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REPORT ON GEOTECHNICAL SITE INVESTIGATION

for

PROPOSED SEA WALL

at

1122 PITTWATER ROAD, COLLAROY

Prepared For

SP 677

Project No.: 2018-045

April, 2018

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APPENDICES

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Date: 19th April 2018
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GEOTECHNICAL REPORT FOR PROPOSED SEAWALL
1122 PITTWATER ROAD, COLLAROY, NSW

1. INTRODUCTION:

This report details the results of a geotechnical investigation carried out for a proposed seawall at 1122 Pittwater Road, Collaroy, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of the Owners Corporation SP677.

The site is situated on the eastern side of Pittwater Road, at the intersection with Ramsay Street which passes along the northern boundary. It is within near level to gently east dipping topography and consists of a residential property that extends from the Pittwater Road reserve onto Collaroy Beach. The site contains a multi storey residential unit development with lawn backyard supported above the beach by an informal seawall consisting of large sandstone and concrete boulders. The rear 10m of the site is formed as the beach.

It is understood that the proposed works involve construction of an engineered seawall which is to span across the rear of the entire site. The proposed seawall is expected to extend from the crest of the existing seawall to the rear property boundary, with the toe of the seawall at approximate RL -0.90m AHD to resist scour.

As part of the investigation, a geotechnical inspection of the site including testing along with a particle size distribution analysis of the sand is required for the Coastal Engineerôs design. The investigation was undertaken as per Tender No. P18-068, Dated: 20th March 2018 for design and construction purposes.

The investigation comprised:

a) A geotechnical inspection and mapping of the site and adjacent properties by a Principal Engineering Geologist.
b) Drilling of two boreholes using hand tools along with Dynamic Penetrometer (DCP) testing to investigate the subsurface geology. Hand tools were utilised due to access limitations of the site.
c) Collection of a beach sand sample for determination of the particle size distribution.

The following plans and drawings were supplied/available for the work:

- Site survey plan by CMS Surveyors, Survey Instruction No. 6951A, Dated: 21st March 2018.

2. FIELD WORK:

2.1. Methods:

The field investigation comprised a walk over inspection and mapping of the site and adjacent properties on the 3rd April 2018 by a Principal Engineering Geologist At the time of investigation (4.00pm), the approximate tide level was 0.60m at Collaroy Beach based on the data of the Bureau of Meteorology.

The beach level at the eastern boundary of the site was measured at each borehole/test location via use of the survey plan data and onsite measurements. This determined the sand surface level at approximate R.L. 2.80m (AHD). Profiles of the beach are provided showing the estimated sand surface level at each test location at the time on investigation, see Figure: 2.

The investigation included a photographic record of site conditions along with the drilling of two auger boreholes (BH1 & BH2) using a hand auger to determine sub-surface geology and allow sample collection.

Dynamic Penetrometer (DCP) testing was carried out from ground surface adjacent to the boreholes and from the base of the boreholes when they had progressed to t1.05m depth, in accordance with AS1289.6.3.2 ï 1997, ñDetermination of the penetration resistance of a soil ï 9kg Dynamic Perth Penetrometerò to estimate near surface soil conditions.

Explanatory notes are included in Appendix: 1. Mapping information and test locations are shown on Figure: 1, along with the beach profiles, Figure: 2 and detailed log sheets in Appendix: 2.

2.2. Field Observations:

The site is located on the eastern side of Pittwater Road on a sand dune whose crest runs through the centre of the site, parallel to Pittwater Road.

The front western side of the site contains a narrow car parking and access area with a multi storey residential apartment building located on the front to centre of the block. To the rear of the building is a concrete car parking area and then narrow lawn yard.

An embankment formed via sandstone boulders extends across the rear of the lawn and was exposed above the beach sand deposits by up to 2.0m in height at the time of inspection. The embankment extends across the rear of the entire site, the neighbouring property to the south (No. 1114) and appears to have been informally dumped as part of previous beach stabilising works, see Photograph: 1.

Photo: 1 – View of site showing informal boulder stabilising at rear of lawn.

To the north of the site is the Ramsay Street road reserve which is formed with a narrow grass verge supported above a boulder sea wall in line with the embankment within the site. Extending from the exposed base of this wall is a stormwater drainage pipe, see Photograph: 2.

Photograph: 2 – showing Ramsay Street road reserve and stormwater pipe discharge

The neighbouring property to the south (No. 1114 Pittwater Road ï Flight Deck) consists of a multi storey residential apartment building located on the centre to rear of the block, adjacent to the continuation of the boulder sea wall identified in the site. The rear of this property also extends onto Collaroy Beach and extensive boulder stabilising works are documented at the rear of this property.

2.3. Field Testing:

The boreholes (BH1 and BH2) were drilled adjacent to the rear east boundary of the site with the hand auger discontinued between 2.55m depth (R.L. 0.25) and 1.90m depth (R.L. 0.85) in loose, wet sand due to a loss of sample return below the water table.

DCP testing was undertaken from surface (DCP1 and 4) and through the boreholes (DCP1a and 4a) and at several locations down the beach front to assess sand densities within the zone of the proposed sea wall structure.

Based on the field borehole logs and DCP test results the subsurface conditions at the project site can be classified as follows:

SAND ï very loose from surface to approximately 0.75m depth then medium dense, becoming very dense below 1.35 to 2.40m depth (approximate R.L. 0.0 to 1.0). The sand is medium grained, sub-rounded quartz sand with extensive shell fragments and occasional carbonate cemented bands.

The water table was identified at a very similar level to the sea tide level and is expected to be match tide fluctuations due to the sandy nature of the soils and close proximity to the foreshore.

2.4. Previous Testing:

Previous geotechnical investigations have been undertaken by Crozier Geotechnical Consultants approximately 110m to the south and 220m to the north of the site. These investigations for new house structures utilised more detailed investigation techniques (CPT) to allow design and construction of new building footings. Both investigations identified loose to medium dense sand from surface to approximately 4.00m depth (R.L. 1.8 to R.L. 1.0) where dense to very dense (potentially cemented) sand, was encountered extending to at least R.L. -1.0.

2.5. Laboratory Testing:

One sample collected from the investigation (BH1, 2.50m depth) was submitted to a NATA accredited laboratory (Macquarie Geotech) for assessment of the Particle Size Distribution via the test method AS 1289.3.6.1. The results identified the sands as being well sorted, medium grained with an average D_{50} of 0.40mm.

3. COMMENTS:

3.1. Geotechnical Assessment:

The site investigation identified the presence of medium grained marine sand over the rear of the project site and extending to at least R.L. 0.70m (AHD), where the water table was encountered preventing further drilling with the hand tools. Based on DCP testing the sand was predominantly very loose to a depth of 0.75m (RL å 0.44m ï 0.76m) at the rear boundary of the site becoming medium dense below this level and then very dense below approximate R.L. 1.0. The water table was identified at approximately 2.55m depth (RL å 0.25m AHD) at a time when the tide estimated at 0.60m from available data.

The proposed works involve construction of a new engineered seawall at the rear of the site. The proposed seawall is expected to extend approximately 9.00m from the crest of the existing boulder seawall/embankment to within 1.00m of the rear property boundary located on the beach, with the toe of the seawall expected at approximate RL -0.90m AHD.

Based on the investigation results and the survey data this will place the base of the sea wall below the water table, which may create problems with excavation. If this is required a temporary support structure will need to be implemented (i.e. sheet piling) to allow de-watering and support of the excavation without excessive bulking of the excavation perimeter.

The very dense sands located below approximate R.L. 1.0m AHD are considered suitable for 150kPa allowable bearing pressures and will be suitable as a foundation for the sea wall provided erosion or loosening as a result of wave action does not result in their disturbance.

The identified stormwater pipe discharge at the end of Ramsay Street will be located within 15m of the sites northern boundary with the invert of the pipe located at R.L. 1.43m, as referenced from the survey drawing. As such it does not appear to require any specific design adjustments for the proposed works within the site.

Prepared By:

Troy Crozier
Principal Engineering Geologist
MAIG. RPGeo; 10197

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 1

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

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

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

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

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

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

Details of the type and method of sampling are given in the report.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7
  as 4, 6, 7
  N = 13
- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm
  as 15, 30/40mm.

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

Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Qc (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Qc = (12 to 18) Cu

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.2). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

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

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

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. To a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

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

Site Anomalies

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

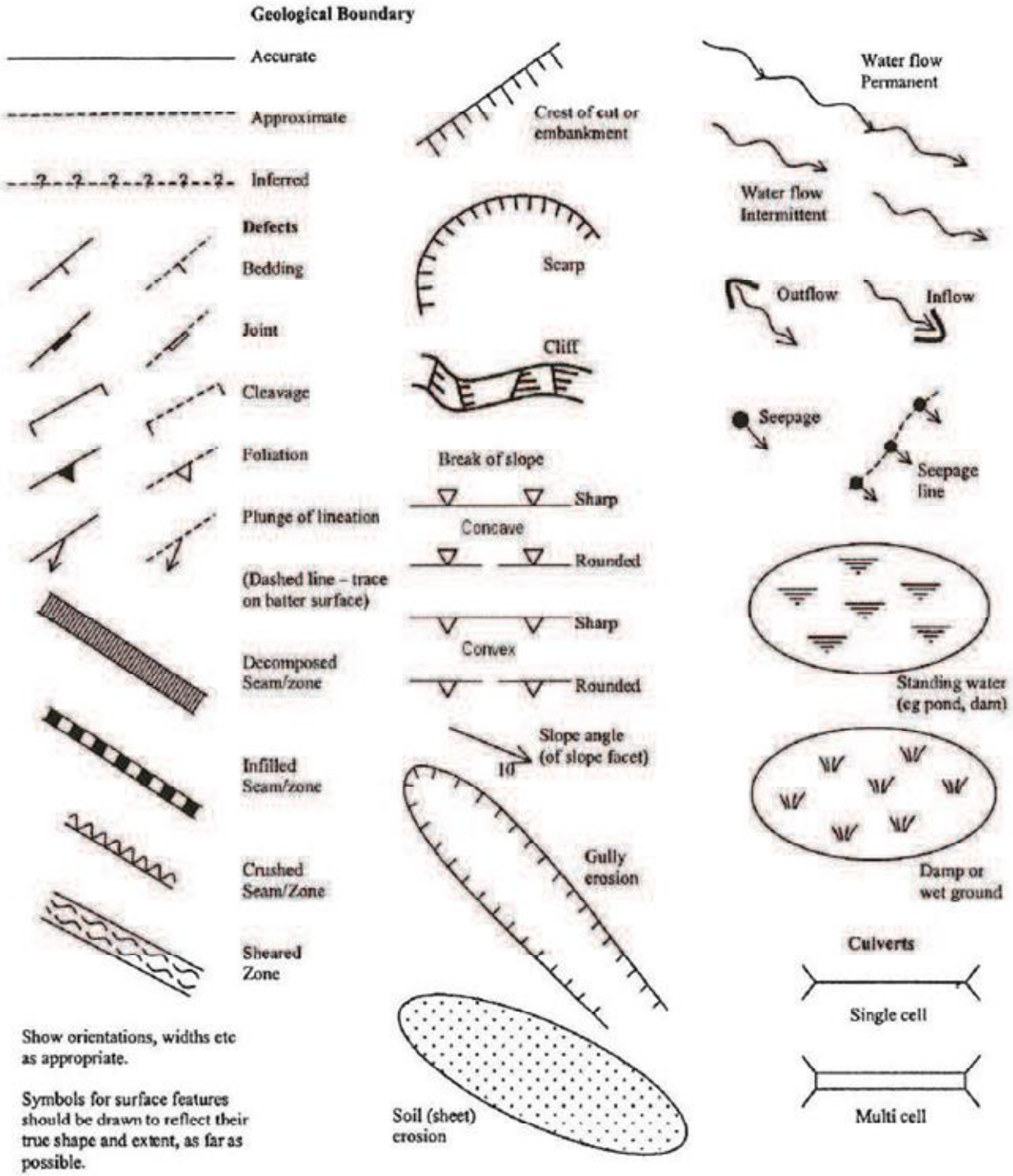
Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a special ally edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

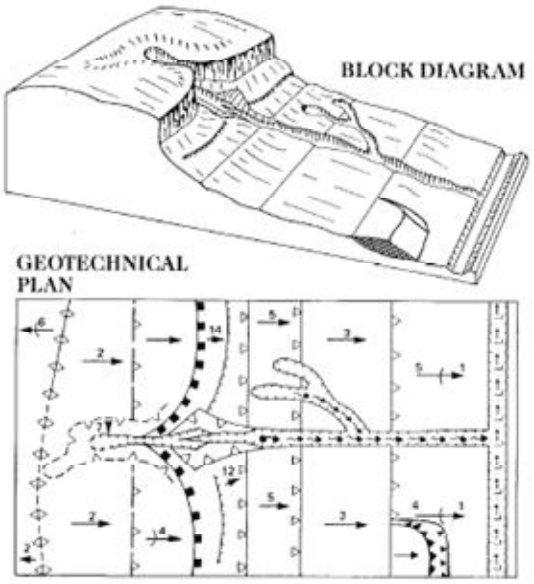
Site Inspection

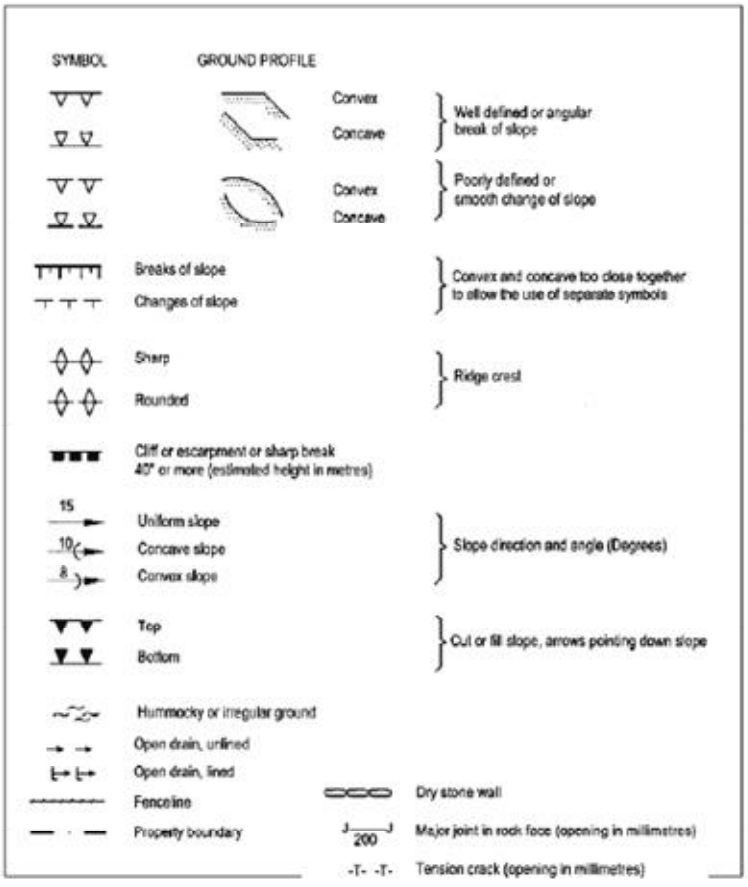
The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

APPENDIX E - GEOLOGICAL AND GEOMORPHOLOGICAL MAPPING SYMBOLS AND TERMINOLOGY



Examples of Mapping Symbols (after Guide to Slope Risk Analysis Version 3.1 November 2001, Roads and Traffic Authority of New South Wales).





Example of Mapping Symbols
(after V Gardiner & R V Dackombe (1983).Geomorphological Field Manual. George Allen & Unwin).

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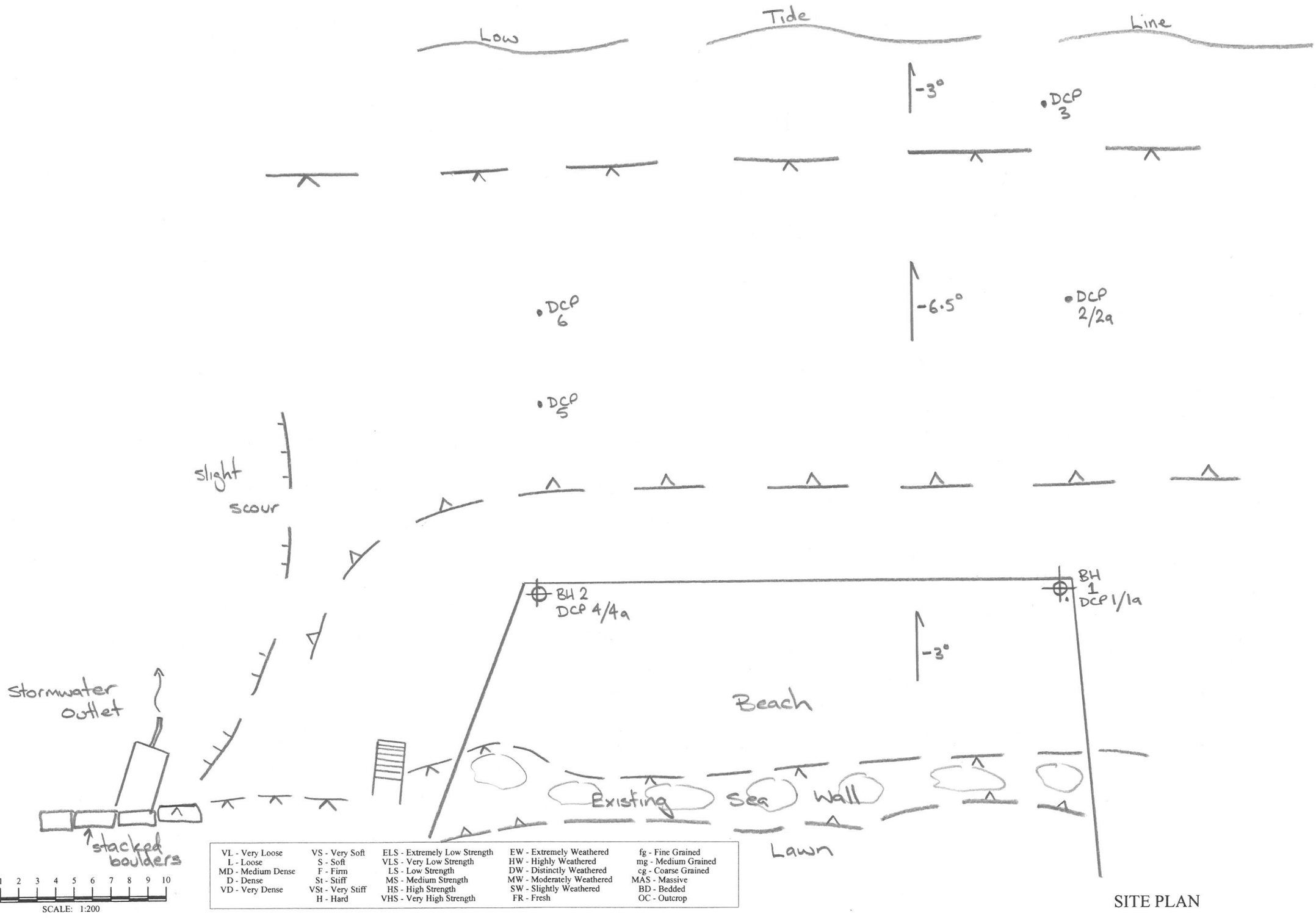
Appendix 2



VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

SITE PLAN FIGURE 1.

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LEGEND

crest of slope | base of slope | -x° slope angle

SCALE: 1:200 @ A3
DRAWING:
DATE:

PREPARED FOR: SP 677

APPROVED BY: TMC
DRAWN BY:
PROJECT: 2018-095

ADDRESS: 1122 Pittwater Rd Collaroy

CROZIER - Geotechnical Consultants
Engineering Geologists & Geotechnical Engineers

PROJECT _____ Job No. _____ Page No. _____ Date _____

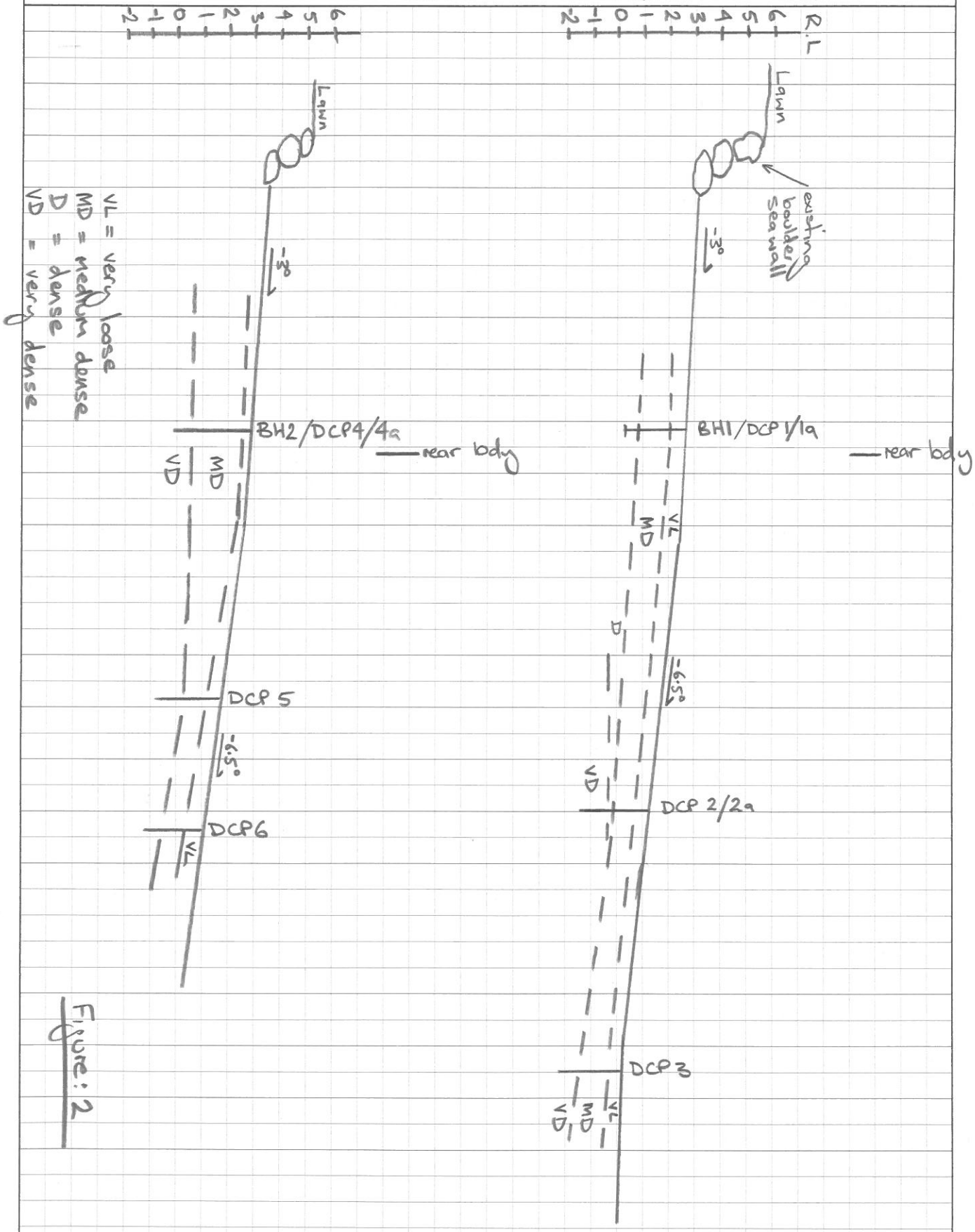


Figure: 2

Comps by / /	Checked by / /	Approved by / /

TEST BORE REPORT

CLIENT: Roy Spring **DATE:** 3/04/2018 **BORE No.:** 1

PROJECT: Engineered Sea Wall **PROJECT No.:** 2018-045 **SHEET:** 1 of 1

LOCATION: 1122 Pittwater Rd, Collaroy **SURFACE LEVEL:** RL å 2.80m

Depth (m)	Description of Strata PRIMARY SOIL - strength/density, colour, grainsize/plasticity, moisture, soil type incl. secondary constituents, other remarks	Sampling		In Situ Testing		
		Type	Depth (m)	Type	Results	
0.00	SAND -- very loose to medium dense, yellow, fine to medium grained, sand with trace shell					
	* became moist at 0.80m					
1.00		D	1.00			
2.00		D	2.00			
	* became wet at 2.30m					
2.55	HAND AUGER DISCONTINUED due to cave in below water table @2.55m					

RIG: None DRILLER: KB LOGGED: TC

METHOD: Hand Auger

GROUND WATER OBSERVATIONS: water table at 2.55m

REMARKS: CHECKED:

TEST BORE REPORT

CLIENT: Roy Spring **DATE:** 10/04/2018 **BORE No.:** 2

PROJECT: Engineered Sea Wall **PROJECT No.:** 2018-045 **SHEET:** 1 of 1

LOCATION: 1122 Pittwater Rd, Collaroy **SURFACE LEVEL:** RL å 2.75m

Depth (m)	Description of Strata PRIMARY SOIL - strength/density, colour, grainsize/plasticity, moisture, soil type incl. secondary constituents, other remarks	Sampling		In Situ Testing	
		Type	Depth (m)	Type	Results
0.00	SAND -- very loose, yellow, medium grained, dry sand with trace shell				
0.30	SAND -- loose to medium dense, yellow, medium grained, moist sand				
1.00	* became wet at 1.60m	D	1.60		
1.90	HAND AUGER DISCONTINUED due to cave in below water table @1.90m				
2.00					

RIG: None DRILLER: KB LOGGED: JY

METHOD: Hand Auger

GROUND WATER OBSERVATIONS: water table at 1.90m

REMARKS: CHECKED:

DYNAMIC PENETROMETER TEST SHEET

CLIENT: Roy Spring **DATE:** 10/04/2018

PROJECT: Engineered Sea Wall **PROJECT No.:** 2018-045

LOCATION: 1122 Pittwater Rd, Collaroy **SHEET:** 1 of 1

	Test Location							
Depth (m)	1a	1	2	3	4a	4	5	6
0.00 - 0.15	--	0	0	0	--	0	0	0
0.15 - 0.30	--	1	1	1	--	1	1	1
0.30 - 0.45	--	2	1	0	--	2	0	1
0.45 - 0.60	--	1	2	2	--	3	2	1
0.60 - 0.75	--	3	3	3	--	3	2	4
0.75 - 0.90	--	4	4	4	--	5	4	4
0.90 - 1.05	2	3	6	5	--	5	5	6
1.05 - 1.20	4	5	8	4	--	3	7	5
1.20 - 1.35	2		8	4	3		8	4
1.35 - 1.50	3		12	7	4		10	6
1.50 - 1.65	5		17	8	5		15	9
1.65 - 1.80	7		17	15	6		17	14
1.80 - 1.95	10		19	18	5		19	15
1.95 - 2.10	8		20	20	1		15	17
2.10 - 2.25	10		17	20	4		14	15
2.25 - 2.40	8		17	13	6		14	13
2.40 - 2.55			16		13			
2.55 - 2.70					18			
2.70 - 2.85					27			
2.85 - 3.00					34			

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER
AS 1289. F3.3, PERTH SAND PENETROMETER -- ALL

REMARKS: **(B)** Test hammer bouncing upon refusal on solid object
-- No test undertaken at this level due to prior excavation of soils

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 3

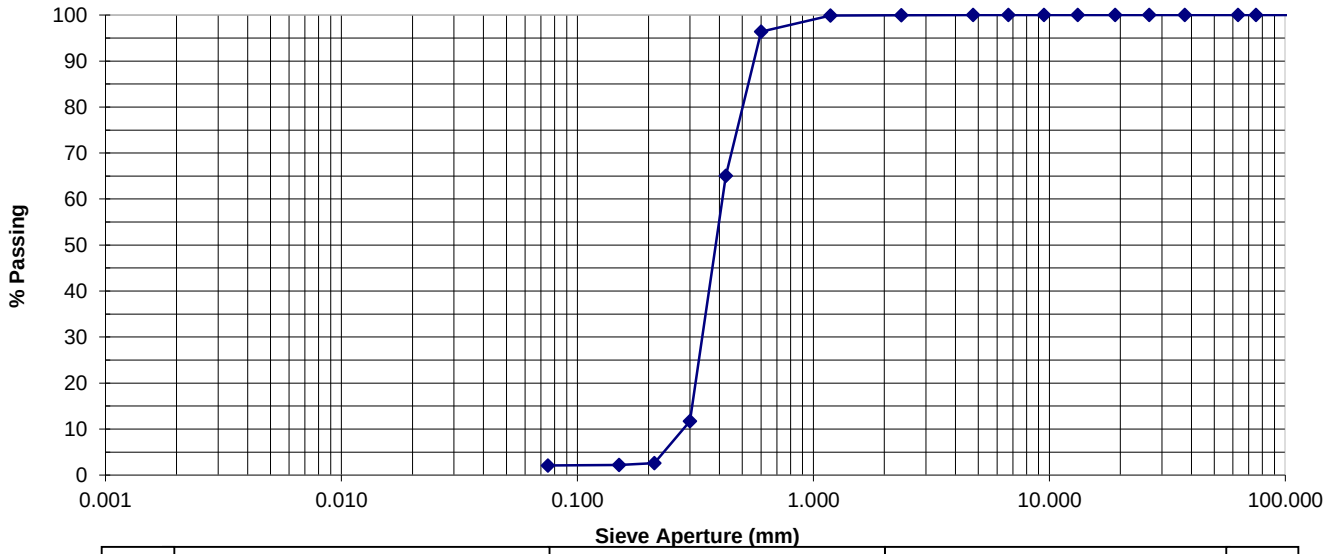
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Crozier Geotech	**Source:**	2018-045 BH1 2.50m
Address:	Unit 12/ 42-46 Wattle Street Brookvale NSW 2100	**Sample Description:**	SAND
Project:	Collaroy (2018-045)	**Report No.:**	S32272-PSD
Job No.:	S18133	**Lab No.:**	S32272

Test Procedure: ☑ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

Sampling: Sampled by Client | Date Sampled: 9/03/2018

Preparation: Prepared in accordance with the test method



Sieve Apperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	100		4.75	100	
75	100		2.36	100	
63	100		1.18	100	
37.5	100		0.600	96	
26.5	100		0.425	65	
19	100		0.300	12	
13.2	100		0.212	3	
9.5	100		0.150	2	
6.7	100		0.075	2	

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

17/04/2018

Date:

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