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Doc GE2.2.1

GEOTECHNICAL INVESTIGATION

For: Parsons Management Group

Project Address: Lot 9007 #40 Courtney Place, Wattle Grove

Project Number: D239723

Job Number: J348962

Revision Number: 0

Date: 23/6/2020

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1. PROJECT DETAILS

1.1. Introduction

At the request of Cale Parsons of Parsons Management Group, Structerre Consulting (Structerre) have conducted a Geotechnical Investigation at Lot 9007 #40 Courtney Place, Wattle Grove. The purpose of the investigation was to provide the following:

- Desk top study including a summary of geology, groundwater, site history (obtained from historical photographs) and potential presence of Acid Sulfate Soils (ASS);
- Summary of encountered ground and groundwater conditions;
- Site Classification in accordance with AS2870;
- Earthquake site factor in accordance with AS1170.4;
- Recommendations for stormwater drainage design;
- Site preparation requirements (earthworks), including site traffic, excavation, reuse of materials and batter slopes;
- Ground bearing capacity and estimated settlements for pad and strip footings founded at 0.5m and 1.0m;
- Geotechnical design parameters for retaining structures and or deep foundations; and
- Preliminary pavement design parameter, indicative California Bearing Ratio (CBR) values determined from penetrometer results and ground conditions encountered.

This report details the scope of the geotechnical investigation, presents an interpretation of ground conditions and material properties across the site, provides geotechnical design parameters for the design of the proposed infrastructure, and evaluates the suitability of materials for use in earthworks. Interpretation of site conditions is based on the subsurface lithology revealed during the investigation programme, visual assessments of the in-situ materials and the results of in situ field tests.

Terms of reference for this investigation were presented in a Structerre Consulting proposal reference Q85883 (dated 9 June 2020), which was submitted to and accepted by Parsons Management Group.

1.2. Site Description & Proposed Development

The site is located at Lot 9007 #40 Courtney Place, Wattle Grove, City of Kalamunda. Courtmey Place lies to the south of the site, Logistics Boulevard to the west, Welshpool Road East to the north, a petrol station to the southwest and a residential property to the east.

The site is generally flat and level as is the surrounding topography. At the time of the field investigation, the site was vacant.

We understand that the site is to be used for the construction of self-storage facility.

1.3. Field Investigation – Scope of Works

The field investigation was carried out on 12 June 2020 and comprised:

- 4 x Sample Retrieval Probe boreholes to a depth of 2.5m over the site for material assessment and soil profiling;
- 4 x In situ percolation tests to determine the permeability of the materials within the upper 1.0m;
- 4 x Perth Sand Penetrometer (PSP) tests in accordance with AS 1289.6.3.3-1997 to a depth of 1.05m for evaluation of relative densities of the upper layers; and
- 3 x Dynamic Cone Penetrometer (DCP) tests in accordance with AS 1289.6.3.2 (1997) to a depth of 2.4m for evaluation of relative densities of the upper layers.

The borehole test locations are shown on the attached site plan in Appendix 1.

Suitably qualified geotechnical personnel from Structerre supervised the fieldwork and all fieldwork, interpretation and terminology used in this report are in accordance with the guidelines presented in AS1726-2017 Geotechnical Site Investigations.

2. DESK STUDY

2.1. Geological Setting

The Armadale sheet 1: 50,000 Environmental Geology Series (Part Sheets 2033 I and 2133 IV, 1986) prepared by the Geological Survey of Western Australia indicates that the following geological layers underlie the site:

- Clayey SAND (Sc) – silty in part, pale grey to brown, medium to coarse-grained, poorly sorted, subangular to rounded, frequent heavy minerals, rare feldspar, of alluvial origin (Guildford Formation Qpa);
- Sandy CLAY (Cs) – white-grey to brown, fine to coarse grained, subangular to rounded sand, clay of moderate plasticity, gravel and silt layers near scarp (Guildford Formation, Qpa).

2.2. Ground Surface and Groundwater Level

The Perth Groundwater Atlas (Waters & Rivers Commission) indicates the ground surface level at this site was approximately 13.0m Australian Height Datum (AHD).

The May 2003 groundwater level at the site was approximately 8.0m AHD and the historical maximum was indicated to be approximately 12.0m. It should be noted that the groundwater levels can vary significantly due to seasonal variation and the data from the recorded maximum levels should be used only as a guide.

2.3. Acid Sulfate Soils

Information from publicly available Landgate website indicates that the site lies within a zone of moderate to low risk of ASS occurring within 3m of natural surface.

2.4. Site History

Historical aerial photographs dating back to 1953 are publicly available through Landgate Map Viewer were assessed and a summary is presented in Table 1.

Table 1 – Historical Site Information

Date	Description
1953	The site is bushland. Welshpool Road East developed
1983	Courtney Place road developed
2000	Residential properties developed around the area
2018	Logistics Boulevard developed and site was cleared
2020	Site remains relatively unchanged to the current day

3. RESULTS OF THE INVESTIGATION

3.1. Subsurface Soil Profile

The subsurface soil profile presented below was determined from the ground conditions encountered within the boreholes and through the interpretation of the PSP and DCP test results:

Table 2 – Subsurface Soil Profile

Depth to Base of Strata (m)	Material Description
1.5	FILL: SAND (fine to medium grained), non-plastic, loose grading to very dense
Not Penetrated (>2.5m)	NATURAL: Sandy CLAY (fine to medium grained), low plasticity, trace gravel, firm grading to stiff

The soils encountered are consistent with the expected site conditions as predicted from the Environmental Geology Map. It is important to note that there may be pockets of fill on site that are deeper than that encountered by the investigation boreholes. The subsurface soil conditions encountered are presented in the bore logs, within Appendix 3.

3.2. Groundwater

Groundwater was not encountered in any of the boreholes during or immediately after drilling. However, based on the Perth Groundwater Atlas, the groundwater is expected to be encountered approximately 5.0m below the existing ground level or at 1.5m, above the more cohesive materials.

3.3. Percolation Testing

Percolation testing of the in-situ soils was undertaken in four locations. Results of the testing are summarised below:

Table 3 – In Situ Percolation Test Results

Test Location	Testing Depth	Soil Type	Permeability
BH1	0.75 - 1.0m	SAND	2.3m/day
BH2	0.75 - 1.0m	SAND	1.2m/day
BH3	0.75 - 1.0m	SAND	2.8m/day
BH4	0.75 - 1.0m	SAND	1.9m/day

3.4. Laboratory Test Results

Selected representative soil samples were tested by Structerre's in-house NATA accredited laboratory for Atterberg Limits, shrink-swell index, organic content and soil compaction. The results are attached in Appendix 4.

3.4.1. Atterberg Limits

Atterberg Limits were tested by Structerre's in-house NATA accredited laboratory. Results of the testing are summarised below:

Table 4 – Atterberg Limit Test Results

Sample	Test Hole	Depth (m)	Soil Description	Liquid Limit % AS1289 3.1.2	Plastic Limit % AS1289 3.2.1	Plasticity Index % AS1289 3.3.1	Linear Shrinkage % AS1289 3.4.1
1	BH2	1.5-2.5	Sandy CLAY trace gravel	31	13	18	6.5

Test results indicate that the natural sandy CLAY has low shrink swell capacity or degree of expansion.

4. GEOTECHNICAL CONSTRUCTION CONSIDERATIONS

4.1. Site Classification

AS 2870-2011 Residential Slabs and Footings provides guidance on site classification for residential slabs and footing design based on the expected ground surface movement and depth of expected moisture changes.

Although the proposed development falls outside the scope of AS 2870, site classification can be used to assist in the design of foundations. The foundation design should be undertaken by a Structural Engineer, taking into consideration ground bearing capacity and the acceptable total and differential settlements of the proposed foundation system.

Based on results of this investigation the site can be classified as a Class “S” provided that all unsuitable materials are removed and replaced with engineer-controlled sand fill materials in accordance with earthwork recommendations outlined in Section 4.3 in this report. The site in its current condition is classified as Class “P”.

4.2. Drainage

The site is suitable for on-site disposal of stormwater runoff subject to the proposed development. For on-site disposal of stormwater runoff, soakwells of sufficient sizes are required, and should be positioned a minimum of 1.2m or the depth of soakwell (whichever is greater) from any proposed or existing foundations (including those beyond the boundaries of the site) to minimise the risk of differential settlement.

To aid with the design of on-site stormwater drainage, groundwater levels and field permeability results are presented in Section 3 of this report.

4.3. Seismic Site Subsoil Class

The seismic subsoil site class has been assessed in accordance with AS 1170.4-2007, using the results of this investigation and published information.

Table 5 – Summary of Seismic Parameters

Hazard Factor	Site Sub-soil Class
0.09	Class Ce –shallow soil site

4.4. Earthworks

All earthworks shall be undertaken in accordance with AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments and are to include the following:

- All unsuitable materials to be stripped and removed from the site. Unsuitable materials include topsoil, uncontrolled fill, deleterious and organic materials.
- It is considered that the near surface sand materials require improvement. Therefore, it is proposed to rake to a depth of approximately 0.5m to ensure potentially unsuitable materials are removed, and the surface compacted.
- Proof compact the exposed surface. The compaction requirements are set out in the table below, as per AS 3798-2007:

Table 6 – Compaction Requirements

Item	Application	Minimum relative compaction, %	
		Minimum density ratio (Standard Compaction Effort) (Cohesive soils)	Minimum density index (Cohesionless soils)
1	Residential - lot, fill, house, sites	95	70
2	Commercial – fills to support minor loadings, including floor loading of up to 20kPa and isolated pad or strip footings to 100kPa	98	75
3	Fill to support pavements a) General fill b) Subgrade (to a depth of 0.3m)	 95 98	 70 75

- After raking and proof compaction, the exposed surface is to be inspected and approved by a representative from this office prior to backfilling. At this stage it can be assessed whether any further materials need to be removed or whether further compaction of the base is required.
- A minimum of 1.5m sand cover is to be maintained above the reactive material in order to achieve a Class “S” site with y_s 5mm.

- The ground level should be built up to design levels with imported fill, if required. The imported fill should consist of free draining sand with not more than 5% passing a 75µm sieve and be free of organic matter and other deleterious materials. The fill materials should be placed in layers not exceeding 300mm loose thickness and compacted to achieve a minimum 8 PSP blows over the interval 150 – 450mm, 9 PSP blows over the interval 450 – 750mm and 11 PSP blows over the interval 750 -1050mm.
- After remedial earthworks have been completed, the earthworks should be inspected and approved by a representative from this office.

It is considered that standard small to medium sized earthmoving equipment would be appropriate for the proposed development. The near surface ground was generally competent and should not pose an issue to site traffic movements.

The material encountered on site can be deemed as 'easy' to excavate with medium sized earthwork equipment (i.e. a 20t excavator). Should excavations be required below groundwater level, dewatering will be necessary.

4.5. Geotechnical Design Parameters

Based on the on-site observations and the PSP and DCP results, the interpreted geotechnical soil parameters of the encountered materials are presented in Table 1:

Table 7 – Soil Parameters

Soil Type	Depths (m)	Friction Angle Ø' (⁰)	Cohesion c' (kPa)	Density Y (t/m³)	Elastic Modulus E (MPa)
FILL: SAND	0 – 1.5	30	0	1.85	15
Sandy CLAY	1.5 – 2.5	28	1	1.90	22

4.6. Shallow Footings – Allowable Soil Bearing Capacities

Based on the findings of the current preliminary geotechnical investigation, shallow pad and strip footings are considered appropriate for the proposed development. Allowable bearing capacities for shallow footings at the site have been calculated under the following assumptions:

- The site preparation procedures specified in Section 4.4 have been carried out;
- The specified level of compaction has been achieved below the base of each footing;
- Loads are vertical and not eccentric;
- Isolated footings (i.e. interaction of foundations has not been considered);
- The foundations are flexible;
- A factor of safety (FoS) of 3.0 against bearing capacity failure;
- Maximum allowable settlement of 20mm.

The tables below present the allowable bearing pressures for pad and strip footings of various dimensions, with embedment depths of 0.5m and 1.0m below finished surface levels.

Table 8 – Allowable Bearing Capacities for Pad Footings

Minimum Depth of Embedment (m)	Minimum Plan Dimension (m)	Allowable Bearing Capacities (kPa)	Settlement (mm)
0.5	0.5	105	5
	1.0	125	10
	1.5	140	15
	2.0	160	25
1.0	0.5	130	5
	1.0	150	10
	1.5	170	15
	2.0	200	25

Table 9 – Allowable Bearing Capacities for Strip Footings

Minimum Depth of Embedment (m)	Minimum Plan Dimension (m)	Allowable Bearing Capacities (kPa)	Settlement (mm)
0.5	0.5	90	5
	1.0	110	15
	1.5	130	25
1.0	0.5	110	5
	1.0	140	15
	1.5	170	25

* Note: it is recommended to limit these values to 250kPa.

The recommended allowable bearing capacities are dependent on the site being dry and well drained, so that the foundation material does not become saturated.

The actual allowable bearing capacity of a particular foundation will be dependent on its location, geometry and founding depth, as well as the founding horizon. Therefore, once specific foundation geometries have been determined and the earthworks completed, it is recommended that the allowable bearing capacity and associated settlements be verified.

Additionally, should undermining issue prevent the excavation of the near surface loose materials, it is recommended that the allowable bearing capacity be reviewed. However, this will likely result in lower allowable bearing capacities.

4.7. Indicative California Bearing Ratio (CBR)

The indicative California Bearing Ratio (CBR) value of the subgrade material, following earthworks can be estimated from the site investigation results and would be appropriate for preliminary design purposes. The indicative value is shown in the below table:

Table 5 – Indicative CBR Values

Material	Indicative CBR (%)	Compaction
SAND (In situ or Imported Fill)	12	95% of MMDD*

* Implies the maximum dry density ratio using Modified compaction in accordance with AS 1289 5.2.1-2003.

For detailed design and construction of the pavements, it is recommended that the CBR values be verified with laboratory Soaked CBR testing on the anticipated subgrade material.

5. CONCLUSIONS

A site investigation was carried out at the proposed commercial development site to assess the geotechnical conditions. Parameter and design recommendations are incorporated in the body of the report. The following conclusions have been drawn from the site investigation:

- The subsurface soil profile encountered comprised loose to very dense sand fill from the surface to 1.5m and underlain by firm to stiff sandy CLAY trace gravel to the investigated depth of 2.5m.
- Groundwater or perched water was not encountered across the site to the depth of 2.5m.
- It is considered that the site is suitable for on-site drainage.
- The site can be classified as an equivalent Class “S” with y_s 5mm in accordance with AS 2870-2011 provided the recommended earthworks are undertaken
- Recommended earthworks include stripping of fill sand and unsuitable materials, excavation of loose materials, proof compaction of the base, placement of engineered fill and compaction of final level.
- Allowable bearing capacity for pad footings range from 105kPa to 200kPa and from 90kPa to 170kPa for strip footings. The estimation of settlement of the footings is limited to 20mm.

6. LIMITATION OF FIELD INVESTIGATIONS

This report has been prepared in accordance with generally accepted consulting practice for Parsons Management Group using information supplied at the time and for the project specific requirements as understood by Structerre. To the best of our knowledge the information contained in this report is accurate at the date of issue, however it should be emphasised that any changes to ground conditions and/or the proposed structures may invalidate the recommendations given herein.

The conclusions and recommendations in this report are based on the site conditions revealed through selective point sampling, representing the conditions of the site in total, although the area investigated represents only a small portion of the site. The actual characteristics may vary significantly between successive test locations and sample intervals other than where observations, explorations and investigations have been made.

The materials and their geotechnical properties presented in this report may not represent the full range of materials and strengths that actually exist on site and the recommendations should be regarded as preliminary in nature. Allowances should be made for variability in ground conditions and any consequent impact on the development. Structerre accepts no responsibility and shall not be liable for any consequence of variations in ground conditions.

If ground conditions encountered during construction are different to that described in this report, this office should be notified immediately.

For and behalf of

STRUCTERRE CONSULTING

Margie Mortera
Geotechnical Assistant

Checked By: David Harding
Employee Title: Geotechnical Supervisor

Authorised By: Luke Young
Employee Title: Geotechnical Engineer
BEng Civil (Hons)

Disclaimer
This report is at the request of the addressee and no liability is accepted by Structerre Consulting to any third person reading or relying upon the report, not withstanding any rule of law and/or equity to the contrary and that this report is strictly confidential and intended to be read and relied upon only be the addressee.

Job #	Revision	Authored	Checked	Authorised
J348962	0	MM	DH	LY

7. REFERENCES

Department of Water – Perth Groundwater Atlas

Geological Survey of Western Australia 1:50,000 Environmental Geology Series

AS 1170.4-2007 Structural design actions – Earthquake actions in Australia

AS 1289.3.1.2-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the liquid limit of a soil

AS 1289.3.2.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the plastic limit of a soil

AS 1289.3.3.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Calculation of the plasticity index of a soil

AS 1289.3.4.1-2009 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the linear shrinkage of a soil

AS 1289.6.3.2-1997 Methods of testing soils for engineering purposes – Soil strength and consolidation tests – Determination of the penetration resistance of a soil – 9kg dynamic cone penetrometer test

AS 1289.6.3.3-1997 Methods of testing soils for engineering purposes – Soil strength and consolidation tests – Determination of the penetration resistance of a soil – Perth sand penetrometer test

AS 1726-2017 Geotechnical site investigation

AS 2870-2011 Residential slabs and footings

AS 3798-2007 Guidelines on earthworks for commercial and residential developments

AS 4055-2012 Wind loads for housing

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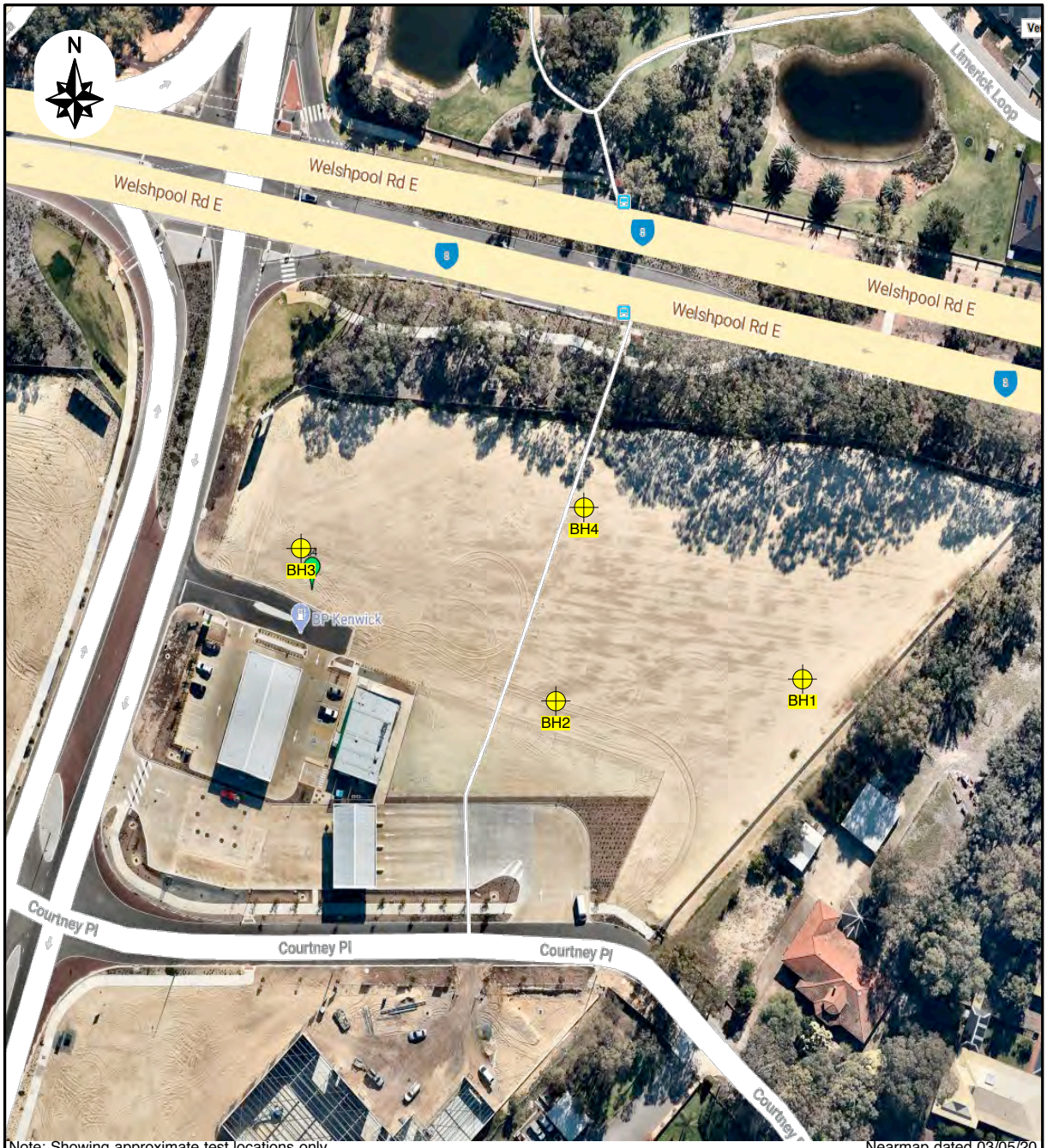
PROJECT No: D239723
JOB No: J348962
PROJECT ADDRESS: Lot 9007 #40 Courtney Place, Wattle Grove
CLIENT: Parsons Management Group

APPENDIX 1 – SITE LOCATION MAP



Note: Showing approximate test locations only

Nearmap dated 03/05/20

LEGEND

BH Borehole

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PROJECT #:	D239723
JOB #:	J348962
CLIENT:	**Parsons Management Group**
SCALE:	NTS
TITLE:	Geotechnical Investigation Site Plan
DATE:	12 Jun '20
DRAWN BY:	MM
CHECKED BY:	DH

DOC: GE:3.001

PROJECT No: D239723
JOB No: J348962
PROJECT ADDRESS: Lot 9007 #40 Courtney Place, Wattle Grove
CLIENT: Parsons Management Group

APPENDIX 2 – SITE PHOTOS

PHOTO 1

PHOTO 2

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PROJECT #:	D239723
JOB #:	J348962
CLIENT:	**Parsons Management Group**
SCALE:	NTS
TITLE:	Site Photographs
DATE:	12 Jun '20
DRAWN BY:	MM
CHECKED BY:	DH

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PROJECT No: D239723
JOB No: J348962
PROJECT ADDRESS: Lot 9007 #40 Courtney Place, Wattle Grove
CLIENT: Parsons Management Group

APPENDIX 3 – BORELOGS

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Project Lot 9007 #40 Courtney Place, Wattle Grove

Client Parsons Management Group

Test No. **BH01**

Project No.	D239723	**Logged By**	Tony Broadway	**Machine**	Hand Auger	**Easting**	403872
Job No.	J348962	**Date**	12/06/2020	**Hole Dia.**	65mm	**Northing**	6458454

Depth	Graphic	Stratum Description	Consistency	PSP Blows/300mm (4 8 12 16)	Samples Depth	Samples Type	Moisture	Water Level
0		SP: SAND: fine to medium grained, non-plastic, pale brown (FILL)	L				D	
			D					
			VD					
1								
		SP: Gravelly SAND: fine to medium grained, non-plastic, brown (Guildford Formation)						
2		Terminated at 2.50 m						
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Lot 9007 #40 Courtney Place, Wattle Grove

Client Parsons Management Group

Test No. **BH02**

Project No.	D239723	**Logged By**	Tony Broadway	**Machine**	Soil Retrieval Probe	**Easting**	
Job No.	J348962	**Date**	12/06/2020	**Hole Dia.**	65mm	**Northing**	

Depth	Graphic	Stratum Description	Consistency	PSP Blows/300mm (4 8 12 16)	Samples Depth	Samples Type	Moisture	Water Level
0		SP: SAND: fine to medium grained, non-plastic, pale brown (FILL)	L				D	
			D - VD					
1					1.5 - 2.5	T		
		CL: Sandy CLAY: fine to medium grained, low plasticity, trace gravel, brown (Guildford Formation)	F-St					
2		Terminated at 2.50 m						
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: As indicated
4. Co-ordinate system: WGS 84

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Project Lot 9007 #40 Courtney Place, Wattle Grove

Client Parsons Management Group

Test No. **BH03**

Project No.	D239723	**Logged By**	Tony Broadway	**Machine**	Soil Retrieval Probe	**Easting**	
Job No.	J348962	**Date**	12/06/2020	**Hole Dia.**	65mm	**Northing**	

Depth	Graphic	Stratum Description	Consistency	PSP Blows/300mm (4 8 12 16)	Samples Depth	Samples Type	Moisture	Water Level
1		SP: SAND: fine to medium grained, non-plastic, pale brown (FILL)	D - VD				D	
2		CL: Sandy CLAY: fine to medium grained, low plasticity, trace gravel, brown (Guildford Formation)	F-St					
		Terminated at 2.50 m						
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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Project Lot 9007 #40 Courtney Place, Wattle Grove

Client Parsons Management Group

Test No. **BH04**

Project No.	D239723	**Logged By**	Tony Broadway	**Machine**		**Easting**	
Job No.	J348962	**Date**	12/06/2020	**Hole Dia.**	65mm	**Northing**	

Depth	Graphic	Stratum Description	Consistency	PSP Blows/300mm (4 8 12 16)	Samples Depth	Samples Type	Moisture	Water Level
1		SP: SAND: fine to medium grained, non-plastic, pale brown (FILL)	D - VD				D	
2		CL: Sandy CLAY: fine to medium grained, low plasticity, trace gravel, brown (Guildford Formation)	St					
		Terminated at 2.50 m						
3								

Remarks

1. Termination reason: Target depth
2. Hole stability:
3. Samples taken: None
4. Co-ordinate system: WGS 84

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PROJECT No: D239723
JOB No: J348962
PROJECT ADDRESS: Lot 9007 #40 Courtney Place, Wattle Grove
CLIENT: Parsons Management Group

APPENDIX 4 – LABORATORY TEST RESULTS

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Sample No.	**33741**	**Client**	Geotechnical
Job No.	J348962	**Project**	Lot 9007, #40 Courtney Pl, Wattle Grove

Laboratory testing carried out at Balcatta Laboratory 1 Erindale Rd, Balcatta WA 6021

SAMPLE DETAILS

BH No. / Depth : BH2 1.5-2.5m
Sample History : 50°C Oven Dried

Sampling Method
Sample Preparation

Client
AS 1289 1.1

ATTERBERG LIMITS

Description	Method	Result (%)
Liquid Limit	AS 1289.3.1.2	31
Plastic Limit	AS 1289.3.2.1	13
Plasticity Index	AS 1289.3.3.1	18
Linear Shrinkage	AS 1289.3.4.1	6.5
Nature of Shrinkage		flat

PARTICLE SIZE DISTRIBUTION

Method: AS 1289.3.6.1
Description: Particle size distribution by sieve analysis

Sieve Size (mm)	% Passing
19.0	100
2.36	91
0.425	78
0.075	54

AS 1726:2017 Clause 6.1
Material Description: Sandy CLAY trace gravel
AS Group Symbol: CL or OL

Accredited for compliance with ISO/IEC 17025
NATA
WORLD RECOGNISED ACCREDITATION
STRUCTERRE CONSULTING ENGINEERS BALCATTA LABORATORY ACCREDITATION NUMBER 18742

Wayne Rozmianiec
Laboratory Manager

Date: 22-Jun-20

Soils Analysis Workbook V 3.32 28-Apr-20

AS 1289.3.6.1 Report Feb 18

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PROJECT No: D239723
JOB No: J348962
PROJECT ADDRESS: Lot 9007 #40 Courtney Place, Wattle Grove
CLIENT: Parsons Management Group

APPENDIX 5 – BORELOG TERMINOLOGY

STRUCterre consulting engineers

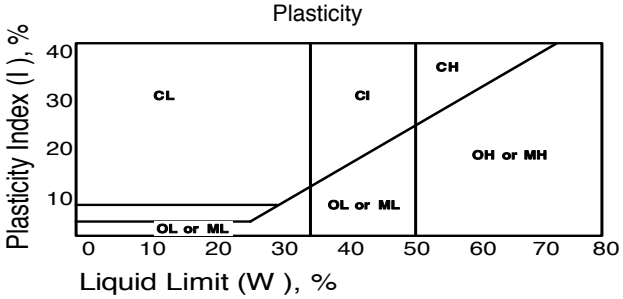
Residential Geotechnical Commercial & Infrastructure
Inspect & Investigate Energy Assessment Environmental

BORELOG TERMINOLOGY

Particle Size Distribution

Major Division	Subdivision	Size
Boulders		>200mm
Cobbles		200 - 63mm
Gravel	Coarse	63 - 20mm
	Medium	20- 6mm
	Fine	6 - 2.36mm
Sand	Coarse	2.36 - 0.6mm
	Medium	0.6 - 0.2mm
	Fine	0.2 - 0.075mm

Plasticity



Consistency of Cohesive Soils

Term	Undrained Strength Su (kPa)	Field Guide
Very Soft	< 12	Exudes between the fingers when squeezed in hand
Soft	12 - 25	Can be moulded by light finger pressure
Firm	25 - 50	Can be moulded by strong finger pressure
Stiff	50 - 100	Cannot be moulded by Fingers. Can be indented by thumb.
Very Stiff	100 - 200	Can be indented by thumb nail
Hard	> 200	Can be indented with difficulty by thumb nail.
Friable	-	Crumbles or powders when scraped by thumbnail

Consistency/Density of Non-Cohesive Soils

Term	Density Index (%)	SPT "N" Value Comparison
Very Loose	< 15	0 - 4
Loose	15 - 35	4 - 10
Medium Dense	35 - 65	10 - 30
Dense	65 - 85	30 - 50
Very Dense	> 85	> 50

Moisture Content

D	Dry
M	Moist
W	Wet
S	Saturated

Minor Components

Term	Assessment Guide	Proportion of Minor Component In:
Trace	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component	Coarse grained soils: < 5 % Fine grained soils: <15%
With	Presence easily detected by feel or eye, soil properties little different to general properties of primary component	Coarse grained soils: 5 - 12 % Fine grained soils: 15 - 30%

Soil Legend

FILL	CLAY	GRAVEL	CONCRETE
TOPSOIL	SILT	LIMESTONE	COMBINATIONS
PEAT	SAND	BEDROCK	eg: Clay, Silty, Sandy

USCS

GW	Well graded gravel	SC	Clayey sand	OL	Organic low plasticity silt	CL	Low plasticity clay
GP	Poorly graded gravel	SM	Silty sand	ML	Low plasticity silt	CI	Intermediate plasticity clay
SW	Well graded sand			MH	High plasticity silt	CH	High plasticity clay
SP	Poorly graded sand			OH	Organic high plasticity silt	PT	Peat

DOC:GE:3.003

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