Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Alterations and Additions
60 Hudson Parade, Clareville

Prepared for
Oliver & Nicola Hartley

Project 215034.00
August 2022

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		2 August 2022
Reviewer		2 August 2022

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Report on Geotechnical Investigation
Proposed Alterations and Additions
60 Hudson Parade, Clareville

1. Introduction

This report presents the results of a geotechnical investigation undertaken for proposed alterations and additions at 60 Hudson Parade, Clareville. The investigation was commissioned in an email dated 22 June 2022 from Oliver Hartley and was undertaken in accordance with Douglas Partners' proposal number 215034.00.P.001.Rev0 dated 03/05/2022.

It is understood that the proposed works will consist of the following:

- Extending the uphill side of the existing house;
- Adding a lower ground floor level within the footprint of the existing house;
- Installing a pool along the northern boundary of the property;
- Various internal and external modifications to the existing house; and
- Constructing a boatshed along the lower boundary of the property.

It is understood that this report will accompany a Development Application to Northern Beaches (Pittwater) Council and has therefore been compiled to comply with the Council's 'Appendix 5 Geotechnical Risk Management Policy' (GRMP) adopted in December 2014. The site is identified on Council's maps as lying within Geotechnical Hazard Zone H1.

The geotechnical investigation comprised a detailed inspection of the property and adjacent areas, hand drilling two boreholes and eight Dynamic Cone Penetrometer (DCP) tests. Details of the fieldwork are given in this report, together with comments on design and construction practice.

2. Site Description and Geology

The site is a rectangular shaped, residential lot on the western side of Hudson Parade. The site is located at the toe of a slope that falls to the foreshore of Pittwater. The site covers an area of 1239 m^2 with major plan dimensions of approximately 23 m by 80 m. It is bounded by residential lots to the north and south, Hudson Parade to the east and Pittwater to the west.

The existing development comprises a two to three-storey brick residence located in the western portion of the site. The ground surface of the property slopes to the west and includes some changes in slope associated with a suspended driveway area in the front of the property and sandstone retaining walls that support garden beds.

A supplied survey plan (C.M.S. Surveyors Pty Ltd, drawing name 21046detail, Issue 1 dated 25/01/2022) indicates that the elevation of the property falls from RL 12.5 m (AHD) along the eastern

boundary to RL 1.0 m along the western boundary. The average slope across the whole site is about 10 degrees.

Reference to the Sydney 1:100 000 Geological Series Sheet 9130 indicates that the site is underlain by the Newport Formation of Triassic age, which comprises interbedded sandstones, siltstones and shales. Weathered, fine-grained sandstone bedrock consistent with the Newport Formation was exposed at sea-level on the foreshore of Pittwater, along the lower boundary of the property.

3. Field Work

3.1 Fieldwork Methods

The hand drilling of two boreholes and DCP testing was carried out on 12 July 2022 under the supervision of an experienced geotechnical engineer.

Boreholes BH1 and BH2 were drilled using a 100 mm diameter hand auger to refusal depths of 0.8 m and 0.9 m, respectively. BH1 refused within the filling and BH2 refused within very stiff to hard clays which were interpreted to be colluvial soils.

Eight dynamic cone penetrometer tests (DCP1 to DCP8) were conducted across the site. The DCP tests were used to assess the in-situ consistency of soils and were terminated at depths between 1.05 m and 2.40 m. In these tests a cone tipped steel rod is driven into the ground using a standard weight hammer dropping a standard distance. The number of blows required to drive the rod each 150 mm into the ground is recorded and is used to assess the in-situ strength of the soils. Refusal will occur on the top of rock but may also occur on gravel or boulders within the soil profile, so gives the indication of the depth of rock but does not prove it.

The approximate locations of the boreholes and DCPs are shown on Drawing 1 in Appendix C.

The surface levels of the boreholes and DCPs were interpolated from the provided survey. The co-ordinates of the boreholes were approximated from a geospatial mapping software package.

3.2 Field Work Results

Details of the subsurface conditions encountered are given in the borehole logs, together with the results of the DCP testing and notes explaining descriptive terms and classification methods used in Appendix D.

The subsurface materials encountered at the two boreholes were:

- **FILL** – BH1 encountered dark grey silty sand fill to a depth of 0.9 m, where refusal occurred in fill. BH2 encountered sandy clay fill to a depth 0.1 m;
- **Sandy CLAY** – BH2 encountered stiff to very stiff colluvial clay to a depth of 0.8 m, where refusal occurred.

The results of the DCP testing presented in Appendix D suggest that the depth to bedrock is typically at depths between 2 m to 2.5 m, being shallower where existing excavations have been undertaken (i.e. DCPs 2 and 3). Early refusal may be due to sandstone "floaters" or cobbles located close to the surface (possibly DCP 7). The higher DCP values encountered towards the base of some of the DCPs indicate possible weathered rock.

No groundwater was encountered in the boreholes at the time of drilling. It should be noted that groundwater levels are transient and are affected by climatic conditions and soil permeability and will therefore vary with time.

3.3 Site Observations

The site was inspected by an experienced geotechnical engineer on 12 July 2022. Photographs of the site at the time of the inspection are included in Appendix B. The principal observations made during the inspection are:

- The existing concrete driveway has been constructed by excavating into the original slope. The excavation face is supported by keystone and stacked rock retaining walls which appear stable (see Photo 1);
- The driveway leads to a suspended concrete parking area which is supported on columns and likely piles. The visible supporting columns are vertical with no signs of tilting (see Photos 2 and 3);
- The two and three level brick house steps down the slope. The external walls of the house display no significant cracking or signs of movement (see Photo 4);
- The house does not have guttering or downpipes to collect stormwater from the roof (see Photo 4). Stormwater discharges around the perimeter of the house. A large concrete dish drain collects water along the southern side of the house and is piped underground to an unknown location (see Photo 5);
- The lower sub-floor of the house was accessed (see Photo 6). There appears to be minor seepage, likely along the top of rock. Given the significant rainfall in the week before the inspection, the area was relatively dry and seepage volumes are estimated to be low;
- The depth of the footings supporting the existing residence were not determined during the inspection, although observations in the sub-floor indicate that the footings could be supported on clays;
- The area surrounding the house has been terraced in areas with a series of small stacked rock retaining walls (see Photo 7). Some of the walls are slightly tilting and bulging. The movement appears to be due to the wall construction rather than slope instability;
- Some large sandstone boulders (or 'floaters') were observed on the property, probably fallen from cliffs upslope thousands of years previously; and
- Medium to high strength, fine grained sandstone bedrock was exposed along the Pittwater foreshore (see Photo 8).

4. Proposed Development

Architectural plans have been prepared by Bennett Murata Architects (job number 2130, drawings numbered DA_000 to DA_004, DA_100 to DA_104, DA_200, DA_201, DA_210, DA_211, DA_212, dated 11/07/2022). The proposed development is summarised below:

- Extend the uphill side of the house, requiring excavations to a depth of about 2 m for a garage;
- Install a pool along the northern boundary of the property, requiring excavations to a depth of about 1.5 m;
- Add a lower floor level within the footprint of the existing house, requiring excavations to a depth of 2 m;
- Various internal and external modifications to the existing house; and
- Construct a boatshed along the lower western boundary of the property, requiring excavations to a depth of about 2 m.

5. Comments

5.1 Interpreted Geological Model

Based on site observations and previous experience on nearby sites, the interpreted geological model comprises a sloping site, with variable depths of filling (possibly up to 1.5 m along the northern boundary) over colluvial or residual sandy clay soils (containing some ironstone fragments or layers) to average depths of 2 m to 2.5 m overlying extremely low to very low strength, interbedded siltstone and sandstone. The top of bedrock is likely to step down the slope beneath the soils rather than be at a consistent depth.

The natural soil and weathered rock profile is most likely mantled by areas of filling in the landscaped or grassed terraces and behind retaining structures.

Groundwater was not encountered in the boreholes and the DCPs were dry upon extraction. It is estimated that the permanent groundwater is at depths in excess of 2.5 m in the area of the house and is likely to be just above the mean tide level along the Pittwater foreshore. Some groundwater seepage should be expected through the soils along the soil/rock interface.

An inferred geological cross-section is shown in Drawing 2, in Appendix C.

5.2 Stability Assessment

Inspection of the site and existing structures has indicated no evidence of defects attributable to significant slope instability or settlement in the recent past. However, uncontrolled excavation into the slope or concentrated disposal of stormwater could trigger slope instability. Furthermore, the slope may be susceptible to ongoing long-term gradual downhill creep movements of the near surface soils.

The presence of large floaters on the site indicates past detachment and movement of sandstone blocks from further up slope. However, it is considered that the likelihood of similar natural rock falls affecting the property is “rare to barely credible” for the life of the proposed structure.

The site soils will be susceptible to erosion where disturbed and care will be required to ensure concentrated surface flows are not created.

5.3 Slope Risk Analysis

The site has been assessed in accordance with the methods of the Australian Geomechanics Society, 2007 (Walker, 2007) and Northern Beaches (Pittwater) Council's GRMP (PC, 2013).

Identified potential hazards within and around the site are summarised in Table 1, together with a qualitative assessment of likelihood of occurrence, consequence and risk to property, resulting from potential slope instability both before and after construction.

Table 1: Property Slope Instability Risk Assessment for Existing and Proposed Developments

Hazard	Likelihood	Consequence	Risk
Settlement or movement of footings founded on boulders	Unlikely – if works are carried out in accordance with this report	Medium	Low
Rapid failure of the excavated face during excavation of the proposed additions and pool	Unlikely – if works are carried out in accordance with excavation procedures in this report	Major	Low
Loss of bearing capacity of the footings of the subject house due to excavations for the lower ground floor	Unlikely – if works are carried out in accordance with excavation procedures this report	Medium	Low
Soil creep causing movement of the structures on the property	Rare – No significant movement observed on site	Medium	Low
A large boulder toppling and falling onto property from upslope	Rare – From Hudson Parade, no rock outcrops were observed	Medium	Low

For loss of life, the individual risk can be calculated from:

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

where:

$R_{(LoL)}$ is the risk (annual probability of loss of life (death) of an individual);

$P_{(H)}$ is the annual probability of the hazardous event occurring (e.g. failure of the excavated face);

$P_{(S:H)}$ is the probability of spatial impact by the hazard (e.g. of the failure reaching the residence, taking into account the distance of a given event from the residence);

$P_{(T:S)}$ is the temporal probability (e.g. of the residence being occupied by the individual) at the time of the spatial impact; and

$V_{(D:T)}$ is the vulnerability of the individual (probability of loss of life of the individual given the impact).

The assessed individual risk to life (person most at risk) resulting from slope instability is summarised in Table 2.

Table 2: Life Risk Assessment for Existing and Proposed Developments

Hazard	$P_{(H)}$	$P_{(S:H)}$	$P_{(T:S)}$	$V_{(D:T)}$	Risk $R_{(LoL)}$
Settlement or movement of footings founded on boulders	10^{-4}	1.0	0.50	0.01	5.0×10^{-7}
Rapid failure of the excavated face during excavation of the proposed additions and pool	10^{-4}	0.04	0.50	0.10	2.1×10^{-7}
Loss of bearing capacity of the footings of the subject house due to excavations for the lower ground floor	10^{-4}	0.15	0.30	0.10	5.0×10^{-7}
Soil creep causing movement of the structures on the property	10^{-5}	0.50	0.10	0.20	1.0×10^{-7}
A large boulder toppling and falling onto property from upslope	10^{-5}	0.50	0.10	0.30	1.5×10^{-7}

When compared to the requirements of the Northern Beaches (Pittwater) Council and the AGS, it is considered that the proposed development meets 'Acceptable Risk Management' criteria with respect to life under current and foreseeable conditions.

Provided that the construction is undertaken in accordance with the recommendations contained in this report, construction of the proposed development is not expected to affect the overall stability of the site or negatively influence the geotechnical hazards identified in Tables 1 and 2.

5.4 Excavation Conditions

It is expected that the excavations for the proposed garage, pool, lower ground floor level and boatshed will be through fill, clay and possibly extremely weathered rock. It is expected that most of the excavations can be readily excavated using conventional earthmoving equipment but it is likely that some large sandstone boulders will be encountered during excavation and these may need rock hammers to break them down prior to removal.

The excavations should be carried out carefully when close to the existing house and neighbouring houses as excavations can collapse if not adequately supported. Depending on the equipment used to undertake the excavation and the type of footings supporting the neighbouring structures, it is also possible that vibrations generated during excavation could cause cracking of sensitive or brittle structures.

Prior to the commencement of construction activities, it is recommended that dilapidation surveys be undertaken on neighbouring properties to document any existing defects so that any claims for damage due to construction activities can be properly assessed.

5.5 Excavation Support

The fill, topsoil, clay and extremely weathered rock on the site cannot stand vertically unsupported.

Excavation for the lower floor extension will be immediately adjacent to the existing house footings and underpinning of these footings may be required. Prior to commencing construction, test pits should be excavated to determine the footing system and depth. This will determine if shoring (i.e. underpinning) will be required.

Areas of the proposed excavations for the pool, boatshed and uphill extension will be located about 1 m from the common boundary. There will probably be insufficient room for temporary batters in these areas and shoring will need to be installed before the bulk excavation commences to ensure site stability is maintained.

Where room permits and the excavation depth is less than 3 m, temporary batter slopes in the fill and soils should be 1.5 H:1 V (Horizontal:Vertical) or flatter. If surcharge loads are located behind the top of the excavation (e.g. slopes or construction plant), then either a flatter slope angle will need to be adopted or other stabilisation measures will be required.

Retaining walls may be designed using the parameters provided in Table 3. Active earth pressure coefficients (Ka) should be used where the walls may deflect slightly and 'At Rest' (Ko) coefficients should be used for shoring required close to existing buildings where any deflections should be minimised.

Table 3: Design Parameters for Retaining Walls

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of At Rest Earth Pressure (Ko)	Coefficient of Passive Earth Pressure (K_p)
Fill	20	0.4	0.6	N/A
Colluvial or Residual Clay – stiff to very stiff	20	0.3	0.45	3.0
Very low strength rock (Class IV Shale)	22	0.2	0.2	Ultimate passive pressure = 400 kPa*

Note: N/A = not applicable

* the passive pressure given for Class IV Shale is an ultimate value and suitable factors of safety or reduction factors should be applied when using this value.

Lateral pressures due to surcharge loads from adjacent buildings, sloping ground surface, pavements and construction machinery should be included where relevant. Hydrostatic pressure acting on retaining walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

5.6 Foundations

Based on the results of the DCP testing and previous experience on the adjacent site to the north, it is expected that most, if not all, of the excavations required for the proposed alterations and additions will be taken down into clay soils or extremely weathered bedrock.

All new foundations founded in clay soils of at least very stiff strength can be proportioned for a maximum allowable bearing pressure (ABP) of 200 kPa. It is anticipated that soil strata of suitable bearing capacity could be intersected at around 1.0 m to 1.5 m below existing ground surface levels, being shallower where existing excavations have been undertaken (i.e. the subfloor level) and possibly deeper where filling has been placed. Therefore piers will most likely be required to support the new structures. All footings located immediately upslope of the existing retaining walls should be taken to below the base level of the walls to prevent surcharging of the walls.

Higher bearing pressures (say ABP=700 kPa) would be permitted for piled footings taken to bedrock of at least very low strength (expected to be at about 2 m to 2.5 m depth), but groundwater inflow into deeper footing excavations could be a construction constraint.

Medium to high strength sandstone bedrock is exposed along the Pittwater shoreline and has a suggested ABP of 3.5 MPa.

The structural engineer will need to consider the potential for differential settlement and allow for construction joints if it is suspected that the footing system and/or founding depths are significantly different between old and new sections of the structure.

All excavations for proposed footings (or existing footings exposed by the builder) should be inspected by an engineering geologist or geotechnical engineer prior to placement of reinforcement and concrete pouring, so as to confirm that strata of sufficient bearing capacity and stability has been reached.

5.7 Disposal of Excavated Material

The scope of this investigation did not include sampling and testing for Waste Classification or Contamination Assessment purposes. All excavated materials to be removed off site will need to be disposed of in accordance with current NSW Environment Protection Authority (EPA) regulations. Under the NSW EPA Waste Classification Guidelines (2014) a waste/fill receiving site must be satisfied that materials received meet the environmental criteria for proposed land use. This includes filling and virgin excavated natural materials (VENM), such as may be removed from this site. Accordingly, environmental testing will need to be carried out to classify spoil prior to disposal. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site.

5.8 Acid Sulphate Soil (ASS) Considerations

Reference to the Hornsby/Mona Vale Acid Sulphate Soil Risk Map (Department of Land and Water Conservation - Edition 2, dated December 1997) indicates the local area to have a “low risk” of ASS.

All bulk and detailed footing excavations proposed on the site will be located upslope (east) of the existing seawall and it is not expected that they will intersect any estuarine soils along the Pittwater foreshore.

Furthermore, field screening and laboratory analysis of the soil samples collected at a similar level on the hillside during an ASS assessment on the adjacent site to south (56 Hudson Parade) did not indicate the presence of any ASS.

It is therefore considered that preparation of an Acid Sulphate Management plan is not required for the proposed development.

5.9 Stormwater Disposal and Site Drainage

It is recommended that gutters and downpipes be installed on the house and proposed development to collect stormwater and pipe it to Pittwater.

6. Conditions Relating to Design and Construction Monitoring

To comply with Council conditions and to enable the completion of Forms 2B and 3, required as part of the construction, building and post-construction certificate requirements of the GRMP, it will be necessary for Douglas Partners Pty Ltd to:

Form 2B

- review the geotechnical content of all structural drawings.

Form 3

- inspect all new footing excavations for the new works to confirm compliance to design with respect to allowable bearing pressure and stability.

7. Design Life and Requirement for Future Geotechnical Assessments

Douglas Partners Pty Ltd (DP) interprets the reference to design life requirements specified within the IGRMP to refer to structural elements designed to retain the subject slope and maintain the risk of instability within acceptable limits.

Specific structures that may affect the maintenance of site stability in relation to the proposed development on this site are considered to comprise:

- existing (and any proposed) stormwater surface drains and buried pipes leading to the stormwater disposal system;
- existing and proposed retaining walls on the site.

In order to attain a structure life of 100 years as required by the Council Policy, it will be necessary for the structural engineer to incorporate appropriate construction detailing and for the property owner to

adopt and implement a maintenance and inspection program. A typical program for developments on sloping sites is given in Table 4.

Note that the program given in Table 4 is provisional and is subject to review or deletion at the conclusion of construction.

Table 4: Recommended Maintenance and Inspection Program

Structure	Maintenance/Inspection Task	Frequency
Stormwater drains, subsoil drains, pipes and pits	Owner to inspect to ensure that the drains, pipes and pits are free of debris and sediment build-up. Clear surface grates of vegetation/litter build-up.	Every year or following each significant rainfall event.
Existing or proposed retaining walls	Owner to check wall for deviation from as-constructed condition.	Every two to three years or following each significant rainfall event.

Where changes to site conditions are identified during the maintenance and inspection program, reference should be made to a relevant professional (e.g. structural engineer or geotechnical engineer).

8. References

1. Pittwater Council's Geotechnical Risk Management Policy (2009)
2. Australian Geomechanics Society (AGS), Practice Note Guidelines for Landslide Risk Management

9. Limitations

Douglas Partners (DP) has prepared this report for this project at 60 Hudson Parade, Clareville in accordance with DP's proposal 215034.00.P.001.Rev0 dated 03/05/2022 and acceptance received from Oliver Hartley dated 24/06/2022. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Oliver & Nicola Hartley for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the (geotechnical / environmental / groundwater) components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

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

About this Report

Site Anomalies

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

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

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

Appendix B

Site Photographs

Photo 1: Driveway to 60 Hudson Parade

Photo 2: Suspended concrete platform

Photo 3: Columns supporting the concrete platform

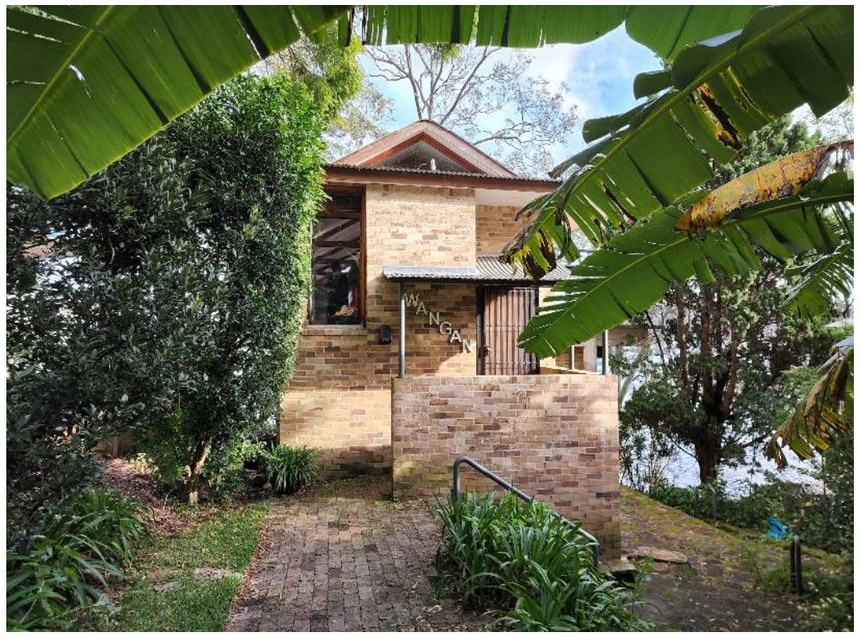


Photo 4: Existing two and three level brick house

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Oliver & Nicola Hartley		TITLE: **Site Photographs** **Proposed Alterations and Additions** **60 Hudson Parade, Avalon**	PROJECT No:	215034
	OFFICE: Sydney	DRAWN BY: RK		PLATE No:	1
	SCALE: NTS	DATE: 12 Jul 2022		REVISION:	A

Photo 5: Concrete dish drain along the southern side of house

Photo 6: The subfloor of the existing house

Photo 7: Downhill side of the house

Photo 8: Sandstone bedrock exposed along the Pittwater foreshore

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Oliver & Nicola Hartley		TITLE:	**Site Photographs** **Proposed Alterations and Additions** **60 Hudson Parade, Avalon**	PROJECT No: 215034
	OFFICE: Sydney	DRAWN BY: RK			PLATE No: 2
	SCALE: NTS	DATE: 12 Jul 2022			REVISION: A

Appendix C

Drawings

Locality Plan

LEGEND

- Approximate Site Boundary
- Approximate Proposed Lower Ground Level Outline
- Approximate Proposed Ground Level Outline
- Approximate Proposed Pool Outline
- Borehole / DCP Test Location
- DCP Test Location
- Sandstone Floater
- Photo Number with Direction of View
- Geological Cross Section

NOTE:
1: Base image from MetroMap (Dated 29.05.2022)
2: Base Survey Plan from C.M.S. Surveyors Pty Ltd, Drawing Name 21046detail, First Issue, (Dated 04.02.2022)

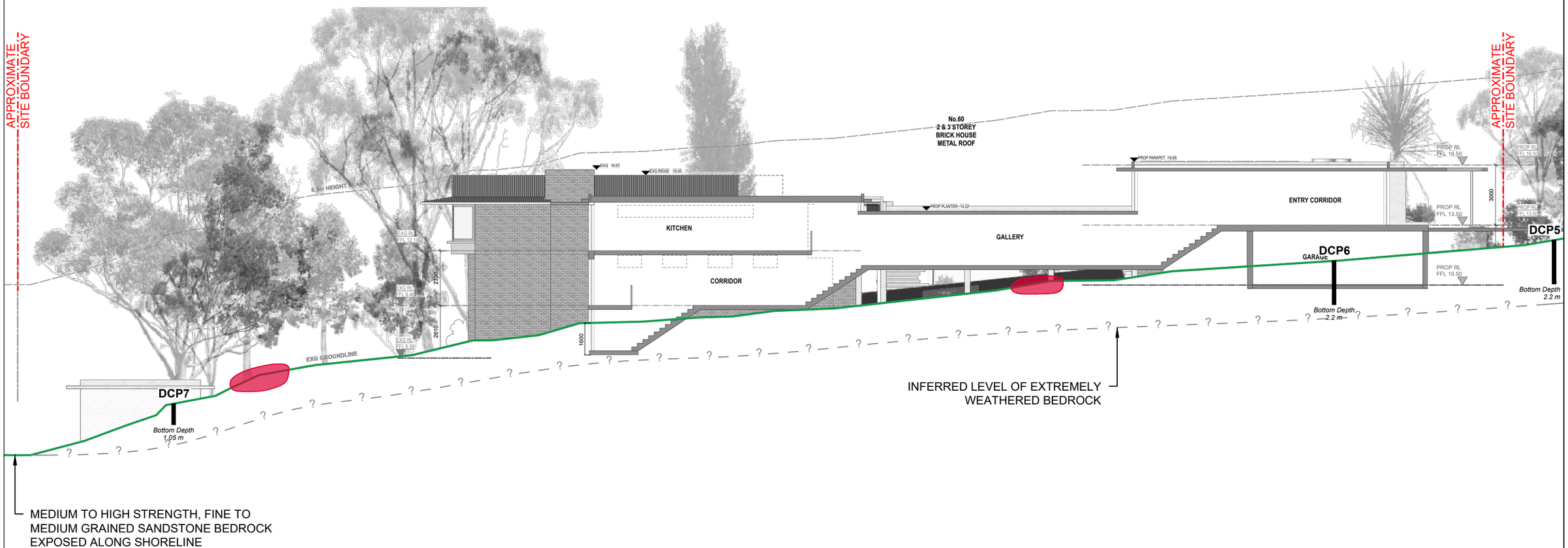
0 2 4 6 8 10 15 20 30 40m
1:400 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Oliver & Nicola Hartley		TITLE: **Test Location Plan**	PROJECT No: 215034.00
OFFICE: Sydney	DRAWN BY: MG	**Proposed Alterations and Additions**	DRAWING No: 1
SCALE: 1:400 @ A3	DATE: 22.07.2022	**60 Hudson Parade, Clareville**	REVISION: 0

A

A'



NOTE:
1: Base Architectural Section from Bennett Murada Architects, Job Number 2130, Drawing No. DA_210 (Dated 11.07.2022)

0 1 2 3 4 6 8 10 15 20m

1:200 @ A3

LEGEND

— ? — — Interpreted Geotechnical Boundary

Sandstone Floater

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Oliver & Nicola Hartley		TITLE: **Geological Section A-A'**	PROJECT No: 215034.00
OFFICE: Sydney	DRAWN BY: MG	**Proposed Alterations and Additions**	DRAWING No: 2
SCALE: 1:200 @ A3	DATE: 20.07.2022	**60 Hudson Parade, Clareville**	REVISION: 0

Appendix D

Field Work Results

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Symbols & Abbreviations

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

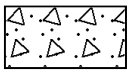
Symbols & Abbreviations

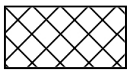
Graphic Symbols for Soil and Rock

General

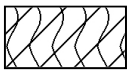

Asphalt

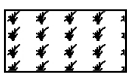

Road base

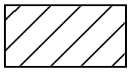

Concrete

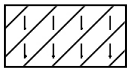

Filling

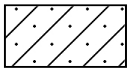
Soils


Topsoil

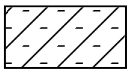

Peat

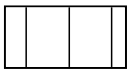

Clay

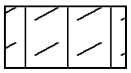

Silty clay

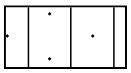

Sandy clay

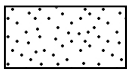

Gravelly clay

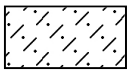

Shaly clay

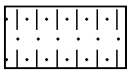

Silt


Clayey silt


Sandy silt

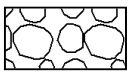

Sand

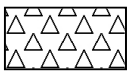

Clayey sand


Silty sand


Gravel

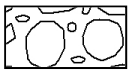

Sandy gravel


Cobbles, boulders

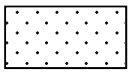

Talus

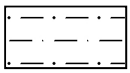
Sedimentary Rocks

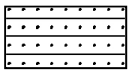

Boulder conglomerate

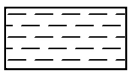

Conglomerate


Conglomeratic sandstone

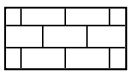

Sandstone


Siltstone

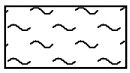

Laminite

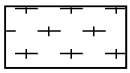

Mudstone, claystone, shale

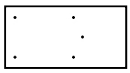

Coal


Limestone

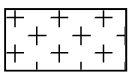
Metamorphic Rocks

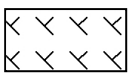

Slate, phyllite, schist

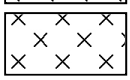

Gneiss

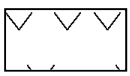

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Oliver and Nicola Hartley
PROJECT: Proposed Alterations and Additions
LOCATION: 60 Hudson Parade, Clareville

SURFACE LEVEL: 8.0 AHD
EASTING: 343676
NORTHING: 6277360
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 215034.00
DATE: 12/7/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
8		FILL/Silty SAND: fine to medium, dark grey, trace clay and building rubble (fragments of brick and ceramics), moist, apparently in a very loose to loose condition							
	0.9	Bore discontinued at 0.9m Refusal of Hand Auger							
7	1								1
6	2								2

5 10 15 20

RIG: Hand tools **DRILLER:** RK **LOGGED:** RK **CASING:** uncased

TYPE OF BORING: 100 mm diameter auger to 0.9m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Oliver and Nicola Hartley
PROJECT: Proposed Alterations and Additions
LOCATION: 60 Hudson Parade, Clareville

SURFACE LEVEL: 7.0 AHD
EASTING: 343654
NORTHING: 6277359
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 215034.00
DATE: 12/7/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
7	0.1	FILL/Sandy CLAY: low to medium plasticity, dark brown, trace building rubble (fragments of brick and tiles), w<PL							5 10 15 20
		Sandy CLAY CL: low plasticity, brown mottled pale yellow and pale grey, fine to medium sand, w<PL, stiff to very stiff, colluvium							
	0.8	Bore discontinued at 0.8m Refusal of Hand Auger							
6	1								1
5	2								2

RIG: Hand tools **DRILLER:** RK **LOGGED:** RK **CASING:** uncased

TYPE OF BORING: 100 mm diameter auger to 0.8m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

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ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Results of Dynamic Penetrometer Tests

Client Oliver & Nicola Hartley
Project Proposed Alterations & Additions
Location 60 Hudson Parade, Avalon

Project No. 215034.00
Date 12/07/2022
Page No. 1 of 1

Test Locations	1	2	3	4	5	6	7	8		
RL of Test (AHD)	8.0	7.0	12.0	8.7	11.0	11.6	3.5	2.1		
Depth (m)	**Penetration Resistance** Blows/150 mm									
0.00 – 0.15	0	4	0	0	0	0	5	0		
0.15 – 0.30	1	5	0	0	1	1	8	1		
0.30 – 0.45	0	6	2	0	2	0	10	0		
0.45 – 0.60	3	7	3	1	1	4	13	2		
0.60 – 0.75	4	9	4	3	3	3	10	8		
0.75 – 0.90	3	15	8	2	4	4	16	9		
0.90 – 1.05	4	18	10	4	5	7	20	10		
1.05 – 1.20	5	19	14	5	6	9		15		
1.20 – 1.35	6	20/100	18	6	8	8		18		
1.35 – 1.50	5	R	25	7	8	6		20		
1.50 – 1.65	7			9	7	9				
1.65 – 1.80	10			10	10	11				
1.80 – 1.95	13			11	12	13				
1.95 – 2.10	17			12	15	15				
2.10 – 2.25	18			16	17/100	20/100				
2.25 – 2.40	24			20	R	R				
2.40 – 2.55	R									
2.55 – 2.70										
2.70 – 2.85										
2.85 – 3.00										
3.00 – 3.15										

Test Method AS 1289.6.3.2, Cone Penetrometer ☑
AS 1289.6.3.3, Sand Penetrometer ☐

Tested By RK
Checked By

Notes 17/100 = 17 blows for 100 mm penetration

R = Refusal

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

Development Application for_____
Name of Applicant

Address of site 60 Hudson Parade, Clareville

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

I, Scott Easton *on behalf of* Douglas Partners Pty Ltd
(Insert Name) (Trading or Company Name)

on this the 2/8/2022 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

- ə 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
- ə 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.
- ə 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.
- ə 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.
- ə have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: 60 Hudson Parade, Clareville - Geotechnical Investigation. Project No. 215034.00

Report Date: July 2022
:
Author: Robert Keaveney

Author's Company/Organisation: Douglas Partners Pty Ltd

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

Architectural Plans - Bennett Murata Architects
Survey - C.M.S Surveyors

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 Scott Easton

Chartered Professional Status CPEng

Membership No. 1371997

Company Douglas Partners Pty Ltd

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements For Geotechnical Risk Management Report for Development Application

Development Application for_____
Name of Applicant
Address of site 60 Hudson Parade, Clareville _____

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotechnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: 60 Hudson Parade, Clareville - Geotechnical Investigation. Project No. 215034.00
Report Date: July 2022
Author: Robert Keaveney
Author's Company/Organisation: Douglas Partners Pty Ltd

Please mark appropriate box

☑ Comprehensive site mapping conducted 12 July 2022 (date)
☑ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
☑ Subsurface investigation required
- ☐ No Justification ……...
- ☑ Yes Date conducted 12 July 2022……

☑ Geotechnical model developed and reported as an inferred subsurface type-section
☐ Geotechnical hazards identified
- ☑ Above the site
- ☑ On the site
- ☐ Below the site
- ☐ Beside the site

☑ Geotechnical hazards described and reported
☑ Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ☑ Consequence analysis
- ☑ Frequency analysis

☑ Risk calculation
☑ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
☑ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
☑ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009
☑ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
☑ Design Life Adopted:
- ☑ 100 years
- ☐ Other ……
  specify

☑ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified
☑ Additional action to remove risk where reasonable and practical have been identified and included in the report.
☐ Risk assessment within Bushfire Asset Protection Zone.

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal 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 …Scott Easton……..
Chartered Professional Status……CPEng……
Membership No. ……1371997……..
Company Douglas Partners Pty Ltd