53A Warriewood Road, Warriewood NSW

PROPOSED SUBDIVISION

GEOTECHNICAL INVESTIGATION

Prepared for PVD No.21 Pty Ltd c/o Craig and Rhodes Pty Ltd

15 June 2021

Construction Sciences

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1. Introduction

Construction Sciences (CS) was commissioned by PVD No.21 Pty Ltd c/o Craig and Rhodes to carry out a geotechnical investigation at 53A Warriewood Rd (Lot 2 DP 1115877), Warriewood NSW 2102 (the site) in order to provide recommendations and commentary on the pavement thickness design, identify geotechnical constraints and assess the severity of acid sulphate soils for the proposed subdivision. The investigation has been carried out in accordance with CS proposal 10791E-Q 537 dated 18 March 2021.

2. Site Description and Geology

The site is an open lot with an existing occupied residential property and has residential properties on both sides. The site has various banks to avoid flooding in the south western direction, heading towards the rear of the property that reaches the Narrabeen Creek. Vegetation at the lot comprised grass ground cover and small to medium sized trees and bushes on the western and southern boundary fences at the time of investigation.

Reference to MINVIEW online surface geology mapping indicates that the site is underlain by Middle Triassic aged Ashfield Shale formation comprising of black to light grey shale and laminite.

The Sydney – 1:100 000 Geological Maps indicates that the north eastern part of the site is underlain by Interbedded laminite, shale and quartz to lithic-quartz sandstone. The balance is underlain by quaternaty alluvium comprising sand silt, peat and swamp deposits.

An overview of the site is shown in Figure 1 below.

Figure 1 General Site Overview – Looking towards the NE from the SW direction

3. Investigation Work

3.1 Fieldwork

Fieldwork was carried out on the 13th and 14th of May 2021 and comprised 9 bore holes spread around the key areas of the proposed subdivision access road. The boreholes were drilled to a maximum depth of 4.0m using a ute mounted drill rig with 220mm diameter auger attachment.

The fieldwork was carried out by a Geotechnical Engineer from CS, who selected test locations, carried out sampling and in-situ testing and compiled engineering logs of the profiles encountered.

Dynamic Cone Penetrometer (DCP) tests were carried out adjacent to the boreholes and samples were taken for laboratory testing to aid assessment of subsurface soil strength.

The approximate borehole locations are shown on the site plan ref: 10791E/P/453-1 presented in Appendix B.

Subsurface soil profiles encountered in the boreholes are generalised in Table 1 below. Reference should be made to the attached borehole logs for a more detailed description of soils encountered at a particular location.

Table 1 Summary of Subsurface Profile

Layer/Description	Depth to Base of Layer (m)
TOPSOIL:	
Clayey Sandy SILT: low plasticity, dark grey and brown	0.0 to 0.8
FILL (BH04 and BH06 only):	
Silty Sandy GRAVEL: fine to medium grained, poorly graded Silty Sandy CLAY: medium plasticity, brown, with gravel Sandy CLAY: medium plasticity, pale grey and grey-brown	>1.0 to 2.2
ALLUVIUM:	
Silty CLAY: medium to high plasticity, grey, trace sand, hard Silty CLAY: low to medium plasticity, pale grey and grey, firm to stiff CLAY: high plasticity, pale grey, trace sand, very stiff to hard Clayey SAND: fine to medium, pale grey, low plasticity, loose to medium dense	3.5 to >4.0
RESIDUAL:	
CLAY: low to medium plasticity, red-brown, orange red and pale-grey, firm to hard CLAY: medium to high plasticity, orange-brown and grey-brown, trace rootlets, soft. Sandy CLAY: medium plasticity, orange-brown	>1.5 to >4.0

Layer/Description	Depth to Base of Layer (m)
Clayey SAND: fine to medium, pale grey and grey, medium plasticity	

Groundwater was encountered during our investigation; this is assumed to be due to the creek that runs behind the property. The groundwater was identified on the rear side of the property, where the land is at its lowest point at 2.7m at BH6 and 0.5m at BH7.

3.2 Interpreted In-Situ CBR

Interpreted California Bearing Ratio (CBR) inferred from in-situ DCP tests with reference to Austroads 2017 – Guide to Pavement Technology Part 2 - Pavement Structural Design (AGPTP2-2017) are given in Table 2 below. DCP results are included in the borehole logs.

Table 2 Inferred CBR Values from In-situ DCP testing

Depth below Surface Level (m)	Inferred In-Situ CBR Value from DCP Test							
	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08
0.0 – 0.1	6	0	11	15	0	6	2	0
0.1 – 0.2	6	2	25	45	0	11	0	0
0.2 – 0.3	15	4	20	25	11	11	4	2
0.3 – 0.4	15	4	35	50	15	13	4	2
0.4 – 0.5	18	2	45	65	15	65	0	2
0.5 – 0.6	15	4	25		15		4	2
0.6 – 0.7	20	8	20		13		6	4
0.7 – 0.8	25	18	6		11		8	6
0.8 – 0.9	29	15	6		6		11	8
0.9 – 1.0	18	25	8		8		13	8
1.0 – 1.1	25	20	6		13		15	13
1.1 – 1.2	18	25	8		13		25	18
1.2 – 1.3	15	31	13		15	15	23	23
1.3 – 1.4	25	35	25		25	18	50	25
1.4 – 1.5	25	35	25		35	15	50	35
1.5 – 1.6	25	18	30		35	15	50	45
1.6 – 1.7	25	25	35		40	11	55	
1.7 – 1.8	30	40	45			6		
1.8 – 1.9		37				6		
1.9 – 2.0		45				11		

2.0 – 2.1	50	18
2.1 – 2.2	65	15
2.2 – 2.3		35
2.3 – 2.4		35
2.4 – 2.5		35
2.5 – 2.6		25
2.6 – 2.7		45
2.7 – 2.8		45
2.8 – 2.9		35
2.9 – 3.0		55
3.0 – 3.1		55

3.3 Laboratory Testing

Laboratory testing comprising thirteen (12) Field Moisture Content (FMC) tests, two (2) Atterberg Limit tests, and two (2) California Bearing Ratio (CBR) tests was carried out to aid assessment of subsurface parameters. Laboratory test results are summarised in Table 3. A copy of the laboratory test certificates can be found in Appendix C.

Table 3 Summary of Moisture Content and Atterberg Limit Test Results

BH ID	Depth (m)	FMC (%)	LL (%)	PL(%)	PI(%)	LS(%)
BH01	0.85	24.7				
BH01	1.3	18.7	-	-	-	-
BH02	0.65	-	41	19	22	10.0
BH02	1.3	15.2	-	-	-	-
BH03	0.9	19.5	-	-	-	-
BH04	1.0	8.6	-	-	-	-
BH05	1.3	18.5	-	-	-	-
BH06	1.0	12.0	-	-	-	-
BH06	2.2	19.5	-	-	-	-
BH06	2.9	21.1	-	-	-	-
BH07	0.45	28.0	-	-	-	-
BH08	1.5	17.4	-	-	-	-
BH09	1.0	-	31	16	15	8.0
BH09	1.5	18.7	-	-	-	-

Table 4 Summary of California Bearing Ratio (CBR) Tests

BH ID	Depth (m)	Soil Description	FMC[1] (%)	OMC[2] (%)	MDD[3] (t/m^3)	CBR[4] (%)
BH 01 CBR01	0.6-1.0	Brown Clay	20.5	19.0	1.74	8
BH05 CBR02	0.7-1.1	Brown Silty Clay	18.4	15.0	1.83	7
BH08 CBR03	0.4-0.9	Grey Brown Clay	19.5	13.0	1.88	9

Notes: [1] Field Moisture Content
[2] Optimum Moisture Content
[3] Maximum Dry Density
[4] California Bearing Ratio

CBR values more than 20% have been rounded to the nearest 5%.

Aggressivity and pH screening tests were also conducted, with the results summarised in Tables 5 and 6 below.

Table 5 Summary of pH Screening Tests

BHID	Depth (m)	pHF	pHFox	CRS %	Net Acidity CRS based Mole/T	Liming rate Kg/T
BH01	1.8	5.4	4.7	-	-	-
BH02	1.4	5.2	4.5	-	-	-
BH05	1.0	5.2	4.5	<0.005	25	1.9
BH06	3.3	7.5	5.7	-	-	-
BH07	0.5	5.6	4.2	-	-	-
BH07	1.2	5.1	3.9	-	-	-
BH07	2.5	4.9	3.8	<0.005	16	1.2
BH08	0.5	7.1	5.4	-	-	-
BH08	1.0	7.0	5.6	-	-	-
BH08	1.5	5.0	4.3	<0.005	86	6.4
BH09	2.0	5.2	4.3	-	-	-

Table 6 Summary of Aggressivity Tests

BHID	Depth	Chloride (mg/kg)	Conductivity (µS/cm)	pH	Sulphate (as SO4, mg/kg)	Moisture (%)
BH07	1.2	38	42	5.3	43	20
BH02	1.2	<10	27	5.6	50	15

4. Discussion and Recommendations

4.1 Geotechnical Model

Based on the borehole logs and review of geological maps the site subsurface lithology may be considered in two profiles.

- The area north east of borehole BH08 is underlain by residual clay profile to termination depth (BH1, 2, 3, 5, 8 and 9).
- The area south west of BH08 underlain by fill and alluvial soils.

Based on the DCP test results all soils including alluvial soils are assessed to be firm to very stiff.

No evidence of a weak alluvial layer was encountered in the boreholes.

It is noted that some areas in Warriewood valley contained peat and soft clay underlain by water charged alluvial loose sand. Presence of such layers may be detected during earthworks when proof roll inspections are carried out.

4.2 Earthworks

It is likely that earthworks would be required to bring some parts of the site above flood level and also to facilitate drainage. Site regrading plans were not available at the time of this commission. CS recommends that the earthworks plans to be reviewed by a geotechnical consultant prior to construction.

In general, the following recommendations are made:

- Topsoil and uncontrolled fill found on site should be removed and sorted for later use where appropriate. It is noted that topsoil depth to be up to 0.8m. CS recommends that vegetative layer of topsoil and fill be stripped and disposed offsite or use for later landscaping if required.
- Topsoil with less than about 0.5% vegetable matter may be blended at a ratio of 3: t general fill : topsoil for incorporating in earthworks.
- Stripped surface should be proof rolled and soft or deflecting areas should be excavated and back filled with suitable fill.
- There may be a requirement for a bridging layer consisting of granular fill or ballast including geogrids and geofabrics at some places depending upon the in-situ moisture condition at the time.

- Slightly or moderately reactive fill materials such as ripped sandstone should be used for filling to reduce the risk of adverse site classification.
- Earthworks should be carried out in accordance with AS3798 Guidelines for Earthworks in Commercial and Residential Development with testing carried out under Level 1.

4.3 Foundation Design Recommendations

Pad / strip / stiffened raft footings founded on stiff or better residual clay may be considered. Load bearing elements may be proportioned for a maximum allowable bearing pressure (ABP) of 100 kPa on stiff or better residual soils expected below 0.8m. Alternatively, high level footings may be placed in controlled fill placed under level 1 testing as described above. Settlements for pad footings on clay are anticipated to be up to about 15mm where loading does not exceed the maximum allowable values.

All footings should be founded on material with similar end bearing capacity to limit differential movement across the building footprint. Individual pad footings should not span the interface between different foundation materials.

Table 7 Allowable Bearing Capacity of Subsurface Material

	Allowable Vertical Bearing Capacity	
Foundation material	**Shallow Footing (kPa)[1]**	**Bored Piles (kPa)[2]**
Topsoil/Uncontrolled Fill [3]	N/A	N/A
Stiff Sandy Clay (expected below 0.8m)/ Controlled fill	100	N/A
Very Stiff Clay (expected below 1.3m)	170	300

Notes:

1. Allowable bearing pressure for shallow footings assuming a geotechnical strength reduction factor of 0.5 and a serviceability factor of 0.5.
2. Allowable end bearing pressure for piles assuming a geotechnical strength reduction factor of 0.5 and a serviceability factor of 0.5. Base of piles to be inspected by a geotechnical engineer to confirm expected materials are encountered and bearing capacity is met. The depth to pile toe should be at least 5 times the diameter.
3. Fill materials are assumed to have been placed under uncontrolled condition and are not suitable as support for the proposed building.

The above design parameters are based on the assumptions that the base of excavation is free of loose or soft soils and water prior to placement of concrete, and an embedment of at least 1.0 m or two to three pile diameter, whichever is greatest, in the material unit.

All footings should be inspected by a Geotechnical Engineer or Principal Certifying Authority (PCA) and constructed with minimal delay following excavation. The Geotechnical Engineer is to confirm encountered conditions satisfy design assumptions. Water that has ponded in the base of excavations and any resultant softened material is to be removed prior to footing construction. If a delay in construction is anticipated, we recommend that a concrete blinding layer of at least 50 mm thickness is placed to protect the foundation material.

4.4 Interim AS2870 Classifications.

Natural site within residual soil area can be given an interim site classification in accordance with AS2870-2011 of Class M (Moderately Reactive). Any cut fill earthworks more than 300mm depth would alter the site classification and the modified site classification should be reviewed by a geotechnical; consultant following earthworks.

Placement of reactive fill would increase the severity of site classification.

The classifications provided here assumes that the site maintenance is carried out based on the recommendations of CSR BTF -18 Foundation Maintenance and Footing performance included in Appendix A and the performance expectations are in accordance with those in Appendix B of AS2870-2011.

4.5 Excavation

No major excavation is expected as part of the proposed development. However, excavations for the purpose of shallow footings and buried services are expected to encounter fill and residual clay soils, which can be readily excavated using conventional earthmoving equipment.

All excavation work should be completed with reference to the Code of Practice 'Excavation Work', by Safe Work Australia. Excavation method statements will need to be prepared by the excavation contractor prior to the issue of CC.

4.5.1 Batter Slopes

Recommended maximum slopes for permanent and temporary batters less than 2m height are presented in Table 8. All deeper excavations or fill embankments should be subjected to geotechnical design.

Table 8 Recommended maximum dry batter slopes

Unit		
	Permanent	**Temporary**
Residual Clay & Alluvial Clay	2.5:1	1:1
Medium Dense Sand (or denser)	3:1	2:1

4.6 Subgrade Design CBR

Table 4 above summarises the results of laboratory CBR tests carried out on the three subgrade samples. CBR values ranged between 7% and 9% and were up to 6.5% wet of standard optimum moisture content.

Inferred in-situ CBR from DCP test results are presented in Table 2 above. CBR interpreted in this way is at in-situ FMC condition, compared to a 4-day soaked condition for the laboratory CBR values, and as such is useful for helping define weak subgrade conditions associated with wetter and or poorly drained in-situ subgrade.

4.7 Pavement Design

Based on Northern Beaches Council guidelines and Austroads 2017 – Guide to Pavement Technology Part 2 - Pavement Structural Design, the pavement design for the proposed subdivision is given in Table 9 below.

The pavement layer thickness has been assessed based off the Northern Beaches Council guidelines for minor and local residential roads.

If a different road description classification is to be assigned, please contact CS and the design can be revised.

Table 9 Flexible Pavement Design

DESA	CBR (%)	Base Course (mm)	Intermediate Course (mm)	Wearing Course (mm)	Total (mm)
$2x10^5$	5	200	120	40	360

Notes: The above pavement thickness is for good subgrade conditions. Where the existing subgrade condition is poor, a select subgrade course must be provided.

Subgrade is to be thoroughly trimmed and compacted by applying a roller of no less than 8 tonnes until it conforms to the required profile and exhibits some degree of compacion. Any unstable or soft patches shall be removed and replaced.

4.7.1 Additional Recommendations

Subsoil drains should be installed to a minimum depth no less than 600mm below finished subgrade level along both sides of all roads or as directed by Council Engineers.

During construction, it is recommended that a Senior Geotechnician, Geotechnical Engineer or other experienced consultant inspect the subgrade following preliminary boxing in order to verify subgrade conditions and the recommended CBR design value. If any adverse moisture conditions are encountered, provisions should be made for potential replacement of subgrade material.

For any sections of road requiring fill placement, the placed fill material must have a CBR value equal to or greater than 15%. The fill, subgrade and pavement layers should also be compacted to the following minimum dry density ratios (AS 1289 5.4.1) during construction.

Basecourse	98% Modified
Subbase	98% Modified
Subgrade/Select fill	100% Standard

4.8 Durability

Two soil samples were tests for durability assessment including chloride, sulphate, pH and Electrical Conductivity. Based on the test results soils were assessed to be non-aggressive to both steel and concrete members in contact with soil.

4.9 Acid Sulphate Soils

Twelve samples from 8 boreholes were subjected to pH screening test.

All samples recorded pH >4.5 in water (pHF).

All samples recorded pHFox >3.0

Based on screening test results and in accordance with NSW Acid Sulphate Soil management manual all samples are assessed to be neither Actual Acid Sulphate (AASS) nor Potential Acid Sulphate (PASS).

Nevertheless, three samples were subjected Chromium Reducible Sulphur suite of tests. The results indicated the soil samples did not contain any unoxidized sulphur. There were minor quantities of existing acidity ranging from 16 Moles/t to 86 moles per tonne of hydrogen with an average of 37moles/ton.

Test results are included in Appendix C.

The soils are assessed to be fine grained soils and therefore if less than 1000t of soil to be disturbed no acid sulphate management is required.

Based on the proposed development where excavation is limited to OSD basin, it is unlikely that more than 1000t of acid sulphate soils would be excavated. Therefore, CS assessed that an Acid Sulphate management Plan is not required.

5. Closure

This report should be read in conjunction with the 'Important Information about this Geotechnical Report' sheet below.

CS trusts this report meets your current requirements. Please do not hesitate to contact George Sourenian 0475 778 595 or george.sourenian@constructionsciences.net if you have any queries.

6. References

AS1726-2017 'Geotechnical site investigations'

Austroads 2017 – Guide to Pavement Technology Part 2 - Pavement Structural Design

Wollondilly Shire Council – Subdivision & Engineering Standard

Appendix A

Important Information and General Notes

Important Information about this Geotechnical Report

Scope of Work

The purpose of this report and any associated documentation is expressly stated in the document. This document does not form a complete assessment of the site, and no implicit determinations about Construction Sciences scope can be taken if not specifically referenced. Whilst this report is intended to reduce geotechnical risk, no level of detail or scope of work can entirely eliminate risk.

The nature of geotechnical data typically precludes auxiliary environmental assessment without undertaking specific methods in the investigation. Therefore, unless it is explicitly stated in the scope of work, this report does not provide any contamination or environmental assessment of the site or adjacent sites, nor can it be inferred or implied from any component of the document.

The scope of work, geotechnical information, and assessments made by Construction Sciences may be summarised in the report; however, all aspects of the document, including associated data and limitations should be reviewed in its entirety.

Standard of care

Construction Sciences have undertaken investigations, performed consulting services, and prepared this report based on the Client's specific requirements, data that was available or was collected, and previous

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Variability in conditions and limitations of data

Subsurface conditions are complex and can be highly variable; they cannot be accurately defined by discrete investigations. Geotechnical data is based on investigation locations which are explicitly representative of the specific sample or test points. Interpretation of conditions between such points cannot be assumed to represent actual subsurface information and there are unknowns or variations in ground conditions between test locations that cannot be inferred or predicted.

The precision and reliability of interpretive assessment between discrete points is dependent on the uniformity of the subsurface strata, as well as the frequency, detail, and method of sampling or testing.

Subsurface conditions are formed by various natural and anthropogenic processes and therefore are subject to change over time. This is particularly relevant with changes to the site ownership or usage, site boundary or layout, and design or planning modifications. Aspects of the site may also not be able to be determined due to physical or project related constraints and any information provided by Construction Sciences cannot apply following modification to the site, regulations, standards, or the development itself.

It is important to appreciate that no level of detail in investigation, or diligence in assessment, can eliminate uncertainty related to subsurface conditions and thus, geotechnical risk. Construction Sciences cannot and does not provide unqualified warranties nor does it assume any liability for site conditions not observed or accessible during the investigations.

Verification of opinions and recommendations

Geotechnical information, by nature, represents an opinion and is based extensively on judgment of both data and interpretive assessments or observation. This report and its associated documentation are provided explicitly based on Construction Sciences opinion of the site at the time of inspection, and cannot be extended beyond this.

Any recommendations or design are provided as preliminary until verified on site during project implementation or construction. Inspection and verification on site shall be conducted by a suitably qualified geotechnical consultant or engineer, and where subsurface conditions or interpretations differ from those provided in this document or otherwise anticipated, Construction Sciences must be notified and be provided with an opportunity to review the recommendations.

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Appendix B
Site Plan and Borehole Logs

LEGEND:

Approximate Borehole Locations

N

Construction Sciences

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Scale: NTS	Client: PVD No.21 c/o Craig and Rhodes	
Date: 19th May 2021	Project: 10791E/P/453	
Drawn By: DK	Location: 53A Warriewood Rd, Warriewood NSW 2102	
Drawing No: 10791E/P/453	Sheet: 1 of 1	**Site Plan 1**

Explanatory Notes

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. Material descriptions are deduced from field observation or engineering examination, and may be appended or confirmed by in situ or laboratory testing. The information is dependent on the scope of investigation, the extent of sampling and testing, and the inherent variability of the conditions encountered.

Subsurface investigation may be conducted by one or a combination of the following methods.

Method	
Test Pitting: excavation/trench	
BH	Backhoe bucket
EX	Excavator bucket
R	Ripper
H	Hydraulic Hammer
X	Existing excavation
N	Natural exposure
Manual drilling: hand operated tools	
HA	Hand Auger
Continuous sample drilling	
PT	Push tube
PS	Percussion sampling
SON	Sonic drilling
Hammer drilling	
AH	Air hammer
AT	Air track
Spiral flight auger drilling	
AS	Auger screwing
AD/V	Continuous flight auger: V-bit
AD/T	Continuous spiral flight auger: TC-Bit
HFA	Continuous hollow flight auger
Rotary non-core drilling	
WB	Washbore drilling
RR	Rock roller
Rotary core drilling	
PQ	85mm core (wire line core barrel)
HQ	63.5mm core (wire line core barrel)
NMLC	51.94mm core (conventional core barrel)
NQ	47.6mm core (wire line core barrel)
DT	Diatube (concrete coring)

Sampling is conducted to facilitate further assessment of selected materials encountered.

Sampling method	
Soil sampling	
B	Bulk disturbed sample
D	Disturbed sample
C	Core sample
ES	Environmental soil sample
SPT	Standard Penetration Test sample
U	Thin wall tube ‘undisturbed’ sample
Water sampling	
WS	Environmental water sample

Field testing may be conducted as a means of assessment of the in situ conditions of materials.

Field testing	
SPT	Standard Penetration Test
HP/PP	Hand/Pocket Penetrometer
Dynamic Penetrometers (blows per noted increment)	
DCP	Dynamic Cone Penetrometer
PSP	Perth Sand Penetrometer
MC	Moisture Content
VS	Vane Shear
PBT	Plate Bearing Test
IMP	Borehole Impression Test
PID	Photo Ionization Detector

If encountered, refusal (R), virtual refusal (VR) or hammer bouncing (HB) of penetrometers may be noted.

The quality of the rock can be assessed by the degree of natural defects/fractures and the following.

Rock quality description	
TCR	Total Core Recovery (%) (length of core recovered divided by the length of core run)
RQD	Rock Quality Designation (%) (sum of axial lengths of core greater than 100mm long divided by the length of core run)

Notes on groundwater conditions encountered may include.

Groundwater	
Not Encountered	Excavation is dry in the short term
Not Observed	Water level observation not possible
Seepage	Water seeping into hole
Inflow	Water flowing/flooding into hole

Perched groundwater may result in a misleading indication of the depth to the true water table. Groundwater levels are also likely to fluctuate with variations in climatic and site conditions.

Notes on the stability of excavations may include.

Excavation conditions	
Stable	No obvious/gross short term instability noted
Spalling	Material falling into excavation (minor/major)
Unstable	Collapse of the majority, or one or more face of the excavation

Explanatory Notes: General Soil Description

The methods of description and classification of soils used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, a material is described as a soil if it can be remoulded by hand in its field condition or in water. The dominant component is shown in upper case, with secondary components in lower case. In general descriptions cover: soil type, plasticity or particle size/shape, colour, strength or density, moisture and inclusions.

In general, soil types are classified according to the dominant particle on the basis of the following particle sizes.

Soil Classification		Particle Size (mm)
CLAY		< 0.002
SILT		0.002 0.075
SAND	fine	0.075 to 0.21
	medium	0.21 to 0.6
	coarse	0.6 to 2.36
GRAVEL	fine	2.36 to 6.7
	medium	6.7 to 19
	coarse	19 to 63
COBBLES		63 to 200
BOULDERS		> 200

Soil types may be qualified by the presence of minor components on the basis of field examination methods and/or the soil grading.

Terminology	In coarse grained soils		In fine soils
	% fines	% coarse	% coarse
Trace	≤5	≤15	≤15
With	>5, ≤12	>15, ≤30	>15, ≤30

The strength of cohesive soils is classified by engineering assessment or field/lab testing as follows.

Strength	Symbol	Undrained shear strength
Very Soft	VS	≤12kPa
Soft	S	12kPa to ≤25kPa
Firm	F	25kPa to ≤50kPa
Stiff	St	50kPa to ≤100kPa
Very Stiff	VSt	100kPa to ≤200kPa
Hard	H	>200kPa

Cohesionless soils are classified on the basis of relative density as follows.

Relative Density	Symbol	Density Index
Very Loose	VL	<15%
Loose	L	15% to ≤35%
Medium Dense	MD	35% to ≤65%
Dense	D	65% to ≤85%
Very Dense	VD	>85%

The plasticity of cohesive soils is defined by the Liquid Limit (LL) as follows.

Plasticity	Silt LL	Clay LL
Low plasticity	≤ 50%	≤ 35%
Medium plasticity	N/A	> 35% ≤ 50%
High plasticity	> 50%	> 50%

The moisture condition of soil (*w*) is described by appearance and feel and may be described in relation to the Plastic Limit (PL), Liquid Limit (LL) or Optimum Moisture Content (OMC).

Moisture condition and description	
Dry	Cohesive soils: hard, friable, dry of plastic limit. Granular soils: cohesionless and free-running
Moist	Cool feel and darkened colour: Cohesive soils can be moulded. Granular soils tend to cohere
Wet	Cool feel and darkened colour: Cohesive soils usually weakened and free water forms when handling. Granular soils tend to cohere

The structure of the soil may be described as follows.

Zoning	Description
Layer	Continuous across exposure or sample
Lens	Discontinuous layer (lenticular shape)
Pocket	Irregular inclusion of different material

The structure of soil layers may include: defects such as softened zones, fissures, cracks, joints and root-holes; and coarse grained soils may be described as strongly or weakly cemented.

The soil origin may also be noted if possible to deduce.

Soil origin and description	
Fill	Anthropogenic deposits or disturbed material
Topsoil	Zone of soil affected by roots and root fibres
Peat	Significantly organic soils
Colluvial	Transported down slopes by gravity/water
Aeolian	Transported and deposited by wind
Alluvial	Deposited by rivers
Estuarine	Deposited in coastal estuaries
Lacustrine	Deposited in freshwater lakes
Marine	Deposits in marine environments
Residual soil	Soil formed by in situ weathering of rock, with no structure/fabric of parent rock evident
Extremely weathered material	Formed by in situ weathering of geological formations, with the structure/fabric of parent rock intact but with soil strength properties

The origin of the soil generally cannot be deduced solely on the appearance of the material and the inference may be supplemented by further geological evidence or other field observation. Where there is doubt, the terms ‘possibly’ or ‘probably’ may be used

Explanatory Notes: General Rock Description

The methods of description and classification of rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, if a material cannot be remoulded by hand in its field condition or in water, it is described as a rock. In general, descriptions cover: rock type, grain size, structure, colour, degree of weathering, strength, minor components or inclusions, and where applicable, the defect types, shape, roughness and coating/infill.

Rock types are generally described according to the predominant grain or crystal size, and in groups for each rock type as follows.

Rock type	Groups
Sedimentary	Deposited, carbonate (porous or non), volcanic ejection
Igneous	Felsic (much quartz, pale), Intermediate, or mafic (little quartz, dark)
Metamorphic	Foliated or non-foliated
Duricrust	Cementing minerology (iron oxides or hydroxides, silica, calcium carbonate, gypsum)

Reference should be made to AS1726 for details of the rock types and methods of classification.

The classification of rock weathering is described based on definitions in AS1726 and summarised as follows.

Term and symbol		Definition
Residual Soil	RS	Soil developed on rock with the mass structure and substance of the parent rock no longer evident
Extremely weathered	XW	Weathered to such an extent that the rock has 'soil-like' properties. Mass structure and substance still evident
Distinctly weathered	DW	The strength is usually changed and may be highly discoloured. Porosity may be increased by leaching, or decreased due to deposition in pores. May be distinguished into MW (Moderately Weathered) and HW (Highly Weathered).
Slightly weathered	SW	Slightly discoloured; little or no change of strength from fresh rock
Fresh Rock	FR	The rock shows no sign of decomposition or staining

The rock material strength can be defined based on the point load index as follows.

Term and symbol		Point Load Index I_s50 (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1.0
High	H	1.0 to 3
Very High	VH	3 to 10
Extremely High	EH	> 10

It is important to note that the rock material strength as above is distinct from the rock mass strength which can be significantly weaker due to the effect of defects.

A preliminary assessment of rock strength may be made using the field guide detailed in AS1726, and this is conducted in the absence of point load testing.

The defect spacing measured normal to defects of the same set or bedding, is described as follows.

Definition	Defect Spacing (mm)
Thinly laminated	< 6
Laminated	6 to 20
Very thinly bedded	20 to 60
Thinly bedded	60 to 200
Medium bedded	200 to 600
Thickly bedded	600 to 2000
Very thickly bedded	> 2000

Terms for describing rock and defects are as follows.

Defect Terms			
Joint	JT	Sheared zone	SZ
Bedding Parting	BP	Seam	SM
Foliation	FL	Vein	VN
Cleavage	CL	Drill Lift	DL
Crushed Seam	CS	Handling Break	HB
Fracture Zone	FZ	Drilling Break	DB

The shape and roughness of defects in the rock mass are described using the following terms.

Planarity		Roughness	
Planar	PR	Very Rough	VR
Curved	CU	Rough	RF
Undulose	UN	Smooth	S
Irregular	IR	Slickensided	SL
Stepped	ST	Polished	POL
Discontinuous	DIS		

The coating or infill associated with defects in the rock mass are described as follows.

Infill and Coating		
Clean	CN	
Stained	SN	
Carbonaceous	X	
Minerals	MU	Unidentified mineral
	MS	Secondary mineral
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
Veneer	VNR	Thin or patchy coating
Coating	CT	Infill up to 1mm

Construction Sciences

Graphic Symbols Index


CLAY


Silty CLAY


Sandy CLAY


Gravelly CLAY


Silty Gravelly CLAY


Silty Sandy CLAY


Sandy Gravelly


CLAY SILT


Clayey SILT


Sandy SILT


Gravelly SILT


Clayey Sandy SILT


Clayey Gravelly SILT


Sandy Gravelly SILT


SAND


Clayey SAND


Silty SAND


Gravelly SAND


Clayey Silty SAND


Clayey Gravelly SAND


Silty Gravelly SAND


GRAVEL


Clayey GRAVEL


Silty GRAVEL


Sandy GRAVEL


Clayey Silty GRAVEL


Clayey Sandy GRAVEL


Silty Sandy GRAVEL


COBBLES & BOULDERS


PEAT, highly organic soil


TOPSOIL


FILL


FILL: Asphalt or Bituminous Seal


FILL: Ballast


FILL: Concrete


FILL: Roadbase


Sedimentary rock: fine, mostly clay (CLAYSTONE)


Sedimentary rock: fine, mostly silt (SILTSTONE)


Sedimentary rock: fine, silt and clay (MUDSTONE, SHALE, LAMINITE)


Sedimentary rock: medium (SANDSTONE, GREYWACKE)

Sedimentary rock: fine to coarse, angular (BRECCIA)

Sedimentary rock: coarse, rounded (CONGLOMERATE)

Sedimentary rock: Organic (COAL)

Sedimentary rock: Carbonate (LIMESTONE, DOLOMITE)

Sedimentary rock: Volcanic (TUFF, VOLCANIC BRECCIA, AGGLOMERATE)

Igneous rock: Felsic, fine (RHYOLITE)

Igneous rock: Felsic, coarse (GRANITE)

Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)

Igneous rock: Mafic, coarse (GABBRO)

Metamorphic rock: Foliated, fine to medium (SLATE, PHYLLITE, SHIST)

Metamorphic rock: Foliated, coarse (GNEISS)

Metamorphic rock: Non-foliated (QUARTZITE, HORNFELS, MARBLE)

Construction Sciences

BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH01

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered		3	0.0		ML	TOPSOIL: Clayey Sandy SILT: low plasticity, dark-grey and brown, fine grained sand, with rootlets	M (≈PL)		TOPSOIL
					3							
					7							
					7	0.40m						
				B 0.60 - 1.00 m CBR	8	0.5		CL-Cl	CLAY: red-brown, with fine to medium grained gravel, trace fine grained sand	M (<PL)	VSt to H	RESIDUAL SOIL
					7							
				D 0.85 - 0.85 m FMC	9							
					10							
					12	1.0						
					8							
					11							
					8							
					7							
				D 1.40 - 1.40 m	10	1.5						
					10	1.50m			TERMINATED AT 1.50 m Target depth			
					11							
					10							
					12							
						2.0						
						2.5						
						3.0						
						3.5						

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES

B	-	Bulk disturbed sample
D	-	Disturbed sample
ES	-	Environmental sample
U	-	Thin wall tube 'undisturbed'

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
S	-	Soft
F	-	Firm
St	-	Stiff
VSt	-	Very Stiff
H	-	Hard

RELATIVE DENSITY

VL	-	Very Loose
L	-	Loose
MD	-	Medium Dense
D	-	Dense
VD	-	Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH02

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered		1 2	0.0		ML	TOPSOIL: Clayey Sandy SILT: low plasticity, dark-grey and brown, fine grained sand, with rootlets	M (≈PL)		TOPSOIL
					2 1 2 4 8 7 10 9 10 13 14 15 8 10 16 15 18	0.5 1.0 1.5 2.0		CI	0.40m CLAY: medium plasticity, orange-red and red-brown, with fine to medium grained gravel, trace sand	M (<PL)	S F VSt	RESIDUAL SOIL
								CI	1.55m CLAY: medium plasticity, red-brown, with fine to medium grained gravel 2.10m	M (<PL)	H	
					20 25	2.5 3.0 3.5			TERMINATED AT 2.10 m Refusal			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH03

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered		5 10 9 14 17 10 9	0.5		CL	TOPSOIL: Sandy Silty CLAY: low plasticity, dark-brown, trace fine to medium grained gravel 0.80m	M (<PL)		TOPSOIL
				D 0.90 - 1.00 m FMC	3 3 4 3 4 6 10 11 12 14 18	1.0 1.5 2.0		CI	CLAY: medium plasticity, mottled orange and brown and pale grey-brown, trace fine to medium grained gravel 2.00m TERMINATED AT 2.00 m Target depth	M (≈PL)	St H	RESIDUAL SOIL
						2.5 3.0 3.5						

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES

B	-	Bulk disturbed sample
D	-	Disturbed sample
ES	-	Environmental sample
U	-	Thin wall tube 'undisturbed'

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
S	-	Soft
F	-	Firm
St	-	Stiff
VSt	-	Very Stiff
H	-	Hard

RELATIVE DENSITY

VL	-	Very Loose
L	-	Loose
MD	-	Medium Dense
D	-	Dense
VD	-	Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH04

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered		7 18 10	0.0		ML	TOPSOIL: Clayey Sandy SILT: low plasticity, dark-brown, fine to coarse grained sand, with fine to medium grained gravel	M (≈PL)		TOPSOIL
					19 25	0.40m 0.5		GP-GM	FILL: Silty Sandy GRAVEL: fine to medium, poorly graded, fine to coarse grained sand	M to D		FILL
				D 1.00 m FMC		1.00m 1.0			TERMINATED AT 1.00 m Refusal			
						1.5						
						2.0						
						2.5						
						3.0						
						3.5						

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

- Water Level on Date shown
- water inflow
- water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
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VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

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PL	-	Plastic limit
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SOIL CONSISTENCY

VS	-	Very Soft
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RELATIVE DENSITY

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L	-	Loose
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VD	-	Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH05

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered			0		ML	TOPSOIL: Sandy Clayey SILT: low plasticity, brown-yellow, fine to coarse grained sand, with rootlets	M (≈PL)		TOPSOIL
									0.30m			
					5			CL-CI	CLAY: low plasticity, orange brown, with fine grained sand	M (<PL)	VSt	RESIDUAL SOIL
					7							
					7	0.5						
					7							
					6							
					5							
					3							
				D 1.00 m AGG	4	1.0		CL-CI	Sandy CLAY: low plasticity, mottled orange-brown and red, trace fine grained gravel	M (>PL)	St to VSt	
					6							
				D 1.20 m FMC	6							
					7							
					11							
					14	1.5			1.50m			
					14				TERMINATED AT 1.50 m Target depth			
					16							
						2.0						
						2.5						
						3.0						
						3.5						

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
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PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES

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MOISTURE

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W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
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RELATIVE DENSITY

VL	-	Very Loose
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Refer to explanatory notes for details of abbreviations and basis of descriptions

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BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH06

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing	Water	Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	▽	D 2.20 m FMC	3 5 5 6 25	0.5		Cl	FILL: Silty Sandy CLAY: medium plasticity, brown, with fine to medium grained gravel	M (<PL)	-	FILL
					7 8 7 7 5 3 3 5 8	1.5 2.0		Cl	1.60m FILL: Sandy CLAY: medium plasticity, pale-grey and grey-brown, fine to coarse grained sand, trace fine grained gravel, sandstone	M (≈PL)		
				D 3.00 m AGG ASS 3.30 m ASS	7 15 14 14 11 17 17 15 21 21	2.5 3.0		Cl-CH	2.20m Silty CLAY: medium to high plasticity, grey, trace fine grained sand	M (>PL)	VSt H	ALLUVIUM
						3.5			3.50m TERMINATED AT 3.50 m Refusal			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

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Construction Sciences

BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH07

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/13 **Date Completed:** 21/5/13 **Logged By:** DK **Checked By:**

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing	Water	Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	▽	D 0.40 m AGG D 0.45 m FMC ASS 0.50 m ASS	1 2 2 2 3 4 5 6 7	0.5 1.0		ML	TOPSOIL: Clayey SILT: low plasticity, dark-grey, with fine grained sand, with rootlets	M (>PL)		TOPSOIL
									0.30m Silty CLAY: low to medium plasticity, pale-grey and grey		F	ALLUVIUM
								CL-CI		M (>PL)	St to VSt	
				ASS 1.20 m ASS	10 10 19 20 20 22	1.5 2.0		CH	1.10m CLAY: high plasticity, pale-grey, trace fine grained sand	M (>PL)	H	
				ASS 2.50 m ASS		2.5 3.0 3.5		CL	2.10m Clayey SAND: fine to medium grained, pale-grey, low plasticity clay	M (>PL)	L to MD	
									4.00m TERMINATED AT 4.00 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Construction Sciences

BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH08

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/14 **Date Completed:** 21/5/14 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test	DCP		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered		1	0		ML	TOPSOIL: Clayey SILT: low plasticity, dark-brown, with fine to medium grained sand, with fine grained gravel, rootlets	M (>PL)		TOPSOIL
				B 0.40 - 0.90 m CBR D 0.45 m AGG ASS 0.45 m ASS	1 1 1 2 3	0.40m 0.5		CI-CH	CLAY: medium to high plasticity, orange-brown and grey-brown, trace rootlets	M (≈PL)	S	RESIDUAL SOIL
				D 1.00 m AGG	4 4 6 8 10 10	0.70m 1.0		CI	CLAY: mottled pale-grey and red-grey, trace fine grained sand	M (≈PL)	F to St VSt to H	
				ASS 1.50 m ASS D 1.50 m FMC	15 18	1.50m 1.5			TERMINATED AT 1.50 m Target depth			
						2.0						
						2.5						
						3.0						
						3.5						

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES

B	-	Bulk disturbed sample
D	-	Disturbed sample
ES	-	Environmental sample
U	-	Thin wall tube 'undisturbed'

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
S	-	Soft
F	-	Firm
St	-	Stiff
VSt	-	Very Stiff
H	-	Hard

RELATIVE DENSITY

VL	-	Very Loose
L	-	Loose
MD	-	Medium Dense
D	-	Dense
VD	-	Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Construction Sciences

BOREHOLE LOG SHEET

Client: PVD No.21 Pty Ltd c/o Craig and Rhodes
Project:
Location: 53A Warriewood Rd, Warriewood

Hole No: BH09

Job No: 10791E/P/453 **Sheet:** 1 of 1

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Ute Mounted Drill Rig **Mounting:** Light Vehicle **Driller:** DTD
Casing/Hole Diameter: None / **Contractor:**
Date Started: 21/5/14 **Date Completed:** 21/5/14 **Logged By:** DK **Checked By:**

Drilling			Water	Sampling & Testing	Depth (m)	Material Description					
Method	Resistance	Casing		Sample or Field Test		Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T	E	None	Not Encountered	D 0.50 m AGG ASS 0.60 m ASS D 1.00 m ATT D 1.50 m FMC ASS 2.00 m ASS ASS 3.50 m ASS	0 0.5 1.0 1.5 2.0 2.5 3.0 3.5		ML	TOPSOIL: Sandy Clayey SILT: low plasticity, dark-brown, fine grained sand, with rootlets	M (≈PL)		TOPSOIL
								0.30m			
								Sandy CLAY: medium plasticity, orange-brown			RESIDUAL SOIL
							Cl		M (>PL)		
								1.80m			
								CLAY: medium plasticity, orange and grey, with fien to medium grained sand			
							Cl		M (>PL)		
								2.80m			
								Clayey SAND: fine to medium grained, medium plasticity, pale-grey and grey			
							SC		M		
								4.00m			

TERMINATED AT 4.00 m
Target depth

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger: V-Bit
AD/T	Solid flight auger: TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy (No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard (Refusal)

WATER

Water Level on Date shown
water inflow
water outflow

FIELD TESTS

SPT	-	Standard Penetration Test
PP	-	Hand/Pocket Penetrometer
DCP	-	Dynamic Cone Penetrometer
PSP	-	Perth Sand Penetrometer
MC	-	Moisture Content
PBT	-	Plate Bearing Test
IMP	-	Borehole Impression Test
PID	-	Photoionisation Detector
VS	-	Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES

B	-	Bulk disturbed sample
D	-	Disturbed sample
ES	-	Environmental sample
U	-	Thin wall tube 'undisturbed'

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet
PL	-	Plastic limit
LL	-	Liquid limit
w	-	Moisture content

SOIL CONSISTENCY

VS	-	Very Soft
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VSt	-	Very Stiff
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RELATIVE DENSITY

VL	-	Very Loose
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Refer to explanatory notes for details of abbreviations and basis of descriptions

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Appendix C
Laboratory Test Results

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
Unit 2, 4 Kellogg Road,
Glendenning NSW 2761

Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

MOISTURE CONTENT REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/249571-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	2/06/2021 Page 1 of 2

Test Procedures:	AS1289.2.1.1

Sample Number	12385/S/898468	12385/S/898469	12385/S/898471	12385/S/898472
ID / Client ID	-	-	-	-
Lot Number	-	-	-	-
Date / Time Sampled	24/05/2021	24/05/2021	24/05/2021	24/05/2021
Sampling Method	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b
Sampled By	Daniel Duffy	Daniel Duffy	Daniel Duffy	Daniel Duffy
Tested By	Christopher McDonald	Christopher McDonald	Christopher McDonald	Christopher McDonald
Date Tested	25/05/2021	25/05/2021	25/05/2021	25/05/2021
Material Source	Existing	Existing	Existing	Existing
Material Type	In-Situ	In-Situ	In-Situ	In-Situ
Borehole	BH01	BH01	BH02	BH03
Depth	0.85 -> 0.85	1.3 -> 1.3	1.3 -> 1.3	0.9 -> 0.9
Moisture Content (%)	**24.7**	**18.7**	**15.2**	**19.5**

Sample Number	12385/S/898473	12385/S/898474	12385/S/898475	12385/S/898476
ID / Client ID	-	-	-	-
Lot Number	-	-	-	-
Date / Time Sampled	24/05/2021	24/05/2021	24/05/2021	24/05/2021
Sampling Method	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b
Sampled By	Daniel Duffy	Daniel Duffy	Daniel Duffy	Daniel Duffy
Tested By	Christopher McDonald	Christopher McDonald	Christopher McDonald	Christopher McDonald
Date Tested	25/05/2021	25/05/2021	25/05/2021	25/05/2021
Material Source	Existing	Existing	Existing	Existing
Material Type	In-Situ	In-Situ	In-Situ	In-Situ
Borehole	BH04	BH05	BH06	BH06
Depth (m)	1.0 -> 1.0	1.3 -> 1.3	1.0 -> 1.0	2.2 -> 2.2
Moisture Content (%)	**8.6**	**18.5**	**12.0**	**19.5**

Remarks

NATA

Accredited for compliance with ISO/IEC 17025 – Testing

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W20Rep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
Unit 2, 4 Kellogg Road,
Glendenning NSW 2761

Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

MOISTURE CONTENT REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/249571-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	2/06/2021 Page 2 of 2

Test Procedures:	AS1289.2.1.1

Sample Number	12385/S/898477	12385/S/898478	12385/S/898479	12385/S/898481
ID / Client ID	-	-	-	-
Lot Number	-	-	-	-
Date / Time Sampled	24/05/2021	24/05/2021	24/05/2021	24/05/2021
Sampling Method	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b	AS1289.1.2.1 Cl 6.4b
Sampled By	Daniel Duffy	Daniel Duffy	Daniel Duffy	Daniel Duffy
Tested By	Christopher McDonald	Christopher McDonald	Christopher McDonald	Christopher McDonald
Date Tested	25/05/2021	25/05/2021	25/05/2021	25/05/2021
Material Source	Existing	Existing	Existing	Existing
Material Type	In-Situ	In-Situ	In-Situ	In-Situ
Borehole	BH06	BH07	BH08	BH09
Depth	2.9 -> 2.9	0.45 -> 0.45	1.5 -> 1.5	1.5 -> 1.5
Moisture Content (%)	**21.1**	**28.0**	**17.4**	**18.7**

Sample Number				
ID / Client ID				
Lot Number				
Date / Time Sampled				
Sampling Method				
Sampled By				
Tested By				
Date Tested				
Material Source				
Material Type				
Borehole				
Depth (m)				
Moisture Content (%)				

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

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Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W20Rep Rev 3

Construction Sciences

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ABN: 74 128 806 735

Address:
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Glendenning NSW 2761

Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/249572-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	2/06/2021 Page 1 of 2

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	12385/S/898470	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.4b	Borehole	BH02
Date Sampled	24/05/2021	Depth (m)	0.65 -> 0.65
Sampled By	Daniel Duffy		
Date Tested	28/05/2021		
Att. Drying Method	Oven Dried	Material Source	Existing
Atterberg Preparation	Dry Sieved	Material Type	In-Situ
Material Description	-		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**41**	
Plastic Limit (%)		**19**	
Plasticity Index (%)		**22**	
Linear Shrinkage (%)		**10.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 250.1mm / None		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W11bRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
Unit 2, 4 Kellogg Road,
Glendenning NSW 2761

Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/249572-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	2/06/2021 Page 2 of 2

Test Procedures:	AS1289.3.1.1, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	12385/S/898480	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.4b	Borehole	BH09
Date Sampled	24/05/2021	Depth (m)	1.0 -> 1.0
Sampled By	Daniel Duffy		
Date Tested	28/05/2021		
Att. Drying Method	Oven Dried	Material Source	Existing
Atterberg Preparation	Dry Sieved	Material Type	In-Situ
Material Description	-		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**31**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**15**	
Linear Shrinkage (%)		**8.0**	
Linear Shrinkage Defects:	None		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W11bRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
Unit 2, 4 Kellogg Road,
Glendenning NSW 2761

Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

CALIFORNIA BEARING RATIO REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/250052-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	8/06/2021 Page 1 of 3

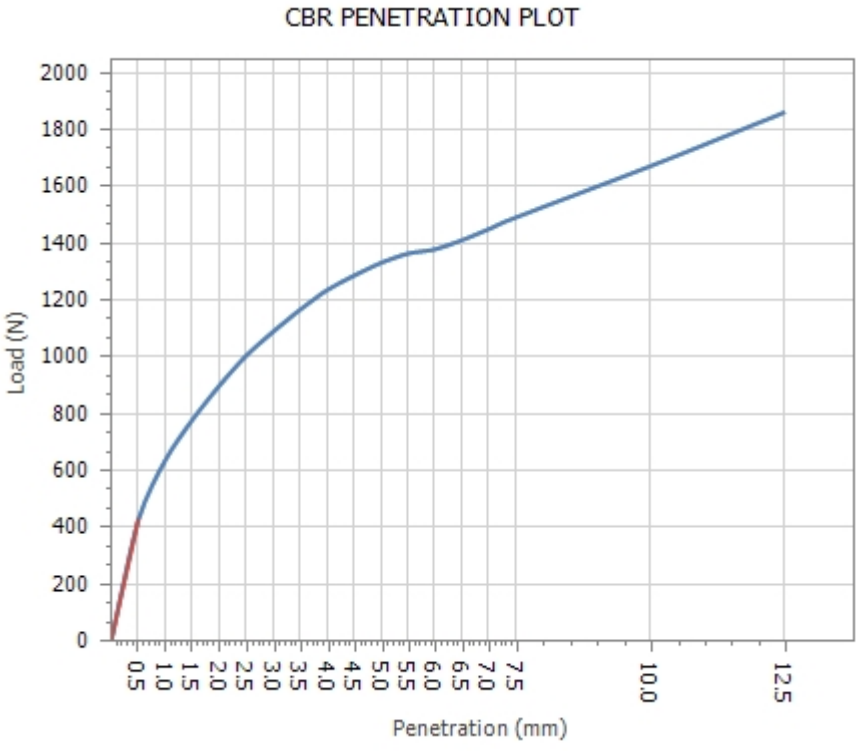
Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1
Sample Number	12385/S/898482
Sampling Method	AS1289.1.2.1 Cl 6.4b
Date Sampled	24/05/2021
Sampled By	Daniel Duffy
Date Tested	1/06/2021
Material Source	Existing
Material Type	In-Situ
Client Reference	-

Sample Location

Borehole		CBR01
Depth	(m)	0.6 -> 1.0

Material Limit Start	-
Material Limit End	-
Compactive Effort	Standard
Material Description	CLAY - Brown

Maximum Dry Density (t/m³):	1.74
Optimum Moisture Content (%):	19.0
Field Moisture Content (%):	20.5
Sample Percent Oversize (%)	1.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.75
Placement Dry Density Ratio (%):	100.0
Placement Moisture Content (%):	19.1
Placement Moisture Ratio (%):	99.5
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	9.0
Dry Density After Soak (t/m³):	1.73
Total Curing Time (hrs)	44
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	22.8
Moisture (remainder) After Soak (%)	20.5
CBR Swell (%):	0.5
Minimum CBR Specification (%):	-
CBR Value @ 2.5mm (%):	**8**



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W2ASRep Rev2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
Unit 2, 4 Kellogg Road,
Glendenning NSW 2761

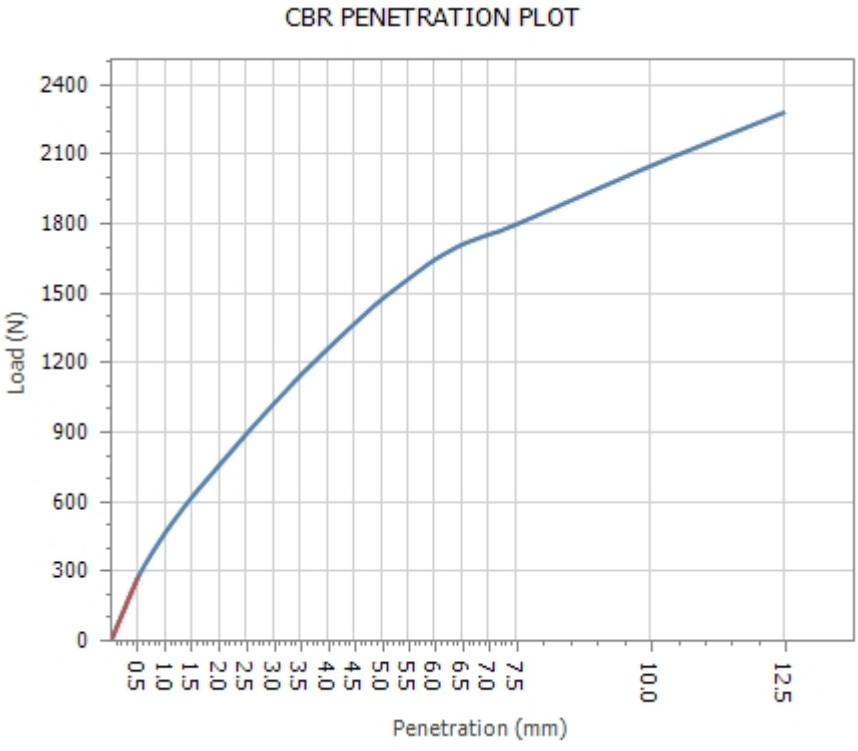
Laboratory: **Glendenning Laboratory**
Phone: 02 9854 1700
Fax: 02 4577 9055
Email: Sydney@constructionsciences.net

CALIFORNIA BEARING RATIO REPORT

Client:	Construction Sciences - Professional Services	Report Number:	12385/R/250052-1
Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
Project:	53A Warriewood RD	Lot Number:	
Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	8/06/2021 Page 2 of 3

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	12385/S/898483	Sample Location	
Sampling Method	AS1289.1.2.1 Cl 6.4b	Borehole	CBR02
Date Sampled	24/05/2021	Depth (m)	0.7 -> 1.1
Sampled By	Daniel Duffy		
Date Tested	7/06/2021		
Material Source	Existing	Material Limit Start	-
Material Type	In-Situ	Material Limit End	-
Client Reference	-	Compactive Effort	Standard
Material Description	Brown Silty Clay		

Maximum Dry Density (t/m³):	1.83
Optimum Moisture Content (%):	15.0
Field Moisture Content (%):	18.4
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.84
Placement Dry Density Ratio (%):	100.0
Placement Moisture Content (%):	14.8
Placement Moisture Ratio (%):	99.5
Test Condition / Soaking Period:	Unsoaked
CBR Surcharge (kg)	9.0
Dry Density After Soak (t/m³):	1.84
Total Curing Time (hrs)	44
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	16.0
Moisture (remainder) After Soak (%)	14.9
CBR Swell (%):	0.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**7**



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
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Client Address:	31 Anvil Road, Seven Hills	Project Number:	12385/P/1528
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Location:	Warriewood	Internal Test Request:	12385/T/111542
Component:	Borehole Sampling	Client Reference/s:	53A Warriewood RD
Area Description:	Warriewood	Report Date / Page:	8/06/2021 Page 3 of 3

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1
Sample Number	12385/S/898484
Sampling Method	AS1289.1.2.1 Cl 6.4b
Date Sampled	24/05/2021
Sampled By	Daniel Duffy
Date Tested	7/06/2021
Material Source	Existing
Material Type	In-Situ
Client Reference	-

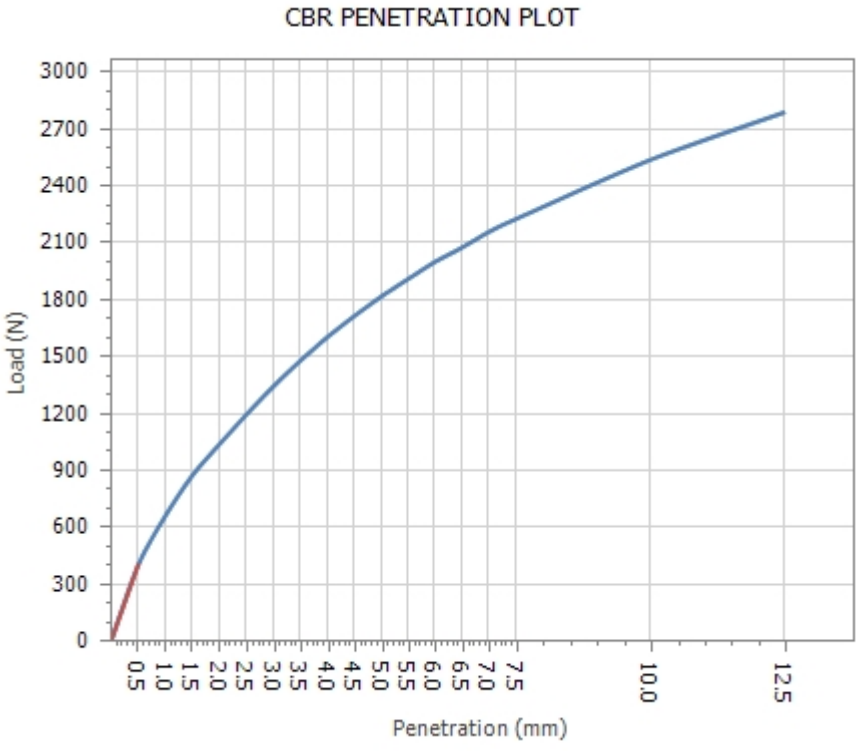
Sample Location

Borehole		CBR03
Depth	(m)	0.4 -> 0.9

Material Limit Start	-
Material Limit End	-
Compactive Effort	Standard

Material Description	Grey Brown Clay

Maximum Dry Density (t/m³):	1.88
Optimum Moisture Content (%):	13.0
Field Moisture Content (%):	19.5
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.89
Placement Dry Density Ratio (%):	100.5
Placement Moisture Content (%):	12.8
Placement Moisture Ratio (%):	97.0
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	9.0
Dry Density After Soak (t/m³):	1.89
Total Curing Time (hrs)	46
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	14.5
Moisture (remainder) After Soak (%)	13.6
CBR Swell (%):	0.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**9**



Remarks

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NATA

Accreditation Number: 1986
Corporate Site Number: 12385

Approved Signatory: Patrick Deasy
Form ID: W2ASRep Rev2

Construction Sciences P/L (Glendenning)
2/4 Kellogg Rd
Glendenning
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NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Attention: **Vipul DeSilva**

Report **795819-S**
Project name
Project ID WARRIEWOOD
Received Date May 14, 2021

Client Sample ID			**BH07 - 1.2**	**BH07 - 0.4**	**BH07 - 0.5 (JAR)**	**BH07 - 2.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S21-My32322**	**S21-My32323**	**S21-My32324**	**S21-My32325**
Date Sampled			**May 14, 2021**	**May 14, 2021**	**May 14, 2021**	**May 14, 2021**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	38	-	-	-
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	42	-	-	-
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.3	-	-	-
Sulphate (as SO4)	10	mg/kg	43	-	-	-
% Moisture	1	%	20	21	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.1	-	5.6	4.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.9	-	4.2	3.8
Reaction Ratings*[S05]	-	comment	1.0	-	1.0	1.0

Client Sample ID			**BH08 - 1.5**	**BH08 - 0.45**	**BH08 - 1.0**	**BH08 - 0.5 (A)**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S21-My32327**	**S21-My32328**	**S21-My32329**	**S21-My32330**
Date Sampled			**May 14, 2021**	**May 14, 2021**	**May 14, 2021**	**May 14, 2021**
Test/Reference	LOR	Unit				
% Moisture	1	%	-	18	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	-	7.0	7.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	-	5.6	5.4
Reaction Ratings*[S05]	-	comment	1.0	-	1.0	1.0

Client Sample ID			0462740212	BH01 - 1.8	BH02 - 1.2	BH04 - 1.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			S21-My32331	S21-My32332	S21-My32333	S21-My32336
Date Sampled			May 14, 2021	May 14, 2021	May 14, 2021	May 14, 2021
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	-	-	< 10	-
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	-	-	27	-
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	-	-	5.6	-
Sulphate (as SO4)	10	mg/kg	-	-	50	-
% Moisture	1	%	-	-	15	15
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	5.4	-	-
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.1	4.7	-	-
Reaction Ratings*[S05]	-	comment	1.0	1.0	-	-

Client Sample ID			BH02 - 1.4	BH05 - 1.0 (BAG)	BH05 - 1.0 (JAR)	BH06 - 3.3 (JAR)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			S21-My32337	S21-My32338	S21-My32339	S21-My32340
Date Sampled			May 14, 2021	May 14, 2021	May 14, 2021	May 14, 2021
Test/Reference	LOR	Unit				
% Moisture	1	%	-	-	15	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.2	5.2	-	7.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.5	4.5	-	5.7
Reaction Ratings*[S05]	-	comment	1.0	1.0	-	1.0

Client Sample ID			BH06 - 3.0	BH09 - 2.0 (JAR)
Sample Matrix			Soil	Soil
Eurofins Sample No.			S21-My32341	S21-My32342
Date Sampled			May 14, 2021	May 14, 2021
Test/Reference	LOR	Unit		
% Moisture	1	%	20	-
Acid Sulfate Soils Field pH Test				
pH-F (Field pH test)*	0.1	pH Units	-	5.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	-	4.3
Reaction Ratings*[S05]	-	comment	-	1.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	May 19, 2021	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	May 19, 2021	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	May 19, 2021	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	May 19, 2021	28 Days
- Method: E045 Anions by Ion Chromatography			
Acid Sulfate Soils Field pH Test	Sydney	May 19, 2021	7 Days
- Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests			
% Moisture	Sydney	May 19, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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Site # 1254 & 14271

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Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: Construction Sciences P/L (Glendenning)
Address: 2/4 Kellogg Rd
Glendenning
NSW 2761

Project Name:
Project ID: WARRIEWOOD

Order No.: P/453
Report #: 795819
Phone: 02 9854 1700
Fax:

Received: May 18, 2021 8:19 AM
Due: May 20, 2021
Priority: 2 Day
Contact Name: Vipul DeSilva

Eurofins Analytical Services Manager : Ursula Long

Sample Detail	CANCELLED	Chloride	Conductivity (1:5 aqueous extract at 25°C as rec.)	HOLD	pH (1:5 Aqueous extract at 25°C as rec.)	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217	X	X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
Perth Laboratory - NATA Site # 23736								
Mayfield Laboratory - NATA Site # 25079								
External Laboratory								

No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID								
1	BH07 - 1.2	May 14, 2021		Soil	S21-My32322		X	X		X	X	X	X
2	BH07 - 0.4	May 14, 2021		Soil	S21-My32323								X
3	BH07 - 0.5 (JAR)	May 14, 2021		Soil	S21-My32324							X	
4	BH07 - 2.5	May 14, 2021		Soil	S21-My32325							X	
5	BH07 -0.5 (BAG)	May 14, 2021		Soil	S21-My32326	X							
6	BH08 - 1.5	May 14, 2021		Soil	S21-My32327							X	
7	BH08 - 0.45	May 14, 2021		Soil	S21-My32328								X
8	BH08 - 1.0	May 14, 2021		Soil	S21-My32329							X	

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Melbourne Laboratory - NATA Site # 1254 & 14271													
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794													
Perth Laboratory - NATA Site # 23736													
Mayfield Laboratory - NATA Site # 25079													
External Laboratory													
9	BH08 - 0.5 (A)	May 14, 2021		Soil	S21-My32330							X	
10	0462740212	May 14, 2021		Soil	S21-My32331							X	
11	BH01 - 1.8	May 14, 2021		Soil	S21-My32332							X	
12	BH02 - 1.2	May 14, 2021		Soil	S21-My32333		X	X		X	X		X
13	BH03 - 2.0	May 14, 2021		Soil	S21-My32334				X				
14	BH03 - 0.9	May 14, 2021		Soil	S21-My32335				X				
15	BH04 - 1.0	May 14, 2021		Soil	S21-My32336								X
16	BH02 - 1.4	May 14, 2021		Soil	S21-My32337							X	
17	BH05 - 1.0 (BAG)	May 14, 2021		Soil	S21-My32338							X	
18	BH05 - 1.0	May 14, 2021		Soil	S21-My32339								X

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Sample Detail						CANCELLED	Chloride	Conductivity (1:5 aqueous extract at 25°C as rec.)	HOLD	pH (1:5 Aqueous extract at 25°C as rec.)	Sulphate (as SO4)	Acid Sulfate Soils Field pH Test	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271													
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794													
Perth Laboratory - NATA Site # 23736													
Mayfield Laboratory - NATA Site # 25079													
External Laboratory													
	(JAR)												
19	BH06 - 3.3 (JAR)	May 14, 2021		Soil	S21-My32340							X	
20	BH06 - 3.0	May 14, 2021		Soil	S21-My32341								X
21	BH09 - 2.0 (JAR)	May 14, 2021		Soil	S21-My32342							X	
22	BH09 - 0.6	May 14, 2021		Soil	S21-My32343				X				
23	BH08 - 0.5 (B)	May 14, 2021		Soil	S21-My32344				X				
Test Counts						1	2	2	5	2	2	12	7

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Chloride	%	101			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	82			70-130	Pass	
Sulphate (as SO4)	%	99			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Chloride	S21-My37108	NCP	%	102			70-130	Pass	
Sulphate (as SO4)	S21-My37108	NCP	%	98			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1	Result 2	RPD	Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S21-My37108	NCP	mg/kg	20	19	8.0	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	S21-My32322	CP	uS/cm	42	45	6.9	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S21-My32322	CP	pH Units	5.3	5.4	<1	30%	Pass	
Sulphate (as SO4)	S21-My37108	NCP	mg/kg	25	24	6.0	30%	Pass	
% Moisture	S21-My32322	CP	%	20	19	4.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised by:

John Nguyen	Analytical Services Manager
Charl Du Preez	Senior Analyst-Inorganic (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Construction Sciences P/L (Glendenning)
2/4 Kellogg Rd
Glendenning
NSW 2761

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
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Attention: **Vipul DeSilva**

Report **797643-S**
Project name ADDITIONAL
Project ID WARRIEWOOD
Received Date May 24, 2021

Client Sample ID			**BH05 1.0**	**BH07 2.5**	**BH08 1.5**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S21-My47085**	**S21-My47086**	**S21-My47087**
Date Sampled			**May 14, 2021**	**May 14, 2021**	**May 14, 2021**
Test/Reference	LOR	Unit			
Chromium Suite					
pH-KCL	0.1	pH Units	4.7	4.8	4.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	25	16	78
sulfidic - TAA equiv. S% pyrite	0.003	% pyrite S	0.040	0.030	0.12
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	N/A	N/A	< 0.02
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0
HCl Extractable Sulfur	0.02	% S	N/A	N/A	< 0.02
Net Acid soluble sulfur	0.02	% S	N/A	N/A	< 0.02
Net Acid soluble sulfur - acidity units	10	mol H+/t	N/A	N/A	< 10
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	N/A	N/A	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	% CaCO3	N/A	N/A	N/A
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	N/A	N/A	N/A
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	N/A	N/A	N/A
ANC Fineness Factor		factor	1.5	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	0.04	0.03	0.14
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	25	16	86
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	1.9	1.2	6.4
Extraneous Material					
<2mm Fraction	0.005	g	73	79	140
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1
% Moisture	1	%	15	21	14

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	May 26, 2021	6 Week
- Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite			
Extraneous Material	Brisbane	May 26, 2021	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Sydney	May 25, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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IANZ # 1290

Company Name: Construction Sciences P/L (Glendenning)
Address: 2/4 Kellogg Rd
Glendenning
NSW 2761

Project Name: ADDITIONAL
Project ID: WARRIEWOOD

Order No.:
Report #: 797643
Phone: 02 9854 1700
Fax:

Received: May 24, 2021 11:08 AM
Due: May 31, 2021
Priority: 5 Day
Contact Name: Vipul DeSilva

Eurofins Analytical Services Manager : Ursula Long

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							X
Brisbane Laboratory - NATA Site # 20794						X	
Perth Laboratory - NATA Site # 23736							
Mayfield Laboratory - NATA Site # 25079							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH05 1.0	May 14, 2021		Soil	S21-My47085	X	X
2	BH07 2.5	May 14, 2021		Soil	S21-My47086	X	X
3	BH08 1.5	May 14, 2021		Soil	S21-My47087	X	X
Test Counts						3	3

eurofins | Environment Testing

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram | **mg/L:** milligrams per litre | **ug/L:** micrograms per litre

ppm: Parts per million | **ppb:** Parts per billion | **%:** Percentage

org/100mL: Organisms per 100 millilitres | **NTU:** Nephelometric Turbidity Units | **MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Chromium Suite									
pH-KCL			%	98			80-120	Pass	
Acid trail - Titratable Actual Acidity			%	101			80-120	Pass	
Chromium Reducible Sulfur			%	101			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	S21-My47085	CP	pH Units	4.7	4.7	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	S21-My47085	CP	mol H+/t	25	24	2.0	30%	Pass	
sulfidic - TAA equiv. S% pyrite	S21-My47085	CP	% pyrite S	0.040	0.040	2.0	30%	Pass	
Chromium Reducible Sulfur	S21-My47085	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	S21-My47085	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
ANC Fineness Factor	S21-My47085	CP	factor	1.5	1.5	<1	30%	Pass	
CRS Suite - Net Acidity (Sulfur Units)	S21-My47085	CP	% S	0.04	0.04	2.0	30%	Pass	
CRS Suite - Net Acidity (Acidity Units)	S21-My47085	CP	mol H+/t	25	24	2.0	30%	Pass	
CRS Suite - Liming Rate	S21-My47085	CP	kg CaCO3/t	1.9	1.8	2.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	S21-My47315	NCP	%	11	14	22	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised by:

John Nguyen	Analytical Services Manager
Myles Clark	Senior Analyst-SPOCAS (QLD)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Located across Australia and New Zealand

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Brisbane (Acacia Ridge)
Brisbane (Beenleigh)
Brisbane (Brendale)
Brisbane (Petrie)
Cairns
Emerald
Gladstone
Gold Coast
Mackay
Moranbah
Rockhampton
Petrie
Sunshine Coast
Toowoomba
Townsville

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Sydney (Seven Hills)
Sydney (St Peters)
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