



Douglas Partners

Geotechnics | Environment | Groundwater

Report on
Acid Sulfate Soil Assessment

Proposed Rezoning
Sanderling Ave, Hawks Nest

Prepared for
Lands Advisory Services Pty Ltd

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Integrated Practical Solutions





Douglas Partners

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	<i>Patrick Heads</i>	14 April 2020
Reviewer	<i>C. Bozinovski</i>	14 April 2020



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Report on Acid Sulfate Soil Assessment

Proposed Rezoning

Sanderling Ave, Hawks Nest

1. Introduction

This report presents the results of an acid sulfate soil assessment undertaken for a proposed rezoning at Sanderling Ave, Hawks Nest. The investigation was commissioned via a services order dated 28 January 2020 by Brett Phillips of Lands Advisory Services Pty Ltd and was undertaken with reference to Douglas Partners' proposal NCL190687 dated 11 November 2019.

It is understood that the site is intended to be rezoned. Details of the proposed development have not been provided as part of this assessment.

The acid sulfate soil (ASS) was undertaken to further assess potential acid sulfate soil conditions in the area of proposed development.

The ASS assessment comprised the following:

- Brief review of previous assessments conducted by DP at the site;
- Review of published mapping information at the site (geological, acid sulfate soils);
- Drilling of five boreholes across the site;
- ASS screening and detailed ASS laboratory testing of selected soil samples to assess acid sulfate soil (ASS) conditions; and
- Preparation of this report presenting the results of the assessment and recommendations for the management of ASS.

The ASS assessment was undertaken with reference to ASSMAC (1998) and QASSIT (2014) guidelines.

The aim of the investigation was to assess the subsurface soil and groundwater conditions across the site for the preliminary assessment of ASS conditions.

2. Site Description

The site is identified as Lot 1 DP 1234229, Sanderling Avenue Hawks Nest, within the Mid-coast Council local government area. The site is approximately 1.48 ha in area and is shown in Drawing 1, Appendix B and Figure 1 below.



Figure 1: Subject site (in yellow)

The site is bounded to the north and east by vacant vegetated land, to the south by Sanderling Avenue and a holiday park and to the west by the Hawks Nest Golf Club.

The site contains a dense ground cover of vegetation such as ferns and small shrubs. Trees are sparsely spaced around the site. General conditions are shown in Figure 2 and Figure 3.



Figure 2: Site Conditions of South Eastern Corner.



Figure 3: Northern Side of Site Facing South.

Reference to NSW LiDAR topographic imaging for the site indicates that surface levels are in the order of RL 5 to RL 8 (AHD).

3. Geology and Hydrogeology

Reference to the 1:250 000 Geological Survey of NSW Statewide geodatabase indicates that the site is underlain by Quaternary alluvium formation which generally comprises gravel, sand, silt and clay.

Reference to the Acid Sulfate Soil Risk Map for Port Stephens, prepared by the Department of Land and Water Conservation (DLWC) indicates that the site is within an area mapped as having a low probability of occurrence of acid sulfate soils (ASS) at depths greater than 3 m below the ground surface.

The regional groundwater flow regime is believed to be towards either the Myall River located approximately 1.2 km west-south-west of the site, or the Tasman Sea located approximately 230 m east of the site. These water bodies are considered to be the nearest sensitive receptors. Based on site topography the depth to groundwater is likely to be within approximately 5 m from the ground surface. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary spatially, and with time.

4. Background

DP has previously conducted a Preliminary Site Investigation for contamination at the site (DP, 2019) which comprised the following:

- Desktop assessment of published information;
- Site history assessment, comprising review of historical aerial photos, discussions with previous site occupiers, Council records search and NSW EPA search;

- Site walk over by a senior engineer;
- Report preparation.

The results of the previous assessment indicated the following for the site:

- The results of the available site history review and site inspection indicates that the site has been subject to limited use over the period of assessment. The site history has also suggested the historical absence of any structures at the site.
- Site observations indicated the presence of minor and localised filling at the surface in the western, southern and eastern portions of the site.

5. Field Work Methods

The field work for the current assessment was undertaken on 24 February 2020 and comprised the following:

- Checking for underground services at proposed bore locations by a professional service locator;
- Drilling of five boreholes to depths of 7.5 m below the ground surface using a truck-mounted drilling rig equipped with push tube and solid flight auger methods;
- Logging of the subsurface profile by a geotechnical engineer from DP;
- Collection of soil samples for ASS testing purposes from regular depths at each test locations.

A geotechnical engineer from DP logged the subsurface profile and collected samples for identification and testing purposes. The approximate test locations were recorded using site features and a hand-held GPS (Accuracy approximately ± 5 m) and are shown on Drawing 1, Appendix C.

6. Field Work Results

The subsurface conditions are presented in detail in the borehole logs, Appendix A. These should be read in conjunction with the general notes preceding them, which explain definitions of the classification methods and descriptive terms.

FILLING Encountered in Bore 3 to 1.4 m, comprising sand filling and silty clay filling. Various inclusions such as subangular to subrounded gravel of up to 15mm, abundant organics, trace concrete fragments, glass and plastic in Bore 3.

SAND Encountered in all bores from the surface / 1.4m to termination, generally comprising dark grey, pale grey, pale brown, dark brown, brown and fine to medium grained sand with trace silt, (loose) abundant organics, including rootlets, and bark fragments in the upper profile (generally to 0.2 m).

Further details are provided in the borehole logs in Appendix A.

Groundwater was encountered during drilling from depths of 3.5m to 4.8m in all boreholes 1 to 5. It should be noted that groundwater levels are affected by factors such as climatic conditions, tidal influence and soil permeability and will therefore vary with time.

7. Laboratory Testing

Laboratory testing for ASS comprised the following:

- A total of 80 ASS screening tests;
- Analysis of a total of 6 samples for detailed ASS testing (chromium suite).

The results of ASS testing are provided in Appendix B and are summarised in Table 1 below.

Table 1: Results of ASS Testing

Sample ID	Sample Depth ^a (m)	Sample Description	Screening Test Results				Laboratory Results								
			pH			Strength of Reaction ^b	pH _{KCL}	S _{KCL}	Scr %S	s-TAA %S	S _{NAS} %S	s-ANC _{BT} %S	Net Acidity ^c %S	Existing and Potential Acidity %S	
			pH _F	pH _{Fox}	pH _F - pH _{Fox}										
1	0.1	Sand	5.7	4.8	0.9	1									
	0.5	Sand	5.6	4.4	1.2	1									
	1	Sand	6.1	5.3	0.8	1									
	1.5	Sand	6.2	4.9	1.3	1									
	2	Sand	5.0	4.9	0.1	1									
	2.5	Sand	6.0	5.3	0.6	1									
	3	Sand	6.0	5.3	0.7	1									
	3.5	Sand	6.2	5.6	0.6	1									
	4	Sand	6.4	5.5	0.9	1	5.1	<0.005	<0.005	<0.01	NA	NA	0.0050	0.0050	
	4.5	Sand	6.4	5.7	0.7	1									
	5	Sand	6.7	5.8	0.9	1									
	5.5	Sand	6.6	6.6	0.0	1									
	6	Sand	7.5	7.4	0.1	1									
	6.5	Sand	7.6	7.4	0.2	1									
	7	Sand	7.6	7.6	0.0	1									
7.5	Sand	7.9	7.6	0.3	1										
2	0.1	Sand	6.2	4.0	2.3	1									
	0.5	Sand	6.3	4.2	2.1	1									
	1	Sand	6.2	4.4	1.8	1	4.7	<0.005	<0.005	<0.01	NA	NA	<0.005	<0.005	
	1.5	Sand	6.4	5.2	1.2	1									
	2	Sand	6.4	5.0	1.4	1									
	2.5	Sand	6.4	4.8	1.6	1									
	3	Sand	6.4	5.3	1.0	1									
	3.5	Sand	6.5	5.7	0.8	1									
	4	Sand	6.6	5.8	0.8	1	5.5	<0.005	<0.005	<0.01	NA	NA	<0.005	<0.005	
	4.5	Sand	6.6	6.0	0.6	1									
	5	Sand	6.6	5.6	1.0	1									
	5.5	Sand	6.6	6.0	0.6	1									
	6	Sand	6.6	6.0	0.6	1									
	6.5	Sand	6.6	5.6	1.0	1									
	7	Sand	6.6	6.0	0.6	1									
7.5	Sand	6.6	6.2	0.4	1										
3	0.1	Sand fill	6.2	4.6	1.6	2									
	0.7	Silty Clay fill	6.2	3.4	2.8	2									
	1.2	Silty Sand fill	6.7	4.3	2.4	2	5.8	<0.005	0.006	<0.01	NA	NA	0.0070	0.0070	
	1.5	Sand	6.2	4.7	1.5	1									
	2	Sand	6.3	4.9	1.4	1									
	2.5	Sand	6.3	4.7	1.6	1									
	3	Sand	6.1	4.8	1.3	1									
	3.5	Sand	6.0	4.9	1.1	1	5.0	<0.005	<0.005	<0.01	NA	NA	0.0060	0.0060	
	4	Sand	6.0	5.1	0.9	1									
	4.5	Sand	5.7	5.7	0.0	1									
	5	Sand	6.0	5.8	0.2	1									
	5.5	Sand	6.2	5.1	1.1	1									
	6	Sand	6.5	6.0	0.5	1									
	6.5	Sand	6.6	5.1	1.5	1									
	7	Sand	6.7	6.7	0.0	1									
7.5	Sand	7.2	7.0	0.2	1										
4	0.1	Sand	5.7	5.5	0.2	1									
	0.5	Sand	5.8	5.4	0.4	1									
	1	Sand	6.0	5.4	0.6	1									
	1.5	Sand	6.1	5.0	1.1	1									
	2	Sand	6.2	5.5	0.7	1									
	2.5	Sand	6.3	5.6	0.7	1									
	3	Sand	6.4	5.8	0.6	1									
	3.5	Sand	6.3	6.0	0.4	1									
	4	Sand	7.0	6.5	0.5	1									
	4.5	Sand	7.6	6.9	0.7	1									
	5	Sand	7.9	7.3	0.6	1									
	5.5	Sand	8.0	7.6	0.4	1									
	6	Sand	8.2	7.8	0.4	1									
	6.5	Sand	8.4	7.7	0.6	1									
	7	Sand	8.4	7.8	0.6	1									
7.5	Sand	8.5	7.8	0.7	1										
5	0.1	Silty Sand	5.6	4.3	1.4	1F									
	0.5	Silty Sand	5.7	4.4	1.3	1F									
	1	Sand	7.2	4.5	2.7	1									
	1.5	Sand	7.5	5.1	2.4	1									
	2	Sand	7.2	5.7	1.5	1									
	2.5	Sand	7.7	5.8	2.0	1									
	3	Sand	7.8	6.0	1.8	1									
	3.5	Sand	7.8	7.0	0.9	1	5.6	<0.005	<0.005	<0.01	NA	NA	<0.005	<0.005	
	4	Sand	7.8	7.2	0.7	1									
	4.5	Sand	7.8	7.1	0.7	1									
	5	Sand	7.7	7.3	0.5	1									
	5.5	Sand	7.9	7.3	0.6	1									
	6	Sand	8.0	7.2	0.8	1									
	6.5	Sand	7.8	7.1	0.7	1									
	7	Sand	7.9	7.3	0.7	1									
7.5	Sand	7.9	7.4	0.5	1										
Guideline	Coarse sands, poorly buffered						Coarse sands, poorly buffered								0.01
	Coarse sands to loamy sands and peats		<4 ^d	<3.5 ^e	≥1 ^f	-	Coarse sands to loamy sands and peats								0.03
	Medium sandy loams to light clays						Medium sandy loams to light clays								0.06/0.03 ^g
	Fine medium to heavy clays & silty clays						Fine medium to heavy clays & silty clays								0.1/0.03 ^g

Notes to Table 1:
a Depth below ground surface
b Strength of Reaction
1 denotes no or slight reaction
2 denotes moderate reaction
3 denotes high reaction
4 denotes very vigorous reaction
F denotes bubbling/frothy reaction indicative of organics
H denotes heat generated
c Calculated by the laboratory based on the ABA equation in ASS Laboratory Methods Guidelines
d For actual acid sulphate soils (ASS)
e Indicative value only for Potential Acid Sulphate Soils (PASS)
f QASSIT Action Criteria for disturbance of 1-1000 tonnes of material
g QASSIT Action Criteria for disturbance of more than 1000 tonnes of material
Bold results indicative of ASS
Shaded results indicate an exceedance of QASSIT (2014) action criteria
pH_F - Soil pH Test (1:5 soil:distilled water)
pH_{Fox} - Soil Peroxide pH Test (1:4 soil:distilled water following oxidation of soil with 30% hydrogen peroxide (H₂O₂))
*Laboratory methods used to quantify ANC are likely to overestimate environmental effectiveness

ASSMAC (1998) suggests that a soil $\text{pH} < 4$ in water is an indicator of actual ASS. The results of screening tests therefore suggest the absence of actual ASS at the locations and depths tested.

The ASSMAC guidelines also suggest that indicators of potential acid sulphate soils (PASS) include the following:

- Soil $\text{pH} < 3.5$ following oxidation with H_2O_2 (i.e. pH_{FOX});
- Drop of 1 pH unit or more between pH_{F} and pH_{FOX} .

The results of screening tests indicated that some (27 of 80 samples) soil samples tested exhibited a pH drop equal to or greater than one unit. In addition, 1 of the 80 samples tested also exhibited a soil pH following oxidation below 3.5 (ie within silty clay filling).

It is noted that ASS screening tests are a qualitative method only and give an indication of the intensity of total acidification (pH). The guidelines indicate that peroxide may also oxidise organic matter (in addition to pyrite) to produce acids which are unlikely to form under natural conditions, thus giving falsely high indication of acid sulphate potential.

Full Chromium suite testing was conducted on six soil samples to further characterise possible ASS based on the results of the screening tests and the published information (i.e. ASS mapped as low probability of occurrence greater than 3 m below the ground surface).

Full Chromium Suite, testing indicated the general absence of ASS, with no exceedance of the adopted QASSIT action criteria (coarse sands that are poorly buffered).

8. Comments

DP has undertaken a review of published information, limited subsurface investigation, ASS screening tests and detailed ASS laboratory testing within the subject site. The results of ASS assessment at the site indicate the general absence of ASS at the locations and depths tested.

Based on the above investigation, disturbance (i.e. excavation or dewatering) of the soils encountered at the site does not require a site-specific acid sulfate soil management plan (ASSMP).

It is noted that limited ASS testing has been conducted. ASS conditions may vary between test locations. During excavation works at the site, it is recommended that inspections are conducted. If any materials are encountered that are different to those sampled and tested or exhibit additional signs of potential ASS (e.g. discolouration, jarosite staining, additional screening tests on excavated materials and extracted water) these should be appropriately segregated for further ASS assessment, and the advice of a qualified environmental consultant should be sought.

9. References

ASSMAC (1998), *ASSMAC Acid Sulphate Soil Manual*, New South Wales Acid Sulphate Soil Management Advisory Committee.

DP (2019), *Preliminary Site Investigation for Contamination, Proposed Rezoning, Sanderling Avenue Hawks Nest*, prepared for Lands Advisory Services, Project 91588, Douglas Partners Pty Ltd.

QASSIT (2014), *Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines*. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Dear, S-E., Ahern, C. R., O'Brien, L. E., Dobos, S. K., McEInea, A. E., Moore, N. G. & Watling, K. M.

10. Limitations

Douglas Partners (DP) has prepared this report for this project at Sanderling Avenue Hawks Nest with reference to DP's proposal NCL190687 dated 11 November 2019 and acceptance received from Lands Advisory Services Pty Ltd dated 28 January 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Borehole Logs – Bores 1 to 5

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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. They may not be the same at the time of construction as are indicated in the report; and
- 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 first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or 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 a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low

reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm 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 150 mm of, say, 4, 6 and 7 as:
4,6,7
N=13
- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:
15, 30/40 mm

Sampling Methods

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.



Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)

- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)

- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;

- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
Soil tends to stick together.
Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w < PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL' (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w > PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈ LL' (i.e. near the liquid limit).
- 'Wet' or 'w > LL' (i.e. wet of the liquid limit).

Symbols & Abbreviations

Douglas Partners



Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U ₅₀	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough


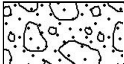
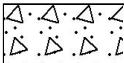

Other

fg	fragmented
bnd	band
qtz	quartz









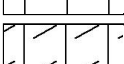
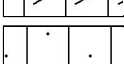
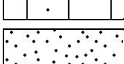
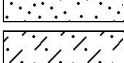
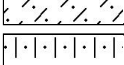
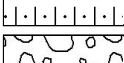
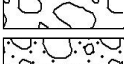
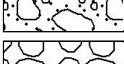

Symbols & Abbreviations

Graphic Symbols for Soil and Rock




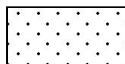
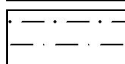
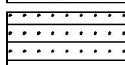
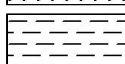

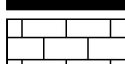
General

	Asphalt
	Road base
	Concrete
	Filling

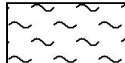
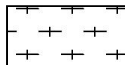
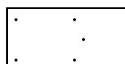
Soils

	Topsoil
	Peat
	Clay
	Silty clay
	Sandy clay
	Gravelly clay
	Shaly clay
	Silt
	Clayey silt
	Sandy silt
	Sand
	Clayey sand
	Silty sand
	Gravel
	Sandy gravel
	Cobbles, boulders
	Talus

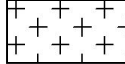

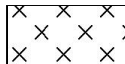
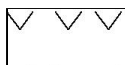

Sedimentary Rocks

	Boulder conglomerate
	Conglomerate
	Conglomeratic sandstone
	Sandstone
	Siltstone
	Laminite
	Mudstone, claystone, shale
	Coal
	Limestone

Metamorphic Rocks

	Slate, phyllite, schist
	Gneiss
	Quartzite

Igneous Rocks

	Granite
	Dolerite, basalt, andesite
	Dacite, epidote
	Tuff, breccia
	Porphyry

BOREHOLE LOG

CLIENT: Lands Advisory Services Pty Ltd
PROJECT: Proposed Rezoning, Acid Sulfate Soil Assessment
LOCATION: Sanderling Ave, Hawks Nest

SURFACE LEVEL: --
EASTING: 423442
NORTHING: 6385093
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 91588.01
DATE: 24/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SAND (SP): Fine to medium grained, dark grey, trace silt, moist, (loose) abundant organics, marine		D	0.1			24-02-20 		
		From 0.4m, grey, reduced silt content, trace organics		D	0.5					
1		From 1.2m, pale brown		D	1.0					
		From 1.8m, dark brown		D	1.5					
2		From 3.0m, (medium dense)		D	2.0					
		From 4.3m, brown, fine to coarse grained		D	2.5					
		From 4.6m, wet		D	3.0					
3				D	3.5					
				D	4.0					
4				D	4.5					
				D	5.0					
5				D	5.5					
6				D	6.0					
7				D	6.5					
				D	7.0					
7.5		Bore discontinued at 7.5m, limit of investigation	D	7.5						
8										
9										

RIG: D- 4T **DRILLER:** Campbell **LOGGED:** Heslop **CASING:** Nil
TYPE OF BORING: 65mm push tube to 5.0m, 110mm solid flight auger to 7.5m
WATER OBSERVATIONS: Free groundwater observed at 4.6m
REMARKS: Coordinates obtained using hand held GPS, typical accuracy ± 5m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Lands Advisory Services Pty Ltd
PROJECT: Proposed Rezoning, Acid Sulfate Soil Assessment
LOCATION: Sanderling Ave, Hawks Nest

SURFACE LEVEL: --
EASTING: 423493
NORTHING: 6385138
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 91588.01
DATE: 24/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SAND (SP): Fine to medium grained, dark grey, trace silt, moist, (loose), abundant organics, including rootlets and bark fragments		D	0.1			24-02-20 		
		From 0.2m, pale grey, reduced silt content and trace organics		D	0.5					
1		From 0.9m, pale brown, reduced organics content		D	1.0					
		From 1.2m, dark brown		D	1.5					
2		From 2.0m, (medium dense)		D	2.0					
				D	2.5					
3		From 3.2m, brown		D	3.0					
				D	3.5					
4		From 3.9m, wet		D	4.0					
		From 4.5m, fine to coarse grained		D	4.5					
				D	5.0					
				D	5.5					
6				D	6.0					
				D	6.5					
7				D	7.0					
7.5		Bore discontinued at 7.5m, limit of investigation	D	7.5						
8										
9										

RIG: D- 4T **DRILLER:** Campbell **LOGGED:** Heslop **CASING:** Nil
TYPE OF BORING: 65mm push tube to 4.0m, 110mm solid flight auger to 7.5m
WATER OBSERVATIONS: Free groundwater observed at 3.9m
REMARKS: Coordinates obtained using hand held GPS, typical accuracy ± 5m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Lands Advisory Services Pty Ltd
PROJECT: Proposed Rezoning, Acid Sulfate Soil Assessment
LOCATION: Sanderling Ave, Hawks Nest

SURFACE LEVEL: --
EASTING: 423532
NORTHING: 6385135
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 91588.01
DATE: 24/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.6	FILL / SAND (SP): Fine to medium grained, brown, with subangular to subrounded gravel up to 15mm in size, dry, abundant organics, trace concrete fragments, glass and plastic	[Cross-hatched pattern]	D	0.1	E	PID=4			
	0.8	From 0.1m, dark grey	[Cross-hatched pattern]	D	0.7	E	PID=3			
	0.9	FILL / SILTY CLAY (CI): Medium to high plasticity, brown, trace fine to coarse grained sand, trace subrounded gravel up to 10mm in size, W<PL	[Cross-hatched pattern]	D	1.2	E	PID=2			
	1.4	FILL / SAND (SP): Fine to medium grained, dark grey, with silt, dry	[Cross-hatched pattern]	D	1.5					
	2.0	FILL / SILTY CLAY (CI): Medium to high plasticity, brown, dry, with fine to medium grained sand, trace subangular to subrounded gravel up to 10mm in size, trace organics, W>PL, trace tile fragments, charcoal fragments	[Dotted pattern]	D	2.0					
	2.5	SAND (SP): Fine to medium grained, dark grey, trace silt, moist, (loose) abundant organics, including rootlets and bark fragments	[Dotted pattern]	D	2.5					
	3.0	From 1.9m, pale grey, reduced silt content, reduced organics content	[Dotted pattern]	D	3.0					
	3.5	From 2.1m, pale brown	[Dotted pattern]	D	3.5					
	4.0	From 2.9m, dark brown, (medium dense)	[Dotted pattern]	D	4.0					
	4.5		[Dotted pattern]	D	4.5					
	5.0	From 4.8m, pale brown, wet	[Dotted pattern]	D	5.0			▼ 24-02-20		
	5.5		[Dotted pattern]	D	5.5					
	6.0		[Dotted pattern]	D	6.0					
	6.5		[Dotted pattern]	D	6.5					
	7.0		[Dotted pattern]	D	7.0					
	7.5	Bore discontinued at 7.5m, limit of investigation	[Dotted pattern]	D	7.5					

RIG: D- 4T **DRILLER:** Campbell **LOGGED:** Heslop **CASING:** Nil
TYPE OF BORING: 65mm push tube to 5.0m, 110mm solid flight auger to 8.0m
WATER OBSERVATIONS: Free groundwater observed at 4.9m
REMARKS: Coordinates obtained using hand held GPS, typical accuracy ± 5m

SAMPLING & IN SITU TESTING LEGEND			
A Auger sample	G Gas sample	PID Photo ionisation detector (ppm)	
B Bulk sample	P Piston sample	PL(A) Point load axial test (s(50) (MPa)	
BLK Block sample	U Tube sample (x mm dia.)	PL(D) Point load diametral test (s(50) (MPa)	
C Core drilling	W Water sample	pp Pocket penetrometer (kPa)	
D Disturbed sample	> Water seep	S Standard penetration test	
E Environmental sample	≡ Water level	V Shear vane (kPa)	



BOREHOLE LOG

CLIENT: Lands Advisory Services Pty Ltd
PROJECT: Proposed Rezoning, Acid Sulfate Soil Assessment
LOCATION: Sanderling Ave, Hawks Nest

SURFACE LEVEL: --
EASTING: 423523
NORTHING: 6385241
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 91588.01
DATE: 24/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SAND (SP): Fine to medium grained, dark grey, trace silt, dry to moist, (loose), abundant organics, including rootlets and bark fragments		D	0.1			24-02-20 		
		From 0.2m, reduced silt content, reduced organic content		D	0.5					
	1	From 0.6m, pale grey		D	1.0					
		From 1.0m, pale brown		D	1.5					
		From 1.3m, dark brown		D	2.0					
	2	From 2.0m, (medium dense)		D	2.5					
		From 2.8m, moist		D	3.0					
		From 3.0m, pale grey		D	3.5					
				D	4.0					
		From 4.2m, wet		D	4.5					
				D	5.0					
				D	5.5					
				D	6.0					
				D	6.5					
				D	7.0					
	7.5	Bore discontinued at 7.5m, limit of investigation	D	7.5						
	8									
	9									

RIG: D- 4T **DRILLER:** Campbell **LOGGED:** Heslop **CASING:** Nil
TYPE OF BORING: 65mm push tube to 3.0m, 110mm solid flight auger to 7.5m
WATER OBSERVATIONS: Free groundwater observed at 4.2m
REMARKS: Coordinates obtained using hand held GPS, typical accuracy ± 5m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Lands Advisory Services Pty Ltd
PROJECT: Proposed Rezoning, Acid Sulfate Soil Assessment
LOCATION: Sanderling Ave, Hawks Nest

SURFACE LEVEL: --
EASTING: 423508
NORTHING: 6385258
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 91588.01
DATE: 24/2/2020
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		SAND (SP): Fine to medium grained, dark grey, with silt, dry, (loose), abundant organics including rootlets From 0.2m, reduced organics content	[Dotted pattern]	D	0.1					
				D	0.5					
	1	From 0.8m, grey From 1.0m, pale brown		D	1.0				1	
				D	1.5					
	2	From 1.9m, dark brown		D	2.0				2	
				D	2.5					
	3	From 3.0m, brown		D	3.0				3	
				D	3.5					
	4	From 3.5m, wet		D	4.0				4	
				D	4.5			▼ 24-02-20		
	5	From 4.5m, fine to coarse grained		D	5.0				5	
				D	5.5					
	6			D	6.0				6	
				D	6.5					
	7			D	7.0				7	
	7.5	Bore discontinued at 7.5m, limit of investigation		D	7.5					
	8								8	
	9								9	

RIG: D- 4T **DRILLER:** Campbell **LOGGED:** Heslop **CASING:** Nil
TYPE OF BORING: 110mm solid flight auger to 7.5m
WATER OBSERVATIONS: Free groundwater observed at 4.5m
REMARKS: Coordinates obtained using hand held GPS, typical accuracy ± 5m

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



Appendix B

Laboratory Testing



Envirolab Services Pty Ltd

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ph 02 9910 6200 fax 02 9910 6201

customerservice@envirolab.com.au

www.envirolab.com.au

CERTIFICATE OF ANALYSIS 238084

Client Details

Client	Douglas Partners Newcastle
Attention	Patrick Heads
Address	Box 324 Hunter Region Mail Centre, Newcastle, NSW, 2310

Sample Details

Your Reference	91588.01, Hawks Nest
Number of Samples	6 Soil
Date samples received	04/03/2020
Date completed instructions received	04/03/2020

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 11/03/2020

Date of Issue 10/03/2020

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

Results Approved By

Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Chromium Suite						
Our Reference		238084-1	238084-2	238084-3	238084-4	238084-5
Your Reference	UNITS	1/4.0	2/1.0	2/4.0	3/1.2	3/3.5
Date Sampled		24/02/2020	24/02/2020	24/02/2020	24/02/2020	24/02/2020
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Date analysed	-	05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
pH _{kcl}	pH units	5.1	4.7	5.5	5.8	5.0
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	<0.005	<0.005	<0.005	0.006	<0.005
a-Chromium Reducible Sulfur	moles H ⁺ /t	<3	<3	<3	4	<3
S _{HCl}	%w/w S	NA	NA	NA	NA	NA
S _{KCl}	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
S _{NAS}	%w/w S	NA	NA	NA	NA	NA
ANC _{BT}	% CaCO ₃	NA	NA	NA	NA	NA
s-ANC _{BT}	%w/w S	NA	NA	NA	NA	NA
s-Net Acidity	%w/w S	0.0050	<0.005	<0.005	0.0070	0.0060
a-Net Acidity	moles H ⁺ /t	<5	<5	<5	<5	<5
Liming rate	kg CaCO ₃ /t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H ⁺ /t	<5	<5	<5	<5	<5
Liming rate without ANCE	kg CaCO ₃ /t	<0.75	<0.75	<0.75	<0.75	<0.75
s-Net Acidity without ANCE	%w/w S	0.0050	<0.005	<0.005	0.0070	0.0060

Chromium Suite		
Our Reference		238084-6
Your Reference	UNITS	5/3.5
Date Sampled		24/02/2020
Type of sample		Soil
Date prepared	-	05/03/2020
Date analysed	-	05/03/2020
pH _{kcl}	pH units	5.6
s-TAA pH 6.5	%w/w S	<0.01
TAA pH 6.5	moles H ⁺ /t	<5
Chromium Reducible Sulfur	%w/w	<0.005
a-Chromium Reducible Sulfur	moles H ⁺ /t	<3
S _{HCl}	%w/w S	NA
S _{KCl}	%w/w S	<0.005
S _{NAS}	%w/w S	NA
ANC _{BT}	% CaCO ₃	NA
s-ANC _{BT}	%w/w S	NA
s-Net Acidity	%w/w S	<0.005
a-Net Acidity	moles H ⁺ /t	<5
Liming rate	kg CaCO ₃ /t	<0.75
a-Net Acidity without ANCE	moles H ⁺ /t	<5
Liming rate without ANCE	kg CaCO ₃ /t	<0.75
s-Net Acidity without ANCE	%w/w S	<0.005

Client Reference: 91588.01, Hawks Nest

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

Client Reference: 91588.01, Hawks Nest

QUALITY CONTROL: Chromium Suite				Duplicate				Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/03/2020	1	05/03/2020	05/03/2020		05/03/2020	[NT]
Date analysed	-			05/03/2020	1	05/03/2020	05/03/2020		05/03/2020	[NT]
pH _{KCl}	pH units		Inorg-068	[NT]	1	5.1	5.1	0	95	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	1	<0.01	<0.01	0	[NT]	[NT]
TAA pH 6.5	moles H ⁺ /t	5	Inorg-068	<5	1	<5	<5	0	98	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	1	<0.005	<0.005	0	[NT]	[NT]
a-Chromium Reducible Sulfur	moles H ⁺ /t	3	Inorg-068	<3	1	<3	<3	0	117	[NT]
S _{HCl}	%w/w S	0.005	Inorg-068	<0.005	1	NA	NA		[NT]	[NT]
S _{KCl}	%w/w S	0.005	Inorg-068	<0.005	1	<0.005	<0.005	0	[NT]	[NT]
S _{NAS}	%w/w S	0.005	Inorg-068	<0.005	1	NA	NA		[NT]	[NT]
ANC _{BT}	% CaCO ₃	0.05	Inorg-068	<0.05	1	NA	NA		[NT]	[NT]
s-ANC _{BT}	%w/w S	0.05	Inorg-068	<0.05	1	NA	NA		[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	1	0.0050	<0.005	0	[NT]	[NT]
a-Net Acidity	moles H ⁺ /t	5	Inorg-068	<5	1	<5	<5	0	[NT]	[NT]
Liming rate	kg CaCO ₃ /t	0.75	Inorg-068	<0.75	1	<0.75	<0.75	0	[NT]	[NT]
a-Net Acidity without ANCE	moles H ⁺ /t	5	Inorg-068	<5	1	<5	<5	0	[NT]	[NT]
Liming rate without ANCE	kg CaCO ₃ /t	0.75	Inorg-068	<0.75	1	<0.75	<0.75	0	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	1	0.0050	<0.005	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.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

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 (not SPOCAS); 60-140% for organics/SPOCAS (+/-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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Project No: 91588.01	Suburb/Town: HAWKS NEST	To: ENVIROLAB SERVICES CHATSWOOD
DP Order No: 149973	DP Contact Person: PATRICK HEARS	
Prior Storage: Esky <input type="checkbox"/> Fridge <input checked="" type="checkbox"/> Shelved <input type="checkbox"/> Freezer <input type="checkbox"/>	Ph: 0299106200	Attn: Simon
Do samples contain 'potential' HBM? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> (If YES, then handle, transport and store in accordance with FPM HAZID)		

Sample				Analytes								Notes
DP ID	Date Sampled	Type S-soil W-water	Lab ID	Full Chromium Suite								
1/4-0	24/2/20	S	1	✓								
2/1-0	↓	↓	2	✓								
2/4-0	↓	↓	3	✓								
3/1-2	↓	↓	4	✓								
3/3-5	↓	↓	5	✓								
5/3-5	↓	↓	6	✓								


Envirolab Services
 12 Ashley St
 Chatswood NSW 2067
 Ph: (02) 9910 6200
 Job No: 238084
 Date Received: 4/3/20
 Time Received: 1030
 Received by: SD
 Temp: Cool/Ambient
 Cooling: Cool/icepack
 Security: Broken/None

PQL (S) mg/kg

PQL (W) mg/L ANZECC PQLs req'd for all water analytes

• PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

*Metals to Analyse (Please circle) As, Cd, Cr, Cu, Pb, Zn, Hg, Ni, Mn, Fe

Total number of samples in container: 6

Date relinquished: 3/3/20 By: PH

Results required by: 11/3/20

Same day 24 hours 48 hours 72 hours Standard

SAMPLES RECEIVED BY LAB

Please sign and date to acknowledge receipt of samples and return by email

Signature: ELS SD

Date: 4/3/20 1030

Lab Ref: ELS STD 238084

Send results to:

Douglas Partners Pty Ltd

Address:

.....

.....

.....

Email:





Appendix C

Drawing 1 – Test Location Plan



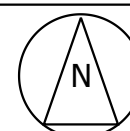
Drawing adapted from Nearmap Image dated 11.02.2020.
 Test locations are approximate only and were located using hand-held GPS.

Legend

-  Borehole Locations
-  Approximate Extent of Possible Filling
-  Approximate Location of Observed Building Rubble
-  Approximate Site Boundary



TITLE: Test Location Plan
 Proposed Rezoning, Acid Sulfate Soil Assessment
 Sanderling Avenue, Hawks Nest



OFFICE: Newcastle

DRAWN BY: PLH

DATE: 14.April.2020

CLIENT: Lands Advisory Services Pty Ltd

PROJECT No: 91588.01

DRAWING No: 1

REVISION: 0

SCALE: 1:800 (A3 Sheet)