Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Officer South Retarding Basins
Officer South

Prepared for
Jacobs Group (Australia) Pty Ltd

Project: 217545.00
15 May 2023

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
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Reviewer		15 May 2023

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Douglas Partners
Geotechnics / Environment / Groundwater

Table of Contents

Report on Factual Geotechnical Investigation
Officer South Retarding Basins
Officer South

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for proposed retarding basins to be constructed at Officer South. The investigation was commissioned by Stephen Sonnenberg of Jacobs Group (Australia) Pty Ltd (Jacobs) and was undertaken in general accordance with Douglas Partners' proposal 217545.00.P.001.Rev0 dated 25 August 2022 and variation proposal 217545.00.P.002.Rev.0 dated 2 March 2023.

The aim of the investigation was to assess the subsurface conditions at 26 No. nominated test locations provided by Jacobs spread over multiple sites. Details of the field work and collected data are presented in this factual report.

2. Site Description

The project areas were generally spread over multiple sites within a 2 km radius situated within farmland / paddocks. A site plan is presented in Appendix B.

At the time of the site investigation, the ground surface was grass covered and used for cattle grazing. Based on available contour data, the general topography of the land appears to be sloping downwards from the north towards the south east portion of the site. The ground surface level over the north-western corner was at about RL 32 m (AHD), the north-eastern corner was at about RL 23 m (AHD) and the southern eastern corner was at about RL 12 m (AHD).

3. Scope of Work

The field work was undertaken over two separate mobilisations; 23 - 30 January 2023 and 27 - 30 March 2023, and comprised the following:

- Drilling of 8 boreholes to a maximum depth of 8.5 m; and
- Excavation of 18 test pits to depths of 3 m, with dynamic cone penetrometer testing adjacent to each test pit location to depths ranging from 2 m to 3 m.

The borehole and test pit locations are shown on Drawing 1 in Appendix B. TP05 toTP08, TP19, BH03 and BH06 were cancelled from the scope of works.

The boreholes (BH01 & BH02, BH04 & BH05, BH07 to BH10) were drilled using a track mounted drilling rig (Geoprobe 7822 DT) owned and operated by Supreme Drilling under DP's supervision to target depths of approximately 8 m below the existing surface level. Drilling was carried out using solid flight augering techniques with standard penetration tests (SPTs) and push-tube samples (U63) collected at regular intervals.

Slotted PVC standpipes were installed at boreholes BH04, BH07, BH09 and BH10 to allow the measurement of groundwater levels (construction details are shown on the logs in Appendix B). The standpipes were finished with steel covers mounted flush with the ground surface. The standpipes were purged to remove any residual drilling fluids following installation.

The boreholes without standpipes were backfilled with the drill cuttings and the surface reinstated to a similar condition to the surrounding ground.

The test pits (TP01 to TP04, TP09 to TP18 and TP20 to TP23) were excavated using an 8 tonne backhoe (Terex 860 Elite). The backhoe was equipped with a 600 mm wide toothed bucket. Disturbed samples were recovered from the test pits for visual classification and selected laboratory testing. On completion, the test pits were backfilled with the excavated spoil, progressively placed and tamped using the excavator bucket.

Ground conditions encountered in the boreholes and test pits were logged in general accordance with AS 1726 by an experienced geotechnical engineer from DP.

Dynamic cone penetrometer (DCP) tests were carried out adjacent to the test pits in accordance with AS 1289.6.3.2, to assess the consistency / strength profile of the shallow soils. In this test, a 1000 mm length of 16 mm diameter steel rod with a 20 mm diameter cone tip was driven into the ground by successively dropping a 9 kg hammer through a height of 510 mm. Blow counts were recorded for each 100 mm penetration, or until effective refusal, defined as 15 blows over less than 100 mm.

The tests were established in the field using a DGPS unit and site features. The coordinates and ground surface levels at the test locations were assessed using the DGPS, which has typical accuracy of 0.1 m horizontally and 0.3 m vertically depending on satellite coverage, and should be considered approximate only. The coordinates are expressed in metres east and north (UTM, Zone 55H) relative to MGA94, and ground surface levels are referenced to Australian Height Datum (AHD). Both are shown on the test pit and borehole logs in Appendix B.

The field work was supervised at all times by a suitably experienced geotechnical engineer from Douglas Partners who was responsible for client liaison, field work co-ordination, logging of the strata encountered, and handling of the samples collected.

4. Field Work Results

4.1 Subsurface Conditions and Ground Model

Details of the sampling, in-situ testing and description of the conditions encountered at the test locations are presented on the logs in Appendix C. The logs should be read in conjunction with the notes '*About this Report*' and accompanying explanatory notes contained in Appendix A.

The subsurface conditions encountered at the test locations generally comprised a layer of topsoil, overlying sand and clay natural soils.

The encountered ground conditions at the test locations are summarised in Table 1.

Table 1: Summary of Subsurface Conditions at Test Locations

Depth Range of Geological Unit (m)			
Test Location	Unit 1	Unit 2a (Alluvial)	Unit 2b (Alluvial)
	TOPSOIL	Sandy SILT / Clayey SILT / Silty SAND	Sandy CLAY / Silty CLAY / Clayey SAND
BH01	0 - 0.1	0.1 – 0.5	0.5 – 8.45 LOI
BH02	0 - 0.1	0.1 - 0.5	0.5 – 7.95 LOI
BH04	0 - 0.1	-	0.1 – 8.45 LOI
BH05	0 - 0.1	-	0.1 – 8.45 LOI
BH07	-	0.0 - 0.7	0.7 – 8.45 LOI
BH08	0 - 0.1	0.1 - 0.4	0.4 – 8.45 LOI
BH09	0 - 0.1	0.1 - 0.5	0.5 – 8.45 LOI
BH10	0 - 0.3	-	0.3 – 8.45 LOI
TP01	0 - 0.1	0.1 - 0.5	0.5 - 3.0 LOI
TP02	0 - 0.1	0.1 - 0.4	0.4 - 3.0 LOI
TP03	0 - 0.1	0.1 - 0.5	0.5 - 3.0 LOI
TP04	0 - 0.1	0.1 - 0.4	0.4 - 3.0 LOI
TP09	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP10	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP11	0 - 0.1	0.1 – 0.4	0.4 – 3.0 LOI
TP12	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP13	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP14	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI

Table 1: Summary of Subsurface Conditions at Test Locations (Continued…)

Test Location	Depth Range of Geological Unit (m)		
	Unit 1	Unit 2a (Alluvial)	Unit 2b (Alluvial)
	TOPSOIL	Sandy SILT	Sandy CLAY / Sandy CLAY / Clayey SAND
TP15	0 - 0.1	0.1 – 0.6	0.5 – 3.0 LOI
TP16	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP17	0 - 0.1	0.1 – 0.6	0.6 – 3.0 LOI
TP18	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP20	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP21	0 - 0.1	NE	0.1 – 3.0 LOI
TP22	0 - 0.1	0.1 – 0.5	0.5 – 3.0 LOI
TP23	0 - 0.05	NE	0.05 – 3.0 LOI

Notes:

NE: not encountered

LOI: limit of investigation

4.2 Groundwater Observations

Groundwater / water seepage was observed between depths of 3.0 m and 8.0 m at the borehole locations whilst drilling. Groundwater was not encountered in the test pit excavations. Groundwater observations made whilst drilling are noted in the respective borehole logs in Appendix C.

Standpipes were installed at boreholes at boreholes BH04, BH07, BH09 and BH10 to enable future measurements of groundwater levels. The standpipes were purged on the day of the install. The details of the standpipes are shown on logs in Appendix C. It is noted that DP were not required to dip the wells and Jacobs would undertake future monitoring of groundwater levels.

It should be noted that groundwater levels are affected by factors such as climatic conditions and land usage and will therefore fluctuate with time.

5. Laboratory Testing

5.1 Geotechnical Soil Testing

Selected samples of soil recovered from the test pits and boreholes were submitted to Douglas Partners' NATA accredited laboratory in Melbourne for testing and the results can be found in the Tables below.

Table 2: Results of Laboratory Testing - Atterberg Limits

Bore / Test Pit	Depth (m)	Description	FMC (%)	LL (%)	PL (%)	PI (%)
TP01	0.50-0.70	Silty CLAY	29.8	75	22	53
TP18	0.60-0.80	Silty CLAY	24.2	68	19	49
BH01	6.13-6.58	Clayey SAND	13.8	32	13	19
BH01	8.00-8.45	Silty CLAY	27.7	66	22	44
BH02	0.50-2.50	Silty CLAY	18.6	52	16	36
BH02	1.23-1.68	Sandy silty CLAY	15.9	47	14	33
BH02	6.00-6.45	Sandy silty CLAY	14.5	39	12	27
BH09	8.00-8.45	Silty CLAY	20.7	55	17	38
BH04	3.5-3.95	Silty CLAY	16.8	42	13	29
BH05	2-2.45	Sandy CLAY	15.1	39	13	26
BH07	6.5-6.95	Silty CLAY	24.8	57	18	39
TP11	0.2-0.4	Sandy SILT	4.5	19	17	2
TP20	0.3-0.5	Sandy SILT	5.2	25	16	9

Notes:
FMC - Field Moisture Content
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index

Table 3: Results of Laboratory Testing - Gradings

Bore / Test Pit	Depth (m)	Description	Gravel (%)	Sand (%)	Silt and clay (%)
TP01	0.50-0.70	Silty CLAY trace sand	0	14	86
TP18	0.60-0.80	Silty CLAY trace sand	0	14	86
BH01	6.13-6.58	Clayey SAND	0	72	28
BH01	8.00-8.45	Silty CLAY trace sand	0	5	95
BH02	0.50-2.50	Silty CLAY with sand	0	28	72

Table 3: Results of Laboratory Testing – Gradings (Continued…)

Bore / Test Pit	Depth (m)	Description	Gravel (%)	Sand (%)	Silt and clay (%)
BH02	1.23-1.68	Sandy silty CLAY	0	35	65
BH02	6.00-6.45	Sandy silty CLAY trace gravel	1	69	30
BH09	8.00-8.45	Silty CLAY with sand	0	24	76

Table 4: Triaxial Permeability Results

Bore	Depth (m)	Description	Coefficient of Permeability (m/s)
BH01	6.0-6.13	Clayey SAND	2×10^{-10}
BH09	3.5-3.90	Silty CLAY	1×10^{-10}

Table 5: Triaxial Compression Results

Bore	Depth (m)	Description	Cell Pressure (kPa)	Maximum Deviator Stress (kPa)	Undrained Shear Strength (kPa)
BH01	2.0-2.4	Silty CLAY	40	211	106
BH02	1.0-1.23	Silty CLAY	20	173	87

Table 6 Results of Laboratory Testing - CBR and Standard Compaction

Bore / Test Pit	Depth (m)	Description	FMC (%)	OMC (%)	CBR (%)	Percentage Swell (%)
TP01	0.5-0.7	Silty CLAY	29.2	28.0	3.0	0.5
TP11	0.2-0.4	Sandy SILT	5.4	14.0	11.0	0.5
TP18	0.6-0.8	Silty CLAY	24.2	23.0	2.5	2.0
BH02	0.5-2.5	Silty CLAY	18.3	17.0	2.5	1.5

Notes:
FMC - Field Moisture Content
OMC - Optimum Moisture Content (Standard)
CBR - California Bearing Ratio

Table 7: Results of Laboratory Testing - Emerson Class

Bore / Test Pit	Depth (m)	Description	Emerson Class No
TP01	0.5-0.7	Silty CLAY	1
BH02	0.5-2.5	Silty CLAY	2
TP09	0.3-0.5	Silty CLAY	2
TP11	0.2-0.4	Sandy SILT	2
TP14	0.3-0.5	Silty CLAY	2
TP18	0.6-0.8	Silty Clay	2
TP20	0.3-0.5	Sandy SILT	3
TP23	0.3-0.5	Silty CLAY	3

Notes:
Emerson Class No (AS 1289.3.8.1)

Detailed laboratory reports are included in Appendix D.

5.2 Aggressivity Testing

Testing for aggressivity and salinity included pH, chloride and sulfate. The results are summarised in Table 6 below.

Detailed laboratory reports are included in Appendix D.

Table 6: Results of Laboratory Testing for Soil Aggressivity

Test Location	Depth (m)	Exposure Classification			
		Concrete		Steel	
		pH	SO_4 (mg/kg)	pH	Cl (mg/kg)
TP01	0.5-0.7	6.2	210	6.2	330
BH02	0.5	5.7	120	5.7	130
TP18	0.6-0.8	5.6	230	5.6	39
TP14	0.3-0.5	6.0	33	6.0	21
TP20	0.3-0.5	6.7	10	6.7	<10
TP23	0.3-0.5	5.3	20	5.3	10
TP11	0.2-0.4	5.9	26	5.9	27

6. Limitations

Douglas Partners (DP) has prepared this report for this project at Officer South in accordance with DP's proposal dated 25 August 2022 and acceptance received from Jacobs. The work was carried out under Jacobs Subcontract Terms and Conditions. This report is provided for the exclusive use of Jacobs Group (Australia) Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Douglas Partners Pty Ltd

Appendix A

About this Report
Notes on Sampling Methods
Notes on Soil Descriptions
Notes on Symbols & Abbreviations

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Symbols & Abbreviations

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

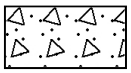
Symbols & Abbreviations

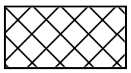
Graphic Symbols for Soil and Rock

General

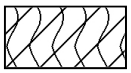

Asphalt

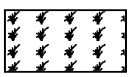

Road base

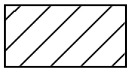

Concrete

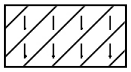

Filling

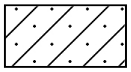
Soils


Topsoil

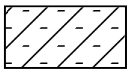

Peat

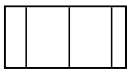

Clay

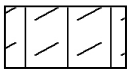

Silty clay

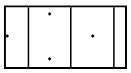

Sandy clay

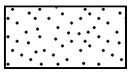

Gravelly clay

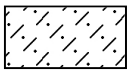

Shaly clay

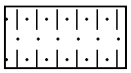

Silt


Clayey silt


Sandy silt

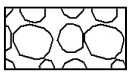

Sand

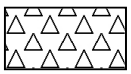

Clayey sand


Silty sand


Gravel

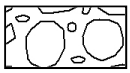

Sandy gravel


Cobbles, boulders

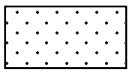

Talus

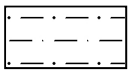
Sedimentary Rocks

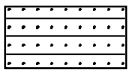

Boulder conglomerate

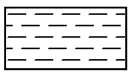

Conglomerate


Conglomeratic sandstone

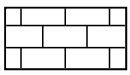

Sandstone


Siltstone

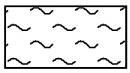

Laminite

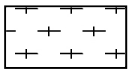

Mudstone, claystone, shale

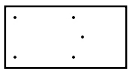

Coal


Limestone

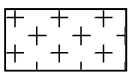
Metamorphic Rocks

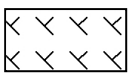

Slate, phyllite, schist

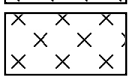

Gneiss

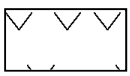

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawings

Site Locality

Name	Easting	Northing	Elevation (m AHD)
BH01	358693.4	5784144	32.6
BH02	359901.2	5783959	28.3
BH04	358697.7	5783360	29.8
BH05	359609.3	5783244	26.8
BH07	358976.6	5782665	26.1
BH08	361584.6	5782226	17.8
BH09	359645	5781875	21.5
BH10	361170.3	5780667	12.4
TP01	358656.8	5784084	32.5
TP02	358711	5784000	31.9
TP03	359931.8	5784096	29.0
TP04	359797.8	5783848	28.7
TP09	358679.4	5783435	30.4
TP10	358796.7	5783352	29.5
TP11	359474.1	5783271	27.6
TP12	359706.9	5783298	26.8
TP13	358894	5782690	26.4
TP14	359046.7	5782590	25.9
TP15	359589	5782116	22.2
TP16	359749.5	5782073	21.6
TP17	359518.2	5781986	22.0
TP18	359733.4	5781781	21.1
TP20	361553.7	5782394	17.9
TP21	361375.5	5782264	18.1
TP22	361245.8	5780814	13.1
TP23	361109.1	5780912	13.4

Coordinates are relative to MGA94 zone 55H

DP is not a registered surveyor, hence coordinates and elevations are approximate

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Jacobs Group (Australia) Pty Ltd		
OFFICE: Melbourne	DRAWN BY: GL	
SCALE: 1:15,000	DATE: May 2023	

TITLE: Test Location Plan

Officer South Retarding Basins
Officer South

N
MGA

PROJECT:	217545.00
DRAWING No:	1
REVISION:	0

Appendix C

Borehole Logs
Test Pit Logs

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 32.6 mAHD
EASTING: 358693
NORTHING: 5784144
DIP/AZIMUTH: 90°/--

BORE No: BH 01
PROJECT No: 217545.00
DATE: 27/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
32	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, grey, fine to medium sand, w<PL, typically very stiff, with organics, grass covered; TOPSOIL							
	0.5	Sandy SILT (ML): low plasticity, grey, fine to medium sand, w<PL, typically very stiff; Alluvial							
31	1	Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, w=PL, very stiff; Alluvial		S	1.0		3,4,5 N = 9		
					1.45				
30	2	From 2m: with occasional bands of Sandy CLAY		U_{63}	2.0		pp = 250-320		
				S	2.4		4,6,6 N = 12		
29	3	From 3m: with fine sand			2.85				
				S	3.5		5,6,9 N = 15		
28	4	From 3.8m: with fine to medium sand			3.95				
	5			S	5.0		5,8,15 N = 23		
27	5.4	Clayey SAND (SC): fine to coarse sand, pale brown mottled brown, moist, medium dense; Alluvial with bands of Sandy CLAY			5.45				
	6			U_{63}	6.0 6.13				
26				S	6.23		8,11,12 N = 23		
					6.58				
	7	From 7.4m: wet						▽	
25	7.8	Silty CLAY (CH): high plasticity, grey mottled orange, w=PL, stiff; Alluvial							
	8			S	8.0		6,6,7 N = 13		
24	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				
	9								
23									

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** JF **CASING:** Uncased
TYPE OF BORING: Solid flight auger
WATER OBSERVATIONS: Groundwater seepage from 7.4m
REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 28.3 mAHD
EASTING: 359901
NORTHING: 5783959
DIP/AZIMUTH: 90°/--

BORE No: BH 02
PROJECT No: 217545.00
DATE: 30/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
28	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, typically very stiff, with organics, grass covered; TOPSOIL							
	0.5	Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, typically very stiff; Alluvial			0.5				
	1	Silty CLAY (CH): high plasticity, pale brown mottled brown, w=PL, stiff; Alluvial			1.0				1
27				U	1.23				
		From 1.5m: with medium sand		S		B	2,4,6 N = 10 0.5-2.5m: Bulk sample		
					1.68				
	2				2.0				2
26		From 2.2m: grey mottled orange		S			5,5,5 N = 10		
					2.45				
		From 3m: very stiff			2.5				
25	3								3
				S	3.5		4,7,10 N = 17		
24	4				3.95				4
	5				5.0				5
	5.1	Sandy CLAY (CH): high plasticity, grey, medium to coarse sand, w=PL, very stiff; Alluvial		S			7,9,12 N = 21		
23					5.45			▽	
	6				6.0				6
22				S			7,9,14 N = 23		
					6.45				
	7	From 6.8m: with bands of Clayey SAND							7
21					7.5				
	7.8			S			5,8,8 N = 16		
	7.95	Silty CLAY (CH); high plasticity, brown mottled orange and grey, w=PL, very stiff; Alluvial			7.95				
	8	Bore discontinued at 7.95m. - Target depth reached.							8
20									
	9								9
19									

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** JF **CASING:** Uncased
TYPE OF BORING: Solid flight auger
WATER OBSERVATIONS: Groundwater seepage from 5.7m
REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 23.9 mAHD
EASTING: 360967
NORTHING: 5783884
DIP/AZIMUTH: 90°/--

BORE No: BH 03
PROJECT No: 217545.00
DATE: 29/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
23	0.0	TOPSOIL / Silty SAND (SM): fine to medium sand, pale brown, low plasticity silt, inferred medium dense, dry to wet; Alluvial TOPSOIL							Flush gatic cover
	0.4	Silty CLAY (CH): high plasticity, brown mottled grey, with fine to medium sand, w<PL, soft; Alluvial							
	1			S	1.0		3,2,2 N = 4		
		From 1.5m: becoming dark brown, w=PL			1.45				Backfill to 3.5m
22	2			U_{63}	2.0		pp = 100-170		
					2.34				
				S			2,2,1 N = 3		Unslotted PVC to 5.13m
21	3				2.79				
		From 3.5m: becoming firm		S	3.5		3,3,4 N = 7		
20	4	From 4m: becoming stiff, slightly darker grey			3.95				Bentonite 3.5-4.5m
19	5	From 4.8m: with fine to coarse quartz sand		S	5.0		4,6,7 N = 13		
					5.45				
18	5.8	Silty CLAY (CH): high plasticity, grey, slightly mottled brown, w<PL, stiff; Alluvial							
17	6								Sand filter pack 4.5-8.13m
	7			S	6.5		4,6,6 N = 12		Slotted PVC 5.13-8.13m
					6.95				
16	8			S	8.0		5,5,7 N = 12		End cap
	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				
15	9								
14									

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** GL **CASING:** Uncased

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS:

REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 29.8 mAHD
EASTING: 358698
NORTHING: 5783360
DIP/AZIMUTH: 90°/--

BORE No: BH 04
PROJECT No: 217545.00
DATE: 28/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, inferred very stiff; TOPSOIL							Flush gatic cover
		Silty CLAY (CH): high plasticity, grey mottled brown, trace coarse sand, w=PL, very stiff; Alluvial							
				U_{63}	1.0		pp = 350-400		
				S	1.26		3,3,4 N = 7		
					1.71				
		From 2m: minus coarse sand		S	2.0		3,3,5 N = 8		Unslotted PVC to 4.5m
					2.45				
		From 3.5-3.95m: band of coarse Sandy Clay		S	3.5		4,6,7 N = 13		Bentonite 3-4m
	3.95	Sandy CLAY (CH): high plasticity, pale brown mottled grey, fine to medium sand, w=PL, stiff; Alluvial			3.95				
				S	5.0		5,6,7 N = 13		
					5.45				
	5.6	Sandy CLAY (CH): high plasticity, grey slightly mottled brown, fine to medium sand, stiff; Alluvial							Sand filter pack 4-8.1m
									Slotted PVC 4.5-8m
				S	6.5		5,6,6 N = 12		
					6.95				
	7.9	Silty SAND (SM): fine to coarse rounded quartz sand, grey, medium dense, wet; Alluvial		S	8.0		16,20,17 N = 37		
	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** GL **CASING:** Uncased
TYPE OF BORING: Solid flight auger
WATER OBSERVATIONS:
REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 29.8 mAHD
EASTING: 358698
NORTHING: 5783360
DIP/AZIMUTH: 90°/--

BORE No: BH 05
PROJECT No: 217545.00
DATE: 29/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
29	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, inferred medium dense; TOPSOIL							
		Sandy CLAY (CH): high plasticity, brown mottled grey, fine to coarse rounded quartz sand, w<PL, firm; Alluvial							
	1			S	1.0		4,3,4 N = 7		
		At 1.4m: band of coarse quartz sand			1.45				
28	2	From 2m: becoming stiff		S	2.0		2,5,6 N = 11		
		From 2.5m: decrease in coarse sand			2.45				
27	3								
26	4			S	3.6		5,7,8 N = 15		
					4.05				
	4.5	Silty CLAY (CH): high plasticity, pale brown mottled grey, w=PL, very stiff; Alluvial							
25	5	From 5.1m: wet		S	5.0		9,8,12 N = 20	▽	
		From 5.4 - 5.5m: band of Silty SAND (SM): fine to coarse sand, grey, wet, medium dense			5.45				
24	6	From 5.8m: with fine to coarse sand, becoming stiff							
				U_{63}	6.5		pp = 150-250		
23	7	From 7m: predominantly grey		S	6.95				
					7.4				
22	8	From 7.9m: decrease in clay content, increase in sand		S	8.0		1,1,0 N = 1		
	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				
21	9								
20									

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** GL **CASING:** Uncased
TYPE OF BORING: Solid flight auger
WATER OBSERVATIONS: Groundwater seepage from 5.1m
REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 26.1 mAHD
EASTING: 358977
NORTHING: 5782665
DIP/AZIMUTH: 90°/--

BORE No: BH 07
PROJECT No: 217545.00
DATE: 28/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
26	0	Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, trace rounded quartz fine gravel, dry to moist, inferred medium dense to dense; Alluvial							Flush gatic cover; Backfill to 0.4m; Bentontie 0.4-1.5m
	0.7								
25	1	Silty CLAY (CH): high plasticity, grey mottled brown, w<PL, stiff; Alluvial		S	1.0		3,3,5 N = 8		Unslotted PVC to 2m
					1.45				
24	2	From 2m: minus fine gravel, with coarse sand, occasional bands of Silty Sand		S	2.0		4,6,10 N = 16		
	2.3	Sandy CLAY (CH): high plasticity, grey, fine to coarse sand, w=PL, inferred stiff; Alluvial			2.45				
23	3								
	3.3	Sandy SILT (MH): high plasticity, grey, fine to medium sand, trace coarse sand,w=PL, firm to stiff; Alluvial			3.5				
	3.58	Silty SAND (SM): fine to coarse sand		U_{63}			pp = 50-250		
22	4			S	3.9		4,4,5 N = 9		
		From 4.5m: with fine to medium sand, pale brown			4.35				Sand filter pack 1.5-8m
	4.9	Clayey SAND (SM): fine to coarse sand, grey, high plasticity clay, wet, medium dense; ALluvial		S	5.0		11,11,13 N = 24		Slotted PVC 2-8m
21	5				5.45				
	6.2	Silty CLAY (CH): high plasticity, pale brown mottled grey, with fine to coarse sand, w>PL, stiff; Alluvial							
20	6	From 6.4m: fine to medium sand, decrease in sand content		S	6.5		4,4,7 N = 11		
					6.95				
19	7								
				S	8.0		4,5,8 N = 13		End cap
18	8								
	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				
17	9								

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** GL **CASING:** Uncased

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS:

REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 17.8 mAHD
EASTING: 361585
NORTHING: 5782226
DIP/AZIMUTH: 90°/--

BORE No: BH 08
PROJECT No: 217545.00
DATE: 27/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	TOPSOIL / Silty SAND (SM): fine to medium sand, pale brown, trace fine quartz gravel, dry to moist, inferred dense; TOPSOIL							Flush gatic cover
		Sandy CLAY (CH): high plasticity, pale grey and brown, w<PL, fine rounded quartz gravel, firm; Alluvial		S	1.0		2,3,4 N = 7		Backfill to 2.5m
					1.45				
		From 2m: occasional bands of hardened Sandy CLAY (CH): high plasticity, grey mottled brown, fine to coarse rounded quartz sand, becoming very stiff		S	2.0		7,13,19 N = 32		Unslotted PVC to 5m
					2.5				
					3.5				Bentonite 2.5 to 4.5
				S			4,7,10 N = 17		
					4.09				
	5.0	Sandy CLAY (CL): low plasticity, pale grey, rounded quartz gravel, medium dense to hard, w<PL; Alluvial			5.0				
				U_{63}			pp >600		
					5.39				
				S			6,7,8 N = 15		
		From 6m: minus mottled grey			5.9				Sand filter pack 4.5 to 8m
					6.5				Slotted PVC 5 to 8m
				S			3,5,6 N = 11		
					6.95				
					8.0				End cap
				S			4,6,6 N = 12		
	8.4				8.33				
		Bore discontinued at 8.4m. - Target depth reached.							

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** GL **CASING:** Uncased

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS:

REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 21.5 mAHD
EASTING: 359645
NORTHING: 5781875
DIP/AZIMUTH: 90°/--

BORE No: BH 09
PROJECT No: 217545.00
DATE: 27/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
21	0.1	TOPSOIL / Clayey SILT (ML): low plasticity, grey, with fine to medium sand, w<PL, typically very stiff, with organics, grass covered; TOPSOIL							Flush gatic cover
	0.5	Clayey SILT (ML): low plasticity, brown, with fine to medium sand, w<PL, typically stiff; Alluvial							
20	1	Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, w=PL, stiff; Alluvial		S	1.0		4,5,6 N = 11		Bentonite to 2.5m
		From 1.2m: with occasional bands of coarse Clayey SAND			1.45				
19	2			S	2.0		3,4,4 N = 8		
					2.45				
18	3	From 3.1m: grey mottled orange							Unslotted PVC to 5m
				U_{63}	3.5		pp = 300-440		
17	4			S	3.9		4,4,6 N = 10		
					4.35				
16	5			S	5.0		5,7,8 N = 15		Sand filter pack 2.5 - 8m
					5.45				
15	6	6.0 Clayey SAND (SC): fine sand, pale grey, moist, medium dense; Alluvial		S	6.5		4,6,7 N = 13		Slotted PVC 5 - 8m
	7				6.95				
14		7.2 Sandy CLAY (CH): high plasticity, pale brown mottled brown, trace medium sand, w=PL, stiff; Alluvial							
	8			S	8.0		4,6,8 N = 14		End cap
13	8.45	Bore discontinued at 8.45m. - Target depth reached.			8.45				
	9								
12									

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** JF **CASING:** Uncased

TYPE OF BORING: Solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 12.4 mAHD
EASTING: 361170
NORTHING: 5780667
DIP/AZIMUTH: 90°/--

BORE No: BH 10
PROJECT No: 217545.00
DATE: 27/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL / Silty SAND (SM) / Sandy SILT (ML): fine to medium sand, pale brown, dry to moist, inferred dense; TOPSOIL							Flush gatic cover
		Silty CLAY (CH): high plasticity, brown mottled grey, w=PL, firm; Alluvial							Backfill to 0.8m
	1	From 1m: occasional bands of sandy CLAY (CH): high plasticity, grey, fine to coarse sand		S	1.0		2,3,2 N = 5		
		From 1.5m: becoming w>PL			1.5				
	2			U_{63}	2.0		pp = 120-150		Unslotted PVC to 4m
					2.45				Bentonite 0.8 to 3.5m
	3	From 3.5m: trace grey green		S	3.5		3,3,4 N = 7		
	4				4.0				
	5			S	5.0		3,3,5 N = 8		
		From 5.5m; wet, becoming pale grey, with fine rounded quartz gravel			5.5				Bentonite 3.5 to 8m
	6								Slotted PVC 4 to 8m
		From 6.5m: increase in sand content, becoming very stiff		S	6.5		14,13,8 N = 21		
	7				7.0				
	8								End cap
	8.45	Bore discontinued at 8.45m. - Target depth reached.							
	9								

RIG: Geoprobe 7822 DT **DRILLER:** Supreme Drilling **LOGGED:** JF **CASING:** Uncased
TYPE OF BORING: Solid flight auger
WATER OBSERVATIONS:
REMARKS: Location coordinates are in MGA94 Zone 55 H.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 32.5 mAHD
EASTING: 358657
NORTHING: 5784084

PIT No: TP 01
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
32	0.1	TOPSOIL / Clayey SILT (ML): grey, w<PL, firm, with organics, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, hard; Alluvial							
	0.5	Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, w=PL, stiff; Alluvial			0.5		0.5-0.7m: Bulk sample		
					0.6	B	pp = 100-130		
					0.7				
					0.9		pp = 150-200		
31	1				1.2		pp = 150-180		
					1.6		pp = 200-220		
		From 1.7m: very stiff							
	2				2.0		pp = 240		2
30					2.5		pp = 300-320		
	3								3
	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 300-340		
29									
	4								4
28									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 31.9 mAHD
EASTING: 358711
NORTHING: 5784000

PIT No: TP 02
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.1	TOPSOIL / Clayey SILT (ML): grey, w<PL, stiff, with rootlets, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, very stiff to hard; Alluvial							
	0.4	From 0.3-0.4m: Silty Sand band, pale grey			0.4		pp = 200-250		
		Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, w=PL, stiff to very stiff; Alluvial			0.7		pp = 250		
31	1				1.0		pp = 200		1
		From 1.4m: very stiff			1.5		pp = 250		
30	2				2.0		pp = 300		2
		From 2.5m: with fine sand			2.5		pp = 300		
29	3								3
	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 350		
28	4								4
27									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 29.0 mAHD
EASTING: 359932
NORTHING: 5784096

PIT No: TP 03
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
29	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, fine sand, brown, w<PL, trace rootlets, very stiff; TOPSOIL							
		Sandy SILT (Ml): low plasticity, fine to medium sand, pale grey, w<PL; Alluvial			0.3		pp = 240-400		
					0.4		pp = 550		
	0.5	Silty CLAY (CH): high plasticity, pale brown mottled grey, with fine to coarse sand, w=PL, firm; Alluvial			0.5		pp = 200-350		
		From 0.7m: w<PL, with fine to medium sand			0.7		pp = 400-450		
28	1				1.1		pp >600		1
27	2 2.0	Sandy CLAY (CH): high plasticity, pale brown mottled grey, fine to medium sand, with silt, w=PL, very stiff; Alluvial			2.0		pp = 250-350		2
	2.5	Silty CLAY (CH): high plasticity, pale brown mottled grey, with fine to coarse sand, w<PL, hard; Alluvial			2.5		pp = 350-400		
26	3 3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 350-450		3
25	4								4

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 28.7 mAHD
EASTING: 359798
NORTHING: 5783848

PIT No: TP 04
PROJECT No: 217545.00
DATE: 24/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
28	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, very stiff, trace rootlets, grass covered; TOPSOIL							
	0.4	Sandy SILT (ML): low plasticity, pale brown mottled brown and grey, trace fine sand, stiff to very stiff; Alluvial			0.3		pp = 400-600		
		Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, trace fine sand, stiff to very stiff; Alluvial			0.5		pp = 350-400		
					0.7		pp = 350-400		
1					1.0		pp = 450		
					1.5		pp = 400-450		
27	1.6	Clayey SAND (SC): fine sand, pale brown mottled brown and grey, moist, dense to very dense, with interbedded Silty CLAY; Alluvial							
2									
26	3.0	Pit discontinued at 3.0m. - Target depth reached.							
25									
24									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 24.3 mAHD
EASTING: 360906
NORTHING: 5783997

PIT No: TP 05
PROJECT No: 217545.00
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
24	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, with rootlets; TOPSOIL							
	0.4	Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, very stiff to hard; Alluvial			0.3		pp >600		
		Silty CLAY (CH): high plasticity, pale grey mottled orange, trace fine sand, w<PL, dry, very stiff to hard; Alluvial			0.6		pp >600		
					0.8		pp >600		
23	1	From 1.1m: w=PL, stiff			1.3		pp = 400		
					1.5		pp = 250-350		
					1.8		pp = 150		
22	2	From 2.2m: stiff to very stiff			2.0		pp = 150		
					2.3		pp = 150		
					2.6		pp = 150		
21	3				3.0		pp = 150-200		
	3.0	Pit discontinued at 3.0m. - Target depth reached.							
20	4								

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 23.7 mAHD
EASTING: 361000
NORTHING: 5783779

PIT No: TP 06
PROJECT No: 217545.00
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.2	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, with rootlets; TOPSOIL							
		Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, hard; Alluvial			0.3		pp >600		
	0.6				0.6		pp >600		
23		Silty CLAY (CH): high plasticity, pale brown mottled brown and orange, trace fine sand, w<PL, very stiff to hard; Alluvial			0.8		pp >600		
	1								1
		From 1.1m: w=PL, stiff to very stiff			1.1		pp = 450-500		>>
					1.5		pp = 250-300		
22					1.8		pp = 100-150		
	2	From 1.9m: with fine to medium sand							2
	2.1	Sandy CLAY (CI): medium plasticity, pale brown and orange, fine to medium sand, stiff to very stiff; Alluvial			2.2		pp = 25		
					2.5		pp = 150-250		
21	2.7	Clayey SAND (SC): fine to medium sand, orange and brown, moist, very dense; Alluvial							
	3								3
	3.0	Pit discontinued at 3.0m. - Target depth reached.							
20									
	4								4
19									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 24.6 mAHD
EASTING: 361376
NORTHING: 5784107

PIT No: TP 07
PROJECT No: 217545.00
DATE: 12/4/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
24	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, with rootlets; TOPSOIL							
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, hard; Alluvial		B	0.3	TP07 0.3-0.5	pp >600		
					0.5		pp = 550-600		
	0.6	Silty CLAY (CH): high plasticity, pale brown, trace fine sand, w<PL, hard							
	1	From 0.9m: w=PL, stiff to very stiff			0.9		pp = 350-400		
					1.2		pp = 200-250		
					1.5		pp = 150-200		
23		From 1.6m: firm to stiff			1.7		pp = 150		
	2	From 1.9m: stiff to very stiff			2.0		pp = 250		
	2.4	Sandy CLAY 9CH): high plasticity, pale brown mottled grey and orange,medium sand, w=PL, very stiff; Alluvial							
22					2.7		pp = 320		
	2.8	Clayey SAND (SC): fine to medium sand, pale brown mottled grey and orange, moist, very dense; Alluvial							
	3 3.0	Pit discontinued at 3.0m. - Target depth reached.							
21	4								
20									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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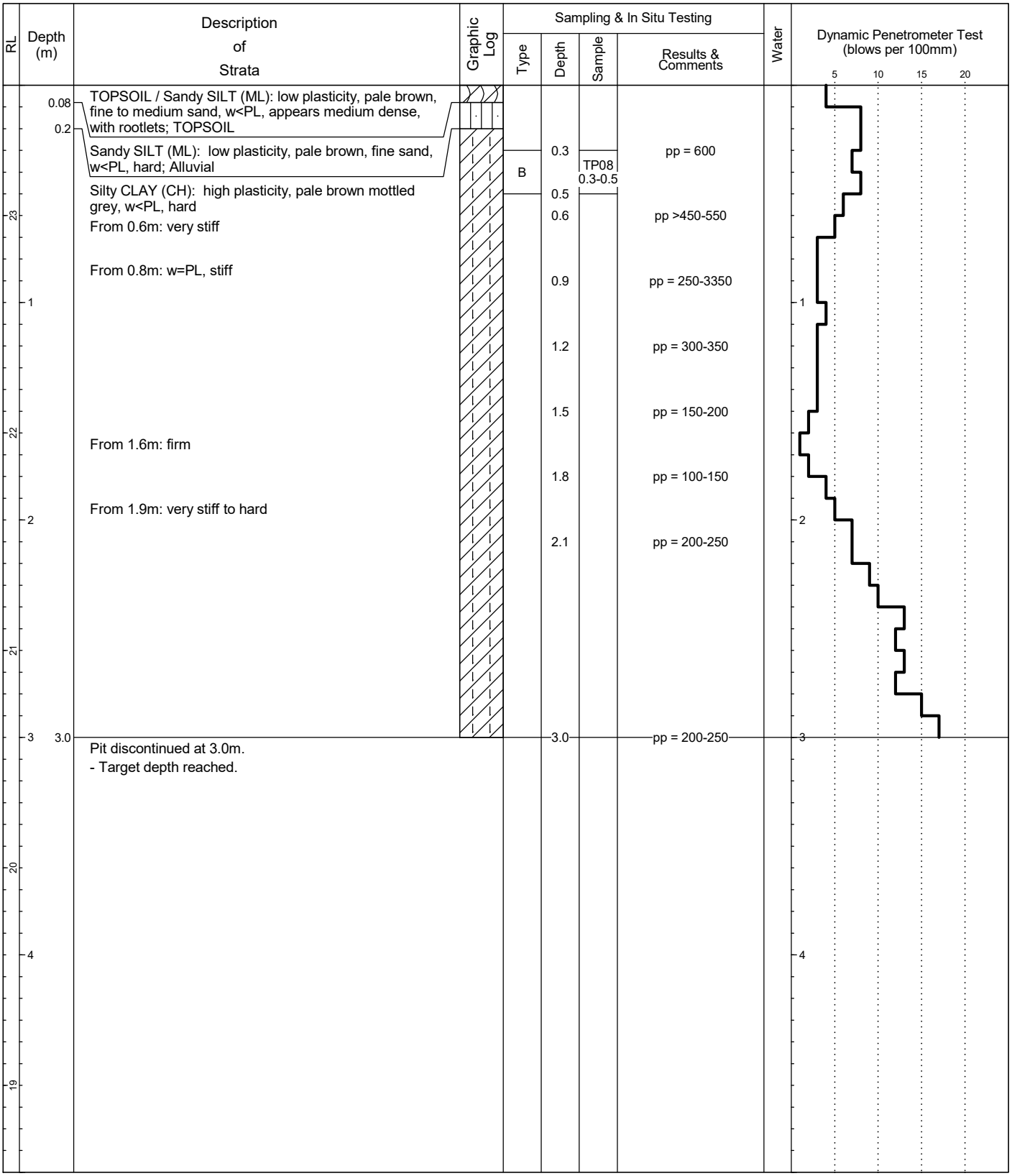
TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 23.6 mAHD
EASTING: 361365
NORTHING: 5783979

PIT No: TP 08
PROJECT No: 217545.00
DATE: 12/4/2023
SHEET 1 OF 1



RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 30.4 mAHD
EASTING: 358678.939
NORTHING: 5783431.669

PIT No: TP 09
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
30	0.1	TOPSOIL / Clayey SILT (ML): brown, w=PL, typically firm, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, very stiff to hard; Alluvial			0.3				
				B	0.4	TP9 - 0.5	pp >600		
	0.5				0.5				
		Silty CLAY (CH): high plasticity, grey and pale brown mottled orange, trace medium sand, w=PL, stiff to very stiff; Alluvial			0.8		pp >600		
	1								1
		From 1.1m: with fine to medium sand			1.3		pp = 250-300		
29		From 1.6m: with interbedded Sandy CLAY			1.6		pp = 250-300		
	2				2.0		pp = 300-350		2
	2.1	Sandy CLAY (CI): medium plasticity, grey mottled orange, fie to medium sand, w=PL, very stiff; Alluvial							
28					2.4		pp = 300-400		
	3								3
	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 400		
27									
	4								4
26									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

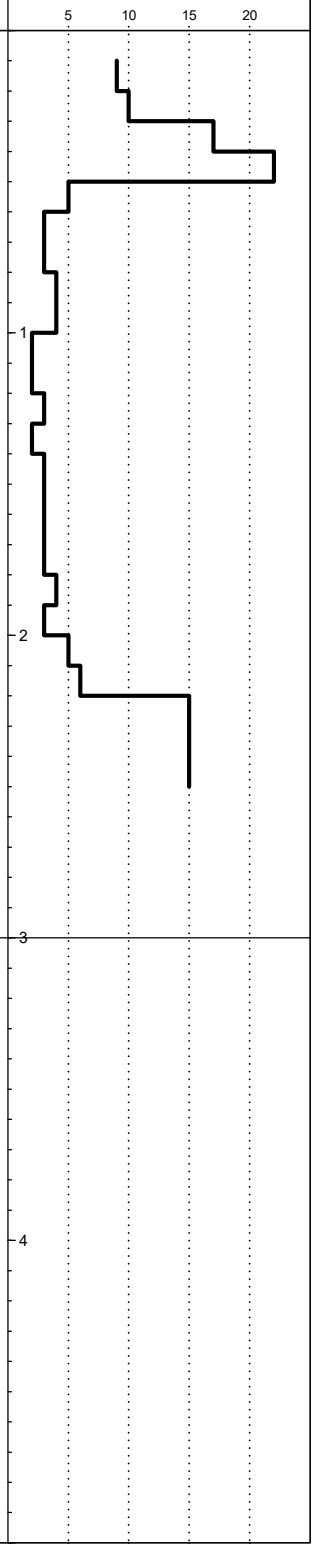
CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 29.6 mAHD
EASTING: 358794.896
NORTHING: 5783350.989

PIT No: TP 10
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
	0.1	TOPSOIL / Clayey SILT (ML): brown, w=PL, typically firm, grass covered; TOPSOIL						
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, hard; Alluvial			0.3		pp >600	
	0.5	Silty CLAY (CH): high plasticity, grey and pale brown mottled orange, w=PL, stiff to very stiff; Alluvial			0.6		pp = 300-400	
29					0.9		pp = 250-300	
	1	From 0.9m: with interbedded Sandy CLAY, with fine fine to medium sand						
					1.3		pp = 250-300	
28					1.7		pp = 250-300	
	2				2.0		pp = 250-300	
					2.4		pp = 250-300	
27								
					2.9		pp = 300-350	
	3	3.0 Pit discontinued at 3.0m. - Target depth reached.						
26								
	4							
25								

Dynamic Penetrometer Test (blows per 100mm)



RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

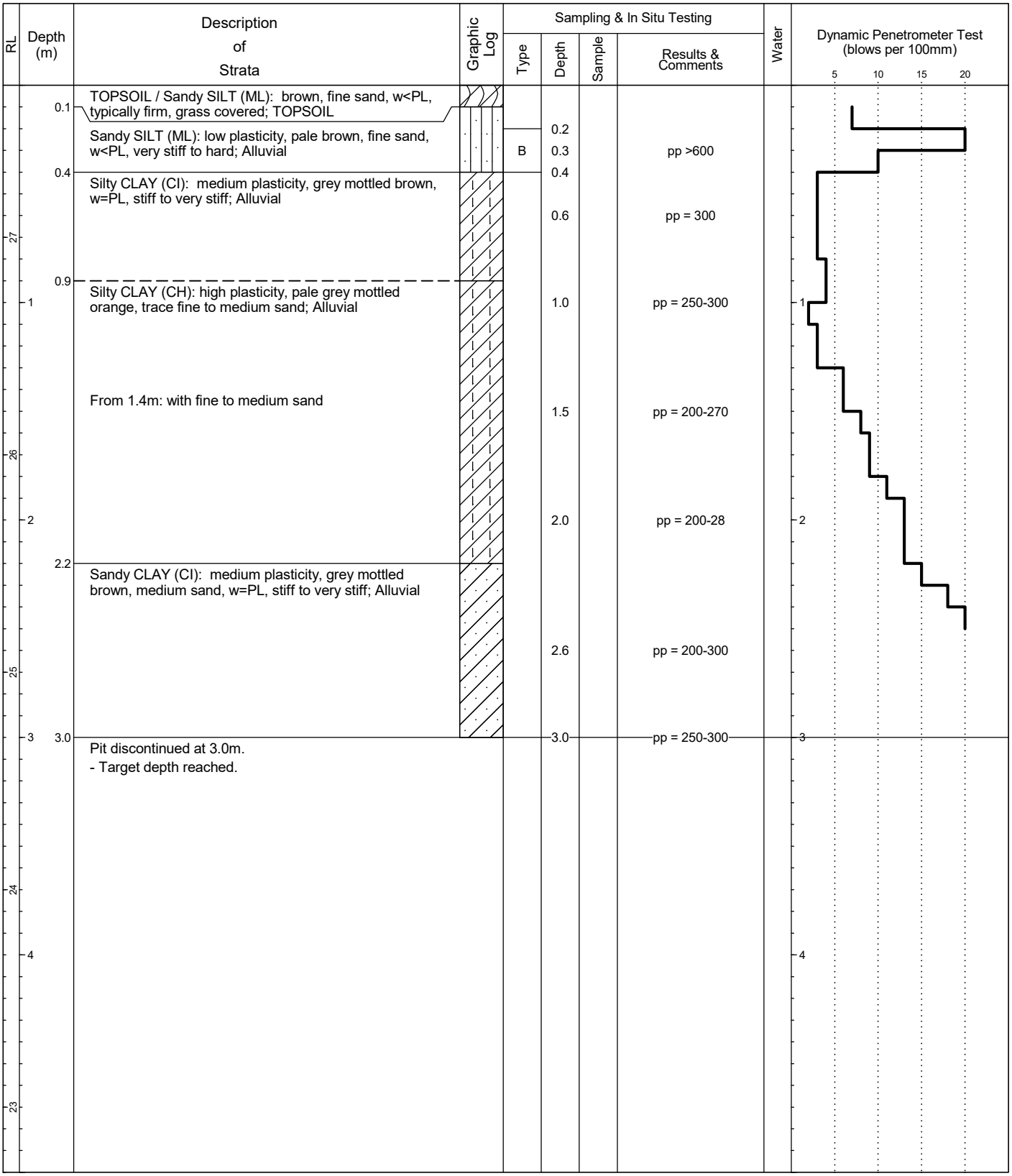
Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 27.7 mAHD
EASTING: 359471.71
NORTHING: 5783271.402

PIT No: TP 11
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1



RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 26.8 mAHD
EASTING: 359708.557
NORTHING: 5783295.929

PIT No: TP 12
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
26.7	0.1	TOPSOIL / Clayey SILT (ML): brown, w=PL, inferred firm, grass covered; TOPSOIL						
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, hard; Alluvial			0.3		pp >600	
26.3	0.5	Silty CLAY(CH): high plasticity, pale brown mottled orange, w=PL, very stiff; Alluvial			0.5		pp >600	
					0.8		pp >600	
25.8	1	From 1m: with fine to medium sand, stiff to very stiff			1.1		pp = 250-350	
25.3	1.5	Sandy CLAY (CI): medium plasticity, pale brown mottled orange, medium sand, w=PL, stiff to very stiff; Alluvial			1.5		pp = 200-250	
	2				2.0		pp = 200-300	
23.8	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 200-250	

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 26.5 mAHD
EASTING: 358893.386
NORTHING: 5782689.77

PIT No: TP 13
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
26	0.1	TOPSOIL / Clayey SILT (ML): brown, w=PL, typically firm, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, brown, fei sand, w<PL, hard; Alluvial			0.3		pp >600		
	0.5	Silty CLAY (CH): high plasticity, grey mottled brown, w<PL, very stiff to hard; Alluvial			0.6		pp >600		
	1	From 1m: w=PL, stiff to very stiff			1.0		pp >600		1
25					1.4		pp = 200-300		
					1.7		pp = 250-300		
	2				2.0		pp = 250-300		2
24					2.4		pp = 300		
		From 2.6m: with fine sand							
					2.9		pp = 250-300		
	3	3.0 Pit discontinued at 3.0m. - Target depth reached.							3
23									
	4								4
22									

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 26.0 mAHD
EASTING: 359045.491
NORTHING: 5782591.303

PIT No: TP 14
PROJECT No: 217545.00
DATE: 30/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
26	0.1	TOPSOIL / Clayey SILT (ML): brown, w=PL, typically firm, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, brown, trace fine sand, w<PL, hard; Alluvial		B	0.3		pp >600		
	0.5				0.5		pp >600		
		Silty CLAY (CH): high plasticity, grey mottled brown and orange, w=PL, stiff to very stiff; Alluvial			0.8		pp >600		
25	1				1.0		pp >600		1
					1.3		pp = 250-300		
					1.7		pp = 250-300		
24	2	From 2m: trace medium to coarse sand			2.1		pp = 250-300		2
					2.4		pp = 250-300		
					2.8		pp = 250-300		
23	3	3.0 Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 250-300		3
22	4								4

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 22.2 mAHD
EASTING: 359589
NORTHING: 5782116

PIT No: TP 15
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
22	0.1	TOPSOIL / Clayey SILT (ML): grey, with fine sand, w<PL, very stiff to hard, trace rootlets, grass covered; TOPSOIL			0.2		pp = 500-600		
		Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, very stiff to hard; Alluvial			0.5		pp = 400-550		
	0.6	Silty CLAY (CH): high plasticity, pale brown mottled grey and brown, trace fine sand, w=PL, very stiff; Alluvial			0.7		pp = 250-300		
21	1				1.0		pp = 260-360		
					1.5		pp = 250-360		
20	2				2.0		pp = 250-320		
					2.5		pp = 300-400		
	3				3.0		pp = 300-400		
19	3.0	Pit discontinued at 3.0m. - Target depth reached.							
	4								
18									

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 21.6 mAHD
EASTING: 359750
NORTHING: 5782073

PIT No: TP 16
PROJECT No: 217545.00
DATE: 24/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, stiff, trace rootlets, grass covered; TOPSOIL			0.2		pp = 290		
		Sandy SILT (ML): low plasticity, grey, fine sand, w<PL, very stiff to hard; Alluvial							
	0.5	Silty CLAY (CH): high plasticity, pale brown mottled grey and brown, with fine to medium sand, w=PL, stiff; Alluvial			0.5		pp = 250		
					0.7		pp = 220-270		
					1.0		pp = 250		
		From 1.4m: very stiff			1.5		pp = 250-300		
					2.0		pp = 350		
					2.5		pp = 250-400		
	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 250-400		

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 22.0 mAHD
EASTING: 359518
NORTHING: 5781986

PIT No: TP 17
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
22	0.1	TOPSOIL / Silty CLAY (CI): brown, trace fine to coarse sand, w<PL, stiff, trace rootlets, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, brown, fine to medium sand, w<PL, very stiff to hard; Alluvial			0.4		pp = 400-600		
	0.6	Sandy CLAY (CI): medium plasticity, pale brown mottled brown, fine to medium sand, w=PL, stiff; Alluvial			0.7		pp = 200-300		
	0.8	Silty CLAY (CH): high plasticity, pale brown mottled brown and grey, with fine to medium sand, w=PL, stiff; Alluvial			0.9		pp = 150-250		
21	1	From 1.3m: sand absent			1.5		pp = 150-250		
20	2	From 2.2m: very stiff, small areas of w>PL, firm to stiff clay			2.0		pp = 150-250		
					2.5		pp = 250-350		
19	3	3.0 Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 270-350		
18	4								

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 21.1 mAHD
EASTING: 359733
NORTHING: 5781781

PIT No: TP 18
PROJECT No: 217545.00
DATE: 23/1/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
21	0.1	TOPSOIL / Silty CLAY (CI): brown, trace fine to coarse sand, w<PL, stiff, trace rootlets, grass covered; TOPSOIL							
		Sandy SILT (ML): low plasticity, dark brown, fine to medium sand, w<PL, very stiff to hard; Alluvial			0.3		pp = 400-600		
	0.5	Silty CLAY (CH): high plasticity, pale brown mottled grey and brown, trace fine sand, w=PL, very stiff; Alluvial			0.5		pp = 350-500		
					0.6		0.6-0.8: Bulk sample		
					0.7	B	pp = 350-400		
					0.8				
20	1				1.0		pp = 220		1
					1.5		pp = 250-350		
	2				2.0		pp = 250-350		2
19	2.1	Clayey SAND (SC): fine to medium sand, pale brown mottled grey and brown, moist, dense; Alluvial							
	3								3
18	3.0	Pit discontinued at 3.0m. - Target depth reached.							
	4								4
17									

RIG: Terex 860 Elite Backhoe 8T

LOGGED: GL

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 18.0 mAHD
EASTING: 361554.218
NORTHING: 5782394.328

PIT No: TP 20
PROJECT No: 217545.00
DATE: 4/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
18	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, grass covered; TOPSOIL						
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, very stiff to hard; Alluvial		B	0.3		pp >600	
	0.5	Silty CLAY (CH): high plasticity, brown mottled pale brown and orange, with medium sand, w=PL, stiff; Alluvial			0.5		pp = 400	
					0.6		pp = 250-350	
	0.8	Sandy CLAY (CH): high plasticity, brown mottled pale brown and orange, medium sand, w=PL, stiff to very stiff; Alluvial			0.8		pp = 250-350	
17	1				1.0		pp = 250-300	
					1.3		pp = 120-170	
					1.7		pp = 150-250	
16	2				2.0		pp = 150-250	
	2.6	Clayey SAND (SC): medium sand, brown mottled pale brown and orange, moist, very dense; Alluvial						
15	3	3.0 Pit discontinued at 3.0m. - Target depth reached.						
14	4							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20; 1, 2, 3, 4

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

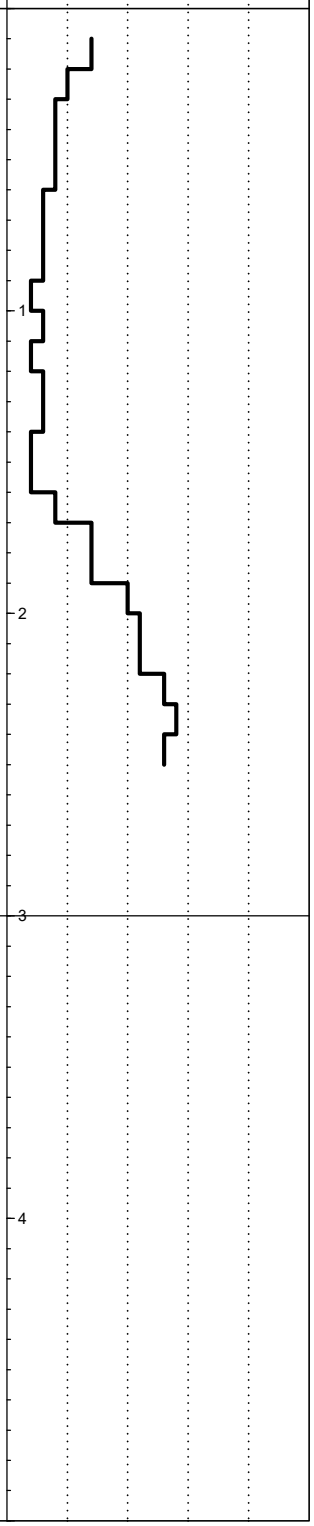
CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 18.1 mAHD
EASTING: 361375.487
NORTHING: 5782264.942

PIT No: TP 21
PROJECT No: 217545.00
DATE: 4/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
18	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, grass covered; TOPSOIL						
		Silty CLAY (CH): high plasticity, brown mottled orange, with fine to medium sand, w<PL, very stiff			0.3		pp >600	
		From 0.5m: pale brown mottled brown, w=PL, very stiff			0.5		pp = 300-400	
					0.8		pp = 300-350	
17	1				1.0		pp = 250-350	
					1.6		pp = 150-250	
		From 1.7m: with fine to medium sand, stiff						
16	2	From 2m: with Sandy CLAY bands / interbedded			2.0		pp = 150-200	
					2.6		pp = 150-250	
	2.8	Clayey SAND (SC): fine to medium sand, brown mottled orange, moist, dense top very dense; Alluvial						
15	3 3.0	Pit discontinued at 3.0m. - Target depth reached.						
14	4							

Dynamic Penetrometer Test (blows per 100mm)



RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 13.1 mAHD
EASTING: 361245.822
NORTHING: 5780813.745

PIT No: TP 22
PROJECT No: 217545.00
DATE: 4/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
13	0.1	TOPSOIL / Sandy SILT (ML): low plasticity, pale brown, fine to medium sand, w<PL, appears medium dense, grass covered; TOPSOIL			0.2		pp >600	
		Sandy SILT (ML): low plasticity, pale brown, fine sand, w<PL, very stiff to hard; Alluvial						
	0.5	Silty CLAY (CH): high plasticity, brown to pale brown mottled orange, w<PL, hard, Alluvial			0.5		pp >600	
		From 0.8m: w=PL, trace fine to medium sand			0.8		pp = 400	
12	1	From 1.1m: stiff to very stiff			1.0		pp >600	
	1.7	Clayey SAND (SC): fine to medium sand, pale brown mottled orange, moist, dense; Alluvial			1.7		pp = 150	
11	2				2.0		pp = 120	
	3.0	Pit discontinued at 3.0m. - Target depth reached.						
10	3							
9	4							

Dynamic Penetrometer Test (blows per 100mm)
5 10 15 20
1
2
3
4

RIG: Terex 860 Elite Backhoe 8T
LOGGED: JF
SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Jacobs Group (Australia) Pty Ltd
PROJECT: Officer South Retarding Basins
LOCATION: Officer South Road, Officer South

SURFACE LEVEL: 13.4 mAHD
EASTING: 361109.12
NORTHING: 5780912.296

PIT No: TP 23
PROJECT No: 217545.00
DATE: 4/3/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
13	0.05	TOPSOIL / Sandy SILT (ML): low plasticity, brown, fine to medium sand, grass covered, w<PL, very stiff to hard; TOPSOIL							
		Silty CLAY (CH): high plasticity, brown, trace fine sand, w<PL, very stiff to hard; Alluvial		B	0.3		pp >600		
					0.5		pp >600		
					0.8		pp >600		
12	1	From 1m: pale brown mottled orange, w=PL, stiff to very stiff			1.0		pp >600		1
					1.4		pp = 150-250		
					1.8		pp = 200-250		
11	2				2.1		pp = 180-250		2
	2.6	Sandy CLAY (CH): high plasticity, pale brown, grey mottled orange, fine to medium sand, w=PL, stiff to very stiff; Alluvial			2.6		pp = 170-250		
10	3								3
	3.0	Pit discontinued at 3.0m. - Target depth reached.			3.0		pp = 140-200		
9	4								4

Dynamic Penetrometer Test (blows per 100mm) scale: 5, 10, 15, 20

RIG: Terex 860 Elite Backhoe 8T

LOGGED: JF

SURVEY DATUM: MGA94 Zone 55 H

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Laboratory Test Certificates

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Melbourne Laboratory
231 Normanby Road South Melbourne Vic 3205
Phone: (03) 9673 3500
Email: scott.benbow@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226A
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 07/03/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP01 , Depth: 0.50-0.70m**
Material: Silty CLAY trace sand

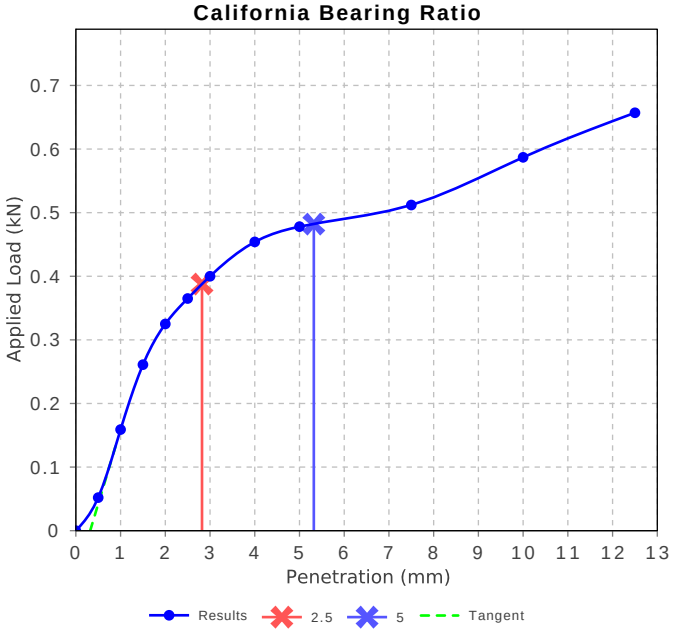
Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	75		
Plastic Limit (%)	22		
Plasticity Index (%)	**53**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**19.0**		
Cracking Crumbling Curling	Curling		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.49		
Optimum Moisture Content (%)	28.0		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.45		
Field Moisture Content (%)	29.2		
Moisture Content at Placement (%)	28.4		
Moisture Content Top 30mm (%)	33.5		
Moisture Content Rest of Sample (%)	29.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	93.6		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**1**		
Soil Description	Silty CLAY trace sand		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

California Bearing Ratio



Pinhole Dispersion Classification (AS 1289.3.8.3)	
Pinhole Dispersion Classification	ND1 Non-dispersive
Rate of Flow on completion (mm/s)	2.4
Natural Moisture Content (%)	29.6
Moisture Content Before Testing (%)	27.5
Standard Maximum Dry Density (t/m^3)	1.49
Time Matured in Cylinder (hh:mm)	24:00
Method of Moisture Determination for Remoulding	OMC
Source of Water Used	Potable water
Was Hole Reformed at 50mm Head	Y
Particles observed in the bottom of cylinder after 1000mm head stage	

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Melbourne Laboratory
231 Normanby Road South Melbourne Vic 3205
Phone: (03) 9673 3500
Email: scott.benbow@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226B
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 07/03/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP18 , Depth: 0.60-0.80m**
Material: Silty CLAY trace sand

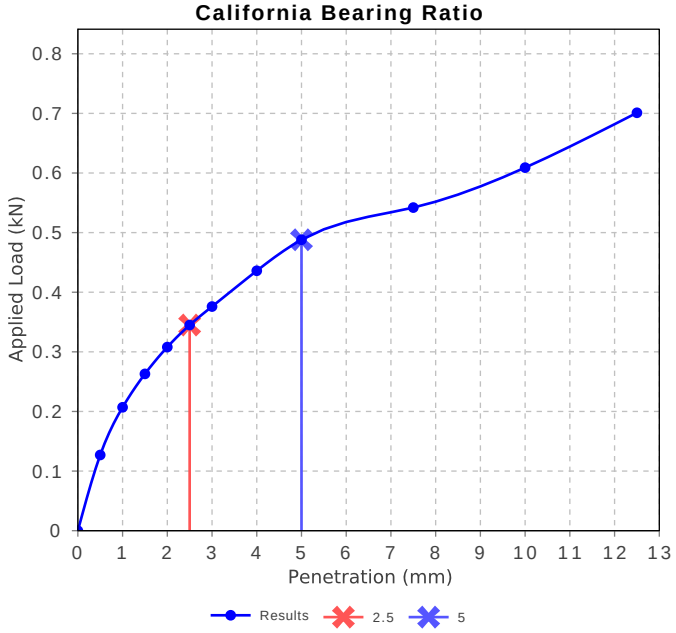
Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	68		
Plastic Limit (%)	19		
Plasticity Index (%)	**49**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**18.5**		
Cracking Crumbling Curling	Curling		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.60		
Optimum Moisture Content (%)	23.0		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.54		
Field Moisture Content (%)	24.2		
Moisture Content at Placement (%)	22.9		
Moisture Content Top 30mm (%)	29.0		
Moisture Content Rest of Sample (%)	23.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	94.0		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		

California Bearing Ratio



Pinhole Dispersion Classification (AS 1289.3.8.3)	
Pinhole Dispersion Classification	ND1 Non-dispersive
Rate of Flow on completion (mm/s)	1.3
Natural Moisture Content (%)	24.1
Moisture Content Before Testing (%)	22.7
Standard Maximum Dry Density (t/m^3)	1.60
Time Matured in Cylinder (hh:mm)	48:00
Method of Moisture Determination for Remoulding	OMC
Source of Water Used	Potable water
Was Hole Reformed at 50mm Head	N
Particles observed in the bottom of cylinder after 1000mm head stage	

Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226E
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 27/02/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01 , Depth: 6.13-6.58m**
Material: Clayey SAND

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	13.8		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	32		
Plastic Limit (%)	13		
Plasticity Index (%)	**19**		
125mm Linear Shrinkage mould used.			

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**8.0**		
Cracking Crumbling Curling	None		
125mm Linear Shrinkage mould used.			

Material Test Report

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Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226F
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 27/02/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH01 , Depth: 8.00-8.45m**
Material: Silty CLAY trace sand

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	27.7		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	22		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.5**		
Cracking Crumbling Curling	Curling		

Material Test Report

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Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

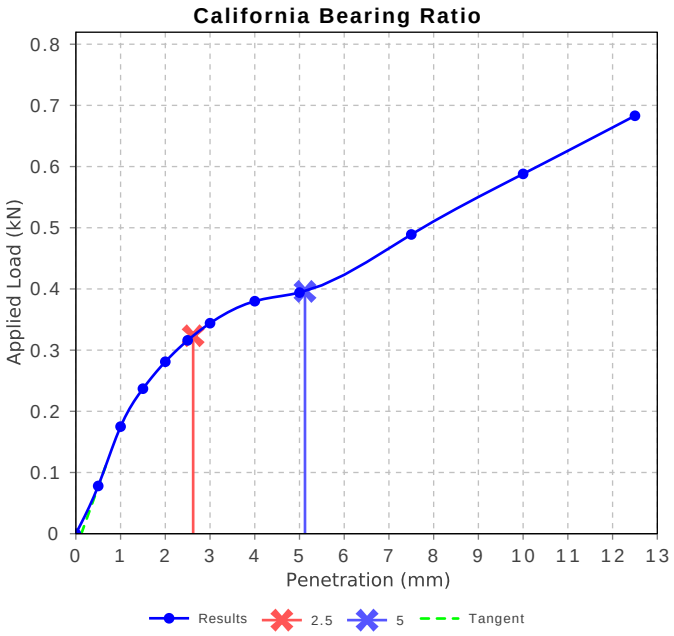
Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226G
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 06/03/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH02 , Depth: 0.50-2.50m**
Material: Silty CLAY with sand

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	52		
Plastic Limit (%)	16		
Plasticity Index (%)	**36**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**14.0**		
Cracking Crumbling Curling	Curling		

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.79		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	97.0		
Laboratory Moisture Ratio (%)	102.5		
Dry Density after Soaking (t/m^3)	1.71		
Field Moisture Content (%)	18.3		
Moisture Content at Placement (%)	17.4		
Moisture Content Top 30mm (%)	25.0		
Moisture Content Rest of Sample (%)	17.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48.8		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY with sand		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	20		



Pinhole Dispersion Classification (AS 1289.3.8.3)	
Pinhole Dispersion Classification	D2 Dispersive
Rate of Flow on completion (mm/s)	0.1
Natural Moisture Content (%)	19.2
Moisture Content Before Testing (%)	16.5
Standard Maximum Dry Density (t/m^3)	1.79
Time Matured in Cylinder (hh:mm)	48:00
Method of Moisture Determination for Remoulding	OMC
Source of Water Used	Potable water
Was Hole Reformed at 50mm Head	Y

Material Test Report

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Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226I
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 27/02/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH02 , Depth: 1.23-1.68m**
Material: Sandy silty CLAY

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	15.9		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	47		
Plastic Limit (%)	14		
Plasticity Index (%)	**33**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Curling		

Material Test Report

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Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226J
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 27/02/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH02 , Depth: 6.00-6.45m**
Material: Sandy silty CLAY trace gravel

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	14.5		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	39		
Plastic Limit (%)	12		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**10.5**		
Cracking Crumbling Curling	None		

Material Test Report

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Approved Signatory: Scott Benbow
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Laboratory Accreditation Number: 828

Report Number: **217545.00-1**
Issue Number: 1
Date Issued: 15/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5226
Sample Number: ME-5226L
Date Sampled: 23/01/2023
Dates Tested: 16/02/2023 - 27/02/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH09 , Depth: 8.00-8.45m**
Material: Silty CLAY with sand

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	20.7		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	55		
Plastic Limit (%)	17		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**13.5**		
Cracking Crumbling Curling	Curling		

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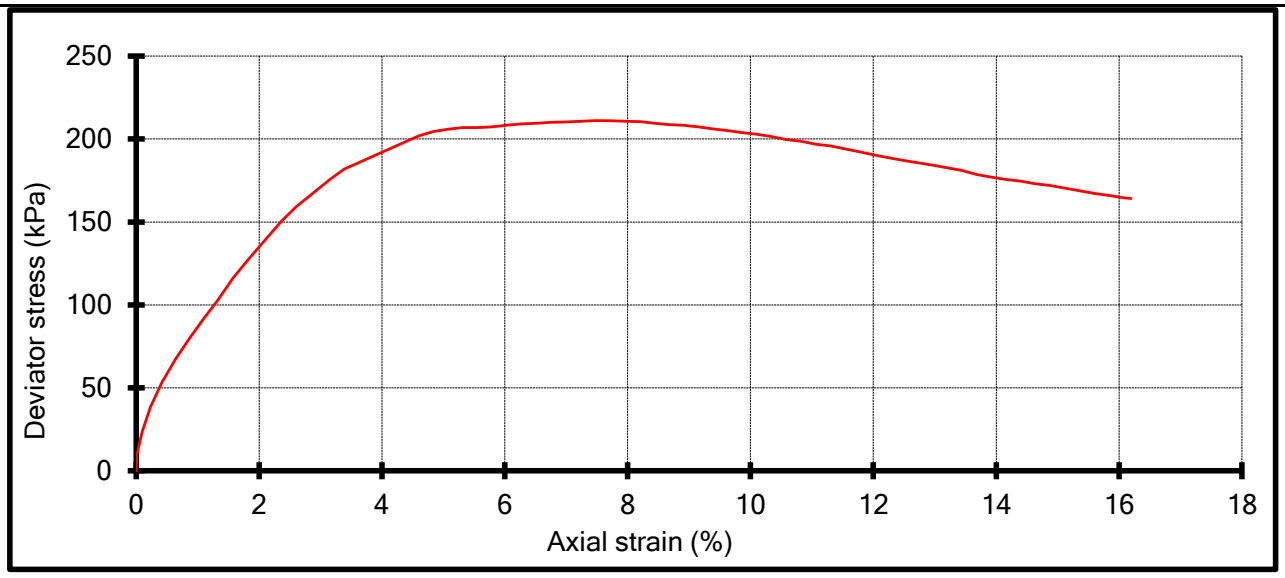
Triaxial Compression Test Results

(UNDRAINED WITHOUT PORE PRESSURE MEASUREMENT)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-2
Project :	Officer South Retarding Basin	**Report Date :**	24 Feb 2023
		Date Sampled :	23 Jan 2023
Location :	Officer South Road, Officer South VIC	**Date of Test:**	23 Feb 2023
Test Location :	BH01	**Sample Type:**	Undisturbed
Depth / Layer :	2.00-2.40(m)	**Page:**	1 of 1
Sample Description:	Silty CLAY	**Geotester Ref:**	ME-5226C



UNDRAINED SHEAR STRENGTH **Stage 1**

C_u **(kPa)** **106**

STAGE DETAILS

Cell pressure (kPa):	40
Strain rate (mm/min):	1.50
Strain at failure (%):	7.72
Maximum deviator stress (kPa):	211

SPECIMEN DETAILS

Dry density (t/m^3):	1.70	
Sample Length (mm):	126	
Sample Diameter (mm):	64	
Specific Gravity (t/m^3):	2.65	(Assumed)
Initial Degree of Saturation (%):	91	

SAMPLE: BEFORE | AFTER TEST

NOTES

1. Membrane corrections were applied.
2. Mode of Failure: Shear 65°

Sampling Method(s): Sampled by DP Engineering. The results apply to the sample as received.
Test Method(s): AS1289.6.4.1, AS1289.2.1.1

NATA Accredited Laboratory Number: 828
Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH/SB
Checked: SB

Peter Chan
Associate

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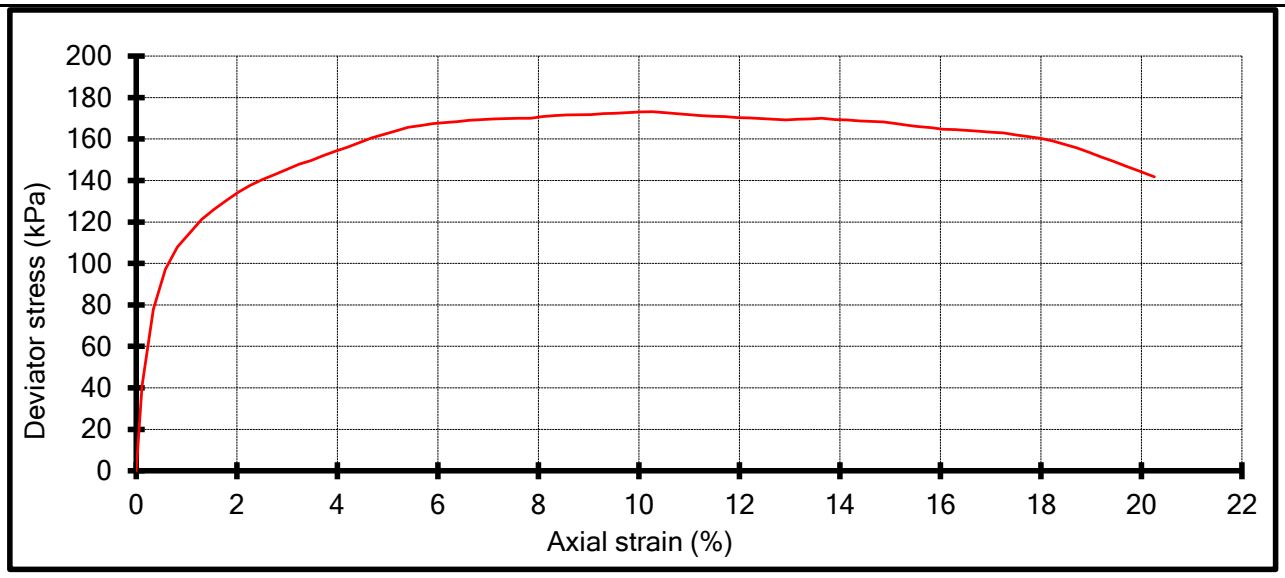
Triaxial Compression Test Results

(UNDRAINED WITHOUT PORE PRESSURE MEASUREMENT)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-3
Project :	Officer South Retarding Basin	**Report Date :**	24 Feb 2023
		Date Sampled :	23 Jan 2023
Location :	Officer South Road, Officer South VIC	**Date of Test:**	23 Feb 2023
Test Location :	BH02	**Sample Type:**	Undisturbed
Depth / Layer :	1.00-1.23(m)	**Page:**	1 of 1
Sample Description:	Silty CLAY	**Geotester Ref:**	ME-5226H



UNDRAINED SHEAR STRENGTH	**Stage 1**
C_u (kPa)	**87**

STAGE DETAILS

Cell pressure (kPa):	20
Strain rate (mm/min):	1.50
Strain at failure (%):	10.27
Maximum deviator stress (kPa):	173

SPECIMEN DETAILS

Dry density (t/m^3):	1.65	
Sample Length (mm):	124	
Sample Diameter (mm):	63	
Specific Gravity (t/m^3):	2.65	(Assumed)
Initial Degree of Saturation (%):	89	

SAMPLE: BEFORE | AFTER TEST

NOTES

1. Membrane corrections were applied.
2. Mode of Failure: Shear 60°

Sampling Method(s): Sampled by DP Engineering. The results apply to the sample as received.
Test Method(s): AS1289.6.4.1, AS1289.2.1.1

NATA Accredited Laboratory Number: 828
Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

Peter Chan
Associate

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-4
Project :	Officer South Retarding Basins	**Report Date :**	17 Mar 2023
		Date Samped:	23 Jan 2023
Location :	Officer South Road, Officer South, Victoria	**Date of Test:**	17 Feb 2023
		Page:	1 of 1

Sample No:	ME-5226D	
Depth / Layer:	BH01, Depth: 6.00-6.13(m)	
Sample Description:	Clayey SAND	
Sample Preparation:	Undisturbed	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	65	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	17.2	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**2×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to the sample as received.

Remarks:

NATA Accredited Laboratory No 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

Scott Benbow
Laboratory Manager

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Results of Constant Head Permeability Test using a Flexible Wall Permeameter

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-5
Project :	Officer South Retarding Basins	**Report Date :**	17 Mar 2023
		Date Samped:	23 Jan 2023
Location :	Officer South Road, Officer South, Victoria	**Date of Test:**	20 Feb 2023
		Page:	1 of 1

Sample No:	ME-5226K	
Depth / Layer:	BH09, Depth: 3.50-3.90(m)	
Sample Description:	Silty CLAY	
Sample Preparation:	Undisturbed	
Oversized Material Retained:	Undisturbed sample - Not Applicable	
Averaged Sample Length:	64	mm
Averaged Sample Diameter:	63	mm
Length-to-Diameter Ratio	1.0 :1	
Moisture Content After Test:	30.5	%
Permeant Used:	Potable Water	
Mean Effective Stress:	50	kPa
Coefficient of Permeability:	**1×10^{-10}**	m/s

Test Method(s): AS1289.6.7.3, AS 1289.2.1.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to the sample as received.

Remarks:

NATA Accredited Laboratory No 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: TH
Checked: SB

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Laboratory Manager

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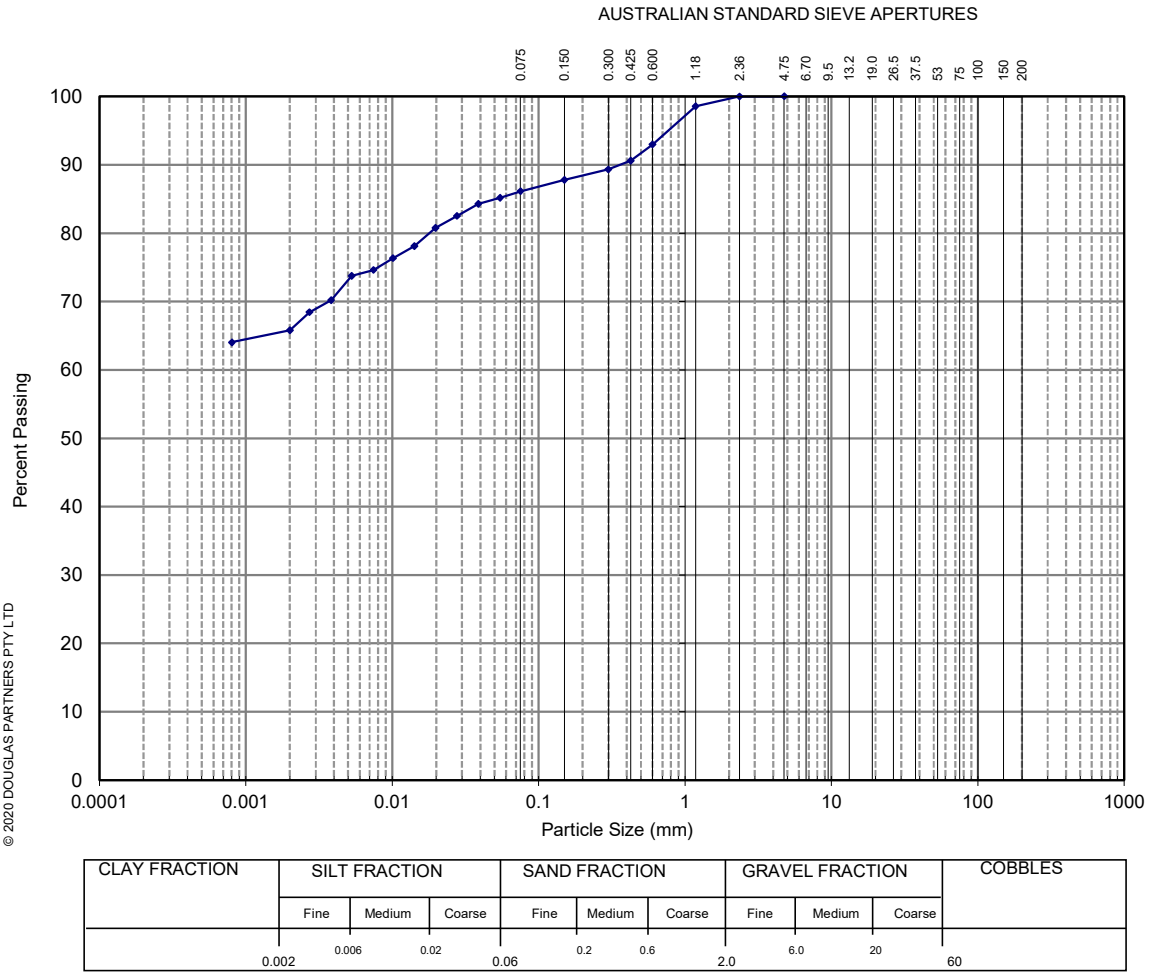
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-6
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	TP01	**Date of Test:**	22/02/2023
Depth / Layer:	0.50-0.70m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	100%
1.18	99%
0.600	93%
0.425	91%
0.300	89%
0.150	88%
0.075	86%
0.039	84%
0.028	83%
0.020	81%
0.014	78%
0.010	76%
0.007	75%
0.005	74%
0.004	70%
0.003	68%
0.002	66%
0.001	64%

Description: Silty CLAY trace sand

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.58 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

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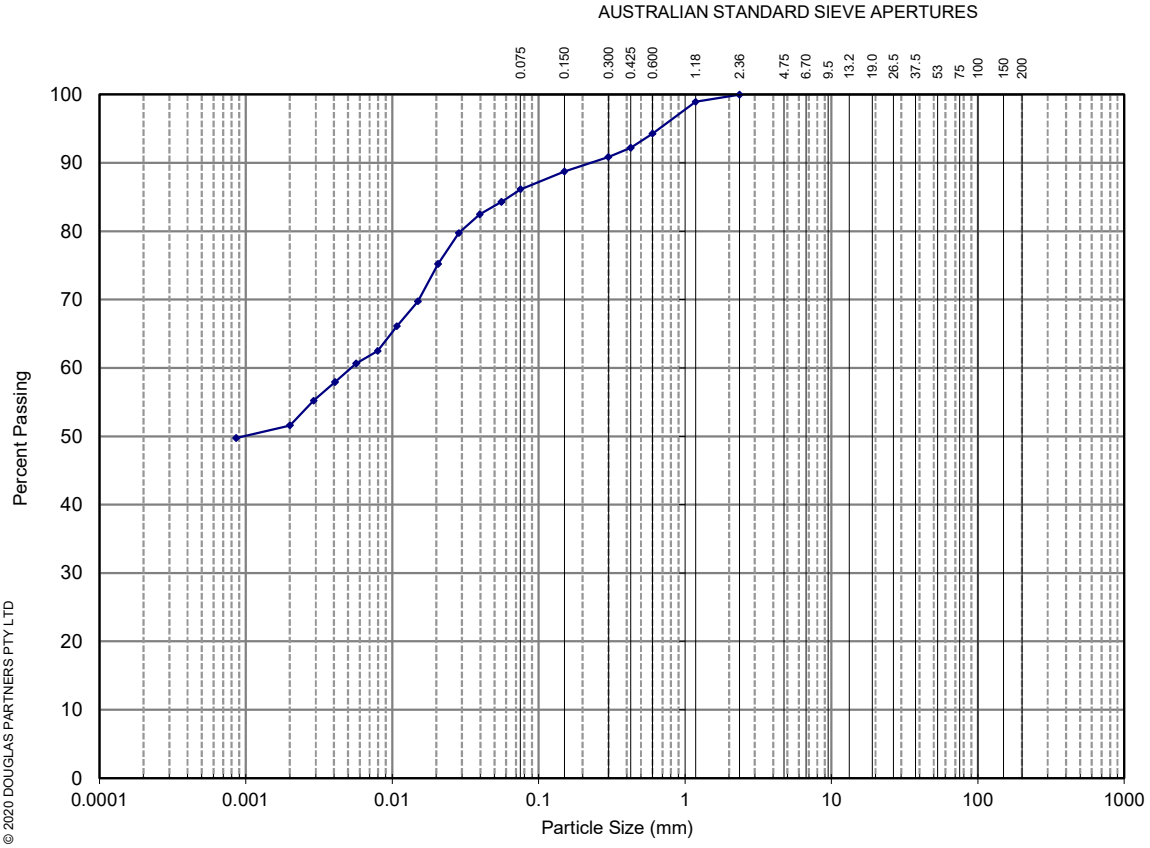
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-7
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	TP18	**Date of Test:**	22/02/2023
Depth / Layer:	0.60-0.80m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	**100%**
1.18	**99%**
0.600	**94%**
0.425	**92%**
0.300	**91%**
0.150	**89%**
0.075	**86%**
0.040	**82%**
0.028	**80%**
0.021	**75%**
0.015	**70%**
0.011	**66%**
0.008	**62%**
0.006	**61%**
0.004	**58%**
0.003	**55%**
0.002	**52%**
0.001	**50%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty CLAY trace sand

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.60 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

Scott Benbow
Laboratory Manager

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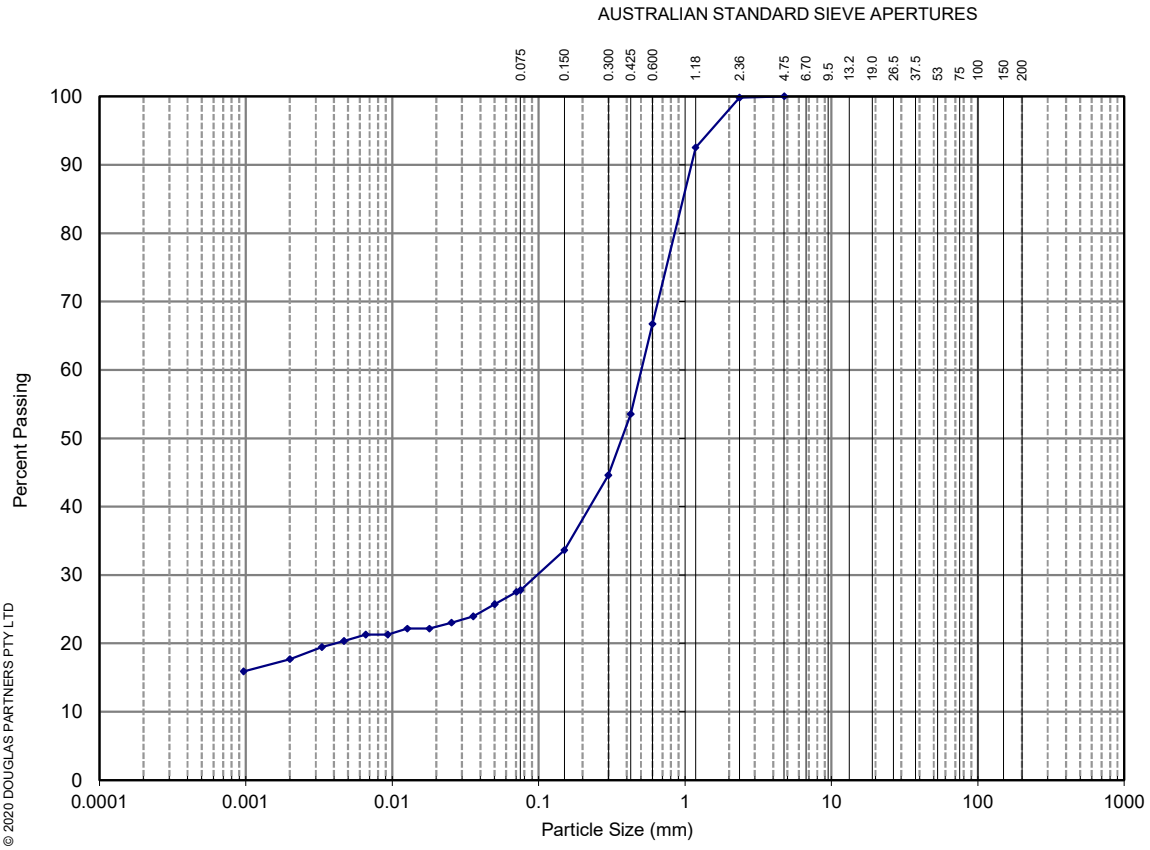
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-8
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH01	**Date of Test:**	22/02/2023
Depth / Layer:	6.13-6.58m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**93%**
0.600	**67%**
0.425	**54%**
0.300	**45%**
0.150	**34%**
0.075	**28%**
0.050	**26%**
0.036	**24%**
0.025	**23%**
0.018	**22%**
0.013	**22%**
0.009	**21%**
0.007	**21%**
0.005	**20%**
0.003	**19%**
0.002	**18%**
0.001	**16%**

Description: Clayey SAND

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.59 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

Scott Benbow
Laboratory Manager

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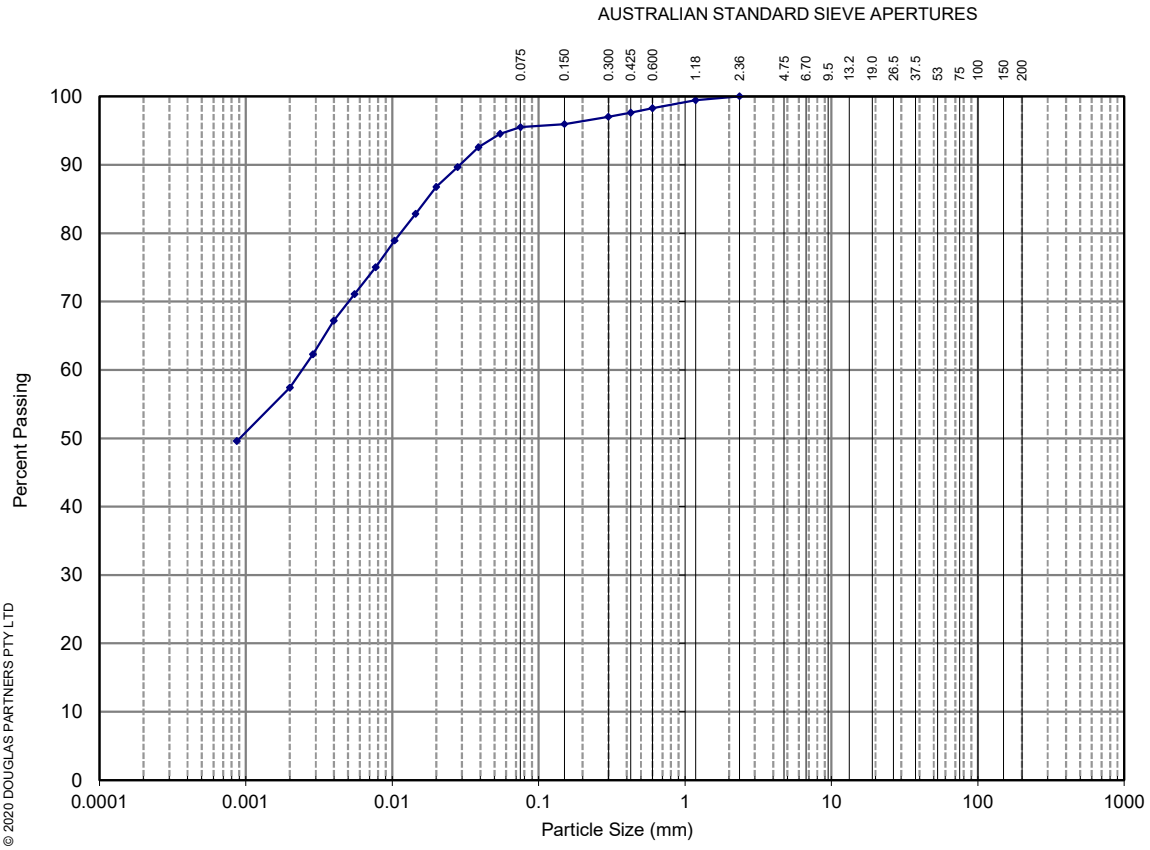
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-9
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH01	**Date of Test:**	22/02/2023
Depth / Layer:	8.00-8.45m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	**100%**
1.18	**99%**
0.600	**98%**
0.425	**98%**
0.300	**97%**
0.150	**96%**
0.075	**95%**
0.039	**93%**
0.028	**90%**
0.020	**87%**
0.014	**83%**
0.010	**79%**
0.008	**75%**
0.006	**71%**
0.004	**67%**
0.003	**62%**
0.002	**57%**
0.001	**50%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty CLAY trace sand

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.58 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

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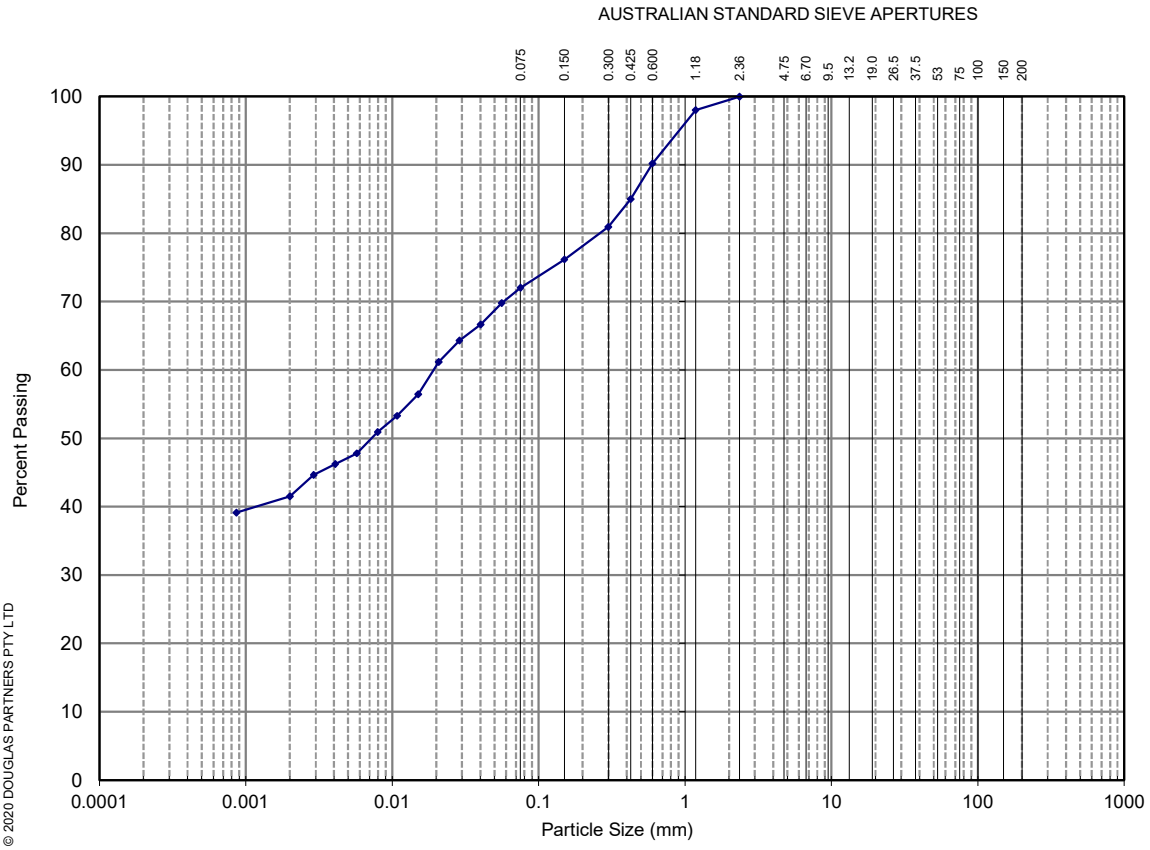
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-10
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH02	**Date of Test:**	22/02/2023
Depth / Layer:	0.50-2.50m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	**100%**
1.18	**98%**
0.600	**90%**
0.425	**85%**
0.300	**81%**
0.150	**76%**
0.075	**72%**
0.040	**67%**
0.029	**64%**
0.021	**61%**
0.015	**56%**
0.011	**53%**
0.008	**51%**
0.006	**48%**
0.004	**46%**
0.003	**45%**
0.002	**41%**
0.001	**39%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02		0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty CLAY with sand

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.61 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

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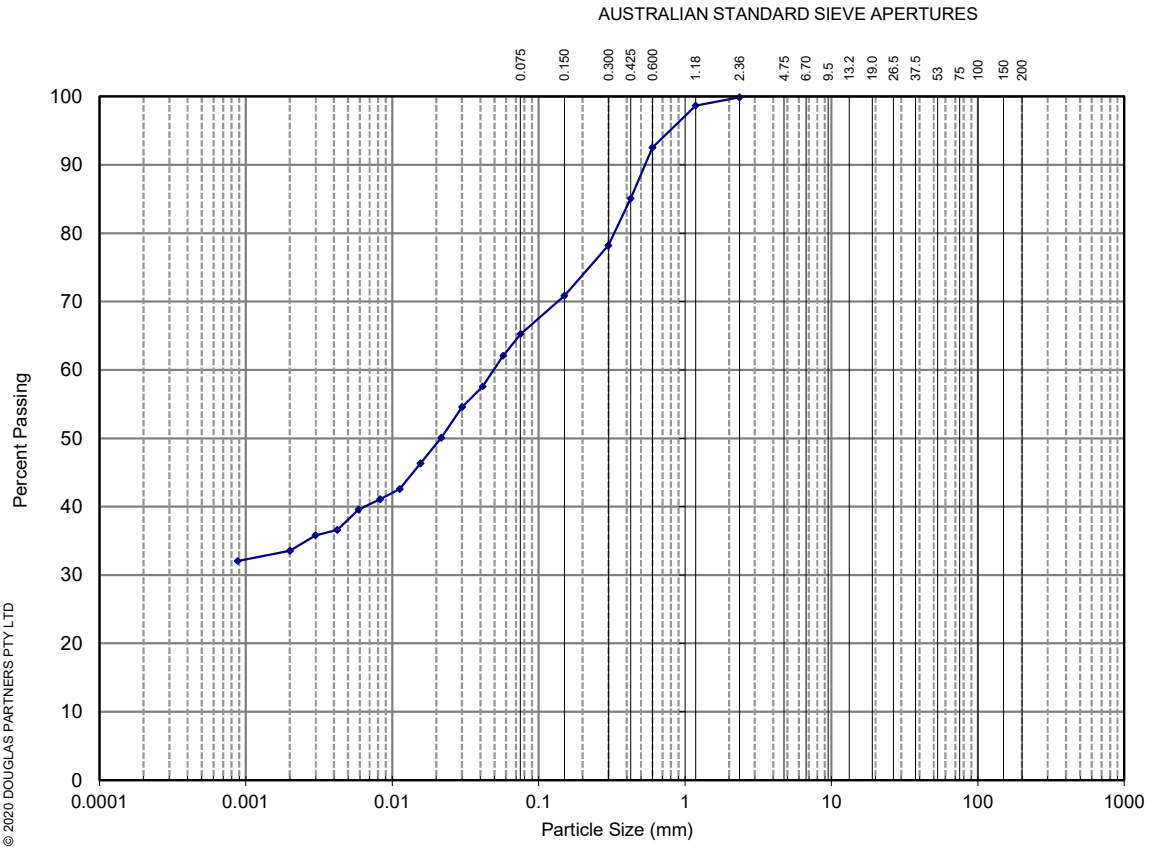
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-11
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH02	**Date of Test:**	22/02/2023
Depth / Layer:	1.23-1.68m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	**100%**
1.18	**99%**
0.600	**93%**
0.425	**85%**
0.300	**78%**
0.150	**71%**
0.075	**65%**
0.042	**58%**
0.030	**55%**
0.022	**50%**
0.016	**46%**
0.011	**43%**
0.008	**41%**
0.006	**40%**
0.004	**37%**
0.003	**36%**
0.002	**34%**
0.001	**32%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: Sandy silty CLAY

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.61 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

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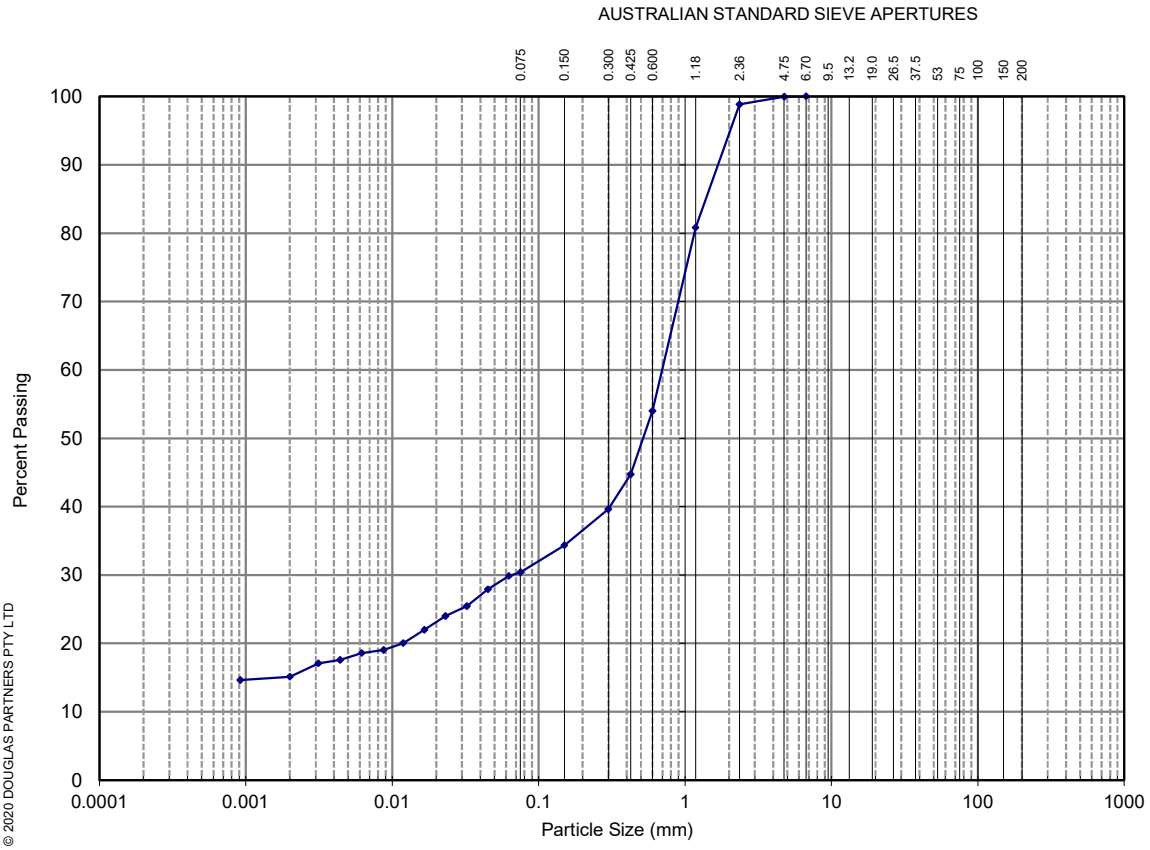
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-12
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH02	**Date of Test:**	22/02/2023
Depth / Layer:	6.00-6.45m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	100%
4.75	100%
2.36	99%
1.18	81%
0.600	54%
0.425	45%
0.300	40%
0.150	34%
0.075	30%
0.045	28%
0.032	25%
0.023	24%
0.017	22%
0.012	20%
0.009	19%
0.006	19%
0.004	18%
0.003	17%
0.002	15%
0.001	15%

Description: Silty clayey SAND trace gravel

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.61 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

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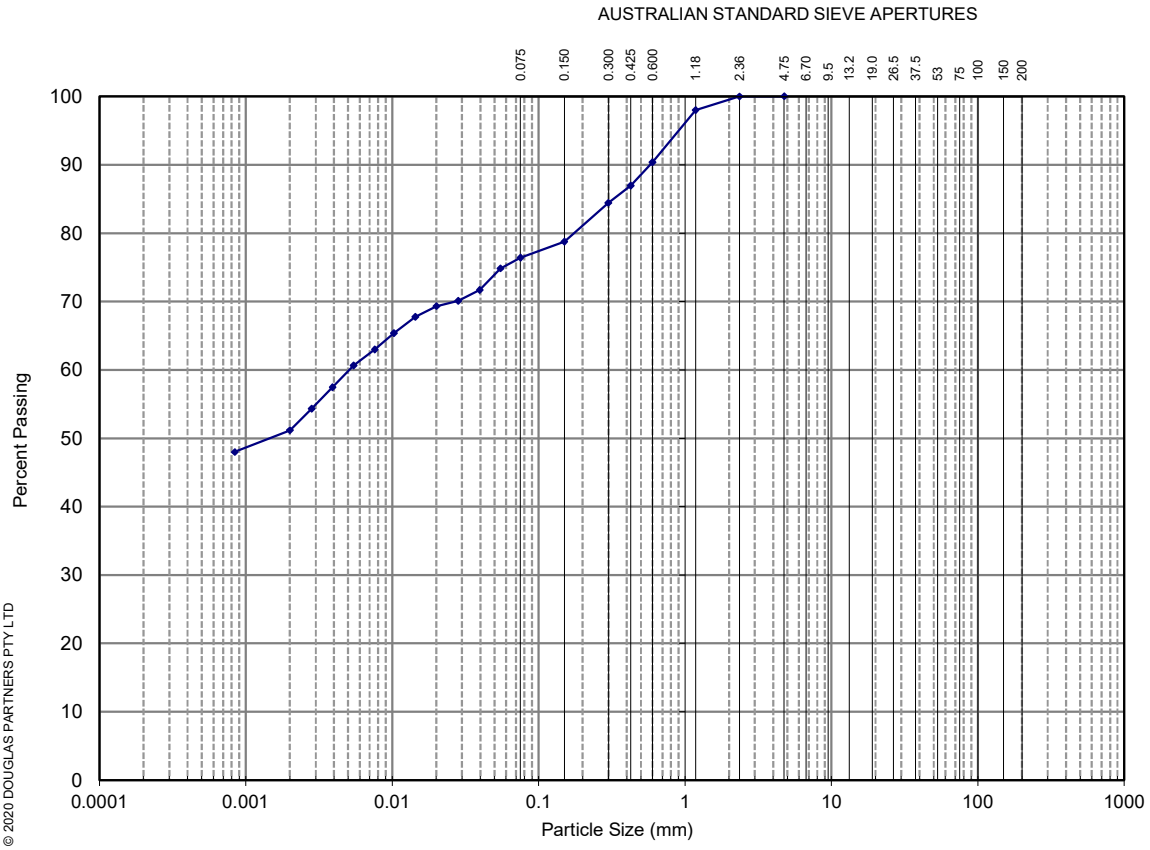
Results of Particle Size Distribution (Hydrometer)

Client :	Jacobs Group (Australia) Pty Ltd	**Project No. :**	217545.00
		Report No. :	217545.00-13
Project :	Officer South Retarding Basins	**Report Date :**	17/03/2023
Location :	Officer South Road, Officer South VIC	**Date Sampled:**	23/01/2023
Test Location:	BH09	**Date of Test:**	22/02/2023
Depth / Layer:	8.00-8.45m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**98%**
0.600	**90%**
0.425	**87%**
0.300	**84%**
0.150	**79%**
0.075	**76%**
0.040	**72%**
0.028	**70%**
0.020	**69%**
0.014	**68%**
0.010	**65%**
0.008	**63%**
0.005	**61%**
0.004	**57%**
0.003	**54%**
0.002	**51%**
0.001	**48%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty CLAY with sand

Test Method(s): AS 1289.3.6.1, AS1289.3.6.3, AS 1289.3.5.1

Sampling Method(s): Sampled by DP Engineering. Test results apply to sample as received.

Loss in pretreatment: 0%

Remarks: Soil Particle Density Passing 2.36 mm Sieve = 2.59 t/m³

Type of Hydrometer: g/l

NATA Accredited Laboratory Number: 828

Accredited for compliance with ISO/IEC 17025 - Testing

Tested: AFD
Checked: SB

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Laboratory Manager

Material Test Report

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Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380A
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 02/05/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH04 , Depth: 3.5-3.95m**
Material: Sandy CLAY

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	42		
Plastic Limit (%)	13		
Plasticity Index (%)	**29**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**9.0**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	16.8		

Material Test Report

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Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380B
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 25/04/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH05 , Depth: 2-2.45m**
Material: Sandy CLAY

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	39		
Plastic Limit (%)	13		
Plasticity Index (%)	**26**		
125mm Linear Shrinkage mould used.			

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.0**		
Cracking Crumbling Curling	Curling		
125mm Linear Shrinkage mould used.			

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	15.1		

Material Test Report

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Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380C
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 26/04/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **BH07 , Depth: 6.5-6.95m**
Material: Silty CLAY

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	57		
Plastic Limit (%)	18		
Plasticity Index (%)	**39**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)		Min	Max
Moisture Content (%)	24.8		

Material Test Report

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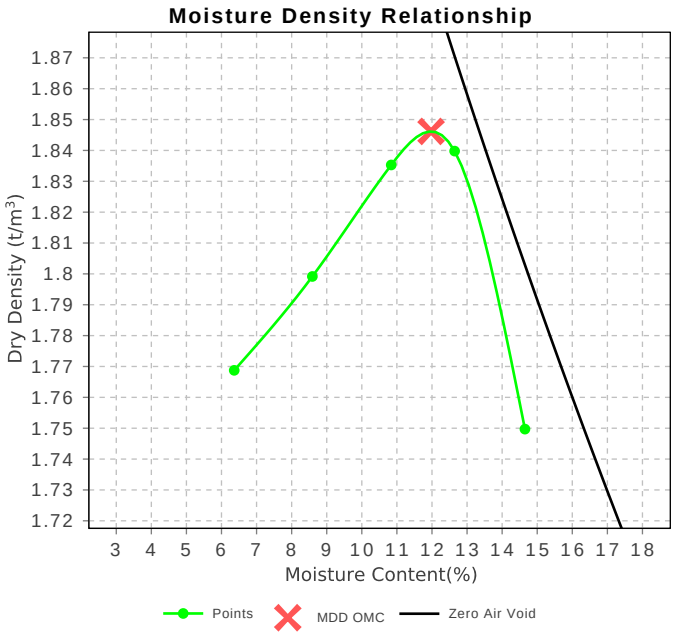
Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380F
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 28/04/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP09, Depth: 0.3-0.5m**
Material: Sandy SILT

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.85		
Optimum Moisture Content (%)	12.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual Assessment		
Curing Hours (h)	115.7		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	4.3

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		



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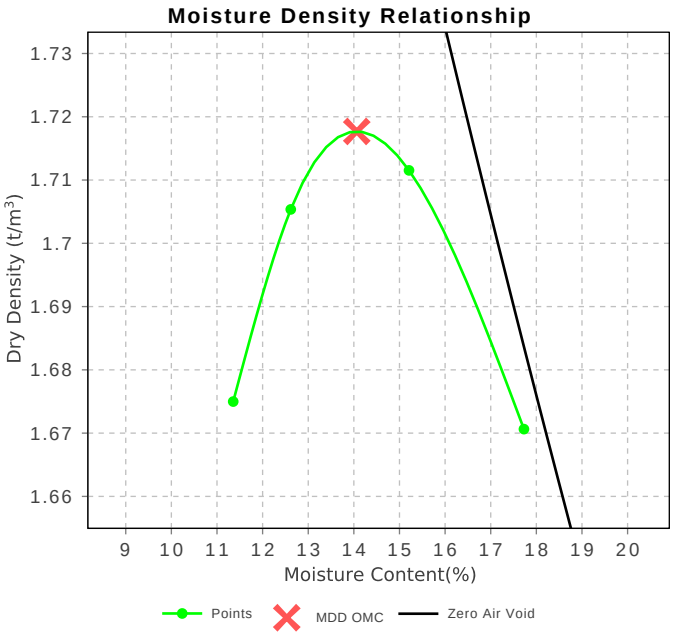
Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

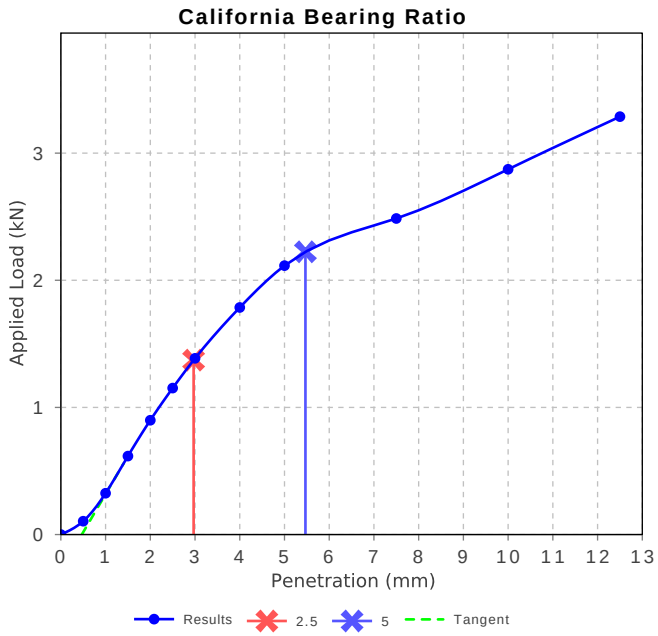
Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380G
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 01/05/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP11 , Depth: 0.2-0.4m**
Material: Sandy SILT

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	14.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual Assessment		
Curing Hours (h)	116.6		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	5.2

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**11**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	14.0		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	102.0		
Dry Density after Soaking (t/m^3)	1.67		
Field Moisture Content (%)	5.4		
Moisture Content at Placement (%)	14.3		
Moisture Content Top 30mm (%)	18.2		
Moisture Content Rest of Sample (%)	18.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	147.4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		





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Email: scott.benbow@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380G
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 08/05/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP11 , Depth: 0.2-0.4m**
Material: Sandy SILT

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	19		
Plastic Limit (%)	17		
Plasticity Index (%)	**2**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**1.0**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	As above		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		

Pinhole Dispersion Classification (AS 1289.3.8.3)	
Pinhole Dispersion Classification	D1 Highly dispersive
Rate of Flow on completion (mm/s)	0.6
Natural Moisture Content (%)	4.5
Moisture Content Before Testing (%)	13.9
Standard Maximum Dry Density (t/m^3)	1.72
Time Matured in Cylinder (hh:mm)	72:00
Method of Moisture Determination for Remoulding	OMC
Source of Water Used	Distilled
Was Hole Reformed at 50mm Head	N

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Melbourne Laboratory
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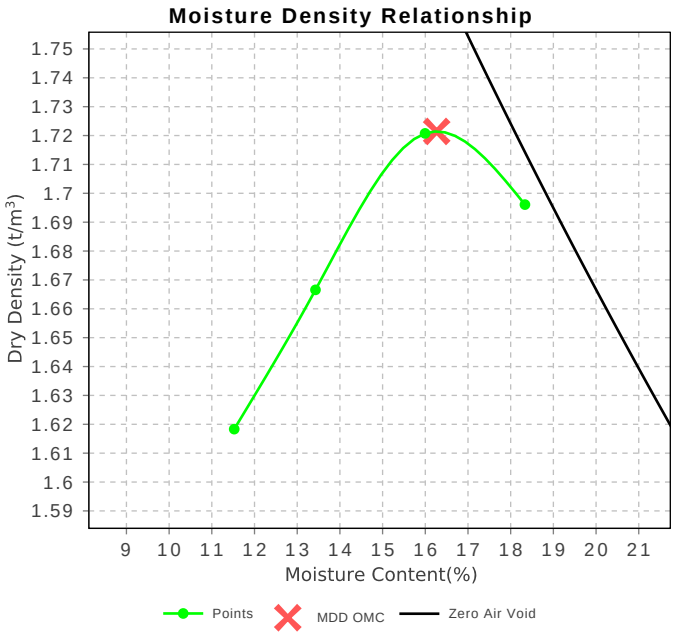
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380H
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 28/04/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP14, Depth: 0.3-0.5m**
Material: Sandy SILT

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.72		
Optimum Moisture Content (%)	16.5		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual Assessment		
Curing Hours (h)	117.0		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	9.6

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Silty CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		



Material Test Report

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Approved Signatory: Scott Benbow
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Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380I
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 04/05/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP20 , Depth: 0.3-0.5m**
Material: Sandy SILT

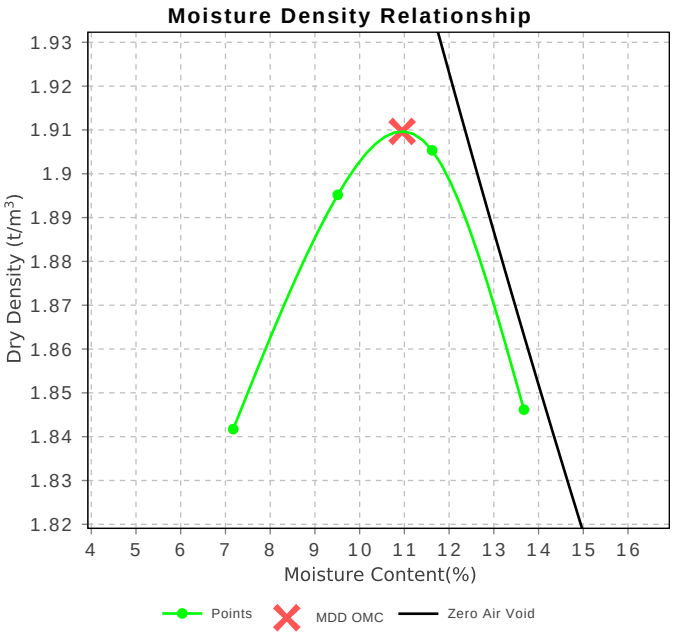
Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.91		
Optimum Moisture Content (%)	11.0		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual Assessment		
Curing Hours (h)	117.9		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	5.2

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	25		
Plastic Limit (%)	16		
Plasticity Index (%)	**9**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**4.5**		
Cracking Crumbling Curling	None		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	As above		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		



Material Test Report

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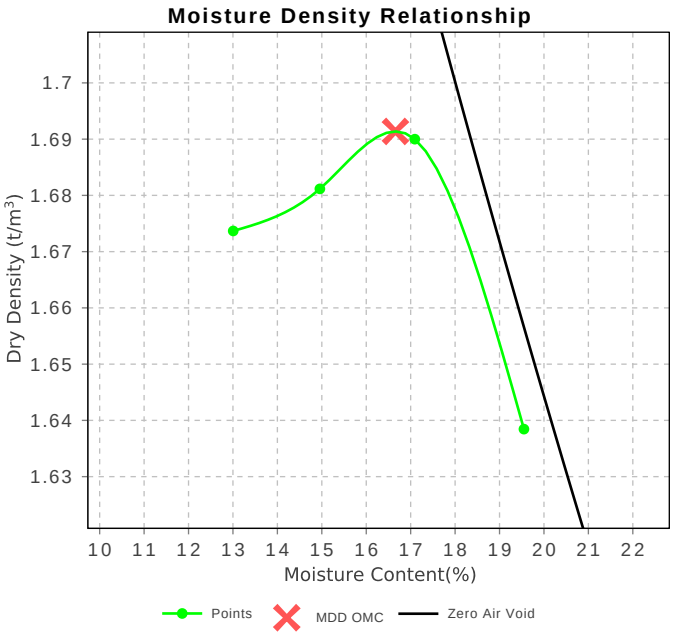
Approved Signatory: Scott Benbow
Laboratory Manager
Laboratory Accreditation Number: 828

Report Number: **217545.00-14**
Issue Number: 1
Date Issued: 12/05/2023
Client: Jacobs Group (Australia) Pty Ltd
Level 11, 452 Flinders Street, Melbourne VIC 3000
Project Number: 217545.00
Project Name: Officer South Retarding Basins
Project Location: Officer South Road, Officer South VIC
Work Request: 5380
Sample Number: ME-5380J
Date Sampled: 23/01/2023
Dates Tested: 19/04/2023 - 28/04/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **TP23, Depth: 0.3-0.5m**
Material: Silty CLAY

Dry Density - Moisture Relationship (AS 1289 5.1.1 & 2.1.1)		Min	Max
Mould Type	1 LITRE MOULD A		
Compaction	Standard		
Maximum Dry Density (t/m^3)	1.69		
Optimum Moisture Content (%)	16.5		
Oversize Sieve (mm)	19.0		
Oversize Material Wet (%)	0		
Method used to Determine Plasticity	Visual Assessment		
Curing Hours (h)	118.8		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.1

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	As above		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	22		



Envirolab Services Pty Ltd
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CERTIFICATE OF ANALYSIS 35958

Client Details

Client	Douglas Partners
Attention	Evan Denton
Address	231 Normanby Road, PO Box 5051, South Melbourne, VIC, 3205

Sample Details

Your Reference	**217545.00 Officer South**
Number of Samples	3 Soil
Date samples received	22/02/2023
Date completed instructions received	22/02/2023

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	01/03/2023
Date of Issue	28/02/2023

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Results Approved By
Pamela Adams, Laboratory Manager, Melbourne
Tara White, Metals Team Leader

Authorised By

Pamela Adams, Laboratory Manager

Aggressivity in Soil				
Our Reference		35958-1	35958-2	35958-3
Your Reference	UNITS	TP01	BH02	TP18
Depth		0.5-0.7	0.5	0.6-0.8
Date Sampled		20/02/2023	21/02/2023	20/02/2023
Type of sample		Soil	Soil	Soil
Date Extracted	-	23/02/2023	23/02/2023	23/02/2023
Date analysed	-	24/02/2023	24/02/2023	24/02/2023
pH 1:5 soil:water	pH Units	6.2	5.7	5.6
Electrical Conductivity 1:5 soil:water	µS/cm	410	210	180
Chloride, Cl 1:5 soil:water	mg/kg	330	130	39
Sulphate, SO4 1:5 soil:water	mg/kg	210	120	230

Cation exchange capacity				
Our Reference		35958-1	35958-2	35958-3
Your Reference	UNITS	TP01	BH02	TP18
Depth		0.5-0.7	0.5	0.6-0.8
Date Sampled		20/02/2023	21/02/2023	20/02/2023
Type of sample		Soil	Soil	Soil
Date extracted	-	27/02/2023	27/02/2023	27/02/2023
Date analysed	-	27/02/2023	27/02/2023	27/02/2023
Exchangeable Ca	meq/100g	3.7	0.9	0.2
Exchangeable K	meq/100g	0.1	0.1	0.2
Exchangeable Mg	meq/100g	7.1	5.0	7.6
Exchangeable Na	meq/100g	1.7	1.5	1.2
Cation Exchange Capacity	meq/100g	13	7.6	9.2

Moisture				
Our Reference		35958-1	35958-2	35958-3
Your Reference	UNITS	TP01	BH02	TP18
Depth		0.5-0.7	0.5	0.6-0.8
Date Sampled		20/02/2023	21/02/2023	20/02/2023
Type of sample		Soil	Soil	Soil
Date prepared	-	23/02/2023	23/02/2023	23/02/2023
Date analysed	-	24/02/2023	24/02/2023	24/02/2023
Moisture	%	24	15	19

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105°C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110-B. Water samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.

QUALITY CONTROL: Aggressivity in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	2	5.7	5.6	2	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	2	210	240	13	108	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	130	120	8	92	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	120	140	15	89	[NT]

QUALITY CONTROL: Cation exchange capacity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	35958-2
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	3	0.2	0.2	0	93	91
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	3	0.2	0.2	0	93	95
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	3	7.6	7.1	7	89	77
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	3	1.2	1.1	9	88	79
Cation Exchange Capacity	meq/100g	1	Metals-020	<1	3	9.2	8.6	7	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

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CERTIFICATE OF ANALYSIS 36978

Client Details

Client	Douglas Partners
Attention	Evan Denton
Address	231 Normanby Road, PO Box 5051, South Melbourne, VIC, 3205

Sample Details

Your Reference	**217545.00 Officer South**
Number of Samples	5 Soil
Date samples received	24/04/2023
Date completed instructions received	26/04/2023

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	03/05/2023
Date of Issue	15/05/2023
Reissue Details	This report supersedes 36978_R00 due to removal of TP08 results from final report.

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Results Approved By
Chris De Luca, Assistant Lab Manager

Authorised By

Pamela Adams, Laboratory Manager

Aggressivity in Soil					
Our Reference		36978-1	36978-2	36978-3	36978-5
Your Reference	UNITS	TP14	TP20	TP23	TP11
Depth		0.3-0.5	0.3-0.5	0.3-0.5	0.2-0.4
Date Sampled		30/03/2023	04/03/2023	04/03/2023	30/03/2023
Type of sample		Soil	Soil	Soil	Soil
Date Extracted	-	27/04/2023	27/04/2023	27/04/2023	27/04/2023
Date analysed	-	27/04/2023	27/04/2023	27/04/2023	27/04/2023
pH 1:5 soil:water	pH Units	6.0	6.7	5.3	5.9
Chloride, Cl 1:5 soil:water	mg/kg	21	<10	10	27
Sulphate, SO4 1:5 soil:water	mg/kg	33	10	20	26

Cation exchange capacity					
Our Reference		36978-1	36978-2	36978-3	36978-5
Your Reference	UNITS	TP14	TP20	TP23	TP11
Depth		0.3-0.5	0.3-0.5	0.3-0.5	0.2-0.4
Date Sampled		30/03/2023	04/03/2023	04/03/2023	30/03/2023
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	01/05/2023	01/05/2023	01/05/2023	01/05/2023
Date analysed	-	01/05/2023	01/05/2023	01/05/2023	01/05/2023
Exchangeable Ca	meq/100g	2.0	2.3	1.1	1.0
Exchangeable K	meq/100g	0.2	0.2	<0.1	0.1
Exchangeable Mg	meq/100g	2.2	1.3	0.3	0.6
Exchangeable Na	meq/100g	0.2	<0.1	<0.1	<0.1
Cation Exchange Capacity	meq/100g	4.6	3.8	1.5	1.8

Moisture					
Our Reference		36978-1	36978-2	36978-3	36978-5
Your Reference	UNITS	TP14	TP20	TP23	TP11
Depth		0.3-0.5	0.3-0.5	0.3-0.5	0.2-0.4
Date Sampled		30/03/2023	04/03/2023	04/03/2023	30/03/2023
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	26/04/2023	26/04/2023	26/04/2023	26/04/2023
Date analysed	-	27/04/2023	27/04/2023	27/04/2023	27/04/2023
Moisture	%	11	7.4	5.3	3.6

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only as analysis outside of the APHA storage times.
Inorg-008	Moisture content determined by heating at 105°C for a minimum of 12 hours.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110-B. Water samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-AES analytical finish.

QUALITY CONTROL: Aggressivity in Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	6.0	6.1	2	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	21	25	17	97	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	33	41	22	101	[NT]

QUALITY CONTROL: Cation exchange capacity						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	1	2.0	1.7	16	95	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	1	0.2	0.2	0	89	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	1	2.2	2.2	0	92	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	1	0.2	0.2	0	91	[NT]
Cation Exchange Capacity	meq/100g	1	Metals-020	<1	1	4.6	4.3	7	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

pH, Chloride, Sulphate and CEC have exceeded the recommended technical holding times, Envirolab Group Form 347 "Recommended Preservation and Holding Times" can be provided on request (available on the Envirolab website)