GeoEnvironmental Pty Ltd
Geotechnical and Environmental Solutions

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November 26, 2018
Project No. 10530/3023
Report No. 18/3586
LWI/ms

SITE INVESTIGATION REPORT

Client: NSW Land & Housing Corporation
Address: 47-49 Curry Street, Wallsend
Proposed Development: Residential development

Site Description

Approx. area (m^2): 1245
Approx. fall: 1 metre to the west, reasonable site drainage
Vegetation: Grass, trees and shrubs
Improvements: Existing fibro dwellings

Geology, Fieldwork Details and Subsurface Conditions

The Newcastle Coalfield geological series sheet at a scale of 1:100,000 shows the site is underlain by Permian Age Wallsend Sandstone of the Newcastle Coal Measures. Rocks within this formation comprise sandstone.

Six boreholes were drilled and six Dynamic cone penetrometer (DCP) tests were carried out on November 14, 2018 at the locations shown on Drawing No. 18/3586. Restricted site access dictated the borehole locations. ***Because there was no access for the drilling, BH2 was drilled using a hand auger.*** The subsurface conditions encountered are shown on the attached borehole logs. Explanation sheets and notes relating to geotechnical reports are also attached.

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.

The subsurface conditions consist of topsoil overlying silty clays and weathered sandstone. The topsoil is present to depths of 0.2 to 0.4 metres. Natural silty clays underlie the topsoil and are present to depths of 0.9 to 1.6 metres. In BH2, the hand auger could not penetrate beyond a depth of 0.5 metres. The consistency of these materials vary between firm to stiff and very stiff. Weathered sandstone underlies these soils to the depth of auger refusal, 1.1 to 1.6 metres.

No groundwater was observed in the boreholes during the fieldwork.

Laboratory Testing

In order to assist with determining the site classification, two shrink/swell tests were carried out on two representative samples retrieved from the site. The detailed test report is attached and summarised below:

Location	Depth (m)	Material Description	Shrink/Swell Index (% per ΔpF)
BH1	0.5-0.67	Orange brown and light grey silty clay	2.2
BH3	0.5-0.7	Orange brown and light grey silty clay	1.3

Site Classification

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

Because there are trees and an existing dwelling present, abnormal moisture conditions (AMC) prevail at the site. (Refer to Section 1.3.3 of AS2870).

Because of the AMC, the site is classified a *problem site (P).* The site may be reclassified *highly reactive (H1),* provided the recommendations given below are adopted.

Foundation Design and Construction

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. In order to overcome the presence of trees, the foundations should be designed in accordance with the procedures given in Appendices H and CH of AS2870-2011. Tree information is attached.

Piers founded in the very stiff natural materials may be proportioned using an allowable end bearing pressure of 450 kPa, provided their depth to diameter ratio exceeds a value of 4. An allowable adhesion of 20 kPa may be adopted for the portion of the shaft below a depth of 0.5 metres.

Footings and piers founded in weathered sandstone may be proportioned using an allowable end bearing pressure of 800 kPa. An allowable adhesion of 80 kPa may be adopted for the portion of the shaft within the weathered rock. When piers are founded on weathered rock adhesion in the overlying soils must be ignored.

In order to ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations is 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.

The site is considered suitable for slab on ground construction provided due regard is given to the groundsurface slope.

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.

Soil Aggressiveness

The exposure classification for the concrete has been determined for the onsite soils. The exposure classification is obtained from Tables 5.1 and 5.2 of AS2870-2011. In regards to the electrical conductivity, the laboratory test results have been multiplied by the appropriate factor to convert the results to EC_e.

Detailed test reports are attached and summarised below, together with the exposure classification.

Sample No.	Electrical Conductivity (dS/m)		pH	Sulfate (ppm)	Exposure Classification
	$EC_{1:5}$	EC_e			
S1/3023	0.021	0.2	5.6	40	A1
S2/3023	0.038	0.3	5.6	40	A1

The minimum concrete strength and reinforcement cover required for the various exposure classifications are given in Tables 5.3 and 5.4 of AS2870-2011.

Reference to DLWC (2002) “Site Investigations for Urban Salinity” indicates that EC_e values of 0.2 and 0.3 dS/m are consistent with the presence of non-saline soils.

Acid Sulfate Soil Assessment

ASS are the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed the majority of 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 storm water 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 take into account the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics not be 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.

Reference to the Wallsend ASS Risk Map indicates the property is an area where there are no known occurrences of ASS. The site is located within as Class 5 area with respect to ASS.

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

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

The property location is underlain by the Wallsend Sandstone with a ground level elevation of greater than 20m AHD. Therefore, the geomorphic or site criteria do not meet the requirements for the presence of ASS. Based on our onsite observations and the subsurface conditions exposed in the boreholes, it is our opinion that the proposed construction will not intercept any ASS. During the fieldwork, groundwater was not observed and as a consequence, construction is not expected to result in the lowering of any groundwater that may be present in the area. Therefore, any nearby ASS that may be present will not suffer any negative impact from the proposed excavation.

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

Additional Comments

Attention is drawn to Appendix B of AS2870 - 2011 regarding the need to properly maintain the foundations. Surface drainage should be provided to avoid the possibility of water ponding near the building and the finished ground surface should fall at least 50 mm over a distance of one metre away from the building.

The above classification has been made assuming that the maximum depth to filling placed in any building platform will be 400 mm and that all footings will bear in either natural ground or in control filling. Prior to the placement of any filling the existing surface should be stripped of all vegetation and topsoil.

The above classification is based on the soil profiles observed at the time of testing. If site works are undertaken, the classification of the actual building platform may vary across the site depending upon the extent of the cut and/or fill and the degree of compaction of any fill. The designer of the footing system must take the above factors into account.

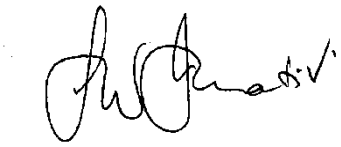
If excavations for rainwater or detention tanks are to be made within 6 metres of the building foundations, advice should be sought regarding their effect on the foundations.

Placing absorption trenches on the high side of the property may create abnormal moisture conditions for the foundations (Refer to Section 1.3.3 of AS2870). This could have a negative effect on the foundation performance and more than likely alter the site classification provided above.

This report has been prepared assuming that no trees other than those noted will be present on the site. If future tree planting is planned, eg. there is a landscaping plan, their effect on the foundation performance must be considered.

This report has been prepared assuming the site development will be limited to one or two storey residential buildings. The information and interpretation may not be relevant if the design proposal changes (e.g. to a five-storey building involving major cuts during the site preparation). If changes occur, we would be pleased to review the report and advise on the adequacy of the investigation.

Yours faithfully



Laurie Ihnativ
Principal Geotechnical Engineer
STS GeoEnvironmental Pty Limited

STS GeoEnvironmental Pty. Ltd.	Scale: Unknown	Date: November 2018
Client: NSW LAND & HOUSING CORPORATION		
SITE INVESTIGATION **47-49 CURRY STREET, WALLSEND** **BOREHOLE AND PENETROMETER LOCATIONS**	Project No. 10530/3023	
	Drawing No: 18/3586	

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.

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation	Project: 10530/3023	**BOREHOLE NO.: BH 1**
Project: 47-49 Curry Street, Wallsend	Date : November 14, 2018	
Location: Refer to Drawing No. 18/3586	Logged: JK Checked By: LWI	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, low plasticity, trace of fine grained sand	CL	FIRM TO STIFF	D
			TOPSOIL			
	S1 @ 0.4 m		SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TOS TIFF	M
	ASS1 @ 0.5 m	0.5				
	U50 0.5-0.67 m					
			SILTY CLAY: light grey with orange brown, medium plasticity, trace of fine grained sand	CL	VERY STIFF	M
	ASS2 @ 1.0 m	1.0				
			SILTY SANDY CLAY: light grey, fine to medium grained sand, medium plasticity, (CW Sandstone)	CL	HARD	M-D
		1.5				
			WEATHERED SANDSTONE: light grey, fine to medium grained		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 1.8 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

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

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (^{o}): 0
Drill Bit: Spiral

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation	Project: 10530/3023	**BOREHOLE NO.: BH 2**
Project: 47-49 Curry Street, Wallsend	Date : November 14, 2018	
Location: Refer to Drawing No. 18/3586	Logged: JK Checked By: LWI	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, medium to high plasticity	CL/CH	SOFT	M
			TOPSOIL			
			SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TO STIFF BECOMING STIFF	M
		0.5	HAND AUGER REFUSAL AT 0.5 M		VERY STIFF	
		1.0				
		1.5				
		2.0				
		2.5				

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Hand Auger

Hole Diameter (mm): 100

Angle from Vertical (^{o}): 0

Drill Bit: Spiral

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation	Project: 10530/3023	**BOREHOLE NO.: BH 3**
Project: 47-49 Curry Street, Wallsend	Date : November 14, 2018	
Location: Refer to Drawing No. 18/3586	Logged: JK Checked By: LWI	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 brown, low plasticity, trace of fine grained sand	CL	FIRM TO STIFF	D-M
			TOPSOIL			
	S2 @ 0.4 m		SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	STIFF	M
	U50	0.5				
			SILTY SANDY CLAY: light grey with orange brown, fine grained sand, medium plasticity (CW Sandstone)	CL	VERY STIFF	M-D
		1.0	WEATHERED SANDSTONE: orange brown with light grey, fine grained		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 1.1 M ON WEATHERED SANDSTONE			
		1.5				
		2.0				
		2.5				

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

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (^{o}): 0
Drill Bit: Spiral

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

STS GeoEnvironmental Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: NSW Land & Housing Corporation	Project: 10530/3023	**BOREHOLE NO.: BH 4**
Project: 47-49 Curry Street, Wallsend	Date : November 14, 2018	
Location: Refer to Drawing No. 18/3586	Logged: JK Checked By: LWI	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, medium plasticity, trace of fine grained sand, occasional gravel	CL	SOFT AND FIRM	M
			TOPSOIL/FILL			
		0.5	SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
					STIFF	
		1.0	SILTY SANDY CLAY: orange brown with light grey, fine grained sand, low plasticity	CL	VERY STIFF	M-D
			WEATHERED SANDSTONE: orange brown with light grey, fine grained, clay seams		EXTREMELY LOW STRENGTH	D
		1.5				
			AUGER REFUSAL AT 1.6 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

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

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Mini Christie
Hole Diameter (mm): 100
Angle from Vertical (^{o}): 0
Drill Bit: Spiral

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: 47-49 CURRY STREET WALLSEND — Project No.: 10530/3023
Client: NSW LAND & HOUSING CORPORATION — Report No.: 18/3586
Address: Locked Bag 5112, Parramatta — Report Date: 23/11/2018
Test Method: AS 1289.6.3.2 — Page: 1 of 1

Site No.	P1	P2	P3	P4		
Location	Refer to Drawing No. 18/3586	Refer to Drawing No. 18/3586	Refer to Drawing No. 18/3586	Refer to Drawing No. 18/3586		
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level		
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	2	1	2	2		
0.15 - 0.30	4	3	3	1		
0.30 - 0.45	4	5	5	2		
0.45 - 0.60	5	10	5	4		
0.60 - 0.75	8	22	13	6		
0.75 - 0.90	10	Refusal	22	5		
0.90 - 1.05	9		Refusal	8		
1.05 - 1.20	22			22		
1.20 - 1.35	Refusal			Refusal		
1.35 - 1.50						
1.50 - 1.65						
1.65 - 1.80						
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						

Remarks: * Pre drilled prior to testing

NATA Accredited Laboratory Number 2750
Accredited for compliance with ISO/IEC 17025
The results of tests, calibrations and / or measurements included in this document are traceable to Australian / national standards

Approved Signatory....
Technician: JK — Laurie Ihnativ - Manager

STS GeoEnvironmental Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@stsgeo.com.au

Tree Heights and Type

Project: 47-49 Curry Street, Wallsend | Project No. / STS No.: 10530/3023

Client: NSW Land & Housing Corporation | Technician: JK

Tree No.	Canopy Radius (m)	Distance from Tree Along Ground (m)	Uphill / Level / Downhill	Height of Tree (m)	Native (Y / N)	Growing / Mature
T1	5.0		U	16.0	N	M

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

Shrink Swell Index Report

Project: 47 - 49 Curry St., Wallsend
Client: New South Wales Land and Housing Corperation
Address: Locked Bag 4009, Ashfield
Test Method: AS 1289.7.1.1

Project No.: 10530/1181D
Report No.: 18/3554
Report Date: 21/11/2018
Page: 1 of 1

Sampling Procedure: AS 1289.1.3.1 Clause 3.1.3.2 - Thin Walled Sampler

STS / Sample No.		3023/1	3023/2				
Sample Location		BH 1	BH 3				
Material Description		Silty Clay, brown w/- some red brown	Silty Clay, orange brown w/- some light grey				
Depth (m)		0.5 - 0.67	0.5 - 0.7				
Sample Date		14/11/2018	14/11/2018				
Shrink	Moisture Content (%)	24.6	22.2				
	Soil Crumbling	NIL	Nil				
	Extent of Cracking	Nil	Open				
	Strain (%)	3.7	2.3				
Swell	Moisture Content Initial (%)	24.1	22.5				
	Moisture Content Final (%)	27.4	23.8				
	Strain (%)	0.4	0.0				
Inert Inclusions (%)		<5	<5				
Shrink Swell Index (%)		**2.2**	**1.3**				

Remarks:

Approved Signatory.....

Technician: BH

Philip Ihnativ - Senior Geotechnician

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1834265**	Page	: 1 of 9
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: ALL REPORTS (ENQUIRIES)	Contact	: Customer Services ES
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 10530	Date Samples Received	: 16-Nov-2018 09:30
Order number	: E-2018-559	Date Analysis Commenced	: 19-Nov-2018
C-O-C number	: ----	Issue Date	: 23-Nov-2018 17:39
Sampler	: JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 21		
No. of samples analysed	: 21		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3022/S1	3022/S2	3023/S1	3023/S2	3024/S1
			Client sampling date / time	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	ES1834265-001	ES1834265-002	ES1834265-003	ES1834265-004	ES1834265-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**6.8**	**6.1**	**5.6**	**5.6**	**6.2**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**28**	**38**	**21**	**38**	**23**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**17.0**	**14.4**	**17.2**	**18.5**	**14.5**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**60**	**90**	**40**	**40**	**30**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3024/S2	3024/S3	3025/S1	3025/S2	3025/S3
				Client sampling date / time	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00
Compound	CAS Number	LOR	Unit		ES1834265-006	ES1834265-007	ES1834265-008	ES1834265-009	ES1834265-010
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**6.0**	**5.0**	**6.4**	**5.4**	**5.4**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**28**	**91**	**26**	**63**	**66**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**17.8**	**18.8**	**19.8**	**17.9**	**13.8**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**80**	**100**	**30**	**60**	**80**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3025/S4	3026/S1	3026/S2	3026/S3	3026/S4
				Client sampling date / time	14-Nov-2018 00:00	15-Nov-2018 00:00	15-Nov-2018 00:00	15-Nov-2018 00:00	15-Nov-2018 00:00
Compound	CAS Number	LOR	Unit		ES1834265-011	ES1834265-012	ES1834265-013	ES1834265-014	ES1834265-015
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**5.8**	**5.9**	**5.8**	**5.4**	**6.5**
EA010: Conductivity (1:5)									
Electrical Conductivity @ 25°C	----	1	µS/cm		**51**	**56**	**37**	**32**	**37**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	0.1	%		**19.3**	**18.8**	**19.9**	**17.2**	**17.4**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**80**	**50**	**80**	**50**	**70**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	3022/ASS1	3022/ASS2	3022/ASS3	3024/ASS1	3024/ASS2
			Client sampling date / time	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	15-Nov-2018 00:00	15-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	ES1834265-016	ES1834265-017	ES1834265-018	ES1834265-019	ES1834265-020
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**5.2**	**3.9**	**3.9**	**4.5**	**4.3**
pH OX (23B)	----	0.1	pH Unit	**4.2**	**4.1**	**4.8**	**3.9**	**3.9**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**14**	**88**	**74**	**33**	**40**
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	**130**	**105**	**60**	**68**
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	**42**	**32**	**27**	**28**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	**0.022**	**0.141**	**0.118**	**0.052**	**0.064**
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	**0.208**	**0.169**	**0.096**	**0.109**
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	**0.067**	**0.051**	**0.044**	**0.045**
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	**0.044**	**0.039**	<0.020	<0.020
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	**0.056**	**0.047**	<0.020	<0.020
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.183**	<0.020	<0.020	**0.030**	<0.020
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.204**	<0.020	<0.020	**0.031**	<0.020
Acid Reacted Calcium (23X)	----	0.020	% Ca	**0.020**	<0.020	<0.020	<0.020	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**10**	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.022**	**0.115**	**0.173**	**0.029**	**0.038**
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.023**	**0.119**	**0.173**	**0.031**	**0.038**
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	<0.020	<0.020	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-G: Retained Acidity								
HCl Extractable Sulfur (20Be)	----	0.020	% S	**----**	**0.056**	**0.060**	**----**	<0.020
Net Acid Soluble Sulfur (20Je)	----	0.020	% S	**----**	<0.020	**0.021**	**----**	<0.020
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t	**----**	<10	<10	**----**	<10
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S	**----**	<0.020	<0.020	**----**	<0.020

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3022/ASS1	3022/ASS2	3022/ASS3	3024/ASS1	3024/ASS2
				Client sampling date / time	14-Nov-2018 00:00	14-Nov-2018 00:00	14-Nov-2018 00:00	15-Nov-2018 00:00	15-Nov-2018 00:00
Compound	CAS Number	LOR	Unit		ES1834265-016	ES1834265-017	ES1834265-018	ES1834265-019	ES1834265-020
					Result	Result	Result	Result	Result
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S		**0.02**	**0.16**	**0.14**	**0.05**	**0.07**
Net Acidity (acidity units)	----	10	mole H+ / t		**14**	**101**	**88**	**33**	**44**
Liming Rate	----	1	kg CaCO3/t		**1**	**8**	**7**	**2**	**3**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		**0.02**	**0.16**	**0.14**	**0.05**	**0.07**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		**14**	**101**	**88**	**33**	**44**
Liming Rate excluding ANC	----	1	kg CaCO3/t		**1**	**8**	**7**	**2**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3024/ASS3	----	----	----	----
				Client sampling date / time	15-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1834265-021	--------	--------	--------	--------
					Result	----	----	----	----
EA029-A: pH Measurements									
pH KCl (23A)	----	0.1	pH Unit		**4.3**	----	----	----	----
pH OX (23B)	----	0.1	pH Unit		**4.1**	----	----	----	----
EA029-B: Acidity Trail									
Titratable Actual Acidity (23F)	----	2	mole H+ / t		**52**	----	----	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t		**78**	----	----	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t		**26**	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S		**0.083**	----	----	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S		**0.125**	----	----	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S		**0.042**	----	----	----	----
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)	----	0.020	% S		<0.020	----	----	----	----
Peroxide Sulfur (23De)	----	0.020	% S		<0.020	----	----	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S		<0.020	----	----	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t		<10	----	----	----	----
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)	----	0.020	% Ca		<0.020	----	----	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca		<0.020	----	----	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca		<0.020	----	----	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t		<10	----	----	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S		<0.020	----	----	----	----
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg		**0.031**	----	----	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg		**0.033**	----	----	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg		<0.020	----	----	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t		<10	----	----	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S		<0.020	----	----	----	----
EA029-G: Retained Acidity									
HCl Extractable Sulfur (20Be)	----	0.020	% S		<0.020	----	----	----	----
Net Acid Soluble Sulfur (20Je)	----	0.020	% S		<0.020	----	----	----	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t		<10	----	----	----	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.020	% pyrite S		<0.020	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	3024/ASS3	----	----	----	----
				Client sampling date / time	15-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1834265-021	--------	--------	--------	--------
					Result	----	----	----	----
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S		**0.09**	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t		**59**	----	----	----	----
Liming Rate	----	1	kg CaCO3/t		**4**	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		**0.09**	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		**59**	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t		**4**	----	----	----	----

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 summarised 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% - medium to high 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.