GEOTECHNICAL AND SALINITY INVESTIGATION REPORT

ADDRESS:	**249, 259 & 271 Railway Terrace, Schofields**
CLIENT:	**JS Architects**
DATE:	**31 July 2017**
REPORT NO:	**NE166-17**

GEOTESTA

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1. INTRODUCTION

Geotesta was engaged by JS Architects to conduct geotechnical investigation including soil contamination assessment at 249, 259 & 271 Railway Terrace, Schofields NSW. The proposed development includes residential development.

The field work was carried out on 15 July 2017. This report presents the geotechnical investigation results including sub-surface soil profile with interpreted geotechnical properties of the assessed subsurface lithology, chemical analysis in relation to salinity and aggressivity, and recommendations on the design parameters of footing, geotechnical parameters including allowable bearing capacity, shaft friction, friction angle, cohesion, and young's modulus.

This assessment has been carried out in general accordance with the following guidelines:

- The soil contamination assessment is performed in accordance with AS4482.1 - 2005, AS4482.2 – 2005;
- Department of Land and Water Conservation (DLWC, 2002), *Site Investigations for Urban Salinity;*
- Western Sydney Salinity Code of Practice March 2003 (Amended January 2004);
- Australian Standard (AS) 3600 (2009), Concrete Structures;
- The National Environment Protection Council (NEPC), amended on 30 April 2013 and
- Other relevant NSW guidelines and legislation.

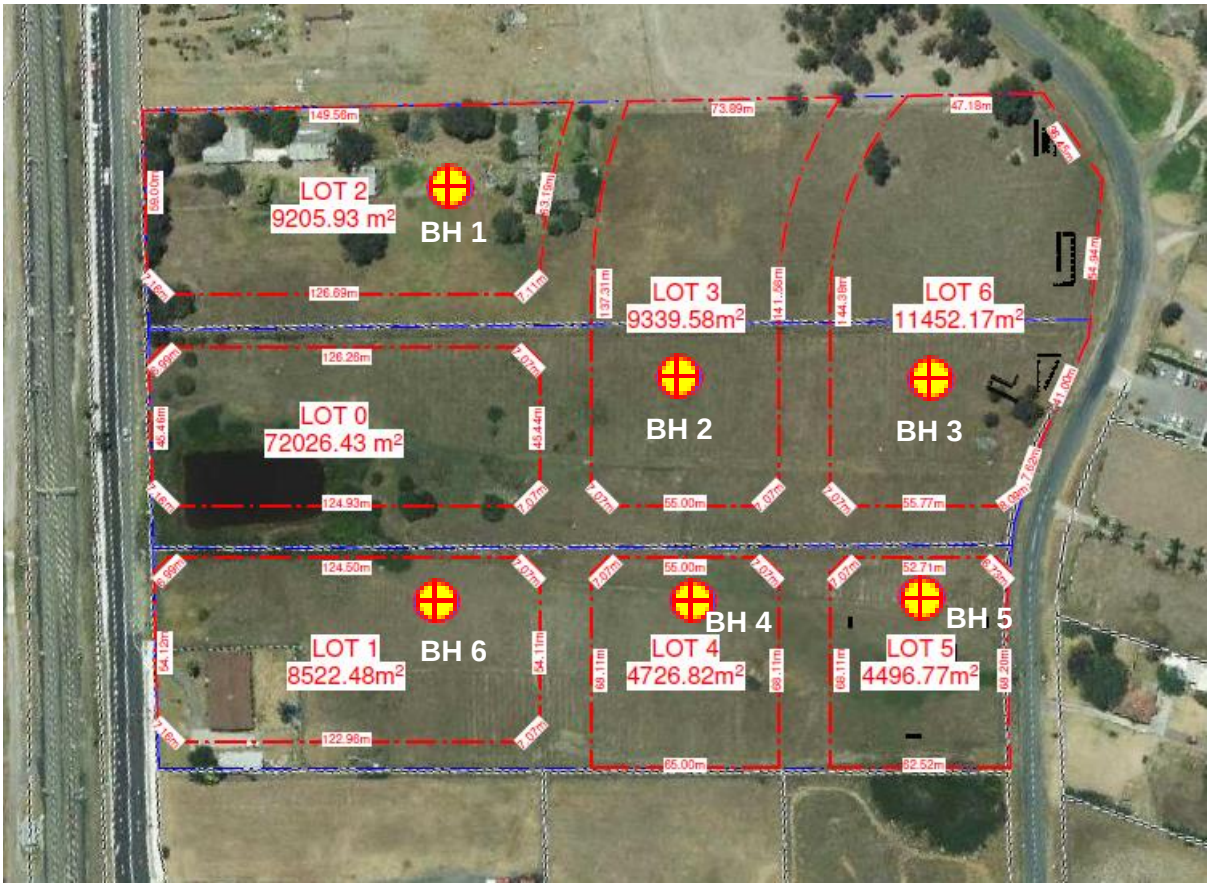
The soil contamination assessment was conducted in general accordance with the Australian Standards. The salinity assessment was carried out with reference to the Department of Infrastructure Planning and Natural Resources (DIPNR) publications.

2. FIELD INVESTIGATION

The investigation involved a total of six (6) boreholes to a maximum depth of 5.5m and six (6) DCP tests adjacent to each boreholes for the proposed residential development. A site plan showing the borehole and DCP test locations is presented on Figure 1. Borehole drilling was undertaken using a drilling rig PIXY 41T. All boreholes were drilled using solid flight augering method.

The soil profiles encountered in the boreholes were logged by a Geotechnical Engineer from Geotesta in accordance with Australian Standard AS 1726-1993. All field observations are presented on the borehole logs attached in Appendix A.

Figure 1: Site Plan, Borehole and DCP test Locations



⊕ *Denotes borehole locations*

3. FINDINGS

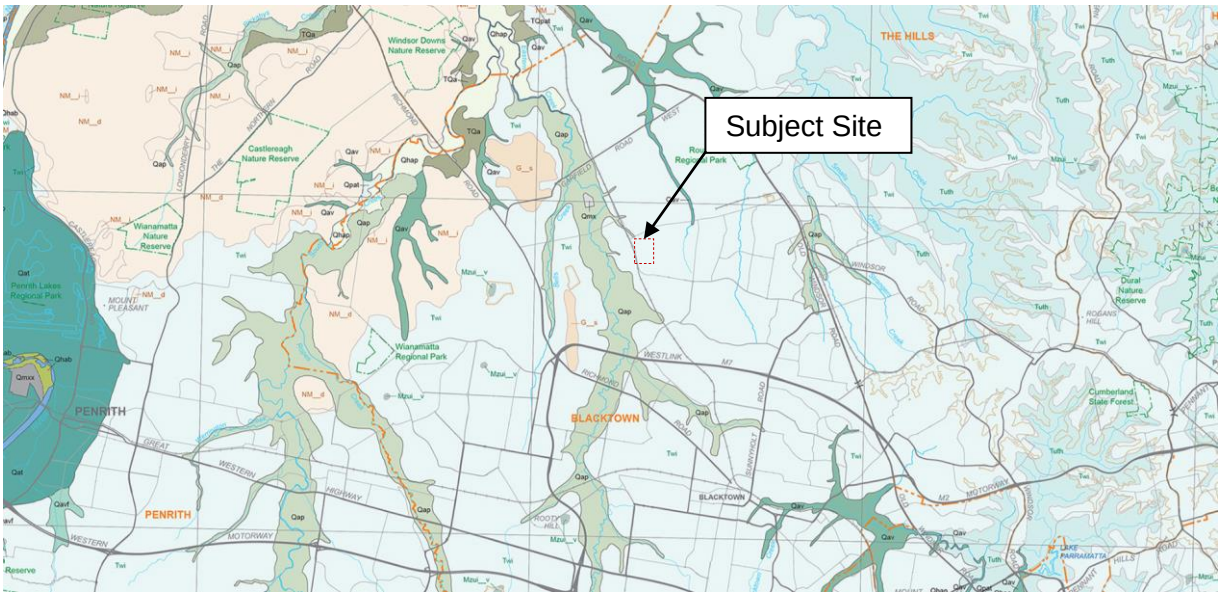
3.1 Site Topography

The proposed site at 249, 259 & 271 Railway Terrace in Schofields is virtually flat. The proposed site is covered by grass with medium to tall trees observed inside and on the perimeter of the site. Site no. 249 is occupied by sheds at the northern part of site, site no. 259 is a vacant land with a reservoir at the western part of site, while site no. 271 is occupied by a dwelling at the south western corner of site (Figure 1).

3.2 Site Geology

The geological origin of the soil profile was identified from our visual examination of the soil samples, geotechnical experience, and reference to geological maps of the area. The geological map of the area indicates that the site is underlain by siltstone, sandstone and shale of Wianamatta Group.

Figure 2: Geology Map of the Site with Package Code



Geological Unit: *Wianamatta Group (Twi) - Sandstone, siltstone and shale; common bioturbation*

3.3 Soil/Rock Profile

The encountered soil profiles are presented in the borehole logs in Appendix A and tabulated in detail in the Table 1 below.

Table 1: Summary of Sub-surface Materials

Borehole No.	Depth (m)	Soil/Rock Type	Compaction Level/Consistency
BH 1	0-0.2	Topsoil	Moderately compacted
	0.2-1.6	CLAY	Firm to stiff
	1.6-2.0	Sandy CLAY	Very stiff
	2.0-2.7	Shale	Hard
BH 2	0-0.2	Topsoil	Moderately compacted
	0.2-0.8	CLAY	Firm to Stiff
	0.8-1.3	CLAY	Very Stiff
	1.3-1.4	Sandy CLAY	Hard
BH 3	0-0.2	Topsoil	Moderately compacted
	0.2-0.6	CLAY	Firm
	0.6-1.3	CLAY	Very Stiff
	1.3-1.6	Sandy CLAY	Very stiff
	1.6-2.4	Shale	Hard
BH 4	0-0.2	Topsoil	Moderately compacted
	0.2-1.5	CLAY	Firm to stiff
	1.5-1.7	Sandy CLAY	Very stiff
	1.7-5.5	Shale	Hard
BH 5	0-0.2	Topsoil	Moderately compacted
	0.2-0.6	CLAY	Firm to stiff
	0.6-1.6	CLAY	Very Stiff
	1.6-2.0	Sandy CLAY	Very Stiff
	2.0-2.7	Shale	Hard
BH6	0-0.2	Topsoil	Moderately compacted
	0.2-0.8	CLAY	Soft to firm
	0.8-1.1	CLAY	Very Stiff
	1.1-2.2	Sandy CLAY	Very Stiff
	2.2-2.8	Shale	Hard

3.4 Site Classification

After considering the area geology, the soil profile encountered in the bores; the site is classified as CLASS M, with respect to foundation construction (Australian Standard 2870-2011 Residential Slabs and Footings).

It has been estimated that the Characteristic Surface Movement (ys) of the underlying natural soil material will be in the range of 20mm to 40mm provided the building site is protected from "abnormal moisture conditions" and is drained as described in AS 2870.

It must be emphasized that the heave mentioned and recommendations referred to in this report are based solely on the observed soil profile observed at the time of the investigation for this report, without taking into account any abnormal moisture conditions as defined in AS2870 – 2011, Clause 1.3.3 that might be created thereafter. With abnormal moisture conditions, distresses will occur and may result in "non-acceptable probabilities of serviceability and safety of the building during its design life," as defined in AS2870-2011, Clause 1.3.1. If these distresses are not acceptable to the builder, owner or other relevant parties then further fieldwork and revised footing recommendations must be carried out.

3.5 Groundwater

Groundwater was not encountered in any of the boreholes.

3.6 Laboratory Testing and Analysis – Salinity and Aggressivity

Three samples were sent to the NATA Accredited Eurofin MGT Laboratory for salinity and exposure classification.

Sample ID	pH	Sulphate (SO_4) (mg/kg)	Conductivity (uS/cm)	Exposure Classification
BH4	7.7	140	330	A2
BH5	8.6	170	500	A2
BH6	6.0	150	200	A2

Referring to the above test results the site is considered non to slightly saline.

An exposure classification for concrete of A2 should be adopted for preliminary design of proposed concrete structures.

4. FOUNDATION RECOMMENDATION

4.1 Strip/Pad Footing System

It is recommended that an engineer designed strip/pad footing system for a Class M site be used on this site. We recommend that the designing engineer refer to AS2870-2011 to ensure design compliance to this document.

The strip footings should be founded in the natural soil layer and penetrate through any fill material, tree roots and founded at least 100mm into the recommended founding material. As a guide with information obtained from the bores and DCP tests, the actual founding depth for strip/pad footings at the test locations should be as follow:

Table 2: Allowable Bearing Capacities for Pad/Strip Footings

Borehole No.	Founding Depth (mm)	Allowable Bearing Capacity (kPa)	Founding Material
BH 1 to BH6	600	120	Clay

The founding depth should be as stipulated above or to hard layer, whichever is encountered first. It should be noted that the soil profile may vary across the site. The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. It is recommended that a geotechnical engineer be engaged during footing excavation stage to confirm the founding depth and founding material.

4.2 Slab on Ground

It is recommended that an engineer designed slab on ground footing system for a Class M site be used on this site. We recommend that the designing engineer refer to AS2870-2011 to ensure design compliance to this document.

The edge and load bearing beams for the slab footings should be founded in the natural soil layer and penetrate through any fill material, tree roots and founded at least 100 mm into the recommended founding material. As a guide with information obtained from the bores and DCP tests the actual founding depth for edge and load bearing beams at the test locations should be as follow:

Table 3: Geotechnical parameters for Slab on Ground Footings

Borehole No.	Founding Depth (mm)	Allowable Bearing Capacity (kPa)	Founding Material
BH 1 to BH 6	600	100	Clay

It should be noted that the soil profile may vary across the site. The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. It is recommended that a geotechnical engineer be engaged during footing excavation stage to confirm the founding depth and founding material.

Slab panels and internal beams can be founded in the natural soil profile or in compacted surface filling and/or as required in the design by engineering principles. Compacted filling used to raise levels beneath panels must be placed and compacted as per specifications for controlled or rolled fill.

Controlled fill is material that has been placed and compacted in layers by compaction equipment within a defined moisture range to a defined density requirement. Except as provided below, controlled fill shall be placed in accordance with AS 3798.

If more than 400mm of CLAY FILL or 800mm of SAND FILL, imported or site derived, including existing FILL material, is required, then the slab must be designed as a suspended slab and supported by a grid of beams founded through any fill material in accordance with the above edge beam recommendations.

4.3 Bored Piers or Screw Piles

Bored piers or Screw piles can be used to support the proposed residential units. The pier/pile foundation of the proposed structure is assumed to be a high redundancy system and the intrinsic test factor (ϕ_{tf}) is assumed to be equal to basic geotechnical strength reduction factor (ϕ_{gb}), in accordance to AS2159-2009. The overall design average risk rating (ARR) is to be calculated by the designer and the corresponding geotechnical strength reduction shall be adopted.

Table 4: Allowable Skin Friction and End Bearing Capacity

Borehole No.	Depth (m)	Soil Type	Allowable Skin Friction (kPa)	Allowable End Bearing Capacity (kPa)
BH 1 to BH6	Below 1.0	CLAY	50	300

4.3.1 Pile Construction Considerations

Where necessary and appropriate, at contractor's discretion, a temporary casing may be used to prevent the pile excavation from collapsing. The inside of the casing must be clean and free of any projections (such as weld backing bars) which could be an obstacle to the placing and positioning of the reinforcement cage for the piles. Temporary casings may be left in place provided that the minimum socket length is not cased and the minimum cover to reinforcement is maintained. Where a casing is left in place, gaps between the casing and the sides of excavations shall be filled with sand, and compact the sand by flooding. In the case of piles subject to high lateral loads (e.g. abutment piles and anchor pier piles), fill such gaps with a cementitious grout containing fine aggregates proportioned to produce a pourable liquid without segregation, with a compressive strength at 28 days not less than 10MPa when sampled and tested to Test Method RMS T375. Cement used for the grout must conform to Specification RMS 3211.

5. EXCAVATION, RETAINING WALL & LATERAL EARTH PRESSURES

5.1 Temporary Cut Batter and Excavation

Excavation in the stiff to very stiff clay can be undertaken to 1.0m depth without battering back. While for an excavation deeper than 1.0m, the cut batter should be no steeper than 1H:1V. The above recommendations are based on the assumption that there is no existing structure adjacent to the excavation area. Even at the above cut batters it should be noted that following rainy periods, some degree of fretting and minor slumping could be anticipated.

Soft excavation condition is expected below approximately 2.0 to 3.0m depth. The table below describes the excavation classes as per SANS 1200D.

Excavation Class	Description
Soft	Excavation in material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0.10kW per millimetre of tined-bucket width, without the use of pneumatic tools such as paving breakers
Intermediate	Excavation in material that requires a back-acting excavator of flywheel power exceeding 0.10 kW per millimetre of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified for soft excavation.
Hard	Hard rock excavation shall be excavation in material (excluding boulder excavation) that cannot be efficiently removed without blasting or wedging and splitting.

5.2 Lateral Earth Pressures

For minimum wall deflection, and for construction methods where restraint is applied via struts, bracing or anchors, the temporary or short-term lateral earth pressure distribution should approximate a trapezoidal distribution, in which a maximum pressure of 10H kPa is obtained at a depth of 0.25H, and where H is the total depth of the excavation to be retained.

For basement walls, where wall deflections are not critical, the maximum pressure may be reduced to 6H kPa.

The above parameters assume that the drained situation exists and that any adjacent surcharge loading be superimposed using an “at rest” earth pressure coefficient (Ko) of 0.57. It is emphasised that where adjoining footings exist, the “at rest” pressures must be maintained and the active design condition is not appropriate.

The lateral earth pressures can be estimated by adopting the following soil parameters interpreted from the investigation borehole BH3, for retaining walls where the active earth pressure condition is permitted to be mobilised.

Table 5: Materials Strength Parameters for Retaining Wall Design

Depth (m)	Soil/Rock Type	Unit Weight (kN/m³)	Cohesion c′ (kPa)	Friction Angle (°)
0-0.2	Topsoil	19	-	28
0.2-1.5	CLAY	18	5	30
1.5-1.7	Sandy CLAY	19	5	32
>1.7	Shale	18	5	35

Note: *c′=effective cohesion; ϕ′=effective angle of friction*

5.3 Anchored Soldier Pile Retention Systems

The use of anchored secant or contiguous piles can be adopted for this site. In considering such a retention system, the following aspects should be taken into account in the design and construction of the proposed retaining walls:

- The anchors should be considered with earth pressure "at rest" condition as the design criteria.
- Additional reinforced Shotcrete layer should be applied to all the exposed faces of the basement excavation prior to the next level of excavation. Shotcrete should be applied before the bulk excavation exceeds a depth of approximately 1.0 meters. However, this may require review once the levels of adjoining footings are known.
- Excavation for the basement level should not extend more than 0.5 meters below the level of the ground anchors if they are used to maintain at rest earth pressures before the anchors are installed and fully pre-stressed.

5.4 Drainage of Retention Systems

As seepage infiltration from perched water table is quite likely to be present in the zones of influence during wet season, it is recommended that a suitable drainage system be installed and maintained behind all retaining wall structures to ensure the dissipation of any hydrostatic forces which may result from the accumulation of any seepage water behind the wall structures. Such seepage water flows should readily be able to be intercepted by the construction of a suitable sub-surface cut-off drain on the high side of the subject site.

If the groundwater is encountered, then the earth retaining wall system should be designed as either an impermeable tank system with installation of contiguous piles or secant piles and additional impervious layer to prevent groundwater flow into the basement.

5.5 Basement Floor Construction

Provided that the basement excavation does not intersect the groundwater table and no hydrostatic pressures will be generated on the underside of the basement floor, the use of a conventional concrete ground slab should perform satisfactorily in relation to the proposed

utilisation. Such floor slabs should be constructed on stiff to very stiff silty clay subgrade at the proposed basement level and may be designed using a Modulus of Subgrade reaction of 55kPa/mm. Under-slab drainage should be provided to the basement to prevent hydrostatic build-up in the event of rising ground water.

Preparation of the basement floor subgrade should consist of stripping to grade and proof rolling the subgrade, ensuring that any localised soft spots are removed and made good with clean granular filling compacted to a dry density not less than 98% of the maximum dry density value determined by the Standard Compaction test in accordance with Australian Standard AS1289 5.11 – 1993.

A suitable dewatering system (spears or sump pump) may be required to pump groundwater in the event that the groundwater is encountered above the basement level. Although groundwater was not encountered during the geotechnical investigation, the presence of perched groundwater resulted from infiltration of surface run-off should not be dismissed.

DOCUMENT CONTROL

Date	**Version**	**Report Prepared By:**	**Report Reviewed by:**
27 July 2017	**NE166-17**	**Rene Kurniadi** BEng M.Sc. Geotechnical Engineer	**Amir Farazmand** BEng MEng MIEAust CPEng Senior Geotechnical Engineer

6. REFERENCES

- Australian Standard (1993), Geotechnical Site Investigations (AS1726).
- Australian Standard (2009), Piling - Design and Installation (AS2159).
- Australian Standard (2002), Earth-retaining Structures (AS4678).
- Australian Standard (2004), Bridge Design Part 5: Concrete (AS5100.5).
- Pells, P.J.N., Mostyn, G., Walker, B.F. (1998) Design Loadings for Foundations on Shale and Sandstone in the Sydney Region.
- National Environment Protection Council, December 1999. National Environment Protection (Assessment of Site Contamination) Measure.
- Australian Standard AS 3600: 2009, Concrete Structures
- Department of Land and Water Conservation (DLWC, 2002) Site investigations for urban salinity.
- CSIRO BTF 18 (2003) Foundation Maintenance and Footing Performance: A homeowner's Guide.
- Department of Infrastructure Planning and Natural Resources (DIPNR, 2002) Salinity Potential in Western Sydney Map.
- Western Sydney Regional Organisation of Councils (WSROC, 2003) Western Sydney Salinity Code of Practice.

Information about This Report

The report contains the results of Soil and water quality Assessment conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information.

Test Hole Logging

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information.

Groundwater

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeability (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, pheratic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

Interpretation of Results

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data. Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

Change in Conditions

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GEOTESTA for appropriate assessment and comment.

Reproduction of Reports

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions should include at least all of the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature.

SITE PHOTOGRAPHS

Site view, looking ????

Appendix A

Borehole Logs

BOREHOLE LOG

BOREHOLE No: BH1

GEOTESTA

Page: 1 **of** 1

Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303184.51
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268292.81
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by: FG	Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	Consistency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00	Solid Mechanical Auger		Topsoil	Silty SAND, brown, dark, moist, moderately compacted	M	M.C	2 3				0.00
0.50			CL	CLAY, brown, orange, pale, low plasticity, moist firm to stiff	M	F	4 4 4 5 4 4 6				0.50
1.00						St	9 11 10 X				1.00
1.50				Sandy CLAY, trace shale fragments, dry, very stiff	D	Vst					1.50
2.00				Shale, highly weathered, grey, dark, dry, friable, hard	D	H					2.00
2.50											2.50
3.00				**END OF BOREHOLE @ 2.7m**							3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

▼ water level

▼ level risen to

● water inflow

Notes:

No groundwater was encountered

● DiSturbed Sample

sampling / testing:

intact sample from core

Standard Penetration test

B Bulk sample

T intact tube sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

BOREHOLE LOG

BOREHOLE No: BH2

GEOTESTA

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Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303304.54
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268241.02
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by: FG	Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	ConsiStency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00	Solid Mechanical Auger		Topsoil	Silty SAND, brown, dark, dry, moderately compacted	M	M.C	1 3				0.00
			CL	CLAY, brown, orange, pale, low plasticity, dry firm to stiff	D	F-St	3 2				
0.50							4				0.50
							3 3				
				Grades very stiff		Vst	6 19				
1.00							X				1.00
				Sandy CLAY, trace shale fragments, dry, hard	D	H					
1.50				**END OF BOREHOLE @ 1.4m**							1.50
2.00											2.00
2.50											2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

Notes:

No groundwater was encountered

DiSturbed Sample

water:

water level

level risen to

water inflow

sampling / testing:

intact sample from core

intact tube sample

Standard Penetration test

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

BOREHOLE LOG

BOREHOLE No: BH3

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Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303361.56
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268250.63
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by: FG	Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	ConsiStency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00	Solid Mechanical Auger		Topsoil	Silty SAND, brown, dark, moist, moderately compacted	M	M.C	1 4				0.00
			CL	CLAY, grey, orange, pale, low plasticity, moist, firm	M	F	3 4				
0.50							4				0.50
				Grades very stiff		Vst	3 17 X				
1.00											1.00
				Sandy CLAY, trace shale fragments, dry, very stiff	D	Vst					
1.50											1.50
				Shale, highly weathered, grey, dark, dry, friable, hard	D	H					
2.00											2.00
2.50				**END OF BOREHOLE @ 2.4m**							2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

▼ water level

▼ level risen to

water inflow

Notes:

No groundwater was encountered

DiSturbed Sample

sampling / testing:

intact sample from core

Standard Penetration test

B Bulk sample

T intact tube sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

BOREHOLE LOG

BOREHOLE No: BH4

GEOTESTA

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Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303303.58
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268165.78
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by:	FG Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	ConsiStency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00			Topsoil	Silty SANDS, brown, dark, firm, moist, moderately compacted	M	M.C					0.00
			CL	CLAY, brown, orange, pale, low plasticity, moist firm to stiff	M	F-St					
0.50											0.50
1.00											1.00
1.50				Sandy CLAY, trace shale fragments, dry, very stiff	D	Vst					1.50
	Solid Mechanical Auger			Shale, highly weathered, grey, dark, dry, friable, hard	D	H					
2.00											2.00
2.50											2.50
3.00											3.00
3.50											3.50
4.00											4.00
				Clay seam, grey, low plasticity, dry, stiff	D	St					
4.50											4.50
5.00											5.00
5.50				**END OF BOREHOLE @ 5.5m**							5.50

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

▼ water level

▼ level risen to

water inflow

Notes:

No groundwater was encountered

● DiSturbed Sample

sampling / testing:

intact sample from core

Standard Penetration test

B Bulk sample

T intact tube sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

BOREHOLE LOG

BOREHOLE No: BH5

GEOTESTA

Page: 1 **of** 1

Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303387.11
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268193.68
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by: FG	Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	ConsiStency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00	Solid Mechanical Auger		Topsoil	Silty SAND, brown, dark, moist, moderately compacted	M	M.C	1 4				0.00
			CL	CLAY, grey, orange, low plasticity, moist, firm to stiff	M	F-St	3 4				
0.50							4				0.50
				Grades very stiff		Vst	8 12 13 X				
1.00											1.00
1.50											1.50
				Sandy CLAY, trace shale fragments, dry, very stiff	D	Vst					
2.00											2.00
				Shale, highly weathered, grey, dark, dry, friable, hard	D	H					
2.50											2.50
				END OF BOREHOLE @ 2.7m							
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

Notes:

No groundwater was encountered

DiSturbed Sample

water:

water level

level risen to

water inflow

sampling / testing:

intact sample from core

intact tube sample

Standard Penetration test

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

BOREHOLE LOG

BOREHOLE No: BH6

GEOTESTA

Page: 1 **of** 1

Client:	JS Architects Pty Ltd	Drilling Co:	Geotesta Pty Ltd	EaSting:	303221.75
Project:	249, 259 & 271 Railway Terrace	Driller:	Ali	Northing:	6268154.67
Job No:	NE166-17	Rig Type:	PIXY 41T	Grid Ref:	
Location:	Schofields	Inclination:	Vertical	Collar RL:	
Date Drilled:	15/07/2017	Bearing:	Vertical	Logged by: FG	Checked by: AF/SD

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

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, Structure	Moisture	ConsiStency / Strength	DCP blows/100mm	FIELD testS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00			Topsoil	Silty SAND, brown, dark, firm, moderately compacted	M	M.C	2 2				0.00
			CL	CLAY, grey, orange, pale, low plasticity, moist, soft to firm	M	S-F	1 3				
0.50							2 2				0.50
							3 4				
1.00				Grades very stiff		Vst	22 X				1.00
	Solid Mechanical Auger			Sandy CLAY, trace shale fragments, dry, very stiff	D	Vst					
1.50											1.50
2.00											2.00
				Shale, highly weathered, grey, dark, dry, friable, hard	D	H					
2.50				Grades red color							2.50
				END OF BOREHOLE @ 2.8m							
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
St	Stiff
VSt	very Stiff
H	hard

relative density:

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

Moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

Notes:

No groundwater was encountered

DiSturbed Sample

water:

water level

level risen to

water inflow

sampling / testing:

intact sample from core

T intact tube sample

Standard Penetration test

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

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

Appendix B

Laboratory Test Results

eurofins | mgt

Certificate of Analysis

Geotesta Pty Ltd (NSW)
44 Mary Parade
Rydalmere
NSW 2116

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Amir Farazmand**

Report **556248-S**
Project name 249 259 271 RAILWAY TERRACE SCHOFIELDS
Received Date Jul 28, 2017

Client Sample ID			**BH4**	**BH5**	**BH6**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**M17-Jl34966**	**M17-Jl34967**	**M17-Jl34968**
Date Sampled			**Jul 17, 2017**	**Jul 17, 2017**	**Jul 17, 2017**
Test/Reference	LOR	Unit			
Conductivity (1:5 aqueous extract at 25°C)	10	uS/cm	330	500	220
pH (1:5 Aqueous extract)	0.1	pH Units	7.7	8.6	6.0
Sulphate (as SO4)	30	mg/kg	140	170	150
% Moisture	1	%	9.3	12	11

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Conductivity (1:5 aqueous extract at 25°C)	Melbourne	Jul 28, 2017	7 Day
- Method: LTM-INO-4030			
pH (1:5 Aqueous extract)	Melbourne	Jul 28, 2017	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Jul 28, 2017	28 Day
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Jul 28, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

ABN– 50 005 085 521
e.mail : EnviroSales@eurofins.com
web : www.eurofins.com.au

Melbourne
2-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name:	Geotesta Pty Ltd (NSW)	**Order No.:**		**Received:**	Jul 28, 2017 4:00 PM
Address:	44 Mary Parade	**Report #:**	556248	**Due:**	Jul 31, 2017
	Rydalmere	**Phone:**	1300852 216	**Priority:**	1 Day
	NSW 2116	**Fax:**		**Contact Name:**	Amir Farazmand
Project Name:	249 259 271 RAILWAY TERRACE SCHOFIELDS				

Eurofins | mgt Analytical Services Manager : Mary Makarios

Sample Detail						Conductivity (1:5 aqueous extract at 25°C)	pH (1:5 Aqueous extract)	Sulphate (as SO4)	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X
Sydney Laboratory - NATA Site # 18217									
Brisbane Laboratory - NATA Site # 20794									
Perth Laboratory - NATA Site # 23736									
External Laboratory									
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
1	BH4	Jul 17, 2017		Soil	M17-Jl34966	X	X	X	X
2	BH5	Jul 17, 2017		Soil	M17-Jl34967	X	X	X	X
3	BH6	Jul 17, 2017		Soil	M17-Jl34968	X	X	X	X
Test Counts						3	3	3	3

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Sulphate (as SO4)			mg/kg	< 30			30	Pass	
LCS - % Recovery									
Sulphate (as SO4)			%	117			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Sulphate (as SO4)	M17-Jl31427	NCP	%	113			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C)	M17-Jl32229	NCP	uS/cm	150	150	3.0	30%	Pass	
pH (1:5 Aqueous extract)	M17-Jl32241	NCP	pH Units	6.9	7.0	pass	30%	Pass	
Sulphate (as SO4)	M17-Jl31426	NCP	mg/kg	< 30	< 30	<1	30%	Pass	
% Moisture	M17-Jl34616	NCP	%	15	16	7.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Mary Makarios	Analytical Services Manager
Alex Petridis	Senior Analyst-Metal (VIC)
Huong Le	Senior Analyst-Inorganic (VIC)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.