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Report
Geotechnical Investigation
28013 Great Southern Highway, Katanning WA

Client:
WAMMCO International

Reference:GI229723PG _Rev0
Date: 9 December 2023

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Quality Information

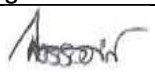
Document Report - Geotechnical Investigation
28013 Great Southern Highway, Katanning WA

Project Ref GI229723PG _Rev0

Date 9 December 2023

Prepared for WAMMCO International

Revision History

Rev.	Date	Details	Prepared by	Authorised	
				Name/Position	Signature
0	09/12/2023	Final Issue	RK	Mohammad Amzad Hossain Sr Geotechnical Engineer	

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APPENDICES

1.0 INTRODUCTION

Perth Geotechnics (PG) was engaged by WAMMCO International to undertake a geotechnical site investigation for the proposed solar farm development at 28013 Great Southern Highway, Katanning WA (the site).

The site location map is shown in Figure 1.

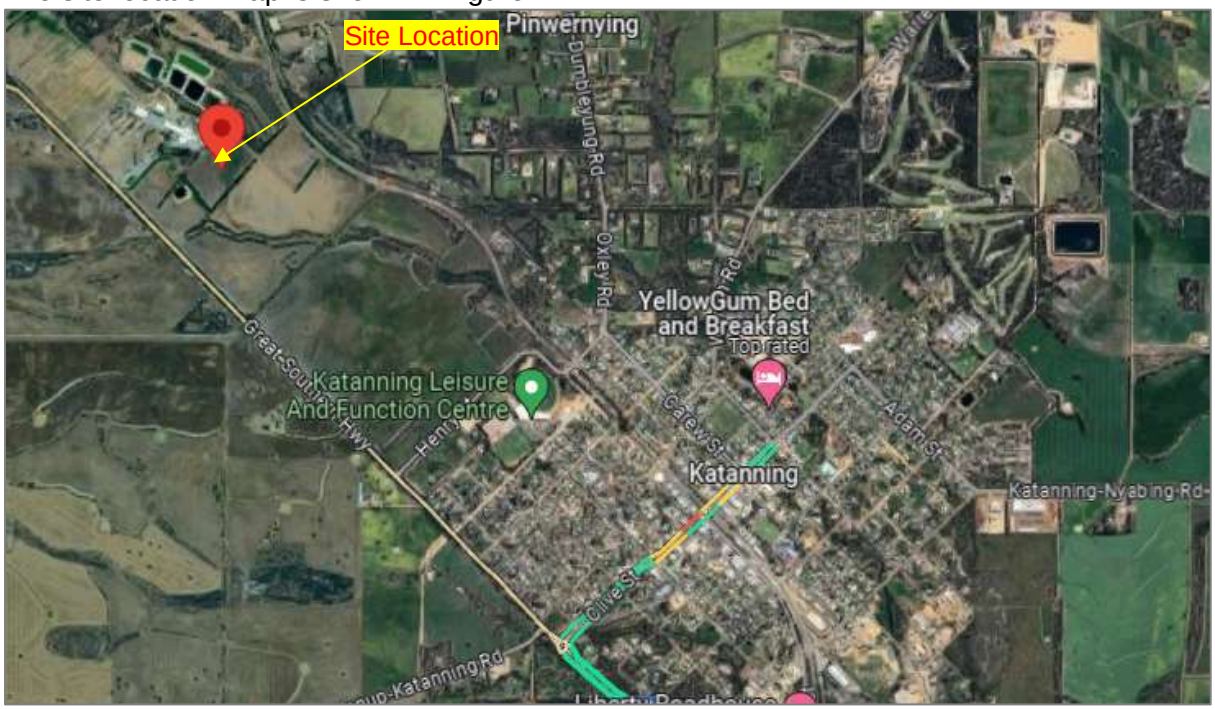


Figure 1. Site Location Map (Source: Google Maps)

The objectives of the investigation were to obtain information on the sub-surface conditions to classify the site in accordance to the definitions provided in Australian Standard AS2870 – 2011 and to provide recommendations on strength and stiffness parameters, bearing capacity for pile and shallow foundations.

Field works were conducted on 15 November 2023. Weather condition on the day of field investigation was sunny and fine.

The scope of the investigation did not include compaction control, wind force calculations or classifications, slope stability checking and any environmental issue.

2.0 PROPOSED DEVELOPMENT

The proposed Solar Farm at 28013 Great Southern Highway, Katanning will be developed in an area adjacent east of the WAMMCO International Company building. The modules and modules with trackers will be installed and be supported by pile and or pad foundation. Other associated structures that comprise internal access tracks, power conversion units and DC isolation box will be constructed.

3.0 SCOPE AND OBJECTIVES

The scope and objectives of the investigation are as follows:

- Conducting of 8 x Bore Holes (BHs) by using a mechanical auger up to 4.5 m depth or refusal;
- Conducting of 8 x Dynamic Cone Penetrometer Tests (DCPs) to 4 m depth or refusal;
- Logging of site soil profile as per Australian Standard AS1726;
- Undertaking 3 x Soil Resistivity (SR) or Electrical Resistivity (ER) Tests on-site;
- Laboratory testing of soil sample;
- Submit a factual report on findings to classify the site in accordance with the Australian Standard AS2870 - 2011;
- Sub-soil class (AS1170.4-2007), earthquake parameter.
- Subsurface conditions in the significant foundation zone.
- Description of groundwater conditions.
- Geotechnical design/strength parameters.
- Site preparation recommendations during construction (AS 3798-2007).
- Provide recommendations on bearing capacity and earthworks.

4.0 SITE CONDITIONS

4.1 Site Setting & Surface Conditions

The solar farm site is located on a flat landscape, approximately 250 m north of the Great Southern Highway and is bounded by greenfield. The site size is approximately 350 m x 225 m (=approx. 7.8 ha).

The surface of the site was observed to be flat and covered with dried weed. The site surface was accessible with a 4WD vehicle and the 8-12 tonne tracked excavator.

Site photos taken during the field investigation are shown in **Appendix D**.

4.2 Site Geology

A review of 1:250,000 Geological Series Map of Dumbleyung (Sheet SI 50-7) indicates that the site is underlain by colluvium and minor alluvium (Qc). Colluvium and alluvium are comprised of silt, sand and gravel.

4.3 Groundwater Information

No groundwater information was available for the proposed solar farm site.

5.0 FIELD INVESTIGATION

5.1 General

The geotechnical site investigation was undertaken on 15 November 2023 in the full-time presence of a geotechnical engineer from PG. The geotechnical site investigation comprised of:

- 8 x Bore Holes (BH1 to BH8)
- 8 x Dynamic Cone Penetrometer Tests (DCP1 to DCP8)
- 3 x Soil Resistivity (SR01-SR03) or Electrical Resistivity (ER1-ER3) Tests on-site.

Test location plan is shown in **Appendix A**.

5.2 Test Hole Logs

Eight Bore Holes (BH1- BH8) were conducted across the site by using an excavator mounted mechanical auger. During BH drilling, the spoil was stockpiled adjacent to the test location. The subsurface profiles exposed in the test holes were logged in accordance with AS1726 and were photographed to provide a visual record of subsurface conditions encountered. Following these activities, each test location was progressively backfilled in the reverse order of excavation works.

All of the 8 BHs were terminated at a depth of 4.5 m below the ground level. Groundwater was not encountered in any of the test holes during the investigation.

Logs and photographs of the BHs are presented in **Appendix B** and **Appendix D**, respectively.

5.3 Dynamic Cone Penetrometer (DCP) Test

Eight (8) Dynamic Cone Penetrometer Tests (DCP1 to DCP8) were conducted adjacent to borehole locations. All DCP tests were undertaken up to 4.0 m depth. The tests were conducted in accordance with test method AS1289.6.3.2, Ref. Table 6.4.6.2 HB 160-2006.

DCP tests implied that the site is in dense (sandy layers) and very stiff to hard (sandy clayey layers) condition up to maximum depth of investigation, 4 m.

The DCP test certificates are attached to this report in **Appendix B**.

6.0 LABORATORY TESTS

6.1 General

Laboratory testing was undertaken by a NATA accredited laboratory. The test standard applicable to each test is recorded on the laboratory testing certificates/reports. The scheduled laboratory testing included:

- 6 x Particle Size Distribution Test
- 6 x Atterberg Limit Test
- 4 x Soil Aggressivity Test.

6.2 Geotechnical Laboratory Test Results

The geotechnical laboratory test results for soil are summarised in **Table 1**. The laboratory test certificates/reports are included in **Appendix C**.

Table 1. Summary of Geotechnical Laboratory Test Results for Soil

Sample ID	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PI (%)	LS (%)	Soil Class (AS1726)
BH1 (2.5-3.5)m	8	47	45	48	22	7	Clayey Sand (SC)
BH1 (3.5-4.5)m	3	55	42	55	21	5	Clayey Sand (SC)
BH2 (2.5-3.5)m	11	59	30	50	21	5	Clayey Sand (SC)
BH4 (2.0-3.0)m	2	41	57	55	29	7	Sandy Clay (CH)
BH5 (2.5-3.5)m	2	41	57	48	18	7	Sandy Clay (CI)
BH6 (2.5-3.5)m	4	50	46	32	17	7	Sandy Clay (CI)

Note: LL= Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, LS = Linear Shrinkage.

Soil sample tested can be classified as Clayey Sand (SC) and Sandy Clay (CI-CH). The sands are of fine to medium grained and silts and clays are of medium to high plasticity.

6.3 Soils Aggressivity Test Results

The aggressivity (chemical) test results are summarised in **Table 2**. The laboratory test certificates are included in **Appendix C**.

Chemical tests were undertaken to establish the corrosivity and aggressiveness of the soil at the site. Exposure classification stated in Tables 6.4.2 (C) and 6.5.2 (C) of AS 2159-2009 'Piling - design and installation' for soils above and below groundwater table were used to assess the soils' aggressivity. These exposure classifications are applicable to all buried concrete and steel structures.

Table 2. Soil Aggressivity Assessment for the Soil Materials

Sample ID	pH	Sulphate in Soil (ppm)	Chloride in Soil (ppm)	Resistivity, ohm.cm	Exposure Classification for [considering Soil Conditions B*]	
					Concrete	Steel
BH1(2.5-3.5m)	6.4	20	22	19,000	Non-aggressive	Non-aggressive
BH2(2.5-3.5m)	6.2	85	89	7,400	Non-aggressive	Non-aggressive
BH5(2.5-3.5m)	5.0	34	35	17,000	Mild	Non-aggressive
BH6(0.8-1.8m)	7.4	59	36	9,400	Non-aggressive	Non-aggressive

**Soil conditions B = low permeability soils or all soils above groundwater

Based on the measured pH, chloride, sulphate and resistivity values, the soil exposure classification for concrete is '**Mild to Non-aggressive**' and for steel is '**Non-aggressive**'.

7.0 SOIL RESISTIVITY TEST

7.1 General

Three (3) Soil Resistivity (SR) or Electrical Resistivity (ER) Tests were undertaken on-site. Soil resistivity is a measure of how much the soil resists the flow of electricity. It is a critical factor in design of systems that rely on passing current through the earth's surface. An understanding of the soil resistivity and how it varies with depth in the soil is necessary to design the grounding system in an electrical substation, switchroom or lightning conductors. Electrical condition in soil is essentially electrolytic and for this reason the soil resistivity depends on moisture content, salt content and temperature and soil resistivity decreases with increase in these parameters.

7.2 Apparatus

Different kinds of equipment's are available in the market to measure the electrical resistivity of soil. The AEMC 6471 Earth Tester is equipped with four probes and connecting leads. The routes chosen should preferably be free of long buried metal pipes or lead sheathed cables etc, but if this is not possible the measurement route should be positioned at right angles to these items wherever possible.

7.3 Test Procedure

The Wenner method was adopted to measure the soil resistivity. The AEMC 6471 soil resistivity tester was used in the measurements which is equipped with four probes and connecting leads. The general measurement setup is shown in **Figure 2**. The four

earth probes were driven into the ground in a straight line, at a distance 'a' metre apart and driven to a depth between 150 mm and 200 mm.

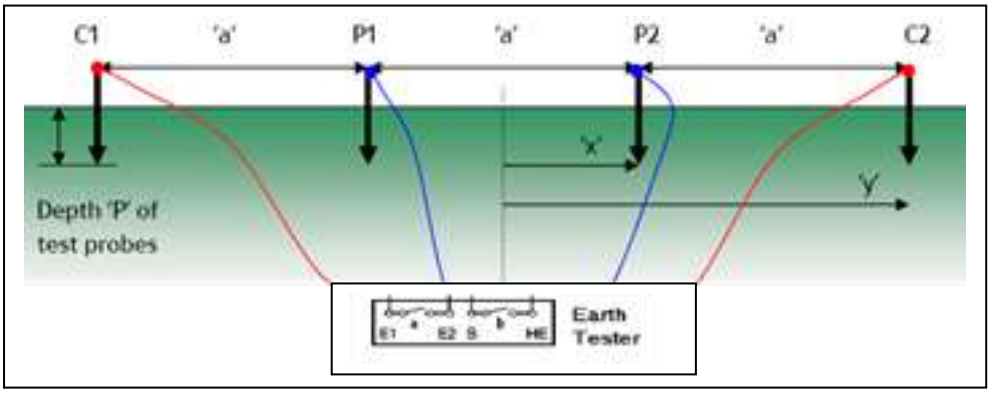


Figure 2: General measurement set up of Soil resistivity Equipment.

The four probes were connected to the tester, with the outer probes connected to the C1 and C2 terminals, and the inner probes to the P1 and P2 terminals. The instrument was kept in a central position and a series of resistance measurements were made as the four electrodes moved out in equal distances from the central point. The meter was left turned on to allow the built- i n filters to operate and reading after 30 seconds was taken. The readings can be significantly varied due to:

- Electrical interference
- High contact resistance at the test probes
- Damaged test leads
- Reading at the lower limit of the instrument's measuring capability

The measurements of soil resistance were taken carefully so as to avoid the significant variation in readings. During testing, readings were taken in two orthogonal directions (East-West and North-South) from the instrument point.

7.4 Calculations

The apparent soil resistivity is given by, $\rho = 2\pi aR$ (Ω.m).

Where, ρ = ground resistivity (Ω.m)

a = electrode spacing (metres)

R = measured resistance (Ω)

A calculation is made to determine the average soil resistivity of all layers of soil between the surface and electrode depth.

Soil Resistivity on-site was carried out in accordance with the following standards:
- AS/NZS 1768:2007 Lightning Protection
- AS/NZS 4853 Electrical hazards on metallic pipelines
- IEEE81 Guide for Measurement of Impedance and Safety Characteristics.

7.5 Field testing

The field soil resistivity tests SR01 to SR03 were conducted at three (3) locations at the proposed solar farm area. The tests were conducted in accordance with above section standards to measurement of soil resistivity, earthing electrode resistance and earth termination network impedance. The tests measured along two orthogonal arrays at each location.

Based on the connection of the earth probes and earth tester over the probe spacing and probe depths, resistances (R) in ohms were recorded from the null meter/earth tester respectively. Each incremental probe spacing and depths were applied, until the maximum probe spacing and depths are achieved. Proposed tests probe spacing were of 1.0 m, 2.0 m, 4.0 m, 8.0 m and 16.0 m.

A summary of the soil resistivity measurements are presented in **Table 3**. Test results are attached in Appendix B of this report.

Table 3. Soil Resistivity Tests Data

Test No.	N – S Direction				E – W Direction			
	Probe Spacing (a) (m)	Probe Depth (m)	Measured Ohms (R) (Ω)	Apparent Resistivity (Ωm)	Rod Spacing (A) (m)	Rod Depth (B) (m)	Measured Ohms (R) (Ω)	Apparent Resistivity (Ωm)
Soil Resistivity Test 1 - SR 01								
1	1.0	0.15	48.23	303.038	1.0	0.15	58.03	364.6132
2	2.0	0.15	9.379	117.86	2.0	0.15	7.962	100.0534
3	4.0	0.15	8.87	222.9274	4.0	0.15	6.92	173.9186
4	8.0	0.20	11.74	590.1168	8.0	0.20	9.66	485.5646
5	16.0	0.20	10.36	1,041.501	16.0	0.20	11.48	1,154.095
Soil Resistivity Test 2 - SR 02								
1	1.0	0.15	96.33	605.2592	1.0	0.15	62.02	389.6832
2	2.0	0.15	5.271	66.23734	2.0	0.15	13.5	169.646
3	4.0	0.15	4.5	113.0973	4.0	0.15	9.44	237.2531
4	8.0	0.20	11.2	562.9734	8.0	0.20	14.02	704.7221
5	16.0	0.20	9.68	973.1397	16.0	0.20	27.8	2,794.761
Soil Resistivity Test 3 - SR 03								
1	1.0	0.15	61.27	384.9708	1.0	0.15	119.4	750.2123
2	2.0	0.15	57.6	723.8229	2.0	0.15	6.09	76.5292
3	4.0	0.15	2.08	52.2761	4.0	0.15	3.69	92.73982
4	8.0	0.20	2.49	125.1611	8.0	0.20	2.84	142.754
5	16.0	0.20	11.8	1,186.265	16.0	0.20	36.25	3,644.247

The apparent soil resistivity ranges from 100.053 to 590.116 ohm.m at SR 01 test area, from 66.237 to 605.259 ohm.m at SR02 test area, and from 52.276 to 750.212 ohm.m at SR 03 test area. From spacing 16.0 m showing high electrode impedance repeatedly after changing 4/5 times electrode position.

The high electrode impedance values, which may be attributed due to several reasons including material composition, variation in local weather, moisture conditions and salt content etc.

Test locations of the soil resistivity are shown in a site plan presented in **Appendix A**. Site photograph are presented in **Appendix E** of this report.

8.0 ENGINEERING CONSIDERATIONS AND RECOMMENDATIONS

8.1 Inferred Subsurface Conditions

A generalised subsurface profile was inferred from the site investigation and described as follows:

- **Clayey Sand (SC) and Sandy Clay (CI-CH)** - fine to medium grained, brown, grey-brown, pale grey (white), dense sand dominated layer, very stiff to hard silt/clay dominated layer, trace gravel, clay and silt are of medium to high plasticity, this soil unit extended up to the maximum depth of investigation, 4.5 m.

8.2 Groundwater

Groundwater was not encountered at any of the BHs within a depth of 4.5 m below the existing ground surface.

8.3 Geotechnical Design Parameters

Geotechnical design parameters for the site were inferred on the basis of the site investigation data and are presented in **Table 4**.

Table 4. Inferred Geotechnical Design Parameters for the Current Site Conditions

Depth (m, bgl)	Layer Description	Soil Parameters					k_v (MN/m^3)	k (m/s)
		ϕ' (deg.)	c_u / c' (kN/m^2)	γ (kN/m^3)	E_u/E' (MPa)	ν'		
0 - 4.5	Clayey Sand (SC) and Sandy Clay (CI-CH) – Dense/Very Stiff to hard	34	- / -	20	- / 70	0.3	12	1×10^{-7} to 1×10^{-9}

Notes: ϕ' = Effective friction angle, c_u = Undrained shear strength, c' = Drained cohesion, γ = Bulk density, E_u = Undrained Elastic Modulus, E' = Drained Elastic Modulus, ν' = Poisson's Ratio, k_v = Modulus of vertical subgrade reaction, k = Coefficient of Permeability.

8.4 Site Classification

Provided earthworks are completed as per the recommendation in **Section 8.6.3** of this report, and on the basis of the site soil profile and surrounding conditions, the site can be classified as "**CLASS M"** in accordance with the definitions provided in Australian Standard AS2870 - 2011. The characteristics surface movement ***Ys*** was estimated to be between 30 mm and 40 mm.

8.5 Earthquake Design Factor

Australian Standard AS1170.4-2007 Structural design actions Part 4 "Earthquake actions in Australia" is recommended for earthquake consideration. AS1170.4-2007 outlines the design criteria required for a structure in consideration of the risk of being subjected to earthquake loads. Earthquake design factors are summarised in **Table 5**.

Table 5. Earthquake Design Factors

Factor/Class	Value/Name	Ref. AS1170.4- 2007
Hazard Factor (z)	0.10	Figure 3.2 (D)
Site sub-soil class	**Class C_e** – Shallow Soil	Section 4 Clause 4.1

8.6 Earthworks

8.6.1 Suitability of Excavated Materials for use as Fill

The majority of the soils encountered at the site comprised of Clayey Sand (SC) and Sandy Clay with 40% to 60 % clay and are considered to be unsuitable for reuse as structural fill material.

8.6.2 Structural Fill

Suitable materials for structural fill shall be a clean sand fill. The fill material at compaction should comprise sand that is free from oversized material (i.e., material > 75 mm in any dimension), contains less than 5% fines (material passing 0.075 mm sieve), and free from foreign material, organic material or other deleterious material. It should also be free from industrial waste, solid waste, or construction and demolition debris.

8.6.3 Site Preparation - Earthworks

Earthworks should be carried out in general accordance with the Australian Standard AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments". The following are general guidelines to be followed during preparation of the site areas within the proposed development footprints:

- Remove and grub all root masses and tree stumps, if any.
- Strip topsoil and any uncontrolled fill, oversize rock, paved materials, demolition debris or other deleterious material and stockpile separately and then remove from the site.
- Proof roll or compact the exposed surface, with required number of passes, a minimum of 6 passes, of a heavy vibratory roller to a dense state, i.e., to 95% of MMDD in accordance with AS1289.5.2.1. Add moisture as needed during the compaction.
- If backfilling is required to raise the site, backfill using imported sand (i.e., structural fill) in loose layer lift thickness not exceeding 350 mm and compact each lift using a heavy vibratory roller to 95% of MMDD in accordance with AS1289.5.2.1. The material at compaction should be moisture conditioned within -1% to +2% of its optimum moisture content.
- Subgrade (or backfill lifts/layers) at proposed carpark, driveway, access road and internal road areas shall be compacted to 98% of MMDD in accordance with AS1289.5.2.1. Add moisture as needed during the compaction.
- Care will need to be taken when compacting in the vicinity of existing structures to avoid damage from excessive vibrations.
- Undertake necessary excavation to the required depth for the proposed shallow foundation, raft, pad and strip footing or pile cap. Temporary excavation up to 1 m depth can be conducted with a maximum dry slope angle of 1V: 1.5H. It is recommended to undertake a series of DCP tests at each footing base to ensure that the ground beneath the footing, at least to 1 m depth, does not comprise loose sands or other deleterious, clay or weak materials. Hand held compactor can be used if the base ground is not in dense state.

It is recommended that a geotechnical engineer supervises the site activities to ensure that all organic, roots and oversize material have been adequately removed from the area and that site is adequately improved, backfilled and compacted as per the procedures described above.

8.7 Bearing Capacity - Strip and Pad Foundation Option

If the earthworks as described in Section 8.6.3 are undertaken prior to the construction, ground will have sufficient bearing capacity to support the proposed pad and strip foundations at the design ground level. As discussed in Section 8.6.3, all footing bases should be in dense state, to a minimum depth of 1 m below the footing excavation level.

The allowable bearing pressures are estimated (**Table 6**) to limit settlements to less than or equal to 20 mm and provide a minimum factor of safety of 2.0 against general bearing capacity failure. These bearing pressures do not consider eccentric and inclined loading conditions and interaction effects (i.e., loadings from adjacent foundations). Furthermore, the calculations assume that the areas beneath the pad, raft and strip foundations have been compacted to a density ratio of 95% modified compaction, MMDD, and are founded at least 0.5 m below final ground grading levels.

Table 6. Allowable Bearing Pressures for Typical Strip and Pad Footings

Embedment Depth (m)	Footing Type	Footing Width (m)	Allowable Bearing Pressure (kPa)	Estimated Settlement (mm)
0.5	Strip	0.5	80	10
		1	100	15
		1.5	120	20
1.0	Strip	0.5	100	10
		1	130	20
		1.5	150	20
0.5	Pad	1	100	20
		2	150	20
		3	160	20
		4	180	20
1.0	Pad	1	150	20
		2	200	20
		3	250	20
		4	250	20

8.8 Pile Foundation

The geotechnical strength reduction factor, ϕ_g, can be considered as 0.45 in accordance with AS2159. Geotechnical parameters for pile foundation design are preliminary estimated for the encountered subsoil materials and presented in **Table 7**.

Table 7. Ultimate Bearing Capacities for Piles

Layer Depth, m	Foundation Material	End Bearing Capacity, f_{bu} (kPa)	Skin Friction, f_{su} (kPa)
0 – 4.5	Clayey Sand (SC) and Sandy Clay (CI-CH) – Dense/Very Stiff to hard	1,500	65

8.9 Lateral Subgrade Modulus for Pile

Lateral Subgrade Modulus (k_h) has been estimated based on an average of 600 mm diameter pile and presented in **Table 8**.

Table 8. Profile of Lateral Modulus of Subgrade Reaction k_h

Depth (m)	k_h (MN/m^3)	Remarks
1.0	5	• Adopted pile diameter = 600 mm
2.0	15	
3.0	30	
4.0	45	
4.5	65	

8.10 California Bearing Ratio (CBR)

The subgrade of the proposed carpark, internal roads, hardstand and driveway areas shall be prepared as per the general guidelines set out in Section 8.6.3 and compacted to a density ratio of 98% MMDD.

Based on the clayey-sandy and sandy-clayey material, a design CBR value of 6% can be considered for this project.

8.11 Excavatability

The very stiff to very dense state of the in-situ soils suggests that the materials should be excavatable with a standard earthmoving equipment (e.g., 10 tonne excavator).

8.12 Cut and Fill Batters

Temporary excavation up to 1 m depth can be conducted with a maximum dry slope angle of 1V: 1.5H. Cut and fill batters above groundwater table will generally be stable at 1V: 2H. Intermediate benches have to be created if excavation is deeper than 1m. However, batters constructed at 1V: 3H will enable re-establishment of vegetation and be less prone to damage from wetting, drying and erosion.

9.0 LIMITATION OF USE

The ground is a product of continuing natural and man-made processes and therefore exhibits characteristics and properties which vary from place to place and can change with time. Geotechnical site investigation involves gathering and assimilating limited facts about these characteristics and properties in order to better understand or predict the behaviour of the ground at a particular site under certain conditions.

This site investigation has been carried out by inspection, using a limited amount of BH, sampling, testing or other means of investigation. Achieving a full coverage of the site to ensure all variations is not practical and is seldom done due to cost constraints as well as the impracticality.

It should be noted that the subsurface conditions encountered by the limited number of field tests as part of this geotechnical site investigation represents the ground conditions at the locations where the samples were taken and where tests have been undertaken and as such are an extremely small proportion of the site to be developed.

The facts reported in this document are directly relevant only to the ground at the place where, and time when, the investigation was carried out and are believed to be reported accurately. Given the limited number of field and laboratory testing carried out with respect to the overall site area, variations between investigation locations are likely and ground conditions different to those presented in this report may be present within the subject site area. The risk

associated with this variability and the impact it will have on the proposed development should be carefully considered.

The level of geotechnical investigation that has been completed to date is considered appropriate for the project objectives. If the above mentioned client, its subcontractors, agents or employees use this factual information for any other purpose for which it was not intended, then the client, its subcontractors, agents or employees does so at their own risk and Perth Geotechnics will not and cannot accept liability in respect of the advice, whether under law of contract, tort or otherwise.

Any interpretation or recommendation given in this report is based on judgement and experience and not on greater knowledge of the facts reported. Perth Geotechnics does not represent that the information or interpretation contained in this report addresses completely the existing features, subsurface conditions or ground behaviour at the subject site.

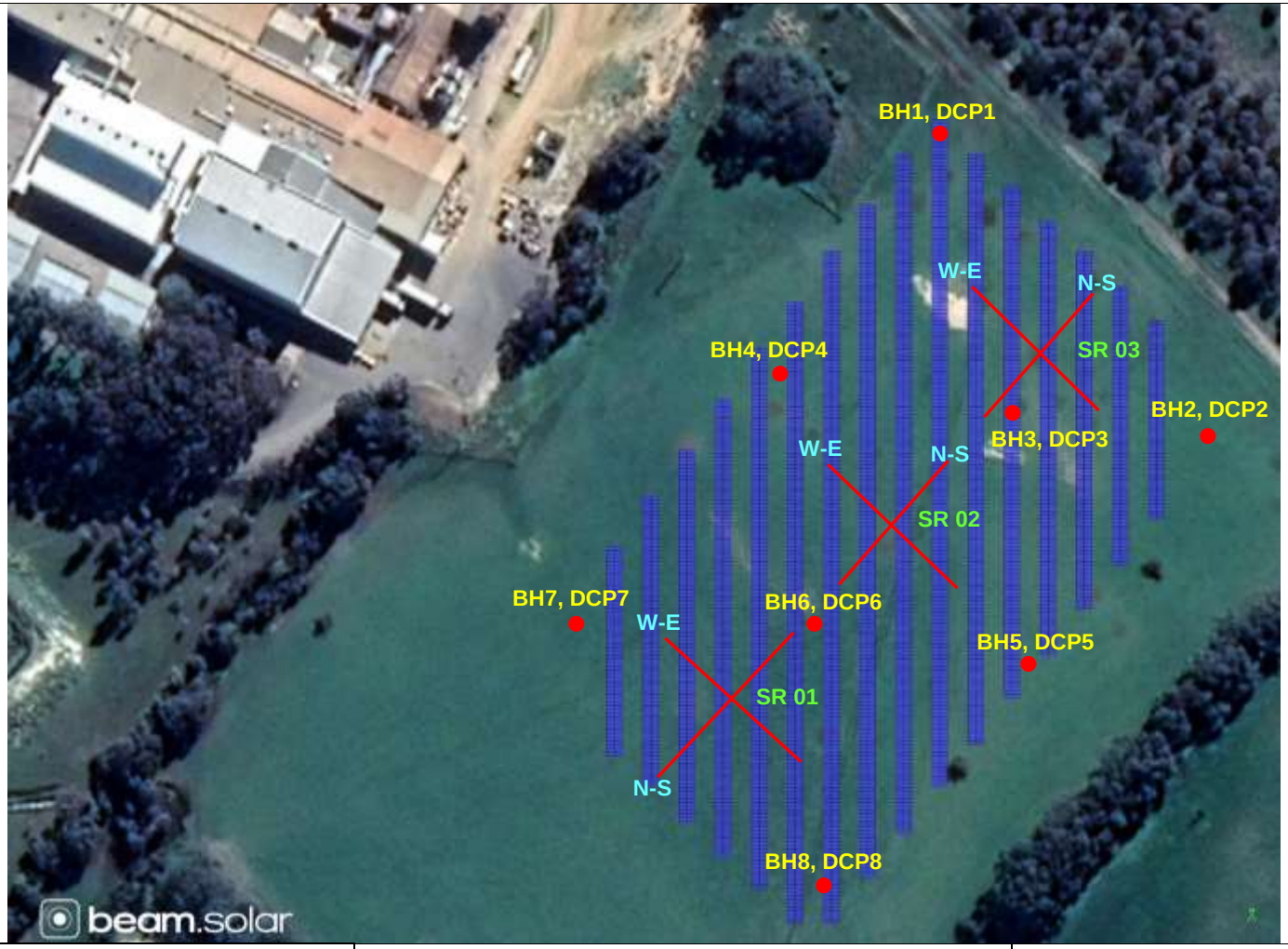
10.0 REFERENCES

- Australian Standard AS1170.4-2007, “Earthquake Actions in Australia”.
- Australian/New Zealand Standard AS/NZS 1547-2012, “On-site Domestic Wastewater Management”.
- Australian Standard AS 1726-1993 "Geotechnical Site Investigations".
- Australian Standard AS 2870-2011, "Residential Slabs and Footings".
- Australian Standard AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments".
- Bowles JE (2013), Foundation Analysis and Design, 5th edition, McGraw Hill London
- CSIRO publication 2003 “Guide to Home Owners on Foundation Maintenance and Footing Performance” in Building Technology File Number 18.
- 1:250,000 Geological Series Map of Dumbleyung (Sheet SI 50-7).
- Institute of Municipal Engineering Australia, WA Division Inc (1998), Local Government Guidelines for Subdivisional Development
- Standards Australia, Hand Book HB 160-2006 "Soil Testing".
- AS/NZS 1768:2007 Lightning Protection
- AS/NZS 4853 Electrical hazards on metallic pipelines
- IEEE81 Guide for Measurement of Impedance and Safety Characteristics.

Perth Geotechnics

APPENDIX – A

SITE PLAN



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Project: Geotechnical Investigation
Location: 28013 Great Southern Highway, Katanning WA

Client: WAMMCO International

Reference: GI229723PG | **Scale:** N.T.S.

Date: 08/12/2022 | **Drawn By:** MH

Site Plan:
Bore Hole (BH), Dynamic Cone Penetrometer (DCP) and Soil Resistivity (SR) Test Locations

Drawing No: 229723_Rev0

Perth Geotechnics

APPENDIX – B

BORE HOLE LOGS AND DCP TEST CERTIFICATES

BORE HOLE LOG

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH1
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with few rootlets	D	VD	
	0.25				SC		**Clayey SAND**- fine to medium grained, grey, pale grey, white, medium to high plasticity, with gravel up to 25mm	SM	D-VD	
1.0								SM	D-VD	
2.0							changes colour to grey, greyish brown, yellowish brown **0**	M	D-VD	
	2.5						changes colour to grey, brown, yellowish brown,			
3.0			BH1					M	D	
	3.5						Changes colour to yellow, yellowish brown			
4.0			BH1					M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

S = Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

BORE HOLE LOG

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH2
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.25				SC		**Gravelly Clayey SAND**- fine to medium grained, brown, reddish brown, medium to high plasticity, with gravel up to 25mm	SM	D-VD	
1.0								SM	D-VD	
2.0								SM	D	
	2.5		BH2				changes colour to grey, greyish brown, yellowish brown			
3.0								M	D-VD	
	3.5									
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

S = Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH3
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	D	
	0.25				SC		**Gravelly Clayey SAND**- fine to medium grained, brown, reddish brown, medium to high plasticity, with gravel up to 25mm	D	D	
1.0								SM	D	
2.0							changes colour to brown, reddish brown, yellowish brown	SM	D	
3.0								M	D	
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

S = Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH4
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.5				CI		**Sandy CLAY**- medium to high plasticity, grey, brown, reddish brown, fine to medium grained sand, with few gravels	D	VSt	
1.0								SM	VSt	
	1.5						changes colour to brown, reddish brown, yellowish brown			
2.0			BH4					SM	VSt	
3.0								M	VSt	
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense
S = Soft
F = Firm
St = Stiff
VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH5
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.2				CI		**Sandy CLAY**- medium to high plasticity, grey, pale grey, fine to medium grained sand, with few gravels	D-SM	VSt-H	
1.0								SM	VSt-H	
	1.5						changes colour to pale grey, white			
2.0								SM	VSt-H	
	2.5									
3.0			BH5					M	VSt	
	3.5									
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:

Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense
S = Soft
F = Firm
St = Stiff
VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH6
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.2				SC		**Clayey SAND**- fine to medium grained, grey, brown, greyish brown, medium plasticity, with few gravels	D-SM	D-VD	
	0.8				Cl		**Sandy CLAY**- medium to high plasticity, brown, yellowish brown, reddish brown, fine to medium grained sand, with few gravels	SM	VSt-H	
1.0										
2.0							changes colour to pale grey, white	SM	VSt	
	2.5									
3.0			BH6					M	VSt	
	3.5									
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense
S = Soft
F = Firm
St = Stiff
VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH7
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.3				Cl		**Sandy CLAY**- medium to high plasticity, brown, reddish brown, grey, fine to medium grained sand, with few gravels	D-SM	VSt-H	
1.0								SM	VSt	
2.0							changes colour to pale grey, white	SM	VSt-H	
3.0								M	VSt	
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

S = Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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Reference:	GI229723PG	**Client:**	WAMMCO International
Project:	Geotechnical Investigation	**Bore Hole ID:**	BH8
Location:	28013 Great Southern Highway, Katanning WA	**Date Commenced:**	15/11/2023
Easting:	50 952 511 **Co-ordinates:** GDA94	**Equipment Type**	Mechanical Auger
Northing:	6 428 874	**Logged By:**	MH
Sampling Type:	B - Bulk Sample	**Checked By:**	RK

Scale (m)	Depth (m)	GWT (m)	Sampling Type/Depth	Graphic Log	UCS Symbol	Sample ID	Soil Description	Moisture Condition	Density	Remarks/Field observations
					SM		**Silty SAND**- fine grained, grey, dark grey, low plasticity, with gravel up to 25mm and few rootlets	D	VD	
	0.2				SC		**Gravelly Clayey SAND**- fine to medium grained, grey, dark grey, medium plasticity, with gravel up to 25mm	D-SM	D-VD	
	0.8				Cl		**Sandy CLAY**- medium to high plasticity, brown, yellowish brown, fine to medium grained sand, with few gravels	SM	VSt-H	
1.0										
	1.2						changes colour to pale grey, white			
2.0								SM	VSt-H	
3.0								M	VSt	
4.0								M		
	4.5						**Terminated at the target depth of 4.5 m**			
5.0										

Remarks:
Sampling Type:
B - Bulk Sample (/Disturbed),
U - Undisturbed Sample

Moisture Condition:
D - Dry, **M** - Moist, **W** - Wet
SM- Slightly Moist
= Water Table

Density:
VL = Very Loose, **L** = Loose,
MD = Medium Dense
D = Dense, **VD** = Very Dense

S = Soft
F = Firm
St = Stiff

VSt = Very Stiff
H = Hard
R = Refusal

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DYNAMIC CONE PENETROMETER (DCP)
TEST CERTIFICATE

(AS 1289.6.3.2)
Correlation of Sand Density - Table 6.4.6.1 (A) & (B) HB 160-2006

Client	WAMMCO International	Project	Geotechnical Investigation
Reference	GI229723PG	Location	28013 Great Southern Highway, Katanning WA
Date Tested	15/11/2023	Tested By	MH/HA

References:	DCP1	DCP2	DCP3	DCP4	DCP5	DCP6
Depth below ground level test commenced	**Penetration Resistance- Blows/100mm (Density Classification)**					
0-100	10 (VD)	10 (VD)	10 (VD)	9 (VD)	12 (VD)	10 (VD)
100-200	9 (VD)	10 (VD)	9 (VD)	10 (VD)	14 (VD)	11 (VD)
200-300	8 (D)	9 (VD)	9 (VD)	9 (VD)	9 (VSt)	11 (VD)
300-400	8 (D)	8 (D)	9(VD)	11 (VD)	9 (VSt)	10 (VD)
400-500	8 (D)	8 (D)	8 (D)	9 (VD)	9 (VSt)	9 (VD)
500-600	9 (VD)	8 (D)	9 (VD)	8 (VSt)	9 (VSt)	8 (D)
600-700	8 (D)	8 (D)	8 (D)	9 (VSt)	5 (VSt)	9 (VD)
700-800	7 (D)	7 (D)	8 (D)	9 (VSt)	9 (VSt)	8 (D)
800-900	8 (D)	8 (D)	8 (D)	8 (VSt)	9 (VSt)	8 (VSt)
900-1000	8 (D)	8 (D)	8 (D)	8 (VSt)	10 (VSt)	9 (VSt)
1000-1100	8 (D)	8 (D)	7 (D)	10 (VSt)	15 (H)	9 (VSt)
1100-1200	7 (D)	7 (D)	7 (D)	10 (VSt)	11 (H)	8 (VSt)
1200-1300	8 (D)	8 (D)	8 (D)	9 (VSt)	12 (H)	9 (VSt)
1300-1400	7 (D)	6 (D)	7 (D)	8 (VSt)	10 (VSt)	11 (H)
1400-1500	8 (D)	8 (D)	8 (D)	9 (VSt)	10 (VSt)	9 (VSt)
1500-1600	9 (VD)	6 (D)	6 (D)	8 (VSt)	11 (H)	10 (VSt)
1600-1700	8 (D)	8 (D)	8 (D)	7 (VSt)	10 (VSt)	9 (VSt)
1700-1800	8 (D)	7 (D)	6 (D)	8 (VSt)	11 (H)	10 (VSt)
1800-1900	9 (VD)	6 (D)	7 (D)	9 (VSt)	12 (H)	9 (VSt)
1900-2000	10 (VD)	7 (D)	8 (D)	9 (VSt)	10 (VSt)	11 (H)

Remarks: R= Refusal

Table A: H = Hard >10, VSt = Very Stiff, 5 – 10, St = Stiff, 3 – 4, F = Firm, 1 – 2, VS - S = Very Soft - Soft, 0 - 1

Table B: VD = Very Dense > 8, D = Dense, 4 – 8, MD = Medium Dense, 2 – 3, L = Loose, 1 – 2, VL = Very Loose < 1

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DYNAMIC CONE PENETROMETER (DCP)
TEST CERTIFICATE

(AS 1289.6.3.2)
Correlation of Sand Density - Table 6.4.6.1 (A) & (B) HB 160-2006

Client	WAMMCO International	Project	Geotechnical Investigation
Reference	GI229723PG	Location	28013 Great Southern Highway, Katanning WA
Date Tested	15/11/2023	Tested By	MH/HA

References:	DCP1	DCP2	DCP3	DCP4	DCP5	DCP6
Depth below ground level test commenced	Penetration Resistance- Blows/100mm (Density Classification)					
2000-2100	10 (VD)	8 (D)	8 (D)	10 (VSt)	11 (H)	10 (VSt)
2100-2200	11 (VD)	7 (D)	8 (D)	9 (VSt)	11 (H)	10 (VSt)
2200-2300	10 (VD)	7 (D)	6 (D)	9 (VSt)	12 (H)	9 (VSt)
2300-2400	10 (VD)	7 (D)	7 (D)	9 (VSt)	10 (VSt)	9 (VSt)
2400-2500	11 (VD)	8 (D)	8 (D)	8 (VSt)	11 (H)	8 (VSt)
2500-2600	9 (VD)	8 (D)	6 (D)	8 (VSt)	11 (H)	8 (VSt)
2600-2700	8 (D)	7 (D)	8 (D)	8 (VSt)	10 (VSt)	9 (VSt)
2700-2800	8 (D)	6 (D)	8 (D)	7 (VSt)	10 (VSt)	9 (VSt)
2800-2900	9 (VD)	7 (D)	7 (D)	8 (VSt)	10 (VSt)	9 (VSt)
2900-3000	8 (D)	6 (D)	8 (D)	9 (VSt)	9 (VSt)	9 (VSt)
3000-3100	8 (D)	6 (D)	7 (D)	9 (VSt)	9 (VSt)	8 (VSt)
3100-3200	8 (D)	7 (D)	7 (D)	10 (VSt)	9 (VSt)	8 (VSt)
3200-3300	8 (D)	6 (D)	8 (D)	9 (VSt)	10 (VSt)	7 (VSt)
3300-3400	8 (D)	6 (D)	7 (D)	8 (VSt)	10 (VSt)	8 (VSt)
3400-3500	7 (D)	8 (D)	8 (D)	8 (VSt)	9 (VSt)	7 (VSt)
3500-3600	7 (D)	8 (D)	8 (D)	8 (VSt)	8 (VSt)	8 (VSt)
3600-3700	8 (D)	9 (VD)	7 (D)	7 (VSt)	8 (VSt)	7 (VSt)
3700-3800	8 (D)	8 (D)	8 (D)	8 (VSt)	8 (VSt)	8 (VSt)
3800-3900	8 (D)	9 (VD)	7 (D)	7 (VSt)	8 (VSt)	7 (VSt)
3900-4000	7 (D)	8 (D)	8 (D)	7 (VSt)	8 (VSt)	8 (VSt)

Remarks: R= Refusal

Table A: H = Hard >10, VSt = Very Stiff, 5 – 10, St = Stiff, 3 – 4, F = Firm, 1 – 2, VS - S = Very Soft - Soft, 0 - 1

Table B: VD = Very Dense > 8, D = Dense, 4 – 8, MD = Medium Dense, 2 – 3, L = Loose, 1 – 2, VL = Very Loose < 1

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DYNAMIC CONE PENETROMETER (DCP)
TEST CERTIFICATE

(AS 1289.6.3.2)
Correlation of Sand Density - Table 6.4.6.1 (A) & (B) HB 160-2006

Client	WAMMCO International	Project	Geotechnical Investigation
Reference	GI229723PG	Location	28013 Great Southern Highway, Katanning WA
Date Tested	15/11/2023	Tested By	MH/HA

References:	DCP7	DCP8	DCP9	DCP10	DCP11	DCP12
Depth below ground level test commenced	**Penetration Resistance- Blows/100mm (Density Classification)**					
0-100	10 (VD)	10 (VD)				
100-200	9 (VD)	11 (VD)				
200-300	9 (VD)	10 (VD)				
300-400	9 (VSt)	9 (VD)				
400-500	9 (VSt)	9 (VD)				
500-600	11 (H)	9 (VD)				
600-700	10 (VSt)	9 (VD)				
700-800	11 (H)	9 (VD)				
800-900	10 (VSt)	11 (H)				
900-1000	10 (VSt)	11 (H)				
1000-1100	9 (VSt)	12 (H)				
1100-1200	10 (VSt)	10 (VSt)				
1200-1300	9 (VSt)	11 (H)				
1300-1400	9 (VSt)	10 (VSt)				
1400-1500	9 (VSt)	10 (VSt)				
1500-1600	8 (VSt)	10 (VSt)				
1600-1700	10 (VSt)	10 (VSt)				
1700-1800	9 (VSt)	9 (VSt)				
1800-1900	8 (VSt)	10 (VSt)				
1900-2000	9 (VSt)	9 (VSt)				

Remarks: R= Refusal

Table A: H = Hard >10, VSt = Very Stiff, 5 – 10, St = Stiff, 3 – 4, F = Firm, 1 – 2, VS - S = Very Soft - Soft, 0 – 1

Table B: VD = Very Dense > 8, D = Dense, 4 – 8, MD = Medium Dense, 2 – 3, L = Loose, 1 – 2, VL = Very Loose < 1

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DYNAMIC CONE PENETROMETER (DCP)
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(AS 1289.6.3.2)
Correlation of Sand Density - Table 6.4.6.1 (A) & (B) HB 160-2006

Client	WAMMCO International	Project	Geotechnical Investigation
Reference	GI229723PG	Location	28013 Great Southern Highway, Katanning WA
Date Tested	15/11/2023	Tested By	MH/HA

References:	DCP7	DCP8	DCP9	DCP10	DCP11	DCP12
Depth below ground level test commenced	**Penetration Resistance- Blows/100mm (Density Classification)**					
2000-2100	10 (VSt)	12 (H)				
2100-2200	11 (H)	11 (H)				
2200-2300	11 (H)	10 (VSt)				
2300-2400	9 (VSt)	10 (VSt)				
2400-2500	9 (VSt)	11 (H)				
2500-2600	10 (VSt)	12 (H)				
2600-2700	9 (VSt)	10 (VSt)				
2700-2800	10 (VSt)	10 (VSt)				
2800-2900	9 (VSt)	10 (VSt)				
2900-3000	9 (VSt)	9 (VSt)				
3000-3100	9 (VSt)	8 (VSt)				
3100-3200	9 (VSt)	8 (VSt)				
3200-3300	8 (VSt)	9(VSt)				
3300-3400	9 (VSt)	7 (VSt)				
3400-3500	9 (VSt)	8 (VSt)				
3500-3600	8 (VSt)	8 (VSt)				
3600-3700	7 (VSt)	7 (VSt)				
3700-3800	8 (VSt)	8 (VSt)				
3800-3900	8 (VSt)	7 (VSt)				
3900-4000	7 (VSt)	8 (VSt)				

Remarks: R= Refusal

Table A: H = Hard >10, VSt = Very Stiff, 5 – 10, St = Stiff, 3 – 4, F = Firm, 1 – 2, VS - S = Very Soft - Soft, 0 - 1

Table B: VD = Very Dense > 8, D = Dense, 4 – 8, MD = Medium Dense, 2 – 3, L = Loose, 1 – 2, VL = Very Loose < 1

Perth Geotechnics

APPENDIX – C

LABORATORY TEST CERTIFICATES

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

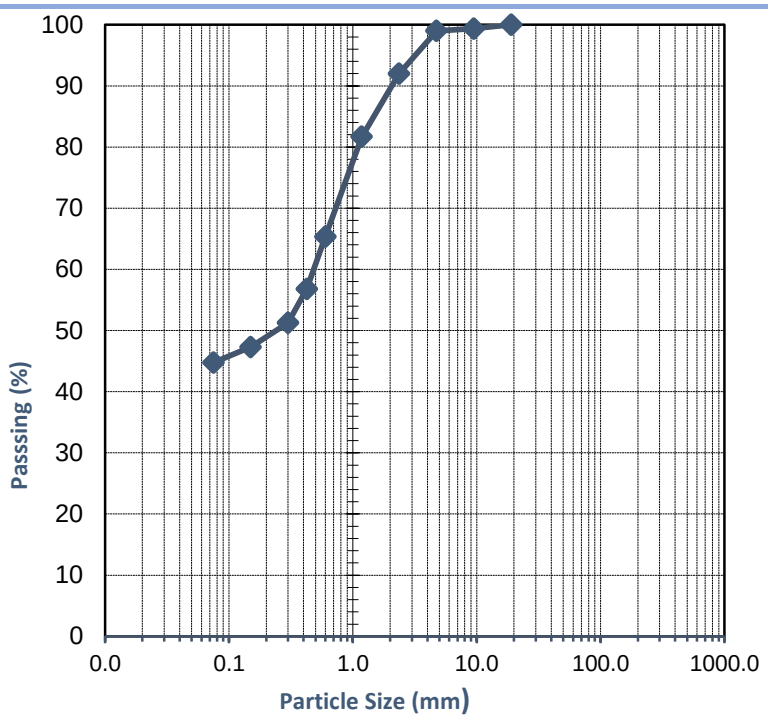
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18607_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18607
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH1 (2.5-3.5)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	100
9.5	99
4.75	99
2.36	92
1.18	82
0.600	65
0.425	57
0.300	51
0.150	47
0.075	45



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
48	26	22	7	250	-

Method of Preparation: Dry Sieved **History of Sample:** Oven Dried <50°C

Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 28/November/2023

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

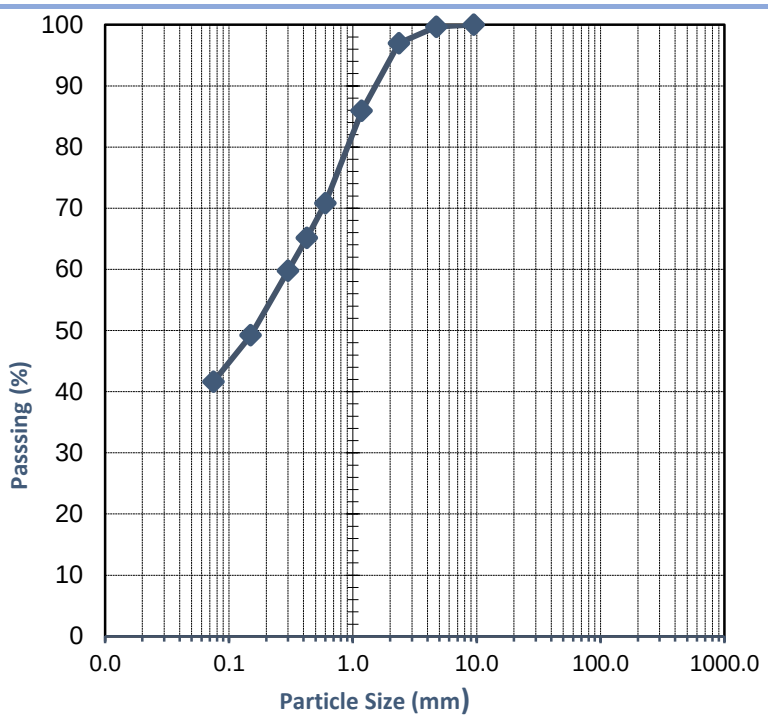
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18608_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18608
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH1 (3.5-4.5)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	97
1.18	86
0.600	71
0.425	65
0.300	60
0.150	49
0.075	42



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
55	34	21	5	250	-

Method of Preparation: Dry Sieved — History of Sample: Oven Dried <50°C

Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 28/November/2023

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

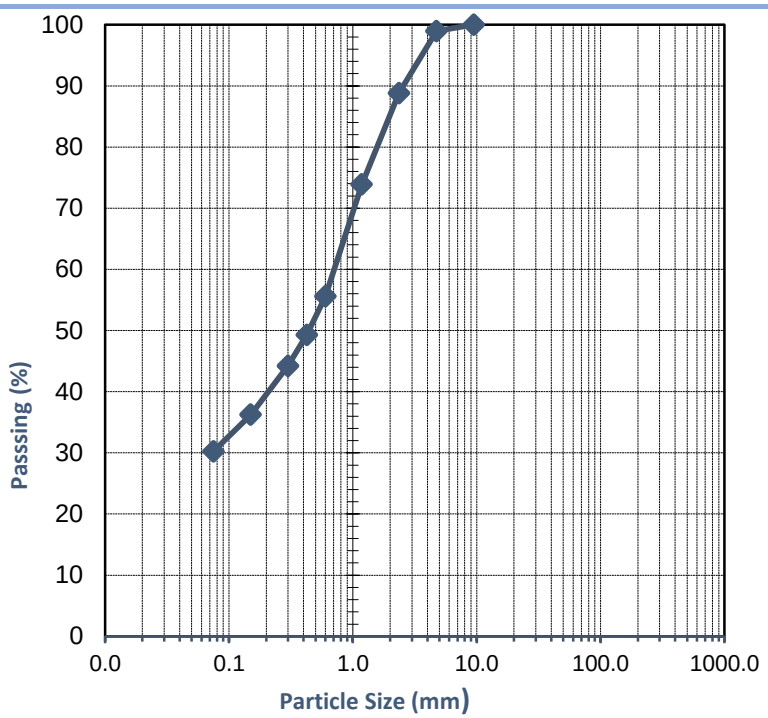
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18609_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18609
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH2 (2.5-3.5)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	
9.5	100
4.75	99
2.36	89
1.18	74
0.600	56
0.425	49
0.300	44
0.150	36
0.075	30



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
50	29	21	5	250	-

Method of Preparation: Dry Sieved — History of Sample: Oven Dried <50°C

Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 28/November/2023

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

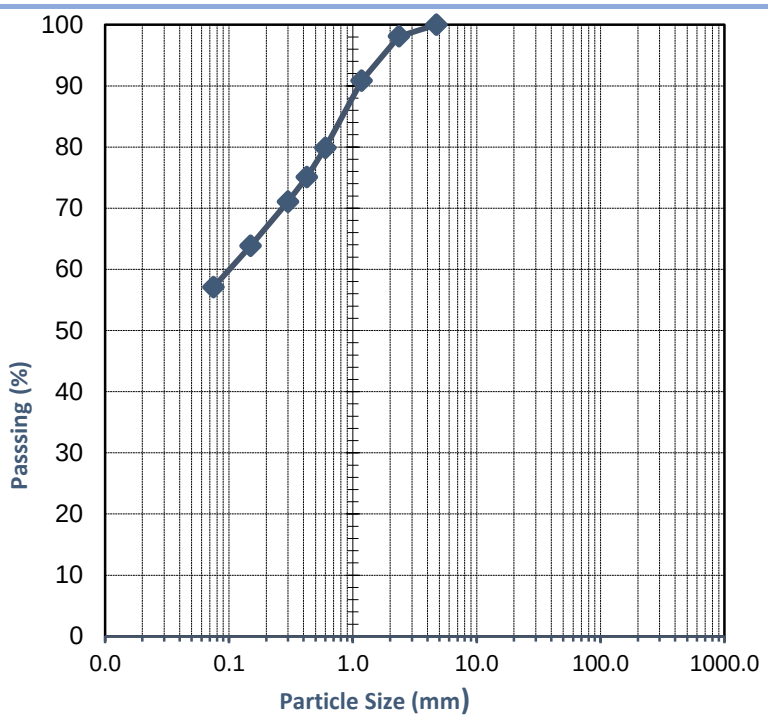
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18605_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18605
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH4 (2-3)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	
9.5	
4.75	100
2.36	98
1.18	91
0.600	80
0.425	75
0.300	71
0.150	64
0.075	57



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
55	26	29	7	250	-

Method of Preparation: Dry Sieved

History of Sample: Oven Dried <50°C

Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 28/November/2023

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

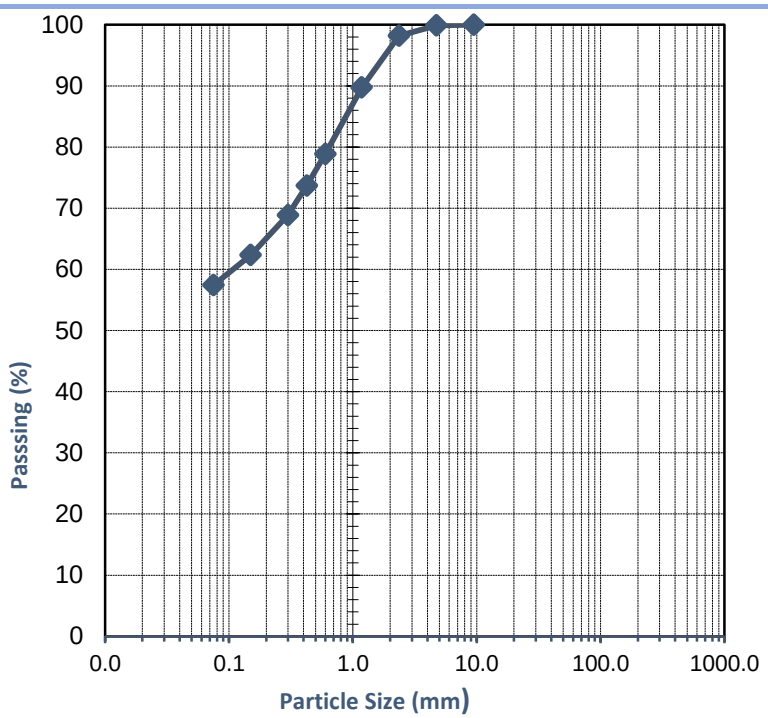
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18606_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18606
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH5 (2.5-3.5)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	98
1.18	90
0.600	79
0.425	74
0.300	69
0.150	62
0.075	57



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
48	30	18	7	250	-

Method of Preparation: Dry Sieved **History of Sample:** Oven Dried <50°C

Comments:

Approved Signatory:

Name: Cody O'Neill

Date: 28/November/2023

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WESTERN GEOTECHNICAL & Laboratory Services

SOIL | AGGREGATE | CONCRETE | CRUSHING

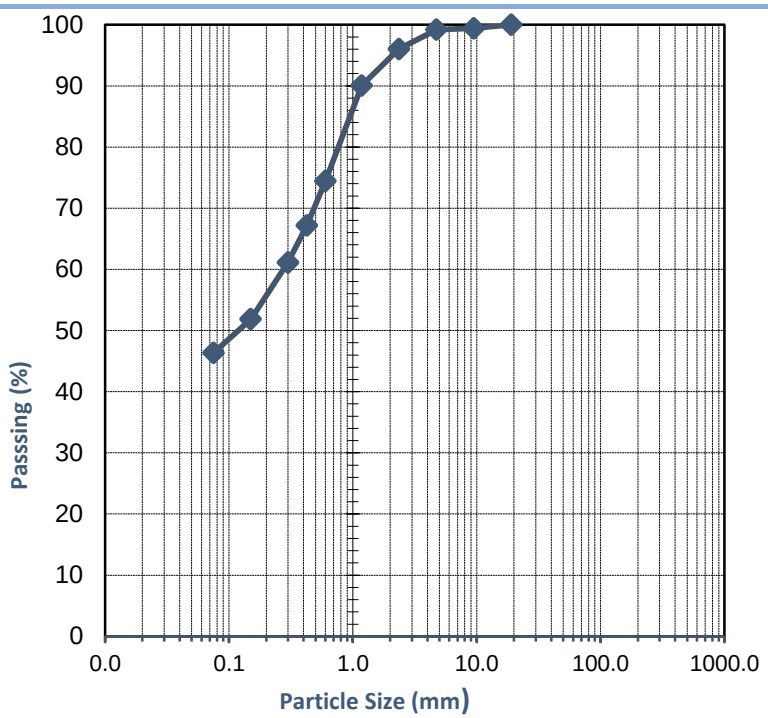
TEST REPORT - AS 1289.3.9.2, 3.2.1, 3.3.2, 3.4.1 & 3.6.1

Client:	Perth Geotechnics	*Ticket No.*	S11689
Client Address:	PO Box 165, Gosnells	*Report No.*	WG23.18604_1_PSDPI
Project:	Material Assessment	*Sample No.*	WG23.18604
Location:	28013, Great Southern Highway Katanning	*Date Sampled:*	Not Specified
Sample Identification:	BH6 (0.8-1.8)m	*Date Tested:*	23/11 - 28/11/2023

Sampling Method: **Sampled by Client, Tested as Received**

TEST RESULTS - Particle Size Distribution of Soil

Sieve Size (mm)	Percent Passing Sieve (%)
125.0	
75.0	
53.0	
37.5	
19.0	100
9.5	99
4.75	99
2.36	96
1.18	90
0.600	74
0.425	67
0.300	61
0.150	52
0.075	46



TEST RESULTS - Consistency Limits (Casagrande)

AS 1289.3.9.2	AS 1289.3.2.1	AS 1289.3.3.2	AS 1289.3.4.1		
Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Linear Shrinkage (%)	Mould Length (mm)	Condition of Dry Specimen:
32	15	17	7	250	-

Method of Preparation: Dry Sieved

History of Sample: Oven Dried <50°C

Comments:

Approved Signatory:

Name: Natasha Bielawski

Date: 28/November/2023

NATA WORLD RECOGNISED ACCREDITATION

Accreditation No. 20599
Accredited for compliance with ISO/IEC 17025 - Testing

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph +61 8 9317 2505
lab@mpl.com.au
www.mpl.com.au

Certificate of Analysis PEK1994

Client Details

Client	Perth Geotechnics
Contact	Mohammad Amzad Hossain
Address	19 Silkie Link, SOUTHERN RIVER, WA, 6110

Sample Details

Your Reference	28013 Great Southern Highway, Katanning WA
Number of Samples	4 Soil
Date Samples Received	28/11/2023
Date Instructions Received	28/11/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date Results Requested by	05/12/2023
Date of Issue	05/12/2023

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Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Authorisation Details

Results Approved By	Lien Tang, Assistant Operations Manager
Laboratory Manager	Michael Kubiak

Certificate of Analysis PEK1994

Samples in this Report

Envirolab ID	Sample ID	Depth	Matrix	Date Sampled	Date Received
PEK1994-01	BH1	2.50-3.50Meters	Soil	15/11/2023	28/11/2023
PEK1994-02	BH2	2.50-3.50Meters	Soil	15/11/2023	28/11/2023
PEK1994-03	BH5	2.50-3.50Meters	Soil	15/11/2023	28/11/2023
PEK1994-04	BH6	0.80-1.80Meters	Soil	15/11/2023	28/11/2023

Certificate of Analysis PEK1994

Inorganics - General Physical Parameters (Soil)

Envirolab ID	Units	PQL	PEK1994-01	PEK1994-02	PEK1994-03	PEK1994-04
Your Reference			BH1	BH2	BH5	BH6
Date Sampled			15/11/2023	15/11/2023	15/11/2023	15/11/2023
Depth			2.50-3.50	2.50-3.50	2.50-3.50	0.80-1.80
pH	pH units		6.4	6.2	5.0	7.4
Electrical Conductivity	µS/cm	2.0	52	140	60	110
Resistivity*	ohm m	1.0	190	74	170	94

Certificate of Analysis PEK1994

Inorganics - General Chemical Parameters (Soil)

Envirolab ID	Units	PQL	PEK1994-01	PEK1994-02	PEK1994-03	PEK1994-04
Your Reference			BH1	BH2	BH5	BH6
Date Sampled			15/11/2023	15/11/2023	15/11/2023	15/11/2023
Depth			2.50-3.50	2.50-3.50	2.50-3.50	0.80-1.80
Chloride	mg/kg	10	22	89	35	36
Sulfate	mg/kg	10	20	85	34	59

Method Summary

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode based on APHA latest edition, Method 4500-H+. Please note that the results for water analyses are indicative only, as analysis can be completed outside of the APHA recommended holding times. Solids are reported from a 1:5 water extract unless otherwise specified. Alternatively, pH is determined in a 1:5 extract using 0.01M calcium chloride or a solid is extracted at a ratio of 1:2.5 (AS1289.4.3.1), pH is measured in the extract.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soil results reported from a 1:5 Soil:Water extract unless otherwise specified. Please note Resistivity is estimated by calculation and may not correlate with results otherwise obtained using the Resistivity current method (based on AS 1289.4.4.1), depending on the nature of the soil being analysed.
INORG-081	Anions determined by Ion Chromatography. Waters samples are filtered on receipt prior to analysis. Solids are analysed from a water extract. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

Perth Geotechnics

APPENDIX – D

SITE PHOTOGRAPH

Perth Geotechnics
ABN: 78 532 814 778
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

Photo 01: Site (Proposed Solar Farm) is looking from northern side

Photo 02: Site (Proposed Solar Farm) is looking from southern side

Perth Geotechnics
ABN: 78 532 814 778
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

Photo 03: Conducting Electrical/ Soil Resistivity (ER) at ER Test 1 location by Wenner 4 Pole Method

Photo 04. Electrical/ Soil Resistivity (ER) test 1 reading at 8 m interval (N-S) direction

Perth Geotechnics
ABN: 78 532 814 778
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

Photo 05: Subsurface probing at Bore Hole (BH5) by mechanical auger

Photo 06: Soil from Bore Hole location (BH5)

Perth Geotechnics
ABN: 78 532 814 778
Tel: 08 6396 2675; M: 0430 130 677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

Photo 07: Soil from Bore Hole location (BH7)

Photo 08: Conducting Dynamic Cone Penetrometer test at DCP2 location

Perth Geotechnics

APPENDIX – E

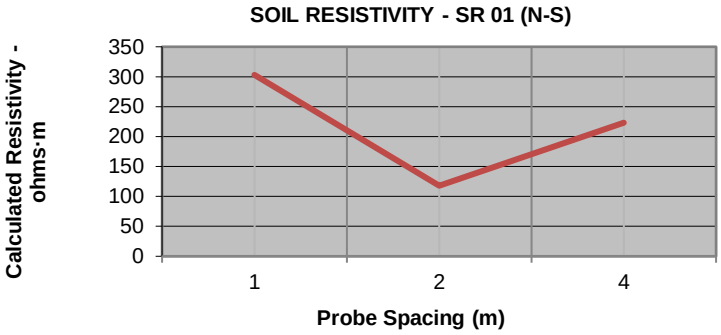
Soil Resistivity Test Certificates

SOIL RESISTIVITY TEST CERTIFICATE

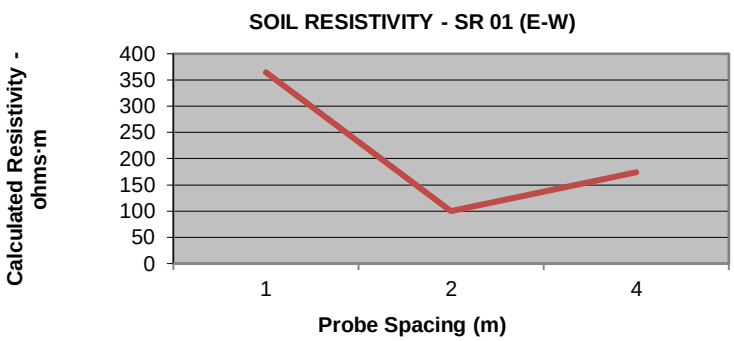
Perth Geotechnics
ABN: 74 660 182 061
Tel: 0863962675; M: 0430130677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

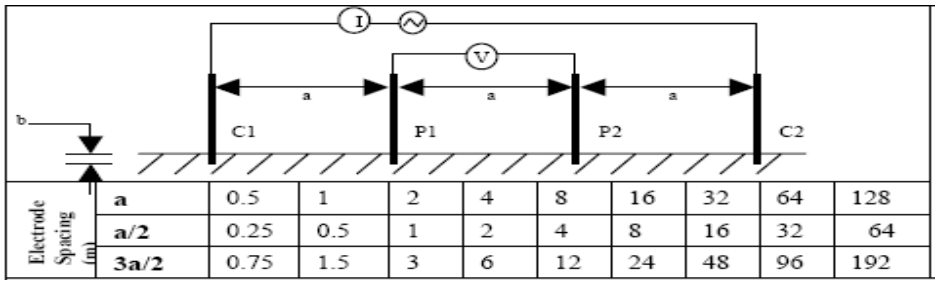
Reference	GI229723PG			Test ID	SR 01
Client	WAMMCO International			Date Tested	15-Nov-23
Project	Soil Resistivity Test			Time	11.30 am
Location	28013 Great Southern Highway, Katanning WA			Weather	Fine and Sunny
Position	Northing: 6 273 717	Easting:	50 549 042	Instrument Type	AEMC 6471 Earth Teste
Test Conducted	Surface			Tested by	MH/HA

TEST STAKE - SR 01 (N-S)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	48.23	303.038
2	150	9.379	117.86
4	150	8.87	222.9274
8	200	11.74	590.1168
16	200	10.36	1041.501

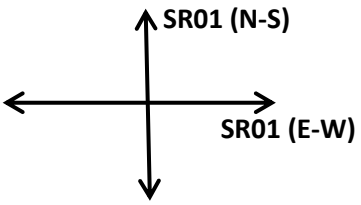


TEST STAKE - SR 01 (E-W)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	58.03	364.6132
2	150	7.962	100.0534
4	150	6.92	173.9186
8	200	9.66	485.5646
16	200	11.48	1154.095





Electrode Spacing (m)									
a	0.5	1	2	4	8	16	32	64	128
a/2	0.25	0.5	1	2	4	8	16	32	64
3a/2	0.75	1.5	3	6	12	24	48	96	192



Testing Arrays

Figure : General Arrangements of soil resistivity test

4 POLE WENNER METHOD

Soil Resistivity test was conducted in accordance with - AS/NZS 1768:2007 Lightning Protection
AS/NZS 4853 Electrical hazards on metallic pipelines
IEEE81 Guide for Measurement of Impedance and Safety Characteristics
Test was conducted in two perpendicular directions, as directed by the client.
Test spacing was: 1m, 2m, 4m, 8m and 16m

REMARKS:

Test was conducted up to 16m spacing in both directions. The test area is covered by grasses and tests were conducted on flat surface.

Prepared by: MH Date: 8/12/2023

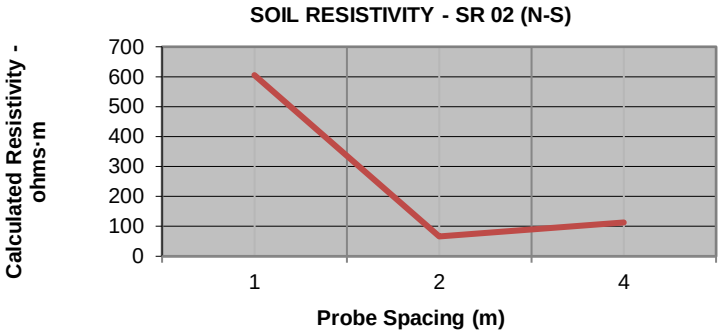
Approved by: RK Date: 8/12/2023

SOIL RESISTIVITY TEST CERTIFICATE

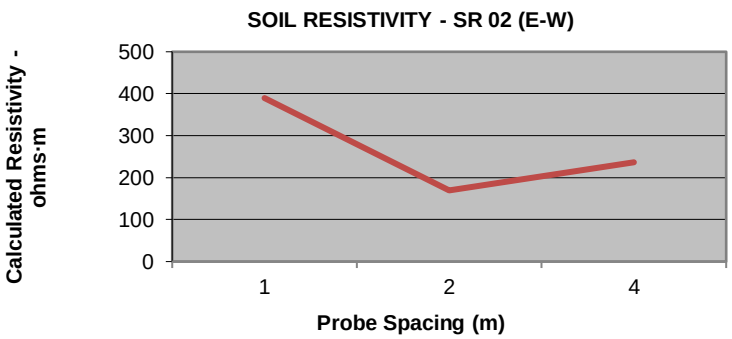
Perth Geotechnics
ABN: 74 660 182 061
Tel: 0863962675; M: 0430130677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

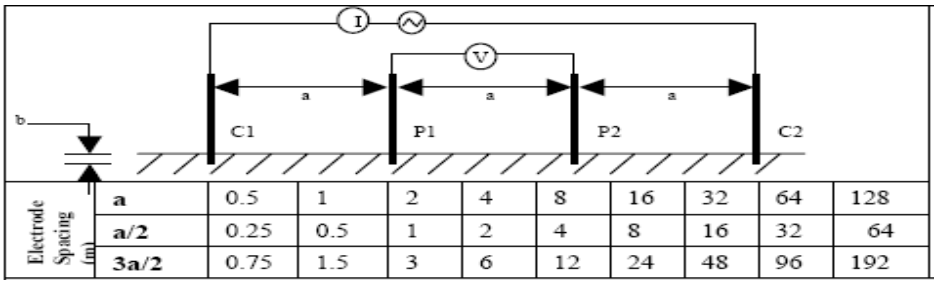
Reference	GI229723PG			Test ID	SR 02
Client	WAMMCO International			Date Tested	15-Nov-23
Project	Soil Resistivity Test			Time	12.45 pm
Location	28013 Great Southern Highway, Katanning WA			Weather	Fine and Sunny
Position	Northing: 6 273 771	Easting:	50 549 095	Instrument Type	AEMC 6471 Earth Teste
Test Conducted	Surface			Tested by	MH/HA

TEST STAKE - SR 01 (N-S)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	96.33	605.2592
2	150	5.271	66.23734
4	150	4.5	113.0973
8	200	11.2	562.9734
16	200	9.68	973.1397

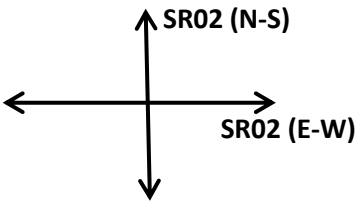


TEST STAKE - SR 01 (E-W)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	62.02	389.6832
2	150	13.5	169.646
4	150	9.44	237.2531
8	200	14.02	704.7221
16	200	27.8	2794.761





Electrode Spacing (m)									
a	0.5	1	2	4	8	16	32	64	128
a/2	0.25	0.5	1	2	4	8	16	32	64
3a/2	0.75	1.5	3	6	12	24	48	96	192



Testing Arrays

Figure : General Arrangements of soil resistivity test

4 POLE WENNER METHOD

Soil Resistivity test was conducted in accordance with - AS/NZS 1768:2007 Lightning Protection
AS/NZS 4853 Electrical hazards on metallic pipelines
IEEE81 Guide for Measurement of Impedance and Safety Characteristics
Test was conducted in two perpendicular directions, as directed by the client.
Test spacing was: 1m, 2m, 4m, 8m and 16m

REMARKS:

Test was conducted up to 16m spacing in both directions. The test area is covered by grasses and tests were conducted on flat surface.

Prepared by: MH Date: 8/12/2023

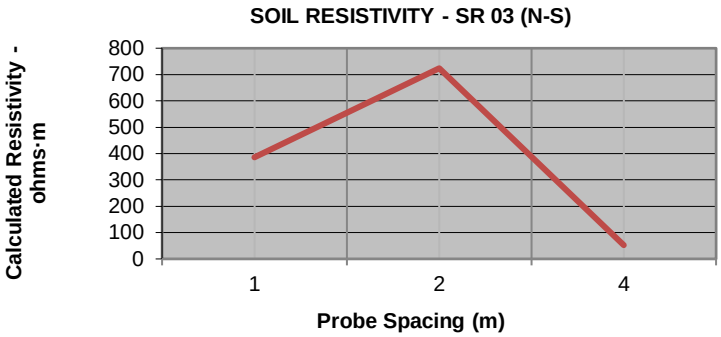
Approved by: RK Date: 8/12/2023

SOIL RESISTIVITY TEST CERTIFICATE

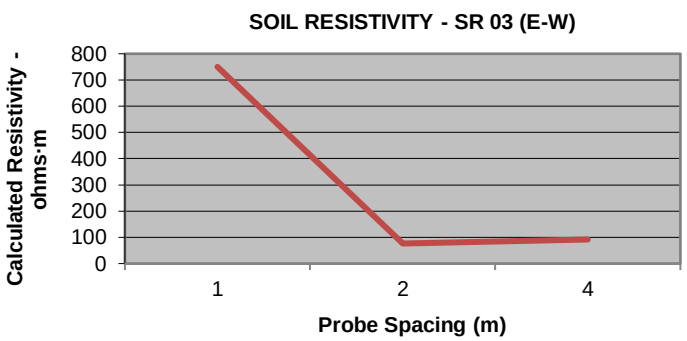
Perth Geotechnics
ABN: 74 660 182 061
Tel: 0863962675; M: 0430130677
PO Box 165, Gosnells WA 6990
E: info@perthgeotechnics.com.au
www.perthgeotechnics.com.au

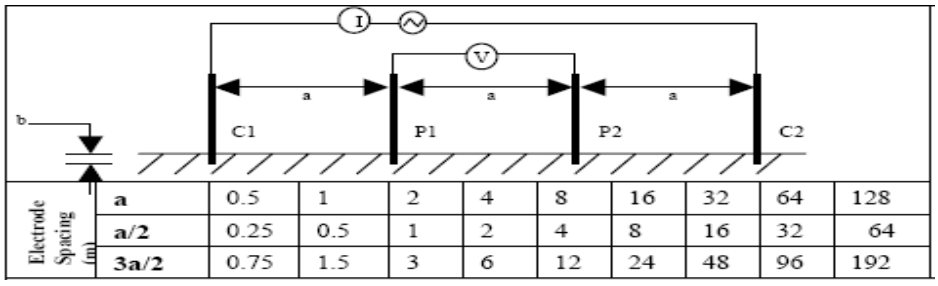
Reference	GI229723PG			Test ID	SR 03
Client	WAMMCO International			Date Tested	15-Nov-23
Project	Soil Resistivity Test			Time	1.45 pm
Location	28013 Great Southern Highway, Katanning WA			Weather	Fine and Sunny
Position	Northing: 6 273 814	Easting:	50 549 127	Instrument Type	AEMC 6471 Earth Teste
Test Conducted	Surface			Tested by	MH/HA

TEST STAKE - SR 01 (N-S)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	61.27	384.9708
2	150	57.6	723.8229
4	150	2.08	52.2761
8	200	2.49	125.1611
16	200	11.8	1186.265

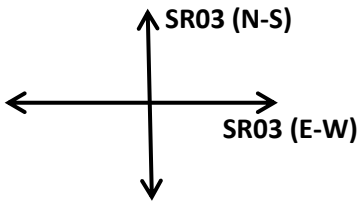


TEST STAKE - SR 01 (E-W)		R (Ω)	ρ (Ωm)
Spacing (m)	Depth (mm)		
1	150	119.4	750.2123
2	150	6.09	76.5292
4	150	3.69	92.73982
8	200	2.84	142.754
16	200	36.25	3644.247





Electrode Spacing (m)									
a	0.5	1	2	4	8	16	32	64	128
a/2	0.25	0.5	1	2	4	8	16	32	64
3a/2	0.75	1.5	3	6	12	24	48	96	192



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