Geotechnical Investigation

32-36 Hope Street, Penrith NSW

Prepared for: Designcorp Architects Pty Ltd

DSC-06-13286/ GTI1
v1 final
15th December 2017

Prepared for:

Designcorp Architects Pty Ltd

Geotechnical Investigation

32-36 Hope Street, Penrith NSW

Version	Details	Date
v1 final	Written By Joe Oo	15th December 2017

Report No: DSC-06-13286/ GTI1 / v1 final

Date: 15th December 2017

Written By:

Joe Oo
Senior Geotechnical Engineer

Reviewed By:

Jon Holliday
Principal Geotechnical Engineer

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ABBREVIATIONS

ADE	ADE Consulting Group Pty Ltd
AHD	Australian Height Datum
AS	Australian Standard
ASS	Acid Sulfate Soil
BGL	Below Ground level
BH	Borehole
CFA	Continuous Flight Auger
COC	Chain of Custody
GTI	Geotechnical Investigation
SPT	Standard Penetration Test
RQD	Rock Quality Designation
SWL	Standing Water Level
SH&EWMS	Safety Health and Environmental Works Method Statement

GEOTECHNICAL INVESTIGATION REPORT
ADE Report No. DSC-06-13286/ GTI1 / v1 final

Date of Investigation:	04.12.2017 – 11.12.2017
Date of Report:	15.12.2017
Client:	Design Corp
Site Address:	32-36 Hope Street, Penrith NSW (Refer to *Appendix I – Site Plan*)

EXECUTIVE SUMMARY

ADE Consulting Group Pty Ltd was commissioned by Design Corp to undertake a geotechnical investigation for the proposed development of a six (6) storey residential apartment with two (2) basement levels at 32-36 Hope Street, Penrith NSW. The objectives of this investigation were to provide information on the subsurface soil and rock profile and groundwater conditions, geotechnical design parameters for building construction and foundations, soil aggressivity in regard to concrete and steel and discuss foundation options for the proposed development.

To achieve the investigation objectives, the scope of field works included: drilling three (3) boreholes to depth of 9.7 m to 14.0 m with Standard Penetration Testing (SPT) of soils within the borehole; rock coring and determination of Rock Quality Designation (RQD); classification of rock according to Pells et al. system based on defects and strength; and installation of a groundwater monitoring well.

The results of the investigation indicated that the subsurface material at the site consisted of Sandy CLAY (Residual Soil) overlying SHALE/ SANDSTONE/SILTSTONE interbedded bedrock. Groundwater was encountered at 3.0m below ground level (bgl) in a monitoring well installed in borehole BH2, probably due to groundwater seepage through residual clay, transition zone of soils to rocks and defects of the underlying sandstone and shale bedrock.

Selected soil/rock samples from the boreholes were tested in a NATA accredited laboratory to determine soil plasticity, soil aggressivity to steel and concrete and strength of the rock. Laboratory test results indicated that the soil is non-aggressive to steel and mildly aggressive to concrete.

Geotechnical design parameters and recommendations for structural foundations are recommended herein based on the investigation and *insitu* testing results, laboratory test results and engineering analyses.

1 INTRODUCTION

1.1 General

ADE Consulting Group Pty Ltd (ADE) was engaged by Design Corp ('Client') to undertake a Geotechnical Investigation for a proposed development consisting of a six (6) storey residential apartment with two basement levels at 32-36 Hope Street, Penrith NSW (hereafter referred to as the 'Site'). The works were conducted in accordance with AS 1726 – 2017, *Geotechnical Site Investigations*.

1.2 Objectives

The objectives of this investigation were to provide the preliminary geotechnical information below:

- Subsurface soil, rock and groundwater conditions;
- Geotechnical design parameters;
- Foundation recommendations; and
- Recommendations pertaining to site preparation, excavation and earthworks.

1.3 Scope of Works

The Geotechnical Investigation included:

- Completion of a Safety, Health & Environment and Safe Work Method Statement prior to undertaking works;
- Drilling and logging of three (3) boreholes using a track mounted drilling rig fully equipped for geotechnical investigation to assess the soil and rock profile;
- Carrying out SPT to determine the soil density/consistency;
- Sampling for laboratory testing to determine particle size distribution of granular soils and soil sulfates, chlorides and pH/EC for aggressivity assessment;
- Rock coring and determination of Rock Quality Designation (RQD);
- Point load testing on rock core retrieved to estimate rock strength; and
- Preparation this report outlining the investigation results and engineering analyses with recommendations and conclusions.

1.4 Previous Investigations

ADE was not provided with previous investigation reports with regards to the subject Site.

1.5 Whole Report

No one section or part of a section, of this report should be taken as giving an overall idea of this report. Each section must be read in conjunction with the whole of this report, including its appendices and attachments.

2 SITE IDENTIFICATION AND GEOLOGY

2.1 Site Description

At the time of our investigation, three single storey residential houses occupied within the Site. The site is rectangular in shape with an approximate total area of 1,880 m^2 (Refer to *Appendix I – Site Plan*). The site is bounded by Hope Street to the front, Colless Street to the south-west and similar residential property in surrounding area. The topography of the site is relatively flat across the proposed development site and occupied by three single storey residential houses.

2.2 Site Geology

The Sydney 1:100 000 *Geological Map of Penrith* indicated that the Site is underlain by Bringelly Shale – comprising shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coral and tuff. The extract of geologic map is shown in Figure 2 of Appendix 1.

3 INVESTIGATION RESULTS

3.1 Fieldwork Description

The fieldworks were undertaken on the 4th to 11th of December 2017. The field investigation comprised the drilling of three (3) boreholes (BH1 to BH3) to a depth of 9.7 m to 14.0 m bgl. SPTs were undertaken in the borehole within soils to assess the subsurface soil consistency and density, and estimate soil strength parameters. Rock coring and core sample retrieval were undertaken for rock classification, determination of RQD and laboratory testing. The borehole was logged on-site by an experienced geotechnical engineer in accordance with AS 1726 – 2017, *Geotechnical Site Investigations*. The approximate location of the borehole is shown on the Site Plan (Refer to *Appendix I – Site Plan*).

Following drilling, a groundwater well was constructed within the borehole BH2 to enable future groundwater depth measurements.

3.2 Fieldwork Results

Borehole logging undertaken onsite by ADE illustrated the conditions and materials encountered in the borehole and the approximate depths at which the subsurface conditions and materials changed (Refer to Appendix II – Borehole Log). An interpretation of the subsurface conditions and materials encountered during the field investigation is given in Table 3.1 below:

Table 3.1 Interpretation of Subsurface Materials

Material encountered	BH1 (m bgl)	BH2 (m bgl)	BH3 (m bgl)
Unit 1. TOPSOIL: Sandy CLAY	0.0 – 0.2	-	-
Unit 2. Sandy CLAY (Residual Soil)	0.2 – 4.4	0.0 – 3.8	0.0 – 3.0
Unit 3a. Class V Rock (SHALE / SANDSTONE interbedded)	4.4 – 5.0	3.8 – 6.1	3.0 – 6.3
Unit 3b. Class IV Rock (SHALE / SANDSTONE interbedded)	-	6.1 – 11.2	-
Unit 3c. Class III Rock (SHALE/SANDSTONE/SILSTONE interbedded)	5.0 – 9.9	11.2 – 14.0	6.3 – 9.7

3.3 Groundwater

A groundwater monitoring well was installed within the borehole BH2 on the 11th of December 2017 and groundwater level was recorded at approximately 3.0 m bgl on the 14th of December 2017.

3.4 Laboratory Test Results

Selected soil samples from the boreholes were tested in a NATA accredited laboratory to determine soil aggressivity to steel and concrete, soil plasticity for classification purposes, and estimate rock strength to *Appendix III – Analytical Reports*). The results of the lab testing are summarised herein.

Table 3.2 Laboratory Test Results – Atterberg Limits

Boreholes ID	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH2	3.0	45	16	28
BH3	1.5	37	16	20

Soils were tested for pH, sulfates and chlorides to assess soil aggressivity. Table 3.2 presents the summary of the aggressivity test results. Laboratory test results indicated that the soil is non-aggressive to steel and mildly aggressive to concrete.

Table 3.3 Aggressivity Results and Classification

Boreholes ID	Depth (m)	pH	Chlorides (mg/kg)	Sulfates SO4 (mg/kg)	Resistivity ohm.cm	Exposure Classification AS2159	
						To Concrete	To Steel
BH2	1.5	5.5	1730	10	1210	Mild	Non-aggressive
BH2	3.0	9.5	520	260	1450	Non-aggressive	Non-aggressive
BH2	4.5	9.6	570	160	1490	Non-aggressive	Non-aggressive
BH3	1.5	7.7	280	230	3320	Non-aggressive	Non-aggressive
BH3	3.0	9.7	100	40	2960	Non-aggressive	Non-aggressive
BH3	6.0	9.3	360	50	2240	Non-aggressive	Non-aggressive

Point load testing was performed on a rock core retrieved from the borehole and the Point Load Strength Index results are included in the borehole logs in Appendix II. The test results were analysed for classification of the rock in accordance with 'Australian Standard (AS) 1726 – Geotechnical Site Investigations' and 'Foundations on Sandstone and Shale In the Sydney Region – Pells et al.

4 GEOTECHNICAL ENGINEERING ASSESSMENT AND RECOMMENDATIONS

4.1 Subsurface Profile

The results of the investigation indicated that the subsurface material at the site consisted of Sandy CLAY (Residual Soil) overlying interbedded SHALE / SANDSTONE bedrock. The predominant bedrock encountered at boreholes was shale. However, shale was interbedded with siltstone, sandstone and some distinct sandstone lamination.

A general interpretation of the soil and rock profile that were encountered during the investigation and rock classification according to Pells et al. system based on defects and strength as shown in Table 4.1 below:

Table 4.1 Interpreted Subsurface Profile

Unit No.	Layers	Material Description	Depth To Top of Layer (m)	Layer Thickness (m)
2	Residual Soil (Sandy CLAY)	Low to medium plasticity, firm to stiff, with sandstone and shale fragments	0.0	3.0 – 4.2
3a	Class V Bedrock (SHALE/SANDSTONE interbedded)	Extremely to highly weathered, very low strength	3.0 – 4.4	0.6 – 3.3
3b	Class IV Bedrock (SHALE/SANDSTONE interbedded)	Slightly to moderately weathered, very low to low strength	6.1	5.1
3c	CLASS III Bedrock (SHALE/SANDSTONE/SILTSTONE Interbedded)	Slightly weathered, low to medium to high strength	5.0 – 11.2	N/A

4.2 Site Factors for Earthquake Design

Based on AS 1170.4 – 2007, the Earthquake Hazard Factor, Z, for the Sydney region is 0.08, and the Site classifies as Sub-Soil Class C_e – Shallow Soil Site.

The Earthquake Design Category should be assessed based on a Probability Factor, K_p, (which is related to an Annual Probability of Exceedance) as defined in Table 3.1 of AS 1170.4 – 2007.

4.3 Excavation and Site Preparation

Based on our understanding that there will be two levels of basement for the proposed building, bulk excavations for the basement are expected to extend down to approximately 6.0 m to 7.0 m bgl. Based on our investigation findings, it is expected that the excavated materials will comprise Sandy CLAY (Residual Soil) and weathered shale/sandstone bedrock. The excavation of soils should be readily achievable using conventional earthmoving plant, such as the excavators with toothed buckets or bulldozers. However low to

medium strength rock may be excavated using a D10T (or larger) dozer with easy to medium to hard ripping. If rock breaking technique is required, saw cutting method may be used along the excavation perimeter. This is to reduce the vibrations transferred to neighbouring properties and reduce any risk to the integrity of the nearby structures.

Should vibratory rock breaking technique be required, we recommend that ground vibrations induced by rock hammering be monitored along the site boundary to ensure that it is within acceptable level. Induced vibrations in structures adjacent to the excavation should not exceed a peak particle velocity (PPV) of 5mm/sec.

We recommend that dilapidation surveys are to be carried out on all adjoining buildings, roads and civil structures so that an accurate record of the existing conditions of these elements are mapped prior to the commencement of bulk excavation works. Excavation works should be complemented by reference to the Code of Practice 'Excavation Work' prepared by Safe Work Australia – March 2015.

4.4 Groundwater Consideration for Basement Excavation

The standing groundwater level was encountered at 3.0 m bgl, probably due to groundwater seepage through residual clay, transition zone of soils to rocks and defects of the underlying sandstone and shale bedrock. It can be expected that some groundwater seepage into the basement excavation will occur during construction and also expected to rise and fall according to prevailing weather patterns. Such seepage should be controlled by perimeter drains to a sump and pump dewatering system. Since we expect that shoring will be constructed around the basement perimeter, temporary dewatering should be implemented to not cause excessive drawdown outside the Site, provided the cut-off is properly designed and constructed.

A hydrogeological study of the Site will be required to assess the effect of dewatering on neighbouring properties and the optimum depth of the shoring cut-off. Permanent dewatering systems are not likely to be approved; therefore, the basement will need to be tanked and designed to take the hydrostatic lateral and uplift pressures associated with groundwater into account. It should be noted that water quality must be determined based on chemical testing to assess the need for treatment prior to discharge.

4.5 Temporary Batter Slopes

The batter slopes for temporary unsupported excavations above groundwater level are given in the table below:

Table 4.2 Summary of Safe Unsupported Batter Slopes

Material	Temporary Batter Slope (H : V)
Sandy CLAY	1.5:1
Extremely weathered Sandstone and Shale	1:1

All excavations should be assessed by a suitably qualified geotechnical engineer if left for an extended period of time.

4.6 Geotechnical Design Parameters for Excavation Retention

A retention system will be required for basement excavation. The geotechnical parameters for design of retaining walls or shoring walls have been derived using available published data, relevant past experience, laboratory test results and SPT information from the borehole, which have been undertaken to assess the strength parameters and consistency/density of the subsurface materials. The recommended geotechnical design parameters are presented in Table 4.3 below:

Table 4.3 Geotechnical Design Parameters for Retaining Walls

Design Parameter	γ (kN/m^3)	C_u (kPa)	c' (kPa)	ϕ' (°)	E' (MPa)	v
Parameter Description	Bulk unit weight	Undrained shear strength	Effective cohesion	Effective angle of internal friction	Drained Young's modulus	Poisson's ratio
Unit 1. Sandy CLAY (Residual)	19	100	5	28	30	0.3
Unit 2. CLASS V Bedrock (SHALE/SANDSTONE Interbedded)	22	-	30	28	80	0.25
Unit 2. CLASS IV Bedrock (SHALE/SANDSTONE Interbedded)	22	-	50	28	150	0.25
Unit 3. Class III Rock (SHALE/SANDSTONE Interbedded)	23	-	100	31	200	0.25

4.7 Foundation Recommendations

It is expected that from the borehole logs, the basement excavation levels may extend into the shale/sandstone bedrock and so shallow footing such as pad or strip footings are generally possible for the foundation types in order to support the structure within shale / sandstone interbedded bedrock. We recommend for uniform support that all the building foundation should be founded within Class III rock. Pad or strip footings may be adopted within Class III rock, however at some other locations short piles would have to be adopted to reach to the Class III if it occurs deeper.

Shallow footings and piles founded in bedrock may be designed in accordance with the following bearing pressures recommended in Table 4.3. These parameters are provided based on Pells Report - *Foundations on Sandstone and Shale in the Sydney Region* (Pells et al).

Table 4.4 Recommended Bearing Pressure for SHALE / SANDSTONE

Geotechnical Unit	Serviceability End Bearing Pressure (kPa)	Ultimate End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)	Elastic Modulus (MPa)
Unit 3a. CLASS V Bedrock (SHALE/SANDSTONE Interbedded)	700	1,500	50	50
Unit 3b. CLASS IV Bedrock (SHALE/SANDSTONE Interbedded)	1,000	3,000	150	150
Unit 3c. Class III Rock (SHALE/SANDSTONE Interbedded)	2,500	10,000	400	350

The following should be considered in pile design:

1. The allowable shaft adhesion from the ground surface to 1.5 pile diameters or 1 m (whichever is greater) shall be ignored for piles installed through residual SAND;
2. Piles end bearing on soil (fill, sand or clay) are not recommended;
3. For piles designed to resist uplift (tension) loading, we recommend that a shaft adhesion value of 50% of the tabulated values be adopted; and
4. A geotechnical reduction factor of 0.5 assuming pile load testing and verification will be specified.
5. All footings and piles should be inspected by a geotechnical engineer to ascertain that the recommended foundation bearing conditions have been achieved and to check on possible variations that may occur between and beyond the boreholes. All piles should be filled with concrete immediately following excavation.
6. All footings should be excavated, cleaned, inspected and poured preferably on the same day as excavation and/or drilling. If a delay in pouring is expected, then we recommend a concrete blinding layer should be placed in the base of pad or strip footing excavations in order to prevent water-ponding in the base of footing excavations.

The allowable bearing pressures presented are based on the ground profile obtained from boreholes. Should ground/soil profile conditions other than those assumed in design be encountered onsite during construction, an experienced geotechnical engineer should be consulted to determine if a re-design is warranted.

4.8 Soil Nailing/Anchoring

The ultimate bond stresses provided in Table 4.5 below may be adopted for anchors with the provision that the anchors should be proof loaded to at least 1.5 times their design working load. Please note that intrusive investigation does not normally include direct testing of ultimate bond parameters. The parameters recommended in this section are based on previous relevant project experience and published values relating to the Sydney region. It is recommended that further suitability and acceptance testing for the designed elements may be required for different structural elements.

Table 4.5 Recommended Ultimate Bond Stress

Material	Ultimate Bond Stress (kPa)
Unit 1. Residual Soil (Sandy CLAY)	40
Unit 2. CLASS V/IV Rock (SHALE/SANDSTONE Interbedded)	180
Unit 3. Class III Rock (SHALE/SANDSTONE Interbedded)	600

5 LIMITATIONS

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based on information provided by the client. The advice herein relates only to this project and all results, conclusions and recommendations made should be reviewed by a competent and experienced person with experience in environmental and geotechnical investigations, before being used for any other purpose. ADE accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced or amended in any away without prior approval by the client or ADE and should not be relied upon by any other party, who should make their own independent enquiries.

This report does not provide a complete assessment of the geotechnical status of the site and it is limited to the scope defined herein. Should information become available regarding conditions at the site (e.g., Conditions exposed at the site during excavation varying significantly with the results within this report), ADE reserves the right to review the report in the context of the additional information.

ADE's professional opinions are based upon its professional judgement, experience, training and results from analytical data. In some cases further testing and analysis may be required, thus producing different results and/or opinions. ADE has limited investigation to the scope agreed upon with its client.

This report has been written with the intent of providing information of the site subsurface to the client for design and construction purposes. Subsurface conditions relevant to the works undertaken by the client should be assessed by a competent contractor who can make their own interpretation of the data represented within this report.

Subsurface conditions will always vary within a worksite and the extremes of these variations cannot be defined by exhaustive investigations, and as such, the measurements and values obtained within this result may not be representative of these extremes.

APPENDIX I SITE PLAN

Figure 1 Site plan with the approximate borehole location, taken from Google Earth on 15.12.2017

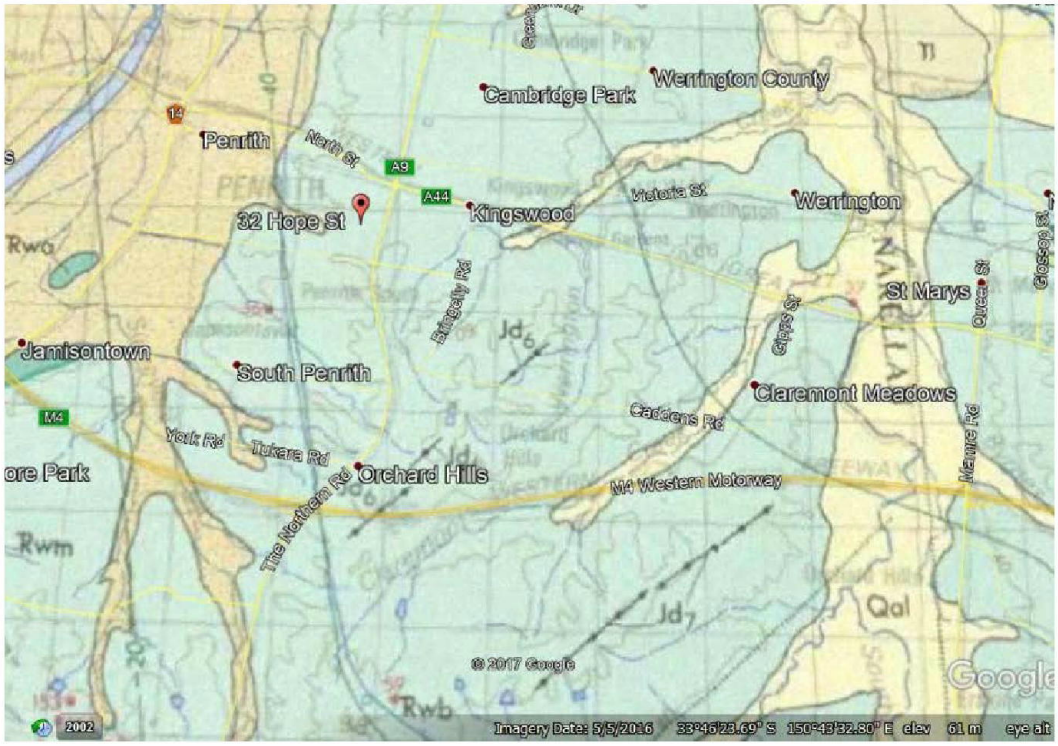


Figure 2 *Geological Map of Penrith* (1:100 000), Taken from NSW Government, Department of Resources and Energy on 15.12.2017, showing the local geology of the proposed development site

APPENDIX II BOREHOLE LOG

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH1

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 5/12/17 **COMPLETED** 5/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** SC **CHECKED BY** JO

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency Density	Samples Tests Remarks	Additional Observations
ADT						TOPSOIL: Sandy CLAY, low plasticity, dark brown, dry	D			RESIDUAL SOIL
			1		CH	Silty CLAY, medium to high plasticity, brown - reddish brown, moist	M			
			2		CH	Silty CLAY, high plasticity, brown mottled grey, slightly moist, with shale fragments and trace of ironstone	M	VSt	SPT 16, 22, 30 N=52	
			3		CH	Silty CLAY, high plasticity, grey mottled brown, moist, with shale fragments	M	H	SPT R	
			4							
ADT			5			SHALE, grey mottled brown				EXTREMELY WEATHERED BEDROCK
						Borehole BH1 continued as cored hole				
			6							
			7							
			8							
			9							
			10							

BOREHOLE / TEST PIT 13286.GPJ 11931.GPJ 15/12/17

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH1

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 5/12/17 **COMPLETED** 5/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** SC **CHECKED BY** JO

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Defect Description
			1								
			2								
			3								
			4								
			5		Continued from non-cored borehole						
CORING			6		SANDSTONE, fine to medium grained, grey, iron stained, cross bedded	MW		D 0.57 A 1.42			PT, 10°, PL, SM, CL
											PT, 10°, PL, SM, CL
			7					D 0.58 A 1.34	100		PT, 0°, PL, SM, CL X 2
								D 1.34 A 1.56			PT, 10°, CU, SM, CL
			8								PT, 0°, CU, SM, CL
					SILSTONE, gray - dark gray	MW					PT, 0°, PL, SM, CL
			9					D 0.94 A 0.76	99		PT, 0°, PL, SM, CL
											PT, 0°, PL, SM, CL
											PT, 0°, PL, RO, CL
			10								PT, 0°, CU, SM, CL

BH1 terminated at 9.9m

CORED BOREHOLE 13286.GPJ GINT STD AUSTRALIA.GDT 15/12/17

ADE Consulting Group

Project : Geotechnical Investigation at 36 Hope St., Penrith NSW

Job No. : DSC-06-13286

Borehole : BH1

Depth : 5.0 m – 10.0 m

Core Photo : BH1

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH2

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 6/12/17 **COMPLETED** 6/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** SC **CHECKED BY** JO

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency Density	Samples Tests Remarks	Additional Observations
ADT						CI	Sandy CLAY, orange, medium plasticity, moist				RESIDUAL SOIL
				1		CI	Sandy CLAY, ligth white, medium plasticity, moist, trace of fine gravel (angular)				
						CI	Sandy CLAY, yellow - brown, medium plasticity, medium grained sand		St	SPT 9, 10, 12 N=22	
				2				M			
	▼			3					H	SPT 38, R	
ADT				4			SANDSTONE, fine to medium grained, yellow, shale fragments				EXTREMELY WEATHERED BEDROCK
				5				M			
				6			SHALE, brown, wet	W			
							Borehole BH2 continued as cored hole				
				7							
				8							
				9							
				10							

BOREHOLE / TEST PIT 13286.GPJ 11931.GPJ 18/12/17

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH2

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 6/12/17 **COMPLETED** 6/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** SC **CHECKED BY** JO

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Defect Description
				1								
				2								
				3								
				4								
				5								
				6		Continued from non-cored borehole						
CORING				7		SHALE, grey, distinct sandstone lamination	HW			47		PT, 0°, PL, SM, CL
						SANDSTONE, grey, fine to medium grained, distinct shale lamination						PT, 0°, PL, SM, CL
				8		CORE LOSS						PT, 0°, PL, SM, CL
						SHALE, fine to medium, grey, distinct shale lamination						PT, 0°, PL, SM, CL
				9						30		PT, 0°, PL, SM, CL
												PT, 0°, PL, SM, CL
				10								Crushed zone
												PT, 0°, PL, SM, CL x 2
												CLAY seam
												CLAY seam x 2
												PT, 0°, PL, SM, CL
												PT, 0°, PL, SM, CL

CORED BOREHOLE 13286.GPJ GINT STD AUSTRALIA.GDT 18/12/17

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH2

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 6/12/17 **COMPLETED** 6/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** SC **CHECKED BY** JO

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Defect Description
CORING				11		CORE LOSS *(continued)*	HW					PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL Crushed zone, Clay Seam CLAY seam, 5mm Crushed Zone
						SHALE, fine to medium, grey, distinct sandstone lamination	HW/MW		D A 0.77 2.21	30		Crushed Zone PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL
				12								PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL x 2 JN, 90°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL
				13		CORE LOSS			D A 0.96 0.87			PT, 0°, PL, SM, CL
						SHALE, fine to medium, grey, indistinct sandstone lamination				74		PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL
				14		BH2 terminated at 14m			D A 0 0.49			PT, 0°, PL, SM, CL
				15								
				16								
				17								
				18								
				19								
				20								

CORED BOREHOLE 13286.GPJ GINT STD AUSTRALIA.GDT 18/12/17

ADE Consulting Group

Project : Geotechnical Investigation at 32 Hope St., Penrith NSW

Job No. : DSC-06-13286

Borehole : BH2

Depth : 6.1 m – 14.0 m

Core Photo : BH2

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH3

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 8/12/17 **COMPLETED** 8/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** LS **CHECKED BY** JO

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Moisture Condition	Consistency Density	Samples Tests Remarks	Additional Observations
ADT			0		CH	Silty CLAY, high plasticity, orange, moist				RESIDUAL
			1		CL-CI	Sandy CLAY, medium plasticity, pale brown, moist				
					CL-CI	Sandy CLAY, medium plasticity, pale brown, moist, with sandstone fragments	M	St	SPT 6, 8, 13 N=21	
ADT			2							
			3			SHALE, brown		H	SPT 17, 27, R	EXTREMELY WEATHERED BEDROCK
			4							
						SHALE, brown, dry				
			5		CH	CLAY, high plasticity, brown, moist				
			6			Borehole BH3 continued as cored hole				
			7							
			8							
			9							
			10							

BOREHOLE / TEST PIT 13286.GPJ 11931.GPJ 15/12/17

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH3

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 8/12/17 **COMPLETED** 8/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** LS **CHECKED BY** JO

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Defect Description
			1								
			2								
			3								
			4								
			5								
			6		Continued from non-cored borehole						
CORING			7		SHALE, gray, distinct sandstone lamination	EW / HW/MW		D 0 A 0.56	47		PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL X 2 PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL JN, 0°, PL, SM, CL PT, 0°, PL, SM, CL X 2 PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL
					SANDSTONE, grey, distinct shale lamination						
			8		SILSTONE, grey - dark grey			D 3.22 A 1.12			PT, 0°, PL, SM, CL JN, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL X 2 JN, 80°, PL, SM, CL Crushed Zone
					SHALE, grey, distinct sandstone lamination						
			9						13		PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL PT, 0°, PL, SM, CO
			10		BH3 terminated at 9.7m	EW		D 0 A 0			

CORED BOREHOLE 13286.GPJ GINT STD AUSTRALIA.GDT 15/12/17

ADE CONSULTING GROUP
New South Wales Office:
ADE Consulting Group
6/7 Millennium Court
Silverwater, NSW 2128
Telephone: (02) 8541 7214
Site:www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

BOREHOLE NUMBER BH3

CLIENT DSC - Designcorp Architecs **PROJECT NAME** Geotechnical Investigation

PROJECT NUMBER DSC-06-13286 **PROJECT LOCATION** 32-36 Hope Street, Penrith NSW

DATE STARTED 8/12/17 **COMPLETED** 8/12/17 **R.L. SURFACE** _____ **DATUM** _____

DRILLING CONTRACTOR ADE **SLOPE** 90° **BEARING** ---

EQUIPMENT Comacchio Geo 205 **HOLE LOCATION** See site plan

HOLE SIZE 125 mm **LOGGED BY** LS **CHECKED BY** JO

NOTES _____

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength $Is_{(50)}$ MPa (EL VL L M H VH EH; D- diametral A- axial)	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Defect Description
			11							CLAY Seam Crushed Zone PT, 0°, PL, SM, CL PT, 0°, PL, SM, CL Crushed Seam
			12							
			13							
			14							
			15							
			16							
			17							
			18							
			19							
			20							

CORED BOREHOLE 13286.GPJ GINT STD AUSTRALIA.GDT 15/12/17

ADE Consulting Group

Project : Geotechnical Investigation at 34 Hope St., Penrith NSW

Job No. : DSC-06-13286

Borehole : BH3

Depth : 6.0 m – 9.7 m

Core Photo : BH3

APPENDIX III LABORATORY TESTING REPORTS

Sydney Laboratory Services A.C.N. 093 452 950
Construction Material Testing
Unit 14/47 Parramatta Road
Granville NSW 2142
Ph: (02) 9648-6669

ATTERBERG LIMITS REPORT

Client:	Designcorp Architects	Job No.:	DSC-06-13286
Address:	32-36 Hope Street, Penrith NSW	Report Date:	14.12.2017
Project:	Hope St, Penrith	Tested By:	ZG
Location:	Hope St, Penrith	Test Location:	BH2 - 3m

Sampling Date:	9.12.2017			
Sampling:	AS 1289.1.2.1 Sampling and preparation of soils- Disturbed samples			
Preparation	AS1289.1.1 ☑ T105 ☐	**Test Procedure:**	AS1289.3.1.1 ☑	AS1289.3.1.2 ☐
			AS1289 3.2.1 ☑	T108 ☐
Laboratory Test No.:	DSC-06-13286 BH2		AS1289 3.3.1 ☑	T109 ☐
Material Description :	Sandy Clay		AS1289.3.4.1 ☐	T113 ☐
		Moisture Content:	AS1289.2.1.1 ☑	T120 ☐

Liquid Limit - Casagrande

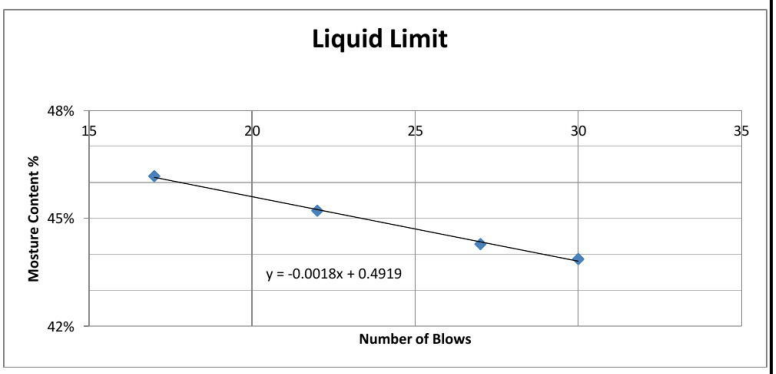
Sample Number	1	2	3	4
Target of Drops	30-40	25-35	20-30	15-25
Number of Drops A	30	27	22	17
Number of Drops B	31	26	23	16
#A = #B ±1	PASS	PASS	PASS	PASS
Identification (Foil or CAN)	41	28	21	71
Mass of Foil/CAN (g)	5.38	5.90	5.42	5.60
Mass of Foil/CAN with Wet Soil (g)	25.78	24.83	24.37	25.07
Constant Mass (Mass 1 + Date/Time)	19.56	19.02	18.47	18.92
Constant Mass (Mass 2 + Date/Time)	19.56	19.02	18.47	18.92
Mass of Foil/CAN with Dry Soil (g)	19.56	19.02	18.47	18.92
Mass of Soil Solid (g)	14.18	13.12	13.05	13.32
Mass of Water (g)	6.22	5.81	5.90	6.15
Water Content (%)	44%	44%	45%	46%
Liquid Limit (graph at 25 blows) (%)	45%			

Plastic Limit - 3 mm diameter soil

Sample Number	1	2	3
Identification (Foil or CAN)	C20	C18	C24
Mass of Foil/CAN (g)	4.09	4.20	3.58
Mass of Foil/CAN with Wet Soil (g)	13.54	12.89	11.69
Mass of Foil/CAN with Dry Soil (g)	12.23	11.67	10.56
Mass of Soil Solid (g)	8.14	7.47	6.98
Mass of Water (g)	1.31	1.22	1.13
Water Content (%)	16%	16%	16%
Plastic Limit (%)	16%		

Plasticity Index

Plasticity Index = Liquid Limit - Plastic Limit (%)	**28%**



Method of Preparation: ☐ Wet-sieved ☑ Dry-sieved
History of Sample: ☐ Natural State ☐ Air-dried ☑ Oven-dried ☐ Unknown

Notes: N/A

Accreditation No.14664.
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

Tests not covered by NATA are denoted with *.

Authorised Signatory:

Bikesh Deoju
Geotechnical Engineer
B. Sc. (Civil Engineering)

Sydney Laboratory Services A.C.N. 093 452 950
Construction Material Testing
Unit 14/47 Parramatta Road
Granville NSW 2142
Ph: (02) 9648-6669

ATTERBERG LIMITS REPORT

Client:	Designcorp Architects	Job No.:	DSC-06-13286
Address:	32-36 Hope Street, Penrith NSW	Report Date:	14.12.2017
Project:	Hope St, Penrith	Tested By:	ZG
Location:	Hope St, Penrith	Test Location:	BH3 - 1.5m

Sampling Date:	9.12.2017				
Sampling:	AS 1289.1.2.1 Sampling and preparation of soils- Disturbed samples				
Preparation	AS1289.1.1 ☑	T105 ☐	**Test Procedure:**	AS1289.3.1.1 ☑	AS1289.3.1.2 ☐
				AS1289 3.2.1 ☑	T108 ☐
Laboratory Test No.:	DSC-06-13286 BH3			AS1289 3.3.1 ☑	T109 ☐
Material Description :	Sandy Clay			AS1289.3.4.1 ☐	T113 ☐
			Moisture Content:	AS1289.2.1.1 ☑	T120 ☐

Liquid Limit - Casagrande

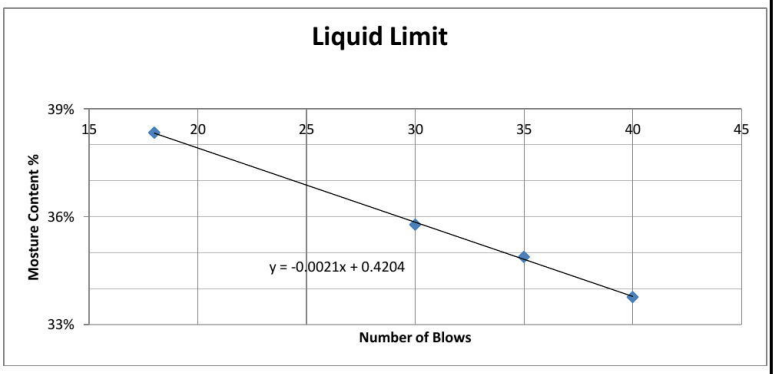
Sample Number	1	2	3	4
Target of Drops	30-40	25-35	20-30	15-25
Number of Drops A	40	35	30	18
Number of Drops B	40	34	30	17
#A = #B ±1	PASS	PASS	PASS	PASS
Identification (Foil or CAN)	C15	54	19	18
Mass of Foil/CAN (g)	4.07	5.00	5.75	5.40
Mass of Foil/CAN with Wet Soil (g)	21.70	24.45	27.23	29.54
Constant Mass (Mass 1 + Date/Time)	17.25	19.42	21.57	22.85
Constant Mass (Mass 2 + Date/Time)	17.25	19.42	21.57	22.85
Mass of Foil/CAN with Dry Soil (g)	17.25	19.42	21.57	22.85
Mass of Soil Solid (g)	13.18	14.42	15.82	17.45
Mass of Water (g)	4.45	5.03	5.66	6.69
Water Content (%)	34%	35%	36%	38%
Liquid Limit (graph at 25 blows) (%)	37%			

Plastic Limit - 3 mm diameter soil

Sample Number	1	2	3
Identification (Foil or CAN)	C19	C30	C17
Mass of Foil/CAN (g)	4.10	3.65	3.74
Mass of Foil/CAN with Wet Soil (g)	12.61	11.74	11.78
Mass of Foil/CAN with Dry Soil (g)	11.39	10.59	10.66
Mass of Soil Solid (g)	7.29	6.94	6.92
Mass of Water (g)	1.22	1.15	1.12
Water Content (%)	17%	17%	16%
Plastic Limit (%)	16%		

Plasticity Index

Plasticity Index = Liquid Limit - Plastic Limit (%)	**20%**



Method of Preparation: ☐ Wet-sieved ☑ Dry-sieved
History of Sample: ☐ Natural State ☐ Air-dried ☑ Oven-dried ☐ Unknown

Notes: N/A

Accreditation No.14664.
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

Tests not covered by NATA are denoted with *.

Authorised Signatory:

Bikesh Deoju
Geotechnical Engineer
B. Sc. (Civil Engineering)

Sydney Laboratory Services

A division of A. D. Envirotech Australia Pty Ltd
Unit 4/10-11 Millennium Court,
Silverwater 2128
Ph: (02) 9648-6669

A.C.N. 093 452 950

Analysis report: DSC-06-13286-1

Customer: A. D. Envirotech Australia Pty. Ltd.
Attention: Maximilian Kemnitz & Songwei Che

Sample Log In Details

Your reference:	DSC-06-13286-1
No. of Samples:	6
Date Received:	12.12.2017
Date completed instructions received:	12.12.2017
Date of analysis:	13.12.2017

Report Details

Report Date:	14.12.2017
Method number:**	ESA-P-21 *ESA-P-16

Results Authorised By:

Ross Nefodov, B.Sc. (Environmental Sc.), M.PE.(Civil Engineering)
Managing Director
NATA approved signatory

Accreditation No.14664.

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Tests not covered by NATA are denoted with *.

General Comments and Glossary

Tests not covered by NATA are denoted with *.
Samples are analysed on "as received" basis.

Samples were delivered chilled	**Yes**
Samples were preserved in correct manner	**Yes**
Sample containers for volatile analysis were received with minimal headspace	**Yes**
Samples were analysed within holding time	**Yes**
Some samples have been subcontracted	**No**

1. All samples are tested in batches of 20.
2. All results for soil samples are reported per gram of dry soil, unless otherwise stated.
3. However surrogate standards are added to samples due to PAH and BTEX analysis and recoveries are calculated, samples' results are not corrected for standards recoveries.
4. Analysis of VOC in water samples are performed on unfiltered waters (as received), spiked with surrogate
5. If heterogenous or insufficient material provided LCS is used as matrix spike for QA/QC purposes.
6. Duplicate sample and matrix spike recoveries may not be prepared on smaller jobs, however, were analysed at a frequency
7. QA/QC samples shown within the report that states the word "BATCH"; Batch Blank, Matrix Spike and Duplicate were prepared on samples from outside of reported job.

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

INS: Insufficient sample for this test
>: Greater than
LCS: Laboratory Control Sample
NT: Not tested
<: Less than
RPD: Relative Percent Difference
NA: Test not required
PQL: Practical Quantitation Limit

Laboratory Acceptance Criteria

Matrix Spikes and LCS: Generally 70-130% for inorganics/metals, 60-140% for organics is acceptable. Matrix heterogeneity may result in matrix spike analyses falling outside these limits.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:
Results <10 times the PQL : No Limit
Results between 10-20 times the PQL : RPD must lie between 0-50%
Results >20 times the PQL : RPD must lie between 0-30%
Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

Accreditation No.14664.
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Tests not covered by NATA are denoted with *.

**Methods Number Description:

ESA-MP-01	Determination of metals by MP-AES
ESA-MP-02	Digestion of soil samples for MP-AES analysis
ESA-MP-03	Preparation of water samples for metals determination by MP-AES
ESA-MP-04	TCLP for inorganic contaminants
ESA-MP-05	Digestion of paint and dust samples for lead content determination
ESA-MP-06	Digestion of air filters
ESA-MP-07	Digestion of swabs for determination of lead content in dust
ESA-MP-11	Procedure for digesting soil, sediment, clay and sludge in quadruplets and analysis by MP-AES for trace metal determination
ESA-P-ORG02	Analysis of PAHs by GC-MS
ESA-P-ORG03	Analysis of TRH and TPH by GC-FID
ESA-P-ORG04	Separatory funnel extraction of PAHs from water matrices including TCLP extracts
ESA-P-ORG05	Separatory funnel extraction of TRH and TPH from water matrices
ESA-P-ORG06	Silica gel clean up of soil and water extracts, prior analysis for STPH
ESA-P-ORG07	Extraction of BTEX and VTRX from soil matrices
ESA-P-ORG08	Analysis of soil extracts and waters by P&T GCMS
ESA-P-ORG09	Extraction of TRH from solid matrices
ESA-P-ORG13	Extraction of OCP OPP and PAH from soil matrices as quadruplets
ESA-P-ORG14	Extraction of PCB (Aroclor) OCP OPP and PAH from soil matrices
ESA-P-ORG15	Analysis of PCB OCP OPP and PAH by GCMS
AS 1289.4.3.1	Determination of the pH value of a soil-Electrometric method
AS 1289.3.6.1	Determination of the particle size distribution of a soil - Standard method of analysis by sieving
T276	NSW RMS Test Method T 276 Foreign materials content of recycled crushed concrete
*Texture Assessment based on; Salinity Notes, Number 8, Oct 2000, ISSN 1 325-4448, "How to Texture soils & Test for Salinity"	
*ESA-P-16	Procedure for measurement of Electrical Conductivity EC
ESA-P-12	Moisture by classical in-house method; **Procedure for gravimetric moisture determination**
*pH FOX Test -Determination of Acid Sulfate Soils Field pH	
*pH measurement as per: The excavated natural material order 2014 Schedule B3: GUIDELINE ON Laboratory Analysis of Potentially Contaminated Soils	
ESA-P-21	Test method for determination of pH value

Accreditation No.14664.

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Tests not covered by NATA are denoted with *.

Lab ID	PQL (mg/kg)	13286-C1	13286-C2	13286-C3	13286-C4	13286-C5	13286-C6
Sample Name		13286 BH2-1.5m	13287 BH2-3m	13288 BH2-4.5m	13289 BH3-1.5m	13290 BH3-3m	13291 BH3-6m
pH (average for 3 measurements)		5.5	9.5	9.6	7.7	9.7	9.3
EC	[dS/m]	0.528	0.465	0.483	0.080	0.227	0.233

New South Wales Office:
A. D. Envirotech Australia Pty Ltd
Unit 4, 10-11 Millennium Court
Silverwater, NSW 2128

Telephone:
(02) 9648 6669
e-mail: info@ADenvirotech.com.au

ABN: 520 934 529 50

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1731469**	Page	: 1 of 4
Client	: **ADE Consulting Group Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: MR BIKESH DEOJU	Contact	: Customer Services ES
Address	: 6/7 MILLENIUM COURT SILVERWATER NSW 2128	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 02 8541 7214	Telephone	: +61-2-8784 8555
Project	: DSC-06-13286	Date Samples Received	: 12-Dec-2017 15:30
Order number	: ----	Date Analysis Commenced	: 12-Dec-2017
C-O-C number	: PM-F-07b1	Issue Date	: 15-Dec-2017 17:27
Sampler	: SONGWEI CHE		
Site	: ----		
Quote number	: EN/097/17		
No. of samples received	: 6		
No. of samples analysed	: 6		

ilac-MRA NATA

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
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.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	13286 BH2-1.5m	13286 BH2-3m	13286 BH2-4.5m	13286 BH3-1.5m	13286 BH3-3m
			Client sampling date / time	06-Dec-2017 00:00	06-Dec-2017 00:00	06-Dec-2017 00:00	08-Dec-2017 00:00	08-Dec-2017 00:00
Compound	CAS Number	LOR	Unit	ES1731469-001	ES1731469-002	ES1731469-003	ES1731469-004	ES1731469-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	12.2	11.0	9.1	18.0	11.8
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	1210	1450	1490	3320	2960
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	260	160	230	40
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	1730	520	570	280	100

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**13286 BH3-6m**	----	----	----	----
			Client sampling date / time	08-Dec-2017 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1731469-006**	--------	--------	--------	--------
				Result	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**5.2**	----	----	----	----
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**2240**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**50**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**360**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1731469**	Page	: 1 of 3
Client	: **ADE Consulting Group Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: MR BIKESH DEOJU	Contact	: Customer Services ES
Address	: 6/7 MILLENIUM COURT SILVERWATER NSW 2128	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 02 8541 7214	Telephone	: +61-2-8784 8555
Project	: DSC-06-13286	Date Samples Received	: 12-Dec-2017
Order number	: ----	Date Analysis Commenced	: 12-Dec-2017
C-O-C number	: PM-F-07b1	Issue Date	: 15-Dec-2017
Sampler	: SONGWEI CHE		
Site	: ----		
Quote number	: EN/097/17		
No. of samples received	: 6		
No. of samples analysed	: 6		

ilac-MRA NATA

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 Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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
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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1309995)									
ES1731302-005	Anonymous	EA055: Moisture Content	----	1	%	21.4	21.7	1.70	0% - 20%
ES1731469-001	13286 BH2-1.5m	EA055: Moisture Content	----	1	%	12.2	12.2	0.00	0% - 50%
ED040S: Soluble Major Anions (QC Lot: 1311774)									
ES1731313-009	Anonymous	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	60	60	0.00	No Limit
ES1731313-008	Anonymous	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	0.00	No Limit
ED040S: Soluble Major Anions (QC Lot: 1315960)									
ES1731276-002	Anonymous	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	----	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 1311775)									
ES1731313-009	Anonymous	ED045G: Chloride	16887-00-6	10	mg/kg	50	50	0.00	No Limit
ES1731313-008	Anonymous	ED045G: Chloride	16887-00-6	10	mg/kg	50	50	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 1315961)									
ES1731276-002	Anonymous	ED045G: Chloride	16887-00-6	10	mg/kg	----	----	----	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED040S: Soluble Major Anions (QCLot: 1311774)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	150 mg/kg	105	80	120
ED040S: Soluble Major Anions (QCLot: 1315960)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	750 mg/kg	100	80	120
ED045G: Chloride by Discrete Analyser (QCLot: 1311775)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	124	75	125
				<10	5000 mg/kg	102	79	117
ED045G: Chloride by Discrete Analyser (QCLot: 1315961)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	102	75	125
				<10	5000 mg/kg	105	79	117

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED045G: Chloride by Discrete Analyser (QCLot: 1311775)							
ES1731313-008	Anonymous	ED045G: Chloride	16887-00-6	1250 mg/kg	107	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 1315961)							
ES1731276-002	Anonymous	ED045G: Chloride	16887-00-6	----		70	130

- **No Matrix Spike (MS) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1731469**	Page	: 1 of 4
Client	: **ADE Consulting Group Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: MR BIKESH DEOJU	Telephone	: +61-2-8784 8555
Project	: DSC-06-13286	Date Samples Received	: 12-Dec-2017
Site	: ----	Issue Date	: 15-Dec-2017
Sampler	: SONGWEI CHE	No. of samples received	: 6
Order number	: ----	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
13286 BH2-1.5m,	13286 BH2-3m,	**06-Dec-2017**	**----**	----	----	**12-Dec-2017**	20-Dec-2017	✓
13286 BH2-4.5m								
Soil Glass Jar - Unpreserved (EA055)								
13286 BH3-1.5m,	13286 BH3-3m,	**08-Dec-2017**	**----**	----	----	**12-Dec-2017**	22-Dec-2017	✓
13286 BH3-6m								
ED040S : Soluble Sulfate by ICPAES								
Soil Glass Jar - Unpreserved (ED040S)								
13286 BH2-1.5m,	13286 BH2-3m,	**06-Dec-2017**	**13-Dec-2017**	03-Jan-2018	✓	**13-Dec-2017**	10-Jan-2018	✓
13286 BH2-4.5m								
Soil Glass Jar - Unpreserved (ED040S)								
13286 BH3-1.5m,	13286 BH3-3m,	**08-Dec-2017**	**14-Dec-2017**	05-Jan-2018	✓	**14-Dec-2017**	11-Jan-2018	✓
13286 BH3-6m								
ED045G: Chloride by Discrete Analyser								
Soil Glass Jar - Unpreserved (ED045G)								
13286 BH2-1.5m,	13286 BH2-3m,	**06-Dec-2017**	**13-Dec-2017**	03-Jan-2018	✓	**13-Dec-2017**	10-Jan-2018	✓
13286 BH2-4.5m								
Soil Glass Jar - Unpreserved (ED045G)								
13286 BH3-1.5m,	13286 BH3-3m,	**08-Dec-2017**	**14-Dec-2017**	05-Jan-2018	✓	**14-Dec-2017**	11-Jan-2018	✓
13286 BH3-6m								

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chloride Soluble By Discrete Analyser	ED045G	3	16	**18.75**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	3	23	**13.04**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chloride Soluble By Discrete Analyser	ED045G	4	16	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride Soluble By Discrete Analyser	ED045G	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride Soluble By Discrete Analyser	ED045G	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Resistivity (1:5)	EA080	SOIL	In house: Calculated from Electrical Conductivity
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Chloride Soluble By Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate.

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.