GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

GEOTECHNICAL INVESTIGATION & ACID SULFATE SOILS (ASS) ASSESSMENT

FOR

INFINITY IDEA PTY LIMITED

2 – 4 Boundary & 85 Railway Streets, Parramatta, New South Wales

Report No: 21/3410

Project No: 31552/5832D-G

December 2021

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Document Control

Report Title: Geotechnical Investigation & Acid Sulfate Soils (ASS) Assessment

Report No: 21/3410

Revision	Details	Date	Amended By
0	Original	2/12/2021	

Following advice from the Building Commissioner, the advice, recommendations and design parameters provided in this report are only valid and to be relied upon if geotechnical inspections of footings and support/shoring systems are conducted by STS Geotechnics during construction.

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1. INTRODUCTION

This report presents the results of a geotechnical investigation and Acid Sulfate Soils (ASS) Assessment carried out by STS Geotechnics Pty Limited (STS) for the proposed construction of a new residential development at 2 – 4 Boundary and 85 Railway Streets, Parramatta, New South Wales.

The following document was provided by the client to assist in the preparation of this report:

- Architectural Drawings, prepared by IDA Design Group, Project No. 28806, Dwg Nos 0003, 0005, 0008, 0009, 1002, 1003, 1004, 1005, 1006, 2001 & 2002.
- Geotechnical Investigation, prepared by SMEC Testing Services Pty Ltd (SMEC), Project No 19831/4572C, Report No 14/1690 dated August 2014.

Based on the above drawings, STS understands the proposed development is to consist of the construction of a four -storey residential building. Carparking is provided in a basement that will require excavating about 3 metres below the existing ground surface. Reference to the Parramatta Council LEP indicates that the site is located within a Class 5 Acid Sulfate Soils area and, therefore, an assessment will be required.

After completion of the fieldwork, a report will be prepared giving information on the following:

- Subsurface conditions,
- Site Classification to AS2870,
- Foundation design parameters,
- Safe batter slopes,
- Temporary and permanent support of the excavation,
- Soil aggressiveness to steel and concrete – AS2870 & AS2159, and
- Acid Sulfate Soils Assessment and the need for an Acid Sulfate Soils Management Plan.

The investigation was carried out in accordance with STS proposal (Ref. P21-516A) dated 10 November 2021.

Our scope of work did not include a contamination assessment.

2. NATURE OF THE INVESTIGATION

2.1. Fieldwork

The fieldwork was carried out by SMEC Testing Services and consisted of drilling four boreholes numbered BH1 to BH4, inclusive, at the locations shown on Drawing No. 14/1690. Restricted site access dictated some of the borehole locations. ***Because there***

was no access for the drilling rig, BH3 and BH4 were drilled using a hand auger. Boreholes were drilled using a Christie drilling rig owned and operated by STS. The boreholes were advanced using solid flight augers. To determine soil strengths Dynamic cone penetrometer (DCPs) tests were carried out at each borehole location. To measure groundwater levels PVC standpipe piezometers were installed in BH1 and BH2.

All fieldwork was undertaken by one of SMEC's experienced senior technical officers who also logged the subsurface conditions encountered.

Representative samples were collected from the boreholes for subsequent laboratory testing.

The subsurface conditions encountered are given on the borehole logs in Appendix A. A description of the terms used is also given in Appendix A. Notes relating to geotechnical reports are also attached.

2.2. Laboratory Testing

To assess the soils for their aggressiveness, soil samples were tested to determine the following:

- pH,
- Sulfate content (SO_4),
- Electrical Conductivity (EC),
- Chloride (Cl).

The detailed test reports are given in Appendix B.

3. GEOLOGY AND SITE CONDITIONS

The Penrith geological series sheet at a scale of 1:100,000 shows that the site is underlain by Triassic Age Ashfield Shale. Rocks within this formation comprise mainly shale and laminite.

The site is located at the north-eastern corner of the intersection of Boundary Street and Railway Street, Parramatta. The site is irregular in shape and has a combined area of approximately 1800m^2. At the time of the fieldwork, there were single storey residential buildings present on the site. Site vegetation comprised grass and trees.

The ground surface falls approximately 2.0 metres to the northeast

4. SUBSURFACE CONDITIONS

The following comments made below are based on the assumption that the conditions encountered in the boreholes are representative of the subsurface conditions at this site. When assessing the subsurface conditions across a site from a limited number of boreholes, there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour regarding the proposed development. The actual condition at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies, particularly on a site such as this where there has been previous development.

The subsurface conditions generally comprise topsoil overlying fill, silty clays and weathered sandstone. Topsoil and fill are present from the surface to depths of 0.2 to 0.3 metres and could not be penetrated in BH3 and BH4. In BH1 and BH2, firm to stiff and very stiff silty clays underlie the topsoil and fill to depths of 2.7 and 2.9 metres. Weathered shale underlies the residual soils to depth of auger refusal, 3.5 and 4.4 metres.

No groundwater was observed in the boreholes during the fieldwork. Four days later the piezometers remained dry.

5. DISCUSSION

5.1. Site Classification to AS2870

The classification has been prepared in accordance with the guidelines set out in the "Residential Slabs and Footings" Code, AS2870 - 2011.

Because of the presence of existing dwellings and trees, abnormal moisture conditions (AMC) prevail at the site. (Refer to Section 1.3.3 of AS2870).

Because of the AMC and the presence of greater than 400mm of fill, the site is classified as a *Problem Site (P).* Provided the recommendations given below are adopted, the site may be reclassified as *Highly Reactive (H1).*

5.2. Excavation Conditions

Based on subsurface conditions observed in the boreholes, it is expected that the proposed excavation will encounter topsoil, fill, silty clays and weathered shale. We anticipate that excavators without assistance should be able to remove the soils and weathered rock, however there is potential for higher strength pockets of shale and ironstone to exist across the site. Should these be encountered, some ripping may be required.

The soils and weathered rock can be temporarily battered at an angle of no greater than 1 to 1. Where this not possible, it will be necessary to provide temporary support. Support will probably need to be drilled and fixed in the rock below the base of the excavation. Concrete soldier piers with shotcrete infill are probably the most cost-effective method of support.

When considering the design of the supports, it will be necessary to allow for the loading adjacent structures close to the boundaries, any ground surface slope and groundwater present. Where the structures are within the zone of influence of the excavation, it will be necessary to adopt K_o conditions when designing the temporary support. Anchors or props can be used to provide the required support. If anchors extend into adjoining property, it will be necessary to obtain the permission of the property owners. The fixed anchor length is that part of the anchor beyond a line drawn upwards at 45 degrees from the base of the excavation. When props or anchors are used for support, a rectangular earth pressure distribution should be adopted on the active side of the support. The permanent excavation support should be designed assuming K_o conditions.

The following parameters are suggested for the design of the retaining wall system where there is a level ground surface:

Active Earth Pressure Coefficient (K_a)	=	0.4
Passive Earth Pressure Coefficient (K_p)	=	4.5 (shale below the depth of auger refusal)
At Rest Pressure Coefficient (K_o)	=	0.55
Total (Bulk) Density	=	20 kN/m^3

Some minor seepage may be experienced in the basement excavation during construction, particularly after periods of increased rainfall. A sump and pump should be adjusted to handle any minor flows. In the longer-term drainage should be provided to direct any seepage to a sump to be pumped out.

5.3. Foundation Design

STS does not recommend founding any structural loads within the topsoil or fill materials.

Pad and/or strip footings founded in natural materials may be proportioned using an allowable bearing pressure of 100 kPa. The minimum depth of founding must comply with the requirements of AS2870.

Pad and/or strip footings founded in weathered shale at the proposed depth of excavation, 3.0 metres may be proportioned using an allowable bearing pressure of 700 kPa.

Should a higher bearing capacity be required piers should be extended to the underlying stronger shale bedrock. Piers founded in weathered shale below the depth of auger refusal may be proportioned using an allowable bearing pressure of 1000 kPa. An allowable adhesion of 100 kPa may be adopted for the portion of the shaft below this depth. Where piers are founded in shale the adhesion in the overlying soils must be ignored.

To ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations are free of all loose material prior to concreting. To this end, it is recommended that all excavations be concreted as soon as possible, preferably immediately after excavating, cleaning, inspecting and approval. Pier excavations should not be left open overnight. The possibility of groundwater inflow needs to be considered when drilling the piers and pouring concrete.

During foundation construction, should the subsurface conditions vary to those inferred in this report, a suitably experienced geotechnical engineer should review the design and recommendations given above to determine if any alterations are required.

5.4. Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulfates and chlorides. To determine the degree of aggressiveness, the test values obtained are compared to Tables 6.4.2 (C) and 6.5.2 (C) in AS2159 – 2009 Piling – Design and Installation. The test results are summarised in Table 5.1.

Table 5.1 – Soil Aggressiveness Summary

Sample No.	Location	Depth (m)	pH	Sulfate (mg/kg)	Chloride (mg/kg)
S1	BH2	0.3	6.3	130	280
S2	BH2	1.5	4.3	120	120

The soils on the site are cohesive and above groundwater. Therefore, soil conditions B are considered appropriate (AS2159).

In accordance with AS2159-2009 the exposure classification for the onsite soils is moderately aggressive to concrete and non-aggressive to steel. In accordance with AS2870-2011 the soils are classified as B1.

6. ACID SULFATE SOIL ASSESSMENT

6.1. Introduction

ASS is the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed most acid sulfate sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, back swamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion, these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the water table.

Any lowering in the water table that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development. Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must consider the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics are not disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed in coastal areas, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

6.2. Presence of ASS

Reference to the Prospect – Parramatta River ASS Risk Map indicates the property is within an area where there are no known occurrences of ASS. It should be noted that maps are a guide only.

The following geomorphic or site criteria are normally used to determine if acid sulfate soils are likely to be present:

- sediments of recent geological age (Holocene)
- soil horizons less than 5 in AHD
- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

6.3. Assessment

The site survey plan shows that the proposed development has a surface elevation of about RL 33 m AHD and the silty clay soils onsite are residual in nature. This is not consistent with the geomorphic criteria necessary for the presence of ASS. Based on the subsurface conditions observed in the boreholes the site development is extremely unlikely to result in the lowering of the groundwater where nearby ASS may be present. Therefore, the proposed works will not result in exposure of ASS allowing oxidation to take place leading to the development of acidic conditions. Based on our onsite observations, it is our opinion that the proposed construction will not intercept any ASS in the area nor cause lowering of any groundwater.

Our assessment is the proposed construction will not require the preparation of an Acid Sulfate Soil Management Plan.

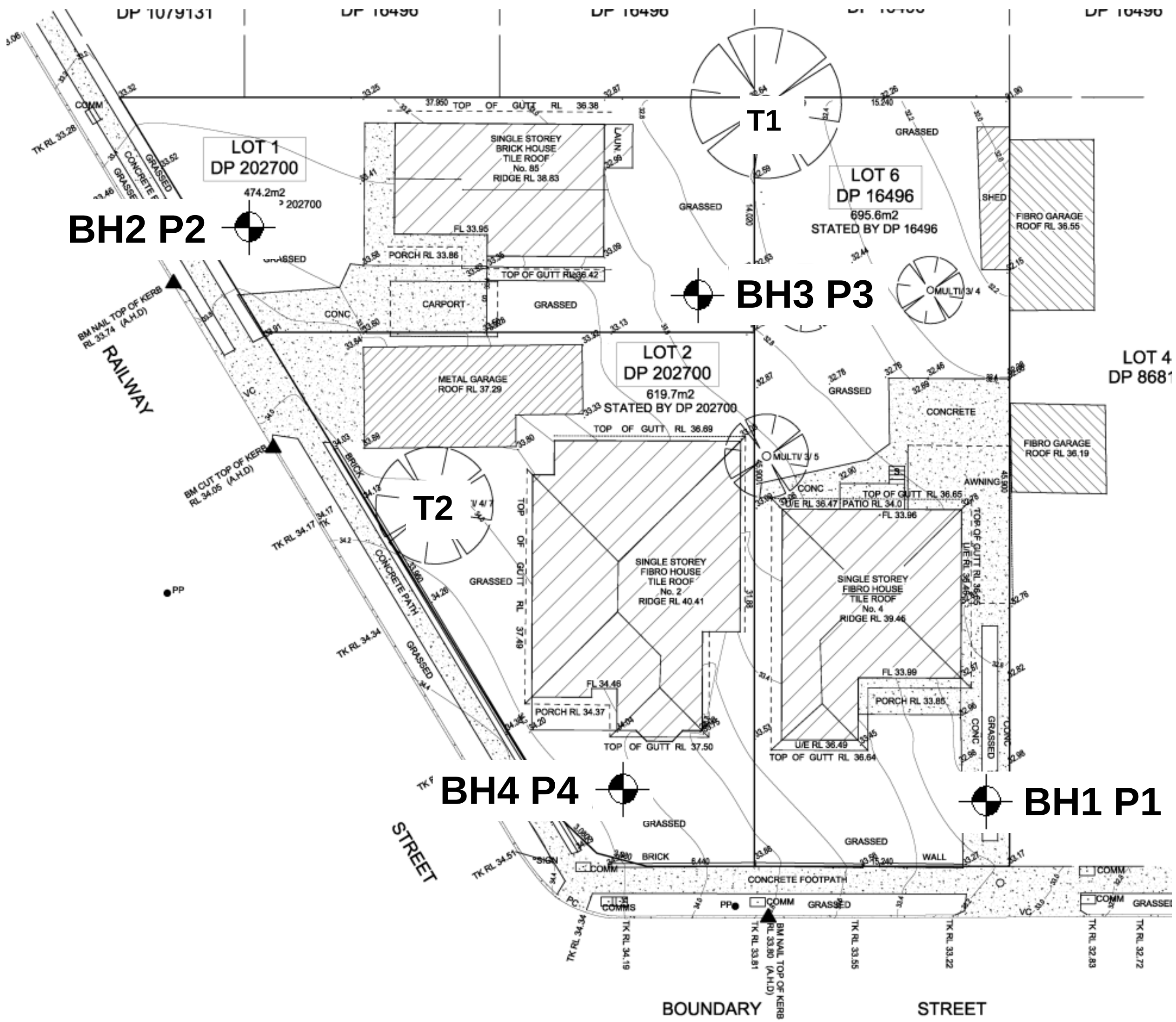
7. FINAL COMMENTS

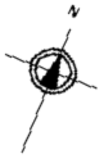
During construction, should the subsurface conditions vary from those inferred above, we would be contacted to determine if any changes should be made to our recommendations.

The exposed bearing surfaces for footings should be inspected by a geotechnical engineer to ensure the allowable pressure given has been achieved.

Ian Watts
Geotechnical Engineer
STS Geotechnics Pty Limited

Laurie Ihnativ
Geotechnical Engineer
STS Geotechnics Pty Limited





SMEC TESTING SERVICES Pty. Ltd.	Scale: Unknown	Date: August 2014
Client: STEVE SARKIS		
GEOTECHNICAL INVESTIGATION **2-4 BOUNDARY & 85 RAILWAY STREETS, PARRAMATTA** **BOREHOLE AND PENETROMETER LOCATIONS**		Project No. 19831/4572C Drawing No: 14/1690

NOTES RELATING TO GEOTECHNICAL REPORTS

Introduction

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC Testing Services Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, SMEC Testing Services Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC Testing Services Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information or Tendering Purposes

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A

BOREHOLE LOGS AND EXPLANATION SHEETS

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Steve Sarkis
Project: 2-4 Boundary and 85 Railway Streets, Parramatta
Location: Refer to Drawing No. 14/1690

Project No.: 19831/4572C
Date : July 31, 2014
Logged: AC

BOREHOLE NO.: BH 1

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark grey, trace of fine grained sand TOPSOIL/FILL	CL	FIRM	D-M
			SILTY CLAY: orange brown/grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
		1.0	SILTY CLAY: grey/orange brown, medium plasticity	CL	STIFF	M
		2.0	SILTY CLAY: grey/grey brown, trace of fine to medium grained sand, trace of fine gravel	CL	VERY STIFF	D-M
		3.0	WEATHERED SHALE: grey		EXTREMELY LOW STRENGTH	D
		4.0	AUGER REFUSAL AT 3.5 M ON WEATHERED SHALE STANDPIPE PIEZOMETER INSTALLED			
		5.0				

NOTES: D - disturbed sample; U - undisturbed tube sample; B - bulk sample
WT - level of water table or free water; N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Christie
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Steve Sarkis
Project: 2-4 Boundary and 85 Railway Streets, Parramatta
Location: Refer to Drawing No. 14/1690

Project No.: 19831/4572C
Date : July 31, 2014
Logged: AC

BOREHOLE NO.: BH 2

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1 @ 0.3 m		SILTY CLAY: dark brown, low plasticity TOPSOIL	CL	FIRM	M
			SILTY CLAY: orange brown/grey, medium to high plasticity	CL/CH	FIRM TO STIFF STIFF	M
	S2 @ 1.5 m	1.0	SILTY CLAY: grey/orange brown, medium plasticity	CL	STIFF VERY STIFF	M
		2.0	SILTY CLAY: grey/grey brown, some fine to medium grained sand, fine gravel	CL	VERY STIFF	D-M
		3.0 4.0	WEATHERED SHALE: grey, clay seams		EXTREMELY LOW STRENGTH	D
		5.0	AUGER REFUSAL AT 4.4 M ON WEATHERED SHALE STANDPIPE PIEZOMETER INSTALLED			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Christie
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Steve Sarkis Project: 2-4 Boundary and 85 Railway Streets, Parramatta Location: Refer to Drawing No. 14/1690	Project No.: 19831/4572C Date : July 31, 2014 Logged: AC	**BOREHOLE NO.: BH 3** Sheet 1 of 1

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			SILTY CLAY: dark grey brown, trace of fine gravel, low plasticity TOPSOIL	CL	FIRM	D-M
			HAND AUGER REFUSAL AT 0.25 M		FIRM TO STIFF	
					STIFF	
		1.0			VERY STIFF	
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample WT - level of water table or free water N - Standard Penetration Test (SPT)	Contractor: STS Equipment: Hand Auger
See explanation sheets for meaning of all descriptive terms and symbols	Hole Diameter (mm): 100 Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Steve Sarkis	Project No.: 19831/4572C	**BOREHOLE NO.: BH 4**
Project: 2-4 Boundary and 85 Railway Streets, Parramatta	Date : July 31, 2014	
Location: Refer to Drawing No. 14/1690	Logged: AC	Sheet 1 of 1

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			SILTY CLAY: dark grey brown, trace of fine gravel, low plasticity TOPSOIL	CL	FIRM	D-M
			HAND AUGER REFUSAL AT 0.2 M		FIRM TO STIFF	
					STIFF	
		1.0			VERY STIFF	
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample WT - level of water table or free water N - Standard Penetration Test (SPT)	Contractor: STS Equipment: Hand Auger
See explanation sheets for meaning of all descriptive terms and symbols	Hole Diameter (mm): 100 Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: 2-4 BOUNDARY AND 85 RAILWAY STREETS, PARRAMATTA — Project No.: 19831/4572C
Client: STEVE SARKIS — Report No.: 14/1690
Address: 44 Sorrell Street, North Parramatta — Report Date: 1/08/2014
Test Method: AS 1289.6.3.2 — Page: 1 of 1

Site No.	P1	P2	P3	P4		
Location	Refer to Drawing No. 14/1690	Refer to Drawing No. 14/1690	Refer to Drawing No. 14/1690	Refer to Drawing No. 14/1690		
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level		
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	2	2	2	2		
0.15 - 0.30	2	3	2	3		
0.30 - 0.45	2	3	3	4		
0.45 - 0.60	2	4	3	4		
0.60 - 0.75	3	5	3	5		
0.75 - 0.90	4	6	4	6		
0.90 - 1.05	4	5	8	8		
1.05 - 1.20	5	6	12	11		
1.20 - 1.35	12	10	20/D	14		
1.35 - 1.50	18	12		17		
1.50 - 1.65	20/D	18		20/D		
1.65 - 1.80		20/D				
1.80 - 1.95						
1.95 - 2.10						
2.10 - 2.25						
2.25 - 2.40						
2.40 - 2.55						
2.55 - 2.70						
2.70 - 2.85						
2.85 - 3.00						
3.00 - 3.15						
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						
3.75 - 3.90						
3.90 - 4.05						

Remarks: * Pre drilled prior to testing

Approved Signatory.....

Technician: AC

Laurie Ihnativ - Manager

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Tree Heights and Type

Project: 2-4 Boundary and 85 Railway Streets, Parramatta

Project No. / STS No.: 19831/4572C

Client: Steve Sarkis

Technician: Ac

Tree No.	Canopy Radius (m)	Distance from Tree Along Ground (m)	Uphill / Level / Downhill	Height of Tree (m)	Native (Y / N)	Growing / Mature
T1	5			10	Y	M
T2	4			8	Y	M

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by SMEC in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarized in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).
- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - low to medium plasticity	H

(b) Grading

"Well graded" Good representation of all particle sizes from the largest to the smallest.

"Poorly graded" One or more intermediate sizes poorly represented

"Gap graded" One or more intermediate sizes absent

"Uniformly graded" Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black	White	Grey	Red
Brown	Orange	Yellow	Green
Blue			

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg. red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

*E1.3 **S**oil Condition*

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 – 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 – 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 – 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 – 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 – 3	0 - 2	0 - 15
Loose	3 – 8	2 - 5	15 - 35
Medium Dense	8 – 25	5 - 15	35 - 65
Dense	25 – 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

"Residual Soil" - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

"Colluvium" - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

"Landslide Debris" - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

"Alluvium" - Material which has been transported essentially by water. Usually associated with former stream activity.

"Fill" - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes "O" or "H" depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an "organic material" by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX B

LABORATORY TEST RESULTS

CERTIFICATE OF ANALYSIS

Work Order	: **ES1416744**	Page	: 1 of 3
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ALL REPORTS (ENQUIRIES)	Contact	: Client Services
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: enquiries@smectesting.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: 19831	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 11297		
C-O-C number	: ----	Date Samples Received	: 31-JUL-2014
Sampler	: AC	Issue Date	: 06-AUG-2014
Site	: ----		
		No. of samples received	: 2
Quote number	: SY/593/14	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

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
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.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

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

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			*Client sample ID*	S1	S2	----	----	----
			Client sampling date / time	[31-JUL-2014]	[31-JUL-2014]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1416744-001**	**ES1416744-002**	**----**	**----**	**----**
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**6.3**	**4.3**	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**81**	**55**	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**22.2**	**15.8**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**130**	**100**	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	**280**	**120**	----	----	----