2 October 2019
Ref: E32537BGlet-ASS

Horton Coastal Engineering Pty Ltd
18 Reynolds Crescent
Beacon Hill, NSW 2100

Attention: Mr Peter Horton

PRELIMINARY ACID SULFATE SOIL SCREENING
PROPOSED ALTERATIONS AND ADDITIONS
NEWPORT SURF LIFE SAVING CLUB, 394 BARRENJOEY ROAD, NEWPORT, NSW

1 INTRODUCTION

Horton Coastal Engineering Pty Ltd ('the client') commissioned JK Environments (JKE) to undertake a preliminary acid sulfate soil (ASS) screening for the proposed alterations and additions at Newport Surf Life Saving Club (SLSC) at 394 Barrenjoey Road, Newport, NSW. The site is identified as part Lot 7094 in DP1059297, part Lot 1 in DP1139445 and part Lots 23 and 24 in DP6248. The site location is shown on Figure 1 and the investigation was confined to the proposed development area as shown on Figure 2.

The investigation was undertaken generally in accordance with a JKE proposal (Ref: EP49373BG) of 7 May 2019 and written acceptance from the client by email of 16 July 2019. A geotechnical investigation was undertaken in conjunction with the ASS assessment by JK Geotechnics and the results will be presented in a separate report (Ref: 32537RErpt).

The aim of the screening was to establish whether actual ASS or potential ASS (PASS) may be disturbed during the proposed development works, and to assess whether an ASS management plan (ASSMP) is required.

Environmental Investigation Services (EIS) has recently been re-branded to JK Environments and will continue to function as the environmental division of JK Group alongside JK Geotechnics and JK Drilling.

1.1 Assessment Guidelines

The ASS assessment and preparation of this report were undertaken with reference to the Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (1998)[1]. Background information on ASS and the assessment process is provided in the appendices.

[1] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)

1.2 Proposed Development Details

We understand that the proposed alterations and additions include a new shared surface to the west of the SLSC, a second level addition and an extension to the north of the existing building. Any excavation details and depths were not known.

2 SITE INFORMATION

2.1 Site Description

The site is located within a relatively flat topography, towards the central portion of Newport beach. The site (the SLSC building) is located over the north-eastern portion of Bert Payne Park which has western frontage onto Barrenjoey Road.

At the time of the fieldwork, the site was occupied by the two-storey rendered SLSC building with garden beds and concrete paved surrounds.

An asphaltic concrete (AC covered) car park formed the western site boundary. The grass covered park area extended south from the site with large pine trees. The northern site boundary was formed by a concrete paved area and extended north from the site by dense vegetation area with intersperse large pine trees. The seaward land grades downslope at approximately 4° to 5° towards the sea. To the northern and southern end of the beach, sandstone cliffs were observed.

2.2 Regional Geology

The geological map of Sydney (1983)[2] indicates the site to be underlain by Quaternary aged deposits of medium to fine grained ''marine'' sands.

2.3 Pittwater Council Local Environmental Plan (LEP) 2014

A review of the Pittwater council LEP indicates that the site is located within parts of ASS risk Classes 3, 4 and 5 (refer to appendices for further details on each risk class).

2.4 Acid Sulfate Soil Risk Map

A review of the ASS risk maps prepared by Department of Land and Water Conservation (1997)[3] indicates that part of the the eastern section of the site site is located in an area classed as 'beach', part of the western section of the site is classed or has 'low probability of ASS risk below 3m below ground level (BGL)' and part of the southern section of the site is classed or has 'low probability of ASS risk between 1-3mBGL'.

[2] Department of Mineral Resources, (1983). *1:100,000 Geological Map of Sydney (Series 9130)*
[3] Department of Land and Water Conservation, (1997). *1:25,000 Acid Sulfate Soil Risk Map (Series 9130N3, Ed 2).*

3 INVESTIGATION REQUIREMENTS AND ASSESSMENT CRITERIA

3.1 Investigation Requirements

The ASS Manual 1998 recommends a minimum of four sampling locations for a site with an area up to 1ha (10,000m^2). For sites greater than 4ha, the manual recommends the use of a reduced density of two locations per hectare subject to the proposed development. For lineal investigations, the manual recommends sampling every 50-100m.

The sampling locations should include all areas where significant disturbance of soils will occur and/or areas with a high environmental sensitivity. In some instances a varied sampling plan may be more suitable, particularly for sites less than 1,000m^2 in area.

The depth of investigation should extend to at least 1m beyond the depth of proposed excavation/disturbance or estimated drop in water table height, or to a minimum of 2m below existing ground level, whichever is greatest.

3.2 Action Criteria

The ASS Manual 1998 presents 'action criteria' for the interpretation of laboratory results. The 'action criteria' define the need to prepare an ASSMP and are based on soil pH, potential acidity and the percentage of oxidisable sulfur for broad categories of soil types. Where disturbance of greater than 1,000 tonnes of ASS is proposed, the action criteria for 'coarse textured soils' apply to all soil types. The following action criteria are presented in the ASS Manual:

Table 3-1: ASS Action Criteria

Category	Description	Criteria
Coarse Textured Soils	Sands to loamy sands	• pH - less than 5; • Total Actual Acidity (TAA)/Total Sulfide Acidity (TSA)/ Total Potential Acidity (TPA) (pH5.5) – greater than 18mol H^+/tonne; and • S_{pos} – greater than 0.03% sulfur oxidisable.
Medium Textured Soils	Sandy loams to light clays	• pH - less than 5; • TAA/TSA/TPA (pH5.5) – greater than 36mol H^+/tonne; and • S_{pos} – greater than 0.06% sulfur oxidisable.
Fine Textured Soils	Medium to heavy clays and silty clays	• pH - less than 5; • TAA/TSA/TPA (pH5.5) – greater than 62mol H^+/tonne; and • S_{pos} – greater than 0.1% sulfur oxidisable.

3.3 Site Specific Action Criteria

The action criteria for coarse textured soils has been adopted for this assessment. This is based on the predominant soil type encountered at the sampling locations (i.e. sand).

4 INVESTIGATION PROCEDURE

4.1 Subsurface Investigation and Soil Sampling Methods

Field work for this investigation was undertaken on 8 and 9 August 2019. Soil samples were collected from four locations in conjunction with the JK Geotechnics investigation, to a maximum borehole depth of 12.15m. Based on the proposed development details provided at the time of reporting, the number of sample locations and the depth of sampling meets the minimum requirements outlined in the ASS Manual 1998. The sampling locations are shown on the attached Figure 2.

The sample locations were drilled using a track mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

Soil samples were obtained at various depths, based on observations made during the field investigation. All samples were placed in plastic bags and sealed with plastic ties with minimal headspace. Each sample was labelled with a unique job number, the sampling location, sampling depth and date. All samples were recorded on the borehole logs attached in the appendices.

The samples were preserved by immediate storage in an insulated sample container with ice and frozen upon return to the JKE office. Samples were subsequently delivered in the insulated sample container (on ice or with ice packs) to a NATA registered laboratory for analysis under standard chain of custody (COC) procedures. Additional samples were frozen and stored pending further analysis.

4.2 Laboratory Analysis

Six selected natural soil samples obtained from the site were analysed for ASS/PASS using the suspension Peroxide Combined Acidity and Sulfur (sPOCAS) analytical methods detailed in AS4969-2008/09[4]. The laboratory testing was undertaken by Envirolab Services (NATA Accreditation Number – 2901). Reference should be made to the laboratory reports (Ref: 223809) attached in the appendices for further information.

[4] Standards Australia, (2008/2009). *Analysis of acid sulfate soil – Dried samples – Methods of test, Parts 1 to 14.* (AS4969-2008/09)

5 RESULTS OF THE INVESTIGATION

5.1 Subsurface Conditions

The subsurface conditions encountered generally consisted of concrete pavement to a maximum depth of approximately 0.095m at BH1 and asphaltic concrete (AC) pavement to a maximum depth of 0.03m at BH2, underlain by fill material to a depth of approximately 0.1-0.3mBGL at BH1 and BH2. No fill was encountered at BH3 and BH4 and was underlain by sand, silty sandy clay and/or silty sand to the termination depth of the boreholes at approximately 9.15mBGL. The fill at BH1 and BH2 was underlain by sand, silty sandy clay, clayey sand and silty clay to the termination depth of the boreholes at approximately 12.15mBGL. The fill material typically consisted of sand or silty sandy gravel. Reference should be made to the borehole logs attached in the appendices for further details.

5.2 Laboratory Results

The soil laboratory results were assessed against the action criteria adopted for the assessment. The results are presented in the attached report tables and summarised below.

Table 5-1: Summary of ASS Results

Analyte	Results Compared to ASS Guidelines
pH_{kcl} and pH_{ox}	The pH_{KCl} results ranged from 4.0 to 10.0. One of the pH_{KCl} results exceeded (i.e. was below) the action criterion of pH 5. Following oxidation, the pH_{ox} results for the samples ranged from 4.9 to 8.2. One of the pH_{KCl} results exceeded (i.e. was below) the action criterion of pH 5. The pH of the samples typically dropped by 0.9 or more units following oxidation.
Acid Trail	• TAA results ranged from less than the practical quantitation limit (PQL) to 29mol H^+/tonne. One of the results was above the action criterion of 18mol H^+/tonne; • TPA results ranged from less than the PQL to 35mol H^+/tonne. One of the results was above the action criterion of 18mol H^+/tonne; and • TSA results ranged from less than PQL to 6mol H^+/tonne. None of the results were above the action criterion of 18mol H^+/tonne.
Sulfur Trail	The S_{pos}% results ranged from less than PQL to 0.01% w/w. The results were below the action criterion of 0.03%.
Liming Rate	The liming rate required for neutralisation was 2.3 kg$CaCO_3$/tonne.

6 CONCLUSIONS

sPOCAS results for one sample identified acidic conditions greater than the action criteria. However, these results are considered to be indicative of mildly acidic soils associated with organic/humic material rather than PASS as significant concentrations of oxidisable sulfur (indicated by the low S_{pos}% results) were not encountered in the sample. As such, and considering the information reviewed for this assessment (risk maps, subsurface conditions etc), PASS or ASS conditions are not considered to be present in the investigation area (to a depth of 12.0m) and are not likely to be disturbed during the proposed development works. An ASSMP is not considered necessary for the proposed development described in Section 1.2 of this report.

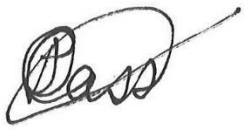
7 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified ASS or PASS issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa;
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose;
- Copyright in this report is the property of JKE. JKE has used a degree of care, skill and diligence normally exercised by consulting professionals in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report;
- If the client, or any person, provides a copy of this report to any third party, such third party must not rely on this report except with the express written consent of JKE; and
- Any third party who seeks to rely on this report without the express written consent of JKE does so entirely at their own risk and to the fullest extent permitted by law, JKE accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

If you have any questions concerning the contents of this letter please do not hesitate to contact us.

Kind Regards



Priya Dass
Senior Environmental Scientist

Vittal Boggaram
Principal Associate

<u>**Appendices:**</u>
Appendix A: Report Figures
Appendix B: Report Tables
Appendix C: Information on Acid Sulfate Soils
Appendix D: Borehole Logs
Appendix E: Laboratory Reports & Chain of Custody Documents

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 10 20 30 40 50

SCALE 1:1000 @A4 METRES

This plan should be read in conjunction with the Environmental report.

Title: **SITE LOCATION PLAN**

Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT,NSW

Report No: E32537BG

Figure: 1

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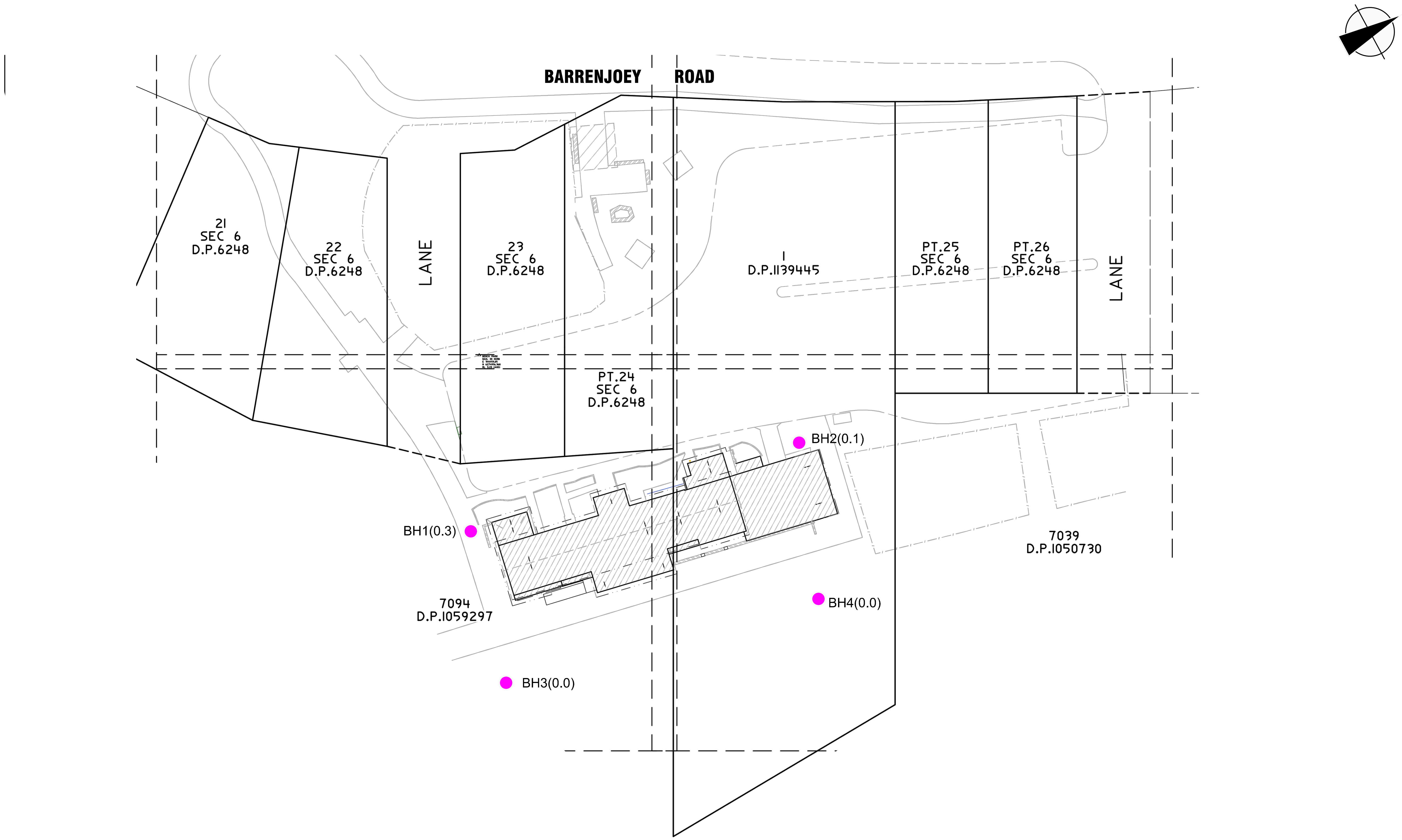
PLOT DATE: 20/09/2019 9:59:05 AM DWG FILE: S:\5 EIS\5C EIS JOBS\32000'S\E32537BG NEWPORT\CAD\E32537BG.DWG



LEGEND:

BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

0 5 10 15 20 25

SCALE 1:500 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title:	**SAMPLE LOCATION PLAN**
Location:	NEWPORT SLSC,394 BARRENJOEY ROAD, NEWPORT, NSW
Report No: E32537BG	Figure: 2

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Appendix B: Report Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration	**PCBs:**	Polychlorinated Biphenyls
ACM:	Asbestos Containing Material	**PCE:**	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
ADWG:	AustralianDrinking Water Guidelines	**pH_{KCL} :**	pH of filtered 1:20, 1M KCL extract, shaken overnight
AF:	Asbestos Fines	**pH_{ox} :**	pH of filtered 1:20 1M KCl after peroxide digestion
ANZG	Australian and New Zealand Guidelines	**PQL:**	Practical Quantitation Limit
B(a)P:	Benzo(a)pyrene	**RS:**	Rinsate Sample
CEC:	Cation Exchange Capacity	**RSL:**	Regional Screening Levels
CRC:	Cooperative Research Centre	**SAC:**	Site Assessment Criteria
CT:	Contaminant Threshold	**SCC:**	Specific Contaminant Concentration
EILs:	Ecological Investigation Levels	**S_{Cr}:**	Chromium reducible sulfur
ESLs:	Ecological Screening Levels	**S_{POS}:**	Peroxide oxidisable Sulfur
FA:	Fibrous Asbestos	**SSA:**	Site Specific Assessment
GIL:	Groundwater Investigation Levels	**SSHSLs:**	Site Specific Health Screening Levels
HILs:	Health Investigation Levels	**TAA:**	Total Actual Acidity in 1M KCL extract titrated to pH6.5
HSLs:	Health Screening Levels	**TB:**	Trip Blank
HSL-SSA:	Health Screening Level-SiteSpecific Assessment	**TCA:**	1,1,1 Trichloroethane (methyl chloroform)
NA:	Not Analysed	**TCE:**	Trichloroethylene (Trichloroethene)
NC:	Not Calculated	**TCLP:**	Toxicity Characteristics Leaching Procedure
NEPM:	National Environmental Protection Measure	**TPA:**	Total Potential Acidity, 1M KCL peroxide digest
NHMRC:	National Health and Medical Research Council	**TS:**	Trip Spike
NL:	Not Limiting	**TRH:**	Total Recoverable Hydrocarbons
NSL:	No Set Limit	**TSA:**	Total Sulfide Acidity (TPA-TAA)
OCP:	Organochlorine Pesticides	**UCL:**	Upper Level Confidence Limit on Mean Value
OPP:	Organophosphorus Pesticides	**USEPA**	United States Environmental Protection Ager
PAHs:	Polycyclic Aromatic Hydrocarbons	**VOCC:**	Volatile Organic Chlorinated Compounds
ppm:	Parts per million	**WHO:**	World Health Organisation

TABLE A

SUMMARY OF LABORATORY RESULTS - ACID SULFATE SOIL ANALYSIS (sPOCAS)

		Analysis	pH_{KCL}	TAA pH 6.5	pH_{ox}	TPA pH 6.5	TSA pH 6.5	S_{POS} %w/w	Liming Rate kg $CaCO_3$/tonne
Acid Sulfate Soil Manual (1998) - Action Criteria		Coarse Textured Soil	pH 5.0	18molH+/ tonne	pH 5.0	18molH+/ tonne	18molH+/ tonne	0.03% w/w	
Sample Reference	**Sample Depth (m)**	**Sample Description**							
BH1	2.9-3.0	Sand	9.4	<5	8.1	<5	<5	0.01	<0.75
BH1 (Lab Replicate)	2.9-3.0	Sand	9.9	<5	8.1	<5	<5	0.009	<0.75
BH1	11.9-12.0	Silty Clay	4.0	29	4.9	35	6	<0.005	2.3
BH2	4.2-4.3	Sand	9.8	<5	8.2	<5	<5	<0.005	<0.75
BH3	0.0-0.1	Sand	9.8	<5	7.6	<5	<5	0.006	<0.75
BH4	1.85-1.95	Sand	9.9	<5	7.8	<5	<5	0.006	<0.75
BH4	4.9-5.0	Sand	10.0	<5	7.8	<5	<5	0.007	<0.75
Total Number of Samples			7	7	7	7	7	7	7
Minimum Value			4.0	29	4.9	35	6	0.006	2.3
Maximum Value			10.0	29	8.2	35	6	0.01	2.3

Values Exceeding Action Criteria: **VALUE** (highlighted)

Appendix C: Information on Acid Sulfate Soils

A. Background

Acid Sulfate Soil (ASS) is formed from iron rich alluvial sediments and sulfate (found in seawater) in the presence of sulfate reducing bacteria and plentiful organic matter. These conditions are generally found in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes. These soils include those that are producing acid (termed actual ASS) and those that can become acid producing (termed potential ASS or 'PASS'). PASS are naturally occurring soils and sediment that contain iron sulfides (pyrite) which, when exposed to oxygen generate sulfuric acid.

B. The ASS Management Advisory Committee (ASSMAC)

The NSW government in 1994 formed the ASSMAC to coordinate a response to ASS issues. In 1998 this group released the Acid Sulfate Soil Manual[5] providing best practice advice for planning, assessment, management, laboratory methods, drainage, groundwater and the preparation of ASS management plans (ASSMP).

In 1997 the Department of Land and Soil Conservation (now part of the Office of Environment and Heritage[6]) developed two series of maps with respect to ASS for use by council and technical staff implementing the ASS Manual 1998:

- ASS Planning Maps – issued to councils and government units; and
- ASS Risk Maps – issued to interested parties.

C. The ASS Planning Maps

The ASS planning maps provide an indication of the relative potential for disturbance of ASS to occur at locations within the council area. These maps do not provide an indication of the actual occurrence of ASS at a site or the likely severity of the conditions.

The maps are divided into five classes dependent upon the type of activities/works that if undertaken, may represent an environmental risk through the development of acidic conditions associated with ASS:

Table 1: Risk Classes

Risk Class	Description
Class 1	All works.
Class 2	All works below existing ground level and works by which the water table is likely to be lowered.
Class 3	Works at depths beyond 1m below existing ground level or works by which the water table is likely to be lowered beyond 1m below existing ground level.
Class 4	Works at depths beyond 2m below existing ground level or works by which the water table is likely to be lowered beyond 2m below existing ground level.
Class 5	Works within 500m of adjacent Class 1,2,3,4 land which are likely to lower the water table below 1m AHD on the adjacent land.

[5] Acid Sulfate Soils Management Advisory Committee (ASSMAC), (1998). *Acid Sulfate Soils Manual* (ASS Manual 1998)
[6] http://www.environment.nsw.gov.au/acidsulfatesoil/index.htm

D. The ASS Risk Maps

The ASS risk maps provide an indication of the probability of occurrence of PASS at a particular location based on interpretation from geological and soil landscape maps. The maps provide classes based on high probability, low probability, no known occurrence and areas of disturbed terrain (site specific assessment necessary) and the likely depth at which ASS are likely to be encountered.

E. Investigation and Laboratory Testing for ASS

The ASS Manual 1998 includes information on assessment of the likelihood of PASS, the need for an ASSMP, and the development of mitigation measures for a proposed development located in PASS risk areas.

The ASS Manual 1998 recommends a minimum of four sampling locations for a site with an area up to 1ha. For sites greater than 4ha, the manual recommends the use of a reduced density of two locations per hectare subject to the proposed development. For lineal investigations, the manual recommends sampling every 50-100m.

The sampling locations should include all areas where significant disturbance of soils will occur and/or areas with a high environmental sensitivity. In some instances a varied sampling plan may be more suitable, particularly for sites less than 1,000m^2 in area.

The depth of investigation should extend to at least 1m beyond the depth of proposed excavation/disturbance or estimated drop in water table height, or to a minimum of 2m below existing ground level, whichever is greatest.

Standard methods for the laboratory analysis of samples are presented in the Australian Standard AS4969-2008/09[7] (part 1 to 14). The principal analytical method is suspension Peroxide Oxidation Combined Acidity and Sulfur (sPOCAS).

The sPOCAS method specified in AS4969-2008/09 supersedes the POCAS method specified in the ASS Manual 1998. When S_{POS} (peroxide oxidisable sulfur) values are close to the action criteria confirmation of the result can be undertaken by the chromium reducible sulfur (S_{CR}) method.

The endpoint for the pH titration in AS4969-2008/09 is pH6.5 as opposed to pH5.5 adopted in the ASS Manual. Therefore the values for Total Actual Acidity (TAA), Total Sulfide Acidity (TSA) and Total Potential Acidity (TPA) will more conservative when analysed using the sPOCAS method specified in AS4969-2008/09.

[7] Standards Australia, (2008/2009). *Analysis of acid sulfate soil – Dried samples – Methods of test, Parts 1 to 14.* (AS4969-2008/09)

Appendix D: Borehole Logs

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BOREHOLE LOG

Borehole No.
1
1/2

Client: HORTON COASTAL ENGINEERING
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER/WASHBORE **R.L. Surface:** ≈ 5.33m
Date: 8/8/19 **Datum:** AHD
Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 95mm.t.				6mm DIA. REINFORCEMENT 60mm TOP COVER
			-	FILL: Sand, fine to medium grained, dark brown.	M			
			SP	SAND: fine to medium grained, light brown.	M	L-MD		MARINE
	N = 10 4,4,6							
		1						
	N = 13 4,5,8					MD		
		2						
				SAND: fine to medium grained, light orange brown, with shell fragments.				
	N = 14 5,7,7	3						
				SAND: fine to medium grained, dark grey and grey.				
				as above, but light orange brown, with shell fragments.				
▶					W			
		4						
	N = 27 13,16,11							
								COMMENCE WASHBORE
		5						
			CL	Silty sandy CLAY: low plasticity, light grey, fine to medium grained sand.	w>PL	St- VSt		
	N = 8 2,4,4	6					290 200 310	
		7						

JKGeotechnics

BOREHOLE LOG

Borehole No. **1**

Client: HORTON COASTAL ENGINEERING

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER/WASHBORE **R.L. Surface:** ≈ 5.33m

Date: 8/8/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		N = 10 3,4,6			CH	Silty sandy CLAY: high plasticity, light grey, fine to medium grained sand.	w>PL	VSt	380 290 360	MARINE
			8							
		N = 17 7,5,12	9		SC	Clayey SAND: fine to medium grained, light grey.	W	MD		
		N = 4 3,2,2	10		CL/SC	Silty sandy CLAY/Clayey SAND: low plasticity, fine to medium grained, light grey and grey.	w>PL/ W	F-St/ VL-L	60 80 100	
			11							
		N = 8 3,3,5	12		CI	Silty CLAY: medium plasticity, light grey and grey, with fine to coarse grained sand.	w>PL	St-VSt	190 380 210	RESIDUAL
						END OF BOREHOLE AT 12.15m				
			13							
			14							

JKGeotechnics

BOREHOLE LOG

Borehole No.
2
1/2

Client: HORTON COASTAL ENGINEERING
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER/WASHBORE **R.L. Surface:** ≈ 5.78m
Date: 9/8/19 **Datum:** AHD
Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0	-	ASPHALTIC CONCRETE: 30mm.t.	D			
			SP	FILL: Silty sandy gravel, fine to coarse grained igneous, fine to coarse grained sand, grey.	M	MD		MARINE
	N = 13 5,6,7			SAND: fine to medium grained, light orange brown, trace of shell fragments.				
		1						
	N = 10 5,5,5					L-MD		
		2						
	N = 10 3,4,6	3						
▶								COMMENCE WASHBORE
		4		SAND: fine to medium grained, light orange brown, with shell fragments.	W	MD		
	N = 26 6,14,12							
		5		as above, but with fine to coarse grained ironstone gravel.		L		
	N = 8 9,6,2	6						
		7						

JKGeotechnics

BOREHOLE LOG

Borehole No.
2
2/2

Client: HORTON COASTAL ENGINEERING
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER/WASHBORE **R.L. Surface:** ≈ 5.78m
Date: 9/8/19 **Datum:** AHD
Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					SC	Clayey SAND: fine to medium grained, light grey.	W	L		MARINE
	ES, DS	N = 9 4,5,4								
			8							
					CH	Silty CLAY: high plasticity, grey, trace of fine to medium grained sand.	w>PL	VSt		
	ES, DS	N = 14 3,5,9	9						270 370 280	
					SC	Clayey SAND: fine to medium grained, light grey and grey.	W	L		
			10							
	ES, DS	N = 9 8,4,5								
			11							
	ES, DS	N = 6 1,3,3	12							
						END OF BOREHOLE AT 12.15m				
			13							
			14							

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BOREHOLE LOG

Borehole No.
3
1/2

Client: HORTON COASTAL ENGINEERING

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE | **Method:** SPIRAL AUGER | **R.L. Surface:** ≈ 4.28m

Date: 8/8/19 | **Datum:** AHD

Plant Type: JK308 | **Logged/Checked by:** J.L./M.E.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		SP	SAND: fine to medium grained, orange brown, trace of shell fragments.	M	L-MD		MARINE
		N = 13 4,5,8								
			1							
		N = 9 4,4,5								
			2							
		N = 10 4,5,5	3							
			4							
▶		N = 20 5,8,12				SAND: fine to medium grained, light orange brown, with shell fragments.	W	MD		
			5							
					SC	Clayey SAND: fine to medium grained, grey brown and red brown.	W	L		
		N = 7 2,2,5	6							
			7		CI	as below.	w>PL	VSt		

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BOREHOLE LOG

Borehole No. **3** 2/2

Client: HORTON COASTAL ENGINEERING
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER **R.L. Surface:** ≈ 4.28m
Date: 8/8/19 **Datum:** AHD
Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								CI	Silty sandy CLAY: medium plasticity, grey, fine to medium grained sand.	w>PL	VSt		ALLUVIAL
				■	N = 10 4,4,6							240 220 220	
	■					8							
								SP	SAND: fine to medium grained, light grey, trace of medium to coarse grained alluvial gravel, clay and silt fines.	W	MD		
	■			■	N = 26 4,10,16	9							
									END OF BOREHOLE AT 9.15m				
						10							
						11							
						12							
						13							
						14							

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BOREHOLE LOG

Borehole No. 4

1/2

Client: HORTON COASTAL ENGINEERING

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER **R.L. Surface:** ≈ 4.08m

Date: 9/8/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0	SP	SAND: fine to medium grained, light brown.	M	MD		MARINE
	N = 12 4,6,6							
		1		as above, but light orange brown, trace of shell fragments.				
	N = 13 6,6,7							
		2						
				as above, but trace of medium to coarse grained ironstone gravel.				
	N = 35 7,16,19	3						
▶				SAND: fine to medium grained, light orange brown, with shell fragments.	W			
		4						
	N = 13 10,8,5							
		5						
				as above, but trace of clay and silt fines.				
	N = 14 4,7,7	6	SM	Silty SAND: fine to coarse grained, brown and grey, with clay fines, trace of fine to medium grained alluvial and sandstone gravel, and shell fragments.				
			SP	SAND: fine to medium grained, grey, with shell fragments, clay and silt fines.				
		7						

SAMPLES: ES, U50, DB, DS

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BOREHOLE LOG

Borehole No.
4

Client: HORTON COASTAL ENGINEERING
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: NEWPORT SLSC, 394 BARRENJOEY ROAD, NEWPORT, NSW

Job No.: 32537RE **Method:** SPIRAL AUGER **R.L. Surface:** ≈ 4.08m
Date: 9/8/19 **Datum:** AHD
Plant Type: JK308 **Logged/Checked by:** J.L./M.E.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					SP	SAND: fine to medium grained, grey, with shell fragments, clay and silt fines.	W	MD		MARINE
	DS	N = 21 3,9,12								
	ES		8							
	DS, ES	N = 15 6,7,8	9							
						END OF BOREHOLE AT 9.15m				
			10							
			11							
			12							
			13							
			14							

ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CI, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CI, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML, MH)
- PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE/MUDSTONE
- SILTSTONE
- CLAYSTONE
- COAL
- LAMINITE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

OTHER MATERIALS

- BRICKS OR PAVERS
- CONCRETE
- ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity *Cu* > 4 and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \quad and \quad C_C = \frac{(D_{30})^2}{D_{10}\,D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

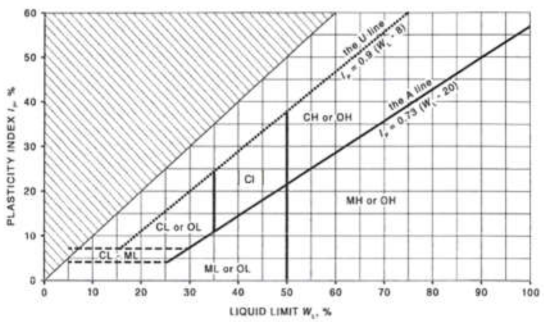
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



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LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record	▼	Standing water level. Time delay following completion of drilling/excavation may be shown.
	C	Extent of borehole/test pit collapse shortly after drilling/excavation.
	►	Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of undrained shear strength.
	PID = 100	Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.
	w ≈ PL	Moisture content estimated to be approximately equal to plastic limit.
	w < PL	Moisture content estimated to be less than plastic limit.
	w ≈ LL	Moisture content estimated to be near liquid limit.
	w > LL	Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D	DRY – runs freely through fingers.
	M	MOIST – does not run freely but no free water visible on soil surface.
	W	WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.
	Hd	HARD – unconfined compressive strength > 400kPa.
	Fr	FRIABLE – strength not attainable, soil crumbles.
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)**; **SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE ≤ 15; 0 – 4
	L	LOOSE > 15 and ≤ 35; 4 – 10
	MD	MEDIUM DENSE > 35 and ≤ 65; 10 – 30
	D	DENSE > 65 and ≤ 85; 30 – 50
	VD	VERY DENSE > 85; > 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as:
		RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock.
		EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock.
		ALLUVIAL – soil deposited by creeks and rivers.
		ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents.
		MARINE – soil deposited in a marine environment.
		AEOLIAN – soil carried and deposited by wind.
		COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits.
		LITTORAL – beach deposited soil.

Classification of Material Weathering

<table>
<tr><th colspan="2">Term</th><th colspan="2">Abbreviation</th><th>Definition</th></tr>
<tr><td colspan="2">Residual Soil</td><td colspan="2">RS</td><td>Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.</td></tr>
<tr><td colspan="2">Extremely Weathered</td><td colspan="2">XW</td><td>Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.</td></tr>
<tr><td>Highly Weathered</td><td rowspan="2">Distinctly Weathered (Note 1)</td><td>HW</td><td rowspan="2">DW</td><td>The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.</td></tr>
<tr><td>Moderately Weathered</td><td>MW</td><td>The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Slightly Weathered</td><td colspan="2">SW</td><td>Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Fresh</td><td colspan="2">FR</td><td>Rock shows no sign of decomposition of individual minerals or colour changes.</td></tr>
</table>

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Appendix E: Laboratory Reports & Chain of Custody Documents

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 223809

Client Details

Client	Environmental Investigation Services
Attention	Priya Dass
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**E32537BG, Newport**
Number of Samples	45 Soil
Date samples received	13/08/2019
Date completed instructions received	13/08/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	20/08/2019
Date of Issue	20/08/2019

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

sPOCAS + %S w/w						
Our Reference		223809-5	223809-12	223809-18	223809-24	223809-39
Your Reference	UNITS	BH1	BH1	BH2	BH3	BH4
Depth		2.9-3.0	11.9-12.0	4.2-4.3	0.0-0.1	1.85-1.95
Date Sampled		08/08/2019	08/08/2019	09/08/2019	08/08/2019	09/08/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	16/08/2019	16/08/2019	16/08/2019	16/08/2019	16/08/2019
Date analysed	-	16/08/2019	16/08/2019	16/08/2019	16/08/2019	16/08/2019
pH_{kcl}	pH units	9.4	4.0	9.8	9.8	9.9
TAA pH 6.5	moles H^+/t	<5	29	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	0.05	<0.01	<0.01	<0.01
pH_{Ox}	pH units	8.1	4.9	8.2	7.6	7.8
TPA pH 6.5	moles H^+/t	<5	35	<5	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	0.06	<0.01	<0.01	<0.01
TSA pH 6.5	moles H^+/t	<5	6	<5	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	0.01	<0.01	<0.01	<0.01
ANC_E	% $CaCO_3$	3.2	[NT]	4.1	1.0	1.3
a-ANC_E	moles H^+/t	640	[NT]	810	200	260
s-ANC_E	%w/w S	1.0	[NT]	1.3	0.32	0.42
S_{KCl}	%w/w S	<0.005	0.005	<0.005	<0.005	0.005
S_P	%w/w	0.01	0.008	0.006	0.008	0.01
S_{POS}	%w/w	0.01	<0.005	<0.005	0.006	0.006
a-S_{POS}	moles H^+/t	7	<5	<5	<5	<5
Ca_{KCl}	%w/w	0.17	0.01	0.20	0.06	0.08
Ca_P	%w/w	1.4	0.02	1.5	0.62	0.70
Ca_A	%w/w	1.2	<0.005	1.3	0.56	0.62
Mg_{KCl}	%w/w	0.010	0.029	<0.005	0.006	0.009
Mg_P	%w/w	0.071	0.034	0.017	0.043	0.044
Mg_A	%w/w	0.061	0.005	0.013	0.037	0.035
S_{HCl}	%w/w S	[NT]	0.005	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	[NT]	<0.005	[NT]	[NT]	[NT]
a-S_{NAS}	moles H^+/t	[NT]	<5	[NT]	[NT]	[NT]
s-S_{NAS}	%w/w S	[NT]	<0.01	[NT]	[NT]	[NT]
Fineness Factor	-	1.5	1.5	1.5	1.5	1.5
a-Net Acidity	moles H^+/t	<5	31	<5	<5	<5
s-Net Acidity	%w/w S	<0.01	0.05	<0.01	<0.01	<0.01
Liming rate	kg $CaCO_3$/t	<0.75	2.3	<0.75	<0.75	<0.75
s-Net Acidity without -ANCE	%w/w S	0.011	[NT]	<0.01	<0.01	<0.01
a-Net Acidity without ANCE	moles H^+/t	7.0	[NT]	<5	<5	<5
Liming rate without ANCE	kg $CaCO_3$/t	<0.75	[NT]	<0.75	<0.75	<0.75

sPOCAS + %S w/w		
Our Reference		223809-42
Your Reference	UNITS	BH4
Depth		4.9-5.0
Date Sampled		09/08/2019
Type of sample		Soil
Date prepared	-	16/08/2019
Date analysed	-	16/08/2019
pH_{kcl}	pH units	10.0
TAA pH 6.5	moles H^+ /t	<5
s-TAA pH 6.5	%w/w S	<0.01
pH_{Ox}	pH units	7.8
TPA pH 6.5	moles H^+ /t	<5
s-TPA pH 6.5	%w/w S	<0.01
TSA pH 6.5	moles H^+ /t	<5
s-TSA pH 6.5	%w/w S	<0.01
ANC_E	% $CaCO_3$	2.9
a-ANC_E	moles H^+ /t	580
s-ANC_E	%w/w S	0.92
S_{KCl}	%w/w S	<0.005
S_P	%w/w	0.01
S_{POS}	%w/w	0.007
a-S_{POS}	moles H^+ /t	<5
Ca_{KCl}	%w/w	0.17
Ca_P	%w/w	1.2
Ca_A	%w/w	1.0
Mg_{KCl}	%w/w	0.012
Mg_P	%w/w	0.071
Mg_A	%w/w	0.059
S_{HCl}	%w/w S	[NT]
S_{NAS}	%w/w S	[NT]
a-S_{NAS}	moles H^+ /t	[NT]
s-S_{NAS}	%w/w S	[NT]
Fineness Factor	-	1.5
a-Net Acidity	moles H^+ /t	<5
s-Net Acidity	%w/w S	<0.01
Liming rate	kg $CaCO_3$ /t	<0.75
s-Net Acidity without -ANCE	%w/w S	<0.01
a-Net Acidity without ANCE	moles H^+ /t	<5
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75

Method ID	Methodology Summary
Inorg-064	sPOCAS determined using titrimetric and ICP-AES techniques. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

QUALITY CONTROL: sPOCAS + %S w/w						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			16/08/2019	5	16/08/2019	16/08/2019		16/08/2019	[NT]
Date analysed	-			16/08/2019	5	16/08/2019	16/08/2019		16/08/2019	[NT]
pH $_{kcl}$	pH units		Inorg-064	[NT]	5	9.4	9.9	5	89	[NT]
TAA pH 6.5	moles H^+/t	5	Inorg-064	<5	5	<5	<5	0	95	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	5	<0.01	<0.01	0	[NT]	[NT]
pH $_{Ox}$	pH units		Inorg-064	[NT]	5	8.1	8.1	0	86	[NT]
TPA pH 6.5	moles H^+/t	5	Inorg-064	<5	5	<5	<5	0	110	[NT]
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	5	<0.01	<0.01	0	[NT]	[NT]
TSA pH 6.5	moles H^+/t	5	Inorg-064	<5	5	<5	<5	0	[NT]	[NT]
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	5	<0.01	<0.01	0	[NT]	[NT]
ANC_E	% $CaCO_3$	0.05	Inorg-064	<0.05	5	3.2	3.5	9	[NT]	[NT]
a-ANC_E	moles H^+/t	5	Inorg-064	<5	5	640	700	9	[NT]	[NT]
s-ANC_E	%w/w S	0.05	Inorg-064	<0.05	5	1.0	1.1	10	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-064	<0.005	5	<0.005	<0.005	0	[NT]	[NT]
S_P	%w/w	0.005	Inorg-064	<0.005	5	0.01	0.01	0	[NT]	[NT]
S_{POS}	%w/w	0.005	Inorg-064	<0.005	5	0.01	0.009	11	[NT]	[NT]
a-S_{POS}	moles H^+/t	5	Inorg-064	<5	5	7	6	15	[NT]	[NT]
Ca_{KCl}	%w/w	0.005	Inorg-064	<0.005	5	0.17	0.13	27	[NT]	[NT]
Ca_P	%w/w	0.005	Inorg-064	<0.005	5	1.4	1.4	0	[NT]	[NT]
Ca_A	%w/w	0.005	Inorg-064	<0.005	5	1.2	1.3	8	[NT]	[NT]
Mg_{KCl}	%w/w	0.005	Inorg-064	<0.005	5	0.010	0.008	22	[NT]	[NT]
Mg_P	%w/w	0.005	Inorg-064	<0.005	5	0.071	0.072	1	[NT]	[NT]
Mg_A	%w/w	0.005	Inorg-064	<0.005	5	0.061	0.064	5	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-064	<0.005	5	[NT]	[NT]		[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-064	<0.005	5	[NT]	[NT]		[NT]	[NT]
a-S_{NAS}	moles H^+/t	5	Inorg-064	<5	5	[NT]	[NT]		[NT]	[NT]
s-S_{NAS}	%w/w S	0.01	Inorg-064	<0.01	5	[NT]	[NT]		[NT]	[NT]
Fineness Factor	-	1.5	Inorg-064	<1.5	5	1.5	1.5	0	[NT]	[NT]
a-Net Acidity	moles H^+/t	5	Inorg-064	<5	5	<5	<5	0	[NT]	[NT]
s-Net Acidity	%w/w S	0.01	Inorg-064	<0.01	5	<0.01	<0.01	0	[NT]	[NT]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	5	<0.75	<0.75	0	[NT]	[NT]
s-Net Acidity without -ANCE	%w/w S	0.01	Inorg-064	<0.01	5	0.011	<0.01	10	[NT]	[NT]

QUALITY CONTROL: sPOCAS + %S w/w					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
a-Net Acidity without ANCE	moles H^+/t	5	Inorg-064	<5	5	7.0	5.7	20	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-064	<0.75	5	<0.75	<0.75	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

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.
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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Environmental Investigation Services
Attention	Priya Dass

Sample Login Details	
Your reference	E32537BG, Newport
Envirolab Reference	223809
Date Sample Received	13/08/2019
Date Instructions Received	13/08/2019
Date Results Expected to be Reported	20/08/2019

Sample Condition	
Samples received in appropriate condition for analysis	Yes
No. of Samples Provided	45 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	12.0
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments
Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

Sample ID	sPOCAS + %S w/w	On Hold
BH1-0.0-0.1		✓
BH1-0.4-0.5		✓
BH1-0.9-1.0		✓
BH1-1.9-2.0		✓
BH1-2.9-3.0	✓	
BH1-3.1-3.15		✓
BH1-3.9-4.0		✓
BH1-5.9-6.0		✓
BH1-7.2-7.3		✓
BH1-8.9-9.0		✓
BH1-10.2-10.3		✓
BH1-11.9-12.0	✓	
BH2-0.1-0.2		✓
BH2-0.4-0.5		✓
BH2-0.85-0.95		✓
BH2-1.85-1.95		✓
BH2-2.9-3.0		✓
BH2-4.2-4.3	✓	
BH2-5.7-5.8		✓
BH2-7.2-7.3		✓
BH2-8.7-8.8		✓
BH2-10.2-10.3		✓
BH2-11.7-11.8		✓
BH3-0.0-0.1	✓	
BH3-0.4-0.5		✓
BH3-0.9-1.0		✓
BH3-1.9-2.0		✓
BH3-2.9-3.0		✓
BH3-3.9-4.0		✓
BH3-4.2-4.3		✓
BH3-4.9-5.0		✓
BH3-5.9-6.0		✓

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Sample ID	sPOCAS + %S w/w	On Hold
BH3-6.9-7.0		✓
BH3-7.9-8.0		✓
BH3-8.9-9.0		✓
BH4-0.0-0.1		✓
BH4-0.4-0.5		✓
BH4-0.85-0.95		✓
BH4-1.85-1.95	✓	
BH4-2.9-3.0		✓
BH4-3.9-4.0		✓
BH4-4.9-5.0	✓	
BH4-5.9-6.0		✓
BH4-6.9-7.0		✓
BH4-8.9-9.0		✓

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info
Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.
Please contact the laboratory immediately if observed settled sediment present in water samples is to be included in the extraction and/or analysis (exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, Total Recoverable metals and PFAS analysis where solids are included by default.
TAT for Micro is dependent on incubation. This varies from 3 to 6 days.

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	EIS Job Number: E32537BG Date Results Required: STANDARD Page: 1	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Priya Dass

Location: Newport

Sampler: JL

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	sPOCAS	pH (1:5 water)
8/8/19	1	BH1	0.0-0.1	P	Fill: Sand		
↓	2	↓	0.4-0.5	↓	Sand		
	3		0.9-1.0		Sand		
	4		1.9-2.0		Sand		
	5		2.9-3.0		Sand	✓	
	6		3.1-3.15		Sand		
	7		3.9-4.0		Sand		
	8		5.9-6.0		Sandy Clay		
	9		7.2-7.3		Silty Clay		
	10		8.9-9.0		Sandy Clay		
	11		10.2-10.3		Silty Clay		
↓	12	↓	11.9-12.0		Silty Clay	✓	
9/8/19	13	BH2	0.1-0.2		Fill: Silty Sandy Gravel		
	14		0.4-0.5		Sand		
	15		0.85-0.95		Sand		
	16		1.85-1.95		Sand		
	17		2.9-3.0		Sand		
	18		4.2-4.3		Sand	✓	
	19		5.7-5.8		Sand		
	20		7.2-7.3		Sandy Clay		
	21		8.7-8.8		Silty Clay		
	22		10.2-10.3		Clayey Sand		
↓	23	↓	11.7-11.8		Clayey Sand		
8/8/19	24	BH3	0.0-0.1		Sand	✓	
↓	25	↓	0.4-0.5	↓	Sand		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 223809
Date Received: 13/8/19
Time Received: 14:20
Received by: WP
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

Sample Containers:
G - 250mg Glass Jar
A - Ziplock Asbestos Bag
P - Plastic Bag

Relinquished By: Priya Dass	Date: 13/08/19	Time: 1420	Received By: WP	Date: 13.8.19

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
ENVIROLAB SERVICES PTY LTD 12 ASHLEY STREET CHATSWOOD NSW 2067 P: (02) 99106200 F: (02) 99106201 Attention: Aileen	EIS Job Number: E32537BG Date Results Required: STANDARD Page: 2	JKEnvironments REAR OF 115 WICKS ROAD MACQUARIE PARK, NSW 2113 P: 02-9888 5000 F: 02-9888 5001 Attention: Priya Dass

Location: Newport

Sampler: JL

Sample Preserved in Esky on Ice

Tests Required

Date Sampled	Lab Ref:	Sample Number	Depth (m)	Sample Container	Sample Description	sPOCAS	pH (1:5 water)
↓	26	BH3	0.9-1.0	P	Sand		
↓	27	↓	1.9-2.0	↓	Sand		
↓	28	↓	2.9-3.0	↓	Sand		
↓	29	↓	3.9-4.0	↓	Sand		
↓	30	↓	4.2-4.3	↓	Sand		
↓	31	↓	4.9-5.0	↓	Sand		
↓	32	↓	5.9-6.0	↓	Clayey Sand		
↓	33	↓	6.9-7.0	↓	Silty Clay		
↓	34	↓	7.9-8.0	↓	Silty Clay		
↓	35	↓	8.9-9.0	↓	Clayey Sand		
9/08/19	36	BH4	0.0-0.1	↓	Sand		
↓	37	↓	0.4-0.5	↓	Sand		
↓	38	↓	0.85-0.95	↓	Sand		
↓	39	↓	1.85-1.95	↓	Sand	✓	
↓	40	↓	2.9-3.0	↓	Sand		
↓	41	↓	3.9-4.0	↓	Sand		
↓	42	↓	4.9-5.0	↓	Sand	✓	
↓	43	↓	5.9-6.0	↓	Silty Sand		
↓	44	↓	6.9-7.0	↓	Sand		
↓	45	↓	8.9-9.0	↓	Sand		

Remarks (comments/detection limits required):

Sample Containers:
G - 250mg Glass Jar
A - Ziplock Asbestos Bag
P - Plastic Bag

Relinquished By: Priya Dass	Date: 13/08/19	Time: 1420	Received By: WP	Date: 13-8-19

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