

APPENDIX G

Geotechnical Assessment, Coffey Geotechnics Pty Ltd, June 2010

**PROPOSED INDUSTRIAL BUILDINGS
MASONITE ROAD, HEATHERBRAE
GEOTECHNICAL ASSESSMENT**

Sandvik Mining And Construction Pty Ltd

GEOTWARA21359AA-AA
22 June 2010

22 June 2010

Sandvik Mining And Construction Pty Ltd
C/- Geoff Craig and Associates Pty Ltd
PO Box 595
RAYMOND TERRACE NSW 2324

Attention: Ian Hill

Dear Ian

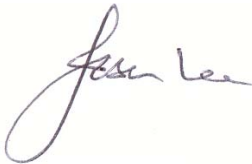
**RE: PROPOSED INDUSTRIAL BUILDINGS
431 MASONITE ROAD, HEATHERBRAE
GEOTECHNICAL ASSESSMENT**

Please find enclosed our report on the above project.

Further advice on the uses and limitations of this report is presented in the attached document,
'Important Information about your Coffey Report'.

If you have any questions regarding this or any other project, please contact Andrew Tait or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd.



Jason Lee

Principal Newcastle Manager

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1 INTRODUCTION

This report presents the results of a geotechnical assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) on behalf of Sandvik Mining and Construction Pty Ltd for a proposed industrial buildings located within at 431 Masonite Road, Heatherbrae.

The work was commissioned by Ian Hill of Geoff Craig and Associates Pty Ltd, in an email dated 21 March 2010.

The scope of work for the geotechnical assessment included providing recommendations on:

- Site preparation and earthworks;
- Foundation recommendations;
- Retaining wall (up to 2m height) design parameters;
- Trafficability of the site during excavation and construction;
- The suitability of site soils for reuse as engineered fill;
- Infiltration rates;
- Acid sulphate soil conditions and requirements for an acid sulphate soil management plan.

A survey plan of the site and an existing site layout plan marked up with the approximate development areas were provided by the client.

2 FIELD WORK

Field work was carried out from 9 to 15 June 2009 and comprised of:

- Boreholes at 39 locations (BH200 to BH239, excluding BH230) using hand auger methods depths of between 2m to 3m. Disturbed samples of representative materials were taken for subsequent laboratory testing from;
- Dynamic Penetrometer (DCP) testing at was undertaken at each borehole location to assess the in situ density of the sand profile;
- Two Double Ring infiltration tests to assess the permeability of the sands at each of the detention basin locations.

All field work was carried out in the full time presence of an Engineering Geologist from Coffey who located the borehole locations, carried out the sampling and testing and produced engineering logs of the boreholes. DCP results and engineering logs of the boreholes are presented in Appendix A, together with explanation sheets defining the terms and symbols used in their preparation. Borehole locations were located and pegged by survey prior to fieldwork. Borehole locations are shown on Figure AB1. Reduced levels of the boreholes have been taken from the survey data provided to Australian Height Datum (AHD) and are shown on the engineering logs.

3 SITE CONDITIONS

3.1 Surface Conditions

The proposed building area is located directly to the west of Masonite Road, Heatherbrae. The site is currently not occupied and is covered by coastal eucalyptus woodland, with a small area in the north eastern corner that appears to have been used for stockpiling of garden mulch in the past and is currently cover by numerous tall pines, large stands of lantana, medium sized trees and shrubs, tall weeds and grass.

Topographically the site is located on a sand plain with some small dunes to the south of the site. The site is flat to slightly sloping to the south.

Drainage appears to be by direct infiltration into the sandy soils with no evidence of overland flow across any part of the site.

There are currently two small wooden structures located in the north eastern portion of the site in a very poor condition, with evidence of one other structure that has completely collapsed due to neglect.

3.2 Subsurface Conditions

Reference to the 1:100,000 scale Newcastle Coalfield Regional Geological Series Sheet 9231 indicates the site is underlain by Quaternary aged deposits comprising sand associated with the Tomago Sand Beds an inner barrier dunal system.

The subsurface profiles encountered at borehole locations are presented on the appended engineering logs and have been divided into geotechnical units as summarised in Table 1.

TABLE 1 – SUMMARY OF GEOTECHNICAL UNITS AND SOIL TYPES ENCOUNTERED AT BOREHOLE LOCATIONS

GEOTECHNICAL UNIT	MATERIAL TYPE	DESCRIPTION	TYPICAL DEPTH RANGE (m)
UNIT 1	TOPSOIL*	SAND, fine to medium grained, dark grey brown to dark brown, dry to moist, typically loose.	0.00 – 0.30
UNIT 2A	AEOLIAN	SAND, fine to medium grained, pale grey, pale brown, moist, typically medium dense.	0.30 – 0.90
UNIT 2B	INDURATED SAND	SAND, fine to medium grained, orange to orange brown, moist, typically dense.	0.90 – 2.00
UNIT 2C	AEOLIAN	SAND, fine to medium grained, pale yellow to white, moist, typically dense to very dense.	Below 2.00
NOTE: * = Some areas in the north eastern corner of the site may contain fill, refer to engineering logs.			

Groundwater was encountered at a depth of 1.0m at location BH 202 during the field investigation. This was the only location that ground water was encountered.

4 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on the above information, foundation soils are expected to comprise loose to medium dense layers to depths of between 0.0m to 2.7m. Options for founding load-bearing structures are therefore as follows:

- Option 1 - Support of load-bearing settlement sensitive structures on pile foundations founded beneath any proposed or existing fill, topsoil and loose to medium dense an variable density layers;
- Option 2 - Removal of all existing fill and topsoil from proposed building areas proof rolled and compact stripped surface with a large vibrating roller or impact roller followed by replacement with approved fill under 'Level 1' earthworks control, as defined in AS3798 – 2007 '*Guidelines on Earthworks for Commercial and Residential Developments*' and support of load-bearing structures on shallow footings. This option is only feasible provided a minimum combined cover depth of 2.0m of sand fill compacted to a minimum Density Index of 70% (AS1289 5.6.1-1998) and dense natural sand below footing level to the top of any loose to medium dense and variable density layers can be achieved.

4.2 Site Preparation

Site preparation and earthworks suitable for structure support should consist of:

- Proposed building areas should be stripped to remove all vegetation, root affected, topsoil and existing fill to a depth to be determined by the foundation / site preparation option that is adopted;
- Following stripping, the exposed subgrade materials should be proof rolled with a large vibrating (20t) roller or impact roller to densify the existing loose to medium dense sand and to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved select material;
- Approved sand fill beneath structures should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum density index of 70% (AS1289 5.6.1);
- All fill should be battered at 1V:2H or flatter and protected against erosion or else supported by properly designed and constructed retaining walls;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007.

4.3 Excavation Conditions

It is expected that all site materials could be excavated by conventional bulldozer blade or excavator bucket at least to the depths indicated on the appended borehole logs and DCP test results. The excavator should use a 'gummy' bucket to avoid over-disturbance of the sands below the depth of excavation.

Due to the sandy nature of site soils, temporary excavations greater than 1m depth should be battered at 1V:2H or supported by a suitable shoring system such as driven sheet piles. Minimum sheet pile wall embedment depths, maximum bending moments and anchor forces may be determined in accordance with the British Steel and Piling Handbook, Seventh Edition, 1997.

Temporary shoring should be designed for surcharge loading from structures or slopes behind the walls. Excavations below the water table will also require dewatering.

Due to the sandy nature of site soils, temporary shallow excavations such as those for footing trenches could also experience some instability and may require some form of temporary support.

4.4 Foundations

4.4.1 Pile Footings

Suitable pile options include grout injected piles, 'Atlas' screw piles, driven piles or steel screw piles. Large heavily driven piles are not recommended due to the potential effect of vibration on neighbouring structures. Conventional bored piles are not recommended due to the potential for collapse of the wet sands.

Piles founded into dense to very dense Unit 2 sands may be designed for the Ultimate Geotechnical Strength parameters provided in Table 2.

TABLE 2 – ULTIMATE GEOTECHNICAL STRENGTH PARAMETERS

FOUNDING MATERIAL	ULTIMATE END BEARING PRESSURE ¹ (kPa)		ULTIMATE SHAFT RESISTANCE (kPa)	
	Non-Displacement Piles (i.e. Grout injected or steel screw piles)	Displacement Piles (i.e. 'Atlas' screw or driven piles)	Non-Displacement Piles (i.e. Grout injected or steel screw piles)	Displacement Piles (i.e. 'Atlas' screw or driven piles)
UNIT 2 (variable density to 2.7m depth)	1,600	3,000	16 ²	35
UNIT 2 (dense to very dense below 2.7m depth)	5,500	10,000	45 ²	85
NOTES: 1 – Ultimate values occur at large settlements (>5% of pile diameter). 2 - No shaft resistance to be allowed for in design using steel screw piles.				

A geotechnical reduction factor of 0.45 should be applied to ultimate capacities to obtain limit state design parameters. It is anticipated that serviceability end bearing pressures will cause settlement of 1% of pile diameter.

The capacity of piles driven to a refusal set may be evaluated by the Hiley pile driving formulae once the pile capacity and hammer size and type are known. Depth to the required set will be dependent on required capacity and size of piles and would be best evaluated by driving test piles.

4.4.2 Shallow Footings

Proposed structural elements may be founded on shallow footings, provided a minimum combined cover depth of 2.0m of sand fill compacted to a minimum Density Index of 70% (AS1289 5.6.1-1998) and dense natural sand below footing level to the top of any loose to medium dense and variable density layers can be achieved.

Shallow footings founded as described above may be proportioned for a maximum allowable bearing pressure of 150kPa. It is anticipated that this bearing pressure will cause a maximum settlement of 25mm.

4.5 Retaining Wall Design Parameters

Recommended design parameters for permanent retaining walls are summarised in Table 6.

TABLE 3 – SUMMARY OF RETAINING WALL DESIGN PARAMETERS

GEOTECHNICAL UNIT	PARAMETER			
	UNIT WEIGHT (γ kN/m ³)	EFFECTIVE FRICTION ANGLE (ϕ'°)	ACTIVE EARTH PRESSURE COEFFICIENT (K_a)	PASSIVE EARTH PRESSURE COEFFICIENT (K_p)
UNIT 2 (Aeolian and Indurated)	21	34	0.28	3.5

The pressure distribution assumed for retaining walls should take into account the amount of movement that can occur. The earth pressure coefficients provided in Table 3 will typically result in movements of about 1% of the wall height. If movements are to be restrained by struts or anchors a higher earth pressure coefficient should be adopted.

Retaining walls should be designed for hydrostatic water pressures unless effective drainage is provided or the ground dewatered behind the walls. The above parameters make no allowance for surcharge loading from existing or proposed slopes or structures.

4.6 Trafficability During Construction

The subsoil profile encountered within the proposed terminal building area comprised either sand fill or aeolian sand. Construction equipment should be chosen with this in mind. Trafficability for quarry trucks on exposed sands is likely to be a problem and provision for a construction platform should be made to allow such trucks to access the site.

4.7 Reuse as Site Soils

All site soils excluding the upper root affect zone of vegetated areas, which is expected to a maximum depth of about 0.4m, and some deeper possible topsoil layers are considered suitable for re-use as controlled fill beneath structures.

4.8 Depth to Groundwater

The depth at which the water table was encountered at borehole locations is shown on the appended borehole logs. Groundwater inflows are likely to occur where excavations proceed below these depths. Such inflows are likely to cause collapse of unsupported excavations and construction will require dewatering the area to be excavated using a speerpoint dewatering system, although indurated sand layers in the upper profile could make installation difficult.

The field work consisted of the cleaning and excavation of the site using a small excavator fitted with a gummy bucket followed by the infiltration test and finally the excavation of a test pit to determine subsurface profile beneath the area tested.

5 INFILTRATION ASSESSMENT

The infiltration tests were carried out generally in accordance with the procedure prepared by Coffey and approved by Council. The procedure essentially follows the test procedure ASTM D3385 - Infiltration Rate of Soils Using Double Ring Infiltrometer. A copy of the procedure and reference is included in Appendix C. The procedure also follows the essential elements of the Draft Infiltration Rate Procedure prepared by Port Stephens Council in regard to pre-wetting and extending the testing period to obtain a consistent result.

5.1 Results of Testing

A summary of the results of the infiltration and permeability testing is presented in Table 4 below:

TABLE 4 – SUMMARY OF INFILTRATION TEST RESULTS

TEST LOCATION	TEST TYPE	TIME TEST (min)	RESULT m/day	COMMENTS
BH 203	DRI	70	51	Topsoil removed.
BH234	DRI	90	51	Topsoil removed.

5.2 Conclusion and Recommendations

5.2.1 General

The double ring infiltrometer measures the vertical permeability of the soil below the testing apparatus and in the absence of a clogging layer or some artificial reconstruction the permeability will be roughly equal to the infiltration rate.

The infiltration rate will vary depending on the presence of a clogging layer, the height of water above the clogging layer and the thickness and permeability of the clogging layer. Providing the permeability of the underlying sand aquifer is higher than that of the clogging layer the actual permeability of the sand aquifer is almost irrelevant to the infiltration rate of the clogged soil profile.

There is virtually no benefit from extensive detailed testing of the permeability of the sand deposit. Extending the testing to refine the estimate of permeability beyond a 90% degree of confidence is a waste of resources.

It is more important to provide a realistic assessment of the permeability of the clogging layer that may develop on the surface of the soils in the infiltration area.

The SAND is unquestionably very permeable and this will not change with time. The clogging is a surface phenomenon only. The surface soils will be subject to clogging and the infiltration will be reduced with time as the clogging layer develops. Further discussion of the clogging is presented in Section 5.2.2 below.

Infiltration testing was conducted on sands of the same formation directly to the south of the site and these results have been reviewed to aid in the assessment of the infiltration rate for this site.

5.2.2 Infiltration Rates of Materials without Clogging

The testing has indicated the following general conclusions:

- Dune SAND unaffected by topsoil or induration has an infiltration rate or permeability of 30m/day to 65m/day. A lower bound design number of 30m/day would appear reasonable;
- Dune SAND with the natural topsoil present has an infiltration rate of 12m/day to 40m/day depending on the fines content in the sand. A lower bound design number of 12m/day would be a reasonable assumption;
- Dune SAND with some induration present has an infiltration rate of 6m/day to 40m/day depending on the degree of induration and the continuity of the indurated layer. A lower bound design number for indurated SAND of 6m/day would be a reasonable assumption;
- Recompacted SAND compacted to a density index of 70% and 75% had a laboratory permeability ranging from 9m/day to 36m/day indicating that the permeability of the compacted SAND is lower but not affected in a major way. A lower bound design number of 9m/day would be a reasonable assumption for re-compacted material.

5.2.3 Infiltration Rates with Clogging

The permeability of the various materials in the local area has been established with a reasonable degree of confidence. The infiltration capacity of the materials is highly dependent on the permeability of the immediate surface soils which are decreased by deposition of fines to form a clogging layer. The clogging layer consists of fine silt and debris eroded from elsewhere on site to accumulate in the low portions of the site and infiltration areas. The assessment of the permeability (and hence effective infiltration rate) of this clogging layer is far more important than the permeability of the deeper sands. If the permeability of the clogging layer is less than that of the deeper soils then no perched water table that could affect the surface infiltration will form and the deeper soils will remain unsaturated down to the water table.

The aquifer on this site is over 30m deep and thus even prolonged wet weather results in only minor variations in groundwater levels. In general stormwater infiltration will not have a significant effect on regional groundwater levels.

The permeability of the clogging layer may or may not have a relation with the permeability of the underlying SAND depending on the origin of the fines forming the clogging layer. If the clay soils are present in the catchment then the clogging layer could have a very low permeability. A major highway produces runoff with a high proportion of rubber fines, oils, greases and dust which has a lower permeability.

Fortunately the catchment area consists of SAND dunes with no major highway present within the subdivision area itself.

The permeability (and therefore the infiltration rate) of the clogging layer is also dependent on the pre-treatment of the water prior to its entry into the infiltration area.

The permeability of the clogging layer is also dependent on the treatment of the infiltration area. The provision of a turfed surface consisting of imported clay soil base attached to the turf may result in a drastic reduction in infiltration rate. Conversely a vigorous growing turf that grows faster than the deposition rate may maintain a high infiltration rate by providing permeability paths through the root penetration of the clogging layer.

The tests in the local area indicate that the natural topsoil even when replaced has a permeability of about 12m/day. This was about the lower bound of the infiltration rate in the excavated and topsoiled drains in the area. The extent that the permeability of the clogging layer will decrease with time is a matter of judgement.

For the catchment area consisting of sand, with no major inputs of fines, the permeability of the clogging layer should be somewhere near the permeability of the soil with topsoil or turf in place with some allowance for further clogging.

Applying a clogging factor of 2 to the permeability of topsoil or turfed layer to future clogging gives a design infiltration rate of 6m/day.

5.2.4 Establishment and Maintenance of Infiltration Capacity

The establishment of an infiltration area should include the excavation of any indurated sand layers within 1.5m of the base of the area and replacement with clean sand from elsewhere on site. Although the indurated sand tested had a reasonable permeability of 6m/day it is thought that some of the indurated layers may have a lower permeability. The indurated layers, particularly in such sand dune areas, are known to be highly variable with large changes in vertical permeability over small distances. Thus to ensure that the infiltration rate is obtained in the critical infiltration areas it is considered prudent to replace the indurated material with clean sand. Provided there is 1.5m of clean sand below infiltration areas it is assessed that the infiltration capacity will not be affected.

Maintenance of the infiltration capacity will depend on the development or otherwise of a clogging layer. This in turn depends on the activities in the catchment areas that result in the generation of fines. If the natural soils are the main contributors to the fines then the infiltration should remain at a reasonable level. The presence of grass or tree roots penetrating the clogging will assist in maintaining a reasonable permeability but the build up may eventually require removal of the clogging layer.

5.3 Design Infiltration Rate

Based on the discussions above the recommended design infiltration rate is 6m / day which takes into account clogging of the surface soils.

6 ACID SULPHATE SOILS (ASS) ASSESSMENT

6.1 Acid Sulphate Soils Risk Map

Reference to the Acid Sulfate Soils Risk Map for Beresfield indicates that the site is located in an area where there is a low probability of occurrence of acid sulfate soil materials greater than 3m below the ground surface.

6.2 Laboratory Testing

21 samples obtained during the field investigation were screened for the presence of actual and potential acid sulfate soils using methods 21Af and 21Bf of the 1998 ASSMAC Guidelines. The results of screening tests are presented in Appendix B and are summarised below:

- pH values in 1:5 soil to distilled water mix ranged from 5.09 to 6.35. A pH of <4 in this test can indicate the presence of actual ASS;
- pH values of soil in 30% H₂O₂ were between 3.98 to 4.85. A pH of <3 in this test can indicate the presence of potential ASS;
- A maximum pH change of 1.83 after oxidation with H₂O₂ was recorded. Significant pH changes (>2) after oxidation with H₂O₂ can indicate potential ASS;
- Slight effervescence was observed during oxidation with H₂O₂ in six of the 21 samples tested. Vigorous effervescent reactions with oxidation in H₂O₂ can indicate potential ASS;
- No odour was released upon oxidation with H₂O₂ in all samples tested. A sulphurous odour is often associated with oxidising potential ASS;
- Temperatures of 18°C to 21°C were recorded for all H₂O₂ oxidation screening tests. Generally the oxidation of significant quantities of pyrite in this test will generate temperatures to >60°C.

Based on the results of screening tests, one sample from BH T8 was sent to Southern Cross University for SPOCAS analysis. The result of SPOCAS analysis is presented in Appendix B and indicates the sample tested is not an actual or potential acid sulfate soil.

6.3 Interpretation of Results

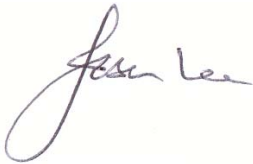
The results of ASS screening tests indicate all of the samples tested are not actual or potential ASS. In addition, sandy soils above the water table would be considered oxidised and therefore not potentially ASS. Therefore an ASS management plan for works involving disturbance of site soils to the depth of investigation is not considered to be necessary.

7 CONSTRUCTION RISK

The extent of testing associated with this assessment is limited to discrete test locations and variations in ground conditions can occur between and away from such locations. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought without delay.

Further advice on the uses and limitations of this report is presented in the attached document, *'Important Information about your Coffey Report'*.

For and on behalf of Coffey Geotechnics Pty Ltd

A handwritten signature in dark ink, appearing to read 'Jason Lee', is written over a faint yellow rectangular background.

Jason Lee

Principal Newcastle Manager

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by

earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures

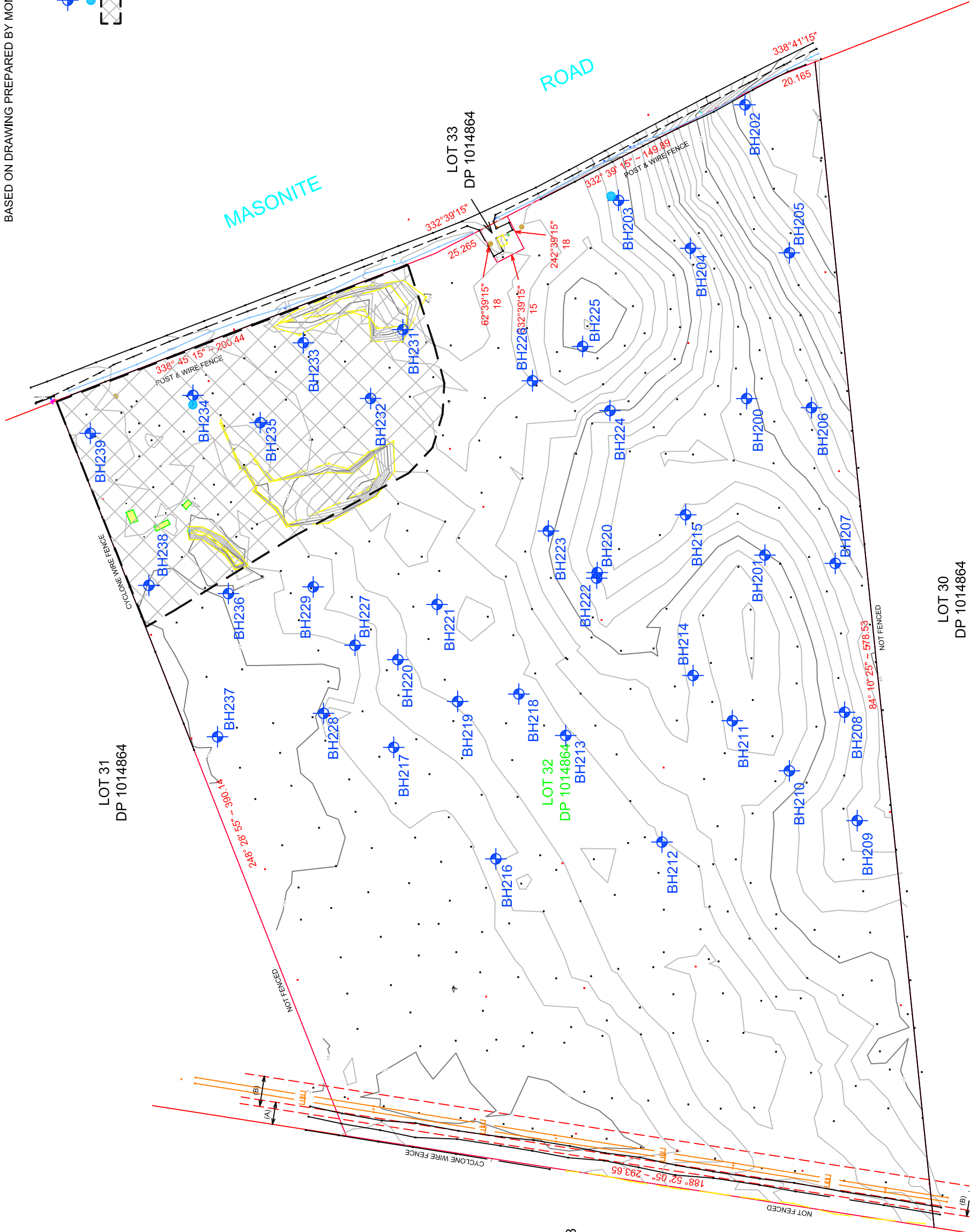


LEGEND

BOREHOLE AND DCP TEST LOCATION

INFILTRATION

APPROXIMATE EXTENT OF FILL



LOT 30
DP 1014864

revision		description		drawn	approved	date	 Scale (metres)				 SPECIALISTS MANAGING THE EARTH				client: SANDVIK MINING AND CONSTRUCTION	
							drawn	NLS					project: PROPOSED INDUSTRIAL BUILDINGS 431 MASONITE ROAD, HEATHERBRAE GEOTECHNICAL ASSESSMENT			
							date	22-06-10					title: TEST LOCATION PLAN			
							scale	1:2000					project no: GEOTWARA21359AA	figure no: AB1		

Appendix A

Results of Field Investigations

Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 μ m to 2.36 mm
	medium	200 μ m to 600 μ m
	fine	75 μ m to 200 μ m

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH S_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING	CEMENTING
Layers Continuous across exposure or sample.	Weakly cemented Easily broken up by hand in air or water.
Lenses Discontinuous layers of lenticular shape.	Moderately cemented Effort is required to break up the soil by hand in air or water.
Pockets Irregular inclusions of different material.	

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material Structure and fabric of parent rock visible.

Residual soil Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil Deposited by wind.

Alluvial soil Deposited by streams and rivers.

Colluvial soil Deposited on slopes (transported downslope by gravity).

Fill Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.

Lacustrine soil Deposited by lakes.

Marine soil Deposited in ocean basins, bays, beaches and estuaries.

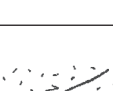
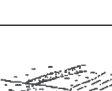
Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)					USC	PRIMARY NAME	
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	GRAVEL	
			Predominantly one size or a range of sizes with more intermediate sizes missing.		GP	GRAVEL	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		GM	SILTY GRAVEL	
			Plastic fines (for identification procedures see CL below)		GC	CLAYEY GRAVEL	
	SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes		SW	SAND	
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	SAND	
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	SILTY SAND	
			Plastic fines (for identification procedures see CL below).		SC	CLAYEY SAND	
	FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm	SILTS & CLAYS Liquid limit less than 50	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.				
			DRY STRENGTH	DILATANCY	TOUGHNESS		
None to Low			Quick to slow	None	ML	SILT	
Medium to High			None	Medium	CL	CLAY	
SILTS & CLAYS Liquid limit greater than 50		Low to medium	Slow to very slow	Low	OL	ORGANIC SILT	
		Low to medium	Slow to very slow	Low to medium	MH	SILT	
		High	None	High	CH	CLAY	
		Medium to High	None	Low to medium	OH	ORGANIC CLAY	
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.			Pt	PEAT		
• Low plasticity – Liquid Limit W _L less than 35%. • Medium plasticity – W _L between 35% and 50%.							

• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM	TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.		SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.		TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.		TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.		INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.

Defect Discontinuity or break in the continuity of a substance or substances.

Mass Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME Simple rock names are used rather than precise geological classification.

PARTICLE SIZE Grain size terms for sandstone are:
Coarse grained Mainly 0.6mm to 2mm
Medium grained Mainly 0.2mm to 0.6mm
Fine grained Mainly 0.06mm (just visible) to 0.2mm

FABRIC Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:

Massive No layering or penetrative fabric.

Indistinct Layering or fabric just visible. Little effect on properties.

Distinct Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	RS	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	XW	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	HW	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	MW	The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	SW	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	FR	Rock substance unaffected by weathering.

Notes on Weathering:

- AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
- Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

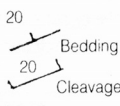
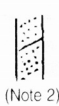
ROCK SUBSTANCE STRENGTH TERMS

Term	Abbreviation	Point Load Index, I_{s50} (MPa)	Field Guide
Very Low	VL	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	EH	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

- In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
- The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
- The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index (I_{s50}). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES		Diagram	Map Symbol	Graphic Log (Note 1)	DEFECT SHAPE	TERMS
Term	Definition				Planar	The defect does not vary in orientation
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.				Curved	The defect has a gradual change in orientation
					Undulating	The defect has a wavy surface
					Stepped	The defect has one or more well defined steps
Joint	A surface or crack across which the rock has little or no tensile strength, but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.				Irregular	The defect has many sharp changes of orientation
					Note: The assessment of defect shape is partly influenced by the scale of the observation.	
					ROUGHNESS TERMS	
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.				Slickensided	Grooved or striated surface, usually polished
					Polished	Shiny smooth surface
					Smooth	Smooth to touch. Few or no surface irregularities
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.				Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
					Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.
					COATING TERMS	
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.				Clean	No visible coating
					Stained	No visible coating but surfaces are discoloured
					Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.				Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.
					BLOCK SHAPE TERMS	
					Blocky	Approximately equidimensional
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formed by weathering of the rock substance in place.				Tabular	Thickness much less than length or width
					Columnar	Height much greater than cross section
					Notes on Defects:	
		1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.				
		2. Partings and joints are not usually shown on the graphic log unless considered significant.				
		3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.				

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 200**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger Easting: 382013 slope: -90° R.L. Surface: 6.1
hole diameter: 82 mm Northing 6371590 bearing: datum: m AHD

drilling information						material substance																			
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrom- eter kPa	meter	structure and additional observations									
	1	2	3																						
HA				N			6.0			SP	SAND: fine to medium grained, pale grey to grey, trace of fines. Becomes orange	D	L												
							0.5					M													
							5.5																		
							1.0																		
							5.0																		
							1.5						MD												
							4.5																		
							2.0				Becomes pale yellow to white														
							4.0																		
							2.5																		
							3.5																		
							3.0						D												
					E		3.0				Borehole BH 200 terminated at 3m														
							3.0																		
							3.5																		
							2.5																		
							4.0																		
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT						support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow					notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal					classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit					consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense				

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 201**

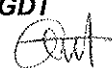
Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger		Easting: 381934		slope: -90°		R.L. Surface: 7.0	
hole diameter: 82 mm		Northing: 6371581		bearing:		datum: m AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	material	structure and additional observations
HA		N				SAND: fine to medium grained, pale grey to pale orange, trace of fines.	
					0.5	Becomes orange	
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Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 202**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger Easting: 382157 slope: -90° R.L. Surface: Not Measured
hole diameter: 82 mm Northing 6371590 bearing: datum: m AHD

drilling information				material substance								
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
HA		N			0.5		SP	SAND: fine to medium grained, pale grey to pale brown, trace of fines.	M	L-MD		
			None Observed		1.0			Becoming wet, strong odour of rotten eggs.	W			
			E		1.5							
					2.0			Borehole BH 202 terminated at 1.5m				
					2.5							
					3.0							
					3.5							
					4.0							

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT dialtube

B blank bit

V V bit

T TC bit

*bit shown by suffix
e.g. ADT

support

M mud N nil

C casing

penetration
1 2 3 4

no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description
based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 203**

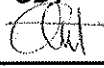
Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger Easting: 382111 slope: -90° R.L. Surface: 3.8
hole diameter: 82 mm Northing 6371653 bearing: datum: m AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HA		N						SP	SAND: fine to medium grained, grey, trace of fines. Becomes pale grey	M	L		
						3.5							
						0.5							
						3.0					MD-D		
						1.0			Becomes orange brown, slightly indurated				
						2.5							
						1.5							
						2.0							
						2.0							
									Borehole BH 203 terminated at 2m				
						1.5							
						2.5							
						1.0							
						3.0							
						0.5							
						3.5							
						0.0							
						4.0							

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT dialtube

B blank bit

V V bit

T TC bit

*bit shown by suffix e.g. ADT

support

M mud

C casing

penetration

1 2 3 4

 no resistance ranging to refusal

water

 10/1/98 water level on date shown

 water inflow

 water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 204**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

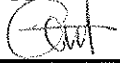
Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger Easting: 382087 slope: -90° R.L. Surface: 6.6
hole diameter: 82 mm Northing: 6371616 bearing: datum: m AHD

drilling information						material substance															
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa				structure and additional observations			
	1	2	3											100	200	300	400				
HA				N			6.5			SP	SAND: fine to medium grained, pale grey to grey, trace of fines.	M	L								
							0.5														
							6.0						MD								
							1.0														
							5.5														
							1.5														
					M		5.0				Becomes orange brown										
							2.0														
							4.5				Becomes pale yellow to white		D								
							2.5														
							4.0														
							3.0														
							3.5				Borehole BH 204 terminated at 3m										
							3.0														
							4.0														
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT						support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit				consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense			

Borehole No. **BH 205**
 Sheet 1 of 1
 Project No. **GEOTWARA21359AA**
 Date started: **10.6.2009**
 Date completed: **10.6.2009**
 Logged by: **GDT**
 Checked by: 

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**
 Principal:
 Project: **PROPOSED INDUSTRIAL SITE**
 Borehole Location: **MASONITE ROAD, HEATHERBRAE**

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
		N						SP	SAND: fine to medium grained, pale grey to grey, trace of fines.	M	L		
			None Observed		4.0	0.5							
				E	3.5	1.0			Becomes dark brown, indurated Becomes pale orange brown.		MD		COFFEE ROCK
					3.0	1.5							
					2.5	2.0			Becomes wet	W			
									Borehole BH 205 terminated at 2m				
					2.0	2.5							
					1.5	3.0							
					1.0	3.5							
					0.5	4.0							

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud	U ₅₀ undisturbed sample 50mm diameter	moisture D dry M moist W wet W _p plastic limit W _L liquid limit	VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore		N standard penetration test (SPT)		St stiff
CT cable tool		N* SPT - sample recovered		VSt very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT dialube		V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample		L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal		D dense
				VD very dense

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

BOREHOLE BH 200-238.GPJ COFFEY.GDT 23.6.10

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 207**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381932 slope: -90° R.L. Surface: 5.2
hole diameter: 82 mm Northing 6371550 bearing: datum: m AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
W	1	2	3	N						SP	SAND: fine to medium grained, pale orange brown to orange, trace of fines.	M	L	100 200 300 400	
					None Observed			5.0							
								0.5							
								4.5							
								1.0							
								4.0							
								1.5							
								3.5					MD		
								2.0							
					E										
								3.0			Borehole BH 207 terminated at 2.1m				
								2.5							
								2.5							
								3.0							
								2.0							
								3.5							
								1.5							
								4.0							

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₀ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore	penetration 1 2 3 4	N standard penetration test (SPT)		St stiff
CT cable tool		N* SPT - sample recovered		VS _t very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT dialube		V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample		L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal		D dense
			moisture	VD very dense
			D dry	
			M moist	
			W wet	
			W _p plastic limit	
			W _L liquid limit	

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Form GEO 5.3 Issue 3 Rev.2

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 210**

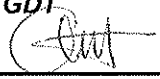
Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger Easting: 381827 slope: -90° R.L. Surface: 7.2
hole diameter: 82 mm Northing 6371569 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400		
HA		N	None Observed		7.0			SP	SAND: fine to medium grained, grey, trace of fines.	D	L			
					0.5									
					6.5				Becomes orange	M				
					1.0						MD			
					6.0									
					1.5									
					5.5									
					2.0									
					5.0				Borehole BH 210 terminated at 2m					
					2.5									
					4.5									
					3.0									
					4.0									
					3.5									
					3.5									
					4.0									

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore	penetration 1 2 3 4	N standard penetration test (SPT)		St stiff
CT cable tool	 no resistance ranging to refusal	N* SPT - sample recovered		VSt very stiff
HA hand auger	water	Nc SPT with solid cone		H hard
DT dialube	10/1/98 water level on date shown	V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample	moisture	L loose
T TC bit		E environmental sample	D dry	MD medium dense
*bit shown by suffix e.g. ADT		R refusal	M moist	D dense
			W wet	VD very dense
			Wp plastic limit	
			W _L liquid limit	

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 211**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger Easting: 381852 slope: -90° R.L. Surface: 7.4
hole diameter: 82 mm Northing 6371596 bearing: datum: m AHD

drilling information						material substance												
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations			
	1	2	3															
HA				N						SP	SAND: fine to medium grained, pale grey to grey.		L					
								7.0										
								0.5			Becomes orange							
								6.5					MD					
								6.0										
								1.5										
								5.5										
								2.0										
								5.0			Becomes pale yellow to white							
								2.5										
								4.5					D					
						E		3.0										
											Borehole BH 211 terminated at 3m							
								4.0										
								3.5										
								3.5										
								4.0										
method						support		notes, samples, tests				classification symbols and soil description based on unified classification system			consistency/density index			
AS AD RR W CT HA DT B V T						auger screwing* auger drilling* roller/tricone washbore cable tool hand auger diatube blank bit V bit TC bit		M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		N nil U ₅₀ undisturbed sample 50mm diameter U ₆₀ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				moisture D dry M moist W wet W _p plastic limit W _L liquid limit			VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	
*bit shown by suffix e.g. ADT																		

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 212**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381793 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371629 bearing: datum: m AHD

drilling information						material substance																							
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter			structure and additional observations												
	1	2	3											100 kPa	200 kPa	300 kPa		400 meter											
HA				N			7.5			SP	SAND: fine to medium grained, grey to pale grey, trace of fines.	M	L																
							0.5																						
							7.0																						
							1.0						MD																
							6.5																						
											Becomes orange brown																		
							1.5																						
							6.0																						
							2.0						D																
						E	5.5				Becomes pale yellow grading to white																		
							2.5																						
							5.0																						
							3.0																						
							4.5				Borehole BH 212 terminated at 3m																		
							3.5																						
							4.0																						
method						support						notes, samples, tests						classification symbols and soil description based on unified classification system						consistency/density index					
AS auger screwing*						M mud						U ₅₀ undisturbed sample 50mm diameter						D dry						VS very soft					
AD auger drilling*						N nil						U ₆₃ undisturbed sample 63mm diameter						M moist						S soft					
RR roller/tricone												D disturbed sample						W wet						F firm					
W washbore												N standard penetration test (SPT)						Wp plastic limit						St stiff					
CT cable tool												N* SPT - sample recovered						WL liquid limit						VSt very stiff					
HA hand auger												Nc SPT with solid cone												H hard					
DT diatube												V vane shear (kPa)												Fb friable					
B blank bit												P pressuremeter												VL very loose					
V V bit												Bs bulk sample												L loose					
T TC bit												E environmental sample												MD medium dense					
*bit shown by suffix e.g. ADT												R refusal												D dense					
																								VD very dense					

Borehole No. **BH 213**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTWARA21359AA**

Client: **SANDVIK MINING AND CONSTRUCTION**

Date started: **10.6.2009**

Principal:

Date completed: **10.6.2009**

Project: **PROPOSED INDUSTRIAL SITE**

Logged by: **GDT**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Checked by: 

drill model and mounting: Hand Auger Easting: 381843 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371681 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400		
HA		N			7.5			SP	SAND: fine to medium grained, grey with trace of fines.	M	L			
						0.5			Becomes pale grey					
					7.0						MD			
					1.0				Becomes orange brown					
					6.5									
					1.5									
					6.0									
					2.0						D			
					5.5				Becomes pale yellow					
					2.5									
					5.0									
					3.0									
					4.5				Borehole BH 213 terminated at 3m					
					3.5									
					4.0									

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud N nil	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone	penetration	D disturbed sample		F firm
W washbore	1 2 3 4	N standard penetration test (SPT)		St stiff
CT cable tool		N* SPT - sample recovered		VSt very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT diatube		V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample		L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal		D dense
			moisture	VD very dense
			D dry	
			M moist	
			W wet	
			Wp plastic limit	
			W _L liquid limit	

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 217**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger		Easting: 381834		slope: -90°		R.L. Surface: 7.3	
hole diameter: 82 mm		Northing: 6371765		bearing:		datum: m AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	structure and additional observations
HA		N		7.0	SP	SAND: fine to medium grained, grey to grey-brown, with trace of fines.	
				0.5		Becomes pale grey	
				6.5			
				1.0			
				6.0			
				1.5		Becomes orange brown.	
				5.5			
				2.0			
				5.0		Borehole BH 217 terminated at 2.1m	
				2.5			
				4.5			
				3.0			
				4.0			
				3.5			
				3.5			
				4.0			
method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	
AS auger screwing*		M mud		U ₅₀ undisturbed sample 50mm diameter		moisture D dry M moist W wet W _p plastic limit W _L liquid limit	
AD auger drilling*		C casing		U ₆₃ undisturbed sample 63mm diameter			
RR roller/tricone				D disturbed sample		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	
W washbore				N standard penetration test (SPT)			
CT cable tool				N* SPT - sample recovered			
HA hand auger				Nc SPT with solid cone			
DT diatube				V vane shear (kPa)			
B blank bit				P pressuremeter			
V V bit				Bs bulk sample			
T TC bit				E environmental sample			
*bit shown by suffix e.g. ADT				R refusal			
		penetration 1 2 3 4					
		no resistance ranging to refusal					
		water					
		10/1/98 water level on date shown					
		water inflow					
		water outflow					

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 218**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381866 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371703 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400		
HA		N			7.5			SP	SAND: fine to medium grained, grey to brown, trace of fines.	D	L			
						0.5								
					7.0				Becomes orange brown	M				
						1.0								
					6.5									
						1.5					MD			
					6.0									
						2.0					D			
					5.5									
						2.5			Becomes pale yellow					
					5.0									
					3.0									
					4.5				Borehole BH 218 terminated at 3m					
						3.5								
					4.0									
					4.0									

BOREHOLE BH 200-238.GPJ COFFEY.GDT 23.6.10

Form GEO 5.3 Issue 3 Rev 2

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore	penetration 1 2 3 4	N standard penetration test (SPT)		St stiff
CT cable tool		N* SPT - sample recovered		VSt very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT dialtube		V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample		L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal		D dense
			moisture	VD very dense
			D dry	
			M moist	
			W wet	
			Wp plastic limit	
			W _L liquid limit	

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 219**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381863 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371733 bearing: datum: m AHD

drilling information						material substance																			
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa				structure and additional observations							
	1	2	3											100	200	300	400								
HA				N			7.5			SP	SAND: fine to medium grained, grey brown, trace of organics and fines.	M	L												
								0.5		SP	SAND: fine to medium grained, pale brown grey, trace of fines.														
							7.0						MD												
								1.0																	
							6.5				Becomes orange brown, slightly indurated														
								1.5																	
							6.0				Becomes pale yellow														
							2.0																		
							5.5				Borehole BH 219 terminated at 2m														
								2.5																	
							5.0																		
								3.0																	
							4.5																		
								3.5																	
							4.0																		
method						support						notes, samples, tests						classification symbols and soil description based on unified classification system				consistency/density index			
AS auger screwing*						M mud N nil						U ₆₀ undisturbed sample 50mm diameter						moisture D dry M moist W wet W _p plastic limit W _L liquid limit				VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense			
AD auger drilling*						C casing						U ₆₃ undisturbed sample 63mm diameter													
RR roller/tricone						penetration						D disturbed sample													
W washbore						1 2 3 4						N standard penetration test (SPT)													
CT cable tool						 no resistance ranging to refusal						N* SPT - sample recovered													
HA hand auger						water						Nc SPT with solid cone													
DT diatube						 10/1/98 water level on date shown						V vane shear (kPa)													
B blank bit						 water inflow						P pressuremeter													
V V bit						 water outflow						Bs bulk sample													
T TC bit												E environmental sample													
*bit shown by suffix e.g. ADT												R refusal													

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 221**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381910 slope: -90° R.L. Surface: 7.7
hole diameter: 82 mm Northing 6371743 bearing: datum: m AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
1	2	3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HA		N			7.5		SP	SAND: fine to medium grained, pale brown to brown, traces of fines.	M	VL		
					0.5			Beomes orange		L		
					7.0					MD		
					1.0							
					6.5							
					1.5			Beomes pale yellow				
					6.0							
					2.0							
					5.5							
					2.5							
					5.0					D		
					3.0			Borehole BH 221 terminated at 3m				
					4.5							
					3.5							
					4.0							
					4.0							

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT diatube

B blank bit

V V bit

T TC bit

*bit shown by suffix e.g. ADT

support

M mud

C casing

penetration

1 2 3 4

no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 222**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger Easting: 381925 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371664 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400		
HA		N			7.5			SP	SAND: fine to medium grained, pale grey to grey, trace of fines.	D	L			
						0.5								
					7.0				Becomes yellow	M				
						1.0					MD			
					6.5									
						1.5								
					6.0									
						2.0			Becomes pale yellow		L			
				E										
					5.5				Borehole BH 222 terminated at 2m					
						2.5								
					5.0									
						3.0								
					4.5									
						3.5								
					4.0									
						4.0								

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT dialtube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 223**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381948 slope: -90° R.L. Surface: 7.0
hole diameter: 82 mm Northing 6371689 bearing: datum: m AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HA		N		None Observed		0.5		SP	SAND: fine to medium grained, pale brown to brown, trace of fines.	D	VL		
					-6.5				Becomes orange to orange brown.	M	L		
					-6.0	1.0					MD		
					-5.5	1.5							
					-5.0	2.0							
									Borehole BH 223 terminated at 2m				
					-4.5	2.5							
					-4.0	3.0							
					-3.5	3.5							
					-3.0	4.0							

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT diatube

B blank bit

V V bit

T TC bit

*bit shown by suffix e.g. ADT

support

M mud

C casing

penetration

1 2 3 4

no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 224**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 382006 slope: -90° R.L. Surface: 7.0
hole diameter: 82 mm Northing 6371656 bearing: datum: m AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
HA				N						SP	SAND: fine to medium grained, dark grey to black, trace of fines.		L		
							6.5	0.5			Becomes pale yellow		MD		
							6.0	1.0			Becomes dark orange brown, slightly indurated				COFFEE ROCK
					E										
							5.5	1.5							
							5.0	2.0					D		
											Borehole BH 224 terminated at 2m				
							4.5	2.5							
							4.0	3.0							
							3.5	3.5							
							3.0	4.0							
method						support		N nil		notes, samples, tests		classification symbols and soil description based on unified classification system		consistency/density index	
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT						M mud C casing penetration 1 2 3 4  water 10/1/98 water level on date shown  water inflow  water outflow				U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		moisture D dry M moist W wet Wp plastic limit W _L liquid limit		VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	

Engineering Log - Borehole

Borehole No. **BH 225**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Client: **SANDVIK MINING AND CONSTRUCTION**

Date started: 10.6.2009

Principal:

Date completed: **10.6.2009**

Project: **PROPOSED INDUSTRIAL SITE**

Logged by: **GDT**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Checked by:

drill model and mounting:	Hand Auger	Easting:	382039	slope:	-90°	R.L. Surface:	8.0
hole diameter:	82 mm	Northing	6371670	bearing:		datum:	m AHD

drilling information										material substance													
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations								
	1	2	3																				
HA				N						SP	SAND: fine to medium grained, pale grey to pale brown, trace of fiens.	M	L										
					None Observed		7.5	0.5															
					E		7.0	1.0			Becomes orange brown, slightly indurated				COFFEE ROCK								
											Becomes pale brown.		MD										
							6.5	1.5															
							6.0	2.0															
											Borehole BH 225 terminated at 2m												
							5.5	2.5															
							5.0	3.0															
							4.5	3.5															
							4.0	4.0															
method						support		notes, samples, tests				classification symbols and soil description				consistency/density index							
AS AD RR W CT HA DT B V T *bit shown by suffix e.g.						auger screwing* auger drilling* roller/tricone washbore cable tool hand auger diatube blank bit V bit TC bit ADT		M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow				N nil U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit				VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense			

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 226**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 382020 slope: -90° R.L. Surface: 7.6
hole diameter: 82 mm Northing 6371696 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400		
HA		N			7.5			SP	SAND: fine to medium grained, grey, trace of fines.	M	VL			
						0.5					L			
						7.0								
						1.0								
						6.5								
											MD			
						1.5			Becomes orange brown, slightly indurated					
						6.0			Becomes highly indurated		D			
						2.0								
									Borehole BH 226 terminated at 2m					
						5.5								
						2.5								
						5.0								
						3.0								
						4.5								
						3.5								
						4.0								
						4.0								

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₀ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore	penetration	N standard penetration test (SPT)		St stiff
CT cable tool	1 2 3 4	N* SPT - sample recovered		VSt very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT diatube		V vane shear (kPa)		Fb friable
B blank bit	water	P pressuremeter		VL very loose
V V bit	10/1/98 water level	Bs bulk sample	moisture	L loose
T TC bit	on date shown	E environmental sample	D dry	MD medium dense
*bit shown by suffix	water inflow	R refusal	M moist	D dense
e.g. ADT	water outflow		W wet	VD very dense
			Wp plastic limit	
			W _L liquid limit	

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 227**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger		Easting: 381891		slope: -90°		R.L. Surface: 7.2	
hole diameter: 82 mm		Northing: 6371782		bearing:		datum: m AHD	
drilling information				material substance			
method	penetration	support	notes samples, tests, etc	depth metres	classification symbol	material	structure and additional observations
HA	1 2 3	N		7.0	SP	SAND: fine to medium grained, grey, trace of fines.	
				0.5			
				6.5			
				1.0		Becomes orange brown to orange	
				6.0			
				1.5			
				5.5			
				2.0			
				5.0		Becomes pale yellow to white	
				2.5			
				4.5			
				3.0			
				4.0		Borehole BH 227 terminated at 3m	
				4.0			
				3.5			
				3.5			
				4.0			
method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	
AS auger screwing*		M mud N nil		U ₆₀ undisturbed sample 50mm diameter		moisture D dry M moist W wet W _p plastic limit W _L liquid limit	
AD auger drilling*		C casing		U ₆₃ undisturbed sample 63mm diameter			
RR roller/tricone				D disturbed sample		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	
W washbore				N standard penetration test (SPT)			
CT cable tool				N* SPT - sample recovered			
HA hand auger				Nc SPT with solid cone			
DT dialtube				V vane shear (kPa)			
B blank bit				P pressuremeter			
V V bit				Bs bulk sample			
T TC bit				E environmental sample			
*bit shown by suffix e.g. ADT				R refusal			
		penetration					
		1 2 3 4					
		no resistance ranging to refusal					
		water					
		10/1/98 water level on date shown					
		water inflow					
		water outflow					

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 228**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381856 slope: -90° R.L. Surface: 7.2
hole diameter: 82 mm Northing 6371800 bearing: datum: m AHD

drilling information					material substance				
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	structure and additional observations
HA	1 2 3	N			7.0		SP	SAND: fine to medium grained, pale grey to grey, trace of fines.	
					0.5				
					6.5				
					1.0			Becomes orange brown	
					6.0			Becomes pale orange to pale yellow	
					1.5				
					5.5				
					2.0				
					5.0			Borehole BH 228 terminated at 2m	
					2.5				
					4.5				
					3.0				
					4.0				
					3.5				
					3.5				
					4.0				
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT					support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				
notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal					classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit				
					consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense				

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 229**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 381919 slope: -90° R.L. Surface: 7.3
hole diameter: 82 mm Northing 6371806 bearing: datum: m AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations	
1	2	3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa		
HA		N						SP	SAND: fine to medium grained, grey, trace of fines, some tree roots.	D	MD			
						7.0								
						0.5			Becomes pale grey	M				
						6.5								
						1.0								
						6.0			Becomes orange brown, slightly indurated					
						1.5								
						5.5								
						2.0								
						5.0					D			
						2.5								
						4.5					MD			
						3.0								
						4.0			Borehole BH 229 terminated at 3m					
						3.5								
						3.5								
						4.0								

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT diatube

B blank bit

V V bit

T TC bit

*bit shown by suffix e.g. ADT

support

M mud N nil

C casing

penetration

1 2 3 4

no resistance ranging to refusal

water

10/1/98 water level on date shown

water inflow

water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description

based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 231**

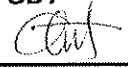
Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger Easting: 382049 slope: -90° R.L. Surface: 8.0
hole diameter: 82 mm Northing 6371757 bearing: datum: m AHD

drilling information						material substance																							
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa			structure and additional observations												
	1	2	3											100	200	300		400											
HA				N							FILL: PEAT, pseudo fibrous dark brown, moderately spongy, trace of fine to medium grained sand, highly organic.	M	VL				TOPSOIL / MULCH												
								7.5	0.5				MD																
								7.0	1.0	SP	SAND: pale grey to grey, trace of fines.		D																
					None Observed			6.5	1.5		Becomes orange																		
					E			6.0	2.0																				
								5.5	2.5		Becomes pale yellow																		
								5.0	3.0		Borehole BH 231 terminated at 3m																		
								4.5	3.5																				
								4.0	4.0																				
method						support						notes, samples, tests						classification symbols and soil description based on unified classification system						consistency/density index					
AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT dialtube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT						M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow						U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal						D dry M moist W wet W _p plastic limit W _L liquid limit						VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense					

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 232**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:



drill model and mounting: Hand Auger Easting: 382012 slope: -90° R.L. Surface: 7.5
hole diameter: 82 mm Northing 6371776 bearing: datum: m AHD

drilling information						material substance																							
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations														
	1	2	3																										
HA				N						SC	Clayey SAND: fine to medium grained, dark brown to black, low plasticity fines.	M	D		FILL														
													VD																
								7.0	0.5	SP	SAND: fine to medium grained, pale orange, grey, trace fo fines.																		
											Becomes orange																		
								6.5	1.0				D																
					E			6.0	1.5																				
								5.5	2.0		Becomes pale yellow																		
								5.0	2.5																				
											Borehole BH 232 terminated at 2.5m																		
								4.5	3.0																				
								4.0	3.5																				
								3.5	4.0																				
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT dialtube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT						support M mud N nil C casing penetration 1 2 3 4  water  10/1/98 water level on date shown  water inflow  water outflow						notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal						classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit						consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense					

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 233**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 382041 slope: -90° R.L. Surface: 7.5
hole diameter: 82 mm Northing 6371810 bearing: datum: m AHD

drilling information					material substance										
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
HA				N						CL	FILL: Sandy CLAY, low plasticity, brown, fine to medium grained sand, trace of rootlets.	M	VSt		TOPSOIL FILL
										SP	SAND: fine to medium grained, dark grey to black, trace of fines. Becomes pale brown grey 				

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 234**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

drill model and mounting: Hand Auger Easting: 382016 slope: -90° R.L. Surface: 7.3
hole diameter: 82 mm Northing 6371864 bearing: datum: m AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
HA	1	2	3	N						SC	FILL: Clayey SAND. fine to medium grained, dark brown, low plasticity clay.	M	L	100 200 300 400	TOPSOIL FILL
							7.0	0.5		SP	SAND: fine to medium grained, grey to pale grey, trace of fines.		D		
							6.5	1.0							
						E	6.0	1.5			Becomes orange brown.				
							5.5	2.0			Becomes brown grey				
							5.0	2.5							
							4.5	3.0			Borehole BH 234 terminated at 2.75m				
							4.0	3.5							
							3.5	4.0							
							3.0								
							2.5								
							2.0								
							1.5								
							1.0								
							0.5								
							0.0								
							-0.5								
							-1.0								
							-1.5								
							-2.0								
							-2.5								
							-3.0								
							-3.5								
							-4.0								
							-4.5								
							-5.0								
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							-70.5								
							-71.0								
							-71.5								
							-72.0								
							-72.5								
							-73.0								
							-73.5								
							-74.0								
							-74.5								

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 235**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger Easting: 382001 slope: -90° R.L. Surface: 7.7
hole diameter: 82 mm Northing 6371831 bearing: datum: m AHD

drilling information						material substance											
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations		
	1	2	3														
HA				N				7.5		SC	FILL: SAND, fine to medium grained, dark brown with some fines.	M	VD		TOPSOIL FILL		
								0.5		SP	SAND: fine to medium grained, grey black, with trace of fines. Becoming grey						
								7.0									
								1.0									
					E			6.5			Becoming orange brown.						
								1.5									
								6.0									
								2.0									
								5.5									
								2.5									
								5.0									
								3.0			Borehole BH 235 terminated at 2.75m						
								4.5									
								3.5									
								4.0									
								4.0									
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT						support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 236**

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by:

[Signature]

drill model and mounting: Hand Auger Easting: 381917 slope: -90° R.L. Surface: 7.0
hole diameter: 82 mm Northing 6371846 bearing: datum: m AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
HA				N						SP	SAND: fine to medium grained, dark brown to black wit some fines and roots.	M	MD		TOPSOIL
										SP	SAND: fine to medium grained, pale grey, trace of fines.		D		
							6.5	0.5			Becomes orange brown to brown, slightly indurated.				
							6.0	1.0			Becomes orange		MD		
							5.5	1.5					D		
							5.0	2.0			Becomes pale yellow				
							4.5	2.5							
							4.0	3.0							
							3.5	3.5			Borehole BH 236 terminated at 3m				
							3.0	4.0							

method	support	notes, samples, tests	classification symbols and soil description based on unified classification system	consistency/density index
AS auger screwing*	M mud N nil	U ₅₀ undisturbed sample 50mm diameter		VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone		D disturbed sample		F firm
W washbore		N standard penetration test (SPT)		St stiff
CT cable tool		N* SPT - sample recovered		VS _t very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT dialtube		V vane shear (kPa)		Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample		L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal		D dense
				VD very dense

Borehole No. **BH 237**

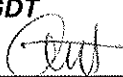
Sheet 1 of 1

Project No. **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

drill model and mounting: Hand Auger Easting: 381842 slope: -90° R.L. Surface: 7.1

hole diameter: 82 mm Northing: 6371851 bearing: datum: m AHD

drilling information				material substance								
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
HA		N		7.0			SP	SAND: fine to medium grained, grey to brown, trace of fines.		L		
				0.5			Becomes pale grey brown.					
				6.5								
				1.0			Becomes brown with some roots					
				6.0								
				1.5						MD		
			E	5.5								
				2.0								
				5.0						D		
			E				Becomes pale yellow grading to white					
				2.5								
				4.5								
				3.0								
				4.0				Borehole BH 237 terminated at 3m				
				4.0								
				3.5								
				3.5								
				4.0								

method

AS auger screwing*

AD auger drilling*

RR roller/tricone

W washbore

CT cable tool

HA hand auger

DT dialube

B blank bit

V V bit

T TC bit

*bit shown by suffix
e.g. ADT

support

M mud

C casing

penetration
1 2 3 4

 no resistance ranging to refusal

water

 10/1/98 water level on date shown

 water inflow

 water outflow

notes, samples, tests

U₅₀ undisturbed sample 50mm diameter

U₆₃ undisturbed sample 63mm diameter

D disturbed sample

N standard penetration test (SPT)

N* SPT - sample recovered

Nc SPT with solid cone

V vane shear (kPa)

P pressuremeter

Bs bulk sample

E environmental sample

R refusal

classification symbols and soil description based on unified classification system

moisture

D dry

M moist

W wet

Wp plastic limit

W_L liquid limit

consistency/density index

VS very soft

S soft

F firm

St stiff

VSt very stiff

H hard

Fb friable

VL very loose

L loose

MD medium dense

D dense

VD very dense

Borehole No. **BH 238**

Engineering Log - Borehole

Sheet 1 of 1

Project No: **GEOTWARA21359AA**

Client: **SANDVIK MINING AND CONSTRUCTION**

Date started: **10.6.2009**

Principal:

Date completed: **10.6.2009**

Project: **PROPOSED INDUSTRIAL SITE**

Logged by: **GDT**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Checked by: 

drill model and mounting: Hand Auger		Easting: 381921		slope: -90°		R.L. Surface: 7.0	
hole diameter: 82 mm		Northing: 6371884		bearing:		datum: m AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.
HA		N				SC	Clayey SAND: fine to medium grained, dark brown, low plasticity clay, some roots.
				6.5	0.5	SP	SAND: fine to medium grained, pale brown, trace of flints,
				6.0	1.0		
				5.5	1.5		
				5.0	2.0		
				4.5	2.5		
				4.0	3.0		
				3.5	3.5		
				3.0	4.0		
Borehole BH 238 terminated at 2m							
method				support			
AS auger screwing*				M mud N nil			
AD auger drilling*				C casing			
RR roller/tricone				penetration			
W washbore				1 2 3 4			
CT cable tool				no resistance ranging to refusal			
HA hand auger				water			
DT diatube				10/1/98 water level on date shown			
B blank bit				water inflow			
V V bit				water outflow			
T TC bit							
*bit shown by suffix e.g. ADT							
notes, samples, tests				classification symbols and soil description based on unified classification system			
U ₅₀ undisturbed sample 50mm diameter				moisture			
U ₆₃ undisturbed sample 63mm diameter				D dry			
D disturbed sample				M moist			
N standard penetration test (SPT)				W wet			
N* SPT - sample recovered				Wp plastic limit			
Nc SPT with solid cone				W _L liquid limit			
V vane shear (kPa)							
P pressuremeter							
Bs bulk sample							
E environmental sample							
R refusal							
consistency/density index							
VS very soft							
S soft							
F firm							
St stiff							
VS _t very stiff							
H hard							
Fb friable							
VL very loose							
L loose							
MD medium dense							
D dense							
VD very dense							

Engineering Log - Borehole

Client: **SANDVIK MINING AND CONSTRUCTION**

Principal:

Project: **PROPOSED INDUSTRIAL SITE**

Borehole Location: **MASONITE ROAD, HEATHERBRAE**

Borehole No. **BH 239**

Sheet 1 of 1

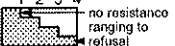
Project No: **GEOTWARA21359AA**

Date started: **10.6.2009**

Date completed: **10.6.2009**

Logged by: **GDT**

Checked by: 

drill model and mounting: Hand Auger		Easting: 381996		slope: -90°		R.L. Surface: Not Measured					
hole diameter: 82 mm		Northing: 6371913		bearing:		datum: m AHD					
drilling information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.				
HA		N				CL	Sandy CLAY: low plasticity, dark brown, fine to medium grained sand, some roots.				
				0.5			SAND: fine to medium grained, pale yellow, trace of fines.				
				1.0			Becomes orange				
				1.5							
				2.0			Becomes pale yellow				
				2.5							
				3.0			Borehole BH 239 terminated at 3m				
				3.5							
				4.0							
method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT				support M mud N nil C casing penetration 1 2 3 4  water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit		consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense	



geotechnics
SPECIALISTS MANAGING THE EARTH

Site Number

BH 203

Job No **GEOTWARA21359AA**

Double Ring Infiltrometer Test

Sheet **1** of **2**

Client **SANDVIK MINING AND CONSTRUCTION**

Office **WARA**

Principal

Date **15/06/09**

Project **INFILTRATION TESTING**

By **GDT**

Location **MASONITE ROAD, HEATHERBRAE**

Checked

Test Fluid

Water

Inner Ring Radius 0.150 m

Outer Ring Radius 0.300 m

Water Head 0.200 m

Depth to Static

Water 2.500 m

Date 10/06/2009 **Time** 9AM

Area of Inner Ring 0.071 sq.m

Area of Annulus 0.212 sq.m

Reading No.	Time Elapsed (mins)	Time Interval (mins)	Volume of Water Added (Litres)	Infiltration Rate (m/day)	Infiltration Rate (m/sec)	Comments
0	2	2	9	91.7	1.1E-03	
1	4	2	9	91.7	1.1E-03	
2	6	2	9	91.7	1.1E-03	
3	8	2	9	91.7	1.1E-03	
4	10	2	8.75	89.1	1.0E-03	
5	12	2	8.75	89.1	1.0E-03	
6	14	2	8.5	86.6	1.0E-03	
7	16	2	8.75	89.1	1.0E-03	
8	18	2	8.5	86.6	1.0E-03	
9	20	2	8.25	84.0	9.7E-04	
10	22	2	8.25	84.0	9.7E-04	
11	24	2	8.25	84.0	9.7E-04	
12	26	2	8.25	84.0	9.7E-04	
13	28	2	8	81.5	9.4E-04	
14	30	2	8	81.5	9.4E-04	
15	32	2	8	81.5	9.4E-04	
16	34	2	7.75	78.9	9.1E-04	
17	36	2	7.75	78.9	9.1E-04	
18	38	2	7.5	76.4	8.8E-04	
19	40	2	7.5	76.4	8.8E-04	
20	42	2	7.5	76.4	8.8E-04	
21	44	2	7.25	73.8	8.5E-04	
22	46	2	7	71.3	8.3E-04	
23	48	2	7.25	73.8	8.5E-04	

coffey**geotechnics**

SPECIALISTS MANAGING THE EARTH

Site Number

BH 203Job No **GEOTWARA21359AA**Sheet **2** of **2****Double Ring Infiltrometer Test**Client **SANDVIK MINING AND CONSTRUCTION**Office **WARA**

Principal

Date **15/06/09**Project **INFILTRATION TESTING**By **GDT**Location **MASONITE ROAD, HEATHERBRAE**

Checked

Test FluidWater**Inner Ring Radius**0.150 m**Outer Ring Radius**0.300 m**Water Head**0.200 m**Depth to Static****Water**2.500 m**Date**10/06/2009**Time**9AM**Area of Inner Ring**0.071 sq.m**Area of Annulus**0.212 sq.m

Reading No.	Time Elapsed (mins)	Time Interval (mins)	Volume of Water Added (Litres)	Infiltration Rate (m/day)	Infiltration Rate (m/sec)	Comments
0	50	2	7	71.3	8.3E-04	
1	52	2	6.75	68.8	8.0E-04	
2	54	2	6.75	68.8	8.0E-04	
3	56	2	6.25	63.7	7.4E-04	
4	58	2	6.25	63.7	7.4E-04	
5	60	2	5.75	58.6	6.8E-04	
6	62	2	5.5	56.0	6.5E-04	
7	64	2	5.5	56.0	6.5E-04	
8	66	2	5.25	53.5	6.2E-04	
9	68	2	5	50.9	5.9E-04	
10	70	2	5	50.9	5.9E-04	
11	72	2	5	50.9	5.9E-04	
12	74	2	5	50.9	5.9E-04	
13	76	2	5	50.9	5.9E-04	
14	78	2	5	50.9	5.9E-04	
15	80	2	5	50.9	5.9E-04	
16	82	2	5	50.9	5.9E-04	
17	84	2	5	50.9	5.9E-04	
18	86	2	5	50.9	5.9E-04	
19	88	2	5	50.9	5.9E-04	
20	90	2	5	50.9	5.9E-04	
21						
22						
23						

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SPECIALISTS MANAGING THE EARTH

Site Number

BH 234Job No **GEOTWARA21359AA****Double Ring Infiltrometer Test**Sheet **1** of **2**Client **SANDVIK MINING AND CONSTRUCTION**Office **WARA**

Principal

Date **15/06/09**Project **INFILTRATION TESTING**By **GDT**Location **MASONITE ROAD, HEATHERBRAE**

Checked

Test Fluid

Water

Inner Ring Radius 0.150 m**Outer Ring Radius** 0.300 m**Water Head** 0.200 m**Depth to Static****Water** m**Date** **Time** **Area of Inner Ring** 0.071 sq.m**Area of Annulus** 0.212 sq.m

Reading No.	Time Elapsed (mins)	Time Interval (mins)	Volume of Water Added (Litres)	Infiltration Rate (m/day)	Infiltration Rate (m/sec)	Comments
0	2	2	6	61.1	7.1E-04	
1	4	2	6	61.1	7.1E-04	
2	6	2	5.75	58.6	6.8E-04	
3	8	2	5.5	56.0	6.5E-04	
4	10	2	5.75	58.6	6.8E-04	
5	12	2	5.5	56.0	6.5E-04	
6	14	2	5.75	58.6	6.8E-04	
7	16	2	5.75	58.6	6.8E-04	
8	18	2	5.5	56.0	6.5E-04	
9	20	2	5.5	56.0	6.5E-04	
10	22	2	5.25	53.5	6.2E-04	
11	24	2	5.25	53.5	6.2E-04	
12	26	2	5	50.9	5.9E-04	
13	28	2	5	50.9	5.9E-04	
14	30	2	5	50.9	5.9E-04	
15	32	2	5	50.9	5.9E-04	
16	34	2	5	50.9	5.9E-04	
17	36	2	5	50.9	5.9E-04	
18	38	2	5	50.9	5.9E-04	
19	40	2	5	50.9	5.9E-04	
20	42	2	5	50.9	5.9E-04	
21	44	2	5	50.9	5.9E-04	
22	46	2	5	50.9	5.9E-04	
23	48	2	5	50.9	5.9E-04	

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SPECIALISTS MANAGING THE EARTH

Site Number

BH 234Job No **GEOTWARA21359AA**Sheet **2** of **2****Double Ring Infiltrometer Test**

Client **SANDVIK MINING AND CONSTRUCTION**
Principal _____
Project **INFILTRATION TESTING**
Location **MASONITE ROAD, HEATHERBRAE**

Office **WARA**
Date **15/06/09**
By **GDT**
Checked

Test Fluid Water
Inner Ring Radius 0.150 m
Outer Ring Radius 0.300 m
Water Head 0.200 m

Depth to Static Water _____ m
Date _____ Time _____

Area of Inner Ring 0.071 sq.m
Area of Annulus 0.212 sq.m

Reading No.	Time Elapsed (mins)	Time Interval (mins)	Volume of Water Added (Litres)	Infiltration Rate (m/day)	Infiltration Rate (m/sec)	Comments
0	50	2	5	50.9	5.9E-04	
1	52	2	5	50.9	5.9E-04	
2	54	2	5	50.9	5.9E-04	
3	56	2	5	50.9	5.9E-04	
4	58	2	5	50.9	5.9E-04	
5	60	2	5	50.9	5.9E-04	
6	62	2	5	50.9	5.9E-04	
7	64	2	5	50.9	5.9E-04	
8	66	2	5	50.9	5.9E-04	
9	68	2	5	50.9	5.9E-04	
10	70	2	5	50.9	5.9E-04	
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						

Dynamic Cone Penetrometer Test Results

Client: SANDVIK MINING AND CONSTRUCTION
Principal:
Project: PROPOSED INDUSTRIAL BUILDING
Location: 431 MASONITE ROAD, HEATHERBRAE

Job No: GEOTWARA21359AA
Date of Issue: 25/06/2009

Sample Details

Test procedure:			Test date:			Date of Actual Test			
Depth below surface	Test Numbers				Readings recorded in blows per 150mm				Test location/Remarks
	200	201	202	203	204	205	206	207	
150	0	0		1	1			0	
300	1	1	1	1	0	1	1	1	
450	1	1	2	1	1	1	2	0	
600	0	2	4	1	2	2	3	1	
750	1	2	2	8	2	3	3	1	
900	1	2	2	2	3	4	3	2	
1050	1	3	3	4	4	3	2	3	
1200	1	8	7	5	4	3	3	2	
1350	1	5	4	6	4	4	3	1	
1500	2	6	7	6	4	4	4	3	
1650	1	5	9	8	3	4	5	3	
1800	3	5	9	8	2	6	5	3	
1950	2	5	12	10	5	8	5	5	
2100	3	10	20	12	5	13	5	7	
2250	3	8	17	12	8	11	8	6	
2400	4	7	21	14	9	11	12	7	
2550	5	7	11	13	10	11	12	8	
2700	8	9	13	18	10	11	14	9	
2850	10	11	16	19	11	13	16	9	
3000	12	12	17	23	14	12	19	10	
3150									
3300									
3450									
3600									
3750									
3900									
4050									
4200									
4350									
4500									
4650									
4800									
4950									
5100									
5250									
Remarks									General Information
									AS 1289 6.3.2
									☐ Drop height 510mm ± 5
									☐ Cone tip
									☒ Blunt tip
									AS 1289 6.3.3
									☐ Drop height 600mm ± 5

Form Number: WARABROOK 142/Issue 1.0

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Dynamic Cone Penetrometer Test Results

Client: SANDVIK MINING AND CONSTRUCTION
Principal:
Project: PROPOSED INDUSTRIAL BUILDING
Location: 431 MASONITE ROAD, HEATHERBRAE

Job No: GEOTWARA21359AA
Date of Issue: 25/06/2009

Sample Details

Test procedure:		Test date:					Date of Actual Test		
Depth below surface	Test Numbers						Readings recorded in blows per 150mm		
	208	209	210	211	212	213	214	215	Test location/Remarks
150	0	1	0	0	1	0	0	1	
300	1	1	1	1	0	1	2	2	
450	2	1	1	2	1	0	2	2	
600	2	2	2	1	1	2	3	2	
750	2	3	2	2	2	3	3	3	
900	2	2	2	2	2	4	4	3	
1050	2	3	3	3	4	3	3	3	
1200	2	2	3	2	4	3	3	5	
1350	3	3	3	2	5	3	3	5	
1500	3	4	3	3	5	5	5	4	
1650	8	3	2	3	5	6	5	4	
1800	3	4	4	4	5	6	6	4	
1950	5	4	4	4	6	7	7	6	
2100	5	5	4	5	7	9	9	6	
2250	6	5	7	6	9	8	10	7	
2400	8	8	6	7	8	8	11	11	
2550	7	11	6	6	10	12	12	11	
2700	8	12	6	8	11	14	13	12	
2850	10	15	7	9	15	14	15	14	
3000	12		7	8	17	18	16	11	
3150									
3300									
3450									
3600									
3750									
3900									
4050									
4200									
4350									
4500									
4650									
4800									
4950									
5100									
5250									
Remarks									General Information AS 1289 6.3.2 ☐ Drop height 510mm ± 5 ☐ Cone tip ☒ Blunt tip AS 1289 6.3.3 ☐ Drop height 600mm ± 5

Form Number: WARABROOK 142/Issue 1.0

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Dynamic Cone Penetrometer Test Results

Client: SANDVIK MINING AND CONSTRUCTION
Principal:
Project: PROPOSED INDUSTRIAL BUILDING
Location: 431 MASONITE ROAD, HEATHERBRAE

Job No: GEOTWARA21359AA
Date of Issue: 25/06/2009

Sample Details

Test procedure:		Test date:					Date of Actual Test		
Depth below surface	Test Numbers						Readings recorded in blows per 150mm		
	216	217	218	219	220	221	222	223	Test location/Remarks
150	1	1	1	0	0	0	0	0	
300	0	0	1	1	1	0	1	0	
450	1	1	0	0	1	1	0	1	
600	2	1	1	1	1	1	1	1	
750	2	1	2	3	2	3	2	1	
900	2	3	1	3	3	3	2	3	
1050	3	4	2	3	3	3	3	5	
1200	4	3	3	5	4	6	6	4	
1350	4	3	4	6	4	7	6	4	
1500	6	2	5	9	5	5	5	3	
1650	5	2	5	7	5	5	4	4	
1800	4	3	6	8	5	4	4	3	
1950	7	3	7	8	6	4	2	5	
2100	6	3	7	10	8	6	2	6	
2250	8	4	9	10	8	6	3	8	
2400	9	3	9	14	10	5	4	12	
2550	9	4	10	14	12	5	5	13	
2700	12	4	11	14	14	7	7	12	
2850	14	5	12	16	16	8	7	14	
3000	16	5	13			9	12	16	
3150		6							
3300									
3450									
3600									
3750									
3900									
4050									
4200									
4350									
4500									
4650									
4800									
4950									
5100									
5250									
Remarks									General Information AS 1289 6.3.2 ☐ Drop height 510mm ± 5 ☐ Cone tip ☒ Blunt tip AS 1289 6.3.3 ☐ Drop height 600mm ± 5

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Dynamic Cone Penetrometer Test Results

Client: SANDVIK MINING AND CONSTRUCTION
Principal:
Project: PROPOSED INDUSTRIAL BUILDING
Location: 431 MASONITE ROAD, HEATHERBRAE

Job No: GEOTWARA21359AA
Date of Issue: 25/06/2009

Sample Details

Test procedure:		Test date:					Date of Actual Test		
Depth below surface	Test Numbers						Readings recorded in blows per 150mm		
	225	226	227	228	229	231	232	233	Test location/Remarks
150			1	3	1	0	4	5	
300	1		2	4	4	0	6	8	
450	2		3	5	4	0	13	10	
600	2	2	2	4	4	5	17	11	
750	2	1	2	4	4	7	14	12	
900	1	2	3	4	3	9	15	10	
1050	1	2	4	5	4	11	12	9	
1200	1	2	5	3	3	10	7	7	
1350	2	2	4	4	3	10	8	6	
1500	3	6	5	5	3	8	10	6	
1650	3	6	4	4	4	8	9	8	
1800	3	8	5	3	3	9	10	10	
1950	3	7	5	5	5	7	11	10	
2100	3	8	5	5	5	8	14	13	
2250	4	8	8	5	5	9	15	11	
2400	8	10	8	6	9	8	16	13	
2550	8	9	8	7	8	7	18	13	
2700	10	11	11	8	9	10	17	14	
2850	17	14	13	9	8	10	18	16	
3000	20	16	15	9	7	11	20	19	
3150						16			
3300									
3450									
3600									
3750									
3900									
4050									
4200									
4350									
4500									
4650									
4800									
4950									
5100									
5250									
Remarks									General Information AS 1289 6.3.2 ☐ Drop height 510mm ± 5 ☐ Cone tip ☒ Blunt tip AS 1289 6.3.3 ☐ Drop height 600mm ± 5

Form Number: WARABROOK 142: Issue 1.0

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Dynamic Cone Penetrometer Test Results

Client: SANDVIK MINING AND CONSTRUCTION
Principal:
Project: PROPOSED INDUSTRIAL BUILDING
Location: 431 MASONITE ROAD, HEATHERBRAE

Job No: GEOTWARA21359AA
Date of Issue: 25/06/2009

Sample Details

Test procedure:		Test date:					Date of Actual Test	
Depth below surface	Test Numbers						Readings recorded in blows per 150mm	
	234	235	236	237	238	239		
150	1	8	2	1	5	4		
300	1	16	3	1	4	4		
450	5	18	4	1	5	5		
600	8	24	5	2	4	9		
750	10	22	5	2	5	9		
900	9	22	5	2	5	9		
1050	8	16	6	1	5	9		
1200	7	16	6	2	3	6		
1350	6	16	5	3	4	9		
1500	7	16	6	3	5	11		
1650	7	17	4	4	4	13		
1800	7	18	5	3	4	10		
1950	9	19	6	3	5	11		
2100	9	25	10	5	6	12		
2250	10		12	6	5	12		
2400	13		11	8	8	12		
2550	13		13	8	7	13		
2700	12		12	9	8	16		
2850	15		12	10	9	24		
3000	15		17	10	12			
3150								
3300								
3450								
3600								
3750								
3900								
4050								
4200								
4350								
4500								
4650								
4800								
4950								
5100								
5250								

Remarks

General Information

AS 1289 6.3.2

☐ Drop height 510mm ± 5
☐ Cone tip
☒ Blunt tip

AS 1289 6.3.3

☐ Drop height 600mm ± 5

Form Number: WARABROOK 142; Issue 1.0

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Appendix B

Results of Laboratory Tests

acid sulfate soil screening test

client:	Coffey Geotechnics Pty Ltd										office:	Newcastle
principal:	Sandvik Mining and Construction										date:	24 June 2009
project:	GEOTWARA21359AA – Proposed Industrial Site										test location:	Newcastle
location:	Heatherbrae, NSW										tested by:	RFK
											checked by:	
date samples recovered:		pH meter used/serial no:		HORIBA D-24		date of calibration:		23/06/09				
hydrogen peroxide pH prior to use:		4.71		hydrogen peroxide temperature prior to use:		19.2°C						

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)					pH Change (ie pH _F -pH _{FOX})	Additional comments	
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour			Colour change during reaction
BH200	2.9 – 3.0		SAND	6.26	10	4.43	21.2	A	Nil	Nil	1.83	
BH201	1.9 – 2.0		SAND	6.18	10	4.48	20.04	B	Nil	Nil	1.70	
BH203	1.0 – 1.1		SAND	5.29	10	4.05	21.2	B-	Nil	Nil	1.24	
BH204	1.5 – 1.6		SAND	5.41	10	4.41	21.3	A	Nil	Nil	1.00	
BH205	0.9 – 1.0		Silty SAND	5.76	10	4.37	21.4	B	Nil	Nil	1.39	
BH205	1.9 – 2.0		Clayey SAND	5.91	10	4.41	20.4	A	Nil	Nil	1.50	
BH232	1.3 – 1.4		SAND	6.35	10	4.72	21.0	A	Nil	Nil	1.63	
BH238	1.0 – 1.1		SAND	6.09	10	4.57	21.1	B	Nil	Nil	1.52	
BH239	2.0 – 2.1		SAND	6.41	10	4.97	21.1	A	Nil	Nil	1.44	
BH220	2.6 – 2.7		SAND	6.33	10	4.90	21.1	B	Nil	Nil	1.43	

NOTES:

1. Observed Reaction:	a. No visible effervescence	b. Slight to moderate effervescence	c. Vigorous effervescent reaction	d. No Reaction
2. Strong Odour:				

acid sulfate soil screening test

client:	Coffey Geotechnics Pty Ltd	office:	Newcastle
principal:	Sandvik Mining and Construction	date:	24 June 2009
project:	GEOTWARA21359AA – Proposed Industrial Site	test location:	Newcastle
location:	Heatherbrae, NSW	tested by:	RFK
		checked by:	

 date samples recovered: pH meter used/serial no: HORIBA D-24 date of calibration: **23/06/09**

 hydrogen peroxide pH prior to use: **4.71** hydrogen peroxide temperature prior to use: **19.2°C**

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	pH _{ox} (oxidation in 30% hydrogen peroxide)				Additional comments
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	
BH212	2.0 – 2.1		SAND	5.09	10	3.98	18.9	A	Nil
BH234	1.1 – 1.3		SAND	5.96	10	4.61	18.1	A	Nil
BH210	1.9 – 2.0		SAND	5.42	10	4.64	18.3	A	Nil
BH237	2.1 – 2.2		SAND	5.99	10	4.85	18.2	A	Nil
BH237	1.5 – 1.6		Silty SAND	5.12	10	4.30	18.6	B	Nil
BH214	2.5 – 2.6		SAND	5.48	10	4.71	18.5	A	Nil
BH229	2.0 – 2.5		SAND	6.19	10	4.73	18.7	A	Nil
BH222	1.9 – 2.0		SAND	5.37	10	4.47	18.9	A	Nil
BH209	2.5 – 2.6		SAND	6.20	10	4.62	18.8	A	Nil
BH224	1.0 – 1.1		Silty SAND	5.90	10	4.60	19.0	A	Nil
BH216	1.0 – 1.1		SAND	6.00	10	4.57	19.2	A	Nil

 NOTES: 1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction d. No Reaction
 2. Strong Odour:

acid sulfate soil screening test

[illegible]