Geotechnical Investigation

Project: Wombelano Windfarm
Report No: AGTE20213

| Geotechnical Investigation and Design | Pavement Investigation and Design | Residential |
| Earthworks Specification's, Level 1 Supervision, | Retaining Walls | Slope Stability Assessment |
Adelaide, Queensland, Melbourne, Warrnambool

Prepared for:

Australian Wind Projects

29 September 2020

Contents

1. Introduction

Australian Geotechnical Testing (AGT) was engaged by Australian Wind Projects to undertake a geotechnical investigation for the proposed Wombelano Windfarm located in Wombelano VIC.

This geotechnical report presents a summary of the sub-surface conditions encountered.

2. Site Description

2.1 Locality

The site is located at the corner of Charam-Wombelano Rd and Goroke-Harrow Rd Wombelano VIC.

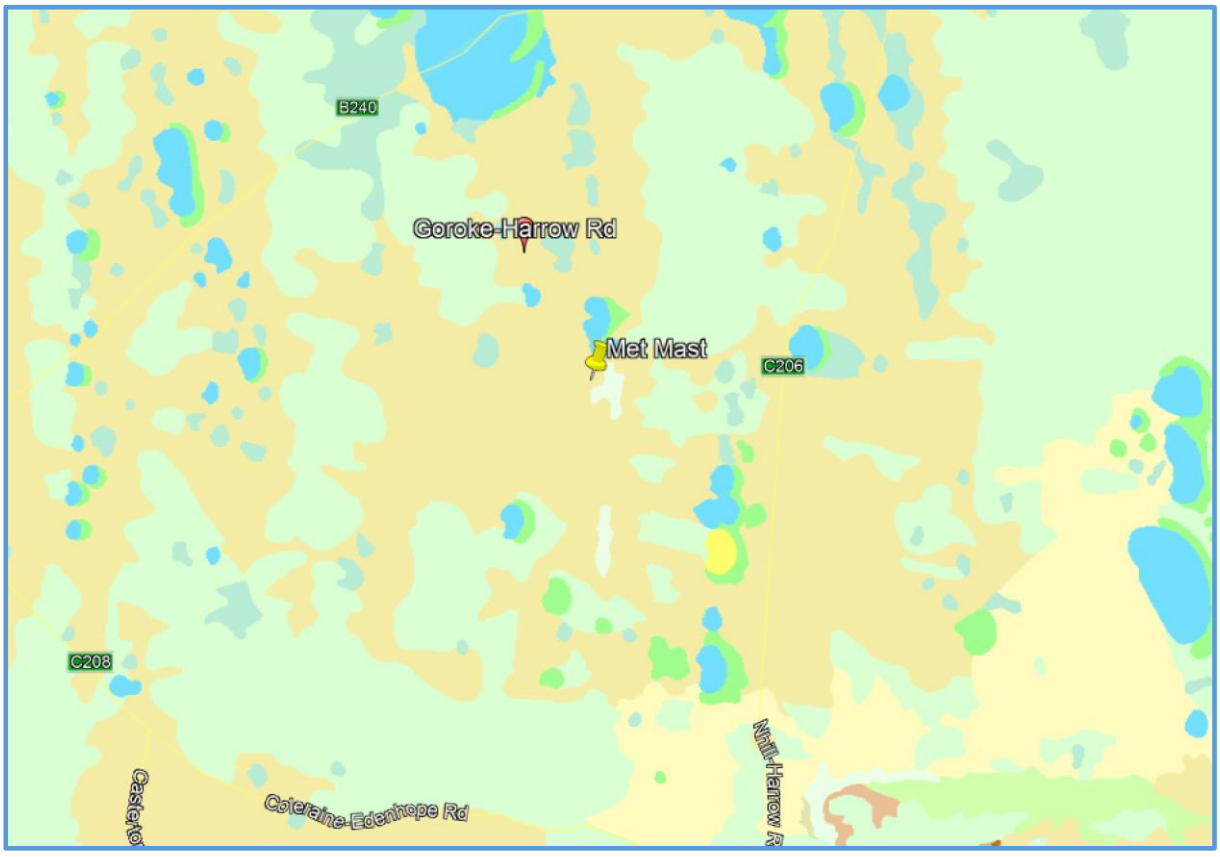
Figure 1 – Site Location

2.3 Regional Geology

Geological Survey of Victoria maps (1:63,360) and information published by the Department of Primary Industries on the Australian Government on-line geological mapping site (1:250,000) shows the site is underlain by swamp and lake deposits and Loxton Sand Quartz sandstone, well sorted fine to medium grained and well bedded.

In general, the anticipated subsurface conditions have been encountered during this site investigation and are considered to be consistent with the geological map.

Figure 2 – Geological Map



3. Site Investigation

The field investigation was undertaken on 28th August and 2nd September 2020, which involved drilling of two (2) boreholes to a maximum depth of 20.0m using a drill rig. No rock was encountered during the drilling. Engineering Logs of the boreholes are presented as Appendix A.

3.1 Boreholes Profiles and Geotechnical Ground Model

Table 3.1 presents a summary of subsurface profile for the boreholes.

The natural ground is covered by topsoil across the site. This is underlain by Sandy Clay and Clayey Sand underlain by poorly graded sand.

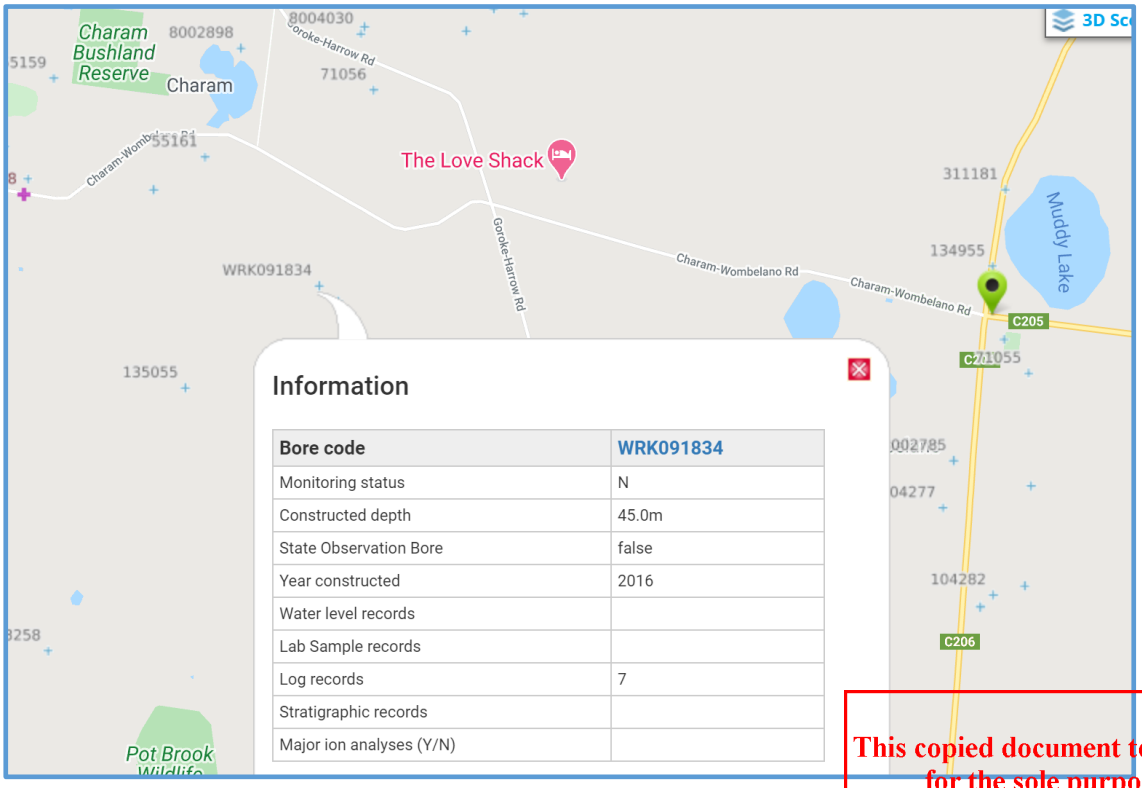
Table 3.1 – Summary of Subsurface Profile

Material	Depth (m)
Topsoil	0.0-0.15m
Clay Sand/Sandy Clay	0.15 – 9.5m
Sand	Below 9.5m

3.2 Groundwater

Groundwater was encountered in BH2 at a depth 4.9m. Considering presence of clay in this depth and no groundwater being encountered in BH1, it is likely that the groundwater is present in the sand layer below 9.5m depth and minor artesian pressure is present pushing the groundwater level to 4.9m in BH2. Groundwater database was also examined and the constructed depth in the closest bore was at 45m below the surface as sown on Figure 3.

Figure 3 – Groundwater Bores



4. Geotechnical Parameters

4.1 Soil Strength Parameters

Table 4.1 presents geotechnical and pile design parameters. The numbers is chosen as representative value to estimate the soil strength.

Table 4.1 – Geotechnical Design Parameters

Soil	Depth(m)	SPT	Undrained Shear Strength		Drained Shear Strength	
			Cohesion (kPa)	Friction (º)	Cohesion (kPa)	Friction (º)
Sandy CLAY	0 – 8.0	31	150	0	10	29
Clayey SAND	8.0 – 10.0	27	-	-	3	35

4.2 Footings

Footings should be founded not less than 0.3m below the finished ground level and at least 0.1m into the natural soil and may be proportioned for an allowable bearing pressure as provided below.

Table 4.2 – Allowable Bearing Capacity

Material	Footing Depth	Allowable Bearing Capacity	
		Shallow Footing	Pier
Sand/Clay	0.5m	120 kPa *	-
Sand/Clay	1.5m	180 kPa *	450 kPa

*The values are indicative, and the design allowable bearing capacity also depends on the footing dimension, type and depth.

Table 4.3 – Pile Design Parameters

Material	Depth	Average Unit Skin Friction	End Bearing Capacity
Sand/Clay	0-2.0m	40 kPa	-
Sand/Clay	2.0-10.0m	75 kPa	450 kPa

Disclaimer

The findings and conclusions contained in this Report are made based on site conditions that existed at the time this work was conducted. The conclusions presented in this report are relevant to the conditions of the site and the state of legislation currently enacted as at the date of this report.

Findings and conclusions are made assuming that the soil, groundwater, geological and chemical conditions detailed within this report are accurate and remain applicable to the site at the time of writing. No other warranties are made or intended.

AGT has used a degree of skill and care ordinarily exercised by reputable members of our profession practicing in the same or similar locality.

does not make any representation or warranty that the conclusions in this report will be applicable in the future as there may be changes in the condition of the site, applicable legislation or other factors that would affect the conclusions contained in this report.

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ENGINEERS AUSTRALIA

Appendix A – Borehole Plan and Engineering Logs

BOREHOLE LOG

BORE No: 01

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Client:	Australian Wind Projects	Drilling Co:	AGT	Easting:	Refer to plan
Project:	Wombelano Wind Farm	Driller:	JF	Northing:	Refer to plan
Job No:	AGTE20213	Rig Type:	GT10	Grid Ref:	
Location:	Wombelano VIC	Inclination:		Collar RL:	
Date Drilled:	02/09/2020	Bearing:		Logged by:	JM Checked by: AF

Test Method: AS 1289.6.3.2-1997 & AS 1726-1993

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density	N-DCP Blows per 100mm	FIELD TESTS	Sampling / Runs	Water Levels	Depth (m)
0.00			Topsoil	Silty SAND : fine to coarse grained green brown	M	L	2				0.00
			SC	Clayey SAND green brown, fine to medium, low plasticity clay	M	L	1 1 5				
1.00			CL	Sandy CLAY yellow brown, fine to medium sand, medium plasticity brown-orange below 1.0m	M	VSt	6 7 7 7 7	Bulk sample 1.0-3.0m			1.00
2.00							10 9 7 8 9				2.00
3.00							9 7 16 20				3.00
4.00											4.00
5.00											5.00
6.00											6.00
7.00				grey brown below 7.5m							7.00
8.00			SC	Clayey SAND light grey, fine to medium, low plasticity clay	M	MD					8.00
9.00											9.00
			SP	SAND, orange, fine to medium	W	MD		Bulk sample @ 10.0			
10.00											10.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water: ▼ water level; ▼ level risen to; ● water inflow

sampling / testing: intact sample from core; intact tube sample (T); Disturbed sample; B Bulk sample; Supp Su from Pocket Penetrometer; Suv Su from Field Vane Shear test

notes:

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

BOREHOLE LOG

BORE No: 01

Page: 2 **of** 2

Client:	Australian Wind Projects	Drilling Co:	AGT	Easting:	Refer to plan
Project:	Wombelano Wind Farm	Driller:	JF	Northing:	Refer to plan
Job No:	AGTE20213	Rig Type:	GT10	Grid Ref:	
Location:	Wombelano VIC	Inclination:		Collar RL:	
Date Drilled:	02/09/2020	Bearing:		Logged by:	JM Checked by: AF

Test Method: AS 1289.6.3.2-1997 & AS 1726-1993

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density	N-DCP Blows per 100mm	FIELD TESTS	Sampling / Runs	Water Levels	Depth (m)
0.00			SP	SAND, orange, fine to medium	W	MD					0.00
1.00											1.00
2.00											2.00
3.00											3.00
4.00											4.00
5.00											5.00
6.00											6.00
7.00											7.00
8.00											8.00
9.00											9.00
10.00				Borehole Terminated at 20m.							10.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water: ▼ water level; ▼ level risen to; ● water inflow

notes:

sampling / testing: ■ intact sample from core; ● Disturbed sample; T intact tube sample; B Bulk sample; Supp Su from Pocket Penetrometer; Suv Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

BOREHOLE LOG

BORE No: 02

Page: 1 **of** 1

Client:	Australian Wind Projects	Drilling Co:	AGT	Easting:	Refer to plan
Project:	Wombelano Wind Farm	Driller:	JF	Northing:	Refer to plan
Job No:	AGTE20213	Rig Type:	GT10	Grid Ref:	
Location:	Wombelano VIC	Inclination:		Collar RL:	
Date Drilled:	28/08/2020	Bearing:		Logged by: JM	Checked by: AF

Test Method: AS 1289.6.3.2-1997 & AS 1726-1993

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density	N-DCP Blows per 100mm	FIELD TESTS	Sampling / Runs	Water Levels	Depth (m)
0.00			Topsoil	Silty SAND : fine to coarse grained green brown	M	L	1				0.00
			SC	Clayey SAND, green brown, fine to medium, low plasticity clay	M	L	1				
			CL	Sandy CLAY	M	VSt	2				
				yellow brown, fine to medium sand, medium plasticity			1	Bulk sample 0.7-1.3m			
1.00				brown-orange below 1.0m			3				1.00
							3				
							7				
							7				
							23				
2.00							18				2.00
3.00											3.00
4.00								SPT at 4.0m: 9/13/18, N=31			4.00
								water table at 4.9m			
5.00											5.00
6.00											6.00
7.00				grey brown below 7.5m							7.00
8.00			SC	Clayey SAND	M	MD		SPT at 8.0m:			8.00
				light grey, fine to medium, low plasticity clay				9/11/16, N=27			
9.00											9.00
			SP	SAND, orange, fine to medium	W	MD					
10.00				Borehole Terminated at 10m. Groundwater envountered at 4.9m.				Bulk sample @ 10.0			10.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water: water level; level risen to; water inflow

notes:

sampling / testing: intact sample from core; Disturbed sample; intact tube sample (T); B Bulk sample; Supp Su from Pocket Penetrometer; Suv Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

Appendix B – Laboratory Test Result – Thermal Resistivity

Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe - Multi Point

Australian Geotechnical Testing
2/1109 Raglan Parade
PO Box 1018
Warrnambool VIC 3280
ph 1300 026 583

info@ausgeotest.com.au

Client:	**Wind Projects Australia**	Job No:	**AGT12338**
Address:	**wpa@windprojectsaustralia.com.au**	Report:	**1**
Project:	**Wombelano Wind Farm**	Date Tested:	**10/09/20 - 25/09/20**
Location:	**Wombelano, VIC**	Test Request No:	**N/A**

Sample No: **12338-1** BH / TP **BH02** Depth: **0.7 - 1.3m**

Material Description: **sandy CLAY**

Sample Location: **Met Mast Borehole**

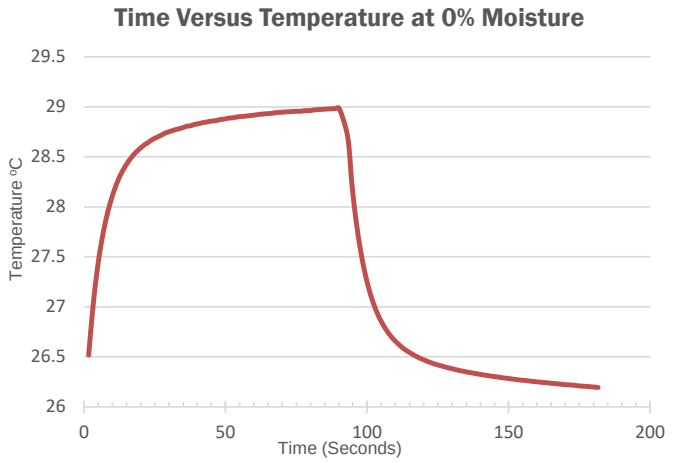
Sampled by: **J.M**
Sample date: 28/08/2020
Method: **AS 1289.1.2.1 6.5.3**

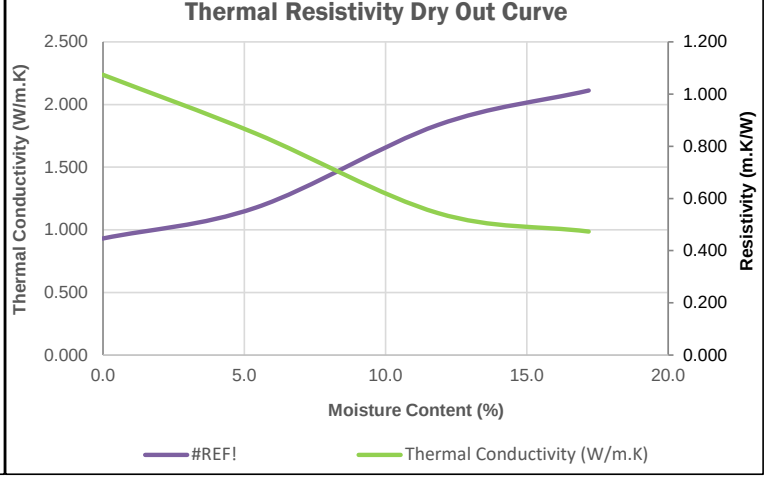
Density and Moisture Content Test Results

Compactive Effort	STD	**Optimum Moisture Content**	17.2%
Oversize Material (>19mm)	0%	**Achieved Dry Density (t/m^3)**	1.76
Average Mould Diameter (mm)	98.63	**Maximum Dry Density (t/m^3)**	1.78
Average Mould Height (mm)	199.78	**Specified Dry Density Ratio**	100%
Specification (Resistivity mK/W)		**Dry Density Ratio at Re-mould**	101%

Summary of Thermal Conductivity Testing

Moisture Content at time of test (%)	17.2	11.8	5.4	0.0
Mass of sample at time of test (g)	8610.0	8460.0	8280.0	8128.0
Moisture Ratio at time of test (%)	100	69	31	0
Initial Temperature (°C)	15.6	16.2	13.8	26.5
Thermal Conductivity (W/m.K)	2.112	1.836	1.178	0.930
Thermal Resistivity (m.K/W)	0.459	0.528	0.823	1.042





Method of Needle Insertion:	Guide Tube
Length of Test (Seconds, heating period only)	90
Correction factor used for Conductivity Measurements:	0.97
Correction factor used for Resistivity Measurements:	1.03

Notes:

Test Methods: AS1289 2.1.1 AS1289 5.1.1 ASTM D5334

Approved Signatory

Date: 28/09/2020

Material Test Report

Report Number: **AGT12338-1**
Issue Number: 1
Date Issued: 28/09/2020
Client: Wind Projects Australia

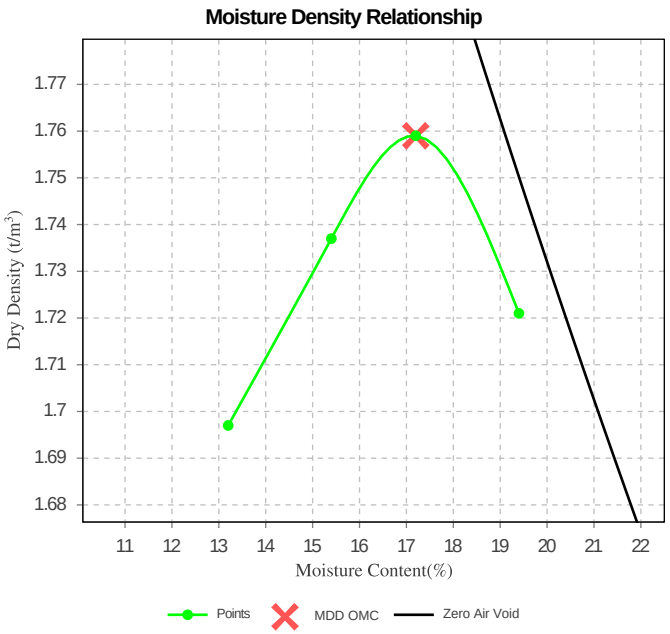
Contact: Kingsley Slipper
Project Number: AGT12338
Project Name: Wombelano Wind Farm
Project Location: Wombelano, VIC
Work Request: 3097
Sample Number: 12338-1
Date Sampled: 28/08/2020
Dates Tested: 10/09/2020 - 10/09/2020
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **BH 02 - Refer to plan, Depth: 0.7m - 1.3m**
Material: Sandy CLAY
Material Source: In situ

Australian Geotechnical Testing
Warrnambool Laboratory
2/1109 Raglan Parade Warrnambool Vic 3280
Phone: (03) 4504 5762
Email: joem@ausgeotest.com.au

Joe Meade (Senior Geotechnician)

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)	
Mould Type	1 LITRE MOULD A
Compaction	Standard
Maximum Dry Density (t/m^3)	1.76
Optimum Moisture Content (%)	17.0
Oversize Sieve (mm)	19
Oversize Material Wet (%)	
Method used to Determine Plasticity	Visual
Curing Hours	>96

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	15.5



Appendix C – Site photos