Geotechnical Assessment

Proposed Residential Development

128 Wallumatta Road, Newport

10791E/P/346-A

Prepared for Robert Moss
22/09/2020

Construction Sciences

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1.0 Introduction

1.1 General

Construction Sciences Pty Ltd (CS) has carried out additional geotechnical studies at 128 Wallumatta Road, Newport. The assessment was commissioned by Robert Moss on 28 August, 2020. The works were carried out in accordance with CS Proposal 10791E/Q/347 dated August 2020.

The assessment has been prepared to support a proposed development application in accordance with the requirements of the Geotechnical Risk Management Policy for Pittwater, 2007 and ensure all requirements have been met.

1.2 Proposed Development

It is understood that the following development is proposed for the site:

> installation of an inclinator extending up from the road to the existing residence;

> Construction of a proposed secondary dwelling downslope of the existing residence. It is assumed that the proposed granny flat would be similar to the existing residence and would be supported on piers. Preliminary concept drawings supplied indicates an excavation up to 3.2m depth battered at 1 Horizontal to 1 Vertical (1H:1V)

> Proposed future additions to the existing residence. It is assumed that the proposed additions would not require any excavation.

It is understood all structures would likely be suspended on piers.

1.3 Project Understanding

This current report is a supplementary to a previous Geotechnical Report prepared by Jack Hodgson Consultants and presents a description of surface and subsurface and geotechnical conditions within the confines of the site and recommendations on the following:

> Consistency/density of in-situ soils within boreholes;

> Geotechnical recommendations for proposed footings;

> The potential risk of slope instability, in accordance with Australian Geomechanics Society 2007, for the proposed residential development in its existing and post developed state.

1.4 Background

The following reports and documents supplied by the client were reviewed:

> Risk Analysis Management for Proposed Inclinator at 128 Wallumatta Road – Report No. VS24513 dated June 2009 prepared by Jack Hodgson Consultants Pty Ltd

> Reference to Pittwater Geotechnical Hazard Map indicates the site is located within Geotechnical Hazard Zone H1.

2.0 Fieldwork

2.1 Walkover Assessment

A walkover assessment was carried out with the client on 29th June 2020 and a Senior Geotechnical Engineer from CS to view site features and surrounds for signs of instability.

2.2 Investigation works

Subsequent fieldwork was carried out on 23rd July, 2020 and comprised one borehole (BH1) auger drilled using a hand auger to a refusal depth of about 0.6m. The strength of the soil profile was assessed from a Dynamic Cone Penetrometer Test (DCP). The borehole log is summarised in Table 3-1 below.

Fieldwork was carried out by a Senior Geotechnical Engineer from CS, who noted relevant site features, set out the borehole location, carried out testing and prepared a field log of the subsurface profile encountered.

The approximate borehole location is shown on the attached Drawing No. 10791E/P/346-1.

3.0 Site Conditions

3.1 Site Description

The following observations were made during the walkover assessment:

- The site is situated on a battle-axe property in hilly terrain on a south facing slope of about 20^0 to 25^0. The upper slope forms a ridge at which point flattens at the crest.
- An existing two storey residence is located at the crest of the hill on flat terrain.
- The site was accessible via a staircase adjacent to the western boundary. The entrance to the site was supported by a block retaining wall and appeared in good condition.
- The existing residence is suspended on sub-floor timber piers and the under croft area appeared dry. The residence appeared to be in good condition, with no signs of structural deformation pertaining to geotechnical conditions observed.
- No tension cracks were observed on the ground within the surrounds of the property.
- The trees located on the mid-slope were not leaning and appeared to show no signs of basal heave.
- Surface soils comprised Clayey Silty SAND.

3.2 Subsurface

Reference to the 1:100,000 Sydney Geological Series Sheet indicates the site is underlain by two bordering geological sets, being:

- Crest/Upper Slope - Wianamatta Group Hawkesbury Sandstone (Rh) comprising medium to coarse grained quartz sandstone including very minor shale and laminate lenses; and,
- Lower and Mid Slope - Narrabeen Group Newport and Garie Formation comprising interbedded laminate, shale and quartz, to lithic quartz sandstone

With reference to previous studies, soil cover on the slope comprises colluvium at the surface and residual at depth, consisting of sandy loam topsoil and clays with rock fragments and floaters through the subsurface profile. The sandy clays and clays merge into the weathered zone of the under-lying rocks at depths expected to be in the range of shallow to about 1.5meters.

The subsurface soil profile encountered in the borehole is summarised below. Reference should be made to the attached borehole log for a more detailed description of soils encountered at the test location.

Table 3-1 Subsurface Lithology of Boreholes (BH1) Encountered

Layer	Description	Depth to Base of Layer (m)
TOPSOIL	Clayey silty SAND, fine to medium grained, dark grey brown, trace of low plasticity fines, grass roots	0.15
RESIDUAL	Sandy CLAY medium plasticity, light brown to orange brown, fine to medium sand, trace of ironstone staining	0.7
PROBABLE WEATHERED ROCK	Sandstone/Shale, possible floater	>0.7

Groundwater was not encountered at the time of drilling. It should be noted that groundwater and seepage may fluctuate with variations of rainfall and other environmental factors.

4.0 Slope Instability

A landslide hazard assessment of the existing slope has been conducted in accordance with the Australian Geomechanics Society Landslide Risk Management Concepts and Guidelines, 2007. A copy of this document can be found at www.australiangeomechanics.org. Appendix C of the document describes the terminology used.

4.1 Historical Record

With reference to the previous report it was concluded that provided the requirements of the report were carried out with good engineering practice the risk to the property would be low and risk to life would be acceptable.

4.2 Previous Instability

Indicators of instability within the soil or rock beneath a site can include, but not be limited to:

> Creep – observed by tilting of structures including trees, retaining walls, and fences or by soil/rock encroaching on roads or over drains, gutters etc.

> Hummocky disturbed ground in or at the base of slopes.

> Tension cracks in or towards the top of slopes.

> Rock outcrop and boulders.

4.3 Site Features Relating to Slope Instability

The main features affecting and/or contributing to slope instability at this site are assessed to be:

> The proposed travelator and granny flat (secondary dwelling) on moderately steep sloping ground of about 25^0.

> The proposed alterations and additions will be located on the crest of the hill on generally flat land.

> The proposed granny flat is located downslope of sandstone rock outcrops.

4.4 Possible Landslide Hazards

On the basis of the visual assessment and subsurface investigations of the site, possible landslide hazards considered applicable to the existing slopes are given in Table 6-1:

Table 4-1 General Possible Failure Mechanisms for Landslide

Possible Failure Mechanisms	Description of Failure Mechanism
Creep	Slow downhill movement of landmass due to steep slopes, groundwater conditions and other factors.
Rotational or Translational failure	Isolated landslips occurring in the soil matrix during periods of heavy rain and other environmental factors
Rock Fall	Rock outcrops/boulders may loosen/dislodge and roll down slope

4.5 Hazard Identification

Based on the site features and proposed development details noted above, the following instability mechanisms are considered relevant for this site:

> Failure of the natural hillside slope containing the proposed granny flat and inclinator;

> Failure by toppling of sandstone outcrops impacting the proposed granny flat;

> Failure of proposed cutting behind the new residence

4.6 Risk Assessment

The risks associated with the hazards identified are assessed as follows:

4.6.1 Hazard Risk

> The overall slope containing the proposed granny flat and inclinator is about 25°. The depth of the overburden soil is assessed to be about 0.7m. Based on information provided and engineering judgement, hillside failure is assessed to be *rare* and the consequence of this failure is assessed to be *medium.* Hence the risk of slope failure is assessed to be **low.**

> The sandstone rock outcrops are assessed to be about 2m in height and although heavily jointed is considered stable in the medium to long term if left undisturbed. The distance between the granny flat down slope is about 10m and vegetation comprises grass and trees. The likelihood of one of the rocks impacting the granny flat is considered *Unlikely* and the consequence *Minor*. Hence the risk of slope failure is assessed to be **low.**

The proposed 3.2m deep excavation behind the proposed new residence (granny flat) is understood to be constructed to 1H:1V batter. The excavation may expose colluvial soils and sandstone boulders. The failure of excavation is assessed to be possible and consequences medium giving a moderate risk of slope instability

4.6.2 Risk to Life

The risk to life is mainly from instability of the south facing hillside slope (1) and the sandstone rock outcrops (2). The risk here is associated with landmass and debris affecting existing upslope and proposed down slope property and/or human activities during and after construction. It is anticipated that this risk can be effectively removed by appropriate construction and engineered design principles as recommended in this report. On this basis it is assessed that the overall risk to life is **low** (refer Table 6-2 below).

Based on current field results and the above comments, the overall risk of slope instability on the allotment is assessed to be **low** by implementing recommendations given in this report.

It is assessed that the site is suitable for construction of the proposed granny flat and inclinator provided the recommendations in this report are implemented.

The above assessment is based on Australian Geomechanics Society (AGS2007) Guidelines. The risk levels are defined in the attached Appendix C and the development should be carried out in accordance with sound engineering principles and good hillside construction practices.

The risk to life of an occupant was estimated based on the following:

$R_{(DI)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$

Where:

$R_{(DI)}$ is the risk (annual probability of loss of life (death) of an individual)
$P_{(H)}$ is the annual probability of the hazardous event (the landslide)
$P_{(S:H)}$ is the probability of spatial impact by the hazard (e.g. of the landslide impacting a building (location) considering the travel distance) given the event
$P_{(T:S)}$ is the temporal probability (e.g. of the building being occupied by the individual) given the spatial impact
$V_{(D:T)}$ is the vulnerability of the individual (probability of loss of life of the individual given the impact).

Table 4-2 Risk to Life for an Occupant

Hazard	Description	$P_{(H)}$	$P_{(S:H)}$	$P_{(T:S)}$	$V_{(D:T)}$	$R_{(DI)}$	Risk Level
1	South Facing Slope	$1x10^{-5}$	0.4	0.83	0.1	$3.3x10^{-7}$	Acceptable
2	Sandstone Outcrops	$1x10^{-4}$	0.1	0.83	0.1	$8.3x10^{-7}$	Acceptable
3	Proposed batter	$1x10^{-3}$	0.05	0.3	0.1	$1.5x10^{-6}$	Slightly above the acceptable risk

Overall risk to life $2.6x10^{-6}$
Notes:

1. South facing slope is 25^0 **$V_{(D:T)}$** $1x10^{-1}$;
2. Outcrops. It is unlikely occupant will know when the failure would occur to allow, time to evacuate. **$V_{(D:T)}$** – $1x10^{-1}$

5.0 Geotechnical Discussions and Recommendations

5.1 General

The generalised subsurface profile encountered within BH1 indicated shallow silty sand topsoils underlain by sandy clays to about 0.7m depth. Sandy Clays were underlain by weathered rock, however the type or quality cannot be ascertained without deeper investigations and is assumed to be weak Class V rock in accordance with Pells et al (refer ref below)

5.2 Footings

Due to the steep nature of the site, piers should be socketed at least 300mm into competent weathered rock. Alternatively, if weathered rock is found at shallow depth, say <400mm, a level pad could be cut and starter bars be dowelled 300mm into weathered rock.

The actual embedment length of the piles should be calculated by using the design values summarised in Table 7-1 for vertical load and lateral resistance on weathered rock.

Table 5-1 Typical Design Values for vertical load on Shale

Rock Class	Serviceability End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)	Typical E_{field} (MPa)
Class V	700	50	**50**

We note that the above design values are based on Pells et al. 1998 (Australian Geomechanics) Rock Classification System based in Sydney Region; we have considered that the Pell's rock classification is suitable to this site.

Where pier socket length exceeds twice the diameter, the load distribution between the shaft and the tip of the pile should be assessed based on one of the methods indicated by Pell et.al 1998. Simple addition of end bearing and skin friction is not acceptable for longer sockets unless appropriate conservative values are assigned for the strength.

All footings should be cleared of debris, softened materials and be inspected by a geotechnical engineer prior to placing of concrete. If groundwater or seepage is encountered in the base of the footing, it should be pumped out prior to pouring of concrete.

The footing system for the site should be designed by a Structural Engineer with generous provision for structural articulation to reduce potential effects of differential movement between areas of varying soil thickness based on engineering design principles.

It is recommended the client seek advice from the developer on the location of any subsoil drains. Footing construction should not interfere with the subsoil drains.

5.3 Excavations

It is recommended that all excavations deeper than 1m should be constructed in stages with support provided to the excavated stage using slope stabilisation methods such as soil nails and shotcrete, terraced retaining walls etc. Alternatively, the depth of excavation should be limited to less than 1m and battered not steeper than 2H:1V.

Deep excavations may also be carried out providing prior support such as contiguous piles embedded in rock

5.4 Risk management

The following risk management steps should be considered for the development.

> - The development should be carried out based on the recommendations of this report, 10791E-P346-A of 15 September 2020 and Jack Hodgson Report VS 24513 of 5 June 2009.
> - Architectural, structural, stormwater and landscape plans should be reviewed by a geotechnical engineer to confirm the intent of the geotechnical report recommendations have been incorporated.
> - Details of excavation batter stabilization should be provided for review.
> - All necessary geotechnical inspections should be carried out by a competent geotechnical engineer.

5.5 Further Investigation

It is recommended that the following review/inspections be undertaken to assess geotechnical conditions and to further reduce the risk of slope instability.

1. Review footing design drawings by a qualified geotechnical engineer.
2. A qualified professional geotechnical engineer should be engaged to verify the foundation materials are suitable for the above recommended allowable end bearing pressure prior to pouring of concrete.

6.0 References

1. Sydney 1:100,000 Geological Series Sheet;
2. Australian Geomechanics Society Landslide Risk Management Concepts and Guidelines, 2007;
3. Australian Geoguide LR8 (Construction Practice).

The report should be read in conjunction with the attached Information Sheets and any other explanatory notes.

We trust the report is sufficient to meet your present requirements. Please do not hesitate to contact NG should you have any queries.

Construction Sciences Pty Ltd

Proposed Residential Development, 128 Wallumatta Road, Newport

APPENDIX A

INFORMATION SHEETS

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 experience.

Construction Sciences findings and assessment represent its reasonable judgment, diligence, skill, with sound professional standards, within the time and budget constraints of its commission. No warranty, expressed or implied, is made as to the professional advice included in this report.

Data sources

In preparing this document, or providing any consulting services during the commission, Construction Sciences may have relied on information from third parties including, but not limited to; sub-consultants, published data, and the Client including its employees or representatives. This data may not be verified and Construction Sciences assumes no responsibility for the adequacy, incompleteness, inaccuracies, or reliability of this information.

Construction Sciences does not assume any responsibility for assessments made partly, or entirely based on information provided by third parties.

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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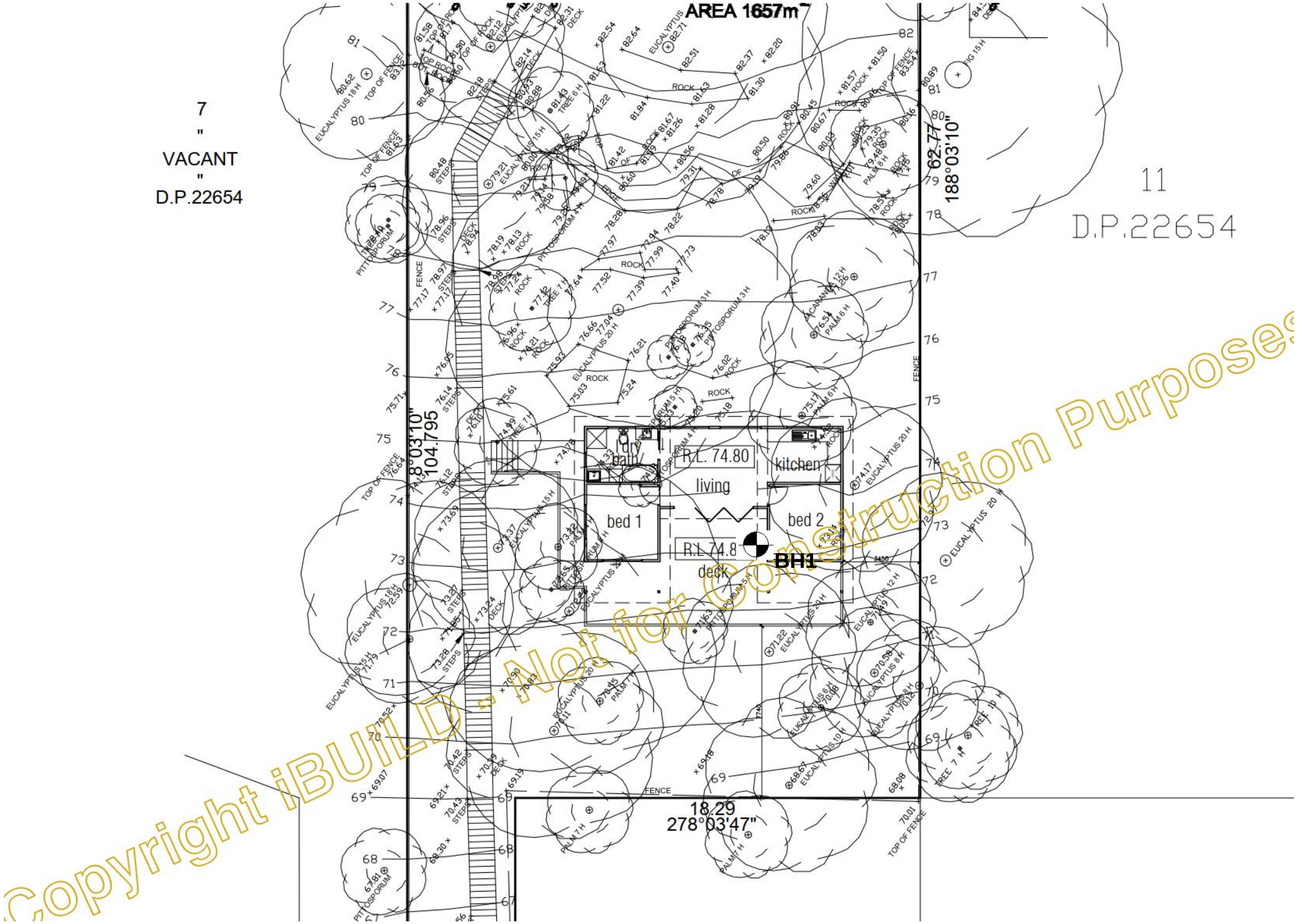
Proposed Residential Development, 128 Wallumatta Road, Newport

APPENDIX B

SITE PLAN



LEGEND:	Construction Sciences 31 Anvil Road SEVEN HILLS NSW 2147 Tel: (02) 8646 2000 Fax: (02) 8646 2025 Web: www.constructionsciences.net	Scale: A4 - NOT TO SCALE		Client: Robert Moss
		Date: 21/9/2020		Project: Proposed Inclinator and Secondary Dwelling
		Drawn By: DS		Location: 128 Wallumatta Road, Newport
		Drawing No: 10791E/P/346-1	Sheet: 1 of 1	**SITE PLAN**

Proposed Residential Development, 128 Wallumatta Road, Newport

APPENDIX C

BOREHOLE LOG

Construction Sciences

BOREHOLE LOG SHEET

Client: Robert Moss
Project: Proposed Residential Development
Location: 128 Wallumatta Road, Newport
Job No: 10791E/P/346

Hole No: BH01

Sheet: 1 of 1

Position: Refer To Site Plan	**Angle from Horizontal:** 90°	**Surface Elevation:**
Rig Type: Hand Auger	**Mounting:** NA	**Driller:**
Casing Diameter: -		**Contractor:** Pascall Group Pty Ltd
Date Started: 23/7/20 **Date Completed:** 23/7/20	**Logged By:** DS	**Checked By:** VDS

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sample or Field Test	DCP (blows per 150 mm)	Depth (m)	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
HA	F	-	Not Encountered		1	0.00m			Clayey silty SAND, fine to medium grained, dark grey brown, trace of low plasticity fines, grass roots	M	-	TOPSOIL 0.00 m: TOPSOIL
					3 2 4 5	0.15m 0.5			Sandy CLAY medium plasticity, light brown to orange brown, fine to medium sand, trace of ironstone staining	M (>PL)	St	RESIDUAL SOIL 0.15 m: RESIDUAL
					15/DB	0.70m 1.0 1.5			TERMINATED AT 0.70 m Target depth			0.70 m: Hand Auger terminated at 0.7m depth on possible weathered rock (or floater?)

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
DT	Diatube

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
HP	- 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=Resdual (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

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	≤ 35%	≤ 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

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)

Proposed Residential Development, 128 Wallumatta Road, Newport

APPENDIX D

GEOTECHNICAL RISK MANAGEMENT POLICY (FORM NO.1

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1 – To be submitted with Development Application

Development Application for Mr and Mrs Robert Moss

Name of Applicant

Address of site 128 Wallumatta Road, Newport

Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report

I, VIPULANANDA DE SILVA on behalf of Construction Sciences P/L
(Insert Name) (Trading or Company Name)

on this the 22 Sept 2020 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $10million.

I:

Please mark appropriate box

- ☐ have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ☐ have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.
- ☐ have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ☐ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: Geotechnical Assessment. 128 Wallumatta Rd Newport

Report Date: 22/09/2020

Author: D. Smith

Author's Company/Organisation: Construction Sciences P/L

Documentation which relate to or are relied upon in report preparation:

Risk Analysis Management for Proposed Structure at 128
Wallumatta Road Ref VS24513 dated June 2005

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature ....

Name Vipulananda de Silva

Chartered Professional Status CPEng NER

Membership No. 623347

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