GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200 Fax: (02) 8783 8210
Email: lab@groundtech.com.au

GTE549 - Salinity Report
27 October 2015

LOGOS PROPERTY
Suite 1202, Level 12
167 Macquarie Street,
Sydney NSW 2000

Attention: Jeff Lord
E-mail: jlord@dblproperty.com

RE: SALINITY INVESTIGATION at 34 Yarrunga Street, Prestons.

This letter presents a geotechnical report on the inspection and testing services associated with the salinity investigation undertaken at the above project.

Should you have any questions related to this report please do not hesitate to contact the undersigned.

For and on behalf of
Ground Technologies Pty Ltd

Reviewed By

A. Bennett
Senior Geotechnical Engineer

J. Harendran
Geotechnical Engineer

Table of Contents

TABLES

APPENDICES

1. INTRODUCTION

Ground Technologies Pty Ltd (Ground Tech) has prepared this report to discuss the results of the salinity assessment undertaken for the proposed industrial subdivision of No.34 Yarrunga Street, Prestons (herein referred to as the “site”). Ground Tech was engaged to provide professional assistance for this component of the project in response to the Secretary’s Environmental Assessment Requirements (SEARs) for the Prestons Industrial Estate SSD 7155 prepared by the Department of Planning and the Environment

The geotechnical investigation included drilling five (5) boreholes using a 4WD Toyota Landcruiser Ute mounted drill rig with 100mm diameter solid flight spiral augers at the locations shown on drawing Figure 1. Seventeen (17) disturbed samples were recovered from the boreholes and submitted to an external laboratory for the salinity suite of chemical testing. This report provides a salinity assessment on the existing soil conditions.

This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site or to the construction method.

It is understood that the proposed works will comprise the demolition of the existing houses and sheds allowing the construction of the Prestons Warehousing and Distribution Estate. Site cuts are not anticipated to extend below a depth of 3.0m below existing ground surface levels.

2. SITE DETAILS

The following information, presented in Table 1, describes the site.

Table 1: Summary of Site Details

Site Address	34 Yarrunga Street, Prestons
Lot & Plan No.	Lot 33, 34, 35, 43 DP2359 Lot 20 DP 117483
Council Area	Liverpool City Council

2.1 Site Description

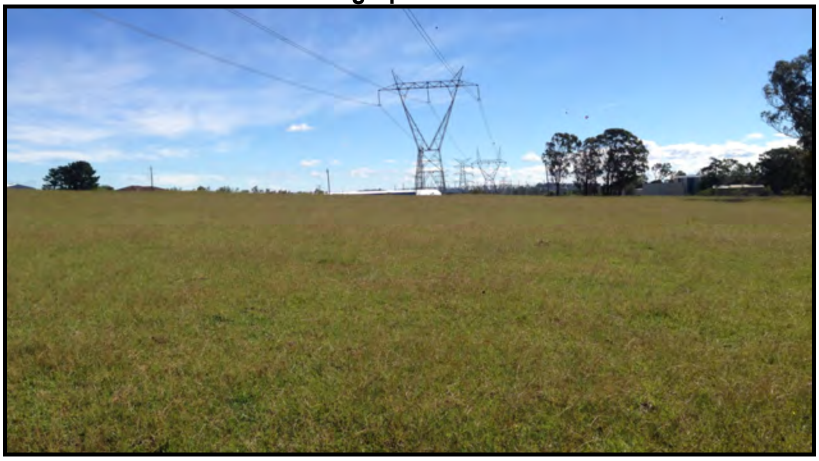
The subject property is irregular in shape, measuring approximately 625m wide along the Yarrunga Street frontage, and 305m deep along the Bernera Road frontage.

Figure 1 – Location of Site

The subject property covers an area of approximately 20.7ha, with the majority of it vacant and grass covered. A high point is located within lot 34, behind the metal shed, with gradients falling away from this point in all directions by grades of up to 3° to 7°.

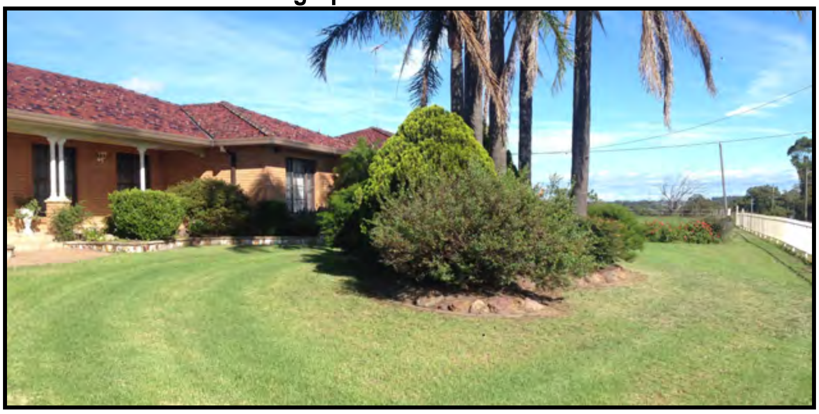
Lot 33 and 35 are grass covered and vacant. High voltage power lines traverse through the site in a north / south alignment.

Photograph 1 – Lot 33

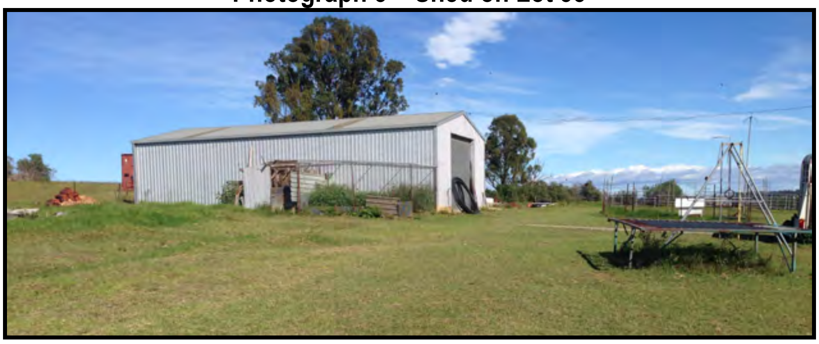


Lot 34 contains a single storey residential house, a metal shed and equipment for loading cattle onto trucks within the northern (front) portion of the lots.

Photograph 2 – House on Lot 33



Photograph 3 – Shed on Lot 33



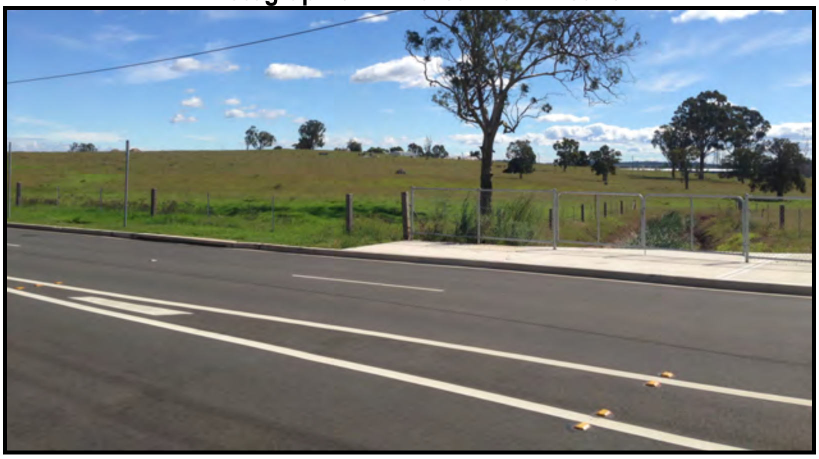
Photograph 4 – Cattle Loading Equipment on Lot 33

Lot 43 contains a metal shed located centrally within the lot

Photograph 5 – Metal Shed on Lot 43

Lot 20 of DP1173483 is predominately vacant. An old drainage line has been re-aligned within this site with a new culvert placed under Kurrajong Road.

Photograph 6 – Fill area within Lot 20



3. SOIL SALINITY

Salt is a naturally occurring mineral that forms in a number of ways. It is a product of rock weathering, especially marine sedimentary rocks. It is picked up by wind blowing over the oceans and carried inland as salt laden moisture. Dispersed salt on the soil surface can be concentrated by the action of the wind. These salt deposits are buried over millions of years, but can later be exposed by erosion or the salt can be mobilised by groundwater.

Salt is a natural part of some landscapes, for example, in inland salt pans, brackish streams, coastal salt marshes and naturally saline soils. However, where human activities such as vegetation clearing, cropping, and housing development have disturbed natural ecosystems and changed the hydrology of the landscape, the movement of salt into rivers and on land is accelerated. This is affecting the natural environment, reducing the viability of the agricultural sector and damaging infrastructure.

Salinity is a dynamic process with the potential for the movement and accumulation of salts to change over time and as a result of land use and management practices. The processes of salinity vary at different scales such as individual sites, regions and whole river catchments, so the impacts can be close to or distant from the cause, depending on the landscape and groundwater characteristics.

The impacts of salinity depend on factors such as the susceptibility of the landscape, land use practices, the type of salt, length and frequency of wetting and drying cycles, the salt concentration in the landscape and the amount of water available.

Urban salinity is mainly caused by rising groundwater bringing salts to the land surface. Towns are often located in areas prone to salinity (such as plains, valleys, or at the foot of a ridge). In addition to the regional causes a rise in groundwater levels (see dryland salinity), urban development itself can lead to localised salinity because of:

- Clearing of native vegetation for urban development
- Over-watering of gardens, parks and sporting fields
- Water leaking from pipes, drains, tanks
- Seepage from sullage pits, and
- Blocking or changing natural drainage paths (such as by building roads).

Recognising the solubility of salt in water is the key to understanding urban salinity processes. When water comes into contact with buildings and other infrastructure, salt can be carried with it. As the water evaporates (or dries) the salt crystals grow and expand, causing physical damage to bricks, mortar and other construction materials. The salt crystals often form a white crust on the surface of bricks. Homeowners often try to wash off the unsightly residue, but this only helps the salt crystals grow even bigger, worsening the problem.

Urban salinity affects built infrastructure, due to the chemical and physical impact of salt on concrete, bricks and metal. The salt moves with water into the pores of bricks and concrete when they are exposed to damp, salt-laden soils. As the water is evaporated from the material, the salt concentrates and over time this can be substantial enough to cause corrosion and damage the material’s structure. This is seen as crumbling, eroded or powdering mortar or bricks, the flaking of brick facing and the cracking or corrosion of concrete. The salt within the material can also have a corrosive effect on steel reinforcing. The long-term consequences can be structural damage.

Some building methods may also contribute to the development of salinity. Compacted surfaces can restrict groundwater flow and concentrate salt in one area. By cutting into slopes to build, groundwater or saline soil may be intercepted and exposed. In addition, fill used to build up an area may be a source of salt, or it may be less permeable, preventing good drainage.

3.1 Geology

The 1:100,000 scale Geological Series Map of the Penrith region indicates that the subject site is underlain by Bringelly Shale of the Wianamatta Group dating back to the Middle Triassic period and generally comprises *shale, carbonaceous claystone, laminate and rare coal / tuff.*

3.2 Salinity Potential

The Department of Infrastructure and Planning (2002) Salinity Potential in Western Sydney map "Salinity Potential in Western Sydney 2002" indicates that the subject site is situated in a region with a moderate to high risk of saline soils.

Figure 2 - Salinity Map with Site Identified

The moderate classification is attributed to scattered areas of scalding and vegetation indicators in areas where the concentrations have not been mapped. There is the possibility of encountering saline areas which were not identified due to localised factors. Saline soils could occur within areas of lower slopes and drainage systems where water accumulation is high or where movement of water through the soil profile is low.

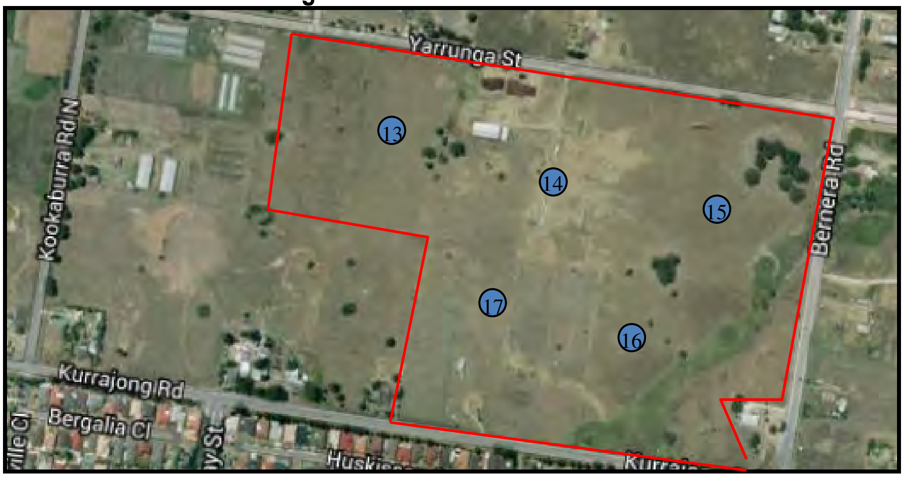
3.3 Hydrogeology

The Shale terrain of much of North/Western Sydney is known for saline groundwater, the salt from which is concentrated within the residual soils by evapo-transpiration. Groundwater was not encountered during the course of this assessment.

4. FIELD INVESTIGATION

Fieldwork was undertaken on the 7th of October 2015 and included drilling five boreholes (TS13 –TS17) using a 4WD Toyota Landcruiser Ute mounted drill rig with 100 mm solid flight spiral augers at locations shown on Figure 1. The boreholes were terminated at a depth of 3.0m below existing ground surface levels.

Figure 1 – Borehole Locations



Seventeen (17) disturbed soil samples were recovered during the course of the field investigation. The samples were recovered at depths close to 0.5m, 1.5m and 2.5m within each borehole with two additional samples recovered at a depth of 2.8m within boreholes TS13 and TS17. These samples were submitted to Australian Laboratory Services (ALS), a NATA accredited laboratory for the salinity suite of testing.

4.1 Soil Profiles

Four (4) distinct geological units were encountered during the field investigation. These units are detailed in table 2 and the approximate depth of each unit is detailed in table 3. Full Borehole logs and field observations are presented in Appendix B.

Table 2 – Summary of Geological Units

UNIT	SOIL TYPE
UNIT A	NATURAL Clayey Silt, brown
UNIT B	NATURAL; Silty Clay, with minor ironstone gravels, grey/brown, mottled red and pale grey/brown, orange/brown, yellow/brown with minor red and pale grey
UNIT C	BEDROCK; Shale, completely weathered, mottled red, pale grey/brown and brown
UNIT D	BEDROCK; Shale, extremely weathered, grey, dark grey, brown, grey, grey/brown

Table 3 – Approximate Depth of each Geological Unit

Borehole	Geological Unit			
	Unit A	Unit B	Unit C	Unit D
	Clayey Silt	Silty Clay	Shale (CW)	Shale (EW)
TS13	0-0.1m	0.1-2.0m	2.0-2.6m	2.6-3.0m
TS14	0-0.3m	0.3-1.9m	1.9-2.2m	2.2-3.0m
TS15	0-0.1m	0.1-2.2m	2.2-3.0m	-
TS16	0-0.3m	0.3-2.2m	2.2-3.0m	-
TS17	0-0.1m	0.1-1.8m	1.8-2.6m	2.6-3.0m

5. SOIL SALINITY ASSESSMENT CRITERIA

This assessments is based on the booklet "Site Investigations for Urban Salinity" published by Department of Land and Water Conservation 2002. Laboratory analysis was completed by Australian Laboratory Services (ALS) Pty Ltd, a NATA accredited laboratory, Certificate Reference number ES1533169.

5.1 Electrical Conductivity

Salinity refers to the presence of excessive salt, which is toxic to most plants. Because salt separates into positively and negatively charged ions when dissolved in water, the electrical conductivity of the water increases as the amount of salt increases. To test the electrical conductivity of soil one part of soil is mixed with 5 parts of water. The result is then multiplied by the soil texture conversion factor to give the final figure. This result is known as extract electrical conductivity (EC_e). The EC_e values of soil salinity class is given below which has been adopted from the booklet "Site Investigations for Urban Salinity" published by Department of Land and Water Conservation 2002. The salinity exposure classification for various concrete strengths (F'c) is detailed in Section 5.1 of AS 2870-2011 "Residential Slabs and Footings" code.

Table 4 - EC_e values of Soil Salinity Class and Exposure Classification for Concrete

Class	EC_e	Exposure Classification for Concrete (AS 2870 – 2011 from Tables 5.1 & 5.3)
Non Saline	<2	A1 (min. F'_c = 20 MPa)
Slightly Saline	2-4	A1 (min. F'_c =20 MPa)
Moderately Saline	4-8	A2 (min. F'_c =25 MPa)
Very Saline	8-16	B1 (min. F'_c =32 MPa)
Highly Saline	>16	B2 (min. F'_c =40MPa)

5.2 Chlorides

Chlorides are negatively charged ions (anions) which are corrosive to building material, particularly steels. In concrete, chlorides react with the steel reinforcement causing it to corrode and expand putting physical stress on the concrete.

5.3 Sulphates

Sulphates are negatively charged particles (anions) which are corrosive to building materials, particularly concrete. Sulphates react with the hydrated calcium aluminate in concrete. The products of the reaction have a greater volume than the original material, producing physical stress in the concrete.

Table 5 - Sulphate and Chloride Values and Aggressivity

Concrete Structure		Steel Structure	
Sulphate (SO4) Units(mg/kg)	Classification	Chloride Units(mg/kg)	Classification
<5,000	Non-aggressive	<20,000	Non-aggressive
5,000-10,000	Mild	20,000-50,000	Mild
10,000-20,000	Moderate	>50,000	Moderate
>20,000	Severe		

Source: *Australian Standard 2159:2009 Piling – Design and Installation Guidelines*

5.4 pH

pH Measures acidity or alkalinity of soil and is important in determining the aggressiveness of the soil to building materials. Acids combine with the calcium hydroxide component of cement to form soluble calcium compounds which can leach from the concrete increasing its porosity and decreasing its strength.

Table 6 – pH Values and Aggressivity

Concrete Structure		Steel Structures	
pH	Classification	pH	Classification
>5	Non-aggressive	>4	Non-aggressive
4.5-5	Mild	3-4	Mild
4.0-4.5	Moderate	<3	Moderate
<4.0	Severe		

Source: *Australian Standard 2159:2009 Piling – Design and Installation Guidelines*

6. FIELD QUALITY ASSURANCE AND QUALITY CONTROL

Soil sampling was carried out using spiral flight augers. Soil samples were collected from the augers using a stainless steel trowel. The trowel was decontaminated between sampling events using the following procedure:

- Soil was removed from the trowel by scrubbing with a brush
- The trowel was washed with phosphate free detergent in a bucket
- The trowel was then rinsed in distilled water in another bucket
- Steps 2 and 3 were repeated
- Drying the trowel with a clean disposable towel

7. LABORATORY TEST RESULTS

Test results are tabulated and presented in table 7 & 8 below. The laboratory test certificate is located in Appendix C. A discussion of the test data is presented in Section 7.1.

Table 7: Analysis of the Soil Samples (Salinity)

Sample	Depth (m)	EC µS/cm	Texture Factor	ECe	Salinity Class
SA1-TS1	0.5	0.230	7	1.61	NS
SA2-TS1	1.5	0.680	7	4.76	MS
SA3-TS1	2.5	0.494	7	3.45	SS
SA4-TS1	2.8	0.401	9	3.60	SS
SA5-TS2	0.5	0.107	7	0.74	NS
SA6-TS2	1.5	0.641	7	4.48	MS
SA7-TS2	2.5	0.457	7	3.19	SS
SA8-TS3	0.5	0.178	7	1.24	NS
SA9-TS3	1.5	0.535	7	3.74	SS
SA10-TS3	2.5	0.603	7	4.22	MS
SA11-TS4	0.5	0.242	7	1.69	NS
SA12-TS4	1.5	0.656	7	4.59	MS
SA13-ST4	2.5	0.712	7	4.98	MS
SA14-TS5	0.5	0.276	7	1.93	NS
SA15-TS5	1.5	0.460	7	3.22	SS
SA16-TS5	2.5	0.262	7	1.83	NS
SA17-TS5	2.8	0.181	9	1.62	NS

Abbreviations:	
NS	*Not Saline*
SS	*Slightly Saline*
MS	*Moderate Saline*
VS	*Very Saline*

Table 8: Analysis of the Soil Samples (Aggressiveness)

Sample	Depth (m)	pH	Chloride	Sulphate	Resistivity	Aggressivity to Concrete	Aggressivity to Steel
		pH Units	mg/kg	mg/kg	Ohm.cm		
SA1-TS1	0.5	5.6	160	630	4350	Not Agg	Not Agg
SA2-TS1	1.5	5.0	820	440	1470	Mild	Mild
SA3-TS1	2.5	5.3	420	360	2020	Mild	Not Agg
SA4-TS1	2.8	5.6	320	290	2490	Not Agg	Not Agg
SA5-TS2	0.5	5.3	20	170	9340	Mild	Not Agg
SA6-TS2	1.5	4.8	860	280	1560	Mild	Mild
SA7-TS2	2.5	5.0	440	230	2190	Mild	Not Agg
SA8-TS3	0.5	5.3	180	590	5620	Mild	Not Agg
SA9-TS3	1.5	4.9	660	220	1870	Mild	Mild
SA10-TS3	2.5	5.0	710	370	1660	Mild	Mild
SA11-TS4	0.5	5.2	210	330	4130	Mild	Not Agg
SA12-TS4	1.5	4.8	830	410	1520	Mild	Mild
SA13-ST4	2.5	4.9	860	480	1400	Mild	Mild
SA14-TS5	0.5	5.1	120	410	3620	Mild	Not Agg
SA15-TS5	1.5	5.0	320	540	2170	Mild	Not Agg
SA16-TS5	2.5	5.7	230	130	3820	Not Agg	Not Agg
SA17-TS5	2.8	7.0	160	80	5520	Not Agg	Not Agg

Abbreviations:	
Not Agg	*Non-Aggressive*
Mild	*Mildly Aggressive*
Mod	Moderately Aggressive

7.1 Results Discussion

From the results presented in Table 7, the electrical conductivity results indicate that the soil salinity is predominately non saline to moderately saline, noting that the moderately saline test results were at the lower end of the classification threshold.

Table 8 provides the test results for the aggressiveness of the soil samples. As mentioned in the earlier sections it is known that soil sulphate and chloride ions are corrosive to building materials including concrete and steel. Sulphate ions crystallize in extreme wet and dry conditions with elevated concentrations of chloride, resulting in the surface fretting of concrete. Hence, the pH, resistivity, chloride and sulphate concentrations in the soil samples are compared with the Australian Standard *2159:2009 Piling – Design and Installation.* The laboratory test values of sulphates, chlorides and pH indicate that the soil samples are mildly aggressive to both steel and concrete.

8. CONCLUSIONS

The investigation for Salinity within the site known as 34 Yarrunga Street, Prestons was conducted in October 2015 included the drilling and logging of five (5) boreholes to 3m in depth. Seventeen (17) soil samples were recovered from within the sub-surface soil profile. These samples were sent to a NATA accredited laboratory to assess the salinity and aggressiveness of the encountered soils.

The laboratory test results indicated the underlying soils encountered within the site were predominately non saline to depths of 3.0m. The soils were also found to be mildly aggressive to both steel and concrete.

Based on the findings of this report, a salinity management plan is not required for the subject site.

9. LIMITATIONS

The conclusions developed in this report are based on the limited soil sampling and testing regime which existed applied to this site assessment. It should be understood that salinity is a dynamic process and can change over time. The findings present in this report are based on conditions at specific sample locations, chosen to be as representative as possible under the given circumstances, and visual observations.

If the materials or conditions encountered are other than those that have been described, Ground Technologies should be notified immediately as further assessment will be required.

The scope and the period of Ground Technologies' services are described in the report and are subject to restrictions and limitations. Ground Technologies did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ground Technologies in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ground Technologies for incomplete or inaccurate data supplied by others.

Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning.

property in this submission shall not pass until all fees for preparation have been settled. This submission is for the use only of the party to whom it is addressed and for no other purpose. No responsibility is accepted to any third party who may use or rely on the whole or any part of the content of this submission. No responsibility will be taken for this report if it is altered in any way, or not reproduced in full. This document remains the property of Ground Technologies Pty Ltd until all fees and monies have been paid in full.

10. REFERENCES

1. Geology of Penrith 1:100000 Geological Series Sheet 9130, 1st Edition - Geological Survey of NSW Department of Mineral Resources 1983.
2. Western Sydney Regional Organisation of Councils Ltd (2003) Western Sydney Salinity Code of Practice
3. Department of Infrastructure, Planning and Natural Resources (2002) Site Investigations for Urban Salinity;
4. Department of Infrastructure, Planning and Natural Resources (2003) Building in a Saline Environment
5. Australian Standards AS2159 – 2009 Pilling – Design and Installation
6. Pam Hazelton and NSW Department of Natural Resources 2007 Interpreting Soil Test Results: What Do All The Numbers Mean?, Pam Hazelton and Brian Murphy
7. Australian Standards AS 2870 – 2011 – Residential Slabs and Footings

APPENDIX A

BOREHOLE LOGS

GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 13

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist stiff to very stiff			
	0.5				SA1	
	1					
	1.5				SA2	
	2	BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA3	
			SHALE, extremeley weathered, low strength, brown		SA4	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 14

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
	0.5	CI	Silty Clay, with minor ironstone gravel, medium plasticity, orange/brown, slightly moist, very stiff		SA5	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist stiff to very stiff			
	1.5				SA6	
	2	BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
			SHALE, extremeley weathered, low strength, grey, grey/brown			
	2.5				SA7	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 15

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
N I L		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, medium plasticity, grey/brown, moist, stiff			
	0.5		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff		SA8	
	1					
	1.5				SA9	
	2					
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA10	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: *4WD Mounted Rig/Solid FlightSpiral Augers*
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 16

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
	0.5	CI	Silty Clay, medium plasticity, grey/brown, moist, stiff		SA11	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff			
	1.5				SA12	
	2					
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2.5				SA13	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200
Fax: (02) 8783 8210
Email: lab@groundtech.com.au

SITE LOCATION: 34 Yarunga Street, Prestons

TEST SITE NO. 17

WATER	DEPTH (m)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION (SOIL TYPE, COLOUR, MOISTURE, CONSISTENCY)	GRAPHIC LOG	SAMPLE	REMARKS
NIL		TOPSOIL	Clayey Silt, brown			
		CI	Silty Clay, medium plasticity, grey/brown, moist, stiff			
	0.5				SA14	
	1		Silty Clay, with minor ironstone gravel, medium plasticity, mottled red and pale grey/brown moist, very stiff			
	1.5				SA15	
		BEDROCK	SHALE, completely weathered, very low strength, red, pale grey/brown, brown			
	2					
	2.5				SA16	
			SHALE, extremeley weathered, low strength, brown		SA17	
	3		*Borehole terminated at 3.0m*			
	3.5					
	4					
	4.5					

Method: 4WD Mounted Rig/Solid FlightSpiral Augers
Date of Drilling: 7/10/2015
Logged and Drilled by: AB

APPENDIX B

LABORATORY TEST RESULTS

CHAIN OF CUSTODY

ALS Environmental

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com
☐BRISBANE 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 27 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5 Rose Gum Road Warabrook NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 024423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: portkembla@alsglobal.com

CLIENT: Ground Technologies
OFFICE: 55 Fifteenth Avenue, West Hoxton
PROJECT: gte549 prestons
ORDER NUMBER:
PROJECT MANAGER: Anthony Bennett **CONTACT PH:** 0433284610
SAMPLER: Anthony Bennett **SAMPLER MOBILE:**
COC emailed to ALS? (YES / NO) **EDD FORMAT (or default):**
Email Reports to: anthony@groundtech.com.au, moustafa@groundtech.com.au
Email Invoice to (will default to PM if no other addresses are listed):

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☒ Standard TAT (List due date):
☐ Non Standard or urgent TAT **(List due date):**

ALS QUOTE NO.: SY/554/14

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)
Custody Seal Intact? Yes No N/A
Free ice / frozen ice bricks present upon receipt? Yes No N/A
Random Sample Temperature on Receipt: °C
Other comment:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Anthony Bennett	Rau		
DATE/TIME: 7/10	DATE/TIME: 7/10/15 14:30	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE	SAMPLE DETAILS MATRIX: SOLID (S) WATER (W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	pH	pHfox	eC	Sulphates	Chlorides	resistivity			Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	SA1	7/10/2015	s			x	x	x	x	x	x			
2	SA2	7/10/2015	s			x	x	x	x	x	x			
3	SA3	7/10/2015	s			x	x	x	x	x	x			
4	SA4	7/10/2015	s			x	x	x	x	x	x			
5	SA5	7/10/2015	s			x	x	x	x	x	x			
6	SA6	7/10/2015	s			x	x	x	x	x	x			
7	SA7	7/10/2015	s			x	x	x	x	x	x			
8	SA8	7/10/2015	s			x	x	x	x	x	x			
9	SA9	7/10/2015	s			x	x	x	x	x	x			
10	SA10	7/10/2015	s			x	x	x	x	x	x			
11	SA11	7/10/2015	s			x	x	x	x	x	x			
12	SA12	7/10/2015	s			x	x	x	x	x	x			
13	SA13	7/10/2015	s			x	x	x	x	x	x			
14	SA14	7/10/2015	s			x	x	x	x	x	x			
15	SA15	7/10/2015	s			x	x	x	x	x	x			
16	SA16	7/10/2015	s			x	x	x	x	x	x			
17	SA17	7/10/2015	s			x	x	x	x	x	x			
				TOTAL	17	17	17	17	17	17	17			

Environmental Division
Sydney
Work Order Reference
ES1533169

Telephone : + 61-2-8784 8555

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1533169**	Page	: 1 of 6
Client	: **GROUND TECHNOLOGIES**	Laboratory	: Environmental Division Sydney
Contact	: MR ANTHONY BENNETT	Contact	:
Address	: PO BOX 1121 GREEN VALLEY NSW,AUSTRALIA 2168	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: anthony@groundtech.com.au	E-mail	:
Telephone	: +61 02 8783 8200	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: gte549 prestons	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 07-Oct-2015 15:30
C-O-C number	: ----	Date Analysis Commenced	: 12-Oct-2015
Sampler	: ANTHONY BENNETT	Issue Date	: 19-Oct-2015 14:25
Site	: ----		
		No. of samples received	: 17
Quote number	: ----	No. of samples analysed	: 17

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA

WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SA1	SA2	SA3	SA4	SA5
			Client sampling date / time	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]
Compound	CAS Number	LOR	Unit	ES1533169-001	ES1533169-002	ES1533169-003	ES1533169-004	ES1533169-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.6	5.0	5.3	5.6	5.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	230	680	494	401	107
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	5.4	5.0	5.2	5.6	5.1
ø pH (Fox)	----	0.1	pH Unit	3.6	3.8	3.8	3.8	3.7
ø Reaction Rate	----	1	-	2	2	1	1	2
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1	%	19.3	16.4	11.0	8.0	16.6
EA080: Resistivity								
^ Resistivity at 25°C	----	1	ohm cm	4350	1470	2020	2490	9340
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	630	440	360	290	170
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	160	820	420	320	20

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	SA6	SA7	SA8	SA9	SA10
Client sampling date / time				[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]
				ES1533169-006	ES1533169-007	ES1533169-008	ES1533169-009	ES1533169-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	4.8	5.0	5.3	4.9	5.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	641	457	178	535	603
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	4.8	4.9	4.9	4.8	5.0
ø pH (Fox)	----	0.1	pH Unit	3.6	2.7	3.7	3.9	3.7
ø Reaction Rate	----	1	-	1	1	2	1	1
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1	%	13.1	9.6	17.9	17.4	14.6
EA080: Resistivity								
^ Resistivity at 25°C	----	1	ohm cm	1560	2190	5620	1870	1660
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	280	230	590	220	370
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	860	440	180	660	710

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SA11	SA12	SA13	SA14	SA15
			Client sampling date / time	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]	[07-Oct-2015]
Compound	CAS Number	LOR	Unit	ES1533169-011	ES1533169-012	ES1533169-013	ES1533169-014	ES1533169-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.2	4.8	4.9	5.1	5.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	242	656	712	276	460
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	5.0	5.0	4.6	5.1	4.8
ø pH (Fox)	----	0.1	pH Unit	3.6	4.2	3.7	3.6	3.7
ø Reaction Rate	----	1	-	2	1	1	2	2
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1	%	19.5	15.6	14.0	17.1	16.0
EA080: Resistivity								
^ Resistivity at 25°C	----	1	ohm cm	4130	1520	1400	3620	2170
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	330	410	480	410	540
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	210	830	860	120	320

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SA16	SA17	----	----	----
			Client sampling date / time	[07-Oct-2015]	[07-Oct-2015]	----	----	----
Compound	CAS Number	LOR	Unit	ES1533169-016	ES1533169-017	--------	--------	--------
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.7	7.0	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	262	181	----	----	----
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	5.2	6.8	----	----	----
ø pH (Fox)	----	0.1	pH Unit	3.6	7.0	----	----	----
ø Reaction Rate	----	1	-	2	4	----	----	----
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1	%	11.0	7.4	----	----	----
EA080: Resistivity								
^ Resistivity at 25°C	----	1	ohm cm	3820	5520	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	80	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	230	160	----	----	----