



Douglas Partners

Geotechnics | Environment | Groundwater

Report on
Supplementary Acid Sulphate Soil Investigation

Proposed Industrial Development
238 – 258 Captain Cook Drive
Kurnell

Prepared for
Kurnell Developments Pty Ltd

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Integrated Practical Solutions





Douglas Partners

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Report on Supplementary Acid Sulphate Soil Investigation

Proposed Industrial Development

238 – 258 Captain Cook Drive, Kurnell

1. Introduction

This report presents the results of a geotechnical investigation by Douglas Partners Pty Ltd (DP) for a proposed industrial development at 238 - 258 Captain Cook Drive, Kurnell. The work was commissioned by Mr Kerry Lowe of Kurnell Developments Pty Ltd and was undertaken in accordance with DP's fee proposal SYD150955.P.001.Rev0 dated 29 July 2015.

It is understood that subdivision of the site into a series of industrial allotments is proposed. The aim of the investigation was to establish subsurface conditions across the site and to provide comments on acid sulphate soils (ASS), assuming a maximum excavation depth of 1 m.

The investigation included the drilling of 22 boreholes over the site area. Details of the investigation methods and results as well as comments on acid sulphate soils are provided herein.

An Acid Sulphate Soil Management Plan (ASSMP) has also been prepared based on the investigation results and is reported separately (ref DP report 84677.01.R.001.Rev0 dated September 2015).

2. Site Description

The site covers an approximately rectangular area of 17 hectares. It is bordered by a large warehouse to the north-east, Captain Cook Drive to the north-west, bushland to the south-east and an unnamed gravel road to the south-west. The site is relatively flat, with surface levels in the vicinity of RL 3 m relative to the Australian Height Datum (AHD).

Currently the site has a number of different land uses, however, most of the site is occupied by industrial buildings and associated offices as well as surrounding grassed areas and internal asphalt roads. The industrial and office buildings are brick and steel structures of various sizes. Many of the industrial buildings appear to be disused, and the four largest of these buildings are linked by overhead pipelines supported on steel trusses elevated well above ground level. There are various items scattered over the ground in the vicinity of these buildings, including a large number of steel drums, pipe sections and fibreglass offcuts, as well as some stockpiles of sandy filling with rubbish and building materials.

Other land uses on the site include an approximately 100 m wide strip of bushland, which runs the length of the south-western boundary. There is also an asphalt paved area in the northern corner of the site used for container and material storage, and some of the grassed area near the north western boundary is used as a horse paddock.

3. Regional Geology and Acid Sulphate Soils Mapping

Reference to the Wollongong - Port Hacking 1:100,000 Geology Sheet indicates that the site is underlain by Pleistocene era transgressive dunes, typically comprising fine to very fine quartzose sand. The south-eastern boundary of the site is located close to the boundary with swamp land, typically comprising peat, sandy peat and mud.

Reference to the corresponding 1:100,000 Soils Landscape Sheet indicates that the site is underlain by disturbed terrain, typically comprising level plain to hummocky terrain extensively disturbed by human activity. The south-eastern boundary of the site is located close to the boundary with aeolian soils of the Kurnell association, typically comprising gently undulating to rolling coastal sand dunes.

Reference to the New South Wales 1:25,000 Acid Sulphate Soil Risk Mapping 1994 - 1998 indicates that the site is partly in an area mapped as disturbed terrain, with soil investigations required to assess the area for ASS, and partly in an area mapped as having a high probability of occurrence of ASS at depths of 1 - 3 m below the ground surface. There will be a risk to the surrounding environment if ASS materials are disturbed by excavation activities.

4. Previous Investigation

DP previously carried out a geotechnical investigation for assessment of hydraulic conductivity and acid sulphate soils in proposed infiltration areas of the site (ref DP report 84677 dated February 2015). The investigation included the drilling of six boreholes (BH1 to BH6), with four of these terminated in sandy soils at 3 m depth and the other two encountering auger refusal on sandstone at depths of 0.8 m and 2.5 m. The previous borehole locations are shown on Drawing 1 in Appendix B.

The boreholes generally encountered silty sand and clayey sand filling to depths of 0.1 - 0.3 m, overlying grey and brown sand, silty sand and clayey sand, overlying sandstone which was encountered in BH2 and BH4 only at depths of 0.5 m and 1.2 m respectively. Groundwater was observed whilst drilling at depths of approximately 1.5 - 2.5 m, except in BH2 where groundwater was observed at 0.5 m depth and BH4 where no groundwater was observed down to the final depth of 2.5 m. The borehole logs from the previous investigation are presented in Appendix D. Notes defining classification methods and descriptive terms are presented in Appendix A.

5. Current Field Work Methods

The aim of the current investigation was to achieve complete site coverage for ASS assessment, for an assumed maximum excavation depth of 1 m. Reference to the New South Wales Acid Sulphate Soils Management Advisory Committee (ASSMAC) *Acid Sulphate Soil Manual* (1998) indicates that for sites greater than four hectares in area, two boreholes per hectare are required to characterise a site with respect to ASS. While the total site area is approximately 17 hectares, it is understood that the strip of bushland along the south-western boundary of the site is to be excluded from the proposed development, which reduces the area under development to approximately 14 hectares. The 22 boreholes completed as part of the current investigation, together with the six boreholes from the

previous investigation, make up a total of 28 boreholes which satisfies the guideline of two boreholes per hectare for the proposed development area of the site.

Additionally, the Acid Sulphate Soil Manual states that investigation must be carried out to at least 1 m below the base of proposed excavations on site. Based on an assumed maximum excavation depth of 1 m, sampling of subsurface materials was undertaken to a depth of 2 m or prior auger refusal in the boreholes drilled as part of the current investigation.

The 22 boreholes undertaken for the current investigation (BH101 to BH122) were drilled using a 3.5 tonne excavator fitted with a 150 mm diameter auger attachment, and were terminated at 2 m depth with the exception of BH105, which encountered auger refusal on possible sandstone bedrock at 1.6 m depth. Sampling of the soil profile was undertaken at 0.1 m depth, 0.5 m depth and then every 0.5 m thereafter to the base of each borehole, to allow for ASS assessment of the samples via subsequent laboratory testing.

The borehole locations are shown on Drawing 1 in Appendix B.

6. Current Field Work Results

Details of the subsurface conditions encountered are given on the borehole logs presented in Appendix C. Notes defining classification methods and descriptive terms are presented in Appendix A.

Based on the results of the investigation, the subsurface profile (excluding pavement surfaces) may be summarised as follows:

- FILLING – Brown and grey, fine to medium grained sand, silty sand and clayey sand filling to generally 0.2 - 0.3 m depth with some rootlets in the upper 50 mm, although deeper towards the northern corner of the site and extending to the base of BH102; overlying,
- SAND/SILTY SAND – Loose, brown and grey, fine to medium grained sand and silty sand, generally becoming wet with a strong organic odour from about 1.5 m depth.

No free groundwater was observed in any of the current boreholes whilst drilling.

7. Laboratory Testing

One hundred and six soil samples were screened by a NATA accredited laboratory to assess the potential for ASS on the site. Screening involves testing the pH of a sub-sample of soil that has been mixed with distilled water (pH_F) and a sub-sample of soil that has been mixed with the oxidising agent, hydrogen peroxide (pH_{FOX}). Low values of pH_F and pH_{FOX} and/or a strong reaction with hydrogen peroxide provide an indication as to whether ASS may be present within the soil. The results of the 106 screening tests are summarised and the laboratory report sheets are presented in Appendix E.

Based on the results of the screening tests, 10 samples were subjected to Suspension Peroxide Oxidation and Combined Acidity and Sulphate (SPOCAS) testing. The results of these tests were assessed against the action criteria triggering the need for an ASSMP, outlined in Table 4.4 of the

ASSMAC *Acid Sulphate Soil Manual* (1998). The results of the ten SPOCAS tests are summarised in Table 1, and the laboratory report sheets are provided in Appendix E.

Table 1: Summary of SPOCAS Test Results

Borehole	Depth (m)	Soil Description	pH _{kcl}	pH _{ox}	S _{POS} (%w/w)	TAA (mol H+/t)	TPA (mol H+/t)	TSA (mol H+/t)	Net Acidity (mol H+/t)	Liming Rate (kg CaCO ₃ /t)
101	2.0	Sand	7.6	4.6	0.01	<5	<5	<5	<10	<0.75
104	1.5	Sand	9.4	7.2	<0.005	<5	<5	<5	<10	<0.75
105	1.0	Sand	6.0	4.9	<0.005	<5	<5	<5	<10	<0.75
107	1.0	Filling	6.6	5.3	<0.005	<5	<5	<5	<10	<0.75
108	1.0	Sand	6.6	5.6	<0.005	<5	<5	<5	<10	<0.75
112	1.5	Sand	6.6	5.7	<0.005	<5	<5	<5	<10	<0.75
113	1.0	Sand	6.5	5.6	<0.005	<5	<5	<5	<10	<0.75
114	1.0	Sand	7.5	6.0	<0.005	<5	<5	<5	<10	<0.75
116	1.5	Sand	7.2	5.7	<0.005	<5	<5	<5	<10	<0.75
121	1.0	Sand	7.3	5.7	<0.005	<5	<5	<5	<10	<0.75

8. Proposed Development

It is understood that subdivision of the site into a number of smaller industrial lots is proposed. Stage 1 and Master Plan proposals have previously been prepared, although reference to Drawing No. 20635 dated 28 July 2015 by Biosis Pty Ltd indicates that the proposed layout of the lots may have changed, due to ecologically sensitive areas identified on the site. It is expected that the final subdivision layout will include industrial lots in the order of 2000 - 3000 m² in area, as well as the rerouting of an existing internal roadway which will link the proposed lots to Captain Cook Drive. Expected depths of excavation for service trenches, foundations or otherwise within the individual proposed lots is unknown at this stage, and is assumed to be not more than 1 m.

9. Comments

Actual acid sulphate soils (AASS) are described as soils that are producing acid in their current state. Potential acid sulphate soils (PASS) are described as soils that are not currently producing acid but may do if exposed to oxidation (i.e. following excavation or lowering of the groundwater table). Assessment of the ASS screening test results and the SPOCAS test results against the ASSMAC action criteria indicates that AASS or PASS are not present within 2 m of the current ground surface levels. As such, an ASSMP will not be required for excavation activities within the upper 1 m of the soil profile on the site.

The above assessment is based on sampling and testing from boreholes carried out to 2 m depth as part of the current investigation. However, results from DP's previous investigation suggest that deeper excavations may encounter ASS. Additionally, dewatering below the level of excavation will also disturb ASS if present within the depth of dewatering. Reference should be made to the ASSMP issued separately to this report (ref DP report 84677.01.R.001.Rev0 dated September 2015) for advice on conducting excavations that may disturb ASS. If excavation to greater than 1 m depth is proposed, then further investigation may be required to assess the extent of ASS within the plan area and depth of the proposed excavation.

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 238 - 258 Captain Cook Drive, Kurnell in accordance with DP's proposal dated 29 July 2015 and acceptance received from Mr Kerry Lowe of Kurnell Developments Pty Ltd dated 3 August 2015. The work was carried out under DP's standard Conditions of Engagement. This report is provided for the exclusive use of Kurnell Developments Pty Ltd for this project only and for the purposes as described in the report. It should not be used for other projects 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 subsurface conditions on the site only at the specific test locations, and then only to the depths investigated and at the time the work was carried out. Subsurface 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 test locations. The advice may also be limited by site accessibility.

This report must be read in conjunction with all of the appended documentation 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 scope of work for this investigation did not include the assessment of surface or subsurface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

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 geotechnical 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

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.

Copyright

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 based on Australian Standard AS 1726, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 - 5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



Rock Strength

Rock strength is defined by the Point Load Strength Index ($IS_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $IS_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $IS_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

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

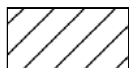
Soils



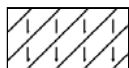
Topsoil



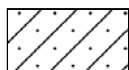
Peat



Clay



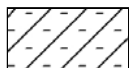
Silty clay



Sandy clay



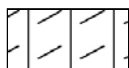
Gravelly clay



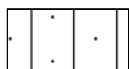
Shaly clay



Silt



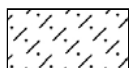
Clayey silt



Sandy silt



Sand



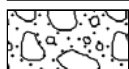
Clayey sand



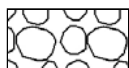
Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



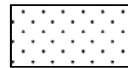
Boulder conglomerate



Conglomerate



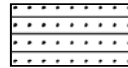
Conglomeratic sandstone



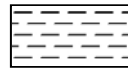
Sandstone



Siltstone



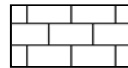
Laminite



Mudstone, claystone, shale

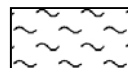


Coal

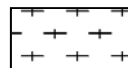


Limestone

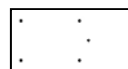
Metamorphic Rocks



Slate, phyllite, schist

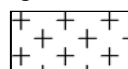


Gneiss

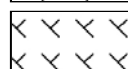


Quartzite

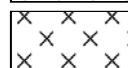
Igneous Rocks



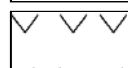
Granite



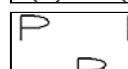
Dolerite, basalt, andesite



Dacite, epidote



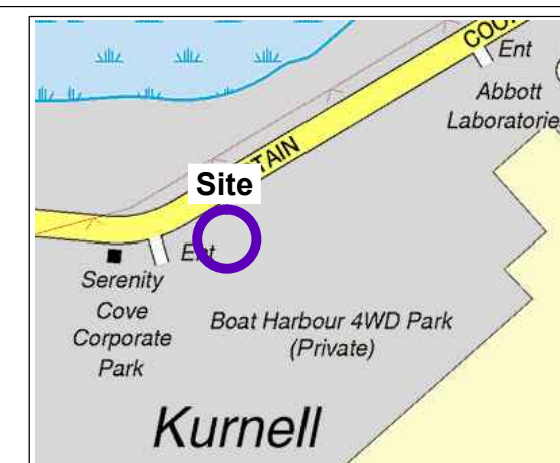
Tuff, breccia



Porphyry

Appendix B

Drawings



Locality Plan

SITE AREA

BUSHLAND TO BE EXCLUDED FROM DEVELOPMENT

LEGEND

- ◆ Previous borehole by DP (report 84677.00 dated Feb 2015)
- ✚ Current borehole location



NOTE:
1. Base drawing from Nearmap.com
2. Test locations are approximate only



CLIENT: Kurnell Developments Pty Ltd

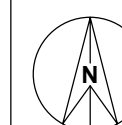
OFFICE: Sydney

SCALE: 1:2500 @ A3

DRAWN BY: PSCH

DATE: 7.9.2015

TITLE: **Borehole Location Plan**
Proposed Industrial Development
238-258 Captain Cook Drive, KURNELL



PROJECT No: 84677.01

DRAWING No: 1

REVISION: 0

Appendix C

Results of Current Field Work

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 2.5 AHD
EASTING: 333786
NORTHING: 6234043
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 84677.01
DATE: 13/8/2015
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			
	0.04	ASPHALTIC CONCRETE								
	0.15	ROADBASE								
		FILLING - brown, clayey, fine sand filling, damp								
				A	0.5					
				A	1.0					
	1.4	SAND - loose, grey, fine to medium sand, moist		A	1.5					
		- brown and wet from 1.6m								
	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.5 AHD
EASTING: 333848
NORTHING: 6233940
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.4 AHD
EASTING: 333865
NORTHING: 6233905
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 2.5 AHD
EASTING: 333885
NORTHING: 6233860
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.3 AHD
EASTING: 333926
NORTHING: 6233770
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3	0.2	SILTY SAND - loose, brown, silty, fine sand, damp		A	0.1					
		SAND - loose, dark grey, fine to medium sand, damp		A	0.5					
	1			A	1.0					
	1.6	- brown and wet from 1.4m		A	1.5					
		Bore discontinued at 1.6m - refusal on possible sandstone bedrock								
	2									
	3									
	4									

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.1 AHD
EASTING: 333771
NORTHING: 6233991
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 2.9 AHD
EASTING: 333783
NORTHING: 6233917
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 84677.01
DATE: 12/8/2015
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			
2	0.2	FILLING - brown, silty, fine sand topsoil filling, damp 0.0-0.05m: with some rootlets		A	0.1					
		FILLING - brown, fine sand filling with some silt, damp		A	0.5					
	1.0			A	1.0					
	1.2	SILTY SAND - dark grey, silty, fine sand with clay and organic matter, moist		A	1.5					
		- wet with strong organic odour from 1.7m								
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
3										
4										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.1 AHD
EASTING: 333836
NORTHING: 6233852
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 84677.01
DATE: 12/8/2015
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			
	0.3	FILLING - brown, silty, fine sand filling, damp 0.0-0.05m: with some rootlets		A	0.0					
		SAND - loose, light brown, fine to medium sand, damp		A	0.5					
	1			A	1.0					
		- light grey and moist from 1.1m		A	1.5					
		- brown and wet from 1.7m		A	2.0					
	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
	3									
	4									

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(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)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.2 AHD
EASTING: 333874
NORTHING: 6233783
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3		SAND - loose, light grey, fine to medium sand, damp		A	0.1					
		- light brown from 0.4m		A	0.5					
	1			A	1.0				1	
		- brown from 1.8m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0				2	
3									3	
4									4	

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(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: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333688
NORTHING: 6233934
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333716
NORTHING: 6233883
DIP/AZIMUTH: 90°/--

BORE No: 111
PROJECT No: 84677.01
DATE: 13/8/2015
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			
3 										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.3 AHD
EASTING: 333777
NORTHING: 6233838
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3	0.2	FILLING - brown, silty, fine sand filling, humid 0.0-0.05m: with some rootlets		A	0.1					
		SAND - loose, grey, fine to medium sand, humid		A	0.5					
	1	- light brown from 1.2m		A	1.0					
	2	- wet from 1.7m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
3										
4										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



Douglas Partners
 Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 2.8 AHD
EASTING: 333816
NORTHING: 6233745
DIP/AZIMUTH: 90°/--

BORE No: 113
PROJECT No: 84677.01
DATE: 12/8/2015
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			
	0.2	FILLING - light brown, fine to medium gravelly sand filling, humid		A	0.1					
		SAND - loose, light brown, fine to medium sand, humid		A	0.5					
				A	1.0					
		- moist from 1.5m		A	1.5					
		- wet from 1.7m								
	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333874
NORTHING: 6233726
DIP/AZIMUTH: 90°/--

BORE No: 114
PROJECT No: 84677.01
DATE: 12/8/2015
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 - loose, brown, fine sand, damp		A	0.1					
				A	0.5					
1		- grey from 1.2m		A	1.0					
		- wet from 1.5m		A	1.5					
		- light brown from 1.6m								
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
3										
4										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 2.9 AHD
EASTING: 333632
NORTHING: 6233881
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 84677.01
DATE: 12/8/2015
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			
	0.15	FILLING - brown, silty, fine sand filling, humid 0.0-0.05m: with some rootlets SAND - loose, light brown, fine to medium sand, humid		A	0.1					
				A	0.5					
1	1.0			A	1.0					
		- grey and wet with organic odour from 1.5m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
3										
4										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333647
NORTHING: 6233804
DIP/AZIMUTH: 90°/--

BORE No: 116
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333745
NORTHING: 6233744
DIP/AZIMUTH: 90°/--

BORE No: 117
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3		FILLING - light brown, silty, fine sand filling, damp 0.0-0.05m: with some rootlets		A	0.1					
	0.5	SAND - loose, light brown, fine to medium grained sand, damp		A	0.5					
	1	- light grey and moist from 1.3m		A	1.0				1	
		- wet from 1.6m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0				2	
0	3								3	
1	4								4	

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.1 AHD
EASTING: 333795
NORTHING: 6233672
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3	0.8	SILTY SAND - loose, light brown, silty, fine sand, damp 0.0-0.05m: with some rootlets		A	0.0			1		
				A	0.5					
	1	SAND - loose, brown, fine to medium sand, damp		A	1.0					
		- dark grey from 1.5m - wet from 1.6m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0			2		
3								3		
4								4		

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

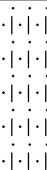
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample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

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.2 AHD
EASTING: 333867
NORTHING: 6233654
DIP/AZIMUTH: 90°/--

BORE No: 119
PROJECT No: 84677.01
DATE: 12/8/2015
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			
3	0.6	SILTY SAND - loose, brown, silty, fine sand, humid		A	0.1					
				A	0.5					
		SAND - loose, light brown, fine to medium sand, humid		A	1.0					
		- dark grey and moist from 1.5m - wet from 1.7m		A	1.5					
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0			2		
3								3		
4								4		

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333585
NORTHING: 6233892
DIP/AZIMUTH: 90°/--

BORE No: 120
PROJECT No: 84677.01
DATE: 13/8/2015
SHEET 1 OF 1

[illegible]

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.0 AHD
EASTING: 333666
NORTHING: 6233731
DIP/AZIMUTH: 90°/--

BORE No: 121
PROJECT No: 84677.01
DATE: 13/8/2015
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 - loose, light brown, fine to medium sand, damp 0.0-0.05m: with some rootlets		A	0.1					
				A	0.5					
1	1			A	1.0					
		- moist from 1.4m		A	1.5					
		- dark grey and wet with organic odour from 1.8m								
2	2.0	Bore discontinued at 2.0m - target depth reached		A	2.0					
3										
4										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(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: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: 3.1 AHD
EASTING: 333785
NORTHING: 6233603
DIP/AZIMUTH: 90°/--

BORE No: 122
PROJECT No: 84677.01
DATE: 13/8/2015
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			
3 <										

RIG: 3.5T Excavator

DRILLER: A & A Hire

LOGGED: MW

CASING: Uncased

TYPE OF BORING: 150mm diameter solid flight auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

Appendix D

Previous Borehole Logs

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333698
NORTHING: 6233996
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 84677
DATE: 28/1/2015
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			
	0.1	FILLING - brown, silty, fine to medium sand filling with some clay and a trace of coarse sand, fine gravel and rootlets, moist		A	0.1					
		SAND - orange-brown, fine to medium sand with some silt, moist		A	0.5					
1		1.0m: becoming dark grey and slightly silty with a trace of clay		A	1.0					
		1.5m: grey, less silty, less clay		A	1.5					
2		2.2m: wet, slight organic odour		A	2.0					
		2.6m: brown		A	2.5					
3	3.0	Bore discontinued at 3.0m - limit of investigation		A	3.0					
4										

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 1.7m

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333990
NORTHING: 6233717
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 84677
DATE: 28/1/2015
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			
		SILTY SAND - grey to dark grey, silty sand with some clay and a trace of rootlets (to 0.05m), moist then wet		A	0.1					
				A	0.3					
	0.5	SANDSTONE - low strength, brown, fine to medium grained sandstone		A	0.5			▼		
	0.6m	medium strength, grey and light orange								
	0.8	Bore discontinued at 0.8m - refusal on sandstone		A	0.8					
1										
2										
3										
4										

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 0.8m

WATER OBSERVATIONS: Free groundwater observed at 0.5m

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U _i	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333632
NORTHING: 6233943
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 84677
DATE: 28/1/2015
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			
	0.1	FILLING - brown, silty, fine to medium sand filling with some clay and a trace of coarse sand and rootlets, moist		A	0.1					
		SAND - orange-brown, fine to medium sand with some silt, moist		A	0.5					
	1			A	1.0					
	1.2	1.1m: brown, becoming slightly silty								
		CLAYEY SAND - dark grey, slightly silty, fine to medium clayey sand, moist		A	1.5					
	1.6									
		SILTY SAND - dark brown, silty, fine to medium sand, moist		A	2.0					
	2									
	2.2	SILTY SAND - dark brown, silty, fine to medium sand with a trace of clay, moist (organic odour)		A	2.5					
		2.5m: becoming wet								
		2.6m: grey-brown								
	3			A	3.0					
	3.0	Bore discontinued at 3.0m - limit of investigation								
	4									

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 2.5m

REMARKS:

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	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333950
NORTHING: 6233677
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 84677
DATE: 28/1/2015
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			
	0.3	FILLING - brown, clayey fine to coarse sand and ripped sandstone (gravel to boulders) filling with some rootlets, moist		A	0.1					
		CLAYEY SAND - dark grey, slightly silty, clayey, fine to medium sand with a trace of rootlets, moist		A	0.5					
	1	0.8m: dark brown with some moderately cemented clayey sand pockets 1.0m: moist to wet		A	1.0				1	
	1.2	SANDSTONE - very low strength, grey and light orange, fine to medium grained sandstone		A	1.5					
	1.8	SANDSTONE - low strength, grey, fine to medium grained sandstone with some very low and low to medium strength bands		A	2.0				2	
	2.5	Bore discontinued at 2.5m - refusal on sandstone								
	3								3	
	4								4	

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333578
NORTHING: 6233918
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 84677
DATE: 28/1/2015
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			
	0.1	FILLING - dark brown, silty, fine to medium sand filling with some clay and a trace of rootlets, moist		A	0.1					
		SAND - orange-brown, fine to medium sand with some silt and a trace of rootlets, moist		A	0.5					
				A	1.0					
1										
	1.2	CLAYEY SAND - dark grey, slightly silty clayey sand, moist		A	1.5					
	1.6	SILTY SAND - grey, fine to medium silty sand, moist								
				A	2.0					
2		2.0m: becoming wet								
		2.3m: grey-brown (organic odour)		A	2.5					
		2.5m: brown, with some clay								
3	3.0	Bore discontinued at 3.0m - limit of investigation		A	3.0					
4										

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 2.0m

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



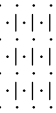
Douglas Partners
 Geotechnics | Environment | Groundwater

BOREHOLE LOG

CLIENT: Kurnell Developments Pty Ltd
PROJECT: Proposed Industrial Development
LOCATION: 238-258 Captain Cook Drive, Kurnell

SURFACE LEVEL: --
EASTING: 333740
NORTHING: 6233658
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 84677
DATE: 28/1/2015
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			
	0.3	FILLING - brown, silty, fine to medium silty sand filling with a trace of fine to medium gravel (generally ironstone and igneous gravel) and rootlets, moist		A	0.1					
	0.7	SILTY SAND - light grey and grey, silty, fine to medium sand with some clay, moist		A	0.5					
	1.0	SAND - grey, slightly silty, fine to medium sand, moist		A	1.0					
	1.3m: light grey, trace silt 1.4m: brown			A	1.5					
	1.9m: wet			A	2.0					
	2.3	SILTY SAND - brown, silty, fine to medium sand with some clay, wet (organic odour)		A	2.5					
	3.0	Bore discontinued at 3.0m - limit of investigation			3.0					

RIG: 3.5 tonne excavator

DRILLER: A & A Hire

LOGGED: KM

CASING: Uncased

TYPE OF BORING: 300mm diameter solid flight auger to 3.0m

WATER OBSERVATIONS: Free groundwater observed at 1.9m

REMARKS:

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 Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

Appendix E

Results of Laboratory Testing

SUMMARY OF ASS SCREENING TEST RESULTS

Borehole	Depth (m)	Soil Description	pH _F	pH _{FOX}	ΔpH	Reaction Rate
101	0.5	FILLING - Brown clayey sand	8.1	7.8	0.3	Moderate
101	1.0	FILLING - Brown clayey sand	8.7	6.3	2.4	Slight
101	1.5	SAND - Grey	9.2	6.8	2.4	Slight
101	2.0	SAND - Brown	7.9	5.8	2.1	Slight
102	0.1	FILLING - Brown silty sand	8.0	6.0	2.0	Slight
102	0.5	FILLING - Brown silty sand	8.0	5.8	2.2	Slight
102	1.0	FILLING - Brown sand	8.2	6.1	2.1	Slight
102	1.5	FILLING - Grey sand	8.1	6.2	1.9	Slight
102	2.0	FILLING - Grey sand	8.2	6.1	2.1	Slight
103	0.1	SAND - Light brown	8.2	6.2	2.0	Slight
103	0.5	SAND - Light brown	8.4	6.5	1.9	Slight
103	1.0	SAND - Light brown	8.3	6.7	1.6	Slight
103	1.5	SAND - Grey	8.6	6.1	2.5	Slight
103	2.0	SAND - Grey	8.5	6.3	2.2	Slight
104	0.1	SILTY SAND - Brown	8.1	6.2	1.9	Slight
104	0.5	SAND - Light brown	8.2	6.2	2.0	Slight
104	1.0	SAND - Light brown	8.2	6.1	2.1	Slight
104	1.5	SAND - Grey	8.6	6.3	2.3	Slight
104	2.0	SAND - Grey	8.1	5.6	2.5	Slight
105	0.1	SILTY SAND - Brown	8.1	5.8	2.3	Slight
105	0.5	SAND - Dark grey	8.2	5.6	2.6	Slight
105	1.0	SAND - Dark grey	8.0	5.8	2.2	Slight
105	1.5	SAND - Brown	7.5	5.9	1.6	Slight
106	0.5	SAND - Light brown	8.7	7.2	1.5	Slight
106	1.0	SAND - Light brown	8.5	6.4	2.1	Slight
106	1.5	SAND - Light brown	8.4	6.4	2.0	Slight
106	2.0	SAND - Dark grey	8.1	5.7	2.4	Slight
107	0.1	FILLING - Brown silty sand	7.3	5.2	2.1	Slight
107	0.5	FILLING - Brown sand	7.4	5.5	1.9	Slight
107	1.0	FILLING - Brown sand	7.5	5.6	1.9	Slight
107	1.5	SILTY SAND - Dark grey	7.6	4.9	2.7	Slight
107	2.0	SILTY SAND - Dark grey	7.4	5.2	2.2	Slight
108	0.1	FILLING - Brown silty sand	7.8	6.1	1.7	Slight
108	0.5	SAND - Light brown	8.0	6.0	2.0	Slight
108	1.0	SAND - Light brown	8.0	5.9	2.1	Slight

Borehole	Depth (m)	Soil Description	pH _F	pH _{FOX}	ΔpH	Reaction Rate
108	1.5	SAND - Light grey	7.9	6.0	1.9	Slight
108	2.0	SAND - Brown	7.8	6.1	1.7	Slight
109	0.1	SAND - Light grey	8.3	6.3	2.0	Slight
109	0.5	SAND - Light brown	8.3	6.3	2.0	Slight
109	1.0	SAND - Light brown	8.2	5.9	2.3	Slight
109	1.5	SAND - Light brown	8.2	6.0	2.2	Slight
109	2.0	SAND - Brown	8.0	6.1	1.9	Slight
110	0.1	FILLING - Brown silty sand	8.6	6.6	2.0	Slight
110	0.5	SAND - Brown	8.8	6.7	2.1	Slight
110	1.0	SAND - Brown	9.0	6.7	2.3	Slight
110	1.5	SAND - Brown	9.2	6.8	2.4	Slight
110	2.0	SAND - Dark grey	8.1	6.1	2.0	Slight
111	0.1	FILLING - Brown silty sand	7.7	5.4	2.3	Slight
111	0.5	SAND - Brown	7.7	5.6	2.1	Slight
111	1.0	SAND - Brown	7.7	5.6	2.1	Slight
111	1.5	SAND - Brown	7.6	5.6	2.0	Slight
111	2.0	SAND - Dark grey	7.2	5.5	1.7	Slight
112	0.1	FILLING - Brown silty sand	7.6	5.8	1.8	Slight
112	0.5	SAND - Grey	7.9	6.0	1.9	Slight
112	1.0	SAND - Grey	8.0	6.0	2.0	Slight
112	1.5	SAND - Light brown	8.0	5.9	2.1	Slight
112	2.0	SAND - Light brown	8.0	6.0	2.0	Slight
113	0.1	FILLING - Light brown gravelly sand	8.1	6.3	1.8	Slight
113	0.5	SAND - Light brown	8.3	6.3	2.0	Slight
113	1.0	SAND - Light brown	8.1	6.0	2.1	Slight
113	1.5	SAND - Light brown	8.3	6.1	2.2	Slight
113	2.0	SAND - Light brown	8.0	6.3	1.7	Slight
114	0.1	SAND - Brown	8.4	6.4	2.0	Slight
114	0.5	SAND - Brown	8.1	6.1	2.0	Slight
114	1.0	SAND - Brown	8.2	6.1	2.1	Slight
114	1.5	SAND - Grey	8.0	6.2	1.8	Slight
114	2.0	SAND - Light brown	7.9	6.6	1.3	Slight
115	0.1	FILLING - Brown silty sand	8.0	6.4	1.6	Slight
115	0.5	SAND - Light brown	8.6	6.6	2.0	Slight
115	1.0	SAND - Light brown	8.8	6.8	2.0	Slight
115	1.5	SAND - Light brown	9.1	6.8	2.3	Slight
115	2.0	SAND - Grey	8.4	6.6	1.8	Slight

Borehole	Depth (m)	Soil Description	pH _F	pH _{FOX}	ΔpH	Reaction Rate
116	0.5	SAND - Brown	8.6	6.4	2.2	Slight
116	1.0	SAND - Brown	8.6	6.4	2.2	Slight
116	1.5	SAND - Brown	8.4	6.1	2.3	Slight
116	2.0	SAND - Dark grey	7.8	5.8	2.0	Slight
117	0.1	FILLING - Light brown silty sand	8.3	6.5	1.8	Slight
117	0.5	FILLING - Light brown silty sand	8.6	6.7	1.9	Slight
117	1.0	SAND - Light brown	8.3	6.2	2.1	Slight
117	1.5	SAND - Light grey	8.3	6.9	1.4	Slight
117	2.0	SAND - Light grey	8.4	6.6	1.8	Slight
118	0.1	SILTY SAND - Light brown silty sand	7.8	6.4	1.4	Slight
118	0.5	SILTY SAND - Light brown silty sand	8.2	6.6	1.6	Slight
118	1.0	SAND - Brown	8.4	6.2	2.2	Slight
118	1.5	SAND - Brown	8.6	6.3	2.3	Slight
118	2.0	SAND - Dark grey	8.2	6.2	2.0	Slight
119	0.1	SILTY SAND - Brown	8.0	6.4	1.6	Slight
119	0.5	SILTY SAND - Brown	8.3	6.3	2.0	Slight
119	1.0	SAND - Light brown	8.1	6.1	2.0	Slight
119	1.5	SAND - Dark grey	8.1	5.5	2.6	Slight
119	2.0	SAND - Dark grey	7.7	5.9	1.8	Slight
120	0.1	FILLING - Brown silty sand	8.4	6.6	1.8	Slight
120	0.5	SAND - Brown	8.5	7.0	1.5	Slight
120	1.0	SAND - Brown	8.6	6.6	2.0	Slight
120	1.5	SAND - Brown	8.5	6.3	2.2	Slight
120	2.0	SAND - Grey	8.0	6.3	1.7	Slight
121	0.1	SAND - Light brown	8.3	6.5	1.8	Slight
121	0.5	SAND - Light brown	8.2	6.3	1.9	Slight
121	1.0	SAND - Light brown	8.1	6.1	2.0	Slight
121	1.5	SAND - Light brown	8.1	6.2	1.9	Slight
121	2.0	SAND - Dark grey	7.7	6.0	1.7	Slight
122	0.1	SILTY SAND - Brown	8.0	6.3	1.7	Slight
122	0.5	SILTY SAND - Brown	8.0	5.9	2.1	Slight
122	1.0	SAND - Grey	8.5	6.5	2.0	Slight
122	1.5	SAND - Grey	8.5	6.3	2.2	Slight
122	2.0	SAND - Grey	8.2	6.1	2.1	Slight

CERTIFICATE OF ANALYSIS 132766

Client:

Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Matt West, Ray Blinman

Sample log in details:

Your Reference:	<u>84677.01, Kurnell</u>
No. of samples:	106 soils
Date samples received:	14/08/15
Date completed instructions received:	14/08/15

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	21/08/15
Date of Preliminary Report:	Not Issued
Issue Date:	21/08/15

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Accredited for compliance with ISO/IEC 17025.

Tests not covered by NATA are denoted with *.

Results Approved By:



Jacinta Hurst
Laboratory Manager

sPOCAS field test						
Our Reference:	UNITS	132766-1	132766-2	132766-3	132766-4	132766-5
Your Reference	-----	BH101	BH101	BH101	BH101	BH101
Depth	-----	0.5	1	1.5	2	0.1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.1	8.7	9.2	7.9	8.0
pH _{Fox} (field peroxide test)*	pH Units	7.8	6.3	6.8	5.8	6.0
Reaction Rate*	-	Moderate	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-6	132766-7	132766-8	132766-9	132766-10
Your Reference	-----	BH102	BH102	BH102	BH102	BH103
Depth	-----	0.5	1	1.5	2	0.1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.0	8.2	8.1	8.2	8.2
pH _{Fox} (field peroxide test)*	pH Units	5.8	6.1	6.2	6.1	6.2
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-11	132766-12	132766-13	132766-14	132766-15
Your Reference	-----	BH103	BH103	BH103	BH103	BH104
Depth	-----	0.5	1	1.5	2	0.1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.4	8.3	8.6	8.5	8.1
pH _{Fox} (field peroxide test)*	pH Units	6.5	6.7	6.1	6.3	6.2
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-16	132766-17	132766-18	132766-19	132766-20
Your Reference	-----	BH104	BH104	BH104	BH104	BH105
Depth	-----	0.5	1	1.5	2	0.1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.2	8.2	8.6	8.1	8.1
pH _{Fox} (field peroxide test)*	pH Units	6.2	6.1	6.3	5.6	5.8
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-21	132766-22	132766-23	132766-24	132766-25
Our Reference:	-----	BH105	BH105	BH105	BH106	BH106
Your Reference	-----	0.5	1	1.5	0.5	1
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.2	8.0	7.5	8.7	8.5
pH _{Fox} (field peroxide test)*	pH Units	5.6	5.8	5.9	7.2	6.4
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-26	132766-27	132766-28	132766-29	132766-30
Our Reference:	-----	BH106	BH106	BH107	BH107	BH107
Your Reference	-----	1.5	2	0.1	0.5	1
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.4	8.1	7.3	7.4	7.5
pH _{Fox} (field peroxide test)*	pH Units	6.4	5.7	5.2	5.5	5.6
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-31	132766-32	132766-33	132766-34	132766-35
Our Reference:	-----	BH107	BH107	BH108	BH108	BH108
Your Reference	-----	1.5	2	0.1	0.5	1
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	7.6	7.4	7.8	8.0	8.0
pH _{Fox} (field peroxide test)*	pH Units	4.9	5.2	6.1	6.0	5.9
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-36	132766-37	132766-38	132766-39	132766-40
Our Reference:	-----	BH108	BH108	BH109	BH109	BH109
Your Reference	-----	1.5	2	0.1	0.5	1
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	7.9	7.8	8.3	8.3	8.2
pH _{Fox} (field peroxide test)*	pH Units	6.0	6.1	6.3	6.3	5.9
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-41	132766-42	132766-43	132766-44	132766-45
Our Reference:	-----	BH109	BH109	BH110	BH110	BH110
Your Reference	-----	1.5	2	0.1	0.5	1
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.2	8.0	8.6	8.8	9.0
pH _{Fox} (field peroxide test)*	pH Units	6.0	6.1	6.6	6.7	6.7
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-46	132766-47	132766-48	132766-49	132766-50
Your Reference	-----	BH110	BH110	BH111	BH111	BH111
Depth	-----	1.5	2	0.1	0.5	1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	9.2	8.1	7.7	7.7	7.7
pH _{Fox} (field peroxide test)*	pH Units	6.8	6.1	5.4	5.6	5.6
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-51	132766-52	132766-53	132766-54	132766-55
Your Reference	-----	BH111	BH111	BH112	BH112	BH112
Depth	-----	1.5	2	0.1	0.5	1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	7.6	7.2	7.6	7.9	8.0
pH _{Fox} (field peroxide test)*	pH Units	5.6	5.5	5.8	6.0	6.0
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-56	132766-57	132766-58	132766-59	132766-60
Your Reference	-----	BH112	BH112	BH113	BH113	BH113
Depth	-----	1.5	2	0.1	0.5	1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.0	8.0	8.1	8.3	8.1
pH _{Fox} (field peroxide test)*	pH Units	5.9	6.0	6.3	6.3	6.0
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-61	132766-62	132766-63	132766-64	132766-65
Your Reference	-----	BH113	BH113	BH114	BH114	BH114
Depth	-----	1.5	2	0.1	0.5	1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.3	8.0	8.4	8.1	8.2
pH _{Fox} (field peroxide test)*	pH Units	6.1	6.3	6.4	6.1	6.1
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	132766-66	132766-67	132766-68	132766-69	132766-70
Your Reference	-----	BH114	BH114	BH115	BH115	BH115
Depth	-----	1.5	2	0.1	0.5	1
Date Sampled		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
pH _F (field pH test)*	pH Units	8.0	7.9	8.0	8.6	8.8
pH _{Fox} (field peroxide test)*	pH Units	6.2	6.6	6.4	6.6	6.8
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-71	132766-72	132766-73	132766-74	132766-75
Our Reference:	-----	BH115	BH115	BH116	BH116	BH116
Your Reference	-----	1.5	2	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	9.1	8.4	8.6	8.6	8.4
pH _{Fox} (field peroxide test)*	pH Units	6.8	6.6	6.4	6.4	6.1
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-76	132766-77	132766-78	132766-79	132766-80
Our Reference:	-----	BH116	BH117	BH117	BH117	BH117
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	7.8	8.3	8.6	8.3	8.3
pH _{Fox} (field peroxide test)*	pH Units	5.8	6.5	6.7	6.2	6.9
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-81	132766-82	132766-83	132766-84	132766-85
Our Reference:	-----	BH117	BH118	BH118	BH118	BH118
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.4	7.8	8.2	8.4	8.6
pH _{Fox} (field peroxide test)*	pH Units	6.6	6.4	6.6	6.2	6.3
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-86	132766-87	132766-88	132766-89	132766-90
Our Reference:	-----	BH118	BH119	BH119	BH119	BH119
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.2	8.0	8.3	8.1	8.1
pH _{Fox} (field peroxide test)*	pH Units	6.2	6.4	6.3	6.1	5.5
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-91	132766-92	132766-93	132766-94	132766-95
Our Reference:	-----	BH119	BH120	BH120	BH120	BH120
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	7.7	8.4	8.5	8.6	8.5
pH _{Fox} (field peroxide test)*	pH Units	5.9	6.6	7.0	6.6	6.3
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-96	132766-97	132766-98	132766-99	132766-100
Our Reference:	-----	BH120	BH121	BH121	BH121	BH121
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	8.0	8.3	8.2	8.1	8.1
pH _{Fox} (field peroxide test)*	pH Units	6.3	6.5	6.3	6.1	6.2
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-101	132766-102	132766-103	132766-104	132766-105
Our Reference:	-----	BH121	BH122	BH122	BH122	BH122
Your Reference	-----	2	0.1	0.5	1	1.5
Depth		12/08/2015	12/08/2015	12/08/2015	12/08/2015	12/08/2015
Date Sampled		Soil	Soil	Soil	Soil	Soil
Type of sample						
pH _F (field pH test)*	pH Units	7.7	8.0	8.0	8.5	8.5
pH _{Fox} (field peroxide test)*	pH Units	6.0	6.3	5.9	6.5	6.3
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test	UNITS	132766-106
Our Reference:	-----	BH122
Your Reference	-----	2
Depth		12/08/2015
Date Sampled		Soil
Type of sample		
pH _F (field pH test)*	pH Units	8.2
pH _{Fox} (field peroxide test)*	pH Units	6.1
Reaction Rate*	-	Slight

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
 Asbestos was authorised by Approved Signatory: Not applicable for this job

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

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.

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: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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.

CERTIFICATE OF ANALYSIS

132766-A

Client:

Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Matt West, Ray Blinman

Sample log in details:

Your Reference:	<u>84677.01, Kurnell</u>
No. of samples:	106 soils
Date samples received / completed instructions received	14/08/15 / 26/08/15

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	1/09/15 / 1/09/15
Date of Preliminary Report:	Not Issued

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

Results Approved By:



Jacinta Hurst
Laboratory Manager

sPOCAS Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ----- -----	132766-A-4 BH101 2 12/08/2015 Soil	132766-A-18 BH104 1.5 12/08/2015 Soil	132766-A-22 BH105 1 12/08/2015 Soil	132766-A-30 BH107 1 12/08/2015 Soil	132766-A-35 BH108 1 12/08/2015 Soil
Date prepared	-	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015
Date analysed	-	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015
pH _{kd}	pH units	7.6	9.4	6.0	6.6	6.6
TAA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
pH _α	pH units	4.6	7.2	4.9	5.3	5.6
TPA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TSA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
ANCE	% CaCO ₃	<0.05	0.47	<0.05	<0.05	<0.05
a-ANCE	moles H ⁺ /t	<5	95	<5	<5	<5
s-ANCE	%w/w S	<0.05	0.15	<0.05	<0.05	<0.05
SKCl	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
SP	%w/w	0.02	<0.005	<0.005	<0.005	<0.005
SPOS	%w/w	0.01	<0.005	<0.005	<0.005	<0.005
a-SPOS	moles H ⁺ /t	9	<5	<5	<5	<5
CaKCl	%w/w	0.11	0.07	0.01	0.03	0.02
CaP	%w/w	0.14	0.17	0.02	0.04	0.02
CaA	%w/w	0.024	0.10	<0.005	0.006	<0.005
MgKCl	%w/w	0.005	<0.005	<0.005	<0.005	<0.005
MgP	%w/w	<0.005	0.006	<0.005	<0.005	<0.005
MgA	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
Fineness Factor	-	1.5	1.5	1.5	1.5	1.5
a-Net Acidity	moles H ⁺ /t	<10	<10	<10	<10	<10
Liming rate	kg CaCO ₃ /t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H ⁺ /t	NA	<10	NA	NA	NA
Liming rate without ANCE	kg CaCO ₃ /t	NA	<0.75	NA	NA	NA

sPOCAS Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ----- -----	132766-A-56 BH112 1.5 12/08/2015 Soil	132766-A-60 BH113 1 12/08/2015 Soil	132766-A-65 BH114 1 12/08/2015 Soil	132766-A-75 BH116 1.5 12/08/2015 Soil	132766-A-99 BH121 1 12/08/2015 Soil
Date prepared	-	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015
Date analysed	-	31/08/2015	31/08/2015	31/08/2015	31/08/2015	31/08/2015
pH _{KCl}	pH units	6.6	6.5	7.5	7.2	7.3
TAA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
pH _{Ca}	pH units	5.7	5.6	6.0	5.7	5.7
TPA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TPA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TSA pH 6.5	moles H ⁺ /t	<5	<5	<5	<5	<5
s-TSA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
ANCE	% CaCO ₃	<0.05	<0.05	<0.05	<0.05	<0.05
a-ANCE	moles H ⁺ /t	<5	<5	<5	<5	<5
s-ANCE	%w/w S	<0.05	<0.05	<0.05	<0.05	<0.05
SKCl	%w/w S	<0.005	<0.005	<0.005	<0.005	<0.005
SP	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
SPOS	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
a-SPOS	moles H ⁺ /t	<5	<5	<5	<5	<5
CaKCl	%w/w	0.008	0.008	0.05	0.03	0.04
CaP	%w/w	0.008	0.009	0.06	0.05	0.05
CaA	%w/w	<0.005	<0.005	0.014	0.014	0.010
MgKCl	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
MgP	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
MgA	%w/w	<0.005	<0.005	<0.005	<0.005	<0.005
Fineness Factor	-	1.5	1.5	1.5	1.5	1.5
a-Net Acidity	moles H ⁺ /t	<10	<10	<10	<10	<10
Liming rate	kg CaCO ₃ /t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H ⁺ /t	NA	NA	NA	NA	NA
Liming rate without ANCE	kg CaCO ₃ /t	NA	NA	NA	NA	NA

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.

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
sPOCAS						Base Duplicate %RPD		
Date prepared	-			31/08/2015	132766-A-4	31/08/2015 31/08/2015	LCS-1	31/08/2015
Date analysed	-			31/08/2015	132766-A-4	31/08/2015 31/08/2015	LCS-1	31/08/2015
pH _{kcl}	pH units		Inorg-064	[NT]	132766-A-4	7.6 7.7 RPD: 1	LCS-1	93%
TAA pH 6.5	moles H ⁺ /t	5	Inorg-064	<5	132766-A-4	<5 <5	LCS-1	97%
s-TAA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	132766-A-4	<0.01 <0.01	[NR]	[NR]
pH _α	pH units		Inorg-064	[NT]	132766-A-4	4.6 4.7 RPD: 2	LCS-1	104%
TPA pH 6.5	moles H ⁺ /t	5	Inorg-064	<5	132766-A-4	<5 <5	LCS-1	90%
s-TPA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	132766-A-4	<0.01 <0.01	[NR]	[NR]
TSA pH 6.5	moles H ⁺ /t	5	Inorg-064	<5	132766-A-4	<5 <5	LCS-1	89%
s-TSA pH 6.5	%w/w S	0.01	Inorg-064	<0.01	132766-A-4	<0.01 <0.01	[NR]	[NR]
ANCE	% CaCO ₃	0.05	Inorg-064	<0.05	132766-A-4	<0.05 <0.05	[NR]	[NR]
a-ANCE	moles H ⁺ /t	5	Inorg-064	<5	132766-A-4	<5 <5	[NR]	[NR]
s-ANCE	%w/w S	0.05	Inorg-064	<0.05	132766-A-4	<0.05 <0.05	[NR]	[NR]
SKCl	%w/w S	0.005	Inorg-064	<0.005	132766-A-4	<0.005 <0.005	LCS-1	111%
SP	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.02 0.02 RPD: 0	LCS-1	91%
SPOS	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.01 0.01 RPD: 0	LCS-1	86%
a-SPOS	moles H ⁺ /t	5	Inorg-064	<5	132766-A-4	9 9 RPD: 0	LCS-1	86%
Ca _{KCl}	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.11 0.09 RPD: 20	LCS-1	99%
Ca _P	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.14 0.13 RPD: 7	[NR]	[NR]
Ca _A	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.024 0.038 RPD: 45	[NR]	[NR]
Mg _{KCl}	%w/w	0.005	Inorg-064	<0.005	132766-A-4	0.005 <0.005	LCS-1	103%
Mg _P	%w/w	0.005	Inorg-064	<0.005	132766-A-4	<0.005 <0.005	[NR]	[NR]
Mg _A	%w/w	0.005	Inorg-064	<0.005	132766-A-4	<0.005 <0.005	[NR]	[NR]
SHCl	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
SNAS	%w/w S	0.005	Inorg-064	<0.005	[NT]	[NT]	[NR]	[NR]
a-SNAS	moles H ⁺ /t	5	Inorg-064	<5	[NT]	[NT]	[NR]	[NR]
s-SNAS	%w/w S	0.01	Inorg-064	<0.01	[NT]	[NT]	[NR]	[NR]
Fineness Factor	-	1.5	Inorg-064	<1.5	132766-A-4	1.5 1.5 RPD: 0	[NR]	[NR]
a-Net Acidity	moles H ⁺ /t	10	Inorg-064	<10	132766-A-4	<10 <10	LCS-1	86%
Liming rate	kg CaCO ₃ /t	0.75	Inorg-064	<0.75	132766-A-4	<0.75 <0.75	LCS-1	86%

Client Reference: 84677.01, Kurnell

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
sPOCAS						Base II Duplicate II %RPD		
a-Net Acidity without ANCE	moles H ⁺ /t	10	Inorg-064	<10	132766-A-4	NA NA	[NR]	[NR]
Liming rate without ANCE	kg CaCO ₃ /t	0.75	Inorg-064	<0.75	132766-A-4	NA NA	[NR]	[NR]

Report Comments:

Asbestos ID was analysed by Approved Identifier:
Asbestos ID was authorised by Approved Signatory:

Not applicable for this job
Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
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Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

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