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# Proposed Solar Farm 101 Coombes Road, Mangalore

**ADVERTISED  
PLAN**

Geotechnical investigation for  
Energy Forms

Report 20C 1467  
January 2021

# 101 Coombes Road, Mangalore

## Geotechnical Investigation for Energy Forms

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## **APPENDIX**

**Site Plan**

**Engineering Logs**

**Field Test Results**

**Descriptive Terms**

## **1 INTRODUCTION**

Energy Forms commissioned Geotechnical Testing Services (GTS) to undertake a geotechnical investigation for the proposed solar farm development at the 101 Coombes Road, Mangalore.

The purpose of the investigation was to assess general subsurface conditions at the site with a view to providing comments and design parameters for the proposed construction.

It is understood that the proposed development consists of a solar farm bordering the Seymour-Avenel Road and Station Rd, Mangalore.

## **2 SITE AND GEOLOGY**

### **2.1 SITE LOCATION AND GENERAL CONDITIONS**

The site has a slight fall toward the southern boundary and is currently being utilised for agricultural purposes. At the time of the investigation, the surface of the site was dry to moist with a good coverage of natural grasses. There were many small to large size trees along the southern and eastern boundaries of the site. There was no visual evidence of surface rock or surface cracking.

### **2.2 GEOLOGY**

The Victorian Government's online "Geovic" map shows the site to be underlain by Quaternary aged sedimentary deposits of the Shepparton formation with Devonian aged sedimentary rock to the northeast of the site with this generally confirmed by the field data.

## **3 FIELDWORK**

The geotechnical investigation was conducted on the 8<sup>th</sup> of December 2020 and involved the drilling of 20 boreholes by a Gemco drilling rig to depths of between 2.3 and 3.0 metres. Dynamic Cone Penetrometer (DCP) and Pocket Penetrometer (PP) tests were conducted in the boreholes with the results included on the engineering logs.

The field investigation was conducted by a technician under the direction of a Geotechnical Engineer, who logged the subsurface profile and determined the testing program. The engineering logs are included in the Appendix with their locations shown on the enclosed site plan.

The field investigation indicated that the soil profile is relatively uniform and typical of a sedimentary profile, and may be summarised as follows:

**TOPSOIL: (Clayey) Sandy SILT**, pale brown, brown, low plasticity, medium dense to dense to depth of between 0.1 to 0.6 metres

*Overlying alternating layers of*

**Silty CLAY**, medium to high plasticity, brown, brown mottled pale grey, traces to some fine to medium sand and gravel, stiff to very stiff

*and*

**Clayey SAND**, fine to coarse, low plasticity clay fines, traces of fine to medium gravel, dense to depths of 1.7 to 3.0 metres

*Overlying*

**SILTSTONE**, extremely weathered, low to medium strength to termination depth (BH15 & BH16 only)

There are variations to the above with some boreholes having alternating layers of stiff to very stiff Sandy and Silty Clay, and a Clayey Sand layer in the upper profile of BH5 & 6. Therefore, reference should be made to the appended borehole logs for the full description of the subsurface conditions at each location.

Groundwater inflow was not encountered over the investigated depths.

## **4 FIELD TEST RESULTS**

### **4.1 IN-SITU RESISTIVITY**

In-situ electrical resistivity testing was undertaken at two sites with tests conducted in the location of the proposed PV panel arrays towards the northern boundary, and near the proposed inverter and battery storage area towards the north eastern boundary (see appended site plan). The testing procedure involved the use of a Fluke 1625-2 earth/ground tester using the Wenner testing method, where four electrodes are inserted approximately 0.25 metres into the ground, positioned in-line and equally spaced at the required test depths (i.e. probe separation is approximately proportional to testing depth).

At each location, the tests were attempted at 1, 2, 4 and 10 metre separation intervals. It is noted that at test site RE2, ground moisture conditioning around the probes was undertaken as per the Fluke 1625-2 earth/ground tester handbook, however the soil moisture was too low to determine the mean soil resistivity at intervals greater than 2 metres. The summary of the soil resistivity testing results has been provided in the table below, with the field data attached in the appendix.

Test #: RE1	Alignment 1 (North-South)				Alignment 2 (East-West)			
Depth a, (m)	1	2	4	10	1	2	4	10
Earth Electrode Resistance, R <sub>E</sub> (Ω)	1.2	0.68	0.48	0.18	1.46	0.82	0.60	0.19
Mean Soil Resistivity ρ (Ωm)	7.54	8.55	12.06	11.31	9.17	10.30	15.08	11.94
Test centre location: 55H 337997 E, 5911645 N (see attached site plan)								
Test #: RE2	Alignment 1 (North-South)			Alignment 2 (East-West)				
Depth a, (m)	1		2		1		1	
Earth Electrode Resistance, Re (Ω)	197.2		20.9		252		25.5	
Mean Soil Resistivity ρ (Ωm)	1239.0		262.6		1583.4		320.4	
Test centre location: 55H 337997 E, 5911645 N (see attached site plan)								

It is noted that due to the dry nature of the soil, that the resistivity tests may need to be conducted following the winter period.

## 5 ENGINEERING RECOMMENDATIONS

It is understood from the drawing "PV Solar Overall Layout Plan – Mangalore" provided by energy forms, that the proposed development consists of arrays of sun-tracking PV panels with associated infrastructure including an inverter and battery storage technology. As such, the footing will likely consist of shallow steel driven piles for the PV arrays and concrete raft slab or pad footings for the for the associated infrastructure.

Based on the results of this investigation, particular conditions at the site dictate that the founding medium and minimum depth below existing surface levels is outlined below.

Founding medium description	Minimum founding depth (mm)	Borehole region
<b>Silty CLAY</b> , medium to high plasticity, traces to some fine to medium sand, stiff to very stiff	200	BH 1, 2, 12, 14, 15 and 16
	300	BH 3, 4 and 8
	400	BH 9, 10, 11, 13, 18 and 20
	600	BH 7, 19
<b>Clayey SAND</b> , fine to coarse, brown, low plasticity fines, medium dense to dense	200	BH 5 & 6
<b>Sandy CLAY</b> , low plasticity, brown, fine to medium sand, very stiff	500	BH 17

For edge and internal beams of a raft slab, strip and pad (stump) footings founded as above there is an allowable bearing pressure of 100kPa available.

For driven or bored piles there is an allowable end bearing pressure of 150 kPa below the minimum founding depths as given in the table above. In addition, the sandy/silty clay and clayey sand material below a depth of 0.6 metres will provide an allowable skin friction of 15 kPa and a lateral resistance of 50 kPa.

It is noted that siltstone rock was encountered in the regions of BH15 and BH16 at depths of 1.7 and 2.1 metres respectively. If the driven or bored piles extend down to the weathered rock, there is an allowable end bearing pressure of 400 kPa, in addition the weathered siltstone rock will provide an allowable skin friction of 40 kPa and a lateral resistance of 250 kPa.

In as far as a site classification in accordance with AS2870-2011 is applicable to a construction of this type, the site is classified as **Class H1**. It is noted that this classification is based on the higher reactive clay which was not evident across the entire site. As such, it is estimated that the characteristic surface movement ( $y_s$ ) across the site may vary within the range of 25 to 50mm.

It is noted that the clayey sand material in the upper profile of BH6 was considered dense, and with the Silty Clay material being very stiff in several locations where the DCP count was in excess of 10 per 100mm. As such, driving of piles, particularly in the dense sand of BH6 may prove difficult.

## **6 IMPORTANT NOTES ABOUT THIS REPORT**

The results from this investigation relate to the specified sites labelled throughout this document, and hence the information obtained may need to be extrapolated to the rest of the designated area. While care has been taken throughout this investigation, soil conditions can vary between each individual test site and at depths greater than that drilled during this investigation. Hence, if variations from this report are found during excavations/construction then Geotechnical Testing Services should be notified so it can be assessed and appropriate advice provided.

The soil colours provided in the bore logs attached may vary with soil moisture content and individual interpretation, therefore colour alone should not be used to identify these soils.

Strength characteristics of soils often exhibit a large variation between wet and dry conditions. Soil characteristics of a soil profile are given on the soil conditions at the time of the investigation.

## 7 DISCLAIMER

This investigation has been carried out in goodwill and under the instructions of Energy Forms. The investigation has been undertaken with the care and skill of competent personnel as defined within Geotechnical Testing Services quality system. It is not a comprehensive investigation but a guide to the conditions throughout the designated area.

This document has been prepared for Energy Forms, and hence no responsibility or liability is being accepted to any third party, where any part of the report is used in either isolation or without consideration of the whole document. This document is not appropriate where there has been a significant change in the project or either for the specific needs of the reader.

Please, don't hesitate to contact the undersigned, if you require any further information or assistance.

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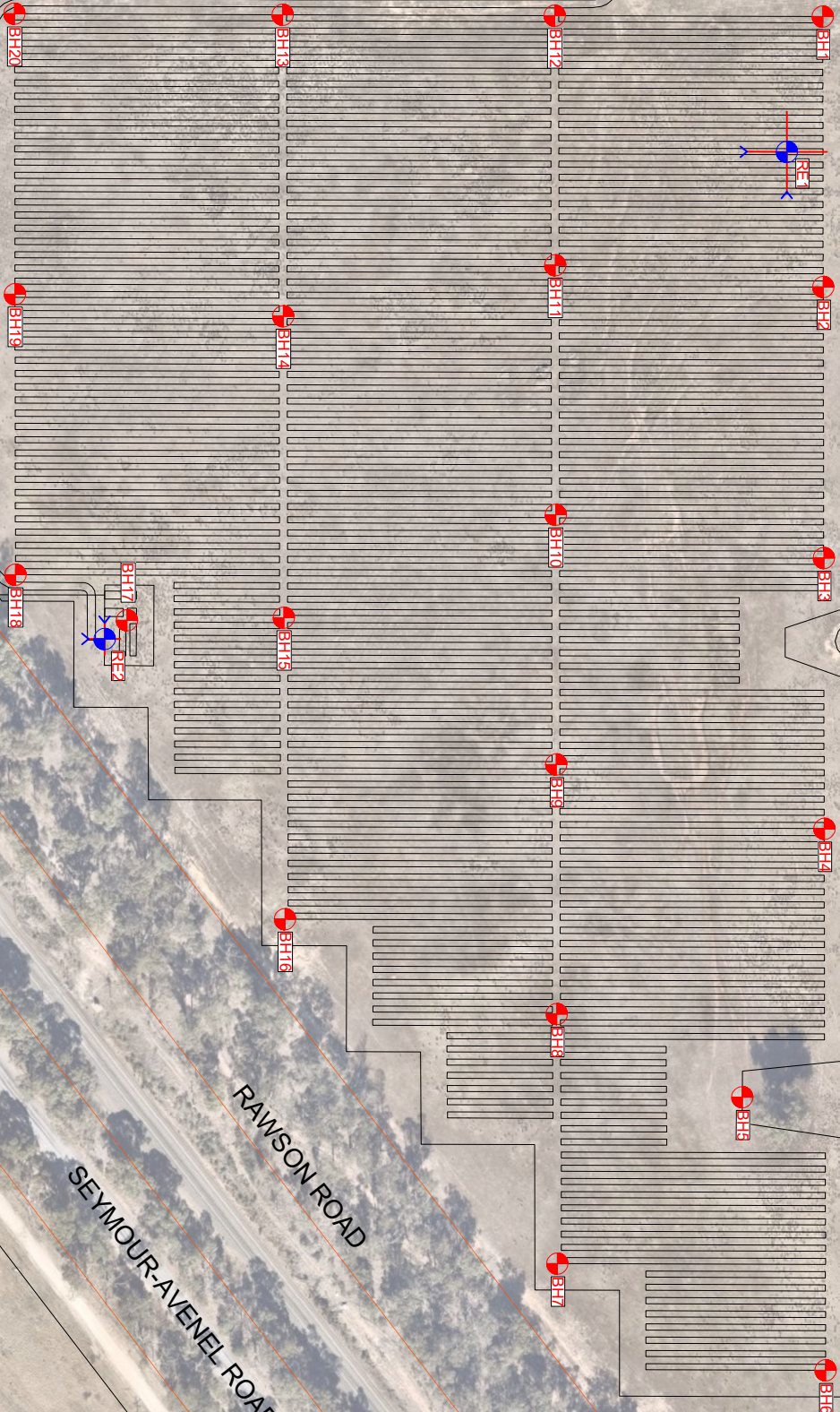
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# APPENDIX



STATION ROAD



RAWSON ROAD

SEYMOUR-AVENEL ROAD



**GEOTECHNICAL  
INVESTIGATION**  
APPROXIMATE LOCATIONS:  
NOT TO SCALE

**CLIENT:** ENERGY FORM  
**PROJECT:** SOLAR FARM - 101 COMBES  
ROAD, MANGALORE

GTS REF: 20C 1467  
DATE: 8 DEC. 2020

Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
FILL: Sandy SILT (ML), pale brown	200mm			D	St	FILL			
Silty CLAY (CH), high plasticity, brown	0.50			M	VSt		DCP=9		
							DCP=9		
							DCP=9		
							DCP=10		
	800mm			D	VSt		DCP=20		
Silty CLAY (CI), medium plasticity, pale brown, some fine to coarse sand	1.00								
	1.50								
	1800mm			D	D				
Clayey SAND (SW), fine to coarse, pale brown, low plasticity clay fines, some fine to medium gravel	2.00								
	2.50								
	3.00								
BH1 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms					Date:	8/12/2020			
Project :	Proposed Solar Farm					Logged by:	RC & MM			
Location :	101 Coombes Road, Mangalore, Victoria									
Drill model :	Gemco HS7	Slope		90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing		-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support	
FILL: Sandy SILT (ML), pale brown	200mm			D	St	FILL				
Silty CLAY (CH), high plasticity, brown	0.50			M	St		DCP=8			
							DCP=6			
							DCP=4			
	1.00						DCP=2			
							DCP=3			
							DCP=3			
	1300mm						DCP=3			
Silty CLAY (CI), medium plasticity, brown mottled pale grey, traces of fine sand	1.50			M	F-St	PP @ 1.5m = 200 kPa				
	2.00									
	2.50									
	3.00					PP @ 3.0m = 200 kPa				
BH2 terminated at 3.0 metres	3.50									
	4.00									



Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
FILL: Sandy SILT (ML), pale brown				D	St	FILL			
	300mm								
Silty CLAY (CH), high plasticity, brown, some fine sand	0.50			M	VSt		DCP=9		
							DCP=9		
							DCP=8		
							DCP=7		
	800mm						DCP=8		
Silty CLAY (CI), medium plasticity, brown	1.00			M	St-VSt		DCP=10		
	1.50					PP @ 1.5m = 250 kPa			
	1800mm								
Sandy CLAY (CL), low plasticity, brown, orange/brown, fine to coarse sand	2.00			M	St				
	2500mm								
Silty CLAY (CI), medium plasticity, brown	2.50			M	St-VSt				
	3.00					PP @ 3.0m = 260 kPa			
BH3 terminated at 3.0 metres									
	3.50								
	4.00								



# ENGINEERING BOREHOLE LOG

PO Box 13, Strathdale 3550  
Ph (03) 54414881 Fax (03) 5441 5089

Borehole no. 4  
Sheet no. 1 of 1  
Job no. 20C 1467

Client : Energy Forms		Date: 8/12/2020	
Project : Proposed Solar Farm		Logged by: RC & MM	
Location : 101 Coombes Road, Mangalore, Victoria			
Drill model : Gemco HS7	Slope 90 deg	RL surface: <i>Not measured</i>	
Hole diameter : 100mm	Bearing - deg	Datum : -	

Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown				D	St				
	300mm								
Silty CLAY (CH), high plasticity, brown	0.50			M	St				
	800mm								
Silty CLAY (CI), medium plasticity, brown, some fine sand	1.00			M	St				
	1.50								
	2000mm								
Sandy CLAY (CL), low plasticity, brown, fine to coarse sand, some fine gravel	2.00			M-W	St				
	2.50								
	3.00								
	3.50								
	4.00								

PP @ 1.5m = 150 kPa

Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown	100mm			D	St				
Clayey SAND (SW), fine to coarse, brown, low plasticity, traces of fine to medium gravel	500mm	0.50		M	MD		DCP=11		
							DCP=8		
Silty CLAY (CI), medium plasticity, brown mottled pale grey, some fine sand	1.00			M	VSt	PP @ 1.0m = 380 kPa	DCP=5		
	1.50					PP @ 1.5m = 240 kPa	DCP=4		
							DCP=5		
							DCP=10		
	2.00								
Sandy CLAY (CL), low plasticity, brown, fine to coarse sand, traces of fine gravel	2.50			M	VSt				
	3.00					PP @ 3.0m = 420 kPa			
BH5 terminated at 3.0 metres	3.50								
	4.00								

Client :	Energy Forms	Date:	8/12/2020						
Project :	Proposed Solar Farm	Logged by:	RC & MM						
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg RL surface: Not measured						
Hole diameter :	100mm	Bearing	- deg Datum : -						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown	200mm			D	St				
Clayey SAND (SP), fine, pale brown, low plasticity	0.50			M	D		DCP=2		
							DCP=5		
	800mm						DCP=8		
Silty CLAY (CI), medium plasticity, brown, some fine sand	1.00			M	St-F		DCP=11		
	1.50								
	2.00					PP @ 1.5m = 150 kPa			
	2.50								
	3.00					PP @ 3.0m = 90 kPa			
BH6 terminated at 3.0 metres	3.50								
	4.00								



Client :	Energy Forms	Date:	8/12/2020						
Project :	Proposed Solar Farm	Logged by:	RC & MM						
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg						
		RL surface:	Not measured						
Hole diameter :	100mm	Bearing	- deg						
		Datum :	-						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Clayey Sandy SILT (ML), pale brown, fine sand, low plasticity, traces of fine gravel	0.50			D	St				
	600mm								
Silty CLAY (CI - CH), medium to high plasticity, brown	1.00			D	VSt		DCP=20		
				M		PP @ 1.0m = 600+ kPa			
	1.50					PP @ 1.5m = 600+ kPa			
	2.00								
Sandy CLAY (CL-CI), low to medium plasticity, brown, fine to coarse sand	2.50			D	St				
	3.00								
BH7 terminated at 3.0 metres	3.50								
	4.00								

Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg	RL surface: <i>Not measured</i>					
Hole diameter :	100mm	Bearing	- deg	Datum : -					
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Clayey Sandy SILT (ML), pale brown, low plasticity	300mm			D	St	PP @ 1.0m = 600+ kPa			
Silty CLAY (CI), medium plasticity, brown	0.50			M	VSt		DCP=8		
							DCP=12		
							DCP=20		
Silty CLAY (CH), high plasticity, brown	1.00			M	VSt				
	1.50								
	1600mm			M	D				
Clayey SAND (SW), fine to coarse, brown, low plasticity, traces of fine gravel	2.00								
	2200mm			M	VSt				
Silty CLAY (CI), medium plasticity, brown mottled pale grey, traces of fine sand	2.50								
	3.00					PP @ 3.0m = 350 kPa			
BH8 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg	RL surface: <i>Not measured</i>					
Hole diameter :	100mm	Bearing	- deg	Datum : -					
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown				D	St				
	400mm						DCP=13		
Silty CLAY (CH), high plasticity, brown	0.50			M	VSt	PP @ 0.5m = 600+ kPa	DCP=13		
							DCP=16		
							DCP=15		
	900mm						DCP=14		
Silty CLAY (CI), medium plasticity, brown mottled plae grey	1.00			M	VSt	PP @ 1.0m = 400 kPa			
	1.50								
	2.00								
	2200mm								
Silty CLAY (CH), high plasticity, brown mottled pale grey	2.50				VSt	PP @ 3.0m = 310 kPa			
	3.00								
BH9 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms					Date:	8/12/2020		
Project :	Proposed Solar Farm					Logged by:	RC & MM		
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown				D	St	PP @ 1.0m = 500 kPa			
400mm									
Silty CLAY (CH), high plasticity, brown	0.50			M	VSt		DCP=10		
							DCP=6		
							DCP=5		
	1.00						DCP=7		
1200mm							DCP=12		
Clayey SAND (SP), fine, pale brown, low plasticity				D-M	D				
	1.50								
2000mm	2.00								
Silty CLAY (CI), medium plasticity, brown mottled grey				M	VSt				
	2.50								
3000mm	3.00					PP @ 3.0m = 240 kPa			
BH10 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms	Date:				8/12/2020					
Project :	Proposed Solar Farm	Logged by:				RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria										
Drill model :	Gemco HS7	Slope		90 deg		RL surface: <i>Not measured</i>					
Hole diameter :	100mm	Bearing		- deg		Datum : -					
Material Description		Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support	
Sandy SILT (ML), pale brown					D	St	PP @ 1.0m = 400 kPa				
400mm											
Silty CLAY (CH), high plasticity, brown		0.50			M	St			DCP=8		
									DCP=5		
									DCP=5		
		1.00							DCP=4		
1200mm					M	VSt	PP @ 1.5m = 450 kPa				
Silty CLAY (CI), medium plasticity, brown mottled pale brown, traces of fine sand		1.50							DCP=3		
									DCP=3		
1600mm					M	D					
Clayey SAND (SW), fine to corase, brown, orange/brown, low plasticity		2.00									
2300mm					M	VSt	PP @ 3.0m = 320 kPa				
Silty CLAY (CI), medium plasticity, brown, traces of fine sand		2.50									
3.00											
BH11 terminated at 3.0 metres											
3.50											
4.00											

Client :	Energy Forms	Date: 8/12/2020							
Project :	Proposed Solar Farm	Logged by: RC & MM							
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown	200mm			D	St	PP @ 1.0m = 600+ kPa			
Silty CLAY (CH), high plasticity, brown	0.50			M	VSt		DCP=6		
							DCP=8		
	1.00						DCP=9		
							DCP=9		
Silty CLAY (CI), medium plasticity, brown	1200mm			M	VSt	PP @ 1.5m = 520 kPa			
	1.50								
Sandy CLAY (CL), low plasticity, brown, fine to coarse sand	1800mm			D-M	St-VSt				
	2.00								
	2500mm			M	VSt				
Silty CLAY (CH), high plasticity, brown mottled orange/brown, pale grey	2.50								
	3.00					PP @ 3.0m = 600+ kPa			
BH12 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms	Date:	8/12/2020						
Project :	Proposed Solar Farm	Logged by:	RC & MM						
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg						
		RL surface:	Not measured						
Hole diameter :	100mm	Bearing	- deg						
		Datum :	-						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown				D	St				
	400mm						DCP=20		
Silty CLAY (CH), high plasticity, brown mottled red/brown, then brown mottle pale brown	0.50			M	VSt	PP @ 0.7m = 600+ kPa			
	1.00					PP @ 1.0m = 600+ kPa			
	1200mm								
Silty CLAY (CI), medium plasticity, pale brown, traces of fine sand	1.50			M	VSt				
	2.00								
	2100mm								
Sandy CLAY (CL), low plasticity, pale brown, fine to coarse sand	2.50			D	VSt				
	3000mm								
BH13 terminated at 3.0 metres	3.00								
	3.50								
	4.00								

Client :	Energy Forms	Date: 8/12/2020							
Project :	Proposed Solar Farm	Logged by: RC & MM							
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope 90 deg	RL surface: <i>Not measured</i>						
Hole diameter :	100mm	Bearing - deg	Datum : -						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown	200mm			D	St	PP @ 1.5m = 600+ kPa			
Silty CLAY (CI - CH), medium to high plasticity, brown	0.50			M	VSt		DCP=6		
							DCP=8		
							DCP=12		
							DCP=13		
							DCP=13		
	1.00						DCP=15		
	1.50								
	2.00			M	D				
Clayey SAND (SW), fine to coarse, brown, low plasticity, traces of fine to medium gravel	2000mm								
	2.50								
	3.00								
BH14 terminated at 3.0 metres									
	3.50								
	4.00								



Client :	Energy Forms	Date: 8/12/2020							
Project :	Proposed Solar Farm	Logged by: RC & MM							
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope 90 deg	RL surface: Not measured						
Hole diameter :	100mm	Bearing - deg	Datum : -						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown	200mm			D	St	FILL			
Silty CLAY (Cl), medium plasticity, brown, traces of fine gravel	0.50			M	St		DCP=9		
							DCP=8		
	800mm			M	VSt		DCP=10		
Silty CLAY (CH), high plasticity, brown mottled pale grey, traces of fine to medium gravel	1.00						DCP=13		
	1.50						DCP=14		
	1700mm			D	L-M	Rock: low to medium strength			
SILTSTONE (XW), extremely weathered	2.00								
	2.50								
BH15 terminated at 2.7 metres	3.00					By Refusal			
	3.50								
	4.00								

Client :	Energy Forms	Date:	8/12/2020						
Project :	Proposed Solar Farm	Logged by:	RC & MM						
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg						
		RL surface:	Not measured						
Hole diameter :	100mm	Bearing	- deg						
		Datum :	-						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
FILL: Sandy SILT (ML), pale brown	200mm			D	MD	FILL			
Silty CLAY (CH), high plasticity, brown	0.50			M	St-VSt		DCP=11		
	1.00					PP @ 1.0m = 280 kPa	DCP=7		
	1.50					PP @ 1.5m = 240 kPa	DCP=5		
	2.00						DCP=4		
	2100mm						DCP=5		
SILTSTONE (XW), extremely weathered				D	L-M	Rock: low to medium strength	DCP=4		
BH16 terminated at 2.3 metres	2.50					By Refusal			
	3.00								
	3.50								
	4.00								

Client :	Energy Forms	Date:	8/12/2020							
Project :	Proposed Solar Farm	Logged by:	RC & MM							
Location :	101 Coombes Road, Mangalore, Victoria									
Drill model :	Gemco HS7	Slope	90 deg							
			RL surface: <i>Not measured</i>							
Hole diameter :	100mm	Bearing	- deg							
			Datum : -							
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support	
Sandy SILT (ML), pale brown				D	St	PP @ 1.7m = 220 kPa				
								DCP=20		
Sandy CLAY (CL), low plasticity, brown, fine to medium sand				D-M	VSt					
Silty CLAY (CI), medium plasticity, brown mottled pale grey, traces of fine sand				M	VSt					
						</				

Client :	Energy Forms	Date:		8/12/2020					
Project :	Proposed Solar Farm	Logged by:		RC & MM					
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90	deg	RL surface: <i>Not measured</i>				
Hole diameter :	100mm	Bearing	-	deg	Datum : -				
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), pale brown				D	St				
	400mm								
Silty CLAY (CI), medium plasticity, orange/brown, brown, some fine sand	0.50			M	St-VSt		DCP=4		
							DCP=8		
							DCP=6		
	1.00						DCP=6		
							DCP=4		
	1.50					PP @ 1.5m = 550 kPa			
	2.00								
	2100mm								
Clayey SAND, fine to coarse, orange/brown, low plasticity	2.50			M	D				
	3.00								
BH18 terminated at 3.0 metres									
	3.50								
	4.00								

Client :	Energy Forms	Date:	8/12/2020						
Project :	Proposed Solar Farm	Logged by:	RC & MM						
Location :	101 Coombes Road, Mangalore, Victoria								
Drill model :	Gemco HS7	Slope	90 deg						
		RL surface:	Not measured						
Hole diameter :	100mm	Bearing	- deg						
		Datum :	-						
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), low plasticity, pale brown	0.50			D	St				
	600mm						DCP=6		
Silty CLAY (CI), medium plasticity, brown, pale brown, some fine sand	1.00			M	St		DCP=14		
	1.50					PP @ 1.5m = 200 kPa	DCP=12		
	2.00						DCP=4		
	2100mm						DCP=5		
Silty CLAY (CH), high plasticity, dark brown	2.50			M	VSt				
	3000mm					PP @ 3.0m = 500 kPa			
BH19 terminated at 3.0 metres	3.50								
	4.00								

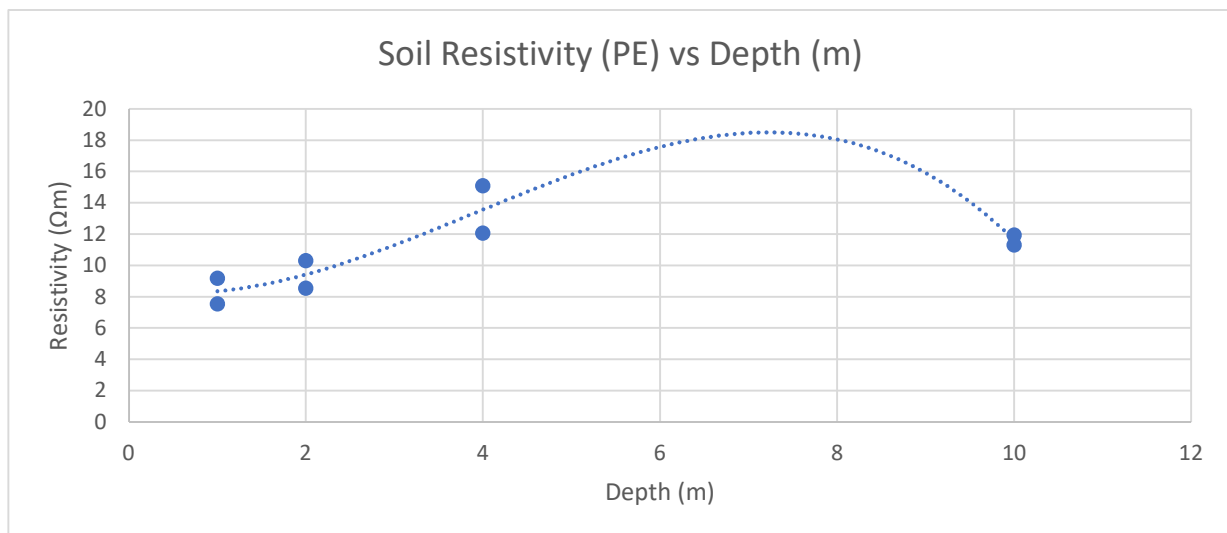
Client : Energy Forms		Date: 8/12/2020							
Project : Proposed Solar Farm		Logged by: RC & MM							
Location : 101 Coombes Road, Mangalore, Victoria									
Drill model : Gemco HS7		Slope 90 deg							
		RL surface: Not measured							
Hole diameter : 100mm		Bearing - deg							
		Datum : -							
Material Description	Depth (m)	Graphic log	Water	Moisture condition	Consistency density, index	Structure, additional observations	Notes Samples Tests	Method	Support
Sandy SILT (ML), low plasticity, pale brown, fine sand				D	D				
-----400mm									
Silty CLAY (CI), medium plasticity, brown, dark brown, some fine sand	0.50			D	VSt		DCP=14		
							DCP=20		
	1.00								
	1.50					PP @ 1.5m = 470 kPa			
	2.00								
	2.50								
	3.00								
BH20 terminated at 3.0 metres									
	3.50								
	4.00								



## MEASUREMENT OF SOIL RESISTIVITY WORKSHEET

Project:	Mangalore Solar Farm	Our Ref:	20C-1467
Location:	Station Road, Mangalore	Date:	15/12/2020
Device:	Fluke 1625-2 Earth/Ground Tester	Tester:	PB/ED

	Alignment 1				Alignment 2 (90° to first test)			
Test	1	2	3	4	5	6	7	8
Probe Distance (m) = a	1	2	4	10	1	2	4	10
Max Earth Spike Depth (m)	0.3	0.6	1.2	3	0.3	0.6	1.2	3
Resistance ( $\Omega$ ) = $R_E$	1.2	0.68	0.48	0.18	1.46	0.82	0.6	0.19
Mean Soil Resistivity ( $\Omega$ m) = $P_E$	7.5398	8.5451	12.064	11.31	9.1735	10.304	15.08	11.938



### FIELD NOTES:

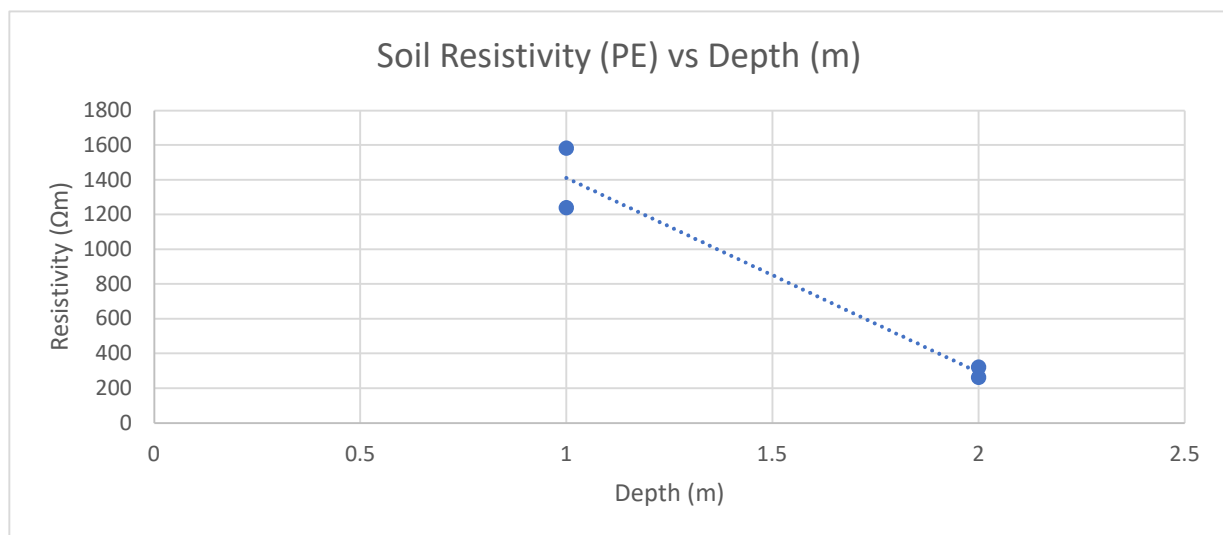
Alignment 1 - centre - 55H337997, 5911645 , bearing north/south

Alignment 2 bearing east/west

## MEASUREMENT OF SOIL RESISTIVITY WORKSHEET

Project:	Mangalore Solar Farm	Our Ref:	20C-1467
Location:	Station Road, Mangalore	Date:	15/12/2020
Device:	Fluke 1625-2 Earth/Ground Tester	Tester:	PB/ED

	Alignment 1				Alignment 2 (90° to first test)			
Test	1	2	3	4	5	6	7	8
Probe Distance (m) = a	1	2			1	2		
Max Earth Spike Depth (m)	0.3	0.6			0.3	0.6		
Resistance ( $\Omega$ ) = $R_E$	197.2	20.9			252	25.5		
Mean Soil Resistivity ( $\Omega$ m) = $P_E$	1239	262.64			1583.4	320.44		



### FIELD NOTES:

Alignment 1 - centre - 55H338181, 5911378 bearing east/west

Alignment 2, bearing north/south

initial test returned limit error, moistened soil with tap water as per manual guidance.



## DESCRIPTIVE TERMS BOREHOLE/EXCAVATION LOG

### Classification Symbol & Soil Name

Classification of material and its description is based on the Unified Classification System as referenced in AS1726 – 1993 Geotechnical Site Investigations, Appendix A. A summary of the more common terms is included within.

### Particle Size Descriptive Terms

Name	Subdivision	Size
Boulders		>200mm
Cobbles		63 – 200mm
Gravel	Coarse	20 – 63mm
	Medium	6 – 20mm
	Fine	2.36 – 6mm
Sand	Coarse	0.6 – 2.36mm
	Medium	200 – 600 micron
	Fine	75 – 200 micron
Silt		2 – 75 micron
Clay		< 2 micron

### Consistency of Cohesive Soils

Term	Undrained shear strength, $s_u$ (kPa)	Field Guide
Very Soft (VS)	<12	A finger can be pushed well into the soil with little effort
Soft (S)	12 – 25	A finger can be pushed into the soil to about 25mm depth
Firm (F)	25 – 50	The soil can be indented about 5mm with the thumb
Stiff (St)	50 – 100	The surface of the soil can be indented with the thumb
Very Stiff (VSt)	100 – 200	The surface of the soil can be indented by thumb nail
Hard (H)	>200	The surface of the soil can be marked only with the thumbnail
Friable (F)	-	Crumbles or powders when scraped by thumbnail

### Density of Granular Soils

Term	Density Index (%)
Very Loose (VL)	< 15
Loose (L)	15 – 35
Medium Dense (MD)	35 – 65
Dense (D)	65 – 85
Very Dense (VD)	> 85

### Minor Components

Term	Field Guide	Proportion of Minor Component In:
Trace of	Presence just detectable by feel or eye	Coarse grained soils: <5% Fine grained soils: <15%
Some	Presence easily detectable by feel or eye	Coarse grained soils: 5-12% Fine grained soils: 15-30%

### Moisture Condition

Dry (D)	Looks & feels dry. Cohesive soils are usually hard, powdery or friable. Granular soils run freely through the hand.
Moist (M)	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere. Free water does not form.
Wet (W)	As for moist, but with free water forming on hands when remoulded.




### Method

<b>S</b>	Auger Screwing	<b>W</b>	Washboring
<b>D</b>	Auger Drilling	<b>N</b>	Natural Exposure
<b>R</b>	Roller/tricone	<b>E</b>	Existing Excavation

### Support

<b>B</b>	Blade/bucket	<b>*</b>	Nil
<b>C</b>	Coring	<b>C</b>	Casing
<b>H</b>	Hammer Drill	<b>M</b>	Mud/polymer

### Water

*	Not observed
	Observed water level (date shown)
	Observed water inflow
	Observed water outflow
R	Refer to report for details

### Structures, Additional Observations

<b>PP</b>	Pocket Penetrometer test (kPa)
<b>DCP</b>	Dynamic Cone Penetrometer test (blows/100mm)

### Notes, Samples, Tests

<b>U63</b>	Undisturbed sample, 63mm diameter
<b>D</b>	Disturbed sample
<b>N*</b>	Standard Penetration Test, (*) Sample Figure = results

### Surface

_____	Known boundary
-----	Probably boundary
-?-?-?-?-?-?	Possible boundary