - M	L	0%		FILL
							SC-SM	CLAYEY SILTY SAND: pale brown yellow; of low plasticity, trace gravel; sand, medium to fine grained; gravel, sub-rounded to angular, up to 10mm; moist; loose to medium dense.	M	L - MD	0.5%		TOPSOIL
							CH	CLAY: grey mottled brown; of high plasticity, trace sand; moist; very stiff.	M	VSt	3.5%		ALLUVIUM
							CI-CH	SILTY SANDY CLAY: pale brown orange; of medium to high plasticity, trace gravel; gravel, angular, up to 20mm; moist; stiff.	M	St	2%		
							CI	SILTY SANDY CLAY: pale grey mottled yellow; of medium plasticity; moist; stiff.	M	St	1.5%		
								WEATHERED SILTSTONE: trace of gravel, angular, up to 20mm, silty clay in seams. of low plasticity, pale orange mottled cream.	M	H	0.3%		RESIDUAL SOIL
								WEATHERED SILTSTONE: fragmented pieces, non-plastic. pale yellow cream.	M	H	0%		BEDROCK
								Hole Terminated at 3.00m - Refusal					

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

Borelogs and laboratory test results

Soil description notes

The dominant soil constituents are given in capital letters followed by secondary textures. The dominant feature is determined from the Unified Soil Classification System and a soil symbol is used to define a soil layer as follows:

Table 3 Borelog symbols

USC SYMBOL	SYMBOL MEANING
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
CI	Clay of intermediate plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty soil

The appropriate symbols are selected on the results of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

Plasticity

The potential for undergoing change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (%) is as follows:

Table 4 Description of plasticity

DESCRIPTION OF PLASTICITY	LIQUID LIMIT FOR SILT (%)	LIQUID LIMIT FOR CLAY (%)
Low	$\leq$ 50	$\leq$ 35
Medium	Not Applicable	>35 - $\leq$ 50
High	>50	>50

Condition

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are fixed by the shear strength of the soil as observed visually by the pocket penetrometer values and resistance to deformation to hand moulding.

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silt and sandy materials, and these are usually based on resistance to drilling penetration. Other condition terms, such as friable, powdery or crumbly may also be used.

Moisture content

For cohesive soils, the following code is used:

Table 5 Code for cohesive soils

SYMBOL	PLASTIC CONDITION	MOISTURE CONDITION
MC≈LL	Moisture content near the liquid limit	Moist to wet
MC<LL	Moisture content less than liquid limit	Moist to wet
MC>PL	Moisture content greater than plastic limit	Damp to moist
MC≈PL	Moisture content near the plastic limit	Damp to moist
MC<≈PL	Moisture content less than or equal to plastic limit	Dry to damp to moist
MC<PL	Moisture content less than plastic limit	Dry to damp
MC«PL	Moisture content much less than plastic limit	Dry

For cohesionless soils, the following code is used:

Table 6 Code for cohesionless soils

MOISTURE CONDITION	DEGREE OF SATURATION
Dry	0
Humid	1 to 25
Damp	25 to 50
Moist	50 to 75
Wet	75 to 99
Saturated	100

Cohesive consistency – Pocket penetrometer (PP)

The instrument is used in the field or the laboratory to provide approximate determination of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

Table 7 Values for cohesive consistency

STRENGTH	SYMBOL	READINGS (kPa)
Very Soft	VS	<25
Soft	S	25 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very Stiff	VSt	200 to 400
Hard	H	>400

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